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The land market with multifunctional land use: how to deal with infrastructure?

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Abstract
There is at present much discussion in The Netherlands on so-called multifunctional land use. This concept addresses the challenge to combine several socio-economic functions in the same area, so as to save scarce space and to exploit economies of synergy. An important aspect in analysing multifunctional land use concerns the role of the land market. In general, the higher the degree of multifunctionality of land use, the more expensive it will become to realise. Therefore, one could question if a free land market would facilitate multifunctional land use in an optimal way, and if not, what the relevant forms of market failures are.
Of all different land use functions, especially the infrastructure component is interesting to analyse, since it facilitates many other land use functions in a multifunctional setting. The provision of infrastructure, however, is generally different from the other land use functions, since the government instead of private investors usually provides it. The way the land market is organised could affect the composition of the different land use functions, including infrastructure.
The present paper aims to offer a new contribution to the economics of land-use by addressing the differences between the (optimal) realisation of multifunctional land use in a free or a regulated land market. The importance of transport infrastructure for facilitating multifunctional land use will be explained, and an analysis will be made of possible consequences for the provision of transport infrastructure in a free land market compared to a regulated one.

1 Introduction

Economic science has traditionally put great interest in land use. This interest stems from three characteristics of land: i) land is scarce, ii) land has alternative use options, and iii) land has a social value in the economy. Economists have typically focussed on questions of efficiency and (more recently) sustainability of land use. These studies are generally concerned with 'monofunctional' land use patterns. Since recently, however, also the concept of multifunctional land use has gained interest. The central purpose of multifunctional land-use as a planning concept is to use scarce space as wisely as possible. If population density is growing, the price of scarce space will increase, conform economic theory. Consequences of this development are that a tendency will arise to make more intensive use of the scarce space, especially since land is reproducible only in limited amount. At the same time, spatial claims are often conflicting, resulting in a struggle for space. Furthermore, a specific kind of land-use often affects the functional opportunities of adjacent land. In the case of monofunctional land-use, a spatial specialisation will arise (e.g., a residential vs. a business area). This is in accordance with the standard concentric land-use theory of Von Thünen which forms (via Alonso, Muth and many others) the basis for the so-called bid-rent curves. These are regarded as very important in the Anglo-Saxon literature (Priemus et al., 2000). They deal with concentric spatial functional specialisation around the Central Business District of a city. The market process is the main driver in the competition around the scarce space in these models.
This theory has not been very central in The Netherlands, where there is traditionally limited room for an effective and efficient working market mechanism in a system of regulated spatial planning (zoning, spatial planning plans, etc.). The use of land has often been determined institutionally and price was not the central factor in the allocation process. With the upsurge of market mechanisms in different (public) sectors, urban land-rent theories will probably gain attention in The Netherlands as well. However, there is still strict governmental control on land-use functions.
The present paper aims to offer a new contribution to the economics of land-use by addressing the differences between the (optimal) realisation of multifunctional land use in a free or a regulated land market. In Section 2, a definition of multifunctional land use will be presented, whereas Section 3 will focus on the role of infrastructure in multifunctional land use projects. Section 4 provides a general overview of theory on markets as well as relevant forms of market failures and government failures, which issues will be analysed for the land market in particular in Section 5. An analysis of land use within a monocentric ring is made in Section 6, focussing on specific types of market failures for multifunctional land use. Section 7 contains concluding remarks

2 Definition of multifunctional land use

When multiple functions emerge at the same location, there is a shift from monofunctional land use to *multifunctional land use*. To define multifunctional land use adequately, it is important to identify its time dimensions and its geographical scale levels. The longer the time-span the greater the extent of multifunctional land use. The larger the scope of the geographical scale, the greater the extent of multifunctional land use. A practical definition of multifunctional land use should therefore reflect that the concept is best understood as a relative non-binary one: that

is, it seems more appropriate to define a degree of multifunctionality then to make a strict demarcation between mono- and multifunctional land use patterns.

