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1997

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citation for published version (APA)

Nijkamp, P., & Ouwersloot, H. (1997). *Social and spatial ubiquity of information and communication technology: a policy perspective*. (Research Memorandum; No. 1997-26). Faculty of Economics and Business Administration, Vrije Universiteit Amsterdam.

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Social and Spatial Ubiquity of Information and Communication Technology a Policy Perspective

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Hans Ouwersloot

Research Memorandum 1997-26



**SOCIAL AND SPATIAL UBIQUITY OF INFORMATION
AND COMMUNICATION TECHNOLOGY
A POLICY PERSPECTIVE**

Peter Nij kamp
Hans Ouwersloot

Social and Spatial Ubiquity of Information and Communication Technology a Policy Perspective

**Peter Nijkamp
Hans Ouwersloot**

Abstract

In this paper, we **analyze** some fundamental impacts of the process of informatization. In particular, we address socio-economic and spatial impacts and discuss possible consequences for policy. Our objective is to discuss issues concerning the desirability, necessity and possibility of government responses to the process of informatization. After a general introduction, we turn to a more detailed discussion of three highly relevant areas for policy: market structures, urban networks and media use. Finally we discuss the options for policy, as well as the need to regulate the informatization process

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1. Introduction

Nowadays it is generally accepted that we live in an information era, at least as far as Western societies are concerned. We should not forget however, that 'eras' usually last several decades, and the information era has only just begun. So it seems more appropriate to speak of the transitional phase between the industrial and the information age. Apart from this semantic argument, there are other reasons to buttress the thesis that the information era has not yet manifested itself in full detail. For example, the current rate of technological developments, which are highly dynamic and unpredictable, lead to continuous innovations that are developed and exploited. There is ample opportunity for speculation, which inevitably lead to such visionary predicaments as the 'global village', 'the wired society' or 'the paperless society'. Solid scientific research however, seems limited because of the sparse number of empirical facts and figures.

As with the beginning of almost every era, the most important driving force is a newly developed technology. Such technological developments stand in mutual relationship to societal developments and have an impact upon each other. Usually however, the impacts on society are felt for a much longer period, and not seldom influence the fundamental characteristics of a society. The invention of the steam engine for example, in the first place triggered the industrial revolution. The technology caused this revolution, but meanwhile, rising wages had paved the way for the **successful** application of the steam engine. Clearly, the steam engine had an impact on society for a much longer period than the end of the nineteenth century. One may argue that this influence stretches as far as the 1950s.

This paper addresses the policy issues evolving **from** the process of informatization (which will be defined in the next section). Policy is, to a significant extent, a reaction to societal trends and developments, which in their turn are largely influenced by technological developments. Since technological progress and the impacts on society are highly uncertain, it is apparent that an analysis of policy in reaction to these development leads to a great amount of uncertainty. We therefore maintain this discussion on a general level and look for underlying themes rather than topics. Our goal is to study the possible impacts of informatization on a number of areas relevant for policy-making, and discuss the potential implications, given a generalized set of policy targets. In particular, we consider the policy target of an efficiently-working economy with a minimal disturbance from policy intervention. In other words, we discuss whether the informatization trend gives additional impetus for the public authorities to withdraw **from** the economic playing field.

As described above, the topic is clearly too broad and too general to apprehend in the context of one paper. Therefore, we restrict ourselves in two important ways. First, we use the concept of informatization only in relation to economic transactions. In this specific context, we *define informatization as the increasing share of the value of traded products or services that is comprised of non-material • intangible • attributes of these tradeables*. It is important to note that informatization in this sense can occur in two distinct ways. One is **that** this increase of value may be due to **uniqu** products, which is related to the process of cultural identification. Young people in particular seem to be very sensitive to this type of informatization. Wearing Nikes or Reeboks gives one a certain level of esteem which has absolutely nothing to do with the inherent quality of the shoes. Secondly, informatization may be a real process, in the sense that the product, service, or its use actually increases in quality, for example, because of improved utility, reliability or durability. For instance, research that has led to better designs

leading to more comfortable or stylish shoes is - from one vantage point- a real effect of informatization.

A second restriction that we adopt in this paper is our exclusive concentration on consequences that can be expected in the economic domain. In particular, when we move to a discussion of policy consequences, we address topics relative to the functioning of economic processes. Although the context of this paper is mainly Western European, the issues discussed have a broader validity.

This brings us to the following organization of the paper. In the next section we give a summary overview of the process of informatization and discuss a number of closely related issues. This overview is not complete, but it does highlight arguments which are important to our discussion. This has the inevitable danger of subjectivity, but we have tried to keep the discussion balanced. In Sections 3 to 5 we treat in greater detail the potential - theoretical - effects of the informatization trend on three dedicated areas which carry significant policy relevance. These areas are the market structure, urban networks and media usage. In Section 6 we turn to the role of governments. The relation between policy and the process of **informatization** is bi-directional and we treat both directions. So in this section, we first discuss the policy alternatives of the government in relation to information networks which are of basic importance to the emergence of the information era. Secondly, we discuss the impact of informatization on the role and legitimacy of government intervention in the economic process. Section 7 concludes this paper.

