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Table of Contents

INTRODUCTORY NOTE

This is truly a working paper. It explores the process of transformation of cities and regions under the impact of the current technological revolution. Yet, the overarching hypothesis of this paper is that such technological change can only be understood in the framework of two fundamental historical processes that are transforming our societies: the restructuring of the capitalist mode of production, and the emergence, within capitalism, of the informational mode of development. By mode of development we understand the particular form in which the elements of the process of production are combined to obtain the product. In the industrial mode of development, productivity results from an increase in the quantity of labor, matter, or energy in the process of production.In the informational mode of development productivity results from the way of combining the elements of the process of production, itself depending upon knowledge able to predict the most productive combination. Industrial development is based on the quantity of the *product*. Informational development is based on the quality of the *process*. Both modes of development coexist historically, but the new informational mode raises in its dominance at an exponential rate. Yet, both modes of development are framed (in our area, and in the world economy) by capitalist relationships of production and social organization. At the same time, the forms and processes of capitalism are being profoundly affected by the new mode of development. It is this interaction between modes of production, mode of development, and technological change, that is examined in this paper, while attempting to understand the new urban and regional processes emerging in our societies.

We should emphasize that we will not be projecting *future spatial trends* in most of the discussion. We will be referring to actual developments currently under way. Yet, evidence on these new developments is so tenuous,and the process of change is so fast, that we are forced to a very tentative and speculative style of analysis, in line with the exploratory purpose of this paper. The lack of reliable evidence on our subject-matter, explains also three characteristics of this paper that should be noticed:

a) It uses a considerable number of sources obtained from new papers and magazines, more than we used to in scholarly research. The reason is that the most recent developments are reported in the press in a relatively short time, but it takes years to transform them into reliable scholarly research.

b) Our analysis, at this point, refers exclusively to the United States. The reasons for such a specific field of observation are obvious: the U.S. is the society where current processes of technological change *and* economic restructuring are the most advanced, and their consequences on space the most visible; and it is the society on which we have the most information, so that our exploration ca be made somewhat less purely speculative.

c) Finally, a fundamental dimension of our exploration (originally a part of our project) will not be treated here: the interaction between the new technologies, social relations, and cultural patterns. In fact, there is an almost total absence of research and reliable information on this area, at the point that we have considered useless a theoretical elaboration that could not rely on a minimum basis of the changing trends in this dimension. Since there is research in progress in the area, to fill this gap in a future development of this paper is certainly a major concern of our working agenda.

Thus, with all due precautions, and accepting in advance the limitations inherent to all exploratory investigation we would like to propose some tentative hypothesis on the new relationships between space and society, that are emerging under the simultaneous impact of economic restructuring and technological change.

TOWARDS THE INFORMATIONAL CITY?
High Technology, Economic Change, and Spatial Structure: Some Exploratory Hypotheses

Manuel Castells

1. The Blurred Profile of High Technology

It is now apparent that we are in the beginning of a fundamental technological revolution, as equally important, if not more, as the first industrial revolution. Yet, the phenomenon is so sudden, so recent and so striking, that it is generally ill-perceived, and often distorted. In fact, its moving reality serves to fuel all kinds of messianic prophecies, as well as to fulfill a variety of economic and political interests. When entering such a shaky ground, it seems wise to proceed cautiously, step by step.

First of all, we must recognize which are the discoveries we are referring to. Nevertheless, for our specific research purpose, it seems unnecessary to undertake the overwhelming task of cataloguing and assessing the major scientific breakthroughs that have changed in a few years the map of our knowledge. It is equally beyond our reach and our competence to refer in detail to the content of each technology, particularly since there is at this point an abundant literature that summarizes the most important new developments for each science.[1] What is required, for *our* research concerns is to recall, *and to differentiate* the main areas in which the recent progress made in science and technology are having, and will increasingly have, a major impact on the forms and trends of social and economic organization.

For the sake of clarity, we will risk proposing a *descriptive typology* of the main fields in which qualitative technological innovation is occurring, with an immediate impact on socio-economic structures, and with a foreseeable effect of altering the basic elements of our way of living. The implications are that technological innovation in each of these areas will have relatively specific effects on the economy, in society, and on the spatial forms, even if they are ofter interrelated. But to understand their interaction we have to first establish the difference between the major trends of technological innovation, and to single out, at least tentatively, their potential impact, and the empirical trends actually related to each one of them.

A summary overview of current technological developments allows us to distinguish between the following areas:

1. *Micro-electronics*, fundamentally based on the miniaturization of integrated circuits, and in the increasing informational power of these circuits.
2. *Telecommunications*, whose main transformation concerns the use of satellites, and the application of fiber optics and laser rays to the transmission technology.
3. *Information systems*, that allow for the combination of computers and telecommunications, in an interactive information network.
4. *Decentralized Mass Communication*, where the use of satellites, cable television, and VCRs fundamentally alter the one-way flow of the traditional mass media system.

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[1] See, for instance, National Research Council, ***Outlook for Science and Technology, The Next Five Years.*** San Francisco: W.H. Freeman and Co., 1982; Also, Committee on Science, Engineering, and Public Policy of the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine: ***Frontiers in Science and Technology***, New York-San Francisco: W. H. Freeman and Co., 1983.

5. *Automation of the work process*, both in the factories and in the offices, which includes the development of robotics and might extend to high-level managerial functions with the development of artificial intelligence.
6. *Genetic engineering*, with its major foreseeable application in the health sciences, industrial chemicals, agriculture and food production, and, much later, in new energy sources.
7. *Advanced industrial materials*, with major immediate applications in aerospace, transportation equipment, and military hardware.

We leave aside in this typology other areas that result from a specific application of the current technology (such as space travel and operating) or that do not seem (at least, to the eyes of the layman) to be able to fundamentally modify our ways of functioning. The most important case in this sense is the research on alternative sources of energy, and very particularly solar energy.[2] Unless there is a major shock in oil supply (much bigger than the 1973 embargo, or the 1979 price hike) it is very unlikely that research in photovoltaic cells will go beyond very limited applications, except for political reasons.[3] And the work on nuclear fision, apparently the most promising as a sizeable alternative, still needs many years (well into the 21st century) to achieve substantial results, if there are any to come.

If we try to go a step further in the way of analyzing the connection between new technologies and the socio-economic system, we find ourselves confronted with the problem of empirically identifying which are the "high-tech" industries." The courageous research effort in this direction by Glasmeier, Markusen and Hall[4] is quite revealing of the difficulties of such an enterprise.

They point out that the three most cited measures of high tech industries, namely: the perceived degree of technical sophistication of the product; the role of growth in employment; and research and development expenditures, "lack operational precision and have been employed at too high a level of aggregation" (p. 3)--let alone, we will add, the absence of analytical meaning of such immediate indicators. As a matter of fact, some human services, particularly in the health field, have a much higher rate of growth in employment, while being very traditionally labor-intensive, and with little skill requirements for labor. The R&D expenditures mix too many conflicting elements together, from biomedical research to marketing tests. Glasmeier, Markusen and Hall's own indicator to identify high tech industries (the proportion of engineers, scientists and computer scientists as a percentage of total industry occupations) is the most reasonable one can use for strictly operational purposes. Yet, a look at the list of high tech industries obtained through this indicator (Table 1) shows the problems researchers can run into, when they have to assimilate "office computing machines" to "plastics and synthetic resins," or "commercial equipment" to "construction equipment."

The problem lies, in our opinion, in the fact that it is almost impossible to side-step the question of *the conceptual definition of the new technologies*. Though "high tech" is an ideological notion, it actually refers to some basic transformation in our way of working, managing, and, ultimately, living and dying. Is there a common matrix to the basic current of technological innovation? We believe there is, and it is precisely because of this that we are not just witnessing a constellation of discoveries but a new

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[2]For a discussion of the relationship between economic policies and energy sources, see: Robert Stobaugh and Daniel Yergin, eds., *Energy Future. Report of the Energy Project at the Harvard Business School.* New York: Random House, 1979.

[3]See: Eugene B. Colpe and James P. Hawley, *Photovoltaics: Technology for Energy Independence.* Sacramento: State of California, Office of the Governor, Commission on Industrial Innovation, 1983.

[4]Amy K Glasmeier, Ann R. Markusen, Peter Hall, *Defining High Technology Industries.* Berkeley: University of California, Institute of Urban and Regional Development, Working Paper No. 407, June 1983.

TABLE 1

Defining High Technology Industries

Rank	SIC	Title	Eng./Eng.Tech. Compt.Sci.	Life and Physical Scientists	Mathe-maticians	Eng./Eng.Tech. Compt.Sci. Sci. & Math.	% all Professional and Technical
		Manufacturing	5.51	.26	.05	5.82	16.11
1	376	Missiles	40.90	.21	.08	41.19	55.70
2	357	Office Computing Machines	26.62	.05	.03	26.70	32.48
3	381	Engineering, Laboratory Instruments, and Scientific Instruments	25.67	.73	.05	26.45	32.70
4	366	Communication Equipment	21.30	.26	.30	21.86	32.26
5	383	Optical Instruments and Lenses	18.73	1.03	.04	19.80	24.10
6	286	Industrial Organic Chemicals	14.51	4.85	.24	19.60	24.91
7	372	Aircraft and Parts	17.95	.24	.34	18.53	25.39
8	283	Drugs	8.86	8.59	.22	17.67	23.77
9	291	Petroleum Refining	11.76	2.42	.44	14.62	19.71
10	382	Measuring and Controlling Instruments	13.93	.12	.09	14.14	17.28
11	367	Electronic Components and Assembly	12.7	.10	.02	12.84	15.70
12	281	Industrial Inorganic Chemicals	9.46	3.14	.05	12.65	15.52
13	282	Plastics and Synthetic Resins	9.38	1.81	.17	11.36	14.86
14	351	Engines and Turbines	10.16	.48	.01	10.65	16.67
15	348	Ordnance	9.37	.99	.06	10.42	15.80
16	289	Misc. Chemicals	6.35	3.70	.05	10.10	12.98
17	386	Photographic Equipment	8.67	.80	.01	9.48	13.26
18	362	Electrical Industrial Apparatus	9.24	.03	.03	9.30	12.35
19	361	Electrical Transmission Equipment	8.55	.03	.01	8.59	10.72
20	353	Construction Equipment	8.34	.05	.04	8.43	12.24
21	285	Paints	3.22	4.97	.01	8.20	10.73
22	303	Reclaimed Rubber	5.26	2.27	--	7.53	7.53
23	356	General Industry Machinery	7.21	.04	.02	7.27	11.44
24	374	Railroads	6.58	.08	.09	6.75	9.60
25	365	Radio and TV Receiving Equipment	6.62	.06	.04	6.72	10.04
26	287	Agricultural Chemicals	4.58	1.79	.11	6.48	9.59
27	354	Metal Working Machinery	6.27	.01	.00	6.28	8.78
28	384	Medical & Dental Supply	5.42	.57	.04	6.03	9.94
29	284	Soap	3.14	2.71	.06	5.91	9.03

Source: Glasmeier, Markusen, Hall, 1983.

paradigm of production and social organization. At least, this is our *hypothesis*, some of whose traces we will try to find in our specific field of observation.

Two major features characterize the current stream of technological innovation:

- The outcome is *process-oriented* instead of being *product-oriented*.
- The object of the technological discoveries as well as of their applications is *information*.

What computers do is to process, and eventually generate, information. What telecommunications do is to transmit information, with a growing complexity of interactive loops and feedbacks. What the new media do is to disseminate information. What automation does is to introduce pre-informed devices in other activities. And what genetic engineering does is to decode the information system of the living matter to try to program it.

This is why *computers* and *telecommunications* are the core of the technological revolution. Because through their capacity to process and inter-connect *all* information produced in all fields and all spheres of activity, they accelerate each particular innovation, as well as the diffusion of each innovation into other areas.

This hypothesis, concerning the production, distribution, and management of information, and the use of this information to affect *processes* (economic, social, political, cultural, and scientific), as being the subject matter of the new technological revolution, will guide us in observing the set of interactions between new technologies and the transformation of spatial forms. Its usefulness will only be justified in terms of the light it will be able to cast on our observations.

To study this set of relationships we must also proceed through a number of distinctions. Too often, the impact of new technologies on spatial forms has been considered, mainly, on the basis of the locational patterns of high tech industries. This is certainly an important factor of the new spatial trends linked to the technological revolution. But it has to be considered in a broader framework that must examine, at least, the following relationships:

- The locational impact of high tech industries on the new inter-regional, international, and intra-metropolitan division of labor, including the consideration of the specific qualities required by each high tech activity in terms of a favorable environment.
- The direct effect of technology on spatial forms through the transformation of the communication technologies.
- The influence of high tech on spatial forms and processes, through the impact of the new technology in the economic structure.
- The indirect effect of high tech on the space through its influence on socio-cultural patterns.

In addition to these distinctions, the analysis must keep in mind that:

a. the effects of technology on space are inextricably intertwined with the effects of other processes (such as uneven economic development, public policies, and grassroots mobilization). Therefore, we will have to consider *tendencies*, that will be integrated into a more complex set of interactions to actually account for the production of spatial forms.

b. The different areas of technological innovation could have very different types of relationships to the spatial structure.

c. In any case, observations and data are so scarce and so approximative concerning this subject, that the only task that can be accomplished at this point is to ask the relevant research questions and to suggest some empirical indications about a few tentative answers. Yet, there is so much at stake that it seems to us it is still worth trying an exploratory analysis that will treat, point by point, the several questions that we have asked before proceeding to an attempt of integrating the results into the proposal of what could be the blueprint for the spatial profile of the informational mode of development.

2. The Locational Pattern of High Tech Manufacturing Industries and its Impact on the Spatial Structure

The most straightforward approach to studying the relationship between spatial structure and high tech industries is to analyze their locational pattern, trying to identify the characteristics that attract these industries. After all, it is precisely this "formula" that has been actively sought by regions and communities desiring to lure industries with high growth potential.

The study by Glasmeier, Hall, and Markusen on high-technology industries' spatial tendencies[5] is the most recent (1983) and comprehensive data source on the matter. It proceeds to a statistical analysis of the spatial distribution of 100 4-digit sectors into the 277 U.S. metropolitan areas, observing their evolution, in terms of employment and plants, between the last two available censuses of manufacturing, 1972 and 1977.

At first sight, the study suggests that it would be difficult to argue that such a pattern exists. As the authors put it, "the degree of geographical concentration is quite distinct across high tech sectors and varies almost as much within industrial groupings as across the entire set" (p. 7). But rather than spatial diversification what we actually observe is a pattern of diversified spatial behavior depending upon specific industries: between 1972 and 1977, the great majority of the sectors tended to disperse, *but* military-related sectors and bulk materials processing remained concentrated, and semiconductors, resistors, and telephone equipment further concentrated (p. 61). This is fundamentally due to the fact that "high-tech industries [as defined in the study] are not a homogeneous group; they are highly diverse in their rates of growth (or decline), their potential for plant or job growth, and their patterns of location" (p. 60).

Similarly, the results of a well designed regression analysis to find correlates of high tech performance across metropolitan areas are mixed and little conclusive. Five metro features (particularly defense spending) account for nearly 18% of the variation of high tech jobs as a proportion of area labor force. Nine characteristics explain 29% of the variation of employment change, but, besides defense, the main correlated variable is *high* housing prices, a result which raises some doubts about the direction of causality. Changes in aggregate plants are better explained: 68% of the variation, if we consider the effect of 9 characteristics. Yet, the main variable (some 26% of the variation) is the size of the labor force in 1977, which again, simply indicates that large metropolitan areas grew more in absolute numbers of plants because they have the higher statistical chances to do so.

Nevertheless, in spite of the shortcomings due to the difficulty of the study, the regression analysis *does show* some interesting results concerning the locational tendencies of high tech manufacturing. Defense spending was the most consistent and significant variable positively correlated with high tech location, followed by the presence of an airport. The location of major corporate headquarters in a metropolitan area acted negatively on high tech location, suggesting the differentiation between the space of high tech *manufacturing* and that of the advanced service city. The presence of a major university was significant but operated quite variably. The arts index,

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[5] Amy K. Glasmeier, Peter Hall, and Ann R. Markusen, ***Recent Evidence on High-Technology Industries' Spatial Tendencies: A Preliminary Investigation.*** Berkeley: University of California, Institute of Urban and Regional Development, Working Paper No. 417, October 1983.

constructed to indicate the cultural quality of life, was, surprisingly, negatively correlated, while pollution and housing costs were positively associated, probably *because* of the high tech manufacturing activities, rather than the other way around.

This is maybe why the researchers state that "we believe these results offer strong support for our view that individual high-tech industries are highly heterogeneous and display quite disparate spatial tendencies which can only be understood by analyzing disaggregated sectors" (p. 46)--and, we would add, by analyzing specific *components* of the production process within each sector, since, for instance, design and assembly represent quite different spatial logics. We shall turn in a few paragraphs to examine the scarce evidence existing in individual high tech sectors, while recalling that in-depth analyses will be fruitful only because of the preliminary research at an aggregate level, such as the one we are commenting on here.

Similarly, if it is true that the entropy index constructed by Glasmeier, Hall, and Markusen revealed a very diverse locational pattern, we should also pay attention to Tables 2 and 3, elaborated by the same team, that *do show* a profile of high-tech-prone and high-tech-repulsion areas that closely resemble the popular image in the sunbelt-snowbelt literature: California, Texas, Massachusetts (Massachusetts being the systematic anomaly in the Northeast), Florida, and Arizona, oppose New York, Philadelphia, Cleveland, Baltimore, as well as Miami and Los Angeles, the generally speaking, non-high tech areas of the sunbelt.

So, the overview undertaken by Glasmeier, Hall and Markusen provides some crucial hints into the subject, but these trends will have to be studied with a more refined method at a more disaggregated level. We need to understand the spatial logic of specific sectors as well as the dynamics of specific places, which is something that the same team is already undertaking as a research perspective. For the moment, we have to rely on some more factual evidence on high tech industries and high tech areas, such as the theses of Servet Mutlu,[6] Michael Storper[7] and Anna Lee Saxenian.[8] Their work is actually of such good quality that it will allow the formulation of some exploratory ideas on a relatively solid ground. We will also rely on some additional sources that will be cited in due course. On the basis of this research material, we will undertake the analysis of the evolution of locational patterns of some key industries (semiconductors, computers hardware, computers software, biotechnology, etc.), before focusing on the spatial characteristics of the areas that seem to be most attractive for high tech manufacturing activities.

2.1. The Spatial Logic of The Semiconductors Industry

Semiconductors manufacturing remains the archetype of high tech industries. Since it is also the industry on which we have the most detailed information, a careful synthesis of what we know will be a useful procedure for unveiling the spatial logic of high tech activities. Enough has been written on the origins and characteristics of semiconductors, as the core of the electronics industry, so that we will not repeat it, referring the reader to some of the abundant literature on the matter,[9] except for those

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[6] Servet Mutlu, *Inter-regional and International Mobility of Industrial Capital. The Case of the American Automobile and Industrial Capital.* Berkeley: University of California, Department of City Planning, Ph.D. Dissertation, 1979.

[7] Michael Storper, *The Spatial Division of Labor: Technology, the Labor Process, and the Location of Industries.* Berkeley: University of California, Department of Geography, Ph.D. Dissertation, 1982.

[8] Anna Lee Saxenian, *Silicon Chips and Spatial Structure: The Industrial Basis of Urbanization in Santa Clara County, California.* Berkeley: University of California, Department of City Planning, Master's Thesis, 1980.

[9] See, for instance: M.L. Dertouzas and J. Moses, eds., *The Computer Age--A Twenty-Year View.* Cambridge, MA: MIT Press, 1979; Adam Osborne, *Running Wild--The Next Industrial Revolution.* Berkeley: Osborne-McGraw Hill, 1979; and, for analysis of the interaction between the evolution of the technology and the institutional environ-

TABLE 2

The Top Ten Net Employment Winners and Losers, 1972-1977

Winners		*Losers*	
San Jose, CA	31909	New York, NY	-8975
Anaheim, CA	30612	Philadelphia, PA	-8586
Houston, TX	18932	Cleveland, OH	-8170
San Diego, CA	16782	Miami, FL	-6584
Boston, MA	15173	Syracuse, NY	-5521
Dallas, TX	12067	Baltimore, MD	-4245
Worcester, MA	9893	Jersey City, NJ	-4062
Oklahoma City, OK	8363	Parksburg, WV-OH	-3664
Lakeland, FL	8132	Los Angeles, CA	-3220
Phoenix, AZ	7976	Decatur, IL	-3130
Median gain	248	Median loss	740

Source: Glasmeier, Markusen, Hall, *op. cit.*, 1983.

TABLE 3

The Top Ten Net Plant Winners and Losers, 1972-1977

Winners		*Losers*	
Anaheim, CA	464	New York, NY	-159
Los Angeles, CA	367	Jersey City, NJ	-17
San Jose, CA	339	Elmira, NY	-9
Dallas, TX	276	Muncie, IN	-9
Chicago, IL	224	Albany-Schnectady, NY	-7
Houston, TX	204	Port Arthur, TX	-7
Boston, MA	191	E. Lansing, MI	-7
Minneapolis, MN	158	Wilmington, DE	-6
San Francisco, CA	151	Johnstown, PA	-5
Detroit, MI	145	Kokomo, IN	-5
Median gain	9		

Source: Glasmeier, Markusen, Hall, *op. cit.*, 1983.

aspects of the production process and its evolution, that are crucial to understanding the transformation of the industry's spatial patterning.

First of all, Storper's data (Table 4, Chart 1) show that employment in semiconductors is *heavily* concentrated in 4 states (72.5% in California, Arizona, Texas, and Massachusetts) as of 1980, and that it was so since 1969, while California has even increased its lead in recent years. If plants are included in the picture, two other states, New York (because of IBM) and Colorado are also significant. Giving attention to the spatial division of different functions within the industry, it is apparent that research and managerial functions tend to concentrate in the suburbs of some major metropolitan areas, particularly in the "Silicon Valley" (Santa Clara County, San Jose SMSA, California) and along Route 128 in the vicinity of Boston, while the U.S.-based production functions tend to concentrate in the new growing Western rim: Texas, Colorado, Oregon, Idaho, Washington State, Arizona, and Utah.

Nevertheless, it is difficult to apprehend the new spatial logic at such an aggregate level and at one point in time. This is why we shall return to an analysis of the specificity of the semiconductors industry, both in terms of its process of production and in its historical evolution. On both counts, a number of characteristics appear to have had decisive consequences on the spatial patterning of the sector:

1) Semiconductors is, definitely and above anything else, a *science-based industry*. So, it is, at the same time, extremely footloose in most aspects of production and distribution (for instance, transportation costs are minimal), but at the same time, totally dependent on those conditions that refer to accessibility, knowledge, information, and scientific and technical labor. Thus, location in the vicinity of major universities producing advanced engineering degrees, as well as in an area conducive to maintaining a pool of upper level professionals, scientists, and technicians, is a must.

2) *The process of production* is composed of four very different phases that can be *highly discrete in time and space*, and that have also distinct requirements in terms of their labor force.[10] Thus, semiconductors is structurally prone to an internal spatial differentiation, particularly if we consider the insensitivity of the industry to the transportation costs of its light-weight components.

Mask-making, that is engineering the circuit that will go into the chip and reducing it through lithography, involves highly specialized research-trained personnel. *Wafer fabrication*, where the circuits become materialized into wafers that undergo a series of complex operations before being cut into individual chips, requires highly skilled workers and quality control supervision. The chips are then *assembled* to form integrated circuits: this is a routine labor-intensive operation. Finally, *testing* is a capital intensive, widely automated process (Mutlu, p. 106). Spatially, design and mask-making will be entirely dependent upon an ever-innovative milieu of science and technology. Wafer fabrication and testing will be increasingly capital-intensive operations requiring highly-trained personnel, whose turnover should be minimum to maximize the learning process. *Assembly* employs a large quantity of unskilled cheap labor: it can be decentralized to cheap labor areas, both nationally and internationally. Theoretically it could also be easily automated should labor costs or labor unrest rise. Yet, except for IBM, such has not been the tendency in the industry,* partly because it has always been able to tap new sources of cheap labor, particularly female labor that seems to be the preferred

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ment: Michael Borrus and James Millstein, *Technological Innovation and Industrial Growth: A Comparative Assessment of Biotechnology and Semiconductors*. Research Report prepared for the U.S. Congress, Office of Technology Assessment, December 1982.

[10]See the excellent analysis of the production process in the semiconductors industry by Servet Mutlu, *op. cit.*, 1979.

* Nevertheless, in mid-1984, it appears that there is an increasing trend toward automation of assembly work in the U.S. Apple is leading in this new trend.

TABLE 4

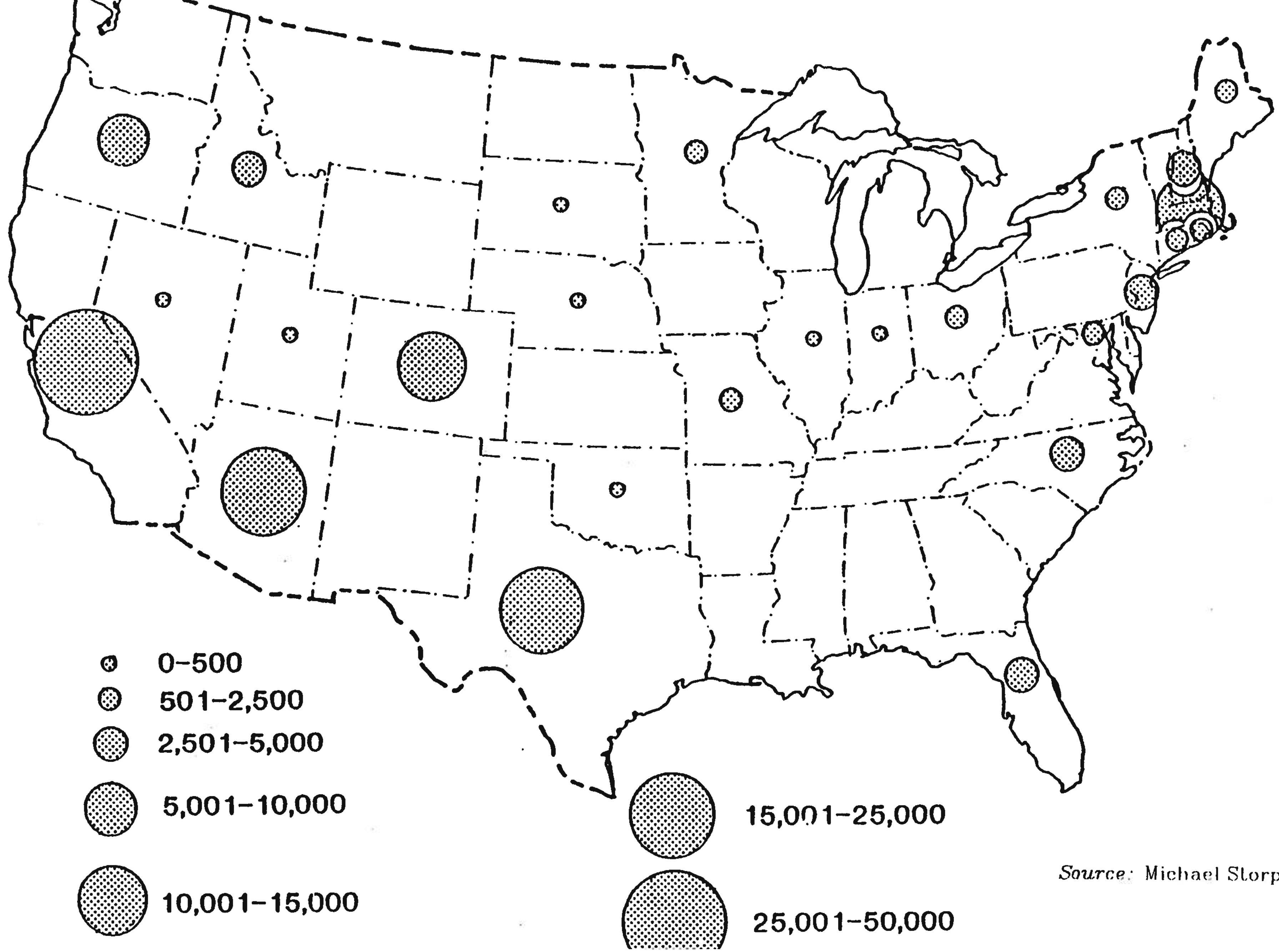
Location of the Semiconductor Industry

	Production Employment* Our Statistics, 1980	Production Employment Census, 1977	Value-Added 1977	Establish-ments 1977
Total	100% 102.99	100% 63.5	100% 3,409.6	100% 545
Top Four States	72.5%	72.5% 46.1	74.0% 2,523.5	58.8% 321
First State	30.4% CA	28.5% 18.1 CA	34.4% 1,172.6 CA	33.0% 180 CA
Second State	18.3% AZ	20.4% 13.0 TX	17.2% 568.6 TX	10.8% 59 NY
Third State	14.6% TX	12.6% 8.0 PA	12.3% 422.4 NY	8.44% 46 MA
Fourth State	9.2% MA	11.0% 7.0 AZ	10.5% 359.9 PA	6.6% 36 TX

Sources: State Industrial Directories; *Key Plants*, Marketing Economics Incorporated, New York, 1980. Sources gathered and elaborated by Michael Storper.

*SIC 3674 and part of SIC 3679.

CHART 1 EMPLOYMENT (Semiconductor), 1969 SIC 3674



Source: Michael Storper

labor force of the semiconductors business, both in the U.S. and abroad (Southeast Asia, Mexico). Also, the argument is generally advanced (particularly by Mutlu) that the high rate of technological innovation and the fierce competition could render obsolete very quickly expensive automated equipment, discouraging investment in fixed capital in assembly to concentrate resources on the crucial area of R&D expenditures. The hypothesis seems to be verified by the fact that the only case of extensive automation in the assembly process during the 1970's was IBM, which produces only for in-house consumption, and therefore could control its own pace of innovation. Yet, the future seems uncertain in terms of this fund that has accounted for the international and inter-regional dispersion of assembly-lines in semiconductors. On the one hand, Third World labor seems to become more expensive and less docile.[11] On the other hand, though it is doubtful that the pace of innovation will slow down in the near future, the vertical integration of electronics and the process of consolidation in a few giant transnationals will probably allow *some* internal control of innovation, therefore reducing the risk of obsolescence and allowing more room for automation. The more recent data suggest that such a process is underway.[12]

3) The industry has been spurred originally by *government contracts, particularly in defense and space programs*. One can say, following the lines of Borrus and Millstein's analysis[13] (yet without them having said that) that semiconductors would have never existed in their present form, had it not been for the specifications of the defense contracts, particularly their insistence on miniaturization and performance, as well as by their lack of concern about the costs involved. Thus, these areas targeted as potential beneficiaries by the Defense and Space programs will have a definite edge over other areas. This includes basically California, Texas, Florida and the Western States, for a number of reasons: the West Coast military build up for the Pacific War, the presence of military bases and training camps on the desert rims, the good weather conditions for aircraft and missile testing, and, last but not least, the advanced weapons system research network built in California as a spin-off of the East Coast-originated (yet West Coast-implemented) Los Alamos pioneering effort to build the atomic bomb, having the heritage of research laboratories such as Livermore, that, in connection with Stanford and Cal Tech in Pasadena are probably responsible for the most advanced weaponry in human history, becoming a privileged connection for innovative semiconductors manufacturing. Military-oriented advanced research was, of course, conducted in other major centers, Chicago and Princeton during the war, as well as at MIT and Johns Hopkins' APL all along. Yet, uniquely in California we find a combination of high-level military research and widespread military markets allowing for the required frequent and easy contacts between research, manufacturing and testing.

4) The semiconductors industry, as well as electronics in general, is dominated by a *deep aversion of management toward unions*. As Storper and Walker[14] have pointed out this is not motivated primarily by labor costs. Though assembly-line semiconductor workers earn less than the average manufacturing worker, the industry has flourished in high-cost labor areas (San Jose, Boston) and for skilled labor the policy tends to be paternalistic and rooted in in-house ideology, bonuses, and special benefits. Yet, unions

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[11] We rely on information gathered by on-going research in Hong Kong's electronics companies by Jeff Henderson of the University of Hong Kong, and by Vivian Lin (University of California, Berkeley) on the electronics companies in Singapore and Malaysia.

[12] Ann R. Markusen, *High Tech Jobs, Markets and Economic Development Prospects*. Berkeley: University of California, Institute of Urban and Regional Development, Working Paper No. 403, April 1983.

[13] Borrus and Millstein, *op. cit.*, 1982.

[14] Michael Storper and Richard Walker, "The Spatial Division of Labor and the Location of Industries" in Larry Sawers and William K. Tabb, *Sunbelt, Snowbelt, Urban Development and Regional Restructuring*. New York: Oxford University Press, 1984, pp. 19-43.

are discouraged by all possible means, and electronics actually exhibits one of the lowest unionization rates. The reasons seem to be three-fold:

a) the occupational structure is heavily scored upwards, with about 1/3 of professionals and technicians, generally unenthusiastic about joining a union, given their chances of individual mobility.

b) the majority of unskilled workers are women, which have usually had trouble with the sexist tradition of the blue-collar workers unions. Immigrants are also reluctant to unionize, given their social vulnerability.

c) But the most important element is the management's strongly negative attitude toward unionization. The two preceding reasons explain not why they have such an attitude but why it tends to perpetuate itself throughout time. The fundamental reason for this attitude seems to be cultural: it can be traced to the entrepreneurial "pro-scientific innovation" ideology that permeates the milieu. Most of the companies were started by scientists and engineers with no business experience and little patience with bureaucracies. In fact that was an important reason why they left major companies stalled in their routine. So, they could accept having to pay more, but not to have to negotiate the implementation of their discoveries. This libertarian brand (against government, organized labor, and bureaucracies in general) is an indispensable clue to understanding the new world of high tech manufacturing.[15]

d) Nevertheless, even the most aggressive entrepreneurs working on the cutting edge of technology need capital to produce in our society--true, not much to start up a business in semiconductors *until the mid-1970s*, but enough to be impossible for these young scientists to create a company without some *venture capital*. It is one of the merits of Mutlu's analysis to have pointed out the crucial role played by the existence of a dense financial network with an abundant group of wealthy individuals ready to invest, both in Boston and in the San Francisco Bay Area.[16]

Thus, we would propose, as a hypothesis, that these are the *five characteristics* that underlie the spatial logic of semiconductors. If we translate the second characteristic in its different components (the space of innovation, the space of assembly, and the feasibility of spatially disjointed interconnectedness) we would have the *necessary and sufficient conditions for a place to be an ideal location for semiconductors--providing access to science and to technical labor* (basically in engineering); *being a communication hub; being a defense-oriented area; being a "union-free" (!) environment; and being in a wealthy region able and ready to invest its resources through a venture-capital, financial network*. If an area meets some of these conditions but not all, it could become *part* of the system, but a subordinate part until it generates within itself the remaining conditions. But more importantly, these are the conditions that could define not just the characteristics of a semiconductors area, but of the spatial logic of semiconductors.

Before fully developing the analytical implications of this hypothesis, we must now turn to the actual evolution of the spatial patterning of the semiconductors industry, to be able both to verify the hypothesis, and to complement it with the actual complexity of its historical development. Yet, here again we will only report the facts that are necessary to evaluate our argument, without repeating the detailed story that has been carefully documented in the cited sources, particularly in Mutlu's and Storper's theses. We are arguing that semiconductors' creation follows a very specific pattern, as outlined

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15 See the interesting report on Silicon Valley's entrepreneurs in the magazine *Mother Jones*, December 1983.

16 S. Mutlu, *op. cit.*, 1979. The analysis of the intimate connection between semi-conductors and venture capital is also one of the themes of the best socio-anthropological book on high-tech: Everett M. Rogers and Judith K. Larsen, *Silicon Valley Fever: Growth of High-Technology Culture*, New York: Basic Books, 1984.

above, and that this pattern does not refer only to the industry's preference for certain places, but to the spatial fragmentation of the different components of the industry. We think the argument is supported by available evidence that can be organized, in a step-by-step demonstration process, around *seven different sets of facts*, all converging toward the same analysis:

1) *The development of semiconductors was actually missed by the big companies that were already in the business of making electronics components on the basis of the vacuum tube technology*. Though they did reconvert to semiconductors in the late 1960s, they mainly produced them for their own manufacturing processes, basically focused on consumer durables. So, they remained located in their original sites on the East Coast: Westinghouse in Pittsburgh, Sylvania in Long Island, RCA in New Jersey, and General Electric in northern New York, and they only decentralized assembly plants to some peripheral rural areas in search of cheap labor. Since the development of semiconductors was mostly dependent on innovation, and none of these firms chose to invest in the creation of a huge research facility aimed at electronic components, they were gradually pushed aside from the competition, both by innovative large firms and by a burgeoning milieu of small companies.

2) The only established big firm that could have dominated the innovation process in all its elements was, obviously, Western Electric, *since ATT's Bell Laboratories in New Jersey*, were at the very source of the invention of the transistor (in 1947) and of most of the original know-how in the semiconductors field. Yet, threatened with anti-trust law suits (particularly the one brought by the Department of Justice against Western Electric in 1956), Bell decided to diffuse its knowledge, organizing conferences to communicate the results, and liberally licensing the applications of its discoveries. Bell Laboratories, heavily dependent on government research contracts, became in fact a national research facility. In the long term this turned out to be a brilliant business strategy, since telecommunications, undoubtedly dominated by ATT (and now by its spin-offs), became eventually the highway system of the electronic age. Yet, probably this was not a conscious strategy, but simply the combination of the legal constraints with the research dynamics generated within Bell Laboratories. This is in fact one of the crucial matters of a research-oriented economy: that it is very difficult to play the game of innovation and, at the same time, to set up such economic and social limits that kill, or seriously diminish the chances of discovery. Those companies that behaved in this way were rapidly left behind. Bell was not, but the manufacturing applications of its discoveries were not theirs. Dr. William Shockley, one of the inventors of the transistor, became a Professor at Stanford University and founded a company that was not very successful but formed the technical team upon which Fairchild Camera relied to create, in 1958, Fairchild Semiconductors, the source (direct or indirect) of most innovations in Silicon Valley. Spin-offs of Fairchild were Intel, Signetics, and Advanced Micro Devices. Similarly, the main scientific element behind Texas Instruments' early lead in semiconductors, was the hiring, in 1952, of Gordon Teal, a leading scientist at Bell. Thus, Bell was able to organize, by itself alone, the scientific research milieu necessary to the new industry, but interestingly enough its spin-offs were not theirs, and took place in very different locations. New Jersey never became a center for semiconductors in spite of Bell's preeminence, the asset represented by Princeton University, and the location at Princeton of RCA, and in nearby Southern New York of IBM. Why is it that all these elements never clustered to generate an industrial milieu? Partly, it is because each one of those companies or institutions constituted an isolated world, a world apart, too arrogant to solicit and too self-confident to feel threatened by future competition. Secondly, because of the lack of some of the conditions we have hypothesized in our model of high tech locations: the pool of electrical engineers and technicians was not large enough, unions were too influential in the greater New York area, the Army's testing weapons units were not particularly present in the region, and venture capital was not keen to this type of investment, channeled, as it always had been, in New York

toward the stock market. Thus, the greatest institution in electronics research in the world, in spite of its location in a Stanford-like charming semi-rural area, in the vicinity of the great metropolis, could not generate its manufacturing hinterland. The seeds of invention were spread by the wind of risk-taking enterprises toward more fertile grounds.

3) A third series of cases revealing the complex dynamics of semi-conductors location is represented by those *large companies that dominated semiconductors production from the beginning of the technology*, and that constituted independent isolated sites of production. They were essentially three companies: *IBM, Texas Instruments, and Motorola.*

IBM started semiconductors production for its own use in computer making. It organized its own space of production with 3 research centers in Yorktown Heights, New York; San Jose, and Zurich, and with 4 plants that integrated production and R&D facilities in East Fishkill, New York; Burlington, Vermont; Manassas, Virginia; and Endicott, New York. Several distinctive trends characterize IBM's locational pattern: a) Its control of the rate of obsolescence of the technology, through vertical integration in the computers market it dominated, allowed the company to automate assembly operations, thus reducing labor costs without having to disperse the production facilities. Therefore, there was no off-shore production and the two plants located in cheap labor, rural regions (Vermont and Virginia) are the smaller ones: the cost of labor does not seem to be a major factor in IBM's location. b) Access to science and technology was guaranteed by the company itself through its research personnel and network of consultants. Thus, spatial proximity to major research centers was not an important criterion, the center in San Jose being the only major exception to the rule, as a recognition of the emergence of Silicon Valley as the world's center for semiconductors outside IBM. c) IBM developed a pattern of self-sufficiency and isolation in relationship to its environment, with a campus-like ideology for the settlement of its facilities. Semiconductors' location was in fact determined by the location of the firm's computer factories and research centers, themselves historically dependent upon the proximity to the huge market for business services represented by New York. This pattern of indifference to the environment (made easier by a paternalistic policy of high salaries that kept the unions away from the company) resulted both in the location of IBM in atypical high tech environments, and in the absence of the generation of a cluster of high tech activities around IBM.

A different, and extremely interesting case is offered by the development of Texas Instruments in Dallas, and the differential expansion of semiconductors in Texas along parallel lines in Dallas and in Austin. The Dallas network appears to be essentially a spin-off of Ti activity, following a logic relatively close to that of IBM. Ti was originally (1930) a small company in the oil exploration business, that expanded its electronic tools production during the war when it engaged in the fabrication of anti-submarine detectors. Through its contacts with the Navy, Ti decided to use the recently discovered transistor to start research and production in advanced electronic components. In 1953 it hired a major researcher in semiconductors, Dr. Gordon Teal from Bell Laboratories, and in 1956 Ti become a leading business in silicon transistors, mainly for military use. Later, Ti diversified its production, becoming a large producer of hand-calculators and computers. It remained largely located in Dallas and in nearby areas in Texas, with the major exception of a new plant in Attleboro, Massachusetts in the early 1970s.

Ti's location pattern represents a combination of IBM's type of behavior and of the model we have proposed to account for the spatial environment of high tech activities. Initially, Ti used its isolation in Dallas to generate its own milieu of research, and to the benefit of a monopoly of skilled engineers and scientists in the local market, being able as it was to recruit nationally. Yet, given its much lower leverage capacity than the one displayed by IBM, its expansion was made possible by a number of characteristics that made Texas a convenient location for electronics: direct connection with a huge military market; cheap labor and a socio-political environment very hostile to unions; and, since the early 1970s, the transformation of Dallas into one of the major communication hubs. Yet, to shift from the expansion of Ti to the development of semiconductors in Texas, it was necessary to reinforce the scientific basis of the new production, if Texas was going to be something more than a peripheral cheap labor manufacturing area. At this point, the center of the action shifted to Austin, where the only University with a potential for establishing a major research center was located. Through a major influx of State of Texas funds, private donations, and business and military contracts, Austin did become an important center for electronics[17] and, after IBM located a unit there in 1967, a number of small and medium semiconductor companies were spawned around the area, beyond the direct reach of Ti, and supported by venture capital flowing from the oil-rich region to the new promising opportunities of high tech industries. Thus, interestingly enough Texas Instruments and Texas do not seem to share a common development in high tech development, though the accident of Ti's location in Dallas probably generated the first milieu of electronics research, and provided the example to be followed by Texas when it became clear that a new frontier of manufacturing was emerging. Yet, we should remember that Ti, unlike the Silicon Valley companies or Bell, has experienced very few spin-offs, since its relative isolation in Texas for a long time made it more difficult for its researchers to start their own operations in the area. Ti-Dallas and the Austin complex represent two locational models probably linked in their historical development, but clearly distinct in their spatial-functional logic.