There are several current definitions of multifunctional land use. That of Lagendijk and Wisserhof (1999) is the most commonly used. It states that one can speak of multifunctional land use if at least one of the following four conditions are satisfied: (1) intensification of land use (an increase in the efficiency of the land use for a function); (2) interweaving of land use (use of the same area for several functions); (3) using the third dimension of the land (the underground along with the surface area), and (4) using the fourth dimension of the land (use of the same area by several functions within a certain time-frame).
However, there are some remarks to be made that mainly concern the first element of the definition. In comparison with the other elements, intensification is a process, whereas the other three elements represent a state. This means that intensification itself cannot be observed in a static sense, but only in relation to developments over time or between different land use alternatives. Interweaving as well as the use of the third and fourth dimension can be observed as being present or not, at a certain moment. Furthermore, intensification is strictly speaking also a possible characteristic of monofunctional land use. Only above a certain scale level intensification can lead to multifunctional land use, since more land becomes available for other functions. The interweaving of land use is defined by 'use of the same area by several functions', but it is preferable to call this 'diversity'. Interweaving, then, can be seen as the degree in which different functions touch upon other functions. For example, within a project area of 400 m^2, four different functions of 100 m^2 each may be less interwoven than the same number of functions having in total 100 m^2 per function as well, but scattered over the project area.
The combination of different land use functions at one location means that the land use intensity increases. Since in many countries the intensity of land use has increased in the last decades and will probably increase further, it is difficult to develop a clear definition of multifunctional land use. The concept of multifunctional land use is very broad. It can range from a combination of two economic functions to the combination of all nine economic functions shown in Figure 1, depending on the chosen scale level.
In this paper, the project level has been chosen as the scale level. The boundaries of a project will define the area that will be analysed. When seen from a project perspective, it is very hard to indicate whether projects are multifunctional or not. As stated previously, only the degree of multifunctionality of projects can be analysed. Therefore, a more suitable definition of multifunctional land use in a dynamic context would be:
A land use pattern is said to become more multifunctional when the average number of functions per unit of land increases in the area considered. An increased degree of multifunctionality may therefore result from the addition of functions to the area (multifunctionality by diversity) or from a decrease in the average size of monofunctional areas (multifunctionality by interweaving).

Increased multifunctionality may be the result of market forces, government policies, or both. From an economic perspective, market forces can be subdivided into demand factors (such as an increased preference for diversity of products and services and marketing externalities) and supply factors (such as agglomeration externalities).

Multifunctional land use can be seen as a empirical phenomenon and studied as from a spatial economic perspective but, multifunctional land use is also used as a planning concept in order to attain (urban) sustainability.
In the case of multifunctional land use as a planning concept it is important to identify specific focal points in order to design an operational definition of multifunctional land use in actual situations (case studies). Nijkamp et al. (2000) have carried out an electronic interactive consultation about the definition of multifunctional land use. The consultation made clear that when applying the definition of multifunctional land use to actual situations, the time dimension and geographical scale level must be specified, but also the following aspects need explicit consideration:

1. The *efficiency* of the multifunctional land use project, compared to the current use of the land, not only as far as the costs of space and space-saving are concerned, but especially, as far as quality of space and sustainability are concerned;
2. The *diversity* of the project's appearance: this can be an extension, such as a new development, or an intensification, which means a change in the organisation of space;
3. The *synergy* of the economic and spatial functions that are brought together, leading to increasing returns to scale.

3 Infrastructure and multifunctional land use

An empirical analysis of multifunctional land use requires unambiguous definitions of its elements; i.e., of the different land use functions to be distinguished. Our study will distinguish nine such (rather aggregate) functions (Rodenburg, 2001), namely: residential housing, work and business, amenities, infrastructure, recreation and culture, water, agriculture, nature and landscape, and remaining land, which includes the use of land that can not be classified under one of the other determined land use functions. These spatial functions are defined to be mutually exclusive.
Of all land use functions, especially the infrastructure component is interesting to analyse since there exist strong interdepencies between the land-use system and the transportation system (regarded here as the system of transport infrastructure), according to the fundamental assumptions regarding urban structures and location behaviour. Briefly stated, locational decisions made as a result of land-use activities are, to a large extent, the result of the relative costs of travel to various spatial opportunities. Given the structure (layout, capacity, geographical position, etc.) of the transportation system, the pattern of trips generated by these activities affects the costs of travel in the region. It can be said, therefore, that the spatial organisation of land use determines and, at the same time, is being determined by the design and characteristics of the transportation system.
There are at least two important questions with regard to transportation in relation to multifunctional land use (Dijst, 1995). The first is *when* people will make movements. People have to move from one location to another to participate in activities. This means that a movement often is a derived demand instead of a goal in itself. The second question is *why* people move. In transport and traffic science it is assumed that a movement to a certain location to participate in activities only takes place if the subjectively judged benefits of the activity at least counterbalances the costs involved with the movement. It is assumed that people will minimise these costs (expressed in time, money and/or effort) as much as possible.