2. A bird's eye view on informatization

Each transaction in economics - each good or service that is traded - consists of a material, tangible component and an immaterial, intangible component. For example, a bunch of wheat has a certain value. From merely observing the wheat, experts may infer whether it is okay, what type it is etc. These information components are directly and inseparably related to the material component. There are, however, a number of other aspects of the bunch of wheat that cannot be inferred from the material part of the wheat itself such as its origin, the time it has been stored, its treatment during transport, etc. These attributes may well define a significant share of the value of the good.

Informatization was defined earlier as a process of change in which the information component in the transactions of an economy becomes increasingly important. There are two contributing phenomena to the process of informatization and both are strongly related to developments in information technology. In the first place, the cost of information provision has fallen enormously. There is much more information available at much less cost than ever before. At the same time, the possibilities for effectively dealing with this information are also growing at enormous rates. Increasing levels of education, combined with powerful technology to handle information and make meaningful inferences **from** detailed information, **give** rise to this possibility to treat larger amounts of information. When we elaborate on the wheat example above, it may be useful for the consumer to know which farmer produced the wheat, because he can consult a data bank to inquire about the conditions of the farmer's land.

The second contributing phenomenon to the process of informatization is the increase in the share of tradeables that have a large information component. This is illustrated in Figure 1, which shows the relative share in per capita consumption in the Netherlands over the period 1925-1992, in three categories: basic needs, industrial products and services. The figure shows that per capita consumption of services has grown significantly over the period 1960- 1992, while the per capita consumption of the other two categories remained more or less constant. Although products with a large information component are not identical to services, and services are not by definition products with a large information component, it is nevertheless not unreasonable to assume a high correlation between the information component and the service character of a tradeable. Therefore, this figure does not prove the notion that the relative consumption of consumables with a large information component has grown importantly, but gives a strong illustration of the point.

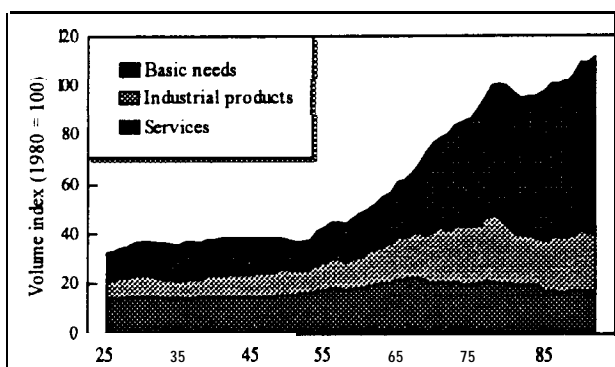


Figure 1 Composition of per capita consumption in the Netherlands, 1925- 1992. *Source, CBS, (1994).*

Figure 1 also suggests an important point about the consumption of basic needs and industrial goods. The per capita consumption of these categories grew steadily over the period 1925- 1960 (approximately), and remained on a more or less constant level afterwards. This not only implies that the overall growth in per capita consumption is entirely attributable to the growth in services but it also suggests that this growth has not led to a decrease in absolute per capita consumption of tangible goods. The message is that informatization is a complement rather than a substitute for tangible products. Consequently, the growth in information consumption does not necessarily lead to a reduction in the consumption of tangible goods. We repeat however, that Figure 1 can only be interpreted as an illustration of the phenomena we suspect will happen. So the above remarks should be read as testable hypotheses, rather than well established conclusions.

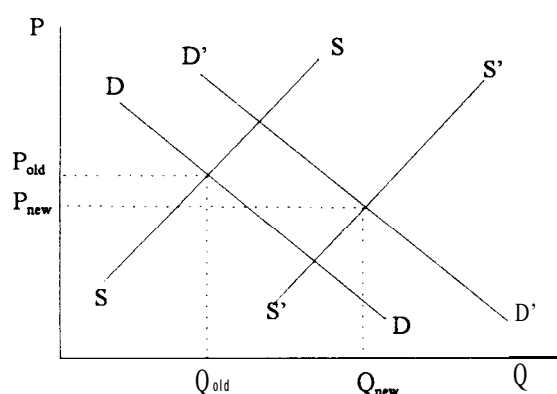


Figure 2 The hypothetical market for information with an exogenous shift in supply and demand.

The process of informatization can be captured economically in a simple diagrammatic presentation, (see Figure 2).