An even more clear case of disassociation between the logic of a major company and that of a region is offered by the expansion of Motorola (the second largest semiconductors company) in Phoenix, Arizona. Here again, Motorola's location in Phoenix (away from its original basis as an auto radio producer in Chicago) was accidental, apparently motivated by a combination of the attractiveness of good weather and pleasant physical environment for its research personnel, and of the existence of a pool of cheap labor, both in Arizona and across the Mexican border. Its development in the middle of a region with no major research facility seems to contradict the fundamental characteristics of a science-based industry as stated in our model. Yet, the size of Motorola, and the fact that it produced partly for its own consumption as a radio and communications manufacturer, allowed the company to create its own research facility by hiring in 1958 Dr. Hogan, a Harvard electronics physicist who created an advanced research team in Phoenix. Though Hogan himself left the company later to join Fairchild, the Motorola's R&D laboratory was able to develop in the isolation of Arizona, partly because of the absence of competition for skilled researchers, partly because of the presence of two key favorable characteristics in Arizona: first of all, a major military market, particularly in aircraft production; and secondly, because of the absence of unions and the abundance of cheap labor. These two elements, together with the proximity of Arizona to the high tech center of California, were much more important than the presence of Motorola for the expansion of Phoenix, and to a lesser extent of Tucson, as the semiconductors manufacturing area of the 1970s. While the engineering programs of both the University of Arizona in Tucson and Arizona State University in Tempe have undergone a dramatic expansion in the last ten years, the emphasis has been on skilled production personnel rather than on advanced research. So, the fact that in 1980 Arizona became the second state in semiconductors employment in absolute numbers, surpassing both Texas and Massachusetts, is *not* connected to Motorola's expansion, but to the decentralization of semiconductors production from California, and close to the growing military and aircraft market in Arizona. It is very likely that, as

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[17] See: The Fantus Company, *Local High-Technology Imitative Study*, Conducted for U.S. Congress' Office of Technology Assessment, Chicago: 1983.

it happened in Texas, Arizona will be able to create a research basis for further expansion into more advanced operations. But as of today, semiconductors employment is more related to the assembly operations than to the advanced equipment pioneered by Motorola. A simple company, whatever large, is not able to generate an industrial environment beyond its own operation. The most it can do is to provide true visibility to an area that, if it has some key features for the development of high tech, will trigger a process of growth to the extent, and only to the extent, of the presence and importance of these features. Arizona, lacking the scientific basis and the financial environment, yet being an ideal location for non-unionized cheap labor and access to the military market, became a core of mitigated success: rapid expansion of low-skilled, high tech manufacturing.

Thus, the largest companies pioneering in semiconductors production were not able to create a dynamics of development around then. When the region did develop, other processes, linked to some basic characteristics, were responsible for such a trend. As Mutlu writes, "the heart of the American semiconductor industry beats elsewhere" (p. 129).

4) It beats in the "*Silicon Valley*" (Santa Clara County, California) and along *Route 128 near Boston*. Why is it so? Our research perspective is that by understanding the characteristics of these *nests* of high technology, we will obtain a better knowledge of the spatial features favoring the new manufacturing activities than by measuring the distribution of some statistical variables across the entire country. The assumption is that it is the *discontinuity* of the characteristics that support a favorable environment for high tech. A different question, and one that we will be dealing with later, is the process of sprawl of high tech activities from these nests to other areas.

In semiconductors, Boston came first. In 1958, of the 55 firms producing semiconductors, 13 were located in Massachusetts, and only 7 in California. Yet, in 1967, the San Jose Metropolitan Area employed more workers in semiconductors manufacturing than all of New England. Thus, a good understanding of the process will require *both* explaining the specificity of Boston and Silicon Valley in relationship to the rest of the country, and the differences between the two areas that could account for the Silicon Valley's preeminence in spite of its late start.*

The most important common characteristic of the two areas is the fact that they concentrate the top research-oriented University complexes in the U.S., particularly in electrical engineering, organized around MIT-Harvard in Boston-Cambridge, and around Stanford-Berkeley in the San Francisco Bay Area. As Table 5 shows, 43 out of 64 science-based firms in the Boston area in 1905 were spin-offs of other research facilities, and 26 of these spin-offs came directly from the universities (21 from MIT!). In the case of Silicon Valley, the connection is even more direct between the stunning development of advanced semiconductors design and production and the deliberate effort accomplished in this direction by Stanford University (and its spin-off Stanford Research Institute) since 1946. Stanford's program was actually started by Frederick Terman, an engineering professor (who became Dean and Provost) and who joined Stanford after having directed a military-oriented research project at Harvard. Not only Stanford built an outstanding electrical engineering program and established close ties with the electronics companies (in 1955 gifts from corporations to Stanford were $500,000 annually, in 1976, they reached $6.9 million) but it also pioneered in the formation of a Stanford Industrial Park in 1956, providing low-rent space for 99-year leases to high tech companies that would both benefit and benefit from the University. Lockheed's aerospace research facility was one of the first to locate. From Stanford's faculty and

*The major research effort on this subject is: Annalee Saxenian, *Silicon Valley: Regional Prototype or Historical Exception*? Paper delivered at a Conference on Microelectronics, University of California, Santa Cruz, May 1983.

TABLE 5

The Origins of the Science-Based Firms by Technical Area in Greater Boston,

circa 1965[a,b,c]

Company Origin	Electronics	Communication System, etc.	Computer Hardware	Data Processing	Instruments	Other	All Companies
MIT	21	9	5	5	12	31	(49)
Harvard	3	1			4	4	(7)
Another Local University						3	3
Non-local University						3	3
Government Laboratory	2	1			1	1	3
Another Company	17	4	6	2	10	28	
TOTAL "SPIN-OFFS"	43	15	11	7	27	100	109
Formed a Subsidiary	1			1	2	9	
Formed Independently	19	10	3	5	8	54	
Other	1						
TOTAL "NON-SPIN-OFFS"	21	10	3	6	10	63	78
TOTALS All Origins	64	25	14	13	37	135	187

Source: D. Shimshoni, "Regional Development and Science Based Industry," in J.F. Kain and R. Meyer, eds., *Essays in Regional Economics* (Cambridge, MA: Harvard University Press, 1971), pp. 111-114, 119. (Cited by Servet Mutlu.)

[a] A science based firm is defined as having 20% or more of its employees in R&D.

[b] A company can be in more than one technical area.

[c] The sample covers 187 firms out of a total of 406 science-based firms in the Greater Boston, circa 1965.

students came the overwhelming proportion of semiconductors firms of the Silicon Valley, either directly or as spin-offs from Fairchild, itself a product of William Shockley's team at Stanford.

The second common feature to the Boston and San Francisco areas is the existence of a very active and well organized network of financial institutions specialized in the channeling of venture capital toward promising small business, particularly important after the small Business Investment Act of 1958 that greatly facilitated these financing arrangements. Given the low-entry barriers in the field of innovative high tech production, and the relatively small capital required to start fabricating a product whose main value is the knowledge incorporated into it, venture capital and personal savings were the main source of financing for the initial stage of the new kind of semiconductors firms.

Another characteristic often cited as common to both areas and distinctive from most of the country, is their pleasant urban atmosphere, physical charm, and rich cultural life. Yet, the images are too vague and subjective to induce this element in the analysis, and most of the qualities usually cited are simple correlates of large university settings. Besides, if one could agree with the urban character of San Francisco, it is difficult to apply this quality to the suburban world of Silicon Valley, whose rural-like residential communities are at the opposite end of the spectrum of the spatial forms in relationship to the old, dense industrial town represented by Cambridge, Massachusetts. So, beyond this very subjective notion of being a "nice place to live" (certainly challenged by hardcore New Yorkers), there is little specificity in the "quality of life" attribute of the two areas, supposedly luring scientists and professionals to reside there, and therefore attracting high tech companies. The causality seems to work in the reverse direction. While there seems to be a definite relationship between the residential quality of life and the preferences of a privileged professional labor force, as we will see, this element applies to the stage of spatial dispersion of high tech activities, and not to the formation of high tech nests; in this case, the primary function seems to be played by the characteristic of being a science-based activity that originates as a spin-off of a major, dense center of research, and that keeps feeding itself from the immediate, daily contact with such a research milieu.

Another common characteristic to both areas is their role as major regional centers connected to a vast industrial hinterland, and as national, indeed international, communication centers that enabled them to organize their expansion through spatial dispersion without losing the location of their research and management headquarters at the very core of the high tech nest.

Other major features of the two areas under consideration are very distinct, and it is precisely this difference that might suggest an explanation of why Silicon Valley replaced Boston as the leading center of semiconductors. It has been argued, by both Mutlu and Saxenian, that one of the reasons for such an advantage was the particular effort put out by Stanford and Berkeley in the quantitative size of their engineering programs: since the 1960s the two universities were granting twice as many Ph.D. degrees in electrical engineering as MIT did, increasing their advantage over time on other leading institutions (see Table 6). While this factor has probably played an important role, it does not seem to us to be necessarily a determinant, since it could also be argued that the Bay Area universities were responding to the growing demand of a market that was spurred there more than anywhere else, for reasons that have to do with the distinctiveness of the San Jose SMSA, and, more generally, of California in relation to Massachusetts.

The first difference is the importance of the labor union culture in Boston-Cambridge, in sharp contrast to the absence of union tradition in San Jose *(unlike* San Francisco, which also accounts for some of the preference for the location of Silicon Valley there rather than in the San Francisco-Oakland metropolitan area). This "union-

TABLE 6

Master's and Doctor's Degrees Awarded in Electrical Engineering in Representative Institutions

		Master's Degrees *Total in 5 Year Periods*					Doctor's Degrees *Total in 5 Year Periods*				
Year		MIT	Stanford	UC Berkeley	Cal Tech	Cornell	MIT	Stanford	UC Berkeley	Cal Tech	Cornell
1950-54	Number	546	329	133	93		65	67	19	26	13
	% of Total	(10.45)	(6.30)	(2.55)	(1.78)	(1.09)	(11.40)	(11.75)	(3.33)	(4.56)	(2.28)
1955-59	Number	665	418	133	172	46	69	94	26	17	17
	% of Total	(9.20)	(5.79)	(1.84)	(2.38)	(0.64)	(9.11)	(12.42)	(3.43)	(2.25)	(1.45)
1960-64	Number	820	670	328	197	123	137	185	72	33	31
	% of Total	(6.26)	(5.11)	(2.50)	(1.50)	(0.94)	(8.30)	(11.21)	(4.36)	(2.00)	(1.88)
1965-69	Number	1,109	873	584	141	364	204	252	158	46	68
	% of Total	(5.61)	(4.41)	(2.95)	(0.71)	(1.84)	(6.20)	(7.66)	(4.80)	(1.40)	(2.07)
1970-74	Number	602	827	630	88	300	231	242	202	43	72
	% of Total	(2.87)	(3.95)	(3.01)	(0.42)	(1.43)	(5.45)	(5.71)	(4.77)	(1.01)	(1.70)

Source: Frederick E. Terman, "A Brief History of Electrical Engineering Education," *Proceedings of the IEEE*, Vol. 64, No. 9 (September 1976), pp. 1403-1405. (Cited by Servet Mutlu.)

free" environment created the conditions for the expansion of semiconductor assembly production on the basis of cheap women and immigrant labor during the early 1970s, adding to the profits of the cash-short young companies.[18]

The second, and probably crucial, difference is the much greater weight of California in general as a military market and as a beneficiary of defense and space contracts (see Table 7). To be sure, MIT was, and still is, a major recipient of military research funds, as are Stanford and the Berkeley-supported Lawrence Livermore Laboratory. But the crucial difference is in contracting beyond the initial research stage for development and testing. In the actual development of weaponry and aircraft and missile tests, California enjoyed a clear advantage, both because of its solid military foundation from the Pacific War, and because of the favorable weather conditions for flight tests. The military market demanded daily contacts with the network of small suppliers and providers, most of which were Silicon Valley companies. Thus to some extent, the semiconductors firms were the manufacturers' connection between the military-oriented basic research and its final military users. Only California brought together the most advanced research and the military and space testing sites. And in between, flourishing among the bucolic orchards of Santa Clara, Silicon Valley came into existence.

5) *Silicon Valley* has become the archetype for the location of high tech manufacturing--so much, that it is rightly considered as an exception. Not because other semiconductors manufacturing present a different location pattern, but because uniquely in the origins of the Silicon Valley the industry displayed all its diverse spatial characteristics *within the same metropolitan area*. The result was a cumulative process of urban contradictions that, as Saxenian's pathbreaking analysis showed, led to the spatial dispersion of the industry's activities, while keeping their internal connection, and emphasizing the spatial requirements for each stage of the production process in each particular location.

Silicon Valley is not the paradise of horse-riding Ph.D.s depicted by the high tech ideology. Storper has insisted in the specificity of the labor force in the semi-conductors industry. It is highly polarized and highly segmented, and the problem is how to bring together in the process of production these segments whose reproduction requirements, and therefore the characteristics of their residential communities are so different, and to some extent contradictory. How will elite universities be coordinated with immigrant labor, exclusive suburban residential communities with chemically polluted manufacturing sites, gentry-like top scientists and engineers with working-class women, cultural innovation with assembly lines, and middle class environmentalists with mobile home dwellers? Originally, as Saxenian documents in her study, strict spatial segregation seemed to supersede the problem. As she writes:

> *Residential segregation allows for the reproduction of the differing qualities of labor power for electronics production. Each of the different communities has different institutions, public services and levels of social consumption which are suited to the reproduction needs of the segment of the workforce that resides there.*
>
> The differential nature of reproduction in Santa Clara County's class segregated communities is highlighted by the variations in residential densities and the type of housing structures across cities. While north county industrial cities are densely settled the western foothill cities average only a single dwelling unit per residential acre. In Los Altos Hills, there was an average of one dwelling unit for every two acres in 1979. By contrast, San Jose and the remaining East and Central valley cities averaged about six dwelling units per acre of

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[18] J.F. Keller, *Industrialization, Immigration and Community Formation in San Jose, California: Social Process in the Electronics Industry*. Ann Arbor: University of Michigan, 1979.

TABLE 7

Defense and Space Prime Contract Awards of $10,000 or More by Census Regions and Selected States

	1964		*1972*			
	Total Defense and Space Prime Contract Awards (%)		I Aircraft (%)	II Space Systems (%)	III Electronics and Communication (%)	IV Total Defense and Space Prime Contract Awards (%)
NEW ENGLAND	8.79		11.1	11.5	12.1	11.45
Connecticut		5.39				
Massachusetts		2.83				
MIDDLE ATLANTIC	22.37		17.1	14.2	22.8	17.58
New York		15.68				
Pennsylvania		3.37				
EAST NORTH CENTRAL	15.84		7.1	2.9	9.4	6.42
WEST NORTH CENTRAL	9.98		19.8	2.1	3.7	10.94
SOUTH ATLANTIC	12.78		11.8	14.1	14.8	13.14
Florida		2.21				
EAST SOUTH CENTRAL	2.06					
WEST SOUTH CENTRAL	5.84		16.3	2.5	7.2	10.28
Texas		4.63				
MOUNTAIN	1.34		0.9	7.5	2.0	3.05
PACIFIC	22.73		15.8	45.1	28.1	27.14
California		20.86				
TOTAL	100		100	100	100	100
AMOUNT ($billion)	12.45		8.62	5.21	4.10	17.94

Source: For 1964, W. Isard, G.J. Karaska, *Unclassified Defense and Space Contracts: Awards by County, State and Metropolitan Area, United States, Fiscal Year 1964* (Philadelphia: World Friends Research Center, Inc., 1965), Table 1; for 1972, Aerospace Industries Association, *Aerospace Facts and Figures, 1974/75* (New York: McGraw-Hill, 1976), p. 129. (Sources collected and elaborated by Servet Mutlu.)

residential land. Further, the residents in the western foothill cities are overwhelmingly single family homes. All of the building permits for Monte Sereno and Los Altos Hills and 93.6% of those for Saratoga between 1960 and 1969 were for single unit structures, while in San Jose and the south valley cities, about 35% of the residential construction permits were for multi-unit housing.

The wide variations in assessed property valuations among the county's cities in turn generates vastly different tax bases. The north county and western foothills have strong tax bases and thus provide high quality public services such as parks and schools for their residents without relying on excessively high tax rates, while the poorer central county cities must set much higher tax rates in order to simply maintain an adequate level of services.

Schools are a key element in differential reproduction of classes, and the income disparities between the county's schools districts is dramatic. In 1975-76, for example, Palo Alto Unified School District had well over twice the assessed value per high school student of San Jose's East Side High School District and between three and six times the assessed valuation of the San Jose's elementary school districts. The Mountain View-Los Altos High School district has an even higher tax base per student.

The county's western foothill cities and Palo Alto are an ideal environment for professional and upper class reproduction. As one industry representative noted, "Our firm remained here because it's an ideal place for millionaires to live." (Interview). The area retains the peaceful, orchard-like character which the whole of the Santa Clara Valley was so famed for during the first half of the century. As a 1970 real estate ad headlined "Country Living" described it, "There's a place where there are still plenty of trees, flowers, fields, orchards, rolling hills . . . your dream and your children have room to grow . . . a beautiful place to live" (San Jose Mercury, 8/16/70). A local newspaper article described the band of residences in the western hills as the most desirable housing in the South Bay area, with large luxury homes set in an attractive rural setting and distinguished by such features as:

> Innovative bathrooms, the vast ones with spa tubs and adjoining private sun decks; tennis and racketball courts; acreage; exercise rooms; quality finishing details; lots of closets; the three car or better garage; quarters for hired help; building design aimed at effortless entertainment and plenty of floor space are features at the top of the luxurious home market.
>
> Recent sales in the over a half million dollar homes have featured a racquetball court in a windowed basement and a swimming pool designed like a forest grotto complete with waterfall (San Jose Mercury, 5/10/80).

These communities are designed to remain well insulated from the communities to the south and east which house the county's large industrial workforce.

The environment of San Jose features endless stretches of poorly constructed "cracker box" tract homes, strip commercial development, and octopus-like freeways. Many residents are housed in inadequate, crowded and often dangerous housing units. A 1968 study noted that much of San Jose's housing was substandard and had degenerated into areas of "blight" almost immediately. It identified sixteen neighborhoods in San Jose which suffered from critical levels of substandard housing (over 20% substandard housing) and described the corresponding "social pathologies" which characterized these neighborhoods (San Jose City Planning Department, 1968). Furthermore, the agricultural lands lost to development in San Jose were not replaced by other forms of open space. In contrast to the foothill cities, San Jose provides minimal recreational open space for its residents. In 1971, the city of San Jose maintained a ratio of approximately 8.0 acres of open space per 1000 people. (This level represents a 5 yard by 7 yard plot of ground per person . . . and more than half of the city's "open space" consists of school playgrounds.) By comparison, a recent study of the Bay Area recommended 15 acres per 1000 people as a minimum level. The relative inadequacy of San Jose's open space provision is also clear when contrasted with other metropolitan areas. In New York City, the 1971 ratio was 25 acres per 1000 people, and in Washington, D.C., the ratio was 71 acres per 1000 people (Stanford Environmental Law Society, 1971). Thus the problem of the unemployed, poor and minority populations of Santa Clara County have all been concentrated in the central and south valley cities. The political fragmentation of the county has left these concerns and costs in the hands of the city politicians of San Jose, Milpitas, Campbell, Morgan Hill and Gilroy" (Saxenian, 1980, pp. 82-85).

Yet, such a tight spatial separation of population and functions did not preclude the development of unbearable contradictions given their coexistence within a contiguous spatial area. The displacement of production workers to the periphery of the area in highly deteriorated surroundings imposed long daily commuting (that bottled up everybody in traffic jams, without too many class distinctions), and put pressure on wages. Housing costs skyrocketed for everybody, given the privilege of living in what probably amounts to the world's hottest manufacturing labor market. Not only housing costs added even more pressure on wages, but they became so out of reach that it became difficult to attract new engineers to the area. Last, but not least, the scientific and professional labor of research centers and Silicon Valley companies fought with their utmost energy to preserve the environmental quality of their residential communities, precisely one of the major elements for their coming to that area. The no-growth movement opposed business growth and created a major constraint on development policies of local governments, thus provoking a "suburban squeeze"[19] in the building of both housing and new manufacturing facilities. Under such pressures, the semiconductors firms that had enough resources decelerated the movement to decentralize their labor-intensive facilities to Third World countries and to other areas of the U.S., leaving in the Silicon Valley their research operations and their headquarters. The firms that could not afford to decentralize reduced their operations to the design functions. Through both mechanisms the Valley became specialized in high-level functions, in a self-reinforcing mechanism that made it increasingly indispensable for companies to be in the Valley to be in the race, and increasingly difficult to maintain other type of activities there.

Along with the urban contradictions, the economic transformation of the semiconductors industry also led to new spatial tendencies. The concentration and amalgamation of firms, the much higher entry barriers to start a company, the growing investment of Japanese and European capital in order to be present in the center of technological innovation, are pushing toward automation, toward increasing technological change in fabrication, and toward increasing interconnection of spatially disjointed operations within a few transnational corporations.

6) *The sprawl of semiconductors industry* occurs along 4 different lines, each one with its own locational characteristics:

a) Off-shore production of labor intensive operations. Yet, the increasing cost of labor even in Third World countries, political unstability, and some national programs to upgrade the level of the in-site production, provoke a changing pattern

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[19]See, for a broader analysis of the Bay Area's suburban housing market: David Dowall, *The Suburban Squeeze*. Berkeley: University of California Press, 1984.

of international location. In the 1960s Hong Kong, Singapore and Korea were the leading producers. Currently, Hong Kong has decreased its relative importance, Taiwan has joined the club, and Singapore has extended the range of its production. Malaysia is becoming a much more important chips producer than Hong Kong, and Mexico clearly emerges as the major production site for the near future (see Table 8). By 1976, off-shore employment in U.S. firms manufacturing semiconductors was twice as large as in the U.S. (see Table 9). Yet, it is likely that this tendency will slow down in the near future, due to easier automation at home, and tighter labor markets in Southeast Asia.

b) Formation of new centers for research and design, given the saturation of Silicon Valley and Route 128 and the growing demand, generally in locations supported by Defense contracts (Colorado Springs, Colorado, or the Scicom corridor in the Baltimore-Washington Area around Johns Hopkins), or by State-sponsored programs (the Research Triangle, around Duke University, in North Carolina).

c) Location of assembly-line facilities in cheap-labor regions in semi-rural areas of the Western U.S., focusing on what Storper calls the "ghetto-peasant worker in high technology," generally women with no other employment chance in the region. These locations tend to be in Oregon, Washington State, Utah, Colorado, and Arizona (see Table 10). Silicon Valley firms interviewed by Saxenian stated as a major criterion for location of their decentralized plants that they should be at a maximum range of 3 hours by plane from Santa Clara. Granted that such a range encompasses a huge territory, it does, however, emphasize the importance of communication between different stages of the production process.

d) New centers are emerging that combine some research and large production facilities. Phoenix-Tucson, Arizona; Austin-San Antonio, Texas; and more recently Salt Lake City, Utah, appear to be the closest, if reduced, expression of the original Silicon Valley model. And they are, in fact, going through a process of emergence of similar contradictions as those that led to the decentralization of the Silicon Valley companies.

7) *The space of semiconductors industry appears then to be a space of variable geometry*--but of a geometry that combines some basic elements: a science-based activity, relying on high-level professionals, yet depending upon labor intensive (cheap or automated) fabrication, originally spurred by venture capital, and nurtured and continuously solicited by military and aerospace markets. Those areas that concentrated all of these characteristics became the nests of the most prominent high tech activities. Those areas that fitted only some of these basic characteristics became links of a chain of hierarchically connected, spatially dispersed production. Through the variations of this complex network of production, distribution, and management functions, a new industrial landscape emerged, shifting jobs, disrupting communities, propelling regions, and spurring ideologies whose colorful western-like images have generally obscured the historical contours of the spatial dimension of advanced technology.

Yet, how valid can be these conclusions for all high tech industries, based on the only observation of semiconductors manufacturing location? Given the exploratory character of this analysis, we will not undertake a similarly detailed study of other sectors, but we will chiefly consider the spatial characteristics of at least 3 other industries that can be clearly considered "high tech": Electronics Computers Equipment, Computer Software, and Genetic Engineering.

2.2. Computerlands

At first sight, the evolution of the locational pattern of computer making seems to be very similar to that of semiconductors. Tables 11 and 12, constructed by Mutlu, show both the footlooseness of the industry in terms of the traditional conditions of cost-

TABLE 8

Number and Temporal Pattern of Offshore Assembly Operations by U.S. Semiconductor Firms,* ** 1963-Spring 1974

	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972-74	Unknown	Total
I Annual number of companies commencing offshore assembly	1		1		2	3	8	5	3	3		
II Cumulative number of companies with offshore assembly	1	1	2	2	4	7	15	20	23	26		
III Location of offshore assembly plant												
Hong Kong	1						1	2		1	3	8
Korea		1	1					5	1			9
Taiwan					1	1	1					3
Singapore						2	2	3			9	
Malaysia										11		11
Other Southeast Asia							1	1		3	1	6
Mexico					2		7	2		3	1	15
Other Latin America					1		1			5	1	8
IV Total number of offshore assembly operations	1	1			4	4	13	12	4	23	6	69
V Offshore assembly by subcontractor							1	6	1	3	2	13

*The survey covers a sample of 32 firms, it includes most of the major producers, which accounted for 75% of U.S. factory sales in 1972 and nearly one-third of the total world sales.

**The affiliates included in the table are the current ones and do not include operations started and then ceased prior to 1972.

Source: W. Finan, *The International Transfer of Semiconductor Technology by U.S. Based Firms* (New York: National Bureau of Economic Research, 1975), pp. 57, 62. (Cited by Servet Mutlu.)

TABLE 9

Employment in the U.S. Semiconductor Industry and U.S. Offshore Assembly Plants, 1963-1972 & 1976

	Domestic Employment		
Year	Production Workers (000)	Total Employment (000)	Estimated Employment in Offshore Plants (000)
1963	37.5	56.3	2.1
1964	37.9	55.3	4.3
1965	48.7	67.4	6.5
1966	59.1	82.2	8.6
1967	57.9	85.4	14.1
1968	60.5	87.4	30.1
1969	69.3	98.8	66.7
1970	60.3	88.5	74.8
1971	45.5	74.7	84.6
1972	58.1	97.0	89.1
1976*	n.a.	106.9	212.6

*1976 estimates are based on the following assumptions:

1) import share weighted foreign wages went up 75% between 1972 and 1976;
2) non-wage foreign costs followed the movement of wages;
3) productivity remained the same in off-shore plants during 1972-76;
4) technological division of labor between the domestic and off-shore plants remained the same in 1976 as it was in 1972;
5) ratio of exports to other countries from off-shore plants to U.S. imports under Tariff Items 806.30 and 800.00 stayed the same.

Sources: Domestic employment figures from U.S. Bureau of the Census, *Census of Manufactures, 1972, General Statistics* (Washington, D.C.: Government Printing Office, 1975), Table IA; *County Business Patterns-United States*, 1976, Table IB, p. 48; W. Finan, *The International Transfer of Semiconductor Technology by U.S. Based Firms* (New York: National Bureau of Economic Research, 1975), p. 86; foreign wages from International Labor Office, *Yearbook of Labor Statistics* (Geneva), various issues; imports from off-shore plants under Tariff Items 806.30 and 807.00, U.S. Bureau of the Census; *U.S. Imports for Consumption and General Imports*, Foreign Trade Report, FT 246, various issues. (Sources collected and elaborated by Servet Mutlu.)

TABLE 10: **Location of Advanced Manufacturing Facilities of Santa Clara County Firms: 1980**

Firm	*Plant Locations*
Hewlett-Packard Company[a]	McMinnville, Corvallis, Oregon; Boise, Idaho; Fort Collins, Greeley, Loveland, Colorado Springs, Colorado; Everett, Spokane, Vancouver, Washington; Roseville, California; Raleigh, North Carolina.
National Semiconductor	Salt Lake City, Utah; Tucson, Arizona; Vancouver, Washington.
Fairchild Camera & Instrument	South Portland, Maine; Worpingers Falls, Massachusetts, Tulsa, Oklahoma (planned).
Intel Corporation	Aloha, Oregon; Chandler, Arizona; Austin, Texas.
Varian Associates[a]	Salt Lake City, Utah; Florence, Lexington, Kentucky; Grove City, Ohio; Geneva, Illinois; Beverly, Danvers, Lexington, Woburn, Massachusetts.
Advanced Micro Devices	Austin, Texas.
American Microsystems, Inc.	Pocatello, Idaho.
Signetics	Orem, Utah.
Intersil	Ogden, Utah.
Memorex[a]	Plano, Texas.
Zilog	Boise, Idaho
Spectra Physics[a]	Eugene, Oregon.
Siltec[a]	Salem, Oregon.

Source: Interviews; *San Jose Mercury News*, Business Section.
Collected and elaborated by Anna Less Saxenian, *op. cit.*, 1980.

Notes:
a Firm is not a semiconductor firm.
b For semiconductor firms, advanced manufacturing is the same as wafer fabrication. For other firms, the process varies.

TABLE 11

Distribution of Employment by Census Regions in the Electronic Computing Equipment Industry (SIC 3573)

		1958*	1963*	1967	1972	1976
U.S. Total Employment		80.9	96.4	96.9	144.6	178.0
NEW ENGLAND	% of T.E.**	3.46	3.63		12.09	
	L.Q.***	0.39	0.43		1.69	
Massachusetts	%5 of T.E.	1.60	3.22		10.44	12.08
	L.Q.	0.37	0.81		3.17	3.81
Boston SMSA	% of T.E.	1.60	2.28			
	L.Q.	0.66	1.32			
MIDDLE ATLANTIC	% of T.E.	43.66	35.06	25.09	18.65	15.62
	L.Q.	1.74	1.46	1.15	0.90	0.82
New York	% of T.E.	36.17	27.90		13.33	9.64
	L.Q.	3.29	2.55		1.51	1.22
New York-Northeastern New Jersey SMSA	% of T.E.	2.34	2.90	2.43	2.97	
	L.Q.	0.22	0.28	0.26	0.35	
Pennsylvania	% of T.E.		4.65		2.07	3.37
	L.Q.		0.57		0.28	0.46
EAST NORTH CENTRAL	% of T.E.		27.59	4.35	4.56	
	L.Q.		1.04	0.15	0.18	
WEST NORTH CENTRAL	% of T.E.		12.03	19.00	14.01	
	L.Q.		2.01	3.04	2.22	
Minnesota	% of T.E.					10.78
	L.Q.					11.36
SOUTH ATLANTIC	% of T.E.				6.70	
	L.Q.				0.46	
Florida	% of T.E.					4.16
	L.Q.					2.26
WEST SOUTH CENTRAL						
Texas	% of T.E.					3.86
	L.Q.					0.65
MOUNTAIN						
Arizona	% of T.E.					3.08
	L.Q.					5.71
PACIFIC						
California	% of T.E.	11.62		28.25		
	L.Q.		1.51		3.47	
San Jose SMSA	% of T.E.			10.77		12.19
	L.Q.				15.17	14.34
San Francisco-Oakland SMSA	% of T.E.			1.17		
	L.Q.				1.23	
Los Angeles-Long Beach SMSA	% of T.E.	4.59		9.74		7.86
	L.Q.	0.99			2.37	1.86
Anaheim-Santa Ana-Garden Grove SMSA	% of T.E.					5.79
	L.Q.					2.14
San Diego SMSA	% of T.E.					2.19
	L.Q.					5.334

Sources: For 1958-1972, U.S. Bureau of the Census, *Census of Manufactures*, issues for the respective years; for 1976, *Country Business Patterns* (Washington, D.C.: U.S. Government Printing Office, 1978) (processed). (Sources gathered and elaborated by Servet Mutlu.)

*Includes accounting machines as well (SIC 3571).

**T.E.: Total Employment.

***L.Q.: Location Quotient.

TABLE 12

Location of Plants of the Main American Computing Equipment Manufacturers

	1966			*1978*	
Company	Location		Employment Code[1]	Location	
IBM	Burlington[a]	VT	D	*COMPUTERS*	
	Endicott[b]	NY	E	Endicott[d]	NY
	Kingston[b]	NY	E	Kingston	NY
	Lexington	KY	D	Poughkeepsie[d]	NY
	Poughkeepsie[b]	NY	E	Brooklyn	NY
	Rochester[e]	MN	D	Burlington[d]	MA
	San Jose[d]	CA	D		
				SMALL INFORMATION HANDLING SYSTEMS AND ASSOCIATED PERIPHERAL EQUIPMENT	
				Boca Raton[d]	FL
				Rochester	MN
				Menlo Park[e]	CA
				PERIPHERALS	
				San Jose[d]	CA
				Los Angeles[e]	CA
				Los Gatos[e]	CA
				Boulder[d]	CO
				Endicott[e]	NY
				Kingston[e]	NY
				Mohawsic[e]	NY
				Poughkeepsie[e]	NY
				Burlington[e]	MA
				Gaithesburg[e]	MD
				Manassas	VI
				Raleigh[d]	NC
				Tucson[d]	AZ
				FEDERAL SYSTEMS	
				Owega[d]	NY
				Manassas[d]	VI
				Gaitherburg[d]	MD
				Houston[f]	TX
				Huntsville[f]	AL
				Cape Kennedy[f]	FL
				Westlake[f]	CA
				Atlantic City[f]	NJ
				Morris Plains[f]	NJ

TABLE 12 (continued)

	1966			*1978*	
Company	Location		Employment Code[i]	Location	
				COMPONENTS	
				Burlington[d]	VT
				Manassas[d]	VI
				East Fishkill[d]	NY
				Endicott	NY
Burroughs[h]	Detroit	MI	D	*COMPUTERS*	
	Paoli[d]	PA	B	Santa Barbara	CA
	Pasadena[d]	CA	D	Pasadena	CA
	Plainfield[c]	NY	C	Proctor	
	Plymouth	MI	E	Fredyfifrin	PA
				Downington	PA
				Plymouth[g]	
				PERIPHERALS	
				Tireman	MI
				Westlake	CA
				FEDERAL SYSTEMS	
				Paoli	PA
				COMPONENTS	
				Carlsbad	CA
				Hollywood	CA
Control Data Corp. (CDC)	Cambridge[c]	MN	A	*COMPUTERS*	
	Chatsworth[a]	CA	A	Minneapolis	MN
	La Jolla[a]	CA	B	St. Paul	MN
	Minneapolis[b]	MN	D		
	Philadelphia	PA	B	*PERIPHERALS*	
	Rockville[a]	MN	B	Campton	KY
	St. Paul	MN	D	Washington	DC
	Spring Grove[c]	MN	A	Minneapolis	MN
	Warren[a]	MI	B		
General Electric	Phoenix	AZ		(exited in 1970)	
	Palo Alto[e]	CA			
Honeywell	Brighton	MA	D	*COMPUTERS*	
	Denver	CO	C	Brighton[d]	MA
	Lawrence	MA		Bilterica	MA
	Lowell	MA		Lawrence[d]	MA
				Phoenix[d]	AZ
				Santa Clara (microprocessors)	CA

TABLE 12 (continued)

	1966			*1978*	
Company	Location		Employment Code[1]	Location	
				PERIPHERAL EQUIPMENT	
				Northboro	MA
				Lawrence	MA
				COMPONENTS	
				Santa Clara	CA
National Cash Register (NCR)	Dayton[b]	OH	E	*COMPUTERS*	
	Hawthorne[b]	CA	E	San Diego	CA
	Ithaca[a]	NY	D	Wichita[g]	KS
				Columbia[g]	SC
				TERMINALS & *SUBSYSTEMS*	
				General Purpose *Terminals*	
				Ithaca	NY
				Retail Terminals	
				Cambridge	OH
				Millsboro	DE
				Financial Terminals	
				Dayton	OH
RCA	Camden	NY	E	(exited in 1971)	
	Palm Beach Gardens	FL	D		
	Van Nuys	CA	D		
Sperry-Rand	Blue Bell	PA	D	*COMPUTERS*	
	Elmira[a]	NY	D	Roseville	MN
	Long Island City	NY	D	St. Paul	MN
	St. Paul	MN	D	Bristol	TN
	Utica	NY	D		
				SMALL BUSINESS SYSTEMS AND *PERIPHERALS*	
				Bristol	TN
				Salt Lake City	UT
				Irvine	CA

TABLE 12 (continued)

	1966		*1978*	
Company	Location	Employment Code[i]	Location	
Sperry-Rand			PERIPHERALS & MEMORY *SYSTEMS*	
			Cupertino	CA
			San Jose	CA
			Santa Clara	CA
			Sunnyvale	CA
			FEDERAL SYSTEMS	
			Clearwater	FL

[a]Only products belonging to SIC 35712 manufactured.

[b]Products of both SIC 35711 and 35712 are manufactured.

[c]Components and products belonging to 357112 are manufactured.

[d]Has both laboratories and manufacturing facilities.

[e]Has only laboratories.

[f]Operations.

[g]Minicomputers.

[h]Circa 1975.

[i]Employment Code: A: under 100 employees; B: 100-499; C: 500-999; D: 1,006-4,999; E: 5,000 and over.

Sources: For 1966, Fortune, *Plant and Product Directory*, 1966, Vol. II (1966); Wickham Skinner, David C.D. Rogers, *Manufacturing Policy in the Electronics Industry* (Homewood, IL: Richard Irwin, Inc., 1968), pp. 109-121; Company Annual Reports: IBM, *Employment Fact Sheet*, various issues; Burroughs Corporation, *Burroughs Corporate Management Systems* (Detroit, 1973); *Burroughs in Brief* (circa 1978); CDC, Committee on Corporate Social Responsibility, *Our Corporation's Contributions to Solving Social Needs* (1972); CDC, *Contact*, Vol. 3, No. 9 (August 1977). (Sources gathered and elaborated by Servet Mutlu.)

saving location, and yet its tendency to cluster in some areas: California, Massachusetts, New York, Minnesota, Texas, and lately Florida. New York means actually IBM and it emphasizes the character of this firm as a global company, constructing its own environment and inter-linking its different locations. The origins of IBM's New York location are historical. The machines were *leased*, as well as the services and the maintenance. Thus, the connection to the New York business and accounting market was crucial at the beginning. Later, when IBM already dominated the mainframe computer market, after the initial lead by Remington-Rand (the first commercial computer, delivered to the U.S. Census Bureau in 1951 was a Univac-1), problems of cash-shortage (precisely due to the rental nature of the business), led to the decision of IBM to concentrate all activities in its already existing facilities to avoid new expenditures in plants building. And yet, as in the case of semiconductors, IBM's environment did not develop into a high tech region, since the vertical integration happened within the firm and there were few spin-offs of its research team.

The emergence of a computer center in St. Paul-Minneapolis, Minnesota can be paralleled to the isolated emergence of Ti in Dallas. Both Remington-Rand (later Sperry-Rand) and Control Data's origins can be traced to a group of particularly skilled Navy engineers that, after the war, created a firm, Engineering Research Associates. They located in St. Paul because through their Navy contacts they obtained capital and infrastructure support from a St. Paul's businessman. This is not to say that location is totally accidental but that it is mainly dependent upon the availability of scientific and technical resources that, in this case, happened to be available in an isolated location in Minnesota. This isolation allowed the companies, and particularly Rand, to enjoy a lack of competition for skilled labor in the local market, while still working on a nationally diversified market, manufacturing a transportation-insensitive product.

As the industry grew and became more competitive in the peripherals and minicomputers market, and even more with the coming of microcomputers in the 1970s, it shifted to other locations, and ended up concentrating in the same areas as semiconductors. By 1976, California accounted for about 1/3 of total employment in computers manufacturing, and the Silicon Valley alone for more than 12% of total U.S. employment, while New York (IBM-base) that represented 38% of employment in 1958 went down to 9.6% in 1976. Furthermore, the majority of computer employment in California, and the overwhelming majority in the Silicon Valley (about 2/3) is made up of non-production workers, thus creating an increasing spatial division of labor within the industry. Massachusetts has also enjoyed a tremendous expansion from 1.6% of total employment in 1958 to 12% in 1976. Texas and Arizona (leading states in semiconductors) are far behind in computers, emphasizing their mixed character as cheap labor states and new high tech centers, the first feature being still quantitatively more important. While some of the new locations of the computer industry seem to be directly geared toward aerospace and military markets (San Diego, Florida), the main elements seem to be: a) the vertical integration of semiconductors manufacturers that had to be able to design their own final products to program innovation b) the high dependence on skilled scientists and engineers c) the existence of a milieu of innovation and exchange of ideas and personnel, that only developed in those areas with a minimum density of electronics industry, as derived from semiconductors production. So, in fact, ***the locational pattern of semiconductors conditions that of the computers making industry***. Current technological discoveries will be likely to accelerate such a trend: for instance, Intel is experimenting with a mainframe computer whose integrated circuits can be contained in one single chip. Thus, the increasing miniaturization of ICs will probably completely integrate computer and semiconductors design and automate and decentralize computer assembly close to the final user markets. Such was, in fact, from the very beginning the locational behavior of U.S. computer firms abroad. Unlike semiconductors, producing offshore to save labor costs, computer firms located their plants, particularly in Europe, to conquer the growing foreign markets, even if, *within* *particular countries*, they located their assembly plants in dispersed areas to take advantage of cheap labor and government incentives (Scotland in the U.K., the Midi in France). This pattern expresses maybe the spatial logic of the computer industry in all its purity: concentration of research and design in a few centers of innovation; worldwide markets; and location of assembly plants in cheap labor areas relatively adjacent to some major market.

It has to be noticed that, again, as in the case of semiconductors and Bell Laboratories, a major computer center did not develop around the pioneering research institution, in this case the University of Pennsylvania, where the first computer was built for the Army in 1946. Though Pennsylvania does have some computer industry (as much as Texas does) it trails other areas, such as Minnesota, where innovation was embodied in business. High tech, while being a science-based industry, *is an industry* and can only be understood as such. It is the combination of management and research that is reshaping the world of our production capabilities.

Computers do not exactly replicate the spatial distribution of semiconductors. But their locational logic does.

2.3. Is Knowledge Placeless?

The *computer software industry*, the fastest growing high tech sector (from less than $1 billion jobs in the late 1970s to an expected $20 billion by 1990), is the ultimate expression of skilled labor-intensive activity. It sells pure knowledge, since the fabrication is reduced to the minimum material expression. Thus, theoretically, it would be an absolutely footloose activity. Yet, according to the most serious study on the industry (that by Hall, Markusen, Osborn and Wachsman),[20] California concentrates 20% of total employment of the about 4,000 firms currently in the market, and it is forecasted that in the next decade employment in software production in California could rise by 230%. Other states with a disproportionate share of software production are Massachusetts, Texas and Washington State. Within California, while the L.A. area still has the largest proportion of employment (50%), because of the sheer size of the area, the Bay Area has increased its proportion during the 1970s up to 35.1%. So, a pattern quite similar to the computer industry seems to emerge. And yet, most of the California firms interviewed by the Institute of Urban and Regional Development (IURD) research team stated that proximity to the market was not a major concern for their location, something quite understandable given the disembodied nature of the product. What seems to account for the location of software firms, and particularly of the most advanced ones, is the consideration of the social and cultural characteristics of the area in terms valued by their professional employees. According to the IURD study, "Eleven (out of twenty eight) interviewees said that lifestyle is of major importance. Many firms located where their founders had lived for some time before founding the firm. Many of these firms, plus some others, located where the lifestyle choices of prospective good employees converged with the preferences of the firm's founders. These firms said explicitly, and many implied, that they located near available good employees. Another three mentioned 'creative atmosphere' as a factor. For eight firms being near a university is an important factor for a full range of business and cultural reasons" (p. 55). Nevertheless, the notion of lifestyle is a very ambiguous one. Lifestyle for whom? And why is "lifestyle" associated with some cities rather than with other ones? The ideology immediately flashes glittering images of sunny California, the Arizona desert, or of a sail across Seattle's Sound. But, again, it is very doubtful that the southern charm

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[20] Peter Hall, Ann Markusen, Richard Osborn, Barbara Wachsman, ***The Computer Software Industry: Prospects and Policy Issues***. Berkeley: University of California, Institute of Urban and Regional Development, Working Paper No. 410, July 1983.

of New Orleans will ever attract high tech *research*, or that one could discount the strong urban atmosphere of Baltimore, hardly associated with high tech *industries*, in spite of the presence of a major university and a well established manufacturing base. The case of the software industry allows us to discuss the issue of what this "lifestyle" is precisely because it is an industry whose only dependency is its creative labor. Here is where the old notion of *milieu* seems to be very useful. New York has always been the center for the writing and publishing industry, as Los Angeles never really abandoned its early lead in the film and television production industry. Originally, New York's publishing relied on the vibrant atmosphere of the major metropolis, and Los Angeles was the biggest city with year-round guaranteed good weather to shoot the film. But the historical roots are less important than the milieu that originated there. The more an industry is dependent upon research-trained, research-oriented labor, the more this labor itself depends on an on-going relationship to a creative milieu to develop new ideas and techniques. Research and creation are a collectively determined process, though the act of innovation might be individual. This is why, the wired software writer, working in his alpine refuge and connected to a Silicon Valley terminal is only a bright advertising spot. Software production is heavily dependent on the existence of a consolidated milieu of *electronics research*, where exchange of ideas and of people is by far more important than the beauty of the environment. Once a highly paid, highly educated labor pool is concentrated in a place, they generally take care of keeping the place beautiful (all places were generally beautiful until the first wave of industrialization and real estate speculation hit them), and of improving the social and cultural quality of the area, helped by the protective barriers of housing prices. But the very basis of software production location is a research milieu, originally generated by an important university *in the field of electronics*, which happens to be generally relatively close to a major city. High tech design centers are, before anything else, science-based industries. They represent the coming of a new logic of the space of production.