Transport can even be regarded as having a negative utility for the most part: the less of it one has to consume, the better it is. Since transport is derived from the initial functions of spatial organisation, transport infrastructure in itself has several derived functions that represent the original functions of spatial organisation. The reason why people use the infrastructure (work, recreation, etc.) defines the derived function.
Especially concerning multifunctional land use projects, the infrastructure function facilitates many other land use functions within the multifunctional setting. People need infrastructure (road, rail) to go to and from work, to do one's shopping, and to perform many other activities, but also for the transport of inputs for and outputs of other functions. The presence of infrastructure in multifunctional land use projects provides certain flows of people that form a potential user group for the other land use functions within the project area. The influence of transport infrastructure on spatial patterns of economic activities is illustrated in Figure 1 (Bruinsma, 1994). However, transport infrastructure can not be seen as an isolated element. There will be exogenous factors that influence, for example, the size, impact, location and type of infrastructure. Therefore, the dashed line in Figure 1 is added to the original figure.

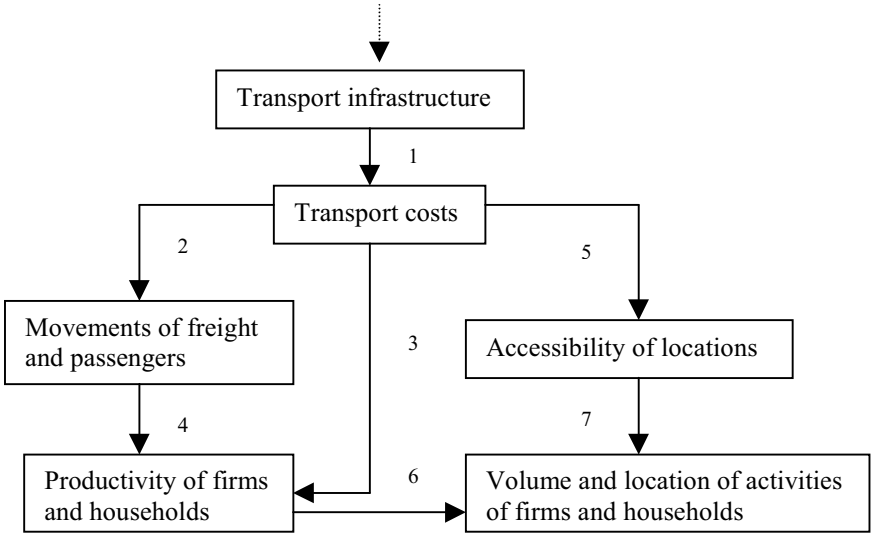

Figure 1: The influence of transport infrastructure on spatial patterns of economic activities (source: Bruinsma, 1994)

The application of this figure can be different dependent on the intensity of land-use. If land is used extensively, the relation between the different elements could turn out to be of less importance compared to a situation where land is used intensively. For example, the realisation of a new or improved piece of infrastructure influences the transport costs by means of shorter distances or higher speed (*1*) which leads to reductions in fuel, capital and/or labour costs. However, using land more intensively by combining different economic functions on one location, could diminish transport costs further. These reductions could result in changes in the choice of transport means, routes and time of departure (*2*), especially if several functions are located very close to each other, partly changing the general way of transport (one single movement for each activity undertaken) into multipurpose trips. This combination of functions will have impact on the choice of transport means, routes and times of departure (*2*) as well, since transport routes will become shorter and for multipurpose trips different transport modes could be chosen compared to the ones chosen for single purpose trips. With a combination of different economic activities, economies

of scale and scope might be realised, leading to an increase in the productivity in the regions concerned (relation *3* and *4*). Furthermore, a decrease in transport costs leads to an increase in accessibility of the locations involved (*5*). In areas with high land-use intensity, the transport costs will not only be influenced by changes in distance or speed, but especially by changes in time. The combination of different economic activities on one-and-the-same location leads to an important decrease in the time that would be involved with practising different activities at different locations. These changes in time consumption have to be included in the transport costs as well, although it is an indirect influence. If the economies of scale and scope that could arise as a result of multifunctional land-use are present, thus influencing the productivity of firms and household and the transport costs, a further expansion of economic activities becomes realistic (relation *6* and *7*).