In this figure, the (hypothetical) market for information is sketched. In the “old” situation, the demand curve for information was DD, while the supply curve was SS. Equilibrium was reached at a quantity of Q_{old} for a price P_{old} . Obviously this is a theoretical, abstract market and Q_{old} and P_{old} are unobservable, imaginary variables. As described above, technological progress has led to an autonomous increase in both the demand and the supply of information. This

means that for the same prices larger quantities of information are demanded and supplied. In the diagram this implies a shift of both curves to the right. As a result of technological progress, the “new” demand curve becomes D'D' (for example), while the “new” supply curve becomes S'S' (for example). In the presentation of the diagram the new quantity is Q_{new} which is clearly larger than Q_{old} . This increase is the process of informatization. The new price is P_{new} . In this diagram P_{new} is less than the old price P_{old} , but it is clear that a similar diagram could be drawn for which P_{new} exceeds P_{old} . The price increase or decrease depends on the size of the shifts of the two curves. Unequivocally however, the new quantity Q_{new} is larger than Q_{old} .

When we take a closer look at the price of information, we observe that it consists of two parts. As with most goods and services, these elements are the production costs and the transportation costs. The interesting thing now is that concerning the product information, technological progress has an effect on both elements, but this impact is much more significant for the transportation costs. Production costs are also influenced, for example, because sources required to generate information are more easily accessible, but this may be set against the increased costs of manipulating the inputs. As far as production is concerned, the picture is unclear. In transportation, however, it is evident that the new technologies have unambiguously led to a decrease in costs, and thus in a decrease in the per unit costs of information. This not only holds for the product information, but also for the information component associated with other products.

The fact that the reduction in costs is mainly attributable to the decrease in transportation costs has significant implications for the organization of production. To develop this point, we refer to the theory of Transaction Costs Economics (TCE) originally developed by Williamson (1979). Although TCE is not without its critics (Ghoshal and Moran, 1996) which may be justifiable particularly when TCE is analyzed in its fundamentals, some important conclusions of TCE stand firmly because of their conceptual strength and their empirical relevance. In particular, TCE explains the mere existence of firms (organizations in general) as a means of exerting control over the **constituent** elements of the production process and to reduce the transaction costs. The basic idea is that the production of a good involves the input of a very large number of individual basic goods and actions by people. By organizing these actions into one unit (the firm), the costs associated with the control of the process and the transactions involved are minimized. Therefore, firms are an efficient way to organize production.

This minimal excerpt from traditional TCE suffices for our purposes. The point is that costs of control and transactions are, to a significant extent, related to information. The particular aspect of control • which pertains to quality standards, delivery times etc. • is to a very large degree a matter of information. But transactions also involve information, as, for example, the bills and other accompanying documents concerns nothing but information.

As a result, these transaction costs, and consequently the cost of information, is an important driving force for the existence and scale of firms. Basically, such transaction costs are a decreasing function of firm size, so to minimize these costs creates an incentive to build large organizations.

In modern versions of TCE, other types of transaction costs also play a role. Gurbaxani and Whang (1991) noted that although the firm may be a coordinating device for minimizing external transaction costs, still other costs within the firm, which are also related to the acquisition of information, **labeled** internal transaction costs, are relevant. Gurbaxani and

Whang in particular, identify agency costs • “costs related to obtaining information on the agents’ behavior” op cit. p. 63, where agents are defined as the various units that make up a firm • and decision-information cost. Both costs components increase with firm size.

Informatization impacts on both external and internal transaction costs. Decreasing external transaction costs forms an incentive for the disintegration of firms; decreasing internal transaction costs works in the opposite direction. The result is unclear, but two further remarks are noteworthy.

The first is that empirical research indicates that the integrative forces seem to be predominant. Secondly, it seems theoretically that disintegration is the more attractive option. Apart from the fact that less vertical disintegration becomes feasible for more or less equal costs, the resulting increased competition will likely reduce the price of the products. It is clear however, that the ultimate outcome is as yet uncertain. It may well be the case, for example, that the reduction of internal transaction costs appears to be the most important to firms now; and that the reduced external transaction costs will only be realized in a later stage. Perhaps the most likely outcome is a strong horizontal integration, made possible by the reduction of internal transaction costs, combined with a vertical disintegration, which is due to the decreased external transaction costs, and so firms thus reap the fruits of increased competition. In this way, the benefits of informatization may be fully exploited by organizations.

By elaborating on this scenario, we observe that the consequences may be diverse and immense. Some examples are:

- Vertical disintegration of firms, for example by outsourcing and related concepts. Less far reaching, but similar in kind, is the process of giving units, or departments more independence while staying within the organization.
- The evolution of multi-location firms. This particularly relates to the spatial separation of parts of the production process while the firm remains an entity. In this way, by choosing an optimal location, various elements of the firm can improve their performance.
- A growth in tele-working. This may be interpreted as the ultimate form of the multi-location firm, when each employee is seen as an independent unit of input into the firms’ production process.

Such processes are inevitably accompanied by an increase in the number of transactions. Both the lower per unit price of transactions and the potential gains from growing competition are expected to more than counterbalance this effect, thus leading to an overall cost reduction for the firm. Finally, the horizontal integration bears the danger of monopolization of the market. Although monopolies are not by definition the “bad guys” of modern economies, (we elaborate on that in Section 6), public authorities have to be very alert when such monopolies arise.