The connection between science and industry is most evident in what for some experts could be the "next industrial revolution:"[21] *genetic engineering*. It is too early to really assess its potential, and even more to understand its future connection to a new form of high tech manufacturing. In 1977 in the U.S. only 18,498 people were employed in manufacturing "biological products" (SIC 2831) and certainly only a tiny proportion of them were related to genetic engineering. We are clearly witnessing the infancy of an industry, but of an industry that could become a major economic force.[*] The U.S. Office of Technology Assessment predicted that between 1981 and the end of the century, genetic engineering could displace current manufactured products' worth of $27 billion. And Sylvester and Klotz report that according to Dr. Glick, President of Genex corporation, the market will be in fact worth of around $40 billion by the year 2000. When one of the leading firms, Genentech, went public in 1980, its founders became instant multimillionaires. And major pharmaceutical, medical, and energy companies, as well as Wall Street firms are actively searching for new potential values in the field. Beyond the smokescreen of science fiction sagas, genetic engineering will most likely become a major high tech industry.

The process of its development and its spatial pattern are very similar to those that characterized semiconductors, microcomputers and software--namely: *small businesses starting as spin-offs of major University-based medical research facilities*. While the scientific origins of genetics engineering can be traced to 1953 to the first model of DNA by Watson and Glick at Cambridge, Massachusetts, the development of the industry

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[21]See: Edward J. Sylvester and Lynn C. Klotz, *The Gene Age. Genetic Engineering and the Next Industrial Revolution*. New York: Charles Scribner's Sons, 1983.

[*]See: Nicole Simmons, "Biotechnology Industry Offers Specialists a Flurry of Jobs," *The New York Times*, March 25, 1984.

occurred only in the late 1970s, after Stanford biologist Paul Berg discovered a way to split genes. Subsequently, the majority of the new start-up companies came from those research centers that were (and are) at the forefront of the discovery: Stanford, UC San Francisco (the major UC Health Sciences Campus), Harvard, MIT, Cal Tech, and Cold Spring Harbor Laboratories in Long Island. The three leading firms certainly fit the pattern: Genentech (South San Francisco) and Cetus (Berkeley) were spin-offs from the UC and Stanford networks, and Biogen, a Geneva-based company was founded by Nobel Prize-winner Walter Gilbert from Harvard. Most of the new companies have clustered around Cambridge, Massachusetts and in the Bay Area. Here again, we find the university as the major inducer of location, as a matter of fact, as the *mining site*: the mineral's name is now knowledge. At that point Harvard University tried to get directly into the new profitable business, but the project was rejected by its own faculty, fearful of the dangers of interference of commercial considerations in the conduct of scientific research. The case, nevertheless, illustrates the current intimate connection between the most advanced University research and the hottest stocks in the market.[22]

So, in the purest case of high tech industry, biotechnology, and taken at its beginning, we observe that the key variable is the relationship to a scientific milieu, which in this case was also the original contracting market through government sponsored contracts to the health sciences institutions.[23] But, would it be true also of the later stages of development of the industry? We can advance the hypothesis that such will be the case for the research laboratories, either located in the vicinity of an international research community or absorbed in the inner world of some pharmaceutical or agricultural giant, ready to form a new kind of Bio-"Bell Laboratories." The diffusion of the products generated by the industry will have no specific space. The impact will be felt across a broad spectrum of manufacturing and agricultural activities, as well as in the health services, because the real output of genetic engineering, as for electronics, concerns less a product than a process--in the latter case, the process of symbolic information, in the former, the process of genetic information. Thus, from the very specifically located nests of high tech emerge a new, ubiquitous, place-less logic of industrial activity, transforming the economy, the workplace, and the consumer markets, without attaching itself to a particular space. The new technologies organize the space of production along a hierarchy of functions that takes the social division between intellectual and manual labor to the ultimate step.

On the basis of these observations we must now try to synthesize the spatial profile of the high tech industries.

2.4. A New Space of Production

2.4.1.) The most important distinctive trend of the locational pattern of high tech industries is the *very strict spatial division of labor* between its different functions: research and design (rather than development), fabrication of main components, and assembly of components to form the final product. In those industries, like computer software or genetic engineering in which the material product is a mere support of information, design, research and development, are the only activities to be considered as typical of the new industry. This spatial division between different functions is determined by the fundamental dependency of these industries upon labor *and* by the basic differences in the characteristics of labor required for each particular task. Thus, the different processes of reproduction of labor power determine the different productive spaces of high tech industries. The 3 types of space are the following:

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[22]See, for instance, "The Hard Sell for Biotech Patents," *Business Week*, December 12, 1983, p. 31.

[23]Borrus and Millstein, *op. cit.*, 1982.

a) At the lower end of the chain, assembly operations tend to be located (and will be increasingly so) in cheap-labor, non-union areas. Of the two elements the absence of union control seems to be the most important, by far. Why do high tech firms tend to be more anti-union than others? We can advance two hypotheses: one refers to history and tradition, that is to the fact that labor and management grew up "together" (though in a class conflict) in the old industries, such as steel and automobile, while the new management of high tech was really part of a new culture in which organized labor had become, in their vision, a threatening bureaucracy; another hypothesis relates to the characteristics of the product: since speed in innovation is crucial, it is also crucial that as soon as a new design is found, its material production should be *accomplished in a time span* as short as possible, without interference of the union in a highly risky, quite secretive commercial strategy. The characteristics of unskilled non-union labor point toward spaces of production such as Third World offshore manufacturing, semi-rural areas in the U.S., and women and immigrant labor pools in the industrialized regions.

b) The process of fabrication, particularly in electronics, but also in robotics, requires a high percentage of skilled labor (including production engineers) and a very careful quality control procedure. Thus, one segment of the industry (except for pure-knowledge activities, such as genetic engineering) will have to rely on a more traditional kind of industrial labor force, closer to what is for instance, aircraft production equipment. The trade-off for the industry on this matter will be to decide between a non-union environment and a large labor pool of skilled industrial workers. Would the 100,000 workers employed in robotics by 1990 be from the same areas in which the 440,000 workers that will be displaced by robotics at the end of the century are currently located?[24] It is doubtful. The anti-union policy of high tech firms will be likely to create new industrial hubs in the newly industrialized regions of the western and southwestern U.S., even bypassing the old industrial cities in the West, such as Los Angeles County or Oakland (but *not* the new industrial area in the L.A. periphery, particularly in Orange County). A new breed of industrial metropolises is in the making. And with it, most likely, a new form of social movements, based on a combination of work-related and environmental-oriented issues. Spatial displacement does not provide an escape from social contradictions. Yet, it does change their form and content, and this is crucial for the understanding of future urban dynamics.

c) The process of research and design will continue to be located in specific areas that constitute a milieu of innovation around a cluster of some major research and training institutions, universities, hospitals, of high tech laboratories. The maturation of the industry will not lead to a change of the characteristics needed for such a space of innovation to operate: it will just increase the number of these areas and their regional diversity. In this sense, the product-cycle theory of location[25] is correct in pinpointing the need to distinguish between different stages of a new process of production. Yet, the very special content of the new industries (whose main product is *information*, rather than the material that embodies it), introduce this basic dichotomy between the general spatial diffusiveness of the final product and the highly specific space of its conception. Such a space, as we have tried to show, responds to a series of characteristics that are better represented by the Silicon Valley and Route 128. Their main feature consists in the campus-like atmosphere they tend to recreate. They are *not* urban areas, filled with traditional elite cultural amenities. Rather, they are suburban refuges, turned toward environmental quality and new cultural experiences. Protected by high salaries and exclusive residences, they are the spaces of eternal adolescence, where informal behavior and personal independence are the key indicator of the most luxurious lifestyle one can afford in a bureaucratic society: autonomy of time, space and values, precisely

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[24] According to Markusen, *op. cit.*, 1983.

[25] See: Ann Markusen, *Profit Cycles, Oligopoly and Regional Development*, Cambridge: MIT Press, 1984.

the same attributes that are attached to innovation and research. Is this "high tech Olympics" reproducible? To some extent, yes, as the example of Austin, and to a lesser extent Colorado Springs and Salt Lake City, show. Thus, it is likely that, with the increasing economic importance of high tech R&D, major expansions will take place in some areas, taking support from some major research facility. High-tech hubs will spread around the national and international geography. But they will bring with them a double spatial and functional hierarchy: a) they will *not* spread its activity on the surrounding region, but rather they will be connected to other disjointed points of conception, production, and distribution; b) they will be subordinated to the original centers of R&D whose technological lead will most likely remain unchallenged, given the difficulty to replace an entire *milieu* based on the accumulation of research networks, exchange of ideas and personal contacts. Only giant multinationals or major government undertakings will be able to create new leading high tech centers "ex-nihilo." The world has just generated a new spatial hierarchy of knowledge, that is, in our age, a hierarchy of wealth and power.

2.4.2.) The combination of spatial division of labor and interconnectedness in the production process leads to a *major requirement for linkages among the different components of the process*. The linkages will become more and more important as the process of vertical integration develops, and as the high tech companies consolidate, concentrate and become bigger, being able to reach a highly diversified market, given the variety of application of high tech products. These linkages are likely to rely on three different procedures, only the first of which is fully developed at the present time: a) *air connections*, particularly for low-weight, high-value products; given the crisis of passenger traffic in the airlines, this movement is likely to profoundly alter air transportation, and will certainly favor air communication hubs on location for high tech dispatching centers; b) *telecommunications systems* for management, consulting, and back up offices, firmly tying high production to the information networks that will be described in the following chapter; c) *decentralization of entire subsets of the production process*, including some R&D operations, particularly at the international level: this move, which is developed only in the computer industry, will not contradict the general logic of spatial hierarchy, it will just divide the plants into hierarchically interdependent subsets.

2.4.3.) *The relationship of high tech industries to their markets* becomes increasingly dominated by a dual spatial pattern:

a) On the one hand, the markets are increasingly diversified in terms of the final use of the products. In a few years semiconductors will be in most manufactured machinery-based products, certainly including consumer durables, computer software will be the dictionary of the electronics age. And automated equipment will re-structure offices and factories. Thus, the market for high tech products will be ubiquitous, and there will be no spatial specificity in terms of the market relationship.

b) On the other hand, some key markets for high tech industries will remain highly specific, though not necessarily limited to a few locations. These are the markets for major government-supported programs, such as defense for electronics, and health care for biotechnology. It is not a small paradox that an industry so vocal against "government interference" and bureaucratic regulation is actually fundamentally a spin-off of government initiatives in non-profit oriented areas. Does this characteristic translate into some specific spatial locations? Yes and no. No, in the sense that both the military and large hospitals, for instance, are all over, so potentially there is substantial footlooseness in relationship to the markets. But yes because there is a specific day-to-day contact relationship for testing and experimenting. And, as for R&D high tech operations, experimenting is generally concentrated in some sites, both for life and for death, for the health sciences and for the defense programs. Thus, while Weinstein and Firestine are correct when they point out that *per capita* dollars in defense contracting in 1972-76 do not particularly favor the sunbelt states,[26] this is not the main point of

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[26]See: Bernard L. Weinstein and Robert E. Firestine, *Regional Growth and Decline in the U.S.* New York:

the story. The key element is the testing site and the military production network in California, Texas, Arizona, and the West in general. And the key element for biotechnology is the connection of large areas such as Chicago, Los Angeles, New York, Boston, San Francisco, Houston, or Washington D.C., to macro-health facilities.

So, a new space of high tech activity emerges around those locations chosen by government to build major programs in defense, aerospace, health, and in the near future, high-level information services, such as key telecommunication centers.

2.4.4.) From the complex set of functions and characteristics associated with high tech production, ***a new spatial logic emerges***, defined above all by the interconnectedness of the process across a variety of places. The most important consequence is that no place controls its meaning by itself, not even the R&D centers. What happens to each place, economically, socially, technologically, depends on a whole network of interaction, whose logic, whose interests, and whose power is place-less.[27] Each area, each region, each city, becomes highly specific, as it is defined by its role within the spatial division of labor, but at the same time it becomes powerless, meaningless, in relationship to the overarching logic that provides for the particular productive role each location performs. *Places become transformed into flows*. The transition of an industrial mode of development to an informational mode of development expresses itself through the dependency of productive locations upon information flows.

3. The Potential Impact of New Communication Technologies on the Spatial Structure

Technological innovation has always played a major role in the shaping of space. It is likely to be even more so during the current process of discovery and implementation of new technologies. Yet, the prophets of futurism have created such a ridiculous atmosphere of science-fiction scenarios, that any serious analysis on this matter should start with a word of caution. Cities and regions are *not* the *direct* result of some telecommunication device. Technology has to be understood as *one* element in a complex matrix in which cultural, economic, social and political factors interact within a historically existent spatial form, to constantly produce, reproduce and transform space.[28] In fact, the organization of this paper corresponds to such a multidimensional perspective exploring the complex and indirect paths of the relationship between technology and space. Nevertheless, we must also consider the *direct effects* that new technologies per se might induce into the spatial forms and processes. We will refer in fact to *tendencies* rather than actual effects, so that these tendencies could materialize in different forms, and at different levels of intensity, according to the broader network of influences within which these tendencies take place. Besides, to draw a clear distinction with the pseudo-science of futurology, we will not speculate about the 21st century. We will try to asses the spatial impact of technologies that are already in the implementation stage. Unfortunately, there is very little reliable empirical evidence directly related to our subject. It is, in fact, our main goal to stimulate this kind of research by providing some tentative insights into the matter, on the basis of available knowledge in this area.

Praeger, 1978, p. 32.

[27]To be sure, society is not reducible to high tech, and therefore, ***all social and economic activity is not place-less***. Rather, the whole dynamics develops precisely on the contradiction between an increasingly place-less production system and an increasingly community-focused social culture on the part of people.

[28]As it has been shown by scholarly research, such as that of Allen Pred. *The Spatial Dynamics of U.S. Urban Industrial Cities 1800-1917*, Cambridge, MIT Press, 1966; or more recently, the major study of Los Angeles by Edward Soja, Rebecca Morales, and Goetz Wolff, "Urban Restructuring: An Analysis of Social and Spatial Change in Los Angeles," in *Economic Geography*, Volume 59, No. 2, April 1983, pp. 195-230.

For the sake of clarity, we will try to summarize the main changes in technology vis a vis their tentative impact on the spatial structure, assessing the effects of each stream of technological change separately, before sketching the profile of the new spatial structure that could emerge from the whole constellation of technological change. Since we are concerned with the implementation of technology, we will *not* examine the technology in itself, but the organized expression of new technologies in their application to social and economic life.

3.1 Information Systems and the Space of Flows

The first major stream of technological change that has to be emphasized in relationship to space is *the development of information systems* in the management of organizations. By information systems we refer to interactive processes of information resulting from the merger of computers and telecommunications in the same network. As Lionel Nicol says, in his study on the emergence of what he calls Information Technology (IT) "the emphasis of IT is on *networking*."[29] With the increased capacity to transmit information at low cost (optical fiber wires, laser transmission, digital coding and decoding), and with the growing use of telecommunication satellites, that equalize the cost of transmission to any place in the network, organizations are reaching the stage of potential *worldwide interconnectedness* at a rapidly decreasing cost. In an age where the economy is increasingly internationalized and in which large-scale organizations rely on intense internal information flows, the development of information systems has an immediate and major potential impact: it allows the spatial fragmentation of organizations and therefore of the processes of production, distribution and management. It does not follow that organizations are placeless: for instance, financial headquarters will still remain in Manhattan or San Francisco for reasons that have to do with the existence of a managerial milieu, the presence of a large labor market of skilled white collar workers, and the importance of fixed assets already invested by corporations in the downtown's real estate.[30] But what information systems allow is removal of the physical barrier of spatial distance for the functioning of the organization, both internally and externally.

The key development in this sense, is the growing capacity of data transmission between computers using the telephone network.[31] Other devices have a more uncertain future, and the impact has yet to be assessed. For instance, much has been said about teleconferencing as an alternative to executive travel. Yet it is too expensive (because of the cost of the earth station) to be really effective.[32] Lionel Nicol reports, nevertheless, that by the end of 1982, 30 fully equipped video teleconferencing rooms existed in the U.S., and the projection was that there would be 300 by 1985.[33] Yet, at a transmission cost of $1,500 an hour between Los Angeles and New York, it is unlikely that teleconferencing would become a major element in the management process, in the little

[29] Lionel Nicol, *Information Technology, Information Networks and On-Line Information Services*, Berkeley: Institute of Urban and Regional Development, University of California, Working Paper, (forthcoming). See also: Jorge R. Schement, Leak A. Lierrow, and Herbert S. Dordick, "The Information Society in California: Social Factors Influencing Its Emergence," *Telecommunications Policy*, 7:1 pp. 64-72, 1983.

[30] See Robert B. Cohen, "Multinational Corporations, International Finance, and the Sunbelt," in David C. Perry and Alfred J. Watkins, eds., *The Rise of the Sunbelt Cities*, Beverly Hills: Sage Publications, 1977; and also Conservation of Human Resources Project, *The Corporate Headquarters Complex in New York City*, New York: Columbia University, 1977; Robert Cohen, *The Corporation and the City*, New York: Columbia University, Conservation of Human Resources Project, 1979.

[31] Something that had been rightly forecasted by James Martin, *Telematic Society: A Challenge for Tomorrow*, Englewood Cliffs: Prentice Hall, 1981 (First edition 1978).

[32] Laton McCartney, "Teleconferencing Comes Down to Earth," *Datamation*, January 1983.

Lionel Nicol, *op. cit.*, 1983, pp. 16-17.

room left between electronic data transmission for the medium-level executives, and personal meetings at the top level in the the decision making process (confidentiality being a major condition of such a process).

What is really new is the capacity for all functional processes to construct their own spatial geometry regardless of locational contingency. The telephone was certainly a major step in this direction.[34] But its carrying capacity was too limited, its use too costly, its ability to store information too restricted, to actually absorb the gigantic flow of messages that constitute the life of organizations. The shift from the telephone network to the information system (actually based on the telephone) creates the possibility of internalizing the management of organization, partially superseding their spatial (and therefore social) environment. *Organizations do not become placeless* (their units are located somewhere), *but their organizational logic does.* It follows a dissociation between the patterns of behavior of organizations and the social characteristics that are space-specific. For instance, a company can move out from a community, while for people it will be more difficult for local culture will mean a major change, and for the city as a physical structure (housing, services, etc.). It will result in continued mismatching between the rigidity of the built environment and the mobility of the economic units.[35]

Thus, information systems allow the logic of functions to substitute for the evolution of places. Time and space become increasingly disassociated.

3.2 Office Automation and the Spatial Logic of Organizations in the New Service Economy

The second major trend we must consider in terms of its potential impact on the spatial structure is the accelerated process of *office automation*. Word processing and data transmission (including facsimile transmissions) are at the core of the process. But the most distinctive feature, as Lionel Nicol points out, is the emergence of *integrated office systems* (IOS), in which the entire organization is re-structured around the possibilities offered by automation and communication technologies.[36] The effects of this development on office work and on office location are quite complex.[37] Barbara Baran and Suzanne Teegarden in their remarkable study on the impact of automation in the insurance industry, emphasize the radically different consequences of the former stage of automation in relation to the more recent developments. As they put it: "The first stage of automation in the insurance industry tended to increase job fragmentation, centralize production by narrow function, heighten occupational sex segregation, and make many routine keyboarding functions spatially "footloose." More recently, however, the greater sophistication of the technologies and transformed market conditions are dictating a new organizational logic which promises to reverse many of these earlier trends."[38] " . . . This evolution can be characterized as the gradual movement from functional approaches to systems approaches, that is, from automating discrete tasks (e.g., typing, calculating) to rationalizing an entire procedure (e.g., new business insurance, claims processing), to reorganizing and integrating all the procedures

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[34]Ithiel de Sola Pool, ed., *The Social Impact of the Telephone*, Cambridge: MIT Press, 1977.

[35]See the evidence presented by Barry Bluestone and Bennett Harrison in their classic book, *The Deindustrialization of America: Plant Closings, Community Abandonment, and the Dismantling of Basic Industry*, New York: Basic Books, 1982.

[36]See: Barbara Baran, *The Transformation of the Office Industry*, Berkeley: University of California, Master of City Planning Thesis, 1982; Michael L. Dertouzos and Joel Moses, *The Computer Age: A Twenty-Year View*, Cambridge: The MIT Press, 1981; Paul Strassman, "The Office of the Future: Information Management for the New Age," *Technology Review*, December-January, 1981.

[37]P.W. Daniels, ed., *Spatial Patterns of Office Growth and Location*, Chichester: John Wiley, 1979.

[38]Barbara Baran and Suzanne Teegarden, *Women's Labor in the Office of the Future*, Berkeley: Berkeley Roundtable on the International Economy, University of California, 1983, p. 13.

involved in a particular decision or product line."[39] " . . . As a result, the work process is, in many cases, being functionally reintegrated. Workers who were formerly divided into functional units are being integrated into divisions which serve a particular sub-set of customers, often on the basis of geographic location and/or market segments."[40]

The first type of automation tends to produce a pattern of scattered location of clerical units, doing piecemeal work, which is connected throughout the organization. This was (and is) one of the major sources of the tendency toward the regional decentralization and metropolitan suburbanization of office work: high location costs in major CBDs encourage the moving away of routine processing functions.[41] In an opposite trend, the current stage of integrated office systems automates most of the routine activities and integrates the process of work in centralized multifunctional units, computer-assisted, and connected through telecommunications. For instance, in the main case study done by Barbara Baran, the insurance company she observed, using this approach, consolidated work previously done in over 60 branch offices within 3 regional centers.[42] So, the current trend seems to be toward spatial centralization, around locations generally determined by the highly skilled professional labor market, thus returning to the traditional pattern of CBDs location, though in a much broader regional spectrum.

In fact, both processes are occurring at the same time, depending upon industries and functions.[43] Therefore, a pattern is emerging characterized by the bipolarization between centralized location of team-work and skilled activities, on the one hand, and the spatial dispersion of routine, low-skill operations, on the other hand. A pattern not dissimilar to what we have observed in high tech manufacturing. In this sense, office automation also tends to increase the importance of the logic of the organization over the characteristics of space in the new locational pattern of office activities.

The other major issue concerning office automation in its relationship to spatial processes concerns the increased chances of work at home.[44] "Cottage work" is one of the favorite themes of futurologists. Information-workers hooking up with the company's computer from their homes, or even from community-based working centers.[45] It would result in a dramatic reduction of space and time used up by large concentration of offices. "Telecommuting" would be the miracle solution to traffic congestion and skyrocketing real estate prices for office space. Data on actual development of these trends are fragmentary and unreliable. *Business Week* recently reported a projection according to which within a decade 18% of the U.S. workforce will be telecommuting.[46] Most likely the trend will be limited to those workers that are already doing *some* work at home. This includes a substantial proportion of professionals that work at home *in*

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[39] *Ibid.*, p. 15.

[40] *Ibid.*, p. 17.

[41] Regina Armstrong, "National Trends in Office Construction, Employment, and Headquarters Location in U.S. Metropolitan Areas," in P.W. Daniels, *op. cit.*, 1979; and Thomas M. Stanback, Jr., *Understanding the Service Economy: Employment, Productivity, Location*, Baltimore: The Johns Hopkins University Press, 1979, particularly Chapter 5.

[42] Barbara Baran, *Insurance*, Draft Research Report, Berkeley: Berkeley Roundtable on the International Economy, University of California, 1984.

[43] See Thomas M. Stanback, Jr., Peter J. Bearse, Thierry J. Noyelle, Robert A. Karasek, *Services: The New Economy*, Totowa, NJ: Allanheld, Osman and Co. Publishers, 1981.

[44] See: Lionel Nicol, op. cit., 1983; "Experiences with Tele-commuting," *EDP Analyser*, November 1982, V. 20:11; "Working Remotely: Where Your Office Will Be?" *Computer World*, V.17:24A, p. 67.

[45] That was, of course, one of the most daring visions of Alvin Toffler's *The Third Wave*, New York: William Morrow, 1980.

[46] "IT's Rush for 'Telecommuting'," *Business Week*, January 23, 1984, p. 99.

addition to going to their work place, though not necessarily every day. Also, unskilled clerical work done at home under the current circumstances (like personal typing, for instance) could very likely be plugged into the system. The prospects for a significant decentralization of clerical work at home are more dubious, the main obstacle being, obviously, the control of the work process by management. True, a possible answer to the dilemma could be the experience of telecommunications, also reported in *Business Week*,[47] in which Phoenix Best Western Hotels organized a booking office in the Arizona Center for Women, a minimum-security *prison*, for taking advantage of a cheap, indeed captive, labor pool. A striking illustration of some unexpected detours of the technological revolution!

Yet, it remains true that the technology exists today that would allow a substantial proportion of office work to be performed in spatially scattered units networked in an information system. Should such a trend develop, the consequences for the urban system would be phenomenal, as well as for social life. The end of the workplace as a social milieu would signal the end of the basic material from which the industrial culture emerged during the 19th century. And, quite obviously, CBDs and the transportation system would be substantially altered toward a center-less, isochronic urban structure in which the system of rush-hours would see its importance greatly reduced.

We think that this trend will only develop to a small, yet sizable, proportion of working time, for the simple reason that the category of professionals who *already* work at home part of the time, will increase its share of the labor force, and will take advantage of the technological possibility of interfacing with the data-basis of their organization, or of some back-up system. The chance of a large scale development of telecommuting among clerical workers could occur only under one hypothesis: if unionization develops among women clerical workers. Until now, one of the foundations for the expansion of the service economy has been that the sexist tradition of the labor movement, along with the characteristics of clerical work, have kept the rate of unionization in most offices at insignificant levels. Should this trend by reversed by increased women's militancy, corporations would be in serious trouble, both financially and organizationally. A likely response by management would be, *jointly*, to automate some functions, and to set up a system of part-time home work on the basis of a previously developed wired system, or digital telephone transmission. The office of the future could then resemble the first "domestic sweatshops" of the first period of industrialization.

3.3 Toward Distant Delivery of Public Services?

A third potential trend that must be considered is the foreseeable impact of new technologies on the *management and delivery of public services*. Are there any serious chances for medical telediagnosis to become a major component of the new health sector? Is broadcasted education a real alternative to the declining public schools? We know the existence of some experiments of service delivery through telecommunications in remote zones, such as Alaska,[48] or in underequipped countries of the Third World.[49] The rationale behind such projection is that given the high cost of well trained doctors or teachers, and their unlikely location in poor or remote areas, less skilled personnel could do the job if assisted by a centralized data source and a series of flexible computer programs. It is difficult to generalize at the level of all services, however. Education

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[47] *Ibid.*

[48] H.E. Hudson and E.B. Parker, "Medical Communication in Alaska by Satellite," *New England Journal of Medicine*, December 20, 1973.

[49] See the summary of developments in this field by Lionel Nicol, *Communications, Economic Development, and Spatial Structures: A Review of Research*, Berkeley: Institute of Urban and Regional Development, University of California, Berkeley, Working Paper No. 404, May 1983.

seems unlikely to be dramatically altered in its organization by current technological developments. "Broadcasted Educational Programs" exist in a variety of countries, but it is generally a second-class auxiliary system for people who do not have the time or the resources to attend regular courses. Computers are increasingly used in helping teaching, particularly in the private schools, but they do not alter fundamentally the social or spatial organization of the education system. It cannot be forgotten that the school has a social function as important if not more so than the transmission of knowledge.[50] And such a function cannot be performed at a distance. In what concerns the Third World experience of tele-transmitted education, Stanford University's Professor of Education Martin Carnoy reports the inadequacy of sophisticated receiving terminal equipment, for which there are no spare parts nor repair and maintenance experts.[51] Thus, decentralized education based on the transmission of a centralized data bank has generaly been a failure. Radio educational programs are in fact the most effective technology, but one that has not been able to overcome the lack of a cultural milieu receptive to the context of educational broadcasting.

Health services are the most likely to experience some dramatic changes based on information technology.[52] The main reasons are the growing high cost of medicine (very particularly of professional and skilled medical personnel), and the rapidity of progress in knowledge, largely associated with the explosion of biological and medical research. Linkage of hospitals and schools to data bases, such as the MEDLARS system of information retrieval connecting to the National Library of Medicine in Bethesda, Maryland, is becoming widely used. Decentralized medical units, with semi-skilled personnel can be connected through television and radio to a major medical center, so that they can be assisted in case of an emergency. There is one such connection between Boston's Logan Airport and the Massachusetts General Hospital.

But the most important foreseeable impact of information technology on health care will be the generalization of computer assistance to the practitioner. So, computers are already doing some screening and pre-diagnosis, and they will be used to set up standard procedures for nurses. The goal is to limit the doctor's intervention to the minimum required time, so to increase doctors' productivity (and the medical practice's profitability, of course).

The interesting implication of this development for the spatial structure is that, in spite of the transmissibility of information, the reinforcement of the technological component of medical care will centralize it even more. Doctors are regrouping themselves in hospitals or in private clinics organized in the shadow of some hospital, and directly relying on its technological infrastructure. True, some community centers could be linked to the data base to improve their capacity of information. But given the crisis of public health services, such strategy is until now very limited, and certainly overridden by the tendency to take the patient into the large hospital complex, including in it is periphery of doctors' individual practice. While preventative medicine must be decentralized by nature, high tech therapeutic medicine is likely to centralize even more its service delivery system.[53] In fact, health services are expanding in the middle of cities, adding space to their location, to become one of the major factors of urban renewal and displacement.[54]

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50 See: Pierre Bourdieu and Jean-Claude Passeron, *La Reproduction*, Paris: Editions du Minuit, 1970.

51 Personal communication.

52 A good review of developments in this field can be found in Frederick Williams, *The Communications Revolution*, Beverly Hills: Sage Publications, 1982, Chapter 14.

53 Paul Starr, *The Social Transformation of American Medicine*, New York: Basic Books, 1982.

54 William Shonick, "The Public Hospital and Its Local Ecology in the U.S.," in *International Journal of Health Services*, Volume 9, No. 3, 1979, pp. 359-395; and Howard Waitzkin, Jacqueline Wallen and John Sharratt, "Homes or Hospitals? Contradictions of the Urban Crisis," in *International Journal of Health Services*, Volume 9, No. 3,

So, the more technological change is internalized within the service-providing organization, and the more the delivery of such a service becomes centralized in spite of the "footlooseness" inherent to information technology, communication flows tend to connect organizations among themselves rather than with people. The obvious exception is pre-programmed information (such as diet information or general knowledge items) that can be transmitted to people's homes. Yet, health information and medical care are not the same. We will deal with information below, when we will be treating the more general issue of home-delivery of information, as one of the most important trends under consideration in this paper.

3.4 Transportation Technology: Business as Usual

A fourth technological trend that potentially would affect the spatial structure a great deal is *transportation*. But, paradoxically enough, major changes in transportation technology are not taking place. What is changing now is the urban transportation system. Most of the important changes in long-distance engineering technology, such as dry-bulk cargo and standing containers, were accomplished during the 1960s. Along with the massive development of air transportation, and with the generalization of the highway system, the transportation technology of the 1960s was a decisive element in the functional and economic homogenization of spatial structure, allowing for the dispersion of population and activities.[55] Everybody thought, at the onset of the oil shock of 1973, that an oil-dependent transportation system would be entirely re-organized in a few years along alternative lines. Technical changes were in fact unessential. Energy conservation was successfully encouraged, more fuel-efficient automobiles were designed, and the aircraft industry came under pressure from the battered airlines to provide more economical planes: The Boeing 767 and the Airbus were the tentative answers, and actually will remain the only real innovation in commercial aviation until the end of the century.

But it has been a major change in *transportation policy*,[56] which is not necessarily determined by technology even if it does use some advanced electronic equipment. The change consists in a new emphasis on intra-metropolitan mass transit systems, following (in spite of its obvious failure!)[57] the model of San Francisco's BART. The interesting thing is that there are the new highway based cities of the West and Southwest, particularly Los Angeles and Dallas, that have engaged in the most ambitious programs of building a new metropolitan in spite of the astronomic cost of such construction. (Mel Webber in 1980 evaluated the cost of 1 km. of subway at $50 million![58]) In the case of the kingdom of the automobile, Southern California, in addition to the L.A. metro, it finally approved a multi-billion dollar project, to start in 1985, to build a high speed train between Los Angeles and San Diego. And Houston is also desperately trying to have approved by the voters (without success until 1984) a proposal to develop a mass transit railway system. Coming after Washington, D.C., Atlanta, Denver and Miami, these trends illustrate the impossibility of extrapolating the dominance of one mode of transportation on the basis of generalization. A combination of real estate interests, downtown workers

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1979, pp. 397-416.

[55]For an informed discussion of research on this matter, see Gregory K. Ingram, "The Interaction of Transportation and Urban Land Use," in Arthur P. Solomon, ed., *The Prospective City*, Cambridge: MIT Press, 1980, pp. 326-333; see also: Mel Webber, "Urbanization and Communications," Berkeley: Institute of Urban and Regional Development, University of California, Reprint No. 90, 1973.

[56]See: Glen Yago, "The Crisis of U.S. Transportation Policy," *International Journal of Urban and Regional Research*, 1983, 2.

[57]Peter Hall, *Great Planning Disasters*, Berkeley: University of California Press, 1982.

[58]Mel Webber, *A Telecommunications Strategy for New Cities of the 21st Century*, Berkeley: Institute of Urban and Regional Development, University of California, Working Paper No. 330, October 1980.

convenience, local political coalitions, and high tech infrastructures' lobby, seem to be able to take advantage of the energy-scare of the 1970s (even with the collapse of oil prices in 1982-83) to push forward the development of metropolitan mass transit *along very specialized spatial patterns:* basically, to bring suburban commuters back and forth to work. Is technology the determinant variable in this evaluation? It is doubtful. *Once the highway-auto system is in place*, it seems that the crucial matter is the rate of occupancy per car. According to Mel Webber,[59] in most metropolitan areas, if it were possible to reach an average of 2 persons per car, the cost would be lower than that of mass transit, (including buses), and traffic congestion would be contained. Therefore, he is proposing to use new technologies to organize a computerized, telephone transmitted car-pool system, that would make it possible for people to share-ride every day.

So, technology can be used either to automate high-speed trains, to provide advanced materials for the aerodynamics of such trains, or to make computer-aided fuel efficient car engines, and to generalize a convenient car-pooling system. In fact, the evolution of urban transportation is combining three elements:

- The highway-auto system will still be the prevailing mode, particularly taking into consideration the foreseeable cheap production of cars through the massive rationalization of automobile factories, and the rationalization of traffic through computer and driver information.
- Mass transit is taking charge of an increasing share of pre-scheduled work-oriented trips in the large metropolitan areas.
- There will be some trade-off between transportation and telecommunications exchange,[60] though the extent and consequences of this tendency will largely depend upon the reality of the coming of the "electronic home," the crucial issue of our subject, to which we shall now turn.

3.5 The Home Information Revolution and the Individualization of Residential Space

Perhaps the most important development in the relationship between new technologies and urban form is the coming of the "*home information revolution.*"[61] It refers not only to the increasing use of home computers, but the the transformation of a large proportion of households into real *communication hubs.*[62] By the end of 1983, about 7% of U.S. households were equipped with home computers, 21% had programmable video games, and 37% subscribed to some kind of cable-TV service (up from 25% in 1980).[63] The progression in home electronics equipment in recent years, as shown by Chart 2, is spectacular. Sales of consumer electronic products reached $19 billion in 1983, an increase of 23% over 1982 sales. Home computers sales accounted for $2 billion in 1983, against $1.3 billion in 1982. Even telephones increased their sales dramatically (by 60% in 1983) reaching 31 million domestic telephone units in 1983. The Cable TV industry was a $6.1 billion industry in 1983, with a spectacular progression *until 1982.* Currently (1984) 56 million of U.S. homes (thus, above 2/3 of all) have been wired for cable, and actual penetration of service has risen to 32 million homes.[64] The

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59 Personal communication.

60 J.M. Niles, F.R. Carlson, P. Gray, and G.H. Hanneman, *The Telecommunications-Transportation Trade-off: Options for Tomorrow*, New York: Wiley Inter-Science, 1976.

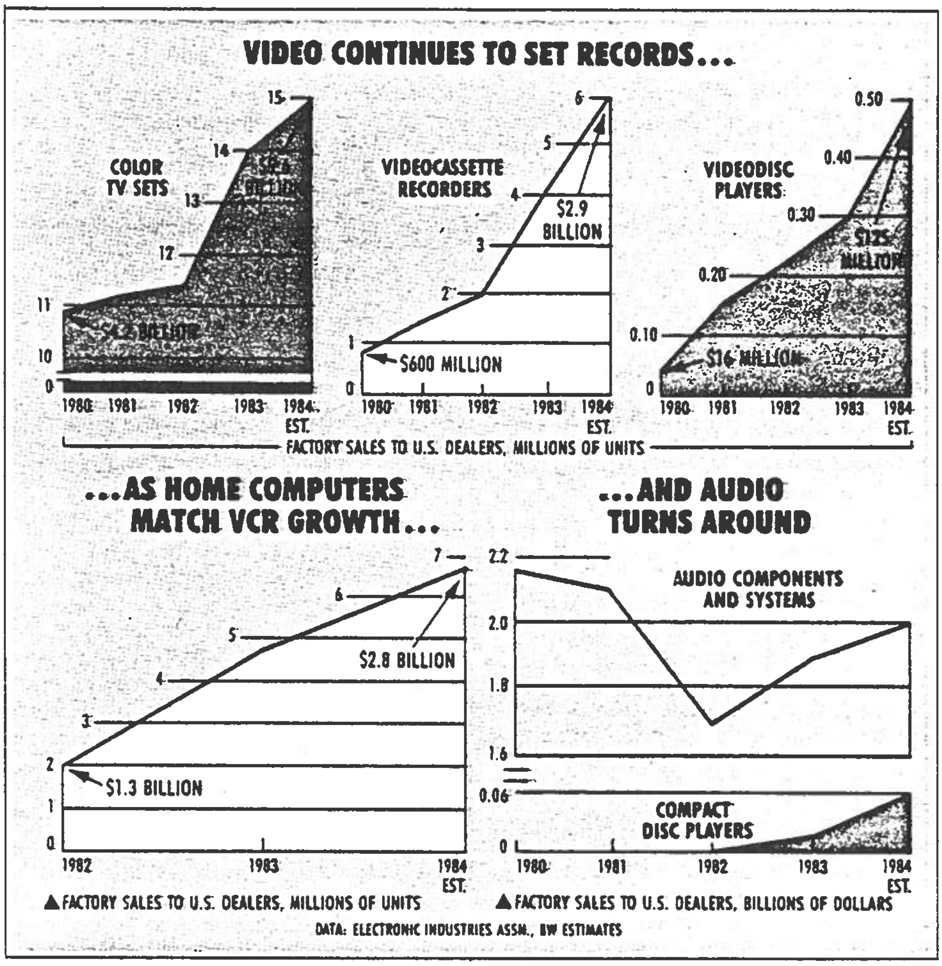
61 "The Home Information Revolution," *Business Week*, June 29, 1981.

62 The major work in this particular subject matter is still Frederick Williams, *The Communications Revolution*, Beverly Hills: Sage Publications, 1982 (updated edition: New York: New American Library, 1983). See also: Thomas F. Baldwin and D. Stevens McVoy, *Cable Communication*, Englewood Cliffs, N.J.: Prentice Hall, 1983.

63 "The Consumer Rush is on for Anything Electronic," *Business Week*, February 27, 1984, pp. 148-150.

64 "Cable Operators Take a Bruising," *The New York Times*, March 4, 1984.

CHART 2



technological development of communications in the field of news and entertainment has an even greater potential impact. To the 150 million television sets in use in the United States (99% of homes have at least one set, 50% at least two), has now been added the explosion of video-cassette recorders (VCRs) and video-disc equipment, along with a new development in specialized radio, video, hi-fi musical equipment, and new forms of television (very sharp, small 13-inch color TV sets, expensive giant screens, and, by 1985, digital TV with perfectly clear images, able to hold the picture, divide the screen, "zoom in" parts of it, etc.). The increasing use of satellites and the affordability of roof-top discs will allow reception of literally hundreds of channels, potentially submerging the receivers' capacity of assimilating signals and information.

Yet, if we know what the current developments are (and it is true that some of them are mind-boggling), it is most uncertain what is the actual use of all this equipment. Home computing seems to be more diffused among professionals, and basically for word processing functions, since more business-oriented activities are generally performed in the work environment. Income tax accounting is a frequent use of personal computers, but it certainly does not use up all the computers' potential. Games seem to be the most general use of the home computer, but, in fact, the video-game industry is in deep crisis, after the initial surge, once the excitement and the novelty leveled off. Thus, while home computers are here to stay, and while their use will develop steadily, with the foreseeable dramatic reduction in their cost and the user-friendly models that the industry will provide, their impact on the home (and on the city) will be less in terms of their own informative capabilities, than as a piece of a broader system, whose ability to interact in communications networks is likely to be the most important element.

It is in the field of *on-line information services* that the new function of the electronic home has been most frequently forecasted. Though this perspective is generally associated to Cable, and to the image of the wired city, a variety of other competing technologies aim at the same target: to deliver a variety of information, with some possibilities of two-way interaction.[65] Packet-type data radio and television allow sending information in bursts, including codes to identify the signal, thus bypassing the current cable operators. But the main source of information delivery is likely to be . . . the telephone, once reconnected to digital transmission capabilities, and with the speed and cost improved through the combination of laser and optical fibers. In fact, different technologies are not mutually exclusive. Given the cost of two-way cable, cable companies are already planning to set up systems that would allow sending information through the already installed wire and receiving the feedback from homes through the telephone line.

But, technologies for what? What will be the services provided by all these communication wonders? We are told that, by 1990, about 1/3 of U.S. homes will have some kind of videotext service.[66] What will be the informational content of such a service? Dorkiek, Bradley, Names and Martin projected the following adoption of services by the U.S. population in 1995:[67]

Type of Information Delivered	*% of All Households in U.S.*
- Addresses, numbers, calendars of events	45%
- Home security (police, fire)	40%
- Shopping by catalog	30%
- Directory of goods and services	30%
- Personal message system	30%
- Games	30%
- Public information, such as zoning, regulations, laws	25%
- Library services	20%

Other sources add weather information, electronic banking, electronic mail, energy monitoring, and the like.

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[65] See Williams, op. cit., 1982.

[66] Estimate by Strategic Inc., San Jose, CA, cited by *Business Week*, June 29, 1981.

[67] H.S. Dorkiek, H.G. Bradley, B. Names, T.H. Martin, "Network Information Services: The Emergence of an Industry," *Telecommunications*, September 1979, pp. 217-234.

CHART 3

One wonders at the real usefulness of the home delivery of these services from the point of view of the consumers, particularly given the current availability of most of this information through the telephone. Are the yellow pages more appealing on screen? Do we really need minute-by-minute updates of the weather forecasts? Is tele-shopping really a sizable alternative to shopping centers? Some of the applications of videotext, such as electronic newspapers featured on the TV screen, have already been discounted, as too inconvenient for readership and not really being able to find any specific use between TV news and your home-delivered morning newspaper. In fact, current experiences of videotext services have been generally disappointing.[68] The French "Telematique" system has not really taken off in spite of the massive support of the French Post Office. The British Presel system has had a moderate success because of its capacity of convey a broader range of miscellaneous information. In the U.S., in 1983, the average pay-cable household takes only 1.3 pay services.[69] People are generally reluctant to pay for services for which they do not have a compelling need, or that they used to have free through the telephone line. Electronic mail, already in fast development, particularly in its facsimile transmission service, concerns more offices than homes. Yet, it could produce some impact on home-delivery of mail through increasing cost of personal mail, given the shrinkage of the market for this kind of service, and thus the higher cost per unit of mail. If this trend develops, we could see a combination of three types of mail: electronic messages through computer hook-ups; self-pick up electronic mail at neighborhood post offices transformed into computerized transmission centers; and the home delivery service as an elite consumer item at an extra cost.

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[68] A result that was rightly foreseen by Williams, op. cit., 1982.

[69] *New York Times*, March 4, 1984.

In fact, the main uses for electronic home services could develop along these different lines: a) Home security, with wired systems of alert in case of an emergency. This is actually the hottest item in the cable business, outside entertainment. b) Public information, such as government regulations or available services (i.e., health, education, libraries, children's programs, etc.). This could be provided as a service by public agencies, thus increasing their reach and capabilities, though certainly reducing the level of personal contact with citizens. c) Electronic banking, which is already being heavily encouraged by banks. In fact, this development is a good example of what is really happening. It is well known that people prefer to deal personally with a bank teller in all money transfers. Automated banking machines have increased the security risks for handling money, in terms of cashing in the street, in terms of potential errors, and in terms of the increased risks of misuse of stolen bank cards (which, unlike credit cards, have no limit of liability if the loss is undeclared). Yet, banks are reducing personnel, closing branches, and mainly automating. With the potential of home electronic banking this movement will dramatically accelerate. Not because of customers' convenience, but because of the dramatic breakthrough in productivity that this will represent for the banking industry. In this sense home electronic services are likely to develop in the future, as ice breaking, because of the internal logic of large service organizations, and the economic advantage represented by the automation of most routine functions. Once some key services are almost mandatorily executed through cable or telephone line, many others will be branched into the same network. In this sense, we do foresee a slow, but steady trend toward the "telecommunicated city." The likely impact will be (as it is already being observed) a decrease in functional travelling around urban areas, and a concentration of activities around three major poles: work places, homes, and pure leisure time and places. At first sight, it seems ideal to be able to concentrate the fact of going out (outside work) just for the pleasure of doing so. But we know that people are very rarely able to take time and travel for just going out: this is the privilege of the youth, and of a small proportion of the middle class, to be able to choose, and to afford, casual leisure. For most people, they use the city in-between the functional activities they "had to do," playing on the margins of instrumentalism and expressiveness, without having necessarily to decide on the optimal use of their time. Internalizing functional activities at home and at work apparently leaves more room for the free use of the city in terms of pure choice. But it also increases the functional zoning of time and space, in such a way that public space becomes the space of leisure (for those who have the time and the money) *and* the space of wandering (for those who do not fit in the functional assignment of work and residence).