A focus on infrastructure in multifunctional land use projects is furthermore interesting because of economics of density in transport. These can be enhanced due to multifunctional land use. Especially for public transport, density of use is very important. The more people use the facilities, the better the facilities can be operated according to the preferences of the users. One could think of increased frequency of transport or extension of the network.

Another reason to specifically analyse the infrastructure function is that its provision is generally different from the other land use functions, since the government instead of private investors usually provides it. This means that there should always be a certain form of public-private partnership in multifunctional land use projects in which infrastructure is one of the functions. Not only the provision of monetary funds, but also the determination of responsibilities in case of calamities should be determined clearly. Before these issues, specific for the inclusion of infrastructure in multifunctional land use projects, can be discussed in more detail, a general overview of land markets, as well as accompanying market and government failures will be provided.

4 General theory on land markets and accompanying market and government failures

4.1 Land market theory

An initial starting point in the analysis of the land market is to see what determines the price of land. David Ricardo (1821) is the founder of the idea that the price of agricultural land is determined by its fertility. The more productive the land, the more a farmer is willing to pay to use the land (the so-called land rent). Farmers are price takers and maximise profit where price equals marginal cost. However, if there is competition among prospective farmers, prices of land increase to the point at which economic profit is zero. At any rent less than the maximum profit, the landowner will be able to find another farmer willing to pay slightly more to use the land. These equilibrium land rents make farmers indifferent between different plots of land, since economic profits equal zero. The higher savings in production costs of very fertile land do not exceed the higher land costs. The equilibrium land rents equal the excess of total revenue over nonland costs, also called the leftover principle: the landowner gets the leftovers, because of competition for land among farmers. This principle does

only hold in a free land market in which restrictions on entry and competition are absent.
The land market can be analysed from a micro and welfare economic perspective (e.g., Varian, 1992). In these theories the 'power of the market' is an important starting point. In a free market where externalities are absent the allocation of land over the different functions will take place efficiently and will result in a 'Pareto optimum'. This means that there is no other allocation possible in which one of the parties improves its position, without making other parties worse off. On such markets, individual behaviour focussed on maximising the own welfare leads to a market equilibrium in which the social Pigouvian welfare (i.e., the sum of individual levels of welfare of individual actors expressed in monetary terms) is maximised. In this equilibrium, the welfare of no single actor can be increased without harming the welfare of other actors. This is also called a Pareto optimum, according to the first welfare theorem (Varian, 1992; Verhoef, 1998). Figure 2 illustrates the optimum by means of supply and demand curves. The market equilibrium is presented by point E, which is also the Pareto optimum, since the price one is willing to pay for an extra unit of a good is equal to the price one wants to receive in order to produce/sell an extra unit of the same good.

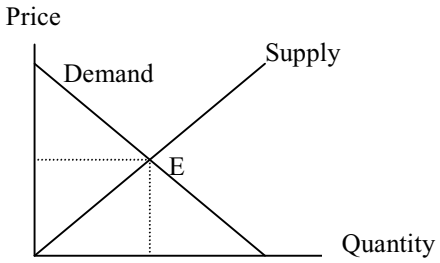

Figure 2: Pareto optimum

However, such a situation of 'perfect markets' should not be regarded as a realistic presentation of the economic market process, since, in practice, it appears that there are always external effects related to land-use and changes in land-use. Another necessary precondition for a social efficient allocation on a market is that buyers and sellers of land cannot influence the prices on the market. They are price takers. There has to be a competitive market. It is this final market condition that is not always fulfilled in practice in the land market. This is caused by, among others, the unique character and the non-displaceability of land. The limited extent of substitution of parcels of land leads to the fact that buyers and sellers can influence the prices of land. Therefore, a situation of 'perfect markets' should be regarded as a hypothetical ideal, offering the opportunity to compare existing market forms. Furthermore, it gives insight to which extent and for which reasons this attractive characteristic of the market does not arise, or is being disrupted. If the market process is regarded according to these principles, insight will be obtained into the most important barriers for realising investments, if it is advisable for the government to intervene in the market process, and what would be the most efficient way of doing this. An important reason, brought up by economic theory, for regulating markets by means of government intervention is the failure of markets (Berechman, 1993). Such failures of markets will be the central issue in the following part, followed by market intervention by governments as well as possible government failures.