The last point in this overview concerns the functioning of markets. Textbook economics begins with the premise that agents have full and perfect information. This premise is often criticized. Does the current trend of informatization lead to a state where this premise is less disputable? This is only partly so. The premise of perfect information concerns knowledge of the supply and demand curves and the qualitative characteristics of the goods (cf the Stigler (1961) analysis of the market for lemons). Informatization will contribute to the suitability-of this premise, but the consequences are far reaching. In an extreme scenario, informatization results in each product becoming unique and exactly identified by its qualitative features (cf. the bunch of wheat example above). Each product will be demanded by one agent and supplied

by one other agent. In the very end, markets as a coordinating mechanism will disappear, but the question remains: how do supply and demand meet?

The economic literature **recognizes** four such coordinating mechanisms: direct search, brokers, dealers and auctions (or the market)⁴. Direct search implies that one supplier searches for one demander of the good (or vice versa), while with auctions, large numbers of agents are present at at least one side of the auction. Dealers are intermediaries who coordinate supply and demand by using an information advantage and holding stock themselves; brokers are similar but do not hold stock. The above mentioned process of goods becoming unique, eliminates the necessity of auctions as an efficient coordination mechanism. Brokers are the best candidates to replace the Walrasian auctioneers, particularly since information is their specialty. Dealers are less likely to become the dominant coordinating mechanism since stock holding becomes increasingly less attractive (cf. the increasing numbers of firms relying on the Just-in-Time principle).

An interesting question is whether these newly emerging coordinating mechanisms impact on the possibilities for achieving policy targets. Two remarks apply. Firstly, when taxes and subsidies are used as a policy instrument, it is well known that the outcomes are in general second-best. First-best solutions can only be reached when taxes and subsidies can be differentiated over perfectly homogeneous groups of agents. In practice it, is impossible to identify perfectly homogeneous groups because their number is too large, both because not enough data is available to identify the groups and because the administrative costs would become prohibitive. It is clear that information technology can contribute to both problems, so that in the **future**, policy measures can better approximate the theoretically first-best solutions.

Secondly, the broker offers public authorities new options for government interventions. Walrasian auctioneers are artificial constructs, but brokers are human. These persons, or more generally, these institutions, can be identified and used as a means to achieve policy targets.

Finally, information becoming increasingly important implies that public authorities can use this phenomenon to achieve policy targets, simply by providing relevant information. In an elementary form, this is current practice (anti-smoking campaigns for example), but it is obvious that this instrument may be refined and extended in many directions. On a superficial level, it seems that in this way, “Big Brother” is going to watch us. There is a significant difference **from** Orwell’s nightmare, however. In our scenario, agents keep their MI freedom of choice, although governments try to influence their choice. So, there is no “Big Brother” making your choices.

This completes our overview of the informatization process and its main consequences. In the next sections, we study these consequences for three dedicated topics: market structures, urban hierarchies and media usage.

⁴The use of the word market is sometimes **confusing**. Market is used as (1) the general term for a coordinating mechanism; (2) in combination with the four coordinating mechanisms in the text (a dealers market); and (3) as a synonym for an auction (large numbers of suppliers meet large numbers of consumers). We try to avoid the confusion by avoiding the **term** market in this part of the paper. In the remainder we will use the term in its general meaning.

3. Market structures

Arguing that markets disappear by being replaced with brokers markets is clearly a sketch of a dynamic process, rather than a state of affairs. Moreover, the extent to which this idealistic picture will emerge moreover depends on a number of factors, particularly the number of actors involved and the degree to which the transactions are subject to the process of informatization. Markets will exist, but the way they work is influenced by informatization. In this section, we ask how informatization influences market structures.

Due to the influence of Industrial Economics, the topic of market structures has gained considerable attention lately. The central paradigm of this branch of economics is the Structure-Conduct-Performance framework. The central thesis is that the structure of a market determines the behavior of the actors on that market and consequently, the performance. This performance relates to both the micro results of firms, and the **meso** result of markets (efficiency), or the macro welfare theme (contribution of market outcome to societal welfare). The question can then be asked which market structure is optimal for a given policy goal. This is more interesting, since market structures appear to be under the direct influence of public authorities by means of regulation, entry conditions and the like.

A market structure is **characterized** by the mutual relationships between suppliers and demanders on the market. A central theme concerns power interpreted as the ability to reach one's goal at the cost of others not reaching their goals. Or alternatively, the relative power of players determines the outcome in zero-sum games. This power can be exerted in price setting (see Ouwersloot et al. (1995) for a **conceptualization** of this process), but also in the selection of standards or other qualitative aspects.