Urban cultures have always been characterized by the mixture of uses. Land use zoning started to segregate people and activities, thus leaning toward the disintegration of the social tissue of cities.* Now, electronic zoning dramatically enhances this tendency, transforming places into uni-functional units, unless an unprogrammed activity could take place. But then, there is a chance that spontaneity and weirdness (if not deviance) will become increasingly associated.

The real "revolution" occurring at home under the impact of new technologies is actually in *entertainment*. Homes are becoming increasingly equipped with a self-sufficient world of images, sounds, news, and information exchanges. The most interesting aspect, nevertheless, is that if the TV set is the centerpiece of the system, television, as we have known it, is on the decline, at least in relationship to its former overall dominance. In recent years, there has been an increasing demand for a more diversified TV, with more emphasis on entertainment and on specific matters, varying according to subsets of the audience. Cable TV was supposed to be a response to this demand for a

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*See: M. Christine Boyer, ***Dreaming the Rational City: The Myth of American City Planning***, Cambridge, Mass.: MIT Press, 1983.

diversified and decentralized TV programming, and this explains the rapid development of local cable systems in the 1970s. Yet, the current state of the industry has not supported the hopes for community TV, more directly connected to people's everyday life. The same national TV networks, as well as some major corporations, stepped into the new, promising markets, and transformed it into an extension of TV programming, with more targeted audiences.[70] In fact, Cable TV has become one of the most concentrated sectors of the media industry. Yet, instead of controlling the viewers' growing desire for autonomy, the taking over of Cable TV by the big networks only accelerated their disaffections, actually provoking a crisis in Cable TV itself. Its development leveled off in 1982. Currently, 40% of Cable TV subscribers disconnect pay services every year.

Companies have responded by raising fees, concentrating on the most profitable sectors of the market, introducing new pay-per-view technology, and slowing the pace of introduction of new services.[71] All of which results in deepening the crisis for the Cable industry. For instance, in spite of all the talk on the promise of two way cable, and the publicity of systems such as Qube in Columbus, Ohio, only 500,000 homes are currently equipped with interactive cable.[72] What is really taking the place of traditional television, is *video*.[73] In 1984, 10 million U.S. homes have VCRs (amounting to about 12% of households), a stunning figure if we recall that in spite of the availability of the technology since the 1950s, mass-market of VCRs started only in 1975, by Sony Betamax. But the progression is accelerating: by 1990, it is expected that 40 million homes will have VCRs.[74] Worldwide, the current figures is 40 million VCRs, with projections for 1990 being 70 million. The same projection estimates that by 1990 home video will be a $10 billion a year industry in the U.S., which is more than the entire American film and music industries combined. The number of video-cassette stores climbed from 6,000 in 1982 to 14,000 in 1984. In California, big supermarkets, such as Alpha Beta and Safeway, are becoming distribution points. And movie theaters are selling video cassettes of the most popular movies they have shown. Video production is growing. In 1982-84 about 2,000 titles have been released, at an average price of $40, with rentals as low as one dollar a night. "Raiders of the Lost Ark," the leader of the new industry, sold 800,000 cassettes in the first year of its releast, distantly followed by "Jane Fonda's Workout," that sold 170,000 copies. Yet, the biggest explosion is still in the making: it consists of musical video (stereo VCRs and video albums) which, it is estimated, will represent about 25% of the entire home-video market by 1988.

The main element in the enticement for video is *increased freedom* of the time of viewing, as well as of the content. The possibility of TV recording, as well as of "pirate recording" offers an unlimited field of accumulation of images, sounds, and information. A new kind of library that finally departs from the Gutenberg Galaxy. Thus, television will still be used as a source for news and instant information (from sports to live televised warfare, as in the Falklands war.[*] So, homes will increasingly become at the same time instant receivers of planetary information (thus, actually creating the global village), and personal refuges of selective consumption of images and sounds. Technologically speaking, most homes will become self-sufficient entertainment centers, thus increasing the tendency toward a home-centered, private life.

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[70] Francoise Sabbah, *The Evolution of Cable TV in the U.S.*, San Francisco: San Francisco State University, Master Thesis in Broadcasting and Communication Arts, 1984.

[71] *New York Times*, March 4, 1984.

[72] *Ibid.*

[73] Peter Stark, "Special Report: VCR Revolution, the Big Changes in Entertainment," *San Francisco Chronicle*, February 27, 1984.

[74] *Ibid.*

[*] Rex Moorfoot, *Television in the Eighties: The Total Equation*, London: British Broadcasting Corp., 1982.

Furthermore, the trend is not only toward home centered entertainment, but toward the *individualization of the communication experience*. The simultaneous development of highly specialized radio stations, and of "walkman" devices, is perhaps the most spectacular expression of the new trend. Not only will be able to stay at home, seeing nobody, and yet receiving news from the entire world, or filling their eyes and ears with a large variety of experiences, but they will also be able (as they *are* already) to leave home without leaving their inner experience of sound and information through these earphones that protect them from the world they do not want to perceive, that is everything that is, not pre-programmed, and, more and more so, personally pre-programmed.

Certainly, these are only *tendencies*, as we have been consistently repeating all along in our analysis, and they can be constructed or reshaped by purposive action, as well as by the interaction with other elements of our culture and our social organization. Besides, there is nothing wrong with the great possibilities that video offers to people who want to control to some extent the audio-visual culture in which we live. Sometimes, the actual social effects are quite unpredictable. For instance, it has been generally assumed that the video explosion would hurt movie theaters as much as TV did. And yet, it does not seem that such is the case. Not only is movie-going increasingly popular in Western Europe, but also in the U.S. the number of screens is actually on the rise (from 16,500 in the late 1970s to about 19,000 in the mid 1980s). The film industry is responding to the video challenge by increasing the quality of exhibition in movie theaters, and video-viewers are apparently attracted to the theaters, very much in the same way the LP records are an advertizing spot for live performances. Images that lead to images that refer to images . . . of the "reality." Which reality?

The electronic home is, above all, a self-sufficient unit of communication in a world increasingly dominated by images and information. People could stay at home and yet communicate, though this communication will be selective and specialized. If we add the technology of individualized communication (pocket-type distribution of data, "walkman"" types of receiving devices, wrist TVs and receiving stations, portable and disposable telephones, etc.) we can concede that the new technologies lead toward the de-localization of experience in the sphere of private life, as they do for work oriented organizations. Homes *could* become dissociated from neighborhood and cities, and still not be lonely, isolated places. They would be populated by voices, by images, by sounds, by ideas, by games, by colors, by news. And yet, you (we) could switch it all off in one gesture, as we already do. So, we know that the world (*at home*) is only there if we wish so. From a strictly technological point of view, there is no more mediation between the individual and a global culture, satellite-transmitted, then specialized, and targeted to specific people, and to specific moods. Thus, in-between, there is no more society, and no more city. At least, not the ones we have known. It is the emerging profile of this new socio-spatial form that we should now try to identify by bringing together the different elements we have presented on the relationship between new technologies and spatial dynamics.

3.6 The Blueprint of the Informational City

All these tendencies converge toward a specific spatial dynamic that we will only outline here for the sake of the progression of our analysis, without being unnecessarily precise on the actual spatial forms that are emerging from such a process. Because, as we already said, we need to introduce other factors (economic, cultural, political) to account for the actual spatial organization corresponding to our historic age. If we summarize the spatial trends that derive from the major technological developments discussed above, we find the following features:

a) A growing de-location of the functional logic of work-oriented organizations. This certainly does not remove from them the need to locate somewhere, nor from the other constraints (economic, cultural, institutional) but it certainly increases their "footlooseness," and emphasizes the interconnectedness of their functions beyond the needs of spatial contiguity. It follows a tendency toward *territorial sprawl of activities* across the country and across the world. In *functional terms*, as we proposed some time ago, *flows substitute for places*. Regional differentiation increases, but at the same time the pattern of spatial location becomes less dependent on the preceding urban concentrations. A more diversified, more diffused, and more interconnected functional space appears to be emerging.

b) As a consequence of the same locational function allowed by communication technologies, a process of *decentralization of activities occurs within metropolitan areas* when the costs of location in urban places by far exceed the need for contiguity, given the accessibility provided by the new "electronic highways." We can there observe a diffusion of activities in the metropolitan areas, along with the formation of an increasing number of subcenters that emphasize the trend toward the polinuclear metropolis.

c) The trend toward individualization of private life centered on a self-sufficient home, decreases the need to relate to the neighborhood and to the city, and maximizes the relationship to the global culture and the importance of the home's comfort and protection. Such a trend, in its spatial terms, is likely to translate into *further residential sprawl*, and in an even *greater importance of the suburbanization process*, in spite of the recent talk about the "back the the city movement". Yet, we must recast the notion of the suburb as a spatial form, avoiding to identify it with the endless strip of single family dwellings of the early Los Angeles, or late Houston, type. The "suburban squeeze" of vacant land, and real estate pieces can also lead to a new type of high-rise suburb, based on condominiums, a process that is already occurring in Orange County, the heart of suburban Southern California. Also, some portion of the central cities in the oldest metropolitan areas can be "recolonized" and transformed into residential zones for middle class families who cannot afford, or do not like, the typical "garden city" suburb. So some areas of Brooklyn, New York, start playing the same role of the suburb: a secluded, individualized, residential area from which middle class professionals commute to their downtown jobs. This is *not* the typical gentrification process characterized by the revival of the urban core. This is the formation of a new type of residential area on the basis of the rehabilitation of the existing urban structure, once available land for new development becomes too distant from the existing centers or sub-centers of activity. The basic transformation, and what authorizes us to see a shift from an urban neighborhood to a suburb, is that, in spite of the presence of a high-rise old building stock, the residential space is segregated into individual homes, socially turned inwards and functionally related to the entire metropolitan area, very much like the traditional suburb habitat. So, the trend is on for a new wave of suburbanization, with the provision that new spatial forms of suburban-like residence will have to be taken into consideration.

d) Along with worldwide territorial sprawl, metropolitan decentralization, and individualization of the residential landscape, the current technological trends will also enhance, simultaneously, the importance of a few *places*, as locations of non-footloose activities, with the consequent reinforcement of the intra-urban hierarchy. In other words, those activities that cannot be easily transformed into flows and that require spatial contiguity enhance considerably the value of specific places. In the informational city, spatial singularity and urban centrality become even more rare and important than in the industrial-commercial city, precisely because of their non-replaceable locational requirements. Thus, high-level managerial functions, specialized leisure areas, key informational institutions (such as universities), very specific productive centers (such as high tech nests), and special service-delivery activities (from hospitals to high-class boutiques) will earmark the metropolitan space with their requirements for spatial contiguity and face to face interaction. Thus, spatial indifferentiation and extreme specificity of a few nodal places are *both* characteristics of the informational city foreshadowed by the new communication technologies. It is in the vicinity of these nodal places that the few residential spots will allowed to coexist in a mixed use of space, because they will be the most desirable dwellings, and thus the residential space of the new elites. It is necessary that we include in this view new privileged residential space and a variety of urban forms: both the professionals living in New York's Soho, and the electronic engineers in their residences at Los Altos Hills, in the heart of the Silicon Valley. The new residential elite is the one able to bring together residence, work, information, and leisure within a short-range of spatial distance, within an area from which generally they travel out by plane. The more the city is based upon flows, the more the elite appropriates the only places still irreducible to flows.

e) This territorial spatial form characterized, simultaneously, by indifferentiated sprawl, specialized concentration, and location discontinuity, does not develop in a historical vacuum. It takes shape on the ruins of the preceeding urban civilization, and cuts across the old and new situations of social exclusion. Flows connect networks that are functionally useful and socially valued, thus certainly enhancing organizational productivity. Nodal places nest the the noble activities and welcome the few, the proud, the urbanites. Secluded individualistic residences turn toward their own inner logic and values, closing their doors to the immediate surrounding environment, and opening their antennas to the voices of the entire Galaxy. But, as Frederick Williams writes:

> Our largest social problem with the new communication technologies is that under a *status quo* policy we create new socioeconomic classes, namely the "communications rich" and the "communications poor." Cable pay TV, tape, direct broadcast satellite, and home computers do not come cheaply to the consumer. . . . Moreover, children reared in homes and attending schools with a high rate of technology use are far more adept for life in a communications technology than those who go without. In the twenty-first century, "information" will more than ever in history represent power.[75]

But the problem is not only the distribution of communication capabilities according to income, it is also the position of different social groups in the spatial structure of the informational city. In a structure organized around flows, people, activities, and cultures that are not valued (or priced) could easily be switched off the network. In a world of individualized homes you can only develop yours if you have the cultural and economic resources to do so. And in a city where only meaningful places are associated to the highest functions, the space with relation to only a few tends to become the space of exclusion for the most. Thus, in-between the discontinuous spatial elements of the informational city, there will remain switched-off, wireless communities, still real people in real places, yet transformed into urban shadows doomed to haunt the ultimate urban dream of the new technocracy.

4. High Technology, Economic Re-structuring, and the Urban Process

4.1 Introduction: Technology and the Economy, Secular Trends and Economic Policies

The most immediate impact of the revolution in information technology is being felt in the sphere of economic activity. As far as economic factors fundamentally affect the spatial structure and the urban process, it is one of our major hypotheses that it is *through the new economy* that the new technologies are deeply modifying our cities and regions. To be sure, there is no one-way causality in such a process. Technological change occurs within a framework of social and economic conditions that facilitate or slow down innovation, and largely condition the direction and characteristics of the technology itself.[76] Thus, in our analysis, we will keep this tension between assessing the

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[75] F. Williams, *op. cit.*, 1983, p. 227.

[76] See: Nathan Rosenberg. *Inside the Black Box: Technology and Economics*. Cambridge, New York: Cambridge University Press, 1982.

specific effects of the new technologies and, at the same time, seeing them as responses to social interests and economic policies required by the current historical dynamics.

For the sake of clarity, the method of analysis we will attempt here will be to identify the role played by the new technologies in each one of the fundamental processes restructuring the economy in the current period, and elaborate about the foreseeable consequences of each one of these processes (with their technological component) on the urban-regional structure. This perspective assumes that the world economic system is in a process of deep structural transformation which is in intimate connection with the technological revolution (though *not* determined by it, rather we think it is the other way around), and that only by understanding the effects of technology within this broader framework (that we call *the economic restructuring of the world capitalism system)* we will be able to assess the impact of high technology in the new urban-regional process. To avoid repetition of previous work, we are forced to refer to previous analyses by ourselves[77] and other colleagues[78] on the structural economic crisis and the fundamental realignment it has triggered, without elaborating it here, except for the need of making the indispensable analytical links with the research topic treated in this text.

As we have argued elsewhere, the capitalist system went through a major crisis in the 1973-83 decade and is trying to emerge from it by means of setting up a new model of economic accumulation and social organization that, while still being capitalist, will be as different as the Keynesian model we knew between 1965 and 1975 was different from pre-Great Depression capitalism. This model relies on a *new international division of labor*[80] with an accelerated process of internationalization of capital, labor, production, and consumption; on a fundamental transformation of the *capital-labor relationship in the work process*,[81] and on a new role of the state and of the public sector, whose main emphasis shifted from redistribution to accumulation, and from legitimation to domination, something that can be schematically called, *the transition from the Welfare state to the Warfare state*.[82] We propose as a hypothesis that the new technologies are playing a major role in these three fundamental processes, and that such a technological-economic impact is crucial to understand the emerging urban structure. We should also immediately add our customary word of caution: technology by itself does not determine the process, so the new technologies are not responsible for the current trends that have, ultimately, political roots; and these economic trends are not necessary evolutions of our societies: they are, they will be, resisted by social counter-tendencies and alternative economic policies, and cities and societies will be the result of the conflictive

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77 Manuel Castells.. *The Economic Crisis and American Society*. Princeton: Princeton University Press, 1980.

78 Martin Carnoy, Derek Shearer, and Russel Rumberger. *A New Social Contract*. New York: Harper and Row, 1983; Samuel Bowles, David Gordon, Thomas Weisskopf, *Beyond the Wasteland*, Garden City: New York: Anchor/Doubleday, 1983.; Barry Bluestone and Bennett Harrison, *The Deindustrialization of America*, New York: Basic Books, 1982.

80 Folder Frobel et alter, *The New International Division of Labor*, Cambridge: Cambridge University Press, 1980; John Zysman and Stephen Cohen, *The Mercantilist Challenge to the Liberal International Order*. Berkeley: BRIE, 1982.

81 See Charles Sabel: *Work and Politics: The Division of Labor in Industry* Cambridge: Cambridge University Press, 1982; David M. Gordon, Richard Edwards, and Michael Reich. *Segmented Work, Divided Workers*, Cambridge: Cambridge University Press, 1982; Alejandro Portes and John Walton: *Class, Labor and the International System*. New York: Academic Press, 1981; Richard Edwards, *Contested Terrain*, New York: Basic Books, 1979; Martin Carnoy and Derek Shearer, *Economic Democracy*, New York: Sharpe, 1980; Jackie West (ed.), *Work, Women and the Labour Market*, London: Routledge and Regan Paul, 1982.

82 Ian Gough, *The Political Economy of the Welfare State*, London: MacMillan, 1973; Wassily Leontieff and Faye Duchin, *Military Spending*, New York: Oxford University Press, 1983; Lloyd Dumas (editor), *The Political Economy of Arms Reduction*, Boulder: Westview Press, 1982; Richard Barnet, *The Lean Years: Politics in the Age of Scarcity*, New York: Simon and Schuster, 1980; Colin Crouch (editor) *State and Economy in Contemporary Capitalism*, London: Croom Helm,1979.

interaction between both sets of tendencies. Yet, the current pattern shows the growing domination of the new capitalist model: it is the urban-regional profile of this model, in the early stage of its implementation, that we attempt to explore in this text.

Nevertheless, the interaction between high technology and the economy in the production of the new spatial structure, also takes place within some secular trends of structural transformation of our economies; indeed, of our societies. Thus, we will need also to pay attention to the role played by the new technologies in reshaping, halting, or accelerating, some of these secular trends. The three most significant seem to be the growing importance of *services* in the economy,[83] the consolidation of the *large corporation*[84] as the predominant organizations form of economic activity, and the process of *uneven development* (between economic units, sectors, regions, and nations) as characteristic of the capitalist mode of production.[85] It must be made clear that the separation between secular trends and economic restructuring is somewhat artificial, and should be considered more as a form of presentation of our hypotheses than as an analytical statement. For instance, the development of services has been largely linked to the expansion of corporations over entire sectors of the world (internationalization of capital), as well as to the rise of the Welfare State (growing resources devoted to social services). On the other hand, the current restructuring is likely to provoke dramatic efforts on the expansion of producer services along with the retrenchment in many public services. Yet, while intimately connected, the historical determination of economic policies and the dynamics of an economic system cannot be entirely assimilated. For instance, the mechanization of agriculture seems an almost necessary process, regardless of economic policies, once a given level of technological progress is reached. So, our analysis will consider first the role of new technologies in the reshaping of three basic secular trends: the growth of services; the dominance of the large corporation; and the current forms of uneven development, focusing on the urban and spatial implications of each trend. Then, in a second part of our analysis, we will refer to the linkages between the new technologies, and the three major processes of the fundamental economic restructuring under way: the new international division of labor; the new conditions of labor in the work process and in labor markets, and the reorganization of the public sector. We will be assessing, for each process, their impact on cities and regions, as it relates to the specific role played by the new technologies in these processes.

4.2 New Technologies,the Service Economy, the Large Corporation, and the Urban Structure.

Advanced capitalist societies have often been characterized as entering the "post-industrial" age.[86] As far as we recognize that they remain capitalist, and that this is a fundamental feature of the entire social and economic organization, we do not have major argument with such a statement. With only one reservation: the term, and the underlying theory, are ambiguous, and the exact implications embodied in the term are unspecified. But the "post-industrialist" perspective has a major merit: to point out the fundamental transformation of our process of production within the overall capitalist logic. In other words, to differentiate between historical forms of existence of capitalism has become as important as to identify an economy as capitalist, in terms of helping our

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[83] See: Victor Fuchs, *The Service Economy*, New York: Columbia University Press, 1968; Thomas M. Stanback, et alter. *Services: the New Economy*, New Jersey: Rowman and Allanheld, 1981.

[84] See: Alfred D. Chandler,*The Visible Hand*, Cambridge: Cambridge University Press, 1977; Robert Cohen: *The Corporation and the City*, New York: Columbia University's Conservation of Human Resources Project, 1978.

[85] David Harvey. *The Limits of Capital*. Oxford: Blackwell, 1982.

[86] See: Alain Touraine, *La Societe Post-industrielle*, Paris: Denoel, 1969; Daniel Bell, *The Coming of Post Industrial Society*, New York: Basic Books, 1976.

understanding of any society.

The most immediate indicator of some fundamental transformation of the way we produce, work, and live is the tremendous expansion of the proportion of the population employed in the so called "Service Sector", in the U.S. from 48.1% in 1940 to 66.7% in 1980. Yet, a number of remarks should be recalled to fully assess this transformation before introducing in the process the variables which we are interested here, namely new technologies and the urban structure.

First of all, the rise of services does not equate the demise of manufacturing. As Table 13 shows, the proportion of the labor force in transformative activities (including construction) is the same in 1980 as that in 1940 (29.8%) which means that it is much higher in absolute terms: the number of manufacturing employees has actually dramatically increased in the U.S. The transfer of jobs has taken place from agriculture to services.

Secondly, it is crucial to distinguish different activities within the service sector, given the broad range of activities generally included in it. Joachim Singelmann[87] has provided a useful typology that differentiates, in terms compatible with government statistics, between distributive services, producer services, social service, and personal services. Table 13, constructed by Singelman until 1970, and completed for 1980 on the basis of data from the Bureau of Labor Statistics, shows the great importance of this distinction. Between 1960 and 1980, distributive services grew moderately, while still employing 23.7% of the total labor force. Personal services declined, with the major exception of the "eating and drinking" category. Producer services almost doubled, while still employing, overall, less workers than personal services. And "social services" literally exploded, jumping from 10% to 24.3% in 1980. Even during the critical 1970's the decline in education has been more than compensated by employment growth in hospitals and medical services, reaching 7.8% of the labor force in 1980. That is more than twice the total labor force in agriculture: a small indication of what secular transformation means in practical terms. . .

Nevertheless, while the importance of the shift of employment toward service activities can hardly be overstated, it must be put into perspective. Because, as Fuchs[88] and Stanback[89] have reminded us, when *measured in constant dollars* there is very little shift in the share of GNP for the output of goods-producing or service-producing sectors between 1961 and 1976. (See Table 14), since the small gains of service outputs here are at the expense of agriculture. Thus, while industry represented in 1980 less than 30% of employment it accounted for about 41% of the GNP. What are the implications in terms of the secular evolution of the economy? The main one is, it seems to us, the growing disjunction between the activities that people do for a living and those that generate growth in our society. This is due to the fact that, as we have proposed years ago[90] the service sector has expanded under a variety of pressures, most of which are due to social mobilization and political concession. A substantial part of employment in the service, particularly in social services, is, in fact, a form of absorbing surplus population generated by increased productivity in agriculture and industry, in a society that still requires full time salaried work to survive, even if we could afford less collective work with more collective production.

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87 See: Joachim Singelman, *The Transformation of Industry From Agriculture to Service Employment.* Beverly Hills, CA: Sage Publications, 1977.

88 Victor R. Fuchs, *The Service Economy*, New York: Columbia University Press, 1968.

89 Thomas M. Stanback, Jr., *Understanding the Service Economy*, Baltimore: The Johns Hopkins University Press, 1979, p. 3.

90 Manuel Castells, "The Service Economy and Postindustrial Society: A Sociological Critique." *International Journal of Health Services*, Vol. 6, no. 4, 1979.

TABLE 13
Percentage Distribution of the Labor Force by Industry Sectors and Intermediate Industry Groups, 1870-1980

Sectors & Industries	1870	1900	1920	1940	1950	1960	1970	1980
EXTRACTIVE	52.3	40.7	28.9	21.3	14.4	8.1	4.5	4.5
Agriculture	50.8	38.1	26.3	19.2	12.7	7.0	3.7	3.6
Mining	1.6	2.6	2.6	2.1	1.7	1.1	0.8	0.9
TRANSFORMATIVE	23.5	27.9	32.9	29.8	33.9	35.9	33.1	29.8
Construction	5.9	5.8		4.7	6.2	6.2	5.8	6.2
Food				2.7	2.7	3.1	2.0	1.8
Textile				2.6	2.2	3.3	3.0	2.1
Metal				2.9	3.6	3.9	3.3	2.7
Machinery	17.6	22.1		2.4	3.7	7.5	8.3	5.2
Chemical				1.5	1.7	1.8	1.6	1.3
Misc. manufacturing				11.8	12.3	8.7	7.7	10.5
Utilities	*	*	*	1.2	1.4	1.4	1.4	1.4
DISTRIBUTIVE SERVICES	11.5	16.9	18.7	20.4	22.4	21.9	22.3	23.9
Transportation	5.0	7.3	7.6	4.9	5.3	4.4	3.9	6.6
Communication				0.9	1.2	1.3	1.5	1.5
Wholesale				2.7	3.5	3.6	4.1	3.9
Retail	6.5	9.6	11.1	11.8	12.3	12.5	12.8	11.9
PRODUCER SERVICES	**	**	2.8	4.6	4.8	6.6	8.2	9.5
Banking				1.1	1.1	1.6	2.6	1.7
Insurance				1.2	1.4	1.7	1.8	1.9
Real Estate				1.1	1.0	1.0	1.0	1.6
Engineering					0.2	0.3	0.4	0.6
Accounting					0.2	0.3	0.4	0.5
Misc. business services				1.3	0.6	1.2	1.8	2.4
Legal services					0.4	0.5	0.5	0.8
SOCIAL SERVICES	3.4	5.1	8.7	10.0	12.4	16.3	21.9	24.3
Medical					1.1	1.4	2.2	3.3
Hospitals				2.3	1.8	2.7	3.7	4.1
Education	1.5	2.3	2.8	3.5	3.8	5.4	8.6	7.7
Welfare				0.9	0.7	1.0	1.2	1.0
Nonprofits					0.3	0.4	0.4	0.6
Postal services				0.7	0.8	0.9	1.0	0.7
Government	0.8	1.0	2.2	2.6	3.7	4.3	4.6	4.7
Misc. social serv.				--	0.1	0.2	0.3	2.3
PERSONAL SERVICES	9.3	9.4	8.1	14.0	12.1	11.3	10.0	10.8
Domestic Serv.	7.4	6.1	4.1	5.3	3.2	3.1	1.7	1.3
Hotels				1.3	1.0	1.0	1.0	1.1
Eating & drinking	2.0	3.4	4.0	2.5	3.0	2.9	3.3	4.4
Repair				1.5	1.7	1.4	1.3	1.5
Laundry				1.0	1.2	1.0	0.8	0.4
Barber & beauty				---	---	0.8	0.9	0.7
Entertainment				0.9	1.0	0.8	0.8	1.0
Misc. personal services				1.6	1.2	0.4	0.3	0.4

Source: 1870-1970: Same as Table 2, pp. 17-18; 1980: "Special Labor Force Report 244," U.S. Department of Labor, Bureau of Labor Statistics, 1981.

* - Utilities included in "Distributive Services"
** - "Finance,Insurance, and Real Estate" included in "Trade"

TABLE 14

Output, Employment and Productivity Growth Rates in the U.S. Economy: 1968-1978

Industry	Output: Constant dollar gross product originating	Full-Time & part-time employees	Productivity gross product originating per hour worked
ALL INDUSTRIES	2.89	1.90	1.41
PRIVATE NON-FARM ECONOMY	3.11	2.15	1.42
AGRICULTURE, FORESTRY & FISHING	1.8	1.18	.68
MINING	1.40	3.68	-2.29
CONSTRUCTION	-.54	1.96	-2.28
MANUFACTURING	2.44	.34	2.34
COMMUNICATIONS	8.36	2.39	5.84
ELECTRIC, GAS & SANITARY SERVICES	3.26	1.69	1.59
WHOLESALE TRADE	3.97	2.68	1.63
RETAIL TRADE	3.06	3.37	.76
FINANCE, INSURANCE, & REAL ESTATE	4.22	3.50	.99
SERVICES	3.82	3.37	.77
Business	5.88	5.95	.69
Health	4.82	7.04	-1.44
Other	2.82	1.6	1.41
GOVERNMENT	1.31	1.02	.56

Source: "Economic Perspective on Trends in the United States Economy, 1968-1978," U.S. Industrial Outlook, 1981,U. S. Department of Commerce, Bureau of Industrial Economics.

This is why Stanback writes that

> Productivity is a key issue in assessing the role of services in our economy. There is little evidence of a strong, cumulative shift of demand from goods to services. Yet the shift toward greater shares of employment in services is well established. For services, taken as a whole, gains in productivity have failed to watch those in nonservice activities; consequently, economic growth has been accompanied by disproportionately large increases in service sector jobs.[91]

Table 15 provides a statistical confirmation of this statement, particularly in government services.

To be entirely fair in this discussion, as Stanback himself points out,[92] it is difficult to analyze productivity in the service sector following the traditional economic accounting. For instance, how is quality of medical care or of educational attention to be measured? Also, we cannot underestimate the indirect effects that some services (producer services, research and development, appropriate government handling of monetary policy, for instance) produce in industrial productivity. Yet, in a given economic system is productive what the dominant rules of such a system consider to be productive. Thus, low-productive services, whichever their *usefulness* will be, will remain a burden for economic growth within the parameters of our system, and the tendency of corporations and governments will be to overcome the obstacles to productivity in the service sector, provided they are able to put aside social demands and political pressures. And here is where the new technologies could play (they are already playing) a fundamental role in the secular economic evolution.

The fact that most services show a lower labor productivity does not mean that they are "parasite" activities. In fact, most producer services are crucial for the development of productivity in the economy as a whole, personal services structure the consumption process, distributive services make possible exchange, and social services, in a good proportion, are crucial for collective consumption and social stability. So, one can hypothesize that for the entire economy to keep growing, we would need more and better service activities. In fact, the fastest growth of office-type occupations, both in industry and services, has been in high-skilled occupations, particularly in 1970-1980, as is shown by Table 15 (computed by Barbara Baran). To be sure, the spectacular growth of social scientists is still insignificant in absolute terms, but other categories' expansion clearly indicate the fundamental evolution occurring within the service activities themselves: the handling of information of all type of information, is increasingly at the core of the entire economic activity. Here is where the contradiction appears: on the one hand, information and knowledge are key productive forces in increasing productivity (that is unit of output per unit of input, all other terms equal);[93] on the other hand, much of the process of management of information is in itself labor-intensive and prone to low-productivity. Thus the increase of productivity in the economy as a whole is countervailed by the increase of low-productive, yet generally indispensable activities. This explains the apparent mystery expressed by Chart 4, constructed by the Bureau of Labor Statistics:[94] between 1948 and 1982, labor output increased substantially as it did, in a lesser extent "multifactor productivity" (that accounts for number of elements outside capital and labor). Yet, what generally failed was the productivity of capital. In other words, the overload costs of production skyrocketed. Part of it has to do with

[91] Stanback, op. cit., 1979, p. 29.

[92] Stanback, op.cit., 1979, pp. 35-36.

[93] See: Edward F. Denison, "The Interruption of Productivity Growth in the U.S." *Economic Journal*, March 1983, pp. 1-22.

[94] See: Jerome A. Mark and William H. Waldorf. "Multifactor Productivity: A New BLS Measure", in *Monthly Labor Review*, Dec. 1983, Vol. 106, No. 12, pp. 3-15.

TABLE 15

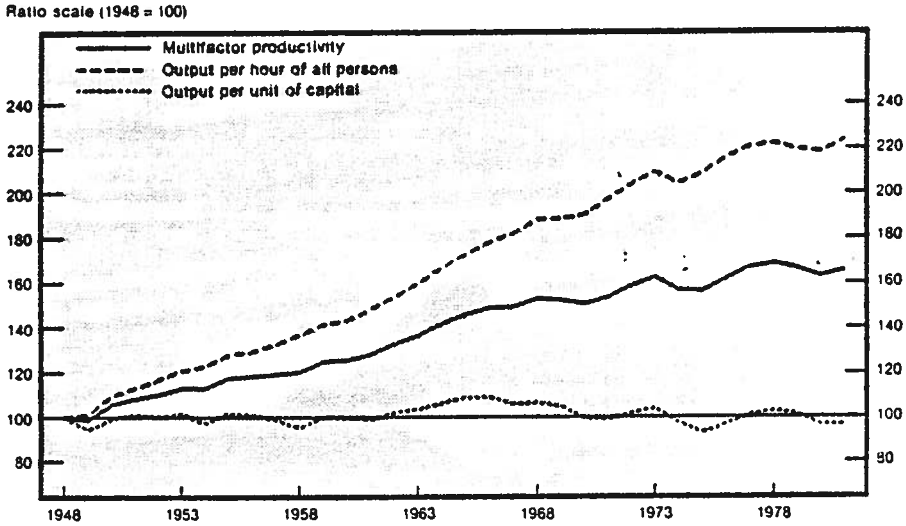
GROWTH OF OFFICE-TYPE OCCUPATIONS, 1960-1980

Occupation	Percentage Increase	
	1960-1970	*1970-11980*
PROFESSIONAL & TECHNICAL WORKERS	57.2	37.5
Computer specialists	--	129.5
Accountant & Auditors	49.8	48.8
Lawyers	30.5	101.0
Personnel & Labor Relation Workers	195.7	55.5
Public Relation Workers	--	114.1
Social Scientists	20.5	321.9
--Economists	50.3	396.4
Technicians, Electrical & Electronic	66.7	68.6
MANAGERS & OFFICIALS	17.8	31.7
CLERICAL & KINDRED WORKERS	47.8	37.7
TOTAL LABOR FORCE	17.3	21.8

Source: Computed from the Special Labor Force Report 244, U.S. Department of Labor, BLS 1981 and the U.S. Department of Commerce, *Historical Statistics of the U.S.: Colonial Times to 1970.*

CHART 4

Indexes of output per hour of all persons, output per unit of capital, and multifactor productivity in the private business sector, 1948 to 1982



government, both in defense and social expenditures. But a substantial part goes to management costs, that is to the handling of information, for a long time more difficult to rationalize and mechanize than the production of goods. Since the new technologies are basically aimed at information-processing, we can see emerging the possibility of the historical supersession of the barrier existing to extend the productivity drive from industry to services. Office automation[95] and telecommunications[96] are leading the change. The "office of the future" is already in our lives[97] and with it, a fundamental reorganization of the production process, with manufacturing and services being increasingly complementary and feeding each other both in demand and in enhancement of their productive capacities. We will see in another section, below, the tremendous potential impact of this trend on the labor market and occupational structure. But, for the moment let us say, concerning the service sector, that the improved productivity generated by the new technologies will trigger an explosion of producer series, particularly in FIRE activities, eventually the fastest growing subsector. As a whole, services will take off, this time not only in terms of employment, but in terms of output. It is now that we are in fact entering into the "service economy," with the additional caveat that the traditional distinction of the production of goods and services will soon be obsolete. What is a computer worth without software? Or a plane without a computer? Or a frozen food dish without the cooking instructions?...

Now, the problem (or the opportunity, in sociological terms) is not entirely due to the need of handling information and managing organizations in a complex society, it is also the result of a redefinition of social needs under the pressure of social movements particularly in public services,[98] as well as a response to the growing surplus population to provide jobs to maintain employment[99] and to keep social peace.[100]

[95] See: Barbara Baran, *The Transformation of the Office Industry: Impacts on the Workforce*, Berkeley: University of California, Master of City Planning, 1982.

[96] See: M. L. Moss (editor), *Telecommunications and Productivity*, Reading, Mass.: Addison-Wesley, 1981.

[97] See: Paul Strassman,"The Office of the Future: Information Management for the New Age," *Technology Review*, Dec. - Jan., 1980.

[98] M. Castells "Collective Consumption and Urban Contradictions in Advanced Capitalism," in L. Lindberg et. all. (eds), *Stress and Contradiction in Modern Capitalism*, Lexington, Mass.: D.C. Heath, 1975.

[99] James O'Connor, *The Fiscal Crisis of the State*, New York: St. Martin's, 1973.

[100] Frances Piver and Richard Cloward, *Regulating the Poor* New York: Vintage Books, 1972.

Thus, the "service economy" is a mixture of disparate functions and activities resulting from a diversified historical origin. Accordingly, the effects of the information technology will be internalized very differently and with specific speed and timing. At the risk of oversimplifying (but we can take the risk in the exploratory mood of this paper) we can say that:

- Producer services, and very particularly what Robert Cohen calls "Advanced Corporate Services," will explode in output, in employment, and in organizational presence.
- Consumer services will bifurcate:

  On the one hand, consumer-oriented *corporate services* (such as banking) will be largely automated, except for consulting-marketing purposes. So, they will spread and decentralize.

  On the other hand, *personal services* (such as "eating and drinking") will proliferate on the basis of labor-intensive, low-productive work, to come into the interstitial spheres of pre-programmed activity. To be sure, McDonalds and other fast-food corporations, will further program their plastic offerings, but they will still rely on teen-agers to provide their service. Yet, some automation (like automatic checking counters) will speed up the function, without nonetheless going all the way to food distributing machines, cultural autonomy still resisting full automation of the consumption process.
- The big battle is building up in the *public sector*, particularly in the fundamental area of *social services*. As Stanback has stressed[101] the public sector will likely be more insulated to pressures toward rationalization or cost-saving technologies, since it is largely removed from market-controls. Furthermore, we will add, since the main origin of many public services *and jobs* is political, the impact of technology is largely irrelevant in terms of rationalization as far as the political conditions remain similar. This is why we will delay full discussion of this issue until we consider the pressures for the restructuring of the public sector. Nevertheless, from the point of view of the structural evaluation of the "service sector" we do have a fundamental bifurcation, motivated by technological change, between a rationalized, largely automated, producer series sector, and a labor-intensive, politically determined social service sector. The lines are drawn: productivity and efficiency versus employment and social usefulness. There is no more "service sector". There are two basic areas of management of information: one, where the remaining people will use machines to increase the efficiency (and the profit!) of the economy; another where refugees from the pre-information age will use their political influence to barricade themselves against the demagogic appeal to the taxpayers. In-between, the untold story: free-time for everybody while the machines pick tomatoes, produce cars, and keep the accounting.

Before we try to draw some implications of these developments of new technologies in services for the urban structure, we need to introduce another element into the picture: the secular trend toward the consolidation of the dominant organizational form in our economy, that is the *large corporation*. As such, this tendency cannot be assimilated to the expansion of the service economy, since it actually has to do with the dynamics of capital accumulation.[102] Nevertheless, the urban effects of corporate capitalism are inextricably linked to the use of services, and even more so when we introduce the specific impact of new technologies on both processes. So, we will treat both of their influences on the urban structure *together* after examining, very carefully, the

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[101] Stanback, op. cit., 1979.

[102] Chandler, op. cit., 1977.

the relationship between the large corporation and the new technologies.

The large corporation characterizes the advanced capitalist economy.[103] Beyond all ideologies, surrounding its existence as the organizational form of late capitalism, it is a fact that the Fortune 500 corporations control over 3/4 of manufacturing assets and overall employment in the U.S.[104] Their "global reach" as multinational corporations make them the core of economic power and decision-making in this planet.[105] That they are the expression of capital or that capital is the instrument of their organizational logic is, today, an irrelevant discussion: capital, capitalists, large corporations, and their top managers are, currently, the same historical actor. How are they affected by the new technologies? In fact, there is a blessing for their organizational logic, in spite of the personal reluctance of middle-managers that still prefer a personal secretary to a word-processing pool. Large corporations have the advantage of economies of scale and of strategic planning. But they can be reduced to confused bureaucracies without remotely-controlled decentralization, and without a proper storage and treatment of multiple-sources information. Computers and communications are the proper answer to such concerns. Thus, leaving aside for the moment the labor-saving strategies in the office, the new information technology allows the large corporation to increase its economic power while maintaining its efficiency through enhanced flexibility, and coordination between semi-autonomous lower-level units.

On the other hand, isn't it true that the new technologies give more room for small business to develop their autonomy, thus counteracting the secular trend toward concentration of capital and economic decision-making? No and yes. Fundamentally, no. As Teitz and Markusen have shown in their study on California's small businesses[106] financial constraints are the overarching consideration for small business, not functional management. They remain satellites of large corporations, or takers of very specific niches in a given market, not real alternatives for economic development, regardless of their role as major job-creators.[107] At the same time, the combination of new technologies and the explosion of "advanced corporate services" leads to the development of new opportunities for small business focused on the treatment of highly specialized information for a corporate market: lawyers, accountants, business consultants, software experts, international advisers, realtors, and leisure specialists. . . The world of the large corporation carries with it a constellation of activities, most of them provided by small business, whose connection to the mainstream will be facilitated by electronic processing of information. So, new technologies enhance both the large corporation and the individual working units that make a living on their environment. There is no small business versus high business, but a network of corporate capitalism, with centers, subcenters, and servants. The whole system being increasingly connected, though in a flexible way, by data transmission equipment.

On the basis of these trends, what can we say of urban processes and spatial forms that express the interaction between high technology, services, and corporate capitalism? How does the service economy affect the urban structure and how the new technologies intervene in this relationship?

Thomas M. Stanback and his co-workers have been systematically studying the question for a number of years.[108] On the basis of these findings we can observe a number of

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[103] Ibid.

[104] R. Cohen, op. cit., 1979.

[105] Richard Barnet and Robert Muller, *Global Reach*, New York: Simon and Schuster, 1974.

[106] Ann R. Markusen and Michael B. Teitz, *The World of Small Business: Turbulence and Survival*, Berkeley: University of California, Institute of Urban and Regional Development, Working Paper No. 408. June 1983.

[107] David Birch. *The Job Generation Process*, Cambridge, Mass.: MIT, 1979.

[108] See: Thomas, M. Stanback, et. alter, *Services: the New Economy*, Montclair, New Jersey: Allanheld, Osman

trends:

- Increasing concentration of export-oriented services in nodal metropolitan areas.
- Increasing concentration of these services within the CBDs of large metropolitan areas.
- Both of these tendencies are particularly accentuated for the "advanced corporate services," as it has been established by Robert Cohen's pioneer research.[109] Cohen also shows that even the booming sunbelt remains largely dependent from the old established basis of headquarters and corporate services in New York, Chicago, and, for banking, San Francisco.[110] In particular, the predominance of New York in all advanced series is overwhelming.
- There has been a process of suburbanization of secondary offices of major companies, as well as of small businesses unable to afford competition for land in the highly priced CBDs. Nevertheless, the bulk of service activities remains in the downtown areas.
- Consumer services have, by and large, followed the suburbanization of middle class residents.
- Local sector services, particularly in health and education, tend to follow the spatial distribution of the population they serve. Yet, some of these services (like big hospitals) are also export-oriented. In this case they tend to dominate a given space, generally in their former location in the inner city.

The current technological change, by accelerating the expansion of services because of the removal of the productivity barrier, is likely to reinforce *these observed trends*. CBDs of nodal metropolitan areas are (and will be) experiencing major growth. While some decentralization of secondary offices to the suburbs and to non-metropolitan areas is occurring (given the possibilities offered by new communication systems) the overall *economic impact of high technology*, by enhancing the role of the large corporation and expanding the service sector, *works actually for the development of downtowns*, with the major exception of those metropolitan areas based in old-line manufacturing (such as Buffalo) and even so, the revival of downtown Baltimore (in spite of the crises of steel and automobile) is one example of the possible successful transition to a service economy on the basis of renewed productivity on the sector.

So, there are three major spatial consequences of the economic effects of new technologies on the service sector:

- The increasing mixture of consumer services and residential areas in the suburban landscape.
- Decentralization of second-level service activities to the suburbs and to non-metropolitan areas.
- Rapid growth of CBDs, particularly in those metropolitan areas that are highly placed in the urban hierarchy of corporate networks.