4.2 Market failures

Some markets do not function well. Under certain conditions, competing markets fail in the efficient allocation of resources. Reason for this is that under such conditions, the marginal costs with which individuals are confronted in the production of certain goods and services differ from the social marginal costs or from the market prices of the economic activities (Berechman, 1993). This leads to inefficiencies that are expressed by over or under production and consumption of these goods and services. Market failures can appear in different forms in which a distinction can be made between economic and market specific disturbances (Eijgenraam, 2000). Disturbances that are a result of changes in the labour market or taxes belong to the first group. Disturbances that are a result of spatial economic reallocation of activities or imperfect competition belong to the second group. An example of disturbances as a result of spatial economic reallocation of activities is an infrastructure project that attracts industries that bring along increasing chances of catastrophic accidents, making government intervention desirable. An example of imperfect competition is that operators of public infrastructure have, to a certain extent, a monopoly position by means of which prices can be set unequal to marginal costs, and quality requirements are more difficult to impose.
The most general forms of market failures are (Verhoef, 1998):

- External effects
- Market power
- Economies of scale and scope
- Public goods and free-rider behaviour
- Imperfect information and uncertainty
- Transaction costs

In the following, a short overview of the different market failures will be provided.

External effects are unintentional and unpriced effects on the welfare of others (Eijgenraam, 2000). They can be subdivided into positive and negative external effects. In the case of negative external effects (external costs) the market cannot fully capture all costs and benefits of production and trade. Costs (externalities) are in this case transferred to others. In the case of positive external effects (external benefits) the effect is often 'internalised' attributing a price to it. External effects in the land use market are often related to specific land use functions. For example, a major road very close to a residential area causes negative external effects like noise nuisance and stench. In such a case, the social costs are higher than the private costs as they would be expressed on the market.

Market power arises if there are such few suppliers active on the market that they can influence market prices. In the case of market power at the supply side of the market (monopoly, oligopoly), there is not enough production from a social point of view, the quality of production is may not be sufficient and provided against high costs, after which the products are sold for too high prices. In the case of the land market, there is market power if only a few groups have land ownership and can decide to whom they sell land (this is often the government).

Economies of scale and scope are an important factor in the clustering process of activities (O' Sullivan, 1996). Situations wherein increasing returns to scale in production occur may lead to spatial clustering of activities. These internal scale economies extensively treated in the industrial economics literature may arise for at least two reasons:

(1) *Factor specialisation*. In a large operation, each worker is assigned a single task. The specialisation of labour increases productivity, because (a) the workers' skills increase with repetition and (b) the workers spend less time switching from task to task.
(2) *Indivisible inputs*. An input to the production process is indivisible if the input has a minimum efficient scale. If an indivisible input is cut in half, the total output of two parts is less than the output of the whole. As output increases, a firm uses more indivisible inputs, and therefore productivity increases.

Public goods and free-rider behaviour are closely linked together. Public goods are characterised by non-rivalry in consumption (consumption by one person does not mean that there is less consumption for other persons) and non-excludability of consumption (it is almost impossible to exclude consumers of consumption). Public goods will in principle not be provided by the (free) market because of the free-rider problem. This means that it is not attractive for individuals to provide the facility by oneself or to pay for it, but to take advantage of the extent in which others provide the facility. In order to reach a social optimal level, it is logical to have is provided by representatives of the public interest: the government. In the land use market, the public goods and free-rider issue mainly counts for infrastructure, which is one of the land use functions. With this type of land use, the transaction costs of making people pay for the use of it, are so high that in general it is refrained from (with the exception of toll roads).

Imperfect information and uncertainty may have a huge impact on investment decisions, especially in cases where information is distributed asymmetrically over different market players and the goals of these players do not run parallel (goal incongruency). Examples can be found in the transport market between government and conveyer, but also between governments and conveyers mutually. This leads to the principal-agent problem in which the principal delegates tasks to the agent, but has no sense whether these tasks are carried out well or not. This kind of market failure is not very relevant for the land market.