Michael Porter has paid considerable attention to the topic of power in market relations (Porter, 1980 and 1985). His detailed analysis basically reduces (at the danger of oversimplifying matters) to the observation that the relative power of an agent is determined by three factors: the number of competitors, the number of opponents (suppliers and **customers**)², and the use of information. Numbers of competitors and opponents determine the freedom of choice of agents. The well-known extremes are the monopoly and pure competition with free entry and exit. In a monopolized market, the monopolist has total power, in a pure competition no single firm has real power. For other market structures, all players have at least some freedom of choice, and they can react to each other's decisions. Knowing these decisions or the situations that lead to them offers the opportunity for strategic behavior. In such cases, the follower generally is in a favorable position. Therefore, information on the actions of competitors and opponents is of great importance in partly competitive markets. At the same time, it is good policy for an individual firm to hide the information concerning its own operations from the other players.

Informatization now leads to a number of contradictory consequences for market structures.

²In a market, almost every firm is both supplier and customer. Similarly, each **firm** has to deal with suppliers and customers. From a viewpoint of market **organization**, and also in the context of power relations, the roles of suppliers and customers are more or less identical. In our discussion we use the term 'opponents' to capture both sides in one word, which at the same time underlines the similarity of the relationships. *On the other hand*, competitors of a firm are those **firms** that perform comparable tasks (i.e. make the same products). So competitors are importantly different from opponents.

First of all, the geographical scale of markets widens. This compensates for the second effect: due to ongoing product differentiation, the per unit number of opponents decreases importantly. Note that these effects correspond to the process of horizontal integration predicted in Section 2. The combined effects however, lead to a greater dependence of the firm on specialized products and their producers/consumers. **Specialization** and product differentiation may be accompanied by the trend of product specifications that can be easily altered (although not dramatically). This trend reintroduces the option to seek alternative suppliers/customers. Finally, a third effect involves the speed of information transfer. This means that concealing information about one's own firm becomes increasingly difficult, even when the firm's decisions are only revealed by the actions it takes.

Before we can infer from these impacts, we observe one more important and relevant development. This concerns the issue of confidence. Confidence relations are defined here as long-running trading relations with the same opponent. The need for such relationships is basically due to a lack of information. When essential pieces of information are missing a long-run trading relationship can substitute for this lack, given the experience that previous transactions were satisfactory. Obviously, informatization leads to a reduction in the information gap, and thus to a reduced need for long-run trading relationships. Consequently, such long-run relationships will diminish.

The emergence of brokers is also relevant here. Consumers will likely need to have confidence in the brokers, so that long-running relationships with these brokers may substitute for the confidence relations with individual suppliers. This confidence can be increased by a certification institute. It is interesting to observe that in the Netherlands, already existing broker markets such as housing and insurance, indeed work with a self-organized certification mechanism. For the Internet, Wagenaar (1997) expects an increase in the number of certified brokers for information intermediation as well.

The overall picture that emerges **from** the aforementioned developments is one of highly dynamic markets in which instability prevails. The more general principle of increasing power **further** supports the expected development of disintegration of firms. Also, within smaller firms, hiding the relevant information is much easier.

From a welfare-economic point of view, there is a limit to the acceptable level of power of individual agents. This is an obvious task for public authorities. The issue of certification should also be responsibility of these authorities, which would be in the interest of the markets themselves. An interesting option in this respect is public approval of private certification institutes. One way or the other, consumers will, in the end, only fully trust certificates **from** an independent organization. Apart from these remarks, it appears that the role for public authorities is quite limited. The trend is actually towards a (purely) competitive market, in which there is no specific role for government. Agents will attempt to gain as much control as possible in this market, and that is governments only concern.

Finally, we observe that the developments described above also affect the important issue of location decisions. The choice of a location is determined by considering a multitude of factors. We expect that informatization influences the relative weights attributed to these factors. Specifically, the importance of factors such as proximity of suppliers and customers will deteriorate due to informatization. Other factors less influenced by this process will gain in weight, such as the physical infrastructure or taxing regimes. In the next section, we discuss

the consequences of these developments for urban networks.

4. Urban networks

Urban networks play an important conceptual role in numerous issues in administration, economics, transport, etc. An urban network may be defined as the structure of mutual relationships between cities in a certain area. The mutual relationships are described in population rankings, distance between cities, and the implicit dependencies of smaller cities upon larger ones. In this section, we briefly discuss the economic-theoretical background of urban networks, its empirical relevance, the impact of informatization on the elements of this background, and the likely consequences for urban networks, particularly in relation to economics and transport.

The need for safety is usually regarded as the single most important reason for the emergence of cities in ancient history. Nevertheless, economic arguments are also put forth to explain the emergence • and especially the success • of the human invention of the city. There are two such arguments (e.g. Segal, 1977). The first is that a city • a concentration of people and human activity • provides a critical mass of **labor** supply and purchasing power required for the evolution of economic activity. Secondly, transport between locations can be more efficient when the infrastructure is used by many agents • a matter of economies of scale. Hence, the bundling of transport between cities, made possible by a bundling of activities within these cities, facilitates the efficient use of infrastructure. The existence of an infrastructure in turn gives the cities an edge when it comes to subsequent location decisions. In this way, cities confirm their own success, thus explaining the never-ending growth of cities.