The last development, which is by far the most significant, is confronted to two major, and potentially explosive contradictions:

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and Co., 1982. Thomas M. Stanback, *Understanding the Service Economy*, op. cit., 1979; Thomas M. Stanback and Richard V. Knight, *The Metropolitan Economy*, New York: Columbia University Press, 1970; Thomas M. Stanback and Thierry J. Noyelle, *Cities in Transition* Totowa, New Jersey: Allanheld, Osman and G. Publishers, 1982.

[109] Robert Cohen, op. cit., 1979.

[110] Robert Cohen, "Multinational Corporations. International Finance, and the Sunbelt" in David C. Perry and Alfred J. Watkins (eds). *The Rise of the Sunbelt Cities, Beverly Hills: Sage, 1977.*

a) On the one hand, because of the lower level of automation and rationalization in the public sector services, these services are not matching the increase in their demand as a result of the new dynamism of downtown areas. As we will discuss below, the situation is being made worse by the simultaneous fiscal retrenchment that accompanies, in most cities, the current economic restructuring. Thus, a booming corporate service economy is revitalizing the CBDs, but declining, low-productive public sector services could handle such a revival or create very serious functional difficulties.

b) On the other hand, the labor force in the service economy is characterized by polarization between a white male dominated sector of professionals and a large pool of low-paid labor, overwhelmingly female and minority. As Stanback and Noyelle write: "The developments alumbrated above suggest that our society may be moving toward an unstable dual economy, in the sense that the transformation of employment systems is pushing toward an increasing separation between two socio-economic strata with increasingly restricted bridges between them: a stratum of managers, professionals, technicians, teachers, and other highly skilled employees living in a relatively well protected and well paying economic world, and a large structure of assemblyworkers, clericals, and service workers, who find it increasingly difficult to make ends meet and to deal with the stress associated with unrewarding and somewhat insecure jobs."[111] As far as the expansion of services is being fueled by the new technologies, there will be a growing polarization of the urban labor market, particularly in the central cities of large metropolitan areas. And this regardless of the impact of high technology on the service jobs themselves, a different question that we will examine in detail in the following section. Thus, the current trend shows a growing corporate service sector, located in high-level metropolitan CBDs in full development, yet daily populated by a growing number of low-paid female, and minority service workers, and coming under the pressure of functional and social demands that cannot be met by a public service sector in deep crisis.

The economic and urban evolution of New York City since 1977 exemplifies these trends. Two recent studies by John Mollenkopf,[112] and by Saskia Sassen-Koob;[113] converge toward the same conclusion: there is a process of simultaneous growth and decline, related to the rapid expansion of services, particularly producer services, and to the closing or downgrading of manufacturing activities, as clearly shown by Tables 17, 18, and 19. After its notorious 1975 fiscal crisis, New York City engaged in a major process of restructuring that led to a concentration of resources and public incentives onto the leading sector of corporate services.[114] As a consequence, there was also a *building boom for office space in Manhattan's CBD.* John Mollenkopf, in another study[115] has calculated that employment in the construction industry, that had *declined* by 39% between 1969 and 1977, experienced the highest percentage of growth (along with business service) in 1977-82: it grew by 31.3%! Available evidence cited in these studies confirms that the expansion of services in New York resulted in a much more polarized social structure, both in terms of jobs and income. Besides, the occupational structure characteristic of large corporations in the service sector, Saskia Sassen-Koob cites an additional reason for such a process of social polarization: the simultaneous development of

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111 *Stanback and Noyelle, op. cit., 1982, p. 141.*

112 *John H. Mollenkopf, The Post-Industrial Transformation of the Political Order in New York City.* Paper delivered at the Social Science Research Council's Conference on New York City, New York, May 4-5, 1984.

113 Saskia Sassen-Koob, *Growth and Informalization: The Case of New York City.* Paper delivered at the Seminar on the Urban Informal Economy in Core and Periphery. The Johns Hopkins University, Baltimore, June 8-10, 1984.

114 See: Charles Brecher and Raymond D. Horton (eds.) *Setting Municipal Priorities, 1983.* New York: New York University Press, 1982.

115 Lee John Mellenkopf, "Economic Development," in Brecher and Horton, op. cit., 1982.

TABLE 16

Shares of Employment* and GNP by Sector, Selected Years, 1948 to 1976

	1948	1961	1976
Employment			
Agriculture	10.8	6.9	4.2
Industry+	43.2	38.6	35.1
Services	46.0	54.5	60.7
GNP (current dollar)			
Agriculture	9.8	4.2	3.1
Industry+	46.8	45.0	41.2
Services	43.9	50.8	55.7
GNP (1972 dollar)			
Agriculture	5.8	4.3	2.9
Industry+	43.0	40.7	40.7
Services	51.3	55.0	56.3

Source: Victor R. Fuchs, *The Service Industries and U.S. Economic Growth Since World War II*, NBER Working Paper, No. 211 (Stanford, Calif.: National Bureau of Economic Research, Inc., 1977), p. 46.

*Full-time equivalent persons engaged.

+Industry includes mining, construction, manufacturing, transportation, communications, and public utilities.

TABLE 17

Non-agricultural Employment in New York City
Annual Averages, 1950-1980
(in thousands)

Industry	1950	Column Percent	1970	1977	1980	1983	Column Percent
TOTAL	3,469	100.0	33,745	3,175	3,302	3,334	1,000
Construction	123	3.5	110	66	77	87	2.6
Manufacturing	1,040	30.0	766	540	496	432	12.9
Non-durable	810	23.3	589	424	390	345	10.3
Apparel	341	9.8	204	154	140	120	3.6
Prntng & Pub	119	3.4	121	90	94	93	2.8
Durable	230	6.6	178	116	105	87	2.6
Transportation	232	6.7	202	157	150	132	3.9
Communications	66	1.9	95	76	82	82	2.5
Utilities	34	1.0	26	26	25	25	0.7
Wholesale trade	322	9.3	302	248	245	239	7.1
Retail trade	433	12.5	434	373	368	369	11.0
Finance, Ins., RE	336	9.7	460	414	448	492	14.7
Services	507	14.6	785	773	895	967	28.9
Government	374	10.8	563	501	517	518	15.5

Source: New York State Department of Labor. 1950 T.C.U and wholesale and retail employment figures estimated.

TABLE 18

Employment Trends for Rising Sectors in New York City, 1969, 1977, 1983 (in thousands)

Sector	1969	1977	1983	77-83 Rate	Percent of gross gain
TOTAL	3,798	3,188	3,344	4.9%	48.6%
Goods production and distribution	1,541	1,123	958	-14.7%	n.a.
Financial Services	466	414	494	19.3%	22.2%
banking	97	118	171		
securities	99	70	116		
Corporate services	147	186	233	25.3%	13.0%
legal services	28	39	55		
mgt consulting & PR	35	22	28		
accounting	23	21	30		
eng & architecture	21	16	20		
Communications and media	249	212	239	12.7%	7.5%
communications	86	76	82		
advertising	39	32	40		
publishing	70	52	57		
Entertainment, culture, and tourism	185	162	182	12.3%	5.5%
restaurants, bars	123	106	114		
hotels	34	24	29		
legitimate theater	10	14	18		
museums	4*	5	6		
Education and research	158	206	210	3.8%	2.2
elmntry & secndry	151	142	140		
colleges	-	44	46		
Health and social svcs	198	240	304	26.7%	17.7%
hospitals	104	119	126		
other health svcs	47	66	85		
social services	47*	55	93		
Government (non-ed)	398	377	382	1.3%	1.4%
local	254	242	255		
state	38	51	52		
federal	106	84	75		

Source: New York State Department of Labor; 1983 figures are 3rd Quarter.

* estimate

TABLE 19

Employment in New York City, 1969, 1977 and 1983
(in thousands)

Sector	1969	1977	1982	Percentage Change 1969-77	Percentage Change 1977-82
ALL SECTORS--TOTAL	3,798	3,188	3,350	-16.2%	55.1%
Declining Sectors	1,541	1.123	996	-27.1	-11.3
Durable Manufacturing	192	116	94	-39.6	-19.0
Apparel	224	154	129	-31.2	-16.2
Other Nondurables (except printing and publishing)	285	180	141	-36.8	-21.7
Transportation (except transportation services)	188	132	113	-29.8	-14.4
Utilities	26	26	25	0.0	-3.8
Wholesale	309	248	246	-19.7	-0.8
Retail (except eating and drinking places)	317	267	248	-15.8	-7.1
Growing Sectors	1,907	1,861	2,113	-2.4	13.5
Construction	105	64	84	-39.0	31.3
Finance, Insurance and Real Estate	466	414	487	-11.2	17.6
Communications and Media[a]	249	212	238	-14.9	12.3
Business Services[b]	147	172	226	17.0	31.3
Entertainment, Culture, Tourism[c]	185	162	179	-12.4	10.5
Human Capital[d]	158	206	227	N.C.	11.2
Social Services[e]	597	617	670	N.C.	8.6
Residual	350	204	241	N.C.	N.C.

Source: New York State Department of Labor, ES 202, flInsured Employment File.

NOTES:
a. SICs 271-273, 47, 48, 731, 733, 735, 781, 782.
b. SICs 736, 737, 7392, 7393, 81, 891, 893, 5081.
c. SICs 58, 70, 7832, 792, remainder 79, 84.
d. SICs 821, 822, 7391 and 892, 823-824 and 829, local and state educational remployment.
e. SICs 80, 83, local, state, and federal noneducational employment.

N.C. means Not Comparable due to shifts in Standard Industrial Classifications (SIC) and coverage of nonprofit employment.

entertainment and personal consumption services, attracted by a larger market of high income professionals. As she writes, "high income gentrification is labor-intensive, in contrast to the typical middle class suburb that represents a capital intensive process . . . In sum, the existence of major growth sectors, notably the producer services, generates low-wage jobs directly through the structure of the work process, and indirectly through the structure of the high-income lifestyles of those therein employed, and the consumption needs of the low-wage work force."[116] In another essay, Sassen-Koob extends her analysis to Los Angeles, where a similar pattern of polarized growth related to the simultaneous rise of advanced corporate services, labor-intensive personal services, and downgraded manufacturing is taking place. Economic and social polarization *within the central city* of the largest metropolitan areas, and within the metropolitan areas themselves, is increasing dramatically as the service economy takes a new qualitative leap forward, under the combined impact of economic restructuring and technological change. New York is the showcase of the process we are are analyzing: a booming CBD, a growing gentrified Manhattan, and yet the persistence of run down, devastated areas, are the spatial signs of a new process of growth that deepens its contradictions, while showing an extraordinary vitality as the economic and informational capital of the world.

Nevertheless, the objection can be raised that this particular pattern of urban development is related to the expansion of the service economy, and has only a remote connection with high technology. In fact, we have no real argument with such a statement. But our general perspective is precisely that we cannot isolate high technology from the overall process of economic and organizational change of which it is an indispensable part. In other words, without the current technological change, large corporations could not be flourishing, nor could the services they require be performed. What characterizes an advanced economy is that the core of its activity is *information-processing*, that is the object of the major technological innovations under way. Thus, the new dynamism of central cities of the high-ranking metropolitan areas is basically the result of the rise of advanced services, with their specific pattern of polarized growth. But the type of services that are expanding, and their organizational logic, are the function *both* of the current capitalist interests *and* of the new technological environment in which they operate. High technology is a *process*, rather than a *product*. And as such, it is inextricably linked to the expression of the advanced service economy and to the new urban process that they jointly determine.

4.3 High Technology, Uneven Development and the Reshaping of the Spatial Economy.

Uneven development is a fundamental mechanism of the capitalist mode of production.[117] It refers to the differential rate of investment (and therefore of allocation of resources) between economic sectors and spatial areas, according to their changing potential of profitability. It follows a differential rate of growth that, by the different level of wealth it generates in various places and activities, tends to have cumulative effects: areas that first rose to economic prominence have a clear advantage over the laggard ones, as far, *and only as far*, there is no major altering of the historical pattern of economic growth. When such an alteration occurs, we then assist to a fundamental transformation of the spatial economy, a process that some authors have named *urban and regional restructuring*.[118]

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[116] Saskia Sassen-Koob, "The New Labor Demand in Global Cities," in Michael P. Smith (editor) *Cities in Transformation* Beverly Hills: Sage Publications, 1983. pp. 139-172.

[117] See: Samir Amin, *Le Development Inegal*, Paris: Editions de Minuit, 1974; and Michel Aglietta *A Theory of Capitalist Regulation: the U.S. Experience*, London: New Left Books, 1979.

[118] Ann Markusen, *Profit Cycles, Oligopoly, and Regional Development*, Cambridge, M.I.T. Press, 1984; Edward Soja, Rebecca Morales, and Goetz Wolff, "Urban Restructuring: An Analysis of Social and Spatial Change in Los Angeles" in *Economic Geography*, Vol. 59, No. 2, April 1983, pp. 195-230.

The entire world is currently undergoing such a process, and it is our hypothesis that this spatial transformation is the result of a fundamental economic transformation of which the rise of high technology is a major element. In this sense, the impact of high-tech on the secular trend of uneven development gives new meaning to such a trend and results in a historically distinct spatial dynamics. The spatial effects of this new form of uneven development are being felt, at least at three different levels: between countries and areas of the world; between regions of each country; and within the large metropolitan areas. We will analyze the first process in the next section when we will examine the new international division of labor, as part of the overall economic restructuring. We turn here to assess the connection between high technology and uneven development in the processes of inter-regional and inter-metropolitan differentiation in the United States.

In recent years, the debate in the field of regional development has been dominated by the "Sunbelt-Snowbelt" problematic.[119] Starting with David Perry and Alfred Watkin's seminal volume, *The Rise of Sunbelt Cities* [120] and on the basis of research presented by Sternlieb and co-authors[121] or Weinstein and Firestine,[122] the stage was set for a reassessment of the spatial structure of the American economic and demographic trends, and indeed of its political system.[123] Charts 5 and 6, compiled by Weinstein and Firestine, andTable 20(compiled by Bluestone and Harrison on the basis of David Birche's data provide a rough illustration of the phenomenon. Since then, the trend has continued and is expected to do so in the near future, as Table 21 shows. Investment, jobs, people, and income, are leaving in growing numbers the traditional Northeastern and North Central centers of U.S. capitalism, to start a new process of growth in the, at first sight, more promising lands of the Southwest, the West, and, to some extent, (particularly in Florida) in the South. To be sure, it is misleading to speak in such broad geographic terms. Yet, a simple look at Table 20 will remind us that, in terns of the overall net employment change between 1969 and 1976, the overwhelming majority of southern and western states did look better than the U.S. average while the majority of Northern states performed below the average.

But while the phenomenon is clear and widely recognized, its causes and consequences are not. The standard interpretation generally presented by both neo-liberal economists and leftist critics finds the source for the movement to the sunbelt in the tendency for capital to search for lower wages, non-unionized labor, and less taxes and government control. Indeed, these are important factors in the process of relocation of activities. But it is by no means clear that they are the overarching consideration for companies to move from their present locations. In fact, Watkins and Perry compared the South's performance between 1940-1960 for low-wage and high-wage manufacturing sectors. They found that while both sectors expanded in the South, growth was particularly rapid in *high-wage* industries, multiplying by two the national average of growth in these sectors.[124] Of course, one can say that high-wage industries in the Southwest will still pay lower wages than in the Northeast, but it is crucial to observe that Sunbelt's

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119 Larry Sawers and William K. Tabb (eds.) *Sunbelt/Snowbelt. Urban Development and Regional Restructuring*, New York: Oxford University Press, 1984.

120 David C> Perry and Alfred J. Watkins (eds.), *The Rise of Sunbelt Cities*, Beverly Hills: Sage, 1977.

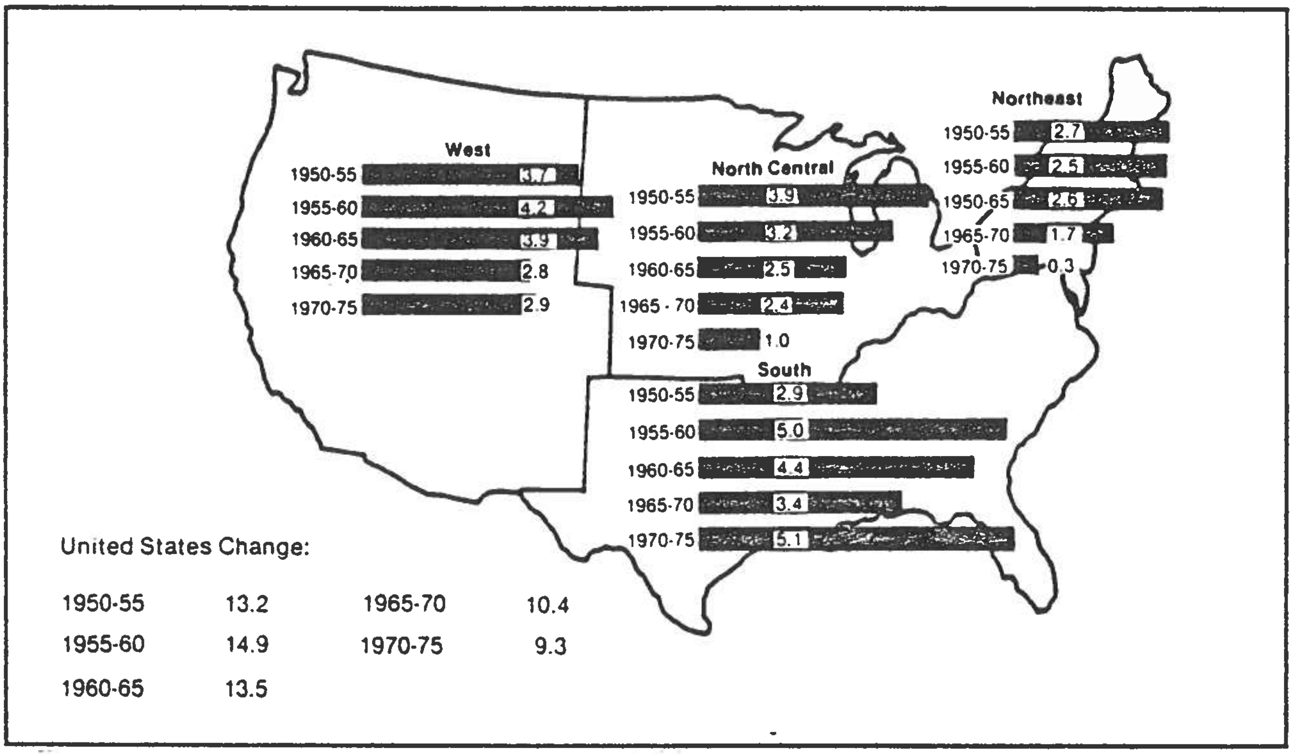
121 George Sternlieb and James W. Hughes (eds.), *Post-industrial America: Metropolitan Decline and Inter-Regional Job Shifts*, New Brunswick, New Jersey: The Center for Urban Policy Research, 1975.

122 Bernard L. Weinstein and Robert E. Firestine, *Regional Growth and Decline in the U.S.: The Rise of the Sunbelt and the Decline of the Northeast*, New York: Praeger, 1978.

123 Kirpatrick Sale, *Power Shift*, New York: Random House, 1975.

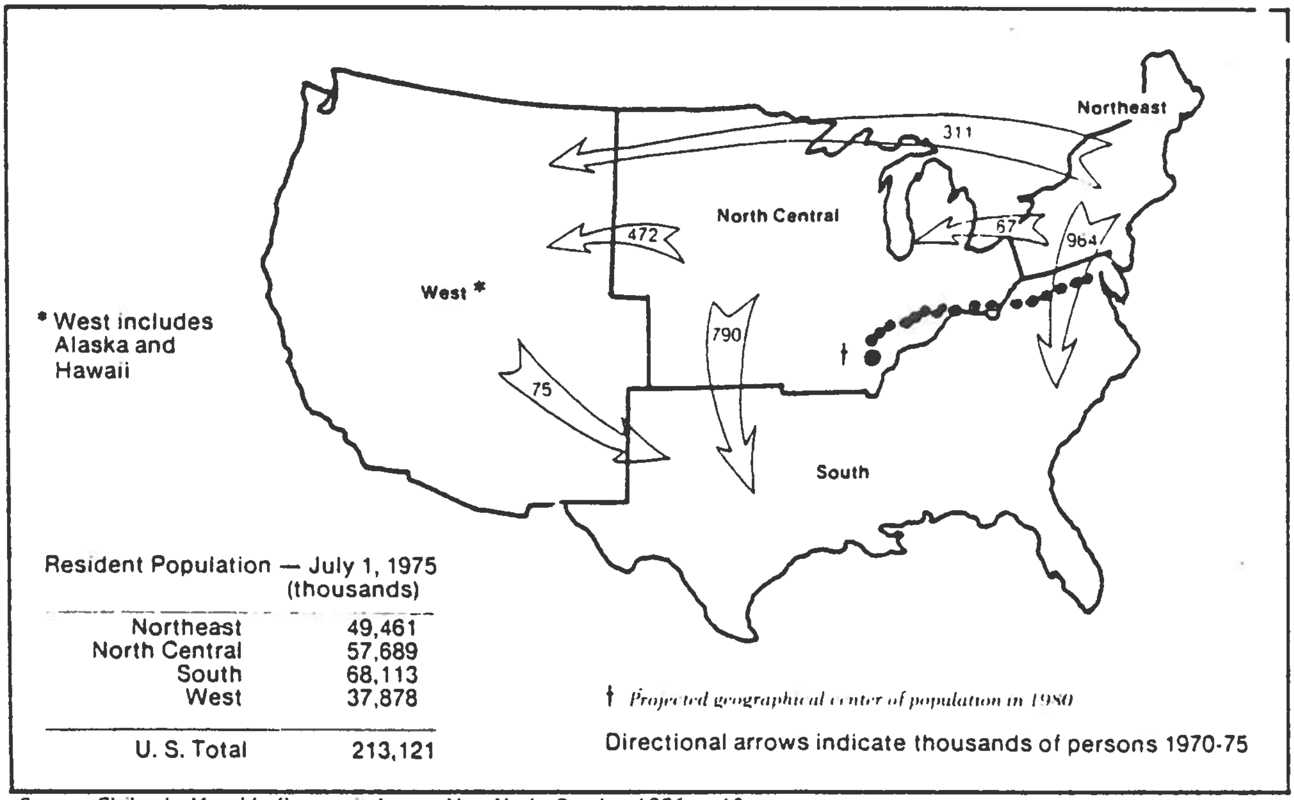
124 Alfred J. Watkins and David C. Perry, "Regional Change and the Impact of Uneven Development" in Perry and Watkins, op. cit., 1977, page 43.

CHART 5 Population Change for Five-Year Periods by Region, 1950-75 (periods beginning July 1; change expressed in millions)



Source: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, ser. P-25, no. 640, November 1976.

CHART 6 Migration Patterns: Where Americans Are Going



Source: Citibank, *Monthly Economic Letter*, New York, October 1976, p. 13.

TABLE 20

Jobs Created and Destroyed by Openings, Closings, Relocations, Expansions, and Contractions of Private Business Establishments in the United States, by State and Region: 1969-76

State/Region	Number of Jobs in 1969 (1)	Jobs Created by Opendings and Immigrations (2)	Jobs Destroyed by Closings and Outmigrations (3)	Jobs Destroyed Created Minus Jobs Destroyed (4)=(2)-(3)	Change (Jobs Jobs Destroyed to Jobs Created (5)=(3)--(2)
Frostbelt	32701200	11321513	11351748	-30235	1.00
Sunbelt	25234900	135959822	10950541	3009281	0.78
U.S. as a Whole	57936100	25281335	22302289	2979046	0.88

Source: Birch, op. cit., as reported by Bluestone and Harrison, op. cit., 1982.

TABLE 21

Growth in the South and West Will Continue to Outpace Other Regions

	Manufacturing Employment		Real Personal Income	
	1971-80	1981-90	1971-80	81-90
	-- Average Annual Percent Increase --			
Northeast & Midwest	*-0.1%*	*0.6%*	*2.1%*	*2.4%*
New England	1.3	0.7	2.4	2.5
Mid-Atlantic	-0.9	0.0	1.3	2.2
East North Central	-0.3	0.7	2.4	2.4
West North Central	1.7	2.1	3.3	2.8
South & West	*2.4%*	*2.6%*	*4.5%*	*3.2%*
South Atlantic	1.4	2.2	3.9	3.2
East South Central	1.3	2.8	3.9	3.8
West South Central	3.7	2.9	5.8	3.1
Mountain	4.8	3.4	5.7	3.8
Pacific	3.3	2.6	4.3	3.0
Total U.S.	*1.0%*	*1.6%*	*3.3%*	*2.8%*

Source: Case Econometrics, *Business Week*, June 1, 1981.

growth is not concentrated in low-wage sectors but, if anything, in "underpaid" high-wage, high growth sectors, which is different, and very important to draw conclusions for the overall dynamics of the economy. Along the same line of reasoning, John Mollenkopf has contributed the most systematic critique of the Sternlieb-Hughes interpretation of the movement[125] by comparing 10 Northern to 11 Southwestern cities on the basis of a series of indicators of the factors supposed to account for the move. He writes: "It is fallacious to conclude that the manufacturing jobs which have been disappearing from the Northeast are reappearing in southwestern cities. Manufacturing actually accounts for *less* growth in southwestern urban employment than services, and these manufacturing jobs differ qualitatively from those the Northeast has lost. Finally, those new manufacturing establishments which have located in the Southwest in preference to the Northeast have not necessarily done so to find low-wage workers, cheaper land or closer proximity to their markets. Indeed, many firms have had to import trained labor for plants being established in the Southwest."[126] When controlled by occupational categories, wages in the Southwest are rapidly closing the gap with the North, and some infrastructural advantages (communications) seem to be offset by others (serious water shortage problems in many cities, for instance) Mollenkopf finds that a pro-business political environment, including less power of labor unions, community groups, and elected officials, is the most important element characteristic of the Southwest. But he introduces a novel hypothesis that relates the development of the Sunbelt to the structural transformation of the economy. Given the growth of services and the emergence of high technology industries as the new source of economic dynamism, those areas that will grow with the new sectors will be the fastest growing ones, simply because they are new and therefore their economic growth is met simultaneously with the decline of preexisting activities. Accordingly, he proposes a typology of cities in three different situations.

a) Cities based on old-manufacturing activities, such as Cleveland, Detroit, or Buffalo. Because of the decline in these activities, that goes uncompensated by the growth of new sectors, the entire urban economy declines.

b) Cities that represent a mixture of old manufacturing and new activities, either in services or high tech, such as New York or Boston. In these metropolitan areas, we observe a process of *simultaneous growth and decline*.

c) Finally, newer cities whose growth is associated with the rise of the new economy, particularly in high tech and corporate services. This is what characterizes much of the Sunbelt.

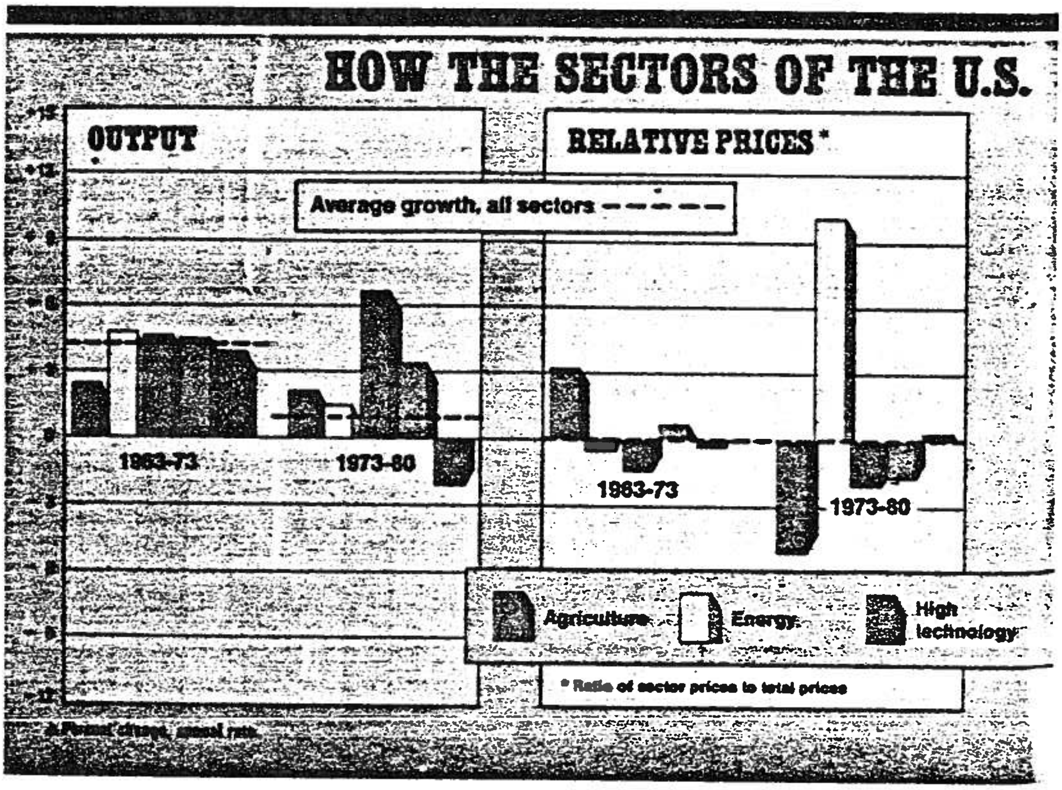
In other words, the general trend is less one of inter-regional shift of activities (in fact runaway shops are more likely to go abroad) that one of increasing sectoral differentiation of the economy, with a specific spatial expression for the location of new activities. And while advanced business services have a tendency to remain in the oldest metropolitan areas, restructuring internally their social and spatial fabric, high tech manufacturing has shown a clear tendency for the newest areas in the South, and, particularly, in the West. In this sense, high technology industry seems to be, *along with energy resources*, and *some* advanced services, the real engine for the rise of sunbelt cities.

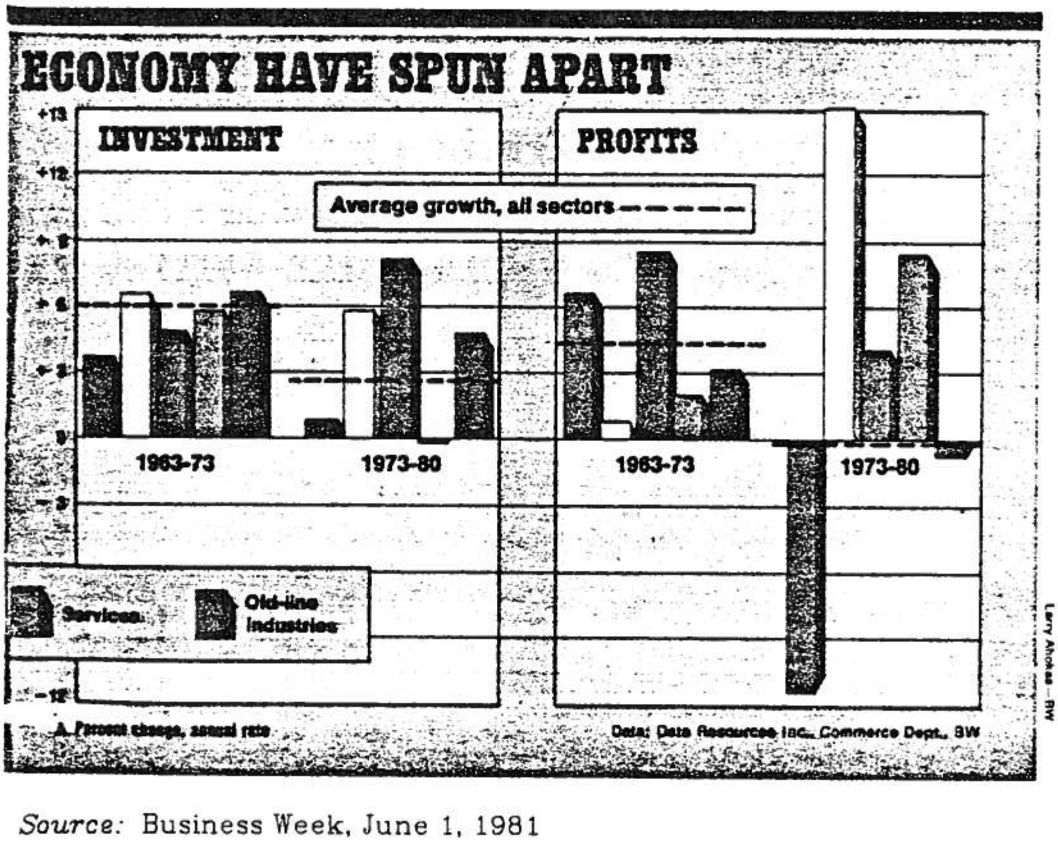
In fact, the U.S. economy (as well as the capitalist economy in general) is undergoing a dramatic process of inter-sectoral differentiation. Some industries literally die while others explode. In this sense it is uneven development at its peak. *Business Week* called it sometime ago, "One country, five separate economies," as it is shown by Charts 7 and 8, elaborated by Data Resources Inc. for *Business Week*.[127] In spite of the obvious diversity

125 John Mollenkopf, *The Contested City*, Princeton: Princeton University Press, 1983, pages 213-253.

126 John Mollenkopf, op. cit., 1983, page 220.

CHART 7





Source: Business Week, June 1, 1981

CHART 8

WHO'S WHO IN THE FIVE SECTORS

For this special issue, BUSINESSWEEK worked with Data Resources Inc. to classify all production in the private economy (excluding wholesale and retail trade) into five key sectors and to measure their output, employment, and prices. These data were supplemented by data on profits and investment from the Commerce Dept. More than 400 industrial classifications were identified. Here are the component industries of each sector:

ENERGY

Coal mining	Gas utilities	Electric utilities
Petroleum refining and related products	Crude petroleum and natural gas	

AGRICULTURE

Dairy products	Tobacco	Misc. crops	Feed grains and grass seed
Livestock	Vegetables	Poultry and eggs	Fruits and nuts
Food grains	Oil-bearing crops	Cotton	Forestry and fishery products

HIGH TECHNOLOGY

Complete guided missiles	Aircraft parts and equipment	*Office machines
Calculating and accounting machinery	Aircraft engines and engine parts	Radio and TV receiving sets
Scales and balances	Engineering and scientific instruments	Radio and TV communication equipment
Industrial controls	Dental equipment and supplies	Semiconductors
Telephone and telegraph equipment	Optical instruments and lenses	Measuring and control instruments
Electron tubes	Photographic equipment and supplies	Surgical appliances and supplies
*Electronic components	Electronic computing equipment	Watches and clocks
*Aircraft	Typewriters	Ophthalmic goods

SERVICES

Hotels and lodging places	Air carriers and related services	Hospitals
Beauty and barber shops	*Transportation services	Educational services
Advertising	Radio and TV broadcasting	*Social services
Eating and drinking places	Communications other than radio and TV	*Passenger transportation
Motion pictures	Banking	Water transportation and related services
Doctors and dentists	Insurance carriers and agents	Pipelines, except natural gas
Other medical and health services	Real estate	Water and sewer services
Nonprofit organizations and misc. professional services	*Misc. personal services	Credit agencies and securities brokers
Railroads and rail-related services	Misc. business services	Owner-occupied dwellings
Motor freight	Automobile repair and services	
	Amusement and recreation services	

OLD-LINE INDUSTRY

The 19 basic industry groups include:	Paper and paper products	Metal mining
Food and tobacco manufacturers	Chemicals and allied products	Metals and metal products
Textiles and textile products	Stone, clay, and glass products	Electrical and nonelectrical machinery and equipment
Lumber and wood products	Construction	

[illegible]

Source: Business Week, June 1, 1981

of criteria each sector (particularly in services) these data usefully reflect the growing divergence of dynamics between different economic sectors, and how much the lines of regions, cities and countries, depend upon their capacity to control the forces so unleashed.

It is within this perspective that the "deindustrialization of America" thesis forcefully argued by Bluestone and Harrison takes its full meaning. "By *deindustrialization* is meant a widespread, systematic disinvestment in the nation's productive capacity. Controversial as it may be, the essential problem with the U.S. economy can be traced to the way capitalism terms of financial resources and of real plant and equipment--has been diverted from productive investment in our basic natural industries into unproductiye speculation, mergers and acquisitions,and foreign investment. Left behind are shuttered factories, displaced workers, and a newly emerging group of ghost towns."[128] It results a pattern of increasing disparity between those sectors (and others) where disinvestment occurs and those (speculative or otherwise) where investment goes. Again, this is the updated version of the process of uneven development, but we should not consider it as being something something "natural." Quite the contrary, these are *decisions* taken by corporations and by governments. But decisions that follow the social logic of a capitalist economy: investment for the sake of profit. In this sense, this is a secular trend within capitalism.

It has been argued recently that the "de-industrialization thesis" lacks of empirical basis. A study by Robert Lawrence, of the Brookings Institute[129] states that between 1973 and 1980 U.S. *manufacturing* output increased in real terms by 12.3%, above the OECD's average of 11.8%. The same trend is even striking in employment: the U.S. increased its employment in manufacturing more rapidly than any other major industrial country, including Japan, and, in fact, the U.S. was the *only* OECD country to have a positive growth rate in aggregate manufacturing work hours between 1973 and 1980.

Bluestone and Harrison have thoroughly responded to Lawrence's (on others') critique in one of the best summary analysis on recent economic trends in the U.S.[130] What the new data show is a pattern of *increasing economic differentiation among occupations, among sectors, and among regions*. In fact, *production* workers in manufacturing did *decline* by nearly 5% between 1973 and 1980, though this decline was compensated by an increase in supervisional, technical and managerial positions. So, the new economy increases overhead labor and decreases direct-production labor (if this is productive or unproductive would require a broader discussion). Secondly, Bluestone and Harrison calculated the employment performance of 15 major industries in 1975-80 and compared it to their performance in 1960-72. Four of the industries (associated with computers, aircraft, and electronics) did *better* than expected on the basis of the extrapolation of previous trends, while 9 industries (including motor vehicles, household appliances, apparel, footwear, electrical distribution equipment, clericals, radio and TV, textiles, and tires) fell below their expected performance by a margin of 361,000 jobs. Thirdly, they point at the spatially distinct patterns of losses and gains in manufacturing employment. The trends vary tremendously across the country, with the Snowbelt/Sunbelt cleavage being obvious, particularly if we definitely agree with the incorporation of much of New England into the rising sun of economic growth. Table 22, compiled by Bluestone and

127 "America's Restructured Economy," *Business Week*, Special Issue. June 1, 1981.

128 Barry Bluestone and Bennett Harrison, *The Deindustrialization of America*, New York, Basic Books, 1982, p. 6.

129 Robert Z. Lawrence,"The Myth of Deindustrialization," *Challenge*, Nov. - Dec. 1983; and Robert Z. Lawrence, "Is Trade Deindustrializing America? A Medium-Term Perspective," *Brooking Papers on Economic Activity*, No. 1, 1983.

130 Barry Bluestone and Bennett Harrison, with the collaboration of Lucy Gorham. *The Economic State of the Union in 1984. Uneven Recovery, Uncertain Future*, January, 1984, Unpublished Working Paper.

Table 22

Percent Change in Total Manufacturing Employment In Selected Industries in Selected States: 1973 - 1980

Industry	U.S.	MA	MY	MI	OH	GA	NC	TX	CA
Total Manufacturing	0.13%	6.4%	-10.3%	-17.3%	-11.0%	3.3%	2.7%	31.5%	20.6%
Durable Goods	2.0	20.0	-4.8	-19.0	-13.1	7.8	17.2	43.0	23.3
Nondurable Goods	-2.4	-9.6	-15.4	-10.0	-5.9	0.9	-4.1	17.8	15.1
Selected Industries:									
Primary metals	-9.7	-	-24.4	-27.7	-20.0	-	-	27.4	-2.2
Fabricated metals	-1.1	-	-10.0	-22.9	10.4	4.6	26.3	29.1	16.4
Non-electr. machines	19.9	42.8	6.3	-7.38	-2.0	36.6	36.8	77.2	43.9
Electrical equipment	13.6	22.6	-1.1	-14.9	-19.2	30.9	17.1	88.2	45.0
Transport. equipment	11.0	7.8	-12.7	-22.84	-18.6	3.8	101.2	23.4	5.8
Instruments	27.6	24.0	4.4	46.1	-3.7	-	-	43.8	60.3
Textiles	-15.4	-16.7	-34.1		-	-8.0	-15.0	-26.6	-
Apparel	-12.8	-10.0	-22.3	-	-22.3	-3.7	1.8	8.2	17.5
Chemicals	6.3	-10.8	-6.5	5.5	9.8	13.4	8.5	25.6	16.5

Source: U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings for States and Areas*, 1939-1978, Bulletin 1370-13, 1979; and *Supplement, 1977-81*, Bulletin 1370-16, 1982.

Harrison, provides a new illustration of the growing regional differentiation.

Thus, as they conclude: "It is important to recognize how the gains from new manufacturing growth and the losses from industrial decline are being shared across the states and regions of the country. In contrast to others (e.g. Schultze and Lawrence), who choose to characterize it as manly an aggregate phenomenon, the deindustrialization of America refers to a process of unequal and uneven development, according to which particular sectors, regions, and groups of citizens pay a disproportionate price for the new competitive strategies being pursued by American business. We have seen this to clearly the case for different industries, races, genders, [and regions]."[131]

So, it is the new wave of uneven development, with its spearheads manly in advanced services and in high technology manufacturing that represents the driving force behind the current process of urban and regional restructuring. But why so? Why high technology activities choose new locations, developing new regions, instead of renewing the traditional manufacturing centers? In other words, why the Sunbelt? A number of reasons have been cited in our discussion. But there are specific arguments relating the characteristics of the new high tech industries to the expansion of the southwestern and western regions of the U.S.

Steven J. Pinkerton, from the University of Southern California, has completed recently a straightforward statistical study on the basis of a series of step-wise repressions between the recent increase in high-tech jobs in 1975-81 in each state of the U.S., the states' total share of high-tech jobs in 1981, and a number of variables calculated for each state.[132]

The results, even if they are too general to be definitive, are very revealing of some basic trends. First of all, in terms of the absolute share of high tech jobs, the study shows that the old industrial states are still dominant given their sheer size, particularly if we include California in the group (as the statistical model constructed by Pinkerton did). As he writes: "The typical high-tech state is highly populated, highly taxed, has numerous defense-related industries and has had a stagnant population growth over the past ten years. In other words, the declining industrial sector of the U.S. still holds a significant share of total U.S. high tech jobs."[133] But, interestingly enough the results completely change when the dependent variable is the increase in high tech jobs in 1975-81, instead of their absolute share, thus, showing the new spatial trends. This variable is negatively correlated with the size of the state population, and positively correlated with the population increase 1970-1980; so there is evidence of a trend toward decentralization of new industries in new areas. There is also a high *negative* correlation with percent unionization that, as Pinkerton observes, could reflect only "the movement from the old industrial corridors but also the reduction in growth in California and Massachusetts."[134] And, as in the study by Glasmeier, Hall, and Markusen, there is a strong correlation between the increase in high tech jobs and government transfers received, and defense spending, underlining anew the government and military inducement of the new spatial structure of the United States. We will elaborate on some of the reasons for this "regional preference" of the federal government in our next section.

Thus, the rise of the Sunbelt is the result of an increasing sectoral differentiation of the economy, in which high tech manufacturing and energy production associate themselves with a new regional environment. Together with the continuing location of

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131 Ibidem, page 20.

132 Steven J. Pinkerton, ***High Technology Growth and Regional Structure***, Los Angeles: School of Urban and Regional Planning, University of Southern California, Seminar Paper for PLUS 508, May 1984.

133 Ibidem, page 9.

134 Ibidem, page 13.

advanced corporate services in the CBDs of the top metropolitan areas that leading trends characteristic of the new process of uneven development seem to be largely responsible for the new geography of America.

Nonetheless, the economic effect of high tech manufacturing activities is by no means homogeneous, and their rate of growth is extremely diversified among industries. Of the 100 high tech industries studied by Glasmeier and Markusen for the period 1972-77, 34 actually lost employment.[135] Yet, the group as a whole increased its employment by 8% nationally well above the 3% performance for overall manufacturing. But again, this growth was extremely differentiated among cities and regions. 86 of the 264 SMSAs analyzed by Glassmeier and Markusen lost high tech employment, including 28 southern metropolitan areas. Generally speaking, "losing metro areas consisted of older big-city SMSAs; winners, on the other hand, reflected newer, adjacent suburban metropolitan areas."[136] So, along with New York, Philadelphia, Cleveland, and other Northern cities, we also find among the list of top 10 losers Miami and Los Angeles. On the other hand, attracting high tech industries is not the sure way to stable economic development. High tech employment tends to be highly concentrated in one industry in many of the areas studied, particularly in the South and the Southwest. For instance, in Austin or in Tucson more than 50% of high tech employment is concentrated in *one* industry (sic 3662, Radio-TV Transmitting Signal Devices and Equipment, in Austin; sic 3761, Guided Missiles in Tucson).[137] This lends credit to the argument put forward by Stanback and Noyelle about the extreme vulnerability of current high tech areas based on rapid development of a limited number of industries without much connection to the regional economy.[138]

In sum, high tech growth accelerates the process of uneven development, both through the inter-sectorial differentiation of the economy, and through the profound restructuring of the spatial organization of production largely determined by the characteristics and functional requirement of the new industries.