Transaction costs have the same effect as transport costs: if they are relatively high to the value of the commodity dealt in, they tend to separate markets geographically. A transaction occurs when a good or service is transferred between separate parties. With a well-working interface, in this case the land market, these transfers occur smoothly without friction. The economic counterpart of friction is transaction costs. When frictions are present in the market environment transactions of goods and services are costly due to behavioural and external factors such as bounded rationality, opportunism, uncertainty-complexity and small numbers exchange (Williamson, 1975). Such factors become important in the presence of uncertainty and malfunctioning markets and determine the form of governance structure a party chooses (market, hybrid or hierarchy). For example, when asset specificity and uncertainty is low, and transactions are made relatively frequent, transactions will be efficiently governed by markets. High asset specificity and uncertainty will lead

transactions to be internalised within an organisation. Medium levels of asset specificity and uncertainty suggest relational contracting (hybrid structures). For example, subcontracting as a governance structure belongs to this category.
Transaction costs can be divided into three main classifications. *Information costs* arise prior to a transaction. When we drop the neo-classical assumption of perfect information, this allows for problems of adverse selection by recognising that economic agents incur costs in the search for information about products, prices, inputs and transaction partners. *Negotiation costs* arise from the physical act of the transaction and include the costs of negotiating and writing contracts or paying for services of an intermediary to the transaction, etc. *Monitoring and enforcement costs* occur *ex post* and include the cost of ensuring that the pre-agreed terms of the transaction are honoured, e.g. monitoring the quality of goods from a supplier or monitoring the actions of a supplier or buyer; also included are the costs of seeking restitution if a contract is broken.

In practice, the market economy, in which numerous individual public decisions are reflected, is not only capable of allocating land among competing uses, but, does, given certain conditions, achieve maximum efficiency, both in the use to which a site is put and the type of building erected. Since the 'certain conditions' as mentioned do not always exist, the price system may not achieve full efficiency in the allocation of resources (Harvey, 2000). Therefore, it is appropriate to examine the part played by planning control in the context of a means of dealing with defects in the market economy.

4.3 The role of the government / government failures

The existence of market failures provides a valid reason for the government to intervene in the market concerned. Many different measures are available to governments to attempt to resolve alleged deficiencies in markets. But these measures all have a different impact on the distribution of welfare in a society. Therefore, governments need to consider alternative ways of intervention. Such an assessment may conclude that it is better not to intervene in the concerned market at all. Governments have a variety of instruments available to change markets that are not functioning efficiently. They can take direct action, provide incentives to the private sector, or mandate action by the private sector (Stiglitz and Driffil 2000).

Direct action
One option is for government simply to take charge in the provision of the concerned goods or services itself. If it believes that the market fails in the provision of a good or service it can nationalise the sector or part of the industry and provide the goods and services itself. Direct action does not per definition require governments to produce the good itself. It can also purchase the good from the private sector and provide it to civilians.

Providing incentives to the private sector
Governments can also decide to operate at a distance, and use pricing incentives to alter the functioning of private markets in desirable ways. It can provide such incentives directly through subsidies or indirectly through the tax system.

Enforcing action in the private sector
Concern about the effectiveness of incentives in achieving the desired result or about their cost may lead governments to require the desired action using legal sanctions to get people to comply. These requirements do have costs, however. These costs are borne indirectly by workers, firms, and consumers and can be very high.

Various sources of government failures do exist. Stiglitz and Driffill (2000) refer to *imperfect information, incentive and inefficiency problems and unforeseen responses.*

Imperfect information
Imperfect information poses a problem in the public as well as in the private sector. In general, spending more on administration and acquiring information leaves less to spend on correcting market deficiencies. As always there are trade-offs to be made.

Incentives and the efficiency of government
Problems of incentives can be worse in the public than in the private sectors. The problem of incentives tend to be worse in the public sector because public officials work under conditions of salary and job tenure that can make it difficult to hire first-rate workers or to reward workers for efficient performance. Government rules make it difficult to pay high-skilled public officials a salary comparable to what similarly qualified and hardworking people earn in the private sector or offer them opportunities for rapid promotion. Elected officials need funds to run their campaigns, and this makes them particularly sensitive to those who can assist with campaign finances (lobbying). Some people view the public sector as being necessarily less efficient than the private sector. There are theoretical reasons to question this, because some of the problems generating inefficiencies in the public sector plague also the private sector. Just as public sector employees typically do not receive any incentive pay neither do most employees in the private sector. Furthermore, large corporations face bureaucratic problems no less than the government does.