With these notions in mind Christaller and **Lösch** developed the so-called *central place theory* in the 1930s and 1940s. It plays an important role even in contemporary research into urban networks. An important conclusion of this theory is that urban networks show a hierarchical pattern whereby the largest city offers the supply of all products and services; the next largest cities offer a few less; the third largest cities offer again a few services less, etc. Implicitly, this theory describes the dependence of the smaller cities on the larger ones, since some services are only supplied on a higher hierarchical level. Moreover, each city on the n -th hierarchical level will seek its missing services in the city of the $(n-1)$ -st level, nearest by, due to the minimization of transportation costs. Finally, the hierarchy will be determined by the size of the populations because of the critical mass argument.

Although the direct empirical relevance of the *central place theory* is limited, it has made an important contribution to understanding urban hierarchies and the associated inter-urban dependencies. For example, the Dutch urban network is far from the idealist **Christaller-Lösch** type of network. Nevertheless, notions that can be traced back to *central place theory* can still be found in contemporary Dutch urban policy.

Considering the effects of informatization, we first have to **recognize** that economic arguments are not the only ones that hold in the analysis of urban networks. We already noted that in the very old days the sociological argument of safety was of **great(er)** importance, and nowadays in the Netherlands, political arguments seem to be the primary driving force for urban developments.

But given these asides we can see a clear effect of informatization on the economic arguments underlying the structure of urban networks. First, the importance of proximity to input (particularly knowledge) reduces strongly. This holds for both information as a product, as well as the information component of other goods. The bundling argument still has its relevance as long as the transport of information requires fixed networks. The growing importance of wireless communication, however, which will eventually include a dominant position for this type of telecommunication, further reduces the need and logic of bundling of transport of information. In the most extreme scenario, the economic arguments will become entirely redundant. The essential point is that location decisions will no longer be made on the basis of these traditional economic arguments. It will no longer be possible to describe location patterns in terms of urban hierarchies. The resulting physical transport of tangible products will show a highly Ass-cross character. Consequently, the urban network will be less hierarchical, but more grounded upon a basis of economic equity (Stough, 1995). In other words, economic centers will disappear.

Clearly, the above describes an idealistic and extreme scenario. An implicit assumption in this scenario is that informatization is a ubiquitous process: all regions and all people profit equally from the informatization process. Gillespie and Cornford (1995) argued that such a scenario currently has limited empirical validity. The developments instead point to a fragmented scenario, in which the undirected and unguided development of the informatization process leads to strategic behavior. The result is that informatization is concentrated in cities. Therefore, Gillespie and Cornford advocate the regulation of this process so that it will not lead to "... a sharp differentiation between places in the range and quality of services provided".

Finally, we repeat that this analysis is strongly biased towards economics. Other, perhaps more relevant approaches of urban networks can be thought of. We strongly advocate such "alternative" analyses to see the differences and the similarities, and to learn more about urban networks (examples of alternative analyses are: Castells (1989) and Graham and Marvin, 1996). Multidisciplinarity is the key to understanding the issues in this highly policy relevant subject.

5. Search and media use

We have identified two consequences of the process of informatization that lead to questions concerning search processes. First, the increased spatial scale of markets, in combination with the fewer per square kilometer number of transaction partners raises the question: how do these partners come to know each other. Secondly, diminishing importance of confidence relations and long-running trading relationships can only become reality when an agent can find new partners relatively easily (i.e. for small cost). This concerns the efficiency of the search process.

The search process can be loosely defined as the process that matches demand and supply. In Section 2 we concluded that the most likely future structure of this process can be identified as a brokers market. In this section, we concentrate on the instruments used to realize the goal of search: to find a transaction partner. We specifically study the topic of media choice. Our analysis will remain on a general level; the pretension to provide answers for concrete media choice problems will be absent.

Our central question is: how do a producer and consumer of a certain product X, with a specified set of product characteristics meet. The most elementary requirement for meeting is that at least one of these agents sends a message. Such a message will be undirected, single to multi-point, because a large part of the population will have to notice the message. A sender hopes that one of the recipients is a desired transaction partner.

Of course, there are factors that influence the success rate of such undirected message. Firstly, the accuracy of the message (does it describe exactly what I want to tell?) plays a significant role. Secondly, media choice is of utmost importance. The population that is reached is in the first place determined by the chosen medium.

The first impact of informatization is that much more data has to be included in the message. Product differentiation is asking this. Nowadays, we do not buy apples, but we buy Golden Delicious from France, not syringed and transported by train. However, a consumer who wants Dutch apples only, does not need to know whether French apples are syringed. Hence, information can be presented in a filtered way. This may lead to a hierarchical search process, an expectation that again is in line with the prediction of the dominance of broker markets. Such hierarchical search processes can already be observed today. A relatively new phenomenon however, is that this hierarchical search covers multiple media. For example, the interested reader of a newspaper ad is quite frequently referred to a home page on the Internet for **further** information.