4.4 Economic Restructuring, High Technology, and the New Urban Process.

4.4.1 Introduction

High technology refers to something else than to a new technique of production. It is a *new form of production* (based on information), and therefore, of social organization. But its development is taking place within the context of a fundamental restructuring of our economic system. It is irrelevant to ask who comes first. Both processes, the restructuring of capitalism and the informational mode of development, are historically linked. They go together, reinforcing each other. Thus, to understand the actual effects of high technology on the economy, and through it, as cities and regions, we have to define its functions within the process of economic restructuring. This process results from the policies (both public and private) that seek to overcome the obstacles to the accumulation process that caused the worldwide crisis of the last decade. Today, we are not in the crisis any more (though we might be soon in another recession). We are rather in the phase of implementation of economic policies aimed at reorganizing the very bases of the model of accumulation *within the realm of capitalism.*[139] Though "Reaganomics"

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135 Amy Glasmeier and Ann Markusen, *Can Everyone Have a Slice of the High-Tech Pie? Metropolitan High Technology Industry Growth in the Mid-70's: Some Winners and Losers.* Paper delivered at the American Collegiate Schools of Planning Conference, San Francisco: October 23, 1983.

136 Ibidem, p. 11

137 Ibidem, p. 11.

138 Stanback and Noyelle, op. cit., 1982.

139 See: Manuel Castells. *The Economic Crisis and American Society*, Princeton: Princeton University Press,

has generally been associated with the main premises of this new model, we would not like to reduce the debate at a simple critique of the policy of a given U.S. Administration. In fact, the Reagan Administration has considerably departed from some key postulates of Reaganomics, such as the reduction of the government deficit. To understand in-depth the process of change we are undergoing we have to look at the essential, lasting elements of the new economic model that is being put forward both in the U.S. and in Europe (regardless of the political tendency, since similar policies are implemented both by Thatcher *and by Mitterrand since 1983)*, and are also largely imposed on many Third World countries by the means of the requirements of the International Monetary Fund to refinance overdue debt payments. We cannot develop fully in the context of this paper the characteristics of the new model of capitalist accumulation, its historical roots, or the likelihood of its fulfillment, confronted as it is to very serious internal contradictions and external conflicts.[140] Yet, for the purpose of evaluating the role and impacts of high technology in the new economy, we must recall what are the main trends of the current restructuring, trends that in fact anticipate on what could be the new model of growth if it achieves full existence:

a) The first, and most fundamental attempt is to redefine the relationship between capital and labor in the production process, increasing productivity and dramatically reducing labor costs, breaking down, if necessary, the social contract reached between business and organized labor in almost all capitalist countries in the aftermath of the 1930's Great Depression and after widespread social mobilization by workers. So, when things come to worst, capitalism returns to its most straightforward logic to raise profits: to extract more value from labor by increasing both relative and absolute surplus value, that is trimming employment, containing wages and benefits, and increasing productivity through work speed-up, rationalization, and automation.

b) Secondly, the fight against inflation is led through budgetary restrictions that disregard the social contract also in the sphere of collective consumption, while at the same time the military budget is increased, both to provide markets for the industry and to ensure the new tools of world power. And again, this is true at the same time for the U.S. and for France. It represents what, following the hypothesis formulated years ago by Tim O'Connor, we call the transition from the Welfare State to the Warfare State.

c) The third major trend, and the most global one, is the growing internationalization of the capitalist economy with a total inter-dependency of the different national economies and now, international division of labor, with the emergence of competitive economies in the Asian Pacific rim. The interpenetration of the national economies happens at the level of capital, labor, markets, and of the production process, in an economic space of increasingly variable geometry. Corporations, governments, and individuals (through migrations) all have incorporated themselves into the new dynamics of the international economy. Countries and nations have ceased to be the economic units of our historical reality.

It is our hypothesis that high technology is playing a major role in these three processes of fundmental realignment. So, in the following pages we will briefly try to examine available evidence of the relationship between high technology, the labor process, the transformation of the public sector, and the internationalization of the economy. We will also focus, for each one of the three major processes under analysis, on the

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1980: Martin Carnoy, Derek Shearer, and Russell Rumberger, *A New Social Contract*, New York: Harper and Row, 1983; Samuel Bowles, David Gordon, Thomas Weisskopf, *Beyond the Wasteland*, New York: Doubleday, 1983.

140 See: Martin Carnoy and Manuel Castells, "After the Crisis?" in *World Policy Journal*, Spring 1984, pp. 495-515.

urban and regional consequences of the role played by high technology in the overall process.

4.4.2 High Technology, Labor, and Cities

The most important social issue raised by the development of high technology is its impact on the labor process and on the job market. At first sight, it is clear that the new wave of technological change is spurring tremendous growth in several new industries, as well as opening possibilities in other sector that no one could have anticipated 10 years ago. Besides well-known developments in electronics, biotechnology, aerospace, and communications, there is a tremendous upswing in areas such s plastics and specialty chemicals,[141] fiber optic glass,[142] transportation,[143] and even more in all kinds of new services necessary for the management, maintenance, and repair, of the new products and their application.[144] We are truly in the midst of the "new industrial miracle" forecasted by different experts in a special issue of *U.S. News and World Report* three years ago.[145] Consequently, as Charts 9 and 10 show, the rate of growth in employment by sectors and by type of occupation heavily favor high technology activities, along with advanced business services, that clearly are as much a part of the new dynamic section of the economy as high tech manufacturing. Thus, there is an undeniable positive effect of high tech and advanced services on the growth of some key sectors, and on corresponding growth of employment in those sectors. Nevertheless, the absolute number of jobs created by these sectors is still very small in relationship to the total labor market, particularly in manufacturing. In this sense, it is essential to distinguish *rates of growth* from *actual aggregate growth* in employment. Table 23 and Table 24 provide a recent BLS' estimate of absolute growth of employment by occupation and by sector during the 1980s.

It appears evident that while the rate of growth of secretarial jobs (28.3%) is well below the 92.3% in data processing mechanics, the important element (from the point of view of the labor market) is that there will be, in 1990, about 77,000 more data processing mechanics, but about 700,000 more secretaries. If one adds the differential in terms of the current weight of each occupation, the contrast is even more striking. Reasoning by sectors (on the basis of Table 24) one also can see that the 27% growth in computers and peripherals in the period 1982-1990 merely adds 200,000 jobs to an already limited basis of 400,000, while a 16% increase in "restaurants and other retailing" represents another three million jobs on top of the 17 million currently existing in the sector. Ann Markusen, on the basis of different research reports for the Commission on Industrial Innovation, State of California has estimated that in four leading high tech sectors (biotechnology, computer software, photovoltics, and robotics), with the highest rates of growth in the entire economy, "about 600,000 total jobs will be available in these sectors in 1990, a more than doubling of present jobs. If we generously estimate total related support jobs generated at four times this direct job creation, the total number of high tech jobs in these sectors would amount to about three million in 1990. While this is substantial, it pales in comparison with the estimated 25 million jobs needed to compensate for jobs expected to be displaced by high technology."[146]

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[141] William J. Broad, "Shades of 'The Graduate': It's Plastics Again," *The New York Times*, March 25, 1984.

[142] Paul Hemp, "Fiber Optic Glass, the Long Pull Ahead," *The New York Times*, March 25, 1984.

[143] "The New Transportation," *The New York Times*, March 25, 1984.

[144] Isadore Barmash, "High-tech Salesmen: a Different Breed," *The New York Times*, March 25, 1984.

[145] *U.S. News and World Report*, November 30, 1981.

[146] Ann R. Markusen, *High Tech Jobs, Markets and Economic Development Prospects*, Berkeley: IURD, Working

CHART 9

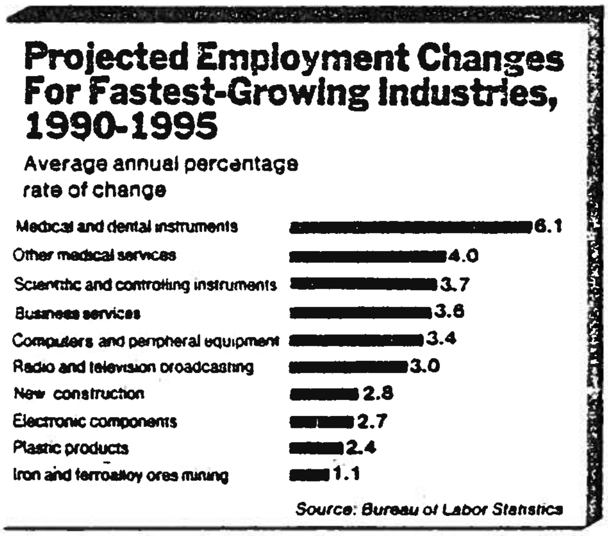

CHART 10

TABLE 23

Occupations
Producing the Most New Jobs

	1980 Employment	Projected Growth 1980-90	Percent Growth
Secretaries	2,469,000	700,000	28.3%
Nurses' aides, orderlies	1,175,000	508,000	43.2
Janitors, sextons	2,751,000	501,000	18.2
Sales clerks	2,880,000	479,000	16.7
Cashiers	1,597,000	452,000	28.4
Professional nurses	1,104,000	437,000	39.6
Truck drivers	1,696,000	415,000	24.5
Fast-food workers	806,000	400,000	49.6
General office clerks	2,395,000	377,000	15.8
Waiters, waitresses	1,711,000	360,000	21.1
Elementary teachers	1,286,000	351,000	19.5
Kitchen helpers	839,000	231,000	27.6
Accountants, auditors	833,000	221,000	26.5
Construction helpers	955,000	212,000	22.2
Automotive mechanics	846,000	206,000	24.4
Blue-collar supervisors	1,297,000	206,000	15.9
Typists	1,067,000	187,000	17.5
Licensed practical nurses	522,000	185,000	35.5
Carpenters	970,000	173,000	17.9
Bookkeepers	975,000	167,000	17.2

Five Fastest Growing High Technology Jobs

	1980 Employment	Projected Growth 1980-90	Percent Growth
Data processing mechanics	83,000	77,000	92.3%
Computer operators	185,000	133,000	71.6
Computer analysts	205,000	139,000	67.8
Office machine servicers	55,000	33,000	59.8
Computer programmers	228,000	112,000	48.9

Source: Bureau of Labor Statistics and *The New York Times*

TABLE 24

Level of Jobs (in millions) and
Rate of Growth for Selected U.S. Industries
(Actual 1982 levels and Projected 1990 Levels)

Industry	1982	1990	Projected Rate of Growth 1982-90
Total Jobs	102.3	118.3	13.6%
Business and professional services	5.9	7.9	32%
Restaurants and other retailing	17.0	20.0	16%
Computers and peripherals	.4	.6	27%
Banking	1.6	2.0	16%
Construction	5.5	7.0	22%
Plastic products	.5	.6	27%
Transportation equipment	1.6	1.8	13%
Steel	.6	.7	11%
Health Care	6.1	8.0	24%

Source: Bureau of Labor Statistics and *The New York Times*

Amy Glasmeier and Ann Markusen have also concluded in their study of high tech location, that the new industries tend to be concentrated in a few areas and that they have very little spin-off in terms of general economic activity induced by their presence.[147] In a related perspective a study by the office of Representative Lee Aspin, cited by *The New York Times*[148] calculated how many jobs could be created by investing $1 billion in different sectors: the figure was 48,000 jobs in Pentagon-related contracts; 10,000 for NASA activities; 50,000 in retail trade; 76,000 on sewer construction; an 100,000 in hiring teachers by investing in education. High tech industries tend to be less labor-intensive than other sectors, and increasingly less so.

In sum, scattered available evidence points toward the conclusion that while the introduction of high technology is a decisive impulse to economic growth, and generates a considerable number of jobs in the high tech industries, the share of these jobs is very small in relationship to the entire labor force. High-tech based development is *not* a job-creating process *in a direct way* (we will examine below its indirect effects).

Another major element to be included in our analysis is the *kind of jobs created by high tech industries*. Studies already cited by Saxenian, by Mutler, by Storper, by Walker and Storper, and by Glasmeier, Hall and Markusen, among others, all converge toward a similar conclusion: a strongly bifurcated occupational structure, with highly skilled, highly paid professionals and technicians at the top, a large mass of unskilled, poorly paid assembly-line workers, and increasingly fewer middle level technicians and skilled workers. An overwhelming majority of unskilled workers are women, and many of them minority, particularly in high-wage areas. The only sector that seems to be closer to the traditional occupational structure in manufacturing is robotics. But, in general, the highly polarized occupational structure is the rule, particularly in the large employment sectors of semi-conductors, specialty chemicals, and electronics equipment. The low level of skill required for most of manufacturing makes it easy for high tech to ship away these jobs (abroad or to isolated rural areas) or, increasingly, to automate them. This seems to be a growing trend. For instance, the new Apple factory in Fremont, CA, where the new "Macintosh" computer is produced, is fully automated: 90% of the assembly process is done by machines, so that only 90 workers per shift are able to produce 1 Macintosh every 27 seconds.

So, it could well be that the current bifurcated occupational structure of high tech industries would be only a transitional phase toward a highly professional labor force putting into motion an army of robots or of unskilled workers abroad. In this sense, high tech as a whole would ressemble increasingly to software of bio-technology industry, where a majority of professionals are backed up by clerical personnel, with a very small proportion of unskilled production workers. Yet, during the next decade there will still be a considerable number of unskilled jobs in high tech provided that labor continues to be cheap, non-unionized, and spatially segregated, either in well-defined suburbs or in isolated non-metropolitan areas. In this sense, the discussion about automation in high tech cannot be separated of the discussion about automation in the whole economy, itself largely determined by the restructuring of the relationship between capital and labor.

In fact, the most important issue is the impact of high technology on employment and the labor process in the overall economy, not just in high tech manufacturing. And on this matter there is very little evidence, particularly since most of the developments

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Paper No. 403, April 1983, page 5.

[147] Amy Glasmeier and Ann Markusen, "Can Everyone Have a Share of the High-tech Pie?" in *Berkeley Planning Journal*, Spring, 1984.

[148] Reported by *The New York Times*, March 25, 1984.

in office automation and robotics are very recent in terms of their implementation on a large scale, practically they have been initiated around the turn of the decade, though their pace is accelerating dramatically. Since the last available data of the U.S. Census of Manufacturing are from 1977 (!), and since statistics concerning office automation are scattered and not comparable, we are reduced, in this fundamental topic, to some "educated guesses," just waiting for the future fruits of the stream of new research currently under way.

Nevertheless, from all indications, *automation is occurring rapidly, both in factories and offices*. This is indeed a major element in the process of economic restructuring. The "solution" to labor costs and militancy is to reduce labor as much as possible, also putting pressure on the remaining employed labor that knows that it is expendable after a certain threshold in its cost. Besides, automation is also stimulated by the need to improve the *quality* of the product, in an increasingly competitive international environment. Nobel Laureate Wassily Leontieff, from New York University, declared a year ago: "The computer and the robot are already beginning to replace the simpler mental functions of blue and white collar workers. Man, as a factor of production, has only two aspects: physical and mental. Both are being replaced. The only solution is to stretch out vacations, shorter work hours and share available jobs. Human workers will go the way of the horse."[149] Along the same line of reasoning, we already mentioned Ann Markusen's estimate of about 25 million jobs being eliminated during the 1980's under the impact of automation. The study on robotics she cites[150] also projects the replacement of about 440,000 workers by robots by the end of the century. A U.S. Congress Committee's Report reportedly estimates that by the 1990's employment in old line industries, such as steel and autos will shrink away from its current share of 20% of the labor force to about 8%[151] In general, few observers doubt that the process of automation made possible by the technological revolution will eliminate hundreds of thousands of jobs in the factories and offices where automation is taking place, which amounts to the bulk of our current economic organization. The question is if these jobs will be replaced or not by other jobs generated by the new high tech activities. For reasons already exposed it is doubtful that high tech manufacturing will create large numbers of jobs within itself, particularly because of its own tendency to automate. But what about the rest of the economy? Could it be said that through increasing productivity and income generation in the existing sectors, new areas of growth will be spurred, particularly in producer services or in consumption, both individual and collective? For instance, in health care? Or in entertainment? This seems to be, *at the aggregate level*, the current tendency of the U.S. economy, that is, with Japan, one of the two economies where automation is taking place at a fast pace. During the 1970s, and in spite of two serious recessions, the U.S. economy generated about 20 million new jobs (and this is not counting jobs in the informal economy) while during the same period Western Europe lost two million jobs.[152] The reason for such a different evolution relies less on the diversity of industrial structure that in the *political capacity* of U.S. business to impose working conditions to the job seekers that, during the 1970's, have been opposed by labor, backed by strong socialist parties in Europe, with the significant exception of the Thatcher government in Britain.[153]

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149 Cited by *Time*, Special Issue: "The New Economy: Technology Has Set Off a Scramble for Jobs, Profits and Global Markets." May 30, 1983.

150 Richard C. Dorf, *Robotics and Computer-Aided Manufacturing/Design: Keys to Increasing Productivity*, Sacramento: State of California, Department of Business and Economic Development, 1982.

151 *Time*, May 30, 1983, page 52.

152 Leslie Wayne, "America's Astounding Job Machine," *The New York Times*, June 17, 1984.

If we add that the "baby boom" generation has already entered the labor market, and that during the 1980s the work force will increase at an average annual rate of about 1.5% well below the 2.7% rate of the 1970s, the prospects are less dark than those usually announced[154] in terms of the *quantity* of available jobs. To be sure, "full employment"is being drastically redefined, to consider a 7-8% rate of unemployment as politically acceptable, thus revising a major historical trend. But given the expansion of the informal economy,[155] the two wage earners households, the rotation of opportunities, and the apparent resignation to consider teenagers as excluded from the normal labor market, the current squeeze of labor is likely to be socially assimilated, again in terms of numbers of available jobs. Nonetheless, *the fundamental feature is the growing mismatching between the characteristics of jobs that disappear and those of the newly created jobs*. On the one hand, an upgrading of professional and technical jobs in advanced services and high technology manufacturing, requires a fundamental retraining of labor, that the educational system is hardly capable to assume, particularly in the secondary public school. On the other hand, the new unskilled jobs are to be found in low-paid service jobs and downgraded manufacturing, where cheap labor is cheaper than automation, where companies cannot afford capital investment, or where the nature of the activity makes it difficult to standardize or automate work. So, routine service jobs, new "sweatshop manufacturing," and non-union labor, are substituting for the traditional unionized auto worker, for the government employee (given the shrinkage in government employment), or even for the poorly-paid but well-covered clerk, now either re-skilled and promoted (the fewer), many of them *white educated* women) or de-skilled and put on temporary jobs (mainly common women, and most of the minorities).[156]

The trend toward the downgrading of the working conditions of the workers suffering from industrial displacement and then re-hired in new jobs has been recently documented by Bluestone and Harrison.[157] On the basis of data of the BLS, they report that, in 1982, when one compares weekly earnings of production workers in declining industries and in fastest-growing industries, the average wage is *reduced* from $310.00 (in the declining sector) to $210.00 (in the expanding seetor). According to their own study, they report that "it was necessary to create 163 electronic components jobs to compensate for the wage bill loss of 100 steelworkers. Similarly, it takes almost *two* department stores jobs or *three* restaurant jobs to make up for the earnings loss of just one average manufacturing position."[158] They also report the results of a study by Patrick Walker of the University of Massachusetts according to which, between 1950 and 1978, 103 of the 221 BLS industries analyzed, showed a significant polarization of skill, with Walker's bimodality index increasing by one third between 1960 and 1978.[159]

A similar picture is depicted by Michael Teitz in his study of the evolution and prospects of the California economy. He writes:

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153 Doreen Massey and Richard Meegan, *The Anatomy of Job Loss*, London: Methuen, 1982.

154 William Serrin, "High Tech is No Jobs Panacea, Experts Say," *The New York Times*, Sept. 18, 1983.

155 See Alejandro Portes, *The Urban Informal Economy*. The Johns Hopkins University: Department of Sociology, 1984.

156 See Barbara Baran and Suzanne Teegarden, op. cit., 1984, page 31.

157 See Bluestone and Harrison, op. cit., 1984, page 31.

158 Ibidem, page 25.

159 Patrick Walker, *The Distribution of Skill and the Division of Labor: 1950-1978*, Amherst: University of Massachusetts, Dept. of Economics, Ph.D Dissertation, May 1983.

> Electronics, especially production of semi-conductors and products derived from them, requires a labor force that differs markedly from that in traditional manufacturing. The proportion of skilled technical and professional workers tends to be much higher than the average in manufacturing, and they are paid correspondingly well. However, production work is highly routinized and selectively low-skilled. Its pay has been below average for manufacturing and it tends to draw on female and immigrant labor pools that are non-unionized. While this form of employment is undoubtedly critical for low-skilled workers, it is problematic for the long-term. It does not offer income opportunities comparable to those being lost in the older, declining industrial sectors, and therefore provides neither easy transition for displaced workers nor long-term prospects for higher income or career mobility. If anything, it has been argued that the high level of education and technical skill required by the technical/professional part of the labor force tends to decrease prospects that production workers could ever be anything more.[160]

This transformation of the occupational structure, under the combined effect of high technology and advanced services (that, by now, it should be clear they are part of the same process of structural transformation), has a decisive impact on social stratification, namely what it is becoming known as the "disappearance of the middle class." Lester Thurow has provided a straightforward description of the phenomenon, and he relates it partly to the emergence of high technology and the decline of old manufacturing. It is useful for the sake of clarity, to cite his own writing:

> A middle-class household is frequently defined as one with an income between 75% and 125% of the median household income. If so, then the middle class--which falls into an income range of $15,000 to $25,200 in 1982--has declined from 28.2% of the population in 1967 to 23.7% now. The American middle class is disappearing.

And he continues, trying to find an explanation for the phenomenon:

> Part of the change in income distribution is due to the characteristics of America's new growth industries. High-technology industries such as microelectronics tend to leave two levels of income distributions--high and low--as opposed to the smokestack industries, like machine tools, with their high-wage, skilled blue-collar workers. There is usually a large group of low-wage assemblers, but not many middle-income jobs. To some extent the reduced number of middle-income jobs is a product of technology and to some extent it is a product of nonunion environment. For what unions did in industries such as autos, steel or machine tools was to convert jobs that probably weren't middle-income jobs. Earnings were redistributed within the industry toward those with the last skills.

One could not express better the close connection between high technology and the restructuring of the relationship between capital and labor.[161]

Thus, in spite of the uncertainty of existing information, some trends seem to appear quite distinctively in terms of the impact of high technology on the labor process:

a) By spurring automation in factories and offices, high technology directly suppresses a substantial number of working time. The fact that this translates into the suppression of jobs is a matter of the social organization of our economy, not of the

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[160] Michael Teitz, "The California Economy, Changing Structure and Policy Responses" in John J. Kirlin and Donald R. Winkler (eds.), *California Policy Choices, 1984*, Los Angeles: School of Public Administration, University of Southern California, 1984, page 53.

[161] Lester C. Thurow, "The disappearance of the Middle Class," *The New York Times*, February 5, 1984.

technology.

b) By putting pressure on the existing jobs, technological change curbs labor and makes it less resilient to capital's strategies.

c) While high tech activities generate new economic growth, and thus jobs, the new jobs in high tech industries fall largely behind the number of jobs their impact eliminates.

d) The occupational structure of high tech industry is characterized by a bipolar distribution of skills, rank, and income. Such an occupational structure is amplified by the social characteristics of labor, with white male on the top, and women and minorities on the bottom.

e) By contributing to a more dynamic economy, high-tech does create jobs indirectly. But these jobs tend to be in a growing service sector (basically in business services, and in personal services, much less in public services) whose occupational structure tends to follow also the bimodal polarized pattern of high tech, if anything even more pronounced. So, the new jobs created are less skilled, less paid, more insecure, and above all, less unionized than those destroyed.

f) Consumer-durables manufacturing that survives automation is dramatically downgraded in the same terms that the low end of the service sector, more and more using immigrant labor (sometimes undocumented), women, and minorities, with the significant exception of Black Americans, generally considered too conscious and too rebel to accept the new conditions of unskilled labor.

It does *not* follow that micro-electronics or biotechnology are part of a capitalist conspiracy to exploit workers. But it is clear that technological change takes place in certain historical conditions and than its use is shaped by these conditions. What in our epoch amounts to be a major instrument in the undermining of the bargaining power achieved by labor through hard social struggles, vis-a-vis capital.

The impact of high technology on labor is having tremendous regional and urban consequences. We have already shown the preference for certain regions both by high tech industries and by the new generation of companies coming out of the country. Table 25, compiled by Bluestone and Harrison, gives an indication of the trends under way that, we know by now, cannot be oversimplified in terms of the Sunbelt/Snowbelt dichotomy. The new regional landscape of the U.S. is part of an economic restructuring where high tech industry's requirements and socio-political environment of capital-labor relations combine to generate an industrial space where capital can start all over again its process of accumulation challenged by decades of social struggles and years of political control. This is de-regulation.

But an even more fundamental spatial restructuring is under way, directly connected to the new capital-labor relationship facilitated by the blossoming of high technology: the new economic and social dualism within the largest metropolitan areas. The polarization of the labor market, taking place *at the same time* in high tech industries, in restructured manufacturing, and in the service sector, expresses itself in terms of socio-spatial segregation in the large metropolitan areas that experience all of these processes simultaneously. So, there is a process of spatial fragmentation and social segmentation of the metropolitan areas--with sectors of activity, social groups, and personal worlds being clustered together by subsets, then separated from each other in terms of their daily experience. It follows an increasing disconnection of urban sub-systems, while a process of re-connection of selected socio-economic segments is going on at a more abstract, functional level. But this is not the separation of space and society: it is rather the uneasy (and even hostile) coexistence of different spaces, different economies and different societies within the same metropolitan area.

The evolution of Los Angeles during the last decade exemplifies archetypically the process we are describing. It will help to communicate an hypothesis to briefly refer to

TABLE 25

Percent Change in Total Manufacturing Employemnt in Selected Industries in Selected States: 1973-1980

Industry	U.S.	MA	NY	MI	OH	GA	NC	TX	CA
Total Manufacturing	0.13%	6.4%	-10.3%	-17.3%	-11.0%	3.3%	2.7%	31.5%	20.6%
Durable Goods	2.0	20.0	-4.8	-19.0	-13.1	7.8	17.2	43.0	23.3
Nondurable Goods	-2.4	-9.6	-15.4	-10.0	-5.9	0.9	-4.1	17.8	15.1
Selected Industries:									
Primary Metals	-9.7	-	-24.4	-27.7	-20.0	-	-	27.4	-2.2
Fabricated Metals	-1.1	-	-10.0	-22.9	10.4	4.6	26.3	29.1	16.4
Non-electrical Machines	19.9	42.8	6.3	-7.3	-2.0	36.6	36.8	77.2	43.9
Electrical Equipment	13.6	22.6	-1.1	-14.9	-19.2	30.9	17.1	88.2	45.0
Tranport. Equipment	11.0	7.8	-12.7	-22.8	-18.6	3.8	101.2	23.4	5.8
Instruments	27.6	24.0	4.4	46.1	-3.7	-	-	43.8	60.3
Textiles	-15.4	-16.7	-34.1	-	-	-8.0	-15.0	-26.6	-
Apparel	-12.8	-10.0	-22.3	-	-22.3	-3.7	1.8	8.2	17.5
Chemicals	6.3	-10.8	-6.5	5.5	9.8	13.4	8.5	25.6	16.3

Source: U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings for States and Areas*, 1939-78, Bulletin 1370-13, 1979; and *Supplement, 1977-81*, Bulletin 1370-16, 1982.

the preliminary results of two pathbreaking studies on the emergence of Los Angeles as a global metropolis exploding with its internal contradictory dynamics, whereas Soja, Morales, and Wolff put it,

> [it] combines the contrasting dynamics of both "Sunbelt" and "Frostbelt" cities, adding to this mix many of the features of intensified industrialization characteristic of Third World export free zones. This has created a peculiar composite metropolis that resembles an articulated assemblage of many different patterns of change affecting major cities in the United States and elsewhere in the world--a Houston, a Detroit, a Lower Manhattan, and a Singapore amalgamated in one urban region."[162]

The basic trend is the direct relationship between capital-labor restructuring and urban restructuring, as expressed by the author of the second study on which we base our analysis. Saskia Sassen-Koob:

> The restructuring of labor demands in these two cities [New York and Los Angeles] contains two major trends. First, there has been a pronounced expansion in the supply of high-income professional and technical jobs associated with the growth of the advanced services and headquarters complex, high-tech industries, and the technological transformation of the work process which has upgraded a vast array of what used to be middle-income jobs. Second, there has been a pronounced expansion of low-income jobs associated with a general shift to a service economy and, more particularly, with the recomposition of industry, an outcome of (a) the technological transformation of the work process, which has, besides upgrading also downgraded a vast array of jobs through the transfer of skills into machines, (b) changes in the industrial mix, notably the decline of older established manufacturing industries in Los Angeles and the rise of low-wage assembly plants in high-tech industries, and (c) the transformation in the organization of the labor process, notably the shift of certain jobs from unionized shops to sweatshops or industrial homework."[163] Indeed, the data collected by Soja, Morales, and Wolff, show that between 1970 and 1980 Los Angeles region added 1.3 million jobs, that is twice as much as high-growth Houston, reaching five million jobs for the overall regional economy. But this aggregate increase in jobs hides very divergent trends: growth in electronics and aerospace, substantial decline in automobile and aircraft frame production, growth in apparel manufacturing, and tremendous growth in advanced corporate services, and supportive consumer activities. This process has attracted to L.A., at the same time, highly qualified professionals, and literally millions of immigrants, many of them undocumented. Both economic activity and residence have a very distinct pattern of spatial segregation. In fact, according to different studies reported by Soja, Morales, and Wolff, Los Angeles has become the most largely "ghettoized" of the large metropolitan areas, something that is illustrated by Chart11. Thus, as they conclude: "The pace and scope of urban restructuring in the Los Angeles region since the 1960s has been truly extraordinary (...) Selective deindustrialization and reindustrialization have been occurring simultaneously, polarizing the labor force and resegmenting the labor and housing markets. A growing cluster of technologically skilled and specialized occupations, claimed to contain the largest concentration of scientists, mathematicians, and engineers in the world,

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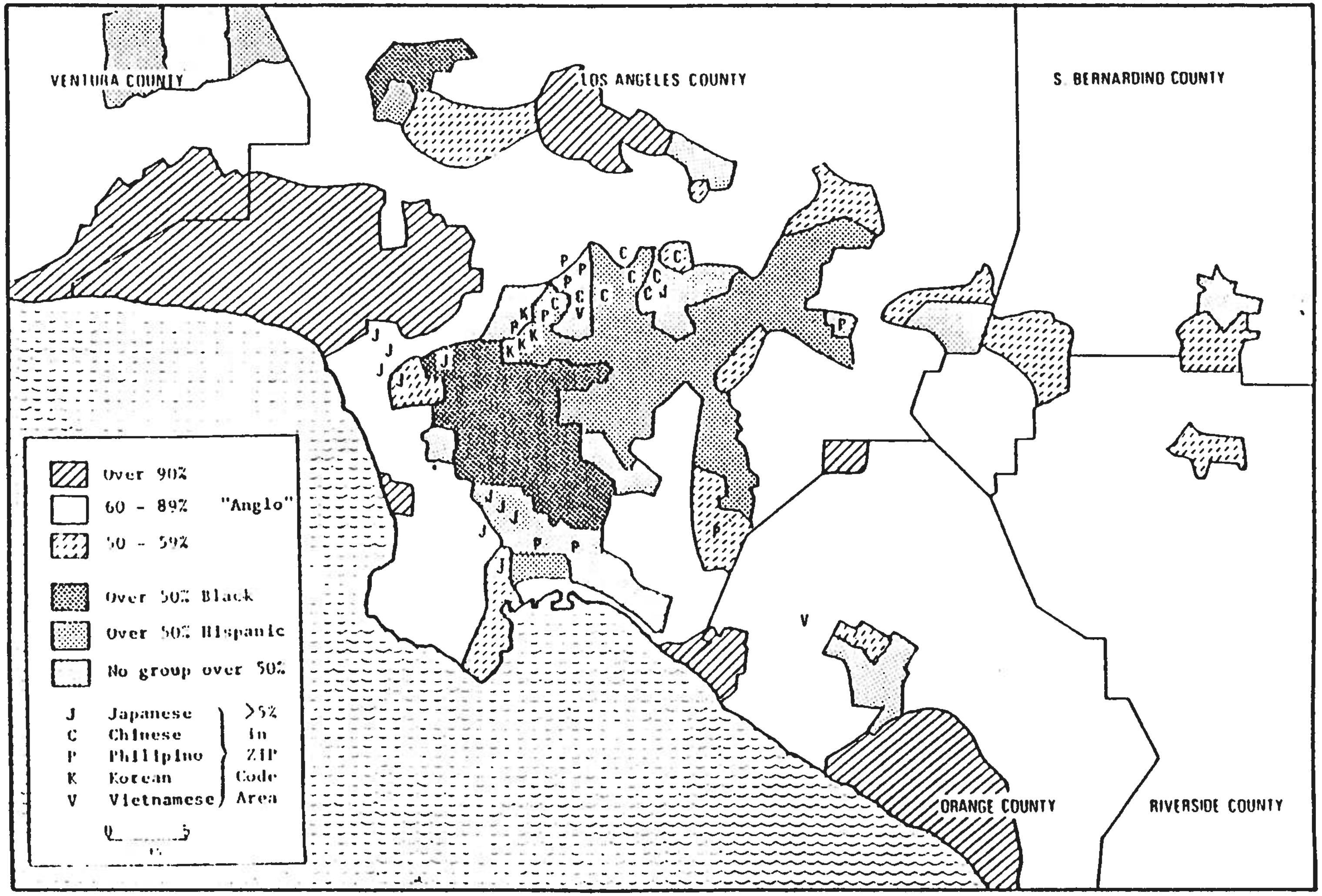
162 Edward Soja, Rebecca Morales, and Goetz Wolff, "Urban Restructuring: An Analysis of Social and Spatial Change in Los Angeles," in *Economic Geography*, Volume 59, No. 2, April 1983, page 195.

163 Saskia Sassen-Koob, "The New Labor Demand in Global Cities," in Michael P. Smith (ed.), *Cities in Transformation*, Beverly Hills: Sage Publications, 1984, pages 161-162.

CHART 11

Distribution of Major Ethnic Groups in the Los Angeles Region, 1980



Source: Soja et al., 1983.

has been complimented by the even more rapid expansion of a massive reservoir of low-skill, poorly organized, low-wage workers, fed from above by a recycling of labor out of declining heavy industry and pressured from below by a growing pool of Third-World immigrants and part-time workers (...) A heavy stream of foreign investment along with a concentration of banking, finance, and corporate management (itself increasingly involved in global economic ventures) fuelled an office-building boom and reshaped the urban landscape, while selective deindustrialization and massive immigration peripheralized and disciplined the labor force and segmented it even more finely than before."[164]

So, what can we say, on the basis of the information and ideas we have reviewed, on the relationship between high technology, the new labor process, and the emerging social and political structure? Basically, two things:

a) What we refer to as "high technology" is not an industry, an activity, or a device: it is a ***process, a particular way to produce*** characterized by the key role that ***information*** plays in the production process. In this sense, "high technology" (understood as information-based production) is penetrating everywhere, and most rapidly in those activities where capital is uneasy with labor. Thus, it eliminates labor massively. At the same time, because it requires a great input of skills, of knowledge, of managerial capabilities, it greatly expands the sphere of highly-skilled, professional labor, yet falling short of matching quantitatively the jobs it suppresses. Furthermore, the development of information-based production is not limited to manufacturing: it actually requires a concomitant expansion of so-called "producer services," so that the distinction between good-producing and service-producing industries is increasingly blurred. The productivity generated by high technology, and the income it induces in the highly-paid professional sectors, create the basis (both in terms of investment and demand) for a wide range of service activities and consumer-oriented downgraded manufacturing, fed by labor displaced from other sectors or other countries. Both processes reinforce each other and require each other. So, polarization of the labor force is a fundamental and necessary process of the informational mode of development. Yet, this polarization does not amount to a new process of class formation, because the two poles are *not* in direct relationship of production. In other words, the Californian engineer eating in a "Burmese" restaurant in New York's SoHo does not "exploit" its Jamaican cook employed by a Korean merchant. . .Yet, both are elements of the same system of polarized *growth* and re-skilling-de-skilling of labor. But the class relationships have been obscured in the process. To the cleavage between ownership and management introduced in the capitalist pole, we now have to add the cleavage between machines and manual workers, and between information-processing and actual material production spreading all over the labor process. It does *not* follow that we are in a classless society, but that the relationship between production relations and people's experience is much more abstract, and can be found only at the level of the whole dynamics of the system, what has less and less meaning at the level of social and political practice, that emerge around different, more cultural categories and strategic forms of behavior.

b) This social evolution, structured by new relationships of production determined by the role of information, has fundamental consequences for the organization and dynamics of space. On the one hand, the polarization of high tech dominated production leads to sharp regional cleavages and to the formation of "ghettoized" areas of selective economic activity (of the Silicon Valley-Route 128 type), increasingly distinct of remote non-metropolitan locations of low-skilled jobs. And this not only

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[164] Soja, Morales, and Wolff, op. cit., 1983, p. 227.

for electronics but for most manufacturing *and* service activities that can be disassociated in space according to the specific characteristics of their labor force. On the other hand, the largest metropolitan areas are going through three combined, but distinct processes, *within the same space:* growth of corporate services and high tech manufacturing, decline of traditional activities (both in services and manufacturing), and development of the new downgraded, *yet booming*, economic sectors. This process of *polarized growth* creates very distinct spheres, yet it has to relate these spheres within the same functional unit. We observe, therefore, the rise of dualized metropolises that that segregate internally their activities, social groups, and cultures, while reconnecting them in terms of their structural interdependency. These metropolises are real magnets at the world level, attracting people, capital, minds, information, materials, and energy, while keeping separate the channels of functioning of all these elements in the actual fabric of the metropolis. We are not in a situation of crisis and decline (like in the case of cities like Detroit or Buffalo), but in a process of interactive growth between elements that ignore each other, while in fact being part of the same system. We are witnessing the rise of urban schizophrenia. Or, in other words, the separation between cities and *society* within the same space.

4.4.3 High Technology and the Spatial Form of the Warfare State.

The most far reaching element of the current economic restructuring is the transformation of the role the State has held in the economy for the last 50 years,in the U.S. since the New Deal.[165] Not that it is withdrawing from economic interventionism, quite the opposite. But the form and context of government intervention are deeply changing, shifting their focus from accumulation *and* redistribution, to selective accumulation *and* military reinforcement. It would be a mistake to consider this trend solely a product of the Reagan Administration, though its policy represents a qualitative step in this direction.[166] But, the last two years of the Carter Administration already showed a significant reversal of the redistribution role of the State, actually echoing policy orientations developed by the Nixon-Ford years.[167] And in Western Europe similar orientations toward retrenchment of social expenditures and to the imposition of strict limits to collective consumption are apparent in Thatcher's England, in Mitterrand's France, in Kohl's Germany, or in Craxi's Italy.

The welfare state is in crisis [168], not because of excessive social transfers, but because an increasingly older demographic structure imposes a growing burden on employers' contribution to transfer payments to the elderly (Retirement pensions account, on the average, for 2/3 of total public social expenditures in the OECD countries).[169] Combined with increased costs of health care, and higher unemployment, the crisis of special security systems underline the conflict between private appropriation

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[165] The classical analysis on the subject continues to be Jim O'Connor's, *The Fiscal Crisis of the State*, New York: St. Martin's Press, 1973; see also: Samuel Bowles and Herbert Gintis, "The Crisis of Liberal Democratic Capitalism: The Case of the United States," in *Politics and Society*, 11(1): 51-93.

[166] Robert Leckachman, *Greed is Not Enough: Reaganomics*, New York: Pantheon, 1981; and John L. Palmer and Isabel Sawhill (eds.), *The Reagan Experiment*, Washington: The Urban Institute Press, 1982.

[167] David Wilmoth, *The Evolution of National Urban Policy in the U.S.*, U.C. Berkeley: Department of City and Regional Planning, Unpublished Ph.D. Dissertation, 1983.

[168], See: OECD, *The Welfare State in Crisis*, Paris: OECD, 1981; Harold L. Wilensky, *The Welfare State and Equality*, Berkeley: U.C. Press, 1975; Ralph M. Kramer, *Voluntary Agencies in the Welfare State*, Berkeley: U.C. Press, 1981.

[169] See: Anne-Marie Guillemard (editor), *Old Age and the Welfare State*, Beverly Hills, CA: Sage Publications, 1983.

and collective redistribution of the economic surplus. Thus, when the state was riding the crest of economic growth with socially accepted inflation during the 1960's, it could provide both for social welfare and for capital investment, including the military and aerospace expenditures. In the case of the U.S., the Great Society's programs, the Vietnam War, and the "Man in the Moon" were financed at the same time. But the price of doing it without excessive taxation, was precisely increasing government borrowing (particularly at the state and local level), and money supply, triggering an inflationary trend that went out of control, once energy and food prices skyrocketed. In other words, to buy social peace and pursue social redistribution without altering its support to capital investment and business profits, the government (all governments) financed their expenditures with inflationary measures. When, to curb inflation, they had to choose between different chapters in the Budget, they went on trimming social expenditures, precisely at the moment where the economic crisis created most hardship for more people in all countries. In fact, to dismantle the Welfare State and to remove the safety net is also an economic policy aimed at labor, because it diminishes the bargaining power of impoverished, potentially unemployed workers, and forces them to take whatever jobs they can find, regardless of the conditions. Current initiatives to impose Workfare programs as a condition for welfare payments in several American states is a new qualitative move toward the dismantlement of the social contract that have been reached during the New Deal, and then renewed and expanded during the 1960's.

The retrenchment of the Welfare State has been particularly pronounced in the sphere of human and community services[170] and, together with the Tax Revolt led by the suburban middle-class, has put tremendous stress on cities, and, in general, on local governments.[171] not only in social services, but also in infrastructure absolutely need for economic development. Even *Business Week* sounded the alarm in 1981, with a special issue on "state and local government in Trouble" where, on the basis of the tendency shown by Chart 12 one can read: "President Reagan's program of fiscal austerity many State and local governments in what economists regards as the best of all worlds: that of having to cut spending and raise taxes at the same time. Such policies are a double whammy for both business and consumers."[172] And also: "For the economic expansion Reagan is predicting requires a strong and healthy public infrastructure. Industry cannot expand without adequate water and sewage systems, and mass transit systems to get its employees to work and its goods to market."[173] In fact some authors have argued that the urban fiscal crisis, and the crisis of New York City in particular, was the test for the social feasibility of implementing the type of economic restructuring that the Reagan's Administration came to represent.[174] The partial dismantlement of the welfare state and the impact of this trend on urban programs and services, have been documented by Norman J. Glickman., in one of the most synthetic studies on the matter.[175]

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170 See: Larry Hirschorn et alter, *Cutting Back: Retrenchment and Redevelopment in Human and Community Services*, San Francisco: Jossey-Bass, 1983.

171 See: Robert W. Burchell and David Listokin (eds.) *Cities Under Stress: The Fiscal Crises of Urban America*, Piscataway, N.J.: The Center for Urban Policy Research, 1981; and Terry N. Clark and Lorna C. Ferguson, *City Money: Political Processes, Fiscal Strain and Retrenchment*, New York: Columbia University Press, 1983.

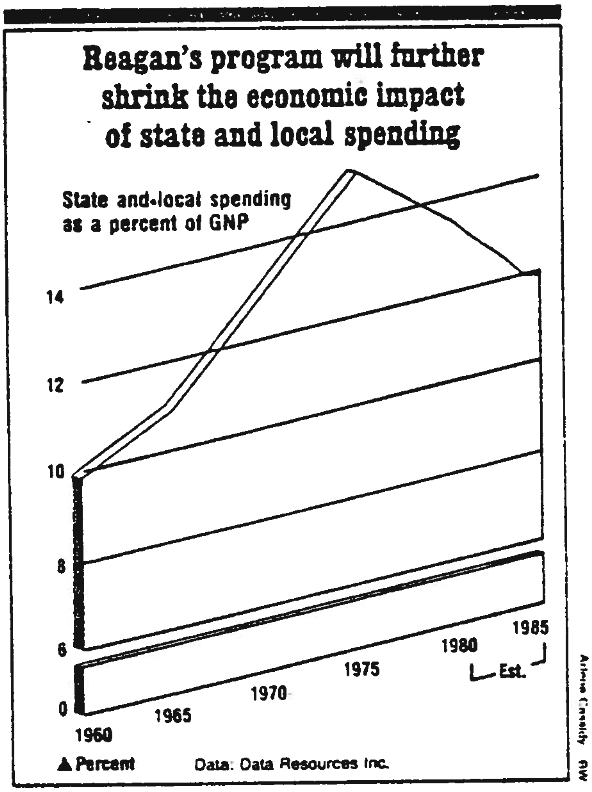
172 *Business Week*, October 26, 1981, page 172.