Unforeseen responses to a programme
The success or failure of programmes in the public sector depends not only on public officials but also on how the private sector responds. Predicting those private responses is difficult.
In the literature on welfare economics, the government is generally assumed to act in some neutral or objective way. To state it differently, an important implicit assumption in welfare theory is that the government acts rationally (Johansson 1991). Under this assumption all civil servants are completely unaffected by narrow self-interest. They try to maximise social welfare without taking notice of the fact that they themselves may lose from such behaviour. Many economists have questioned this assumption of altruistic bureaucrats and politicians. Instead bureaucrats seek to maximise the size of their agency (Niskanen 1971). This increases the status of the agency and the possibility of making a career for those employed in the agency. According to the *theory of a political business cycle,* associated with Nordhaus (1975), it is rational for politicians to manipulate policies and the economy so as to increase the probability of re-election.

These simple examples of government failures hint at the possibility that government intervention in markets, including public sector production of public and/or private

goods, does not necessarily move the economy closer to the attainment of a Pareto-efficient allocation (Johansson, 1991).

5 Multifunctional land use from a monocentric perspective

5.1 Monocentric land use

The land market is a difficult and special market since it is not a homogeneous market. Differences in location and quality of plots make it difficult to compare the units. Besides, land is hardly reproducible and a specific form of land-use influences the use of adjacent land. These special characteristics of the land market, together with historical/cultural evolved urbanisation patterns causing path dependency, explain the active role of the Dutch government with the way the land is used. This is mainly expressed in the spatial planning policy carried out by the national and provincial governments, resulting in municipal development plans. Such spatial planning policy ensures that the margins for other players on the market are limited compared to other markets. Multifunctional land use has gained a prominent place in current Dutch spatial planning. However, many other countries have a free land market in which (almost) no government involvement takes place. Also in these countries, multifunctional land use projects can be found. Therefore, an interesting question is if multifunctional land use would appear most optimally in a free land market or in a regulated land market. In order to be able to address the differences between the (optimal) realisation of multifunctional land use in a free or a regulated land market, we start with an analysis of the monocentric model of land use, which will later on be analysed from a multifunctional point of view.

The monocentric city was the dominant urban form until the early part of the twentieth century. In this city type, industrial and commercial activities are concentrated in the central core area. The monocentric model has four key assumptions (O'Sullivan, 2000):

1. Central export node: there is a railroad terminal at the city centre through which all manufacturing output is exported.
2. Horse-drawn wagons transport manufacturing freight from the factories to the export node.
3. Hub-and-spoke streetcar system: commuters and shoppers travel by streetcar from the residential areas to the central business district. The streets are laid in a radial pattern: the lines form spokes that lead into the hub (CBD).
4. Agglomerative economies: since the office industry depends on face-to-face contacts, employees from different office firms meet in the city centre.

In the monocentric city, manufacturers and office firms are oriented toward the central business district. Manufacturers, on the one hand, are attracted by the central city node, whereas office firms, on the other hand, cluster around the city centre to facilitate face-to-face contact. How will land be allocated between these activities?

The answer on this question can be given by means of bid-rent functions of the different activities. A bid-rent function indicates how much a certain economic activity (e.g., industry firms, offices, residential housing) is willing to pay for different locations. It is negatively sloped, because travel costs increase as distance to

the central market place increases, and it is convex, because economic activities substitute non-land inputs for land as the price of land increases. For residential housing, this is only the case under certain assumptions, such as consumer substitution (the household substitutes non-housing goods for housing, which makes the housing price function convex), and factor substitution (which influences the convexity of the bid-rent function). An example of a bid-rent curve is provided in Figure 3.

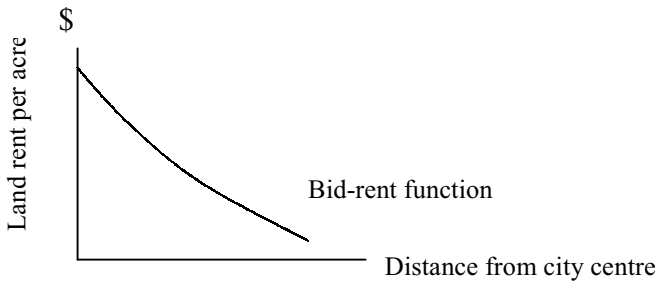

Figure 3: Office bid-rent function

The bid-rent function of offices is relatively steep because of the high transportation costs. They rely on face-to-face contact by high priced consultants to transport their output to clients. Industry firms, in contrast, transport their output by horse drawn wagon, which implies lower transport costs. The residential sector has the lowest transport costs, and thus the lowest bid-rent function. This means that each function outbids other functions at the intersections between the bid-rent functions of the different activities. Since the office function intersects the industry function at a distance of u_0 miles from the city centre, the office district is a circle with a radius of u_0 miles. Thus, activities are spatially arranged on the basis of transport costs.

Moet hier nog een figuur in waarin een grafiek met bid-rent curves wordt gekoppeld aan monocentrische cirkels? Of kunnen we dat als bekend/duidelijk veronderstellen?

The location choice of retailers is somewhat different from the other land use functions. Their location choice mainly depends on scale economies, per capita demand, and shopping externalities. In the monocentric city, the hub-and-spoke streetcar system makes central locations accessible to the entire urban area, causing most retailers to locate here.
Having analysed the spatial allocation of economic activities within a monocentric city, it is interesting to have a look at the land use within one of those monocentric rings. Are economic activities equally spread within a ring or do they show a tendency to cluster? The next section tries to answer this question.

5.2 Land use within a monocentric ring

To be completed.

6 Market and government failures related to multifunctional land use

This section will discuss the market and government failures that are most relevant for the case of multifunctional land use.

6.1 Market failures

As explained in Section 4, a non restricted land market should, in absence of external effects or other forms of market failures, lead to an efficient allocation of land over the different economic land use functions. This means that there is no other allocation possible in which one of the parties improves its position, without making other parties worse off (the so-called Pareto optimum). However, in practice, there are almost always external effects involved in the use of land and changes therein. This means that the use of land influences the welfare of economic subjects that have no say in the use of the land.
Suppose that the use of land for industry or residential use goes together with a decrease in the socially positively valuated biodiversity and a decrease in the size of, also positively valuated, open space. Furthermore, the use of land for agriculture has the positive side effect of gaining an attractive landscape. Transactions in the land market between different parties influence the welfare of citizens who are not involved in those transactions. This means that the marginal utility of the land used for industry or housing is lower for the society as a whole than the marginal utility for the owner of the firm or the house, since the use of agricultural land for development of industry or houses goes together with a decrease in positively valuated open space, biodiversity and agricultural landscape. In other words; a change in the use of land generates negative external effects (CPB, 1999). If the private parties on the market would not reckon with those external effects, the effective demand for land, and thus the land use, would be different. Ceteris paribus, demand for land for residential purposes and industrial use declines, and the demand for agricultural land increases. This means that the social equilibrium price is higher than the old equilibrium price, and the socially optimal allocation of land shifts in the direction of agricultural land, decreasing the amount of land available for residential housing and industry. However, since external effects take place outside the market process, profit maximising firms will not reach the optimal allocation of land. Households and firms will behave as free riders, not willing to take into account the social effects of their behaviour. Furthermore, farmers are not willing to pay a higher price for land in favour of an increase in biodiversity or the preservation of open space, since both side effects do not yield monetary profits. The result will be an inefficient allocation of land in which welfare is not maximised (CPB, 1999).

Another condition that is necessary for an efficient allocation of land is that buyers and sellers of land should behave as if they cannot influence prices; there should be competitive markets. However, this condition is not always fulfilled in the land market due to the unique character and the non-displaceability of land. The limited extent of substitution of parcels of land leads to the fact that buyers and sellers can influence the prices of land, resulting in (potential) price differences within and

between land use functions. The attractiveness of a location is often influenced by agglomeration and other scale effects.

A paragraph on agglomeration effects will be added.

6.2 Government failures

Governments could aim to minimize the efficiency losses due to market failures and aim to maximise the social welfare by arranging the institutional environment, in which the allocation of land takes place, in such a way that an efficient allocation of land will arise. This influence can be shaped by means of orders or bans or by means of imposing levies or the distribution of subsidies. The Dutch government mainly influences the land market by means of regulation based on bans and orders. The government determines the allowed user functions for parcels of land and gives permission to landowners to allocate the land in the most profitable way from a private-economic perspective. Next to this, the government can, by means of dispossession, oblige landowners to give up their land in favour of the production of public welfare. This kind of government intervention implies that landowners do not have fully free use of their property. The possibilities to reach the desired allocation by means of levies and subsidies are limited. These limitations are the result of the presence of agglomeration and scale effects, monopolistic