This brings us to our final point in this section: the role of the Internet. It is clear that the Internet will play an important role in all kinds of human communication in the future, including economic search processes. It is impossible to predict, however, in what direction and to what extent the Internet will become important. A number of questions arise in this respect:

- how will the adoption of computers evolve over time, and moreover which share will be connected to computer networks;
- how will the price mechanism look and will consumers have enough confidence in the reliability of the network with regards to financial transactions;
- how will other media adopt strategic behavior and how will the future equilibrium look;
- will hierarchical search be the dominant paradigm and to what extent, and will it indeed include multiple media or will it be restricted to a single medium.

Concerning these issues, public authorities seem to have adopted a position of wait-and-see what market developments will bring. When public authorities only had an efficient market as their policy goal, this attitude would have been completely justified. A market-driven development may be expected as the most efficient outcome. However, for governments, other motives may be equally important. There are two particular motives to watch closely during the course of events and to react upon when necessary. First, is the familiar possibility of monopolization of markets. Efficient outcomes of market processes are only guaranteed when sufficient competition exists, and this may justify government intervention. A second motive can be that certain media serve two important goals. The **free** press that is represented in journals and newspapers has a particularly important role in the political process of democracies. Hence, a certain degree of media protection against pure economic threats can be justified.

In the next section, we discuss in more detail governments' involvement in the process of

informatization and its derivated effects.

6. Informatization and Regulation

Government's involvement in informatization is bi-directional. First, the possibilities and necessities of regulation are discussed in Section 6.1, Next, the impacts and consequences of informatization for policy instruments are analyzed in Section 6.2.

6. 1 *Regulating the information era*

Concerning the desirability of government intervention in the process of informatization, it has to be noted that:

- informatization may lead to a significant improvement in the efficiency of economic processes, because of the combination of tangible goods and their intangible information aspects;
- informatization may lead to a continuing specification of goods and services, inducing a **shift** from markets to transactions;
- informatization will lead to better knowledge concerning goods and services, although too much information bears the danger of a decrease in the efficiency of the decision-making process. The reason for this is that the supply of too much information itself leads to a decision making process, viz. which information to collect and exploit to make the original decision;
- information can be so valuable that issues concerning the protection of property rights, privacy and the individual may raise difficult questions, that could delay the process of informatization;
- informatization generally assumes a network infrastructure for which issues related to natural monopolies, free entrance, accessibility, contestable markets and separation of ownership and usage are highly relevant.

All this suggests that many informatization-related topics may be left to "the market" as a co-ordination mechanism, but that topics related to market failure require a certain level of government involvement.

For the EC, an important first step towards the liberalisation of the telecommunication market was made by the publication of the "Green Paper" on 'The Development of the Common Market for Telecommunication Services and Equipment' in 1987. In this document, the principles of liberalisation were explicated, but a plea for standardization and harmonization of regulation in the member states was also held.

Informatization in general presupposes the existence, connectivity and entrance to an information network. Many of these networks are public, although they are often exploited by semi-public agents. OECD (1995) gives an interesting overview. An increasing number of networks however, are privately owned. The market has apparently succeeded in organising private networks, not only for intra-firm application, but also for inter-firm objectives (Eliasson, 199 1).

In the World Bank Development Report of 1994, it is argued that government's objectives in infrastructure development should be directed toward achieving growth and sustainability in a market-oriented environment. Policy should give incentives to treat "networks" as a

commercial activity, not as a bureaucracy. Consequently, monopolies have to be fought, and competition has to be favored, in particular by distinguishing between ownership and use of networks. This opens the door to public-private partnerships in various forms, not only for financing, but also for regulation and licensing (cf. the role of FCC and **Oftel**). Hence, even in a highly deregulated economy, there is enough room for informatization policy, which may have as its primary objectives the guarantee of a desired level of competition, as well as the standardization and elimination of bottle necks.

Another EC “Green Paper” on ‘Commercial Communications in the Internal Market’ published in 1996 shows similar conclusions. Market-based communication and information services grow at high rates. Unnecessary and uncoordinated regulation creates numerous barriers to successful commercial activities in this area. This again necessitates standardization and harmonization to fully profit **from** the emerging information era.

6.2 *The impact of informatization on policy*

For a fundamental discussion of the impact of informatization on policy, we first reconsider three basic questions: what is the motivation of policy intervention, what are policy objectives, and what instruments are used?

Basically, a government intervenes in an economy when it becomes clear that without this intervention, certain issues would not go well for example, certain goods would not be produced or a framework for transactions between people would not exist. Government intervention is therefore a way to maximize welfare, which implicitly is defined as the general government objective. Yet, besides this economic objective, other objectives will be pursued in other fields (social, military, law). These various objectives will **often** be at odds. Therefore, a **further** task for governments is to make decisions where partial objectives are conflicting.