173 Ibidem, p. 147.

174 See: William K. Tabb, *The Long Default: New York City and the Urban Fiscal Crisis*, New York: Monthly Review Press, 1982.

175 Norman J. Glickman, *Economic Policy and the Cities: in Search of Reagan's Real Urban Policy*, Paper presented at the North American Meetings of the Regional Service Association. Chicago: 11-13 November, 1983.

CHART 12


Reagan's program will further shrink the economic impact of state and local spending
State and-local spending as a percent of GNP
14
12
10
8
6
0
1960
1965
1970
1975
1980
1985
Est.
▲ Percent
Data: Data Resources Inc.

His results are presented in Tables 26 and 27. It shows a dramatic and rapid reduction from 1979 onwards, from 12.4% of federal outlays to 9.1% in 1982 and a projected 7.5% in 1984.

In a parallel movement, the emphasis of federal spending has been shifted to defense spending. Arms demand, and thus arms production, has soared at the world level. While countries such as France, Israel, Italy, West Germany, England, and Brazil, (not to mention the USSR!) are active exporters in the weaponry business, the U.S. is the leading producer and exporter in absolute numbers. According the the Boston Study Group, U.S. production accounted in 1970 for about 20% of total aims transfers in the world, the figure in 1982 was 45%[176] The movement is accelerating: in 1974, foreign sales of U.S. weapons amounted to $10 Billion; in 1982, to 21 Billion, and in 1983, the projection was $31 Billion.[177] Concerning its own military spending, the U.S. Government is engaged in a massive build-up, particularly since 1981, as Table 28 shows: actual spending rose from $156 Billion in 1981 to $205 in 1983. But the real acceleration is yet to come: the Reagan proposal for 1985 was $264.4 Billion, and for 1989, if re-elected, an astounding $398.8 Billion (see Chart 13). To complete the picture of military spending we should also include a proportion of the budget of other administrations (such as for NASA, an estimated 25%), Department of Energy (Nuclear-Related Research), CIA-covert operations, and National Guards expenses (supported by individual states).

The tendency is very clear in the world in general and in the U.S. in particular: fiscal austerity for social expenditures, and tremendous expansion of military expenditures.[178] We are witnessing an increasing militarization of the economy, as Martin Carnoy and myself have argued elsewhere.[179] Why is this so? Certainly, any trend related to the state has primarily political roots. Increasing competition between the superpowers, struggles of liberation in the Third World, manipulation of national antagonisms both by governments and by foreign agents, fights of influence over countries between the West and the East, and a rampant Cold War, are all elements of an increasingly tense and dangerous world. The response, particularly in the U.S. after the defeat in Vietnam, has been to raise the stakes, using the technological superiority of the West to try to alter the balance of power, with the ultimate illusion of winning an advantageous edge that will enable the U.S. to impose its conditions around the world. The Soviet Union reacted in kind, having herself committed to a military buildup even greater than the one by the U.S. in proportion to their GNP, and the process has spiraled. The national State, in general, and the American State in particular, are getting ready for war, and for war of all kinds, from an all-out war to a limited commando operation, passing through "limited local nuclear wars" or large-scale battles with conventional weapons, and, of course, military support and training for subrogated armies.

The current economic restructuring is fundamentally shaped and conditioned by this political historical trend. It is not the other way around. It is not that because of the economic crisis that governments engage in military spending. This is too much a mechanistic view of how governments operate. What is true is that the economic crisis has increased international tensions, creating a favorable environment for the military buildup. But the defense policy itself has deeper historical and political roots[180] that we

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176 Boston Study Group, cited by Markusen, 1984.

177 Michael Klare, "Opening the Floodgates: 'Arms Diplomacy' of the Reagan Administration" in Ronald Dellums (ed.) *Defense Sense: The Search for a Rational Military Policy*, Cambridge, Mass.: Ballinger, 1983.

178 Lloyd Dumas (ed.), *The Political Economy of Arms Reduction*, Boulder: Westview Press, 1982; and Jacques Gansler, *The Defense Industry*, Cambridge: MIT Press, 1980.

179 Carnoy and Castells, op. cit., 1984.

180 For the historical and political roots of the arms race, see: Daniel Yergin, *Shattered Peace: The Origins of*

TABLE 26

Federal Urban Outlays 1967-1984: Nominal, Real, and as Percent of Total Federal Outlays

	Total Urban-Related Outlays	Real Urban Outlays (1972 $)	Urban Outlays as a % of Federal Outlays
1967	3053	3778	1.9
1968	4994	5900	2.8
1969	9309	10448	5.0
1970	13300	12088	6.8
1971	15895	16216	7.5
1972	22844	22205	9.9
1973	29660	26861	12.0
1974	28287	23486	10.5
1975	31473	24866	9.7
1976	38744	30611	10.6
1977	47631	32795	11.9
1978	55465	35346	12.4
1979	59454	34762	12.1
1980	65508	35016	11.4
1981	69640	34583	10.6
1982	66281	31469	9.1
1983E	66184	30043	8.2
1984E	63377	27230	7.5

Source: The Budget of the United States Government: Special Analyses and *Appendix*, various years. *Economic Report of the President*, 1980. Deflators for 1983 and 1984 are from DRI, Inc. forecasts.

Computed by Norman J. Glickman, 1983.

TABLE 27

Detailed Description of the Urban Budget
Fiscal Years 1977 - 1984

Department and Program	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*
HOUSING AND URBAN DEVELOPMENT								
Community Development Block Grants	2089	2456	3161	3902	4013	3791	3525	3526
Urban Development Action Grants	--	--	73	225	371	388	488	512
Rehabilitation Loan Fund	41	47	100	165	60	-23	1	--
Planning Assistance	77	67	62	52	39	20	4	--
New Communities Assistance Grants	2	1	*	*	1	1	1	--
Subsidized Housing Programs	2443	2920	3559	4529	5747	6880	7774	8532
Housing for Elderly/Handicapped	4	176	459	752	817	742	255	51
Operating Payments: Low Income Housing	506	691	654	824	929	1008	1582	1558
Emergency Mortgage Purchase Assistance	-224	360	271	1039	-74	-37	-227	--
Urban Renewal	850	376	281	212	144	90	70	50
Neighborhood Self-Help Development Program	--	--	--	2	9	--	--	--
Urban Homesteading	--	--	--	--	--	12	20	12
Miscellaneous Appropriations [1]	19	11	15	2	5	1	2	--
Troubled Projects Operating Subsidy	--	--	-12	23	53	29	23	13
Congregate Services	--	--	--	*	1	3	5	6
Housing Counseling Assistance	*	4	5	8	5	3	3	3
FHA Fund	492	357	193	151	182	-237	-329	-1546
Low Rent Public Housing, Loans and Other Expenses	-32	11	-3	34	77	-21	102	136
Non-Profit Sponsor Assistance	*	1	1	1	*	*	*	*
Rental Housing Assistance Fund	-7	-12	66	*	3	*	2	--
New Communities Fund	87	97	31	45	49	16	37	--
Fair Housing Assistance	--	--	--	--	1	2	11	6
GNMA: Special Assistance Functions Fund	-805	-55	58	396	1303	1666	1433	--
GNMA: Guarantee of Mortgage-Backed Securities	-22	-41	-55	-74	-92	-119	-156	-182
GNMA: Participation Sales Fund	-4	-21	-12	34	59	-20	-63	-75
Urban-Related, HUD	5516	7446	8907	12322	13702	14195	14563	12602
Total HUD Outlays	5838	7589	9213	12576	14033	14491	14853	13737
Percent Urban-Related	94.5%	98.1%	96.7%	98.0%	97.6%	98.0%	98.0%	91.7%
COMMERCE								
Local Public Works Program	585	3057	1741	416	83	40	30	30
Business Dev. Loans:								
Econ. Dev. Revolv. Fund	-20	-33	-33	45	-5	46	24	-24
Financial and Technical Assistance	1	*	--	*	*	*	--	--
Job Opportunities Program	98	12	2	5	*	1	--	--
Minority Business Development	54	54	54	56	49	50	57	57
Economic Dev. Assistance Programs	297	330	436	546	502	337	270	207
Urban-Related, Commerce	1015	3420	2200	1068	629	474	381	270
Total Commerce Outlays	2606	5239	4072	3755	11484	2045	1969	1699
Percent Urban-Related	38.9	65.3	54.0	28.4	5.5	23.2	19.3	15.9

TABLE 27 (continued)

ENVIRONMENTAL PROTECTION AGENCY								
Construction Grants	3530	3187	3756	4343	3881	3756	3100	2800
Urban-Related, EPA	3530	3185	3756	4343	3881	3756	3100	2800
Total EPA Outlays	4365	4071	4800	5602	5241	5080	4370	4075
Percent Urban-Related	80.9	78.3	78.3	77.5	74.1	73.9	70.9	68.7
TRANSPORTATION								
Federal Highway Admin. (Urbanized Areas) [2]	861	988	1135	932	808	732	800	800
Urban Mass Transportation Fund	1709	2028	2458	3207	3855	3864	3818	3488
Urban-Related, DOT	2570	3016	3593	4139	4663	4596	4618	4288
Total DOT Outlays	12514	13452	15486	18963	22509	19917	21157	24370
Percent DOT-Related	20.5	22.4	23.2	21.8	20.7	23.1	21.8	17.6
SMALL BUSINESS ADMINISTRATION								
Business Loan and Investment Fund	464	458	471	721	574	704	270	263
Urban-Related, SBA	464	458	471	721	574	704	270	263
Total SBA Outlays	700	2766	1631	1899	1913	631	577	262
Percentage SBA-Related [3]	66.3	16.6	28.9	38.0	30.0	111.6	46.8	100.4
COMMUNITY SERVICES ADMINISTRATION								
Community Services Program [4]	640	768	780	2170	664	133	39	--
Urban-Related, CSA	640	768	780	2170	664	133	39	0
Total CSA Outlays	640	768	780	2170	664	133	39	--
Percentage CSA-Related	100.0	100.0	100.0	100.0	100.0	100.0	100.0	0
DEPARTMENT OF HEALTH AND HUMAN SERVICES AND EDUCATION								
Education [5]	2593	3047	3450	1512	4262	3872	3686	3813
Health Services Administration [6]	1029	1079	1183	1311	1298	1924	1573	786
Grants to States for Medicaid [6]	9713	10680	12407	13957	16833	17391	19326	20799
Assistance Payments Program [6]	6293	6639	6610	7308	8503	7990	7766	7094
Grants for Social and Child Welfare Services [6]	2518	2809	3091	2763	2646	2567	2571	2500
Urban-Related, HSS	22146	24254	26741	26851	33542	33744	34922	34992
Total HHS and Education Outlays	147455	162856	181182	207815	228115	265347	288844	302283
Percentage HHS-Related	15.0	14.9	14.8	12.9	14.7	12.7	12.1	11.6
DEPARTMENT OF THE TREASURY								
State and Local Fiscal Assistance Trust Fund	6760	6823	6848	6829	5137	4569	4567	4567
Anti-Recession Fiscal Assistance Fund	1699	1329	*	--	--	--	--	--
Urban-Related, Treasury	8459	8152	6848	6829	5137	4569	4567	4567
Total Treasury Outlays	49560	56355	56044	76691	93372	110521	118025	134997
Percentage Treasury Outlays	17.1	14.5	10.5	8.9	5.5	4.1	3.9	3.4
DEPARTMENT OF LABOR								
Employment and Training Assistance [7]	3291	4764	6158	7065	6848	4110	3724	3595
Urban-Related, DOL	3291	4764	6158	7065	6848	4100	3724	3595
Total DOL Outlays	22374	22890	22649	29724	30084	30736	42995	34268
[illegible]	14.7	20.8	27.2	23.8	22.8	13.4	8.7	10.5

TABLE 27 (continued)

Total Urban-Related Outlays	47631	55465	59454	65508	69640	66281	66184	63377
Urban-Related Outlays (without Medicaid)	37918	44785	47047	51551	52807	48890	46858	42578
Total Federal Outlays	400506	448368	490997	576674	657204	728375	805202	848483
Urban Outlays as % of Federal Outlays	11.9	12.4	12.1	11.4	10.6	9.1	8.2	7.5
Percent Change Urban-Related Spending	22.94	16.45	7.19	10.18	6.31	-4.82	-0.15	-4.24
Percent Change Urban Spending (without Medicaid)	25.66	18.11	5.05	9.57	2.44	-7.42	-4.16	-9.13
Real Urban Outlays (1972 $)	32795	35346	34762	35016	34583	31469	30043	27230
Percent Change Urban Outlays	7.13	7.78	-1.65	0.73	-1.24	-9.00	-4.53	-9.36
Real Urban Outlays (without Medicare)	26107	28540	27508	27556	26224	23212	21270	18293
Percent Change Real Urban Outlays (without Medicaid)	17.83	9.32	-3.62	0.17	-4.83	-11.49	-8.37	-14.00

Source: *U.S. Budget Appendix* (annual).

[1] Miscellaneous Appropriations represent the remaining outlays of the Model Cities Program and the Community Development Training and Urban Fellowship programs. Model Cities was terminated in 1975 and the others in 1973.

[2] Dollar amounts for the Federal Highway Administration's Urbanized Areas Program represent obligations rather than outlays. The Budget Appendix does not supply information on outlays at that level of the program.

[3] Urban-related outlays may exceed total outlays for an agency due to additional revenue from other sources. In 1982 and 1984, loan repayments from the Disaster Loan Fund created additional revenue which reduced total outlays.

[4] The increase in 1980 CSA spending results from the Energy Assistance Program which represented $1,160,000 in obligations.

-- No outlays

[5] Education outlays are combined in order to simplify the many organizational changes which took place between the Departments of health, Education and Welfare and Education. Two programs were included in FY1977 to 1980: Elementary and Secondary Education and Emergency School Aid. Emergency School Aid became the Equal Educational Opportunities Program in 1980. The program structure changed in FY1981 and three new programs replaced the two existing ones. From FY1981 to 1984, Compensatory Education for the Disadvantaged, Special Programs and Populations, and Bilingual Education have been included in the Education category.

[6] The dollar amounts for the Health Servicers Administration, Grants to the States for Medicaid, Assistance Payments Program, and Grants for Social and Child Welfare Services represent obligations rather than outlays in

[7] Youth programs are included in Employment and Training Assistance.

* Less than $500,000.

TABLE 28

Military Spending: How Projections Change From Year to Year

The $264.4 billion of military spending planned for the fiscal year 1985 represents 29.1 percent of total outlays. President Reagan's forecasts have generally been higher than actual expenditures. In early 1981, for example, he forecast spending of $221.1 billion for 1983; two years later, the estimate was $208.9 billion. Actual spending was $205 billion.

Proposed and actual Department of Defense military outlays, for fiscal years, in billions of dollars.

	1981	1982	1983	1984	1985	1986	1987	1988
Reagan, Feb. '84				231.0	264.4	301.8	339.2	369.8
Reagan, Feb. '83			208.9	238.6	277.5	314.9	345.6	377.0
Reagan, Jan. '82		182.8	215.9	247.0	285.5	324.0	356.0	
Reagan, March '81	158.6	184.8	221.1	249.8	297.3	336.0		
Carter, Jan. '81	$157.6	$180.0	$205.3	$232.3	$261.8	$293.3		
Actual	156.1	182.9	205.0					

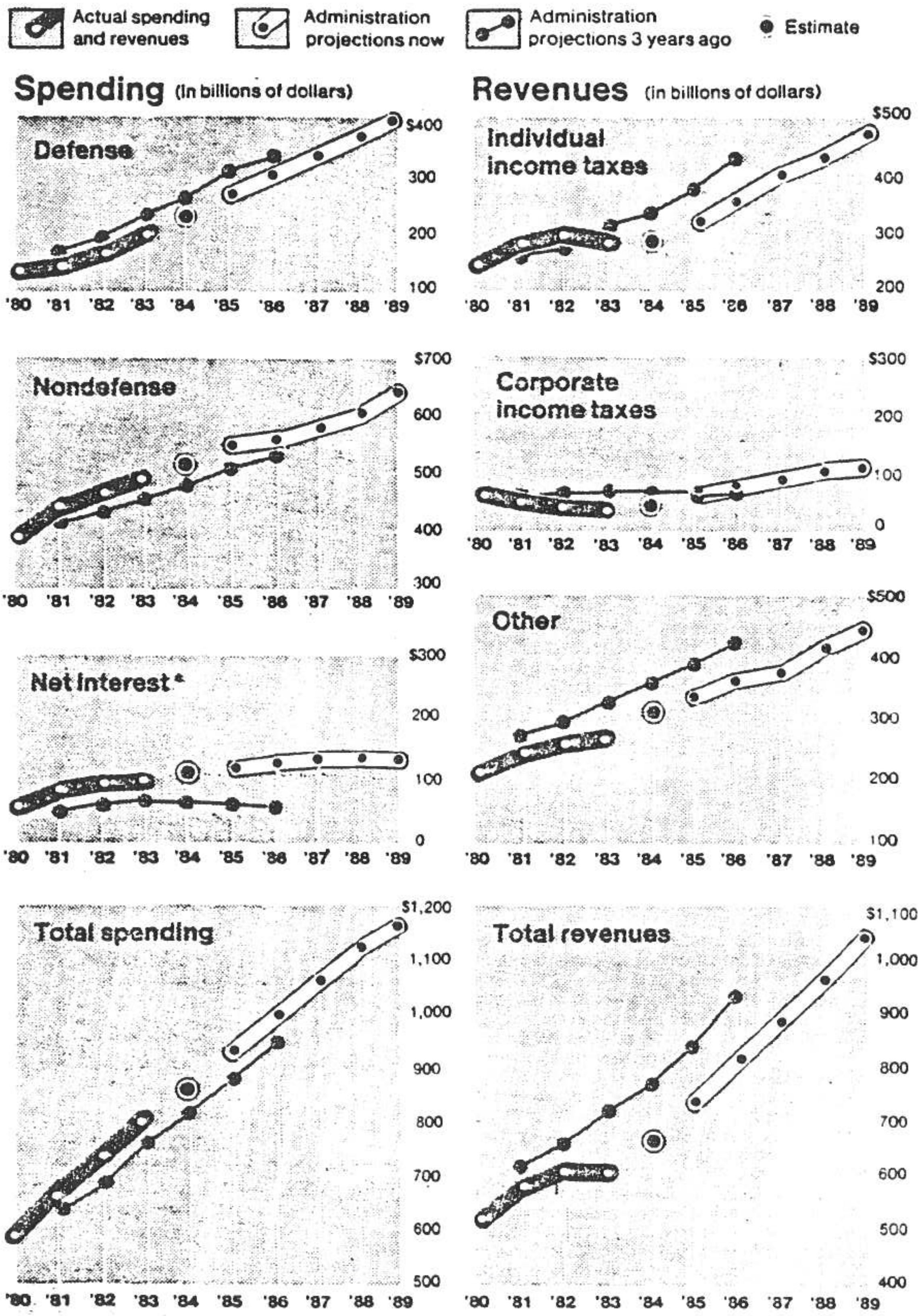
The President's projection for 1989, made in the latest budget proposal, is $398.8 billion. *Source: Defense Department*

Source: New York Times, February 2, 1984.

CHART 13

The Federal budget: How it was, is and might be

President Reagan last week proposed a $925.5 billion budget for the fiscal year that begins in October. The following charts show details of spending and revenue proposals, past and present, and projections for the future. Economic effects of the budget and Democratic reaction to it, pages 2 and 3.

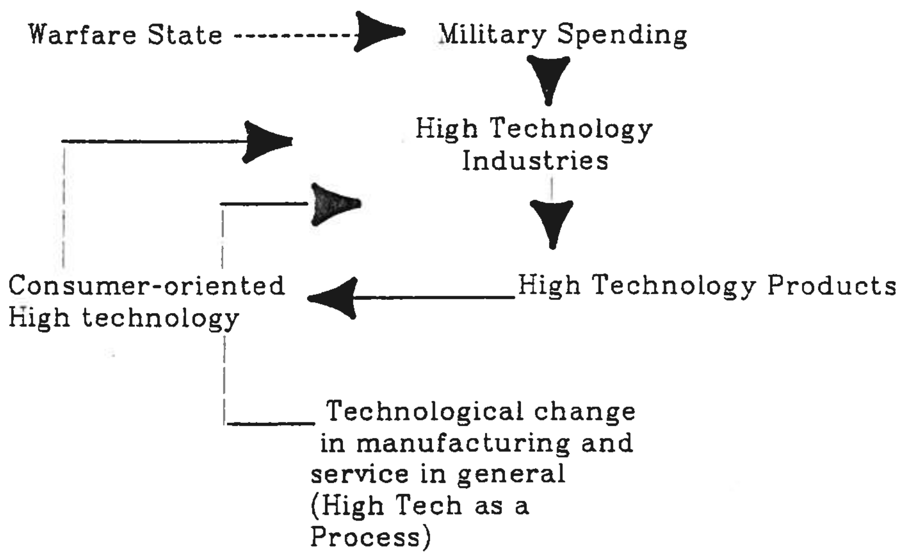


Source: New York Times

cannot analyze here, in this already too broad paper. What matters for our subject is that the state, while disengaging from its commitment to Welfare (having politically subdued, at least for now, social resistance to austerity politics), it has engaged itself in War-preparation activities. And the economy, whose dependency from military expenditures was *decreasing* during the 1960's and first half of 1970's, is now being restructured around a core of highly profitable industries directly related to military production. *And here is where high-technology enters into the picture.*

Many of the technological breakthroughs of the past 40 years, particularly in the field of electronics, have been induced or supported by military demand or the space program. The emphasis on performance, the low elasticity of price, and the abundant funding, characteristic of the military, were key elements that helped the scientific research and the technological developments more than a short-term commercially inspired demand, necessarily concerned with market profitability. In this sense, the State continues to be the Prince for scientists and researchers, provided they accept the lack of control over the use of their inventions.

Nevertheless, during the mid-1970's consumer products and new machinery were becoming increasingly important applications of high technology, especially in electronics. But the new surge in defense spending has reversed the trend in the U.S., actually leaving the lead in consumer electronics to the Japanese. In the U.S. the gigantic military build-up of the last 10 years is spurring development of high tech industries, which in turn rely on the defense market to produce for other purposes a modified version of their products. Thus, the process seems to be operating in the following way:



So, we do not pretend that all high-tech is military-related production. But the *source* of most high-tech industries is, and this has a necessary impact on the type of high tech industries, on their products, on their employment, and, as we will see, on the urban and regional consequences of high-tech induced economic development. But, it should be clear that the *growing militarization of the U.S. economy is not a result of high technology*. In fact, the Japanese experience shows that high tech can expand very rapidly in consumer-oriented, or even in social-service oriented products. And many current developments in the U.S. also follow this pattern (from computer-stimulated walking systems for quadraplegics to factory robots). But the bulk and the core of high

Cold War and the National Security State, Boston: Houghton Mifflin Co., 1977.

tech manufacturing, and therefore of the characteristics of the technologies being researched, are connected to the military market.

Ann Markusen is currently pioneering research in this field.[181] Based on her own study and on another empirical study by David Henry[182] she shows that: "heavily defense-dependent manufacturing sectors are dominated by those in the high-tech category, ad that a substantial proportion of high-tech industries are important military suppliers."[183] Table 29 presents some of the data in support of Markusen's argument. As she points out, the effect of the Reagan's Administration defense buildup is particularly visible in the growth of defense output in all but one of the 36 four digits-sectors studied. A striking figure is the 141% defense output growth in electronic computing equipment. In her study, Markusen calculated that these 36 sectors of military-related high tech production accounted, in 1977, for 47% of all high tech manufacturing employment. Given the rapid increase since 1977, the proportion is likely to be higher now, and, if we consider the projections, it will even be more so in the near future. Also the regression analysis by Glassmeier, Hall, and Markusen, already reported in this Table, showed that defense spending per capita across a set of 226 metropolitan areas was the most significant variable explaining high tech dependence in the economy of a given metropolitan area, a result that is confirmed by a completely independent study carried on by Steven Pinkerton on the distribution of high tech manufacturing among the American states, as we also reported previously.

Numerous empirical studies consulted by Ann Markusen, with the collaboration of Robin Bloch and Janet Anderson, go all in the same direction of establishing an intimate linkage between high-tech production and military procurement. For instance, a study found that, in 1970, defense spending accounted for 48% of all aeronautical engineers, 23% of physicists, 21% of electrical engineers, 19% of all mathematicians and 16% of industrial engineers.[184] And another study reported that 59% of aeronautical engineers, 38% of physicists, 22% of electrical engineers, 20% of technical engineers, 22% of electrical engineers, and 20% of metallurgical engineers were employed by the Defense Department of by defense-related industries.[185] Thus, the expansion of high technology production in the U.S. is, in general, a direct consequence of the militarization of the economy, although its impact on the economy, on the society, and on spatial forms, goes far beyond the original matrix.

This evolution from the welfare state to the Warfare State is reshaping the urban and regional structure of the U.S. Norman Glickman has attempted to measure this impact by calculating the rates of growth and decline of federal outlays for selected programs, between 1981-1984, for different cities and regions, typologized by a number of key variables.[186] Tables 30 and 31 show the results. It is obvious that all welfare-related programs decline substantially, while Defense spending increases sharply, particularly in the chapter "procurement." But even more interesting is to observe the inter-cities and

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[181] Ann R. Markusen, *Defense Spending and the Geography of High Tech Industries*, Berkeley: IURD, Working Paper No. 423, May 1984.

[182] David Henry, "Defense Spending: A Growth Market for Industry," in *U.S. Industrial Outlook 1983*.

[183] See: Markusen, op. cit., 1984, p. 27.

[184] Richard Dempsey and Douglas Schurde, "Occupational Impact of Defense Expenditures," *Monthly Labor Review*, Dec. 1971, pp. 12-15, reported by Markusen.

[185] Max A. Rutziek, "Skills and Location of Defense Related Workers," *Monthly Labor Review*, 93, Feb. 1970, pp. 11-16, reported by Markusen.

[186] Norman Glickman, op. cit., 1983.

TABLE 29

Defense-Related High Tech Industries

SIC #	Industry Name	Employment 1977	Defense Output Share 1982 (%)	Defense Output Share 1987 (%)	Defense Output Growth 1982-87 (%)
2812	Alkalies and Chlorine	11831	5.6	7.1	53.3
2813	Industrial Gases	7332			
2816	Inorgnic Pigments	12003			
2819	Inorganic Chem. Misc.	78192			
2865	Cyclic Crudes, Dyes	35499			
2866	Organic Chem. Misc.	11242			
2892	Explosives	11546	34.3	41.2	58.7
3482	Small Arms Ammunition	12199	25.0	39.9	129.5
3483	Ammunition, Ex Small Arms	20589	90.9	93.2	55.6
3484	Small Arms	17495	13.8	6.5	-43.3
3489	Ordinance	19042	79.7	81.2	35.3
3541	Machine Tools, Cutting	59432	6.2	7.5	54.4
3542	Machine Tools, Forming	23154	4.8	6.3	70.0
3544	Special Dyes, Jogs, Molds	106175	6.0	7.5	45.4
3545	Machine Tool Accessories	54177			
3562	Ball, Roller Bearings	50286	5.8	6.8	45.4
3573	Electronic Computing Equip	192510	7.1	12.7	141.0
3624	Carbon, Graphite Products	12086	7.7	9.3	51.4
3622	Radio, TV Communications	333006	58.0	62.5	54.2
3671	Cathode Ray Tubes	36808	7.3	11.5	105.3
3674	Semiconductors	114011	12.5	12.5	51.4
3675	Electronic Capacitors	28647	17.0	19.8	49.3
3676	Resistors, Electronic	24918			
3677	Resistors, Electric	22424			
3678	Connectors	26020			
3679	Electronic Components	125998			
3721	Aircraft	222805	40.4	46.1	58.7
3724	Aircraft Engines	106322	53.5	56.1	32.9
3764	Missile,Space Engines	17011			
3728	Aircraft Parts	101900	41.2	44.2	34.9
3769	Missile, Spacecraft Parts	10189			
3761	Missiles, Space Vehicles	93933	67.5	79.4	64.4
3795	Tanks, Tank Parts	12122	93.8	95.0	47.2
3811	Engineering Instruments	42178	27.7	33.6	59.9
3825	Instruments Measuring Elec	66622	8.4	9.8	49.7
3832	Optical Instruments	29883	28.0	30.7	38.0

Sources: Census of Manufactures, 1977 as tabulated in Glasmeier, Hall and Markusen, 1983, Table 1, p. 5, and Henry, 1983, Table 3, p. XLVII. The BIE estimates reported by Henry are sometimes aggregated into three digit SICs, thus the shared percentages in the later three columns.

TABLE 30

Concentration Ratios for Selected Programs by City Type

Program	Real % Outlay Change, 1981-84	All Cities	Low Income	High Income	Declining	Slow Growing	Rapidly Growing	Low Unemploy	High Unemploy	Low Hardship	High Hardship
State and Local Fiscal Assistance	-11.5	1.00	1.08	0.92	1.04	0.87	0.99	0.90	1.05	0.79	1.17
Employment and Training (CETA)	-47.6	2.41	1.22	0.78	0.99	0.94	1.18	1.10	0.93	0.97	1.01
Community Development Block Grants	-24.8	1.91	1.41	0.60	1.03	0.92	0.94	1.01	0.99	0.81	1.14
Urban Mass Transit Assistance	-21.9	2.24	0.75	1.23	1.35	0.31	0.13	0.28	1.41	0.26	1.53
Vocational Education	-7.4	2.39	1.19	0.81	0.84	1.04	2.32	1.76	0.56	1.26	0.72
Work Incentive Program (WIN)	-93.9	1.82	1.08	0.91	0.98	1.01	1.04	1.51	0.70	0.99	0.94
S B A	-88.2	1.50	1.06	0.93	0.96	1.04	1.18	1.02	0.98	0.91	1.07
Defense	+37.0		0.95	1.04	0.78	1.45	1.42	1.18	0.89	1.33	0.72
Construction	+53.9	0.58	0.61	1.62	0.38	1.42	5.44	1.96	0.44	1.72	0.40
Payroll	+11.4	--	1.23	0.78	.63	1.68	1.98	1.39	0.77	1.31	0.73
Procurement	+61.7	--	0.80	1.19	0.86	1.32	1.05	1.06	0.96	1.34	0.71

PROGRAM	Real % Outlays Change, 1981-84	Small Cities	Medium Cities	Large Cities 1981-84	Central Cities	Suburbs
State and Local Fiscal Assistance	-11.5	0.78	0.96	1.10	1.08	0.63
Employment and Training (CETA)	-47.6	0.65	1.59	0.87	1.13	0.42
Community Development Block Grants	-24.8	0.89	1.45	0.84	1.04	0.80
Urban Mass Transit Assistance	-21.9	0.09	0.60	1.51	1.18	0.17
Vocational Education	-7.4	0.87	2.19	0.54	1.19	0.13
Work Incentive Program (WIN)	-93.9	0.68	2.07	0.66	1.19	0.13
S B A	-88.2	0.69	1.11		1.06	1.07
Defense	+37.0	1.12	1.27	0.83	0.80	1.48
Construction	+53.9	0.78	0.70	1.21	1.15	0.33
Payroll	+11.4	0.87	1.31	0.91	1.06	0.70
Procurement	+61.7	1.26	1.26	0.78	0.78	1.93

Source: Concentration ratios from Vernez (1980). Changes in budget outlays are computed from *Special Analyses, the Budget of the United States Government*, Fiscal Years 1983 and 1984. Defense outlays are computed from *The Budget of the united States Government*, Fiscal Years 1983 and 1984.

Exploratory Note for Table 30: Columns 1 and 2 represent per capita income in 1970. Low income cities are defined by per capita income less than or equal to $3,304; high income cities have per capita income greater than $3,304. Columns 3, 4, and 5 are defined by population growth between 1970 and 1975; declining cities exhibited negative growth, slow growth cities grew by less than 15% over the period, and rapid growth cities grew by greater than 15%. Columns 6 and 7 define "low" and "high" unemployment by a 1976 unemployment rate of less than, or greater than or equal to 8.9%, respectively. Columns 8 and 9 are based on a hardship index of 100. Finally, city size is defined by cities with populations of less than 100,000 for small cities, 100,000-300,000 for medium cities, and greater than 300,000 for large cities.

TABLE 31

Concentration Ratios for Selected Programs by Region

Program	Real % Outlays Change, 1981-84	New England	Middle Atlantic	East North Central	% West Atlantic Central	South South	East South Central	West Mountain Central	Pacific	
State & Local Fiscal Assistance	-11.5	1.29	1.43	0.69	0.78	1.05	1.25	0.94	1.03	0.77
Employment and Training (CETA)	-47.6	1.23	0.76	0.94	0.81	1.96	1.51	0.80	0.91	1.00
Community Development Block Grants	-24.8	2.13	0.78	0.81	1.56	0.98	1.05	0.99	1.17	0.89
Urban Mass Transit Assistance	-21.9	1.52	2.43	0.70	0.35	0.42	0.39	0.20	0.57	0.66
Vocational Education	-7.4	0.87	0.85	1.02	1.12	1.76	1.66	1.03	1.01	0.68
Work Incentive Program (WIN)	-93.9	0.83	1.03	1.15	0.77	1.34	0.82	0.48	1.57	1.00
S B A	-88.2	0.72	0.95	0.98	0.70	1.45	0.98	1.19	1.21	0.91
Defense	+37.0	0.76	0.53	0.50	0.86	1.31	0.78	1.06	1.48	2.04
Construction	+53.9	0.12	0.13	0.34	0.38	1.02	0.58	1.18	1.53	3.13
Payroll	+11.4	0.42	0.48	0.39	0.80	2.47	1.43	1.21	1.93	1.60
Procurement	+61.7	0.96	0.57	0.57	0.89	0.67	0.44	0.98	1.23	2.27

Source: Concentration ratios from Vernez (1980). Changes in budget outlays are computed from *Special Analyses, The Budget of the United States Government*, Fiscal Years 1983 and 1984. Defense outlays are computed from ***The Budget of the United States** Government*, Fiscal Years 1983 and 1984.

inter-regional variations of both social and defense expenditures: they follow almost systematically opposite patterns. Defense spending increase is more pronounced than average in high-income, non-declining, low unemployment, and "low-hardship" areas; in medium and small, rather than large cities; and overwhelmingly concentrated in suburbs, though this last result (interestingly enough) is exclusively due to the high suburban concentration of *defense procurement*. In terms of regions, the story that we have told many times all along this paper, repeats itself here again for the most recent 1981-1984 period: while concentration ratios for social expenditures vary across the country, depending upon programs, defense expenditures are heavily concentrated in the West South Central, South Atlantic, Mountain, and particularly in the Pacific regions. Study by Glassmeier, Hall and Markusen also reports similar trends with high tech defense -related activities being the most spatially concentrated of all high tech sectors, and showing a preference for the Southwest and the West, for medium-size cities, and for suburban locations when they are adjacent to large metropolitan areas. Why is this so? We have formulated a number of hypotheses all among this study. Markusen adds (or reaffirms) a number of reasons: large extensions of undeveloped land are required, both for building of huge material structures and for the requirements of testing equipment; skilled labor, isolated from the metropolitan environment, and if possible from unions, located in self-contained residential communities close to the production facility, is also a fundamental condition of military-related production; but the main reason seems to be historical and cultural: the existence of huge military bases (for instance linked to the war in the Pacific), and the anti-urban, anti-"big city world" feeling of the military, particularly significant if we consider the sizable cross-over between the Army and management positions in the military industry. Ann Markusen poses the question of the spatial form of the military-industrial complex. Could it be--*we add*--the endless southwestern desert or the infinite Pacific Ocean, ridden by the last cowboys, the nuclear cowboys, in their winged, propelled horses, coming back in the evening, to their small, clean town, to pray in the community church together with their family that, it also, has remained nuclear and indestructible?

Whatever the reasons, it is clear that the military connection of most high tech activities, induced by the state, has had a enormous impact on the spatial dynamics, shifting investment, jobs, and people toward new lands in the outskirts of the metropolitan areas, and in the south and western regins where new activities and new social environments could be recreated, far away from the constraints of a state that was the depository of the social contract agreed upon by classes after decades of struggle. The new urban and regional landscape segregates social universe besides classes or races, adding a new cleavage to the already existing forms of segregation. It is the cleavage between the emerging production system, determined by the Warfare State and generating a new culture (still unnamed), and the declining system of production and social organization, in which the state had become too deeply penetrated by interest groups and historic compromises to be an adequate tool for the commanding height of the economic and political elites. The restructuring of the State[187] actually precedes, and determines, the restructuring of the economy, itself relying on a high technology-led process of production, that fundamentally reshapes the American landscape. The welfare state was born in the furnaces of life of the large inner cities. The warfare state expands over an abstract space of distance and silence.

4.4.4. The New International Economy, Technological Change, and Spatial Reorganization

The growing internationalization of the economy is a fundamental element of the economic restructuring under way in the capitalist system. Though it has been a crucial

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[187] See: Martin Carnoy, *The State and Political Theory*, Princeton: Princeton University Press, 1984.

feature of the expansionary period of 1945-73, the crisis of 1974-75 and the subsequent policies of both corporations and governments have increased the interdependency of the national economies, trying to overcome the crisis by winning a competitive edge over other economic units by investing, producing, or selling in the most advantageous locations at each particular moment.

The process of internationalization concerns certainly the exchange of commodities, but international trade is by no means the most important, let alone the newest, aspect of the new world economy. The process of internationalization concerns, as well, capital flows, migration of labor, the production process, and the organization of management of economic units.[188] The combined result of this process is a complete reorganization of national economies and of their spatial structure, and this is even so for less developed and newly industrialized countries. Nevertheless,because of the specific scope and interests of this paper, we will focus on the impact of the process of internationalization on the United States, and only to the extent that such a discussion is needed to assess the role of technological change in the spatial reorganization induced by the new, international division of labor. We will largely rely on the research conducted for several years by Norman Glickman and his co-authors, on the impact of international trade and capital mobility on cities and regions,[189] on international labor flaws,[190] and on the role of the state in an internationalized economy.[191] Additional sources will be used in due course.

First of all, exports and imports have played an increasing role in the U.S. economy, jumping from 5.3 of the GNP in 1950-52 to 11% of the GNP in 1979, in the case of exports, and from 4.5% to 11.1% of the GNP during the same period. For imports, Charts 14 and 15 provide an indication of the relative importance of exports for manufacturing by sector and state. The trend of increasing importance of international trade for the U.S. economy has accelerated during the 1973-83 period, during the process of restructuring. The acceleration has been much greater for imports, providing a skyrocketing deficit of the balance of trade[192] as shown in Chart 16. The deficit is worsening even more rapidly with the overvaluation of the dollar; current projections put it at a staggering $120 Billion in 1984! At the same time, it has been a certain reorientation of U.S. Trade, both in imports and exports, away from OECD, and towards newly industrialized and oil producing countries. Yet exports to OECD still account for about 60% of total exports, and imports from OECD (particularly from Japan and Germany) for about 58%. But perhaps the most significant trend concerns the changing structure of U.S. Trade: the U.S. is importing more and more manufactured goods, while having an increasing trade surplus in agriculture and services. Within manufacturing, as one would expect "high tech" products,

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188 See: Christian Palloix, "The Self:Expansion of Capital on a World Scale" in *Review of Radical Political Economics*, 9, Summer 1977, 1-28; Folder Frobel et. alter, op. cit., 1980; A. Portes and John Walton, op. cit., 1981; American Assembly: *Global Companies: The Political Economy of World Business*, Englewood Cliffs, N.J.: Prentice Hall, 1975.

189 Norman J. Glickman, *International Trade, Capital Mobility and Economic Growth: Some Implications for American Cities and Regions in the 1980s*. A Report to the President's Commission for a National Agenda for the Eighties, Washington, D.C.: June 3:4, 1980.

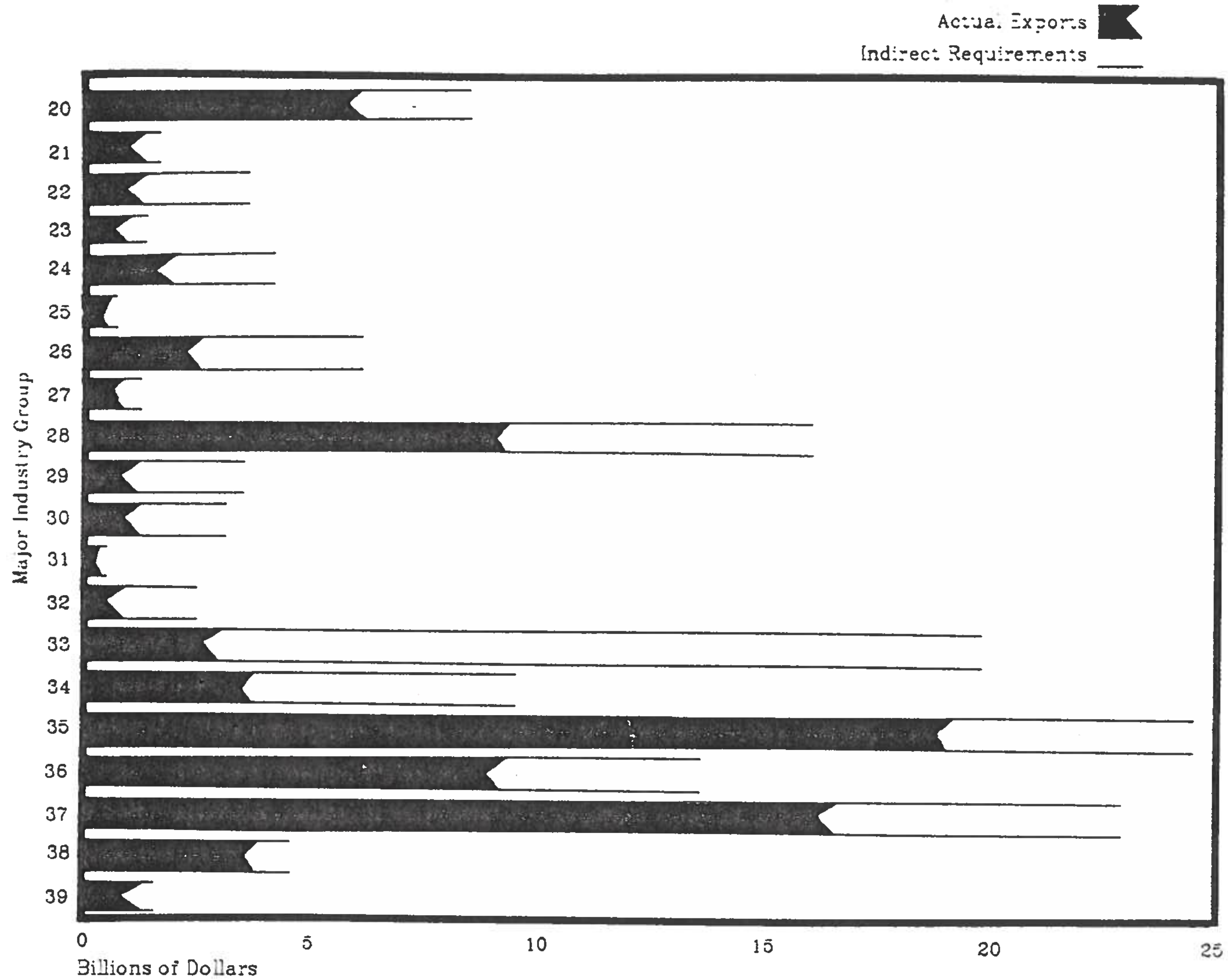
190 Norman J. Glickman and Elizabeth McLean Petras, *International Capital and International Labor Flows: Implication for Public Policy*, Philadelphia: University of Pennsylvania, Working Papers in Regional Science, August, 1981.

191 Norman J. Glickman and Robert R. Alford, *The State in an Internationalized Economy*, Paper presented at a Conference on Local-National Linkages in National Development," sponsored by the U.S. Social Science Research Council, Bellaggio, Italy, March 15-19, 1982.

192 *Business Week*, August 29, 1983, pp. 65-71.

CHART 14

Value of Exports and Indirect Requirements to Support Exports for Manufacturing Industry, 1976 (in billions of dollars)



	Major Industry Group	Actual Exports ($ billion)	Actual Exports and Indirect Requirments ($ billion)
20	Food and kindred products	5.88	8.28
21	Tobacco manufactures	1.02	1.33
22	Textile mill products	1.22	3.44
23	Apparel, other textile products	0.73	1.12
24	Lumber and wood products	1.89	4.00
25	Furniture and fixtures	.18	.35
26	Paper and allied products	2.26	5.95
27	Printing and publishing	.57	1.13
28	Chemicals and allied products	9.27	15.97
29	Petroleum and coal products	1.15	3.45
30	Rubber, misc. plastic products	1.27	3.05
31	Leather and leather products	.28	.40
32	Stone, clay and glass products	.90	2.40
33	Primary metal industries	2.94	19.85
34	Fabricated metal products	3.70	9.46
35	Machinery, except electrical	19.04	24.52
36	Electric, electronic equipment	9.15	13.62
37	Transportation equipment	16.52	22.98
38	Instruments and related products	3.7	4.52
39	Misc. manufacturing industries	1.34	1.62

CHART 15

Exports as a Percent of Total Value of Manufacturing Shipments of Manufacturing Establishments by State, 1972 and 1976

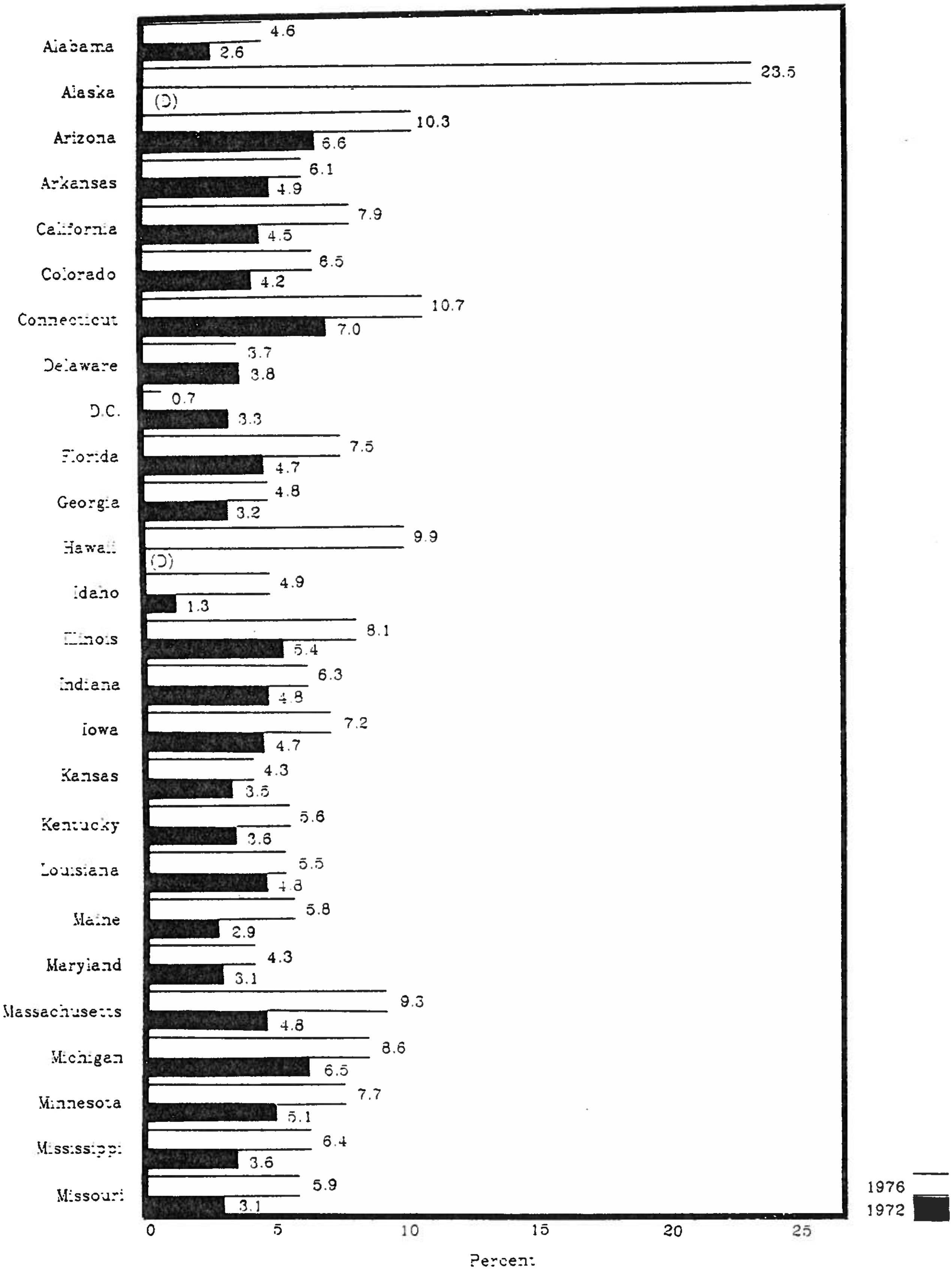
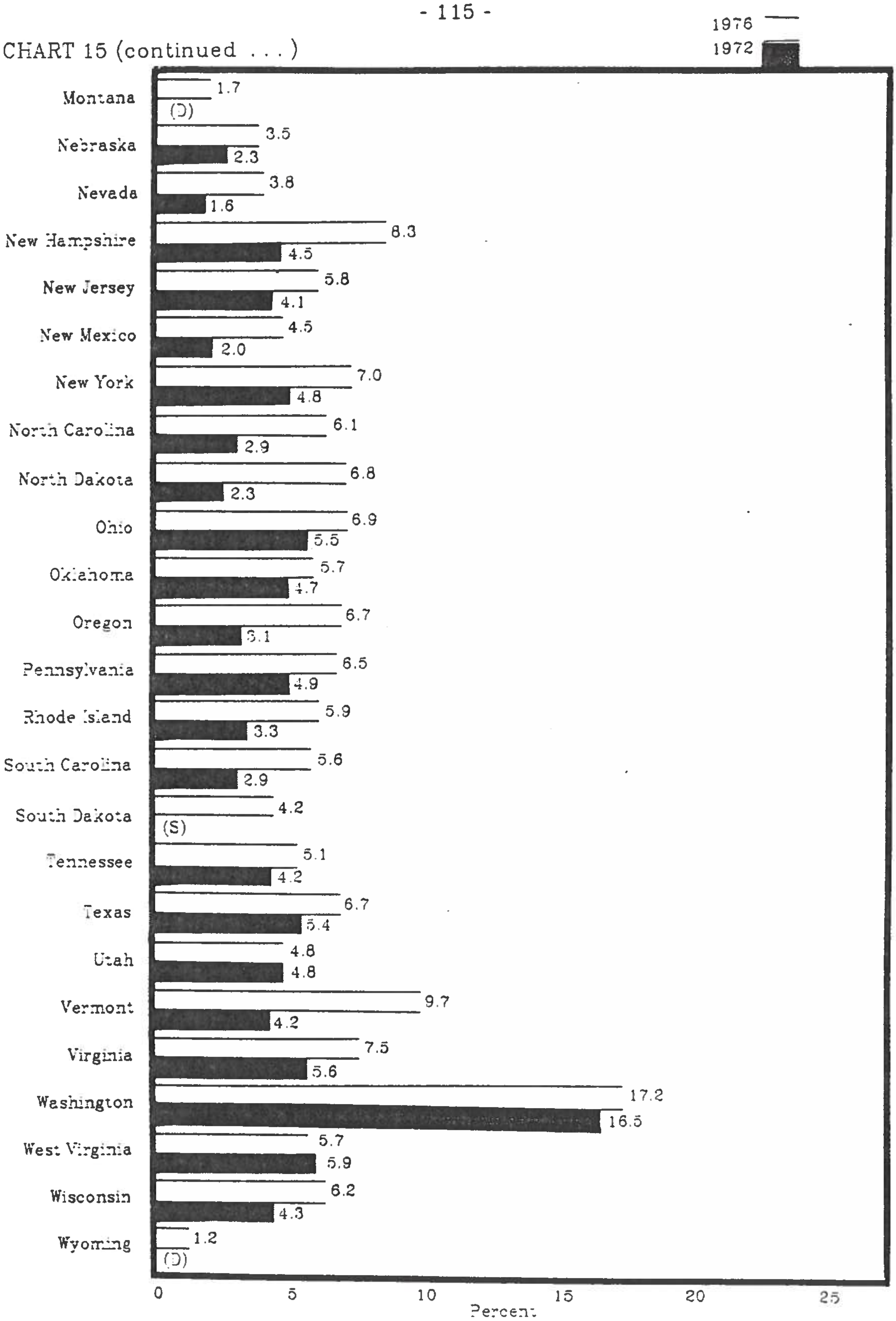


CHART 15 (continued . . .)

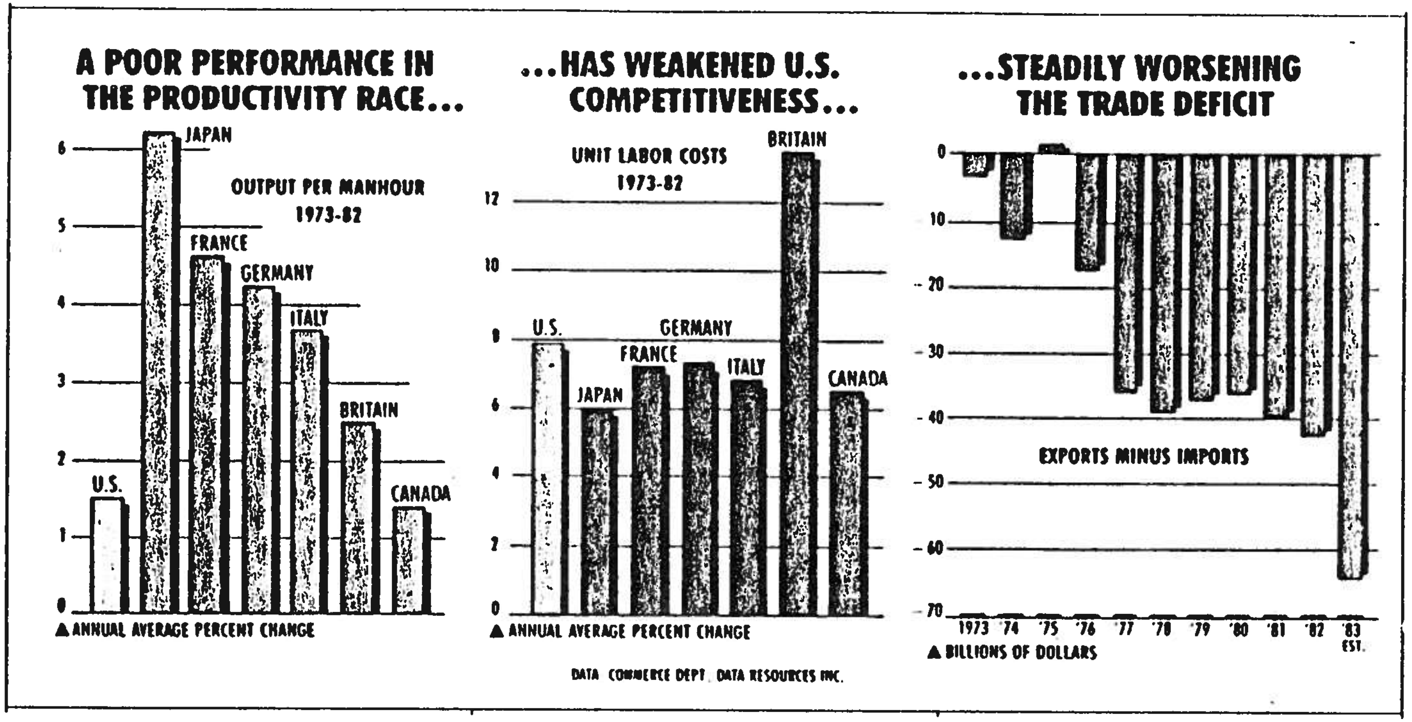


(D) Withheld to avoid disclosing figures for individual 9companies.

(S) Withheld because the estimate did not meet publication standards.

Source: U.S. Department of Commerce, Annual Survey of Manufactures, 1976

CHART 16


A POOR PERFORMANCE IN THE PRODUCTIVITY RACE...
OUTPUT PER MANHOUR 1973-82
U.S.
JAPAN
FRANCE
GERMANY
ITALY
BRITAIN
CANADA
▲ ANNUAL AVERAGE PERCENT CHANGE
...HAS WEAKENED U.S. COMPETITIVENESS...
UNIT LABOR COSTS 1973-82
U.S.
JAPAN
FRANCE
GERMANY
ITALY
BRITAIN
CANADA
▲ ANNUAL AVERAGE PERCENT CHANGE
...STEADILY WORSENING THE TRADE DEFICIT
EXPORTS MINUS IMPORTS
1973 '74 '75 '76 '77 '78 '79 '80 '81 '82 '83 EST.
▲ BILLIONS OF DOLLARS
DATA COMMERCE DEPT. DATA RESOURCES INC.

particularly in electronics, medical equipment, aircraft, and military hardware, are major export sectors, while consumer durables, transportation equipment, steel, textiles, and apparel, are major importers. It follows a growing distortion of the existing U.S. economic structure as it connects to the world economy with tremendous impact into the territorial division of labor between and within U.S. regions and cities.

Secondly, there is a growing internationalization of capital itself, particularly after the massive development of the Eurodollars market during the 1970s, and its reinforcement by the flow of petro-dollars. The newest and interesting trend is that, along with the growing outflow of U.S. capital abroad, it has been a massive increase in direct foreign investment that has grown by 600% between 1973 and 1983 until reaching $111.3 Billion dollars in the U.S.[193] Table 32 and Chart 17 provide an illustration of the process. As a matter of fact, the current recovery, potentially undermined by still high interest rates, is being financed in a decisive proportion by foreign capital that, for instance, holds about 25% of U.S. government debt. Where is this investment going?[194] Interestingly enough, as chart 17 tentatively shows, it is not just speculative investment, but heavily skewed toward manufacturing.And in their manufacturing, in old-line sectors (as automobile and textile) as well as in high tech sectors. It actually seems as if foreign manufacturers were positioning themselves within the U.S. economy in those sectors they used to export, so to be prepared for the coming round of protectionism if the dismantlement of entire manufacturing sectors puts enough political pressure on the U.S. government to restrict imports in automobiles, steel, chemicals, and textiles.

Glickman reports that "most of the investment in new manufacturing plants by foreign corporations has been in the Southest and the Far West, while the acquisition of existing lines was in the New England, Mideast and Great Lake regions."[195] But he also reports a study on the subject by HUD[196] according to which, 64% of foreign manufacturing investment was in distressed cities in 1974. Investments in 1977 and 1978 showed a decline of the flow toward these areas. In general, it seems that there are 4 concurrent strategies at work: a) To buy existing old-line manufacturing, to renew it, and to practice import-substitution of consumer durables within the U.S., b) to create new plants in high-tech sectors in the growing areas, c) to invest in banking, this highly concentrated in New York, Los Angeles, Houston, San Francisco, and Chicago, d) to place purely speculative, capital, particularly in real estate, in New York, Los Angeles, and Houston, in fact in all booming regions and high-level downtowns.[197]

The third trend concerns the renewed internationalization of labor in the U.S., at a moment where, on the contrary, in Europe, the immigration flow is halted or reversed. In the U.S., on the contrary, we witness an immigration flow unprecendented since the 1920s, particularly in California, Texas, and New York.[198] This flow, that could amount to as much as 1.5 million people per year, about 2/3 of them undocumented, is transforming the social fabric and the labor markets in the U.S., particularly in the largest

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193 *Business Week*, June 4, 1983, pp. 103-104.

194 See: Work in process by Erica Schoenberger, Johns Hopkins University, for her Ph.D Dissertation in City and Regional Planning, U.C. Berkeley, on foreign investment in the U.S. economy.

195 Glickman, op. cit., 1980, p. 26.

196 U.S. Dept. of Housing and Urban *Development: The Impact of foreign Direct Investment on U.S. Cities and Regions*, Washington, D.C., HUD, 1979.

197 See: work in progress on Houston's development by Joe Feagin, Dept. of Sociology, The University of Texas at Austin.

198 See, for instance: James Fallows, "The New Immigrants," *The Atlantic*, November, 1983, pp. 65-85.

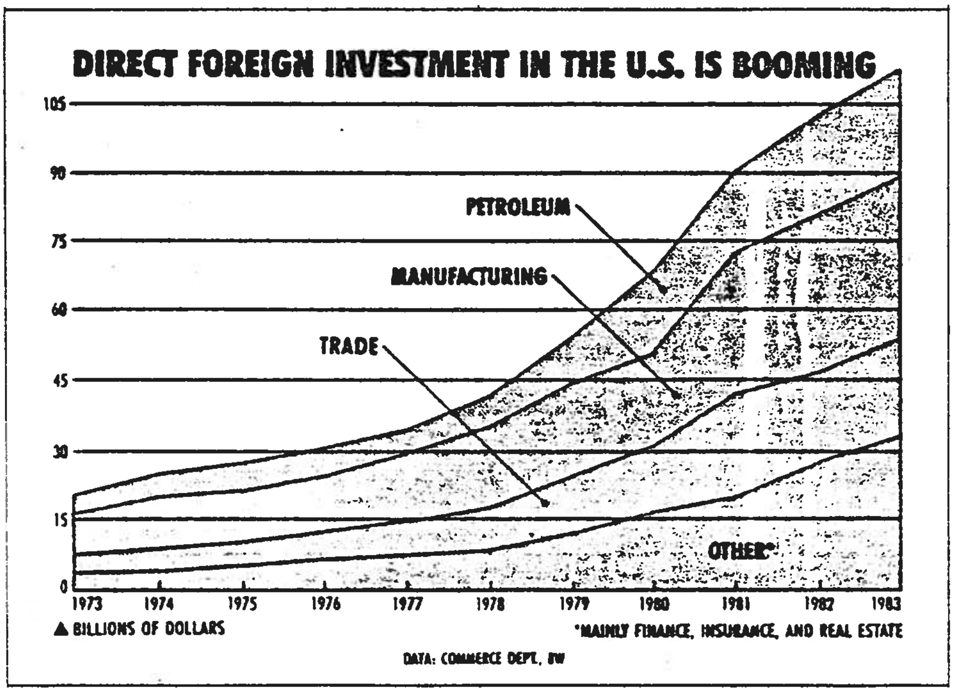
TABLE 32

Who Holds the Biggest Stakes in the U.S.
(in billions of dollars)

	1973	1983*
Britain	$5.4	$23.3
The Netherlands	2.6	21.4
Canada	4.0	9.8
Latin America	0.4	9.2
Japan	0.3	8.7
Germany	0.8	8.2
Switzerland	1.8	4.8
France	0.5	4.7
OPEC	0.1	4.4
Belgium/ Luxembourg	0.6	2.2
TOTAL	$16.5	$96.7

Source: Business Week

CHART 17



metropolitan areas,[199] fueling, among other things, the informal economy: the new international economy and the informal economy are but two faces of the same process.[200]

Fourth, there is an internationalization of the production process itself, with location of different facilities in different countries, according to labor conditions, tax incentives, business climate, and access to specific resources, or to particular markets. We have already mentioned the spatial division of labor characteristic of the semiconductors industry at least in its expansionary phase.[201] But perhaps the most striking example of such an evolution is the current reorganization of the U.S. automobile industry, with the coming of the "world car" as a very concrete expression of the "global factory" announced by Richard Barnet years ago.[202] The process of restructuring of the automobile industry, in relationship to the international economy and the crisis of Detroit, has been analyzed by Ken Trachte and Robert Ross.[203] They show the decline of the U.S. automobile industry when faced to international competition from Japan and Europe: indeed, the U.S. share of world motor vehicle production declined from 76.2% in 1950 to 19.0% in 1982. Even in the U.S. market, foreign imports as a share of passenger cars went up from 15% in 1970 to 28% in 1982. But what it is even more interesting is *the outflow of U.S. automobile companies investment:* by 1980, 37.2% of the total motor vehicle production of the four leading U.S. automobile companies were located abroad. Table 33 provides a striking illustration of the process for Latin America, and Table 34 underlines the importance of foreign sourcing in U.S. automobile production, a trend whose importance has been emphasized both by Tabb,[204] and by Glickman,[205] in their analysis of the new process of production. In other words, the main competitor to the U.S. automobile industry in the U.S. is the U.S. automobile industry abroad... It follows a massive decline in employment, that strikes particularly regions and cities, as Michigan and Detroit that were the centers of the automobile industry (see Table 35). But we should recall that after Detroit, Los Angeles is second in automobiles plant closing. We are *not* in a process of decline of some regions versus the growth of others, but in a process of economic restructuring in which the international mobility of capital largely determines the fate of industrial sectors, labor market segments, spatial areas, and local communities. Another expression of the new internationalization of production is the formation of the so-called *Border Regions*[206] in many economies and particularly in the U.S., the Mexico's Border Region based on the Maquiladoras,[207] that has profoundly transformed

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199 See: Work in Process on U.S. Immigration by Alejandro Portes at the Johns Hopkins University.

200 See: *Proceedings of a Seminar on the Urban Informal Economy at Core and Periphery*, The Johns Hopkins University: Dept. of Sociology, June 8-10, 1974.

201 See for instance: Jeff Henderson and Allen Scott, *The American Semi-Conductors Industry and the New International Division of Labor*, Hong Kong, University of Hong Kong, working paper, 1984.

202 See: Richard Barnett, op. cit., 1874.

203 Ken Trachte and Robert Ross, *The Crisis of Detroit and the Emergence of Global Capitalism*, Paper delivered at the 78th Annual Meeting of the America Sociological Association, Detroit, Sept. 3, 1983.

204 See Tabb, op. cit., 1984.

205 Glickman, op. cit., 1980.

206 Niles Hansen, "International Cooperation in Border Regions: An Overview and Research Agenda" in *International Regional Science Review*, Vol. 8, No. 3, 1983, pp. 255-70.

207 See: Niles Hansen, "Mexico's Border Industry and the International Division of Labor" in *The Annals of Regional Science*, Vol XV, No. 1, March 1981; also: Clark W. Reynolds, *Mexico-U.S. Relations: New Problems and Prospects*. Stanford University, 1983, Unpublished Paper.

TABLE 33

U.S. Automobile Firms: Motor Vehicle Production and Assembly in the United States and Latin America (Thousands of Vehicles)

	General Motors			*Ford Motor Company*			*Chrysler*		
YEAR	U.S.	Latin America	Ratio: U.S./ Latin America	U.S.	Latin America	Ratio: U.S./ Latin America	U.S.	Latin America	Ratio: U.S./ Latin America
1973	6514	226	28.8	3443	284	12.1	2217	156	14
1974	4673	280	16.7	3098	327	9.5	1789	176	10
1975	4650	259	18.0	2500	299	8.4	1508	174	8
1976	6234	266	23.4	2942	305	9.6	2105	176	12
1977	6700	243	27.6	3745	300	12.5	2038	156	13
1978	6876	294	23.4	3790	338	11.	1870	157	11
1979	6445	318	20.3	3075	395	7.8	1429	169	8
1980	4753	340	14.0	1888	417	4.5	883	137	6

Latin America Percent Big Three U.S. Production 1973 - 5.5%; 1980 - 11.9%

Source: United Nations Centre on Transnational Corporations, *Transnational Corporation in the International Auto Industry*, (New York: United Nations, 1983) pp. 102 and 191.
(Compiled by Trackle and Ross, *op. cit.*, 1983)

TABLE 34

Foreign Sourcing: Recent Commitments by U.S. Auto Firms to Manufacture Components in Foreign Subsidiaries for Use in Domestic Production

Auto Firm	*Component*	*No. of Component*	*Source*
G.M.	2.8 litre V-6	400,000/year	G.M. de Mexico
G.M.	1.8 litre L-4	250,000/year	G.M. de Brasil
G.M.	THM automatic transmission	250,000/year	G.M. Strasbourg
Ford	2.2 litre 1-4	400,000/year	Ford-Mexico
Ford	Diesel L-4	150,000/year	Toyo Kogyo*
Ford	2.3 Litre L-4	50,000/year	Ford-Brazil
Ford	Manual Transaxles	100,000/year	Toyo Kogyo*
Ford	Aluminum Cylinder heads	------	Ford-Mexico
Chrysler	L-6 and V-8 engines	100,000/year	Chrysler de Mexico
Chrysler	2.2 Liter L-4	270,000/year	Chrysler de Mexico
AMC/Renault	Car components and power train	300,000/year	Renault in France and Mexico
VW of America	Radiators, stumpings	250,000/year	VW de Mexico
VW of America	L-4 diesel and gas	300,000/year	VW de Mexico

* Ford Motor owns 25% of Toyo Kogyo

Source: U.S Department of Transportation, Office of the Assistant Secretary for Policy and International Affairs, *The U.S. Automobile Industry, 1980*, January 1981, p. 56.

TABLE 35

Motor Vehicle Employment[1]
U.S., Michigan and Detroit SMSA
(in thousands)

YEAR	Total Employment U.S.[a]	Total Employment Michigan[c]	Total Employment Detroit[b]
1949	751.3	n.a.	313
1950	816.2	n.a.	334
1951	833.3	n.a.	339
1952	777.5	n.a.	315
1953	917.3	n.a.	365
1954	765.7	n.a.	288
1955	891.2	n.a.	313
1956	792.5	411.7	252
1957	769.3	387.7	252
1958	606.5	288.4	183
1959	692.3	303.4	194
1960	724.1	311.2	198
1961	632.3	268.4	168
1962	691.7	299.2	177
1963	741.3	315.8	192
1964	752.9	332.3	208
1965	842.7	364.5	227
1966	861.6	381.9	236
1967	815.8	361.8	219
1968	873.7	382.8	233
1969	911.4	398.7	246
1970	799.0	333.6	210
1971	848.5	351.8	216
1972	874.8	367.7	224
1973	976.5	399.0	248
1974	907.7	364.3	232
1975	792.4	327.9	199
1976	881.0	352.8	221
1977	947.3	386.5	239
1978	1,004.9	409.6	252
1979	990.4	392.7	232
1980	788.8	333.5	192
1981	783.9	319.4	178
1982	704.8	287.0	167

[1] SIC 371: Motor Vehicles and Equipment; n.a. = not available

Sources: [a] (1949-1976) *Employment and Earnings, U.S.: 1909-78*, U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 1312-11; (1977-1981) *Supplement to Employment & Earnings, Revised Establishment Data*, p. 88, Bureau of Labor Statistics, June 1981; (1982) "Employment and Earnings," September 1982, p 40, Bureau of Labor Statistics.

[b] "Historical Force Levels and Unemployment Rates," City of Detroit, Planning Department, Data Coordination Division, December 1982. Unpublished data.

[c] *Employment and Earnings: States and Areas, 1939-1975*, U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 1370-12, p. 306; and Bulletin 1370-15; Supplement to *Employment and Earnings: States and Areas, 1982*; 1956 and 1957 and Detroit, 1982: unpublished data, Michigan Employment Security Commission, Research and Statistics Division.

the economic and social character of large areas not only in Mexico but of the U.S. as well.

Finally, the process of internationalization has a specific historical actor: the multinational corporation.[208] It is the emergence of this particular type of organization, transcending national boundaries, cultural specificity, and political controls, within a global strategy whose logic cannot be fully understood in any individual unit, that allows for the expression of the four processes we have described. Not only, according to Glickman, multinational corporations are more likely to relocate activities that other forms of corporate business,[209] but they are the necessary instruments to coordinate activities and programs scattered in many locations and contexts, often all over the planet. It is precisely this ubiquity that allows the multinational corporation to impose its own rules of the game, since its space of variable geometry is specific to its interests, and unmatched by any other power . . . except by another corporation of similar characteristics. It is in the organizational logic of MNC that finds support the hypothesis we have formulated about the space of flows attempting to supersede the space of places. Nevertheless, at the same time, the global reach of the corporation needs a network of advanced services, a material infrastructure, a series of communications facilities, and even a social milieu, that have come to be associated with the high-ranking downtowns in the largest metropolitan areas of the country. So, we find both a tendency toward the de-localization of the logic of the economic process, and toward the concentration of decision-making units in a few commanding heights of the international economy.

Secondly, much of high technology manufacturing epitomizes as we have seen in Section 2 of this paper, the new spatial division of labor, with the locationally distinct hierarchy between research and design, and assembly-line operations, therefore spearheading the new space of global production. Furthermore high technology makes possible, and actually accelerates the internationalization of the production process at three levels: a) Because the value of the products in "high tech" is increasingly linked to their informational component, the light weight of many of these components, together with transportation technology, make easier the spatial division of labor. b) The process of automation and the increasing precision of machine tools (particularly, numerical machines and robotization of the assembly process) make possible a large-scale standardization of the components of most manufacturing activities, and their recombination wherever the location appears to be more convenient. c) The growing importance of skilled professional labor and the decreasing importance of unskilled labor in high-tech reorganized manufacturing reinforce the trend toward the decision to locate high-level operations in a few limited areas of the world, while having a very broad choice of locations for routine operations, including fully automated plants closer to the company's basis. The application of high technology to all manufacturing, definitely segmentates the production process, thus favoring its internationalization.

In the third place, we should remember that high technology is, above all, a *new process of production and management*. Therefore, the more the economy becomes open, internationalized, and competitive, the more the appropriation of high tech, and its implementation in the factories, offices, and communication systems, of a company or of a country, become crucial elements in winning a competitive edge. In this sense, the internationalization of the economy tremendously reinforces the growth and the importance of high technology activities. Furthermore, because of this importance, investment in high tech production, or the conquest of markets for high tech products (in

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[208] United Nations: *Transnational Corporations in World Development: A Re-Examination*, New York: United Nations, 1978; Raymond Vernon: *Sovereignty at Bay: The Multinational Spread of U.S. Enterprises*, New York: Basic Books, 1971.

[209] Glickman, op. cit., 1980, p. 2.

growing demand) become key elements in the strategy to dominate the international economy. The competition between Japanese and America companies in electronics, or the global battle over telecommunications systems illustrate at which point high tech sectors have become the decisive *economic elements* (and not just the technological ones) in the new worldwide competition for wealth, information, and power.

Fourthly, given the strategic role of high tech sectors in the international economy, their development creates a new structure of international *dependency* (and not just interdependency) between countries, companies, regions, cities, and social groups.Without access to the know-how, whichever the speed in the diffusion of innovation, countries or economic units will be always under the structurally prevailing logic of the dominant poles of the system (even if they succeed in being better off in absolute terms), *as far as they continue to play by the current rules of the international economy.*

What leads us to our last, and fundamental point. Because of the political, indeed historical implication, of the repositioning in a world economy, *increasingly internationalized and structured by high technology*, national governments (or even local and regional governments) cannot be limited to their traditional roles. As Zysman and Cohen, have indicated in their comprehensive study of recent trends in the international economy[213], the *developmental states* (whichever the type: Japan, France, or Brazil) have forcefully entered the arena of economic restructuring with international competition as their main concern. It follows that multinational corporations are not alone in the "game" any more, and that the national states try to recover the initiative they have lost to the private sector, by using their resources and influence *both* as *national political actors* and as *international economic actors*. It follows that national industrial policies, geared toward the new connection between high tech and the world economy, become the core of economic restructuring, and therefore of urban and regional reorganization.

We, thus, now turn to summarize the trends we have been able to observe in the spatial restructuring under the conditions of the new international economy:

1) The internationalization of the economy actually reinforces the spatial polarization between sectors in different regions and as their metropolitan areas. Particularly, since manufacturing exports are decreasing and manufacturing imports are on the rise, the old-line industries are increasingly hurt by international competition. Furthermore, outflow of capital investment (for instance in the automobile), and shift of capital toward the promising high tech sectors will augment inter-sectoral differentiation, and therefore the distance between spatial areas we have been able to associate with each economic sector.

2) Yet, this general tendency has to be qualified on two grounds:

   - Given the importance of agricultural exports, and the foreseeable jump in agricultural productivity, the through biotechnology, the new international economy favors the farming states, particularly in the Midwest, but only as far as they are part of the agro-business international complex.

   - Direct foreign investment is likely to counteract some of the de-industrializing processes of regions and cities. Yet, it will do so at the expense of lowering labor costs, therefore likely bypassing strong union cities and interventionist local governments.[214]

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213 John Zysman and Steve Cohen, ***The Mercantilist Challenge to the Liberal International Trade Order***, Washington, D.C.: Joint Economic Committee, U.S. Congress, November 1982.

214 See the current efforts by U.S. Mayors to position their cities in the international economy: William Robbins "Cities Go Where Business Is," ***The New York Times***, June 24, 1984.

3) The concentration of economic power at the world level in a few hundreds of major corporations, is spanning growth of advanced corporate services and headquarters in a few major metropolises, consolidating the formation of what Friedman and Wolf have called *the world city*. As they write: "The world economy is no longer defined by the imperial reach of a Rome, a Venice, or even a London, but by a linked set of markets and production units organized and controlled by transnational capital. World cities are a material manifestation of this control, and they occur exclusively in core and semi-peripheral regions where they serve as banking and financial centers, administrative headquarters, centers of ideological control, and so forth. without them, the world spanning system of economic relations would be unthinkable. [. . .] World Cities lie at the junction between the world economy and the territorial nation state."[215] We would just like to add that an internal hierarchy exists between world cities, and that, in the case of the U.S., New York is in a class by itself, followed by Los Angeles, and, further below, by Sa Francisco in banking, and by Houston in oil-related giant corporations. Also, it should be emphasized the crucial role of communications for the formation of world cities, and, vice versa, the cumulative structuring of communication networks around the communication hubs that world cities come to represent.

4) The new process of international migration concentrates a new labor force, and therefore the informal economy, precisely in these *world cities*, whose "underground" component has also to be underlined as a part of the same system.

5) Finally, perhaps the most striking effect of the new international economy on cities and regions is the loss of their autonomy vis a vis the worldwide economic actors that control their activities in terms of a global logic largely ignored and uncontrolled by local and regional societies. In fact, as Robert Goodman provocatively pointed out, cities and states have become "the last entrepreneurs" courting global economic units to beg for their inclusion in the corporations strategy.[216] A rapidly changing economic space determined by economic units whose size and transnationality places them above social pressures and political controls is a *tendency* that, favored by the internationalization process *and* by high tech, wishes to impose the abstraction of a space of strategic decisions over the experience of place-based activities, cultures, and politics. Yet, the reactions of developmental states in the international economy creates a new dynamics, equally abstract in its horizon, but more directly rooted in political pressures and social values. High technology and the process of internationalization give rise to the space of flows, but the historical dynamics of the decision-making process in the world economy, restore the space of meaning. It is in the middle of this dialectics that cities and regions live, die, struggle, change. And with them, people.

5. Conclusion: Spatial Restructuring, City Lights, and Urban Shadows.

The spatial structure of the U.S. has undergone a fundamental change in the last decade, as it is shown, somewhat schematically, by the results of the 1980 U.S. Census. It is our hypothesis that a major underlying cause of this change has been the interconnected processes of economic restructuring and technological change we have examined here. If this is true, we are only at the beginning of this process and the forces at work are likely to modify in a few years the entire urban problematic.

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215 John Friedmann and Goetz Wolff, *World City Formation: An Agenda for Research and Action, Los Angeles: UCLA, Comparative Urbanization Studies, February 1982, page 5.*

216 *Robert Goodman, The Last Entrepreneurs*, New York: Basic Books, 1979.

Therefore, a useful way to conclude this paper will be to remind some of the basic trends of the transformation of the U.S. spatial structure in the 1970-1980 period, and to relate them to the processes analyzed here, so to show the tentative coherence of our hypotheses with such broad set of observations.

To sum up a considerable body of data and literature that we do not think necessary to reproduce in this paper[217] we will enumerate what seem to be the main trends defining the spatial restructuring of the U.S., as shown in the 1980 Census Data:[218]

1) There has been a process of growing *ruralization*, for the first time in history. That is, the rural population grew as fast as that of urban areas, and the urban population would have declined as a percentage of total population, except for the fact that some rural areas grew so fast that they became urban. The interesting point is that this rural increase was *not* related to development of agricultural employment, but to *industrial growth in rural areas*.

2) Urbanization as a whole has *stagnated or declined, depending on the categories:* the proportion of the U.S. population living in urban areas (including small towns) was 64% in 1950, 70% in 1960, 73.5% in 1970; and 73.3% in 1980.

3) Non-metropolitan growth was substantial, but not for all categories of cities: in fact, nonsuburban towns between 2,500 and 50,000 people grew at a lower rate than both rural areas and urban areas longer than 50,000. Thus, it is *not* the growth of medium-size cities that characterizes the slowing of metropolitan growth, but the increase in the rural areas and in the nonmetropolitan areas of some regions.

4) Process of growth and decline varied tremendously across regions, basically with the West, the Southwest, and Florida in the fast growth category, and the Notheast and North Central regions in process of demographic decline.

5) There has been a process of formation of what Long and DeAre call "super-cities," with the intergration of more suburban *and rural areas* into the functional units of large conurbations, such as New York City-Northeastern New Jersey-Southern Connecticut (17,600,000 in 1980), Los Angeles-Long Beach-San Bernadino-Riverside (10,200,000), Chicago-Northwest Indiana/Aurora/Elgia/Joliet (7,200,000), Philadelphia/Wilmington/Trenton (4,800,000), San Francisco/San Jose (4,450,000) etc.

6) some of these "supercities," like New York, have declined in absolute numbers, not just in the city but in the whole conurbation as defined here. Decline of the metropolitan area has been severe in major cities such as Detroit, Cleveland, Pittsburg , Milwaukee, and Buffalo.

7) The general pattern has been to continue the decline population in central cities.

8) A beginning of demographic decline has been observed in the inner *suburbs* of the oldest metropolitan areas.

9) As a general trend, metropolitan suburbs have continued to grow in absolute and relative terms. The proportion of the urban population living in the suburbs in 1960 was 30%. By 1980, it was 41%, occupying 42% or urban land. Interestingly enough, the increase in the suburban share has been faster in the older cities (where it

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[217] See: National Decision Systems, *1980 U.S. Census Population and Housing Characteristics*, San Diego, CA: NDS, 1982, 5 Volumes; Arthur P. Solomon (ed.) *The Prospective City*, Cambridge: MIT Press, 1980; Katharine L. Bradbury, Anthony Downs, Kenneth A. Small, *Urban Decline and the Future of American Cities*, Washington, D.C.: The Brookings Institution, 1982.

[218] See the excellent analysis of census results by two experts from the U.S. Bureau of Census: Larry Long and Diana DeAre, "The Slowing of Urbanization in the U.S." in *Scientific American*, Volume 249, Number 1, July 1983, pp. 33-39.

reaches 50% in 1980) than in the newer areas.

10) *Density of settlement is decreasing* in all categories: it decreased by 15% in the suburbs, by 17% in central cities, and by 18% in small cities and towns. The so-called "back to the city" movement is really insignificant at the scale of the whole country, though it is certainly important and significant in some areas of some central cities. Yet, even at this level, recent data on New York, for instance, show that it has been largely overestimated:[219] in 1970-80, total population of New York City fell by 800,000 people, while population shrank 1.8 million; the share of families with income over $50,000 declined from 62% to 54%; an analysis of census tracts showed "few dramatic changes in neighborhood distribution"[220] This is not to say that gentrification is not happening or that some neighborhoods in the inner cities are not becoming the nest for upwardly mobile professionals, but the phenomenon is very limited, both in scale and in the selective number of areas where it occurs. As a general trend, it seems that the dominant spatial tendency is toward regional and metropolitan sprawl, with low-density human settlements spreading within the super-city, and in rural areas. It follows a dramatic restructuring within older, dense urban areas, with their potential to be concentrated in some neighborhoods, and substantial decline, and even abandonment of large areas.[221]

11) Population decline in many cities goes along with the *increase in the number of households*, particularly because of the dramatic change in the composition of households: in 1970, 70.5% of total households was maintained by a married couple, while in 1982 the proportion had decreased to 59.4%. Non-family households have increased from 18.8$ to 26.9% in 1982.[222] It follows, a growing mismatch between new forms of living and the physical and legal structure of the built environment.[223]

At a more synthetic level, one can summarize the spatial trends in six major developments and one overarching process. Cities and regions seem to have evolved toward a series of specific sociospatial forms, each one with its own dynamics, yet being structurally interconnected.

a) The process of new *inter-regional division of labor* defines the relative weight of each process in a given metropolitan area.

b) Most *CBDs* in the huge metropolitan areas increasingly concentrate directional activities and continue to engage in a process of economic growth, political dominance, and cultural centrality. Around *this* dynamism, *gentrified neighborhoods* preserve the space of the new urban elite.

c) Around the CBDs, large areas of central cities continue their decline and become more and more "*urban reservations*" for destitute workers and minorities, increasingly accounted for by female-headed families.

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219 Study by Daniel E. Chal, published in the Federal Reserve Bank of New York's *Quarterly Review*, May 1984, cited by *Business Week*, June 12, 1984, page 12.

220 Ibidem.

221 Peter Marcuse, *Gentrification, Abandonment and Displacement in New York City*, Columbia University, Papers in Planning, No. 24, April 1984.

222 See: Arthur J. Norton, "Keeping up with Households" in *American Demographics Journal*, February 1983, pp. 17-21.

223 See: William Alonso, "The Demographic Factor in Housing for the Balance of this Century" in George W. Gau and Michael A. Goldberg (editors), *North American Housing Markets into the Twenty-First Century*, Cambridge, Mass.: Ballinger, 1983, pp. 33-50.

d) Yet, some physically declining areas in the central cities, as well as some inner suburbs, are revitalized economically and socially by the new *immigrant city*,, connected to the growth pole of the metropolitan economy, yet suffering from exploitation and discrimination.

e) Beyond the city borders, *suburbs* continue to spread in a pattern of living and working increasingly individualized and diversified.

f) Suburban sprawl is also become *territorial sprawl*, with diffusion of activities and residence across rural and semi-rural areas, sometimes in autonomous settlements, but often in some form of functional relationship with a nearby super-city.

The whole structure appears to follow a logic that combines *spatial diffusion, territorial hierarchy (including an urban concentration of the highest level)*, and *functional interconnectedness*.

If we refer these tendencies to the information and ideas presented all along this paper, it is easy to observe the close connection between the urban-regional consequences of the processes of economic -technological restructuring and the emerging spatial forms:

- High-tech led economic development and the search for less astringent conditions for capital have fostered the new inter-regional division of labor.
- Advanced corporate services required by the informational mode of development and by the global needs of multinational capital have provoked the revitalization of of high-level CBDs and created the conditions for a limited, yet significant, gentrification of their adjacent neighborhoods.
- The transition from the Welfare State to the Warfare state, along with the planned shrinkage of urban services, has precipitated both the decline of large central cities and the expansion of suburbs, particularly, in the regions where the "new economy" is booming.
- The interpenetration of economies and societies at the international level, facilitated by the new communication technologies, has laid the ground for the "immigrant city," as well as for the ex-industrial "ghost towns" that often become the "back door" for the newcomers into the city.
- The polarized occupational structure favored by high-tech, both in its production and in its application, has considerably helped to deepen the cleavages between cities, between inner cities and suburbs, and within central cities.
- New communication technologies, the coming of the "electronic home," and of the "electronic office," have supported territorial sprawl, suburbanization, and individualization of socio-spatial relations.

Altogether, the two major processes appear to express at the spatial level the dynamics of the current technological and economic restructuring:

1) New technologies allow the emergence of a *space of flows*, substituting for a space of places, while still keeping places, yet with their meaning largely determined by their position in a network of exchanges. The logic of large-scale organizations fits perfectly into a spatial form that abstracts from historical reality and cultural specificity to accommodate to new information and instructions.

2) The new model of capitalist growth, supported by the Warfare State and the informational mode of production, induces a *new territorial division of labor*, based on *polarized growth* and *selective development*, that reflects itself in inter-regional cleavages, intra-metropolitan dualism, and *simultaneous* life and death of our great cities.

Thus, a pattern of coherent relationships appears to exist between the processes we have analyzed and the observed evolution of the U.S. spatial structure. These trends since 1980 have clearly accelerated in similar directions, so it seems that we are just observing the early stages of a new urban process.

To be sure, other factors account for the evolution of spatial forms: demographic trends (the rise and fall of the "baby boom", the aging of the population), cultural patterns, (revolution in the family, use-value orientation of the new urban culture), socio-political processes (the new neighborhood movement, the rejuvenation of local politics, the emergence of women and minorities as a political force, the fundamental clash over criteria defining the "quality of life."[224] In this sense, the analysis of the transformation of the spatial structure must include both the techno-economic restructuring of our societies and the social, political, and cultural debates trying to shape, alter, or even reverse, the process currently under way. Yet, unless these debates place themselves within the actual realm of historical transformation we have tried to identify in this paper, urban darkness will be likely to overshadow city lights.

[224] See: Manuel Castells, *The City and the Grassroots*, Berkeley: University of California Press, 1983.