In Western societies, it is generally believed that the economic objective can best be achieved by **free** competition in markets and that intervention is necessary only when markets fail. From an economic point of view, we have found three intrinsic reasons for market intervention: market failure, the conflict between economic and other objectives, and the construction and maintenance of a legal framework as a prerequisite to transactions. Market failure can be further broken down into three prominent problems (**Fokkema** and Nijkamp, 1994)

- imperfect competition, caused by a cost structure that leads to (natural) monopolies. Berg and Tschirhart (1989) wrote an interesting volume on the regulation of monopolies;
- imperfect information;
- absence of markets, as for example, in the case of externalities and public goods.

The objective of efficiency has been, and will most likely be the central policy objective in the economic domain. Policy that is based on this objective is contingent to external factors of which three need to be discussed here. Firstly, the relative weight that objectives in different domains receive changes over time. This reflects the variety in voter preferences. Secondly, technological progress is important. Policy targets that were **technically impossible** one day, become feasible now. Road pricing is a good example in this case. Thirdly, and relatively recently, it is **recognized** within economics that even efficiency is a multidimensional attribute. Nowadays, a distinction is made between static efficiency (maximal production for minimal cost) and dynamic efficiency, which involves the development of new products and production processes (innovation) at a welfare maximizing rate (see e.g. **Scherer** and Ross, 1990).

Having laid bare the **fundamental** reasons for government intervention and the issues influencing it, we are now ready to discuss the impact of informatization on the role of public authorities.

The first point concerns the fact that objectives in frequently conflicting areas have to be traded off in the formulation of policy. The mere necessity of trade-off will not be influenced by the informatization process. In an indirect way informatization, may very well impact this point. Firstly, an unequal development of informatization in various areas, or among different groups of people may have an impact on many other issues. For example, the “electronic democracy” may be a very efficient and promising additional option for politics. However, only persons with network access can participate in this “democracy”, and hence from a procedural, equity and legal perspective, this idea cannot yet be further developed. Secondly, to guarantee equal access to the merits of the information age, governments may decide that a common standard for the development of software is mandatory, while this standard is at the same time included in basic education programmes. This is in direct conflict with the economic goal of efficiency, which would require the development of **software** in a free and competitive market.

Next, we consider the possible impact of informatization on the three identified reasons for market failure. First, a natural monopoly arises when the **sectoral** cost structure can be characterized as **sub-additive**³. Non-natural monopolies are often enforced by artificial barriers to entry. Again refer to Berg and Tschirhart (1989) for a comprehensive overview.

Transaction costs are an important source of economies of scale. Since informatization reduces these transaction costs, as we discussed above, this reduces the likelihood of monopolies being natural. Disintegration also leads to smaller - single product - firms which are usually characterized by linear cost functions, so are not sub-additive.

Such small firms will however, try to protect their vulnerable position due to limited market power, by creating artificial barriers, for example by standardization or non-public agreements. Once again, informatization will undermine this possibility because it is increasingly difficult to conceal information.

Secondly, it is clear that the point of incomplete information is largely overcome in the information era, as we already discussed in Section 2. There we concluded that the numbers of suppliers and demanders of products become significantly less, and diffuse in space. This would lead to a growing importance of brokerage as a market mechanism. In such broker markets, imperfect information is not a very likely source of market failure. However, the monopolization of the available information and the issue of confidence remain as important concerns.

The third source of market failure was the absence of markets related to the issues of externalities, public goods, etc. The most important sources for externalities are ill-defined property rights (who owns the clean air in a building, the smoker or the non-smoker), **non-rivalry** in consumption, indivisibility of consumption and the impossibility of technical exclusion

³Sub-additivity of the cost **function** implies that the production of an amount x of a product is less costly than the sum of producing y and z of this product, with $y+z=x$, for all x , y and z . Economies of scale are the most important reason for sub-additivity, and for single product **firms** the two concepts are identical. However, sub-additivity is usually also defined for multi-product firms in which case other causes may also play a role.

in consumption. In general, we remark that informatization and information technology can help solve many of these issues; but on the other hand, some problems are fundamental, and are not a matter of information, such as the issue of property rights. Therefore, government intervention will be persistently necessary, although the number of instances in which policy is required will reduce. The most important point remaining will be to create the conditions under which the “right of information” will be guaranteed equally for all agents.

7. Conclusions

Informatization is a complex process which touches upon the fundamental properties of economic processes. Many basic and even elementary questions remain unsolved for the moment. Nevertheless, some general and consequential developments have been identified. These can be summarised as follows: Informatization leads to an increasingly chaotic economy, with more products, less stability and involving a widening spatial area. At the same time, the self-regulating power of the economy increases. Consequently both the possibility and the necessity of government intervention diminish.

Yet some basic task for public authorities remains. Particularly in the case of fundamental market failure which is closely related to the absence of property rights, is government involvement required.

In this paper we addressed the consequences of the informatization process on some dedicated areas, including market structures, urban networks and the new media. The general conclusion is that these particular areas are strongly influenced by the process of informatization such that a significant share of the existing scientific knowledge loses its relevance. Therefore, it is recommended, from a policy perspective as well, to formulate a broad, integrated and especially multi-disciplinary research agenda into the impacts of the process of informatization.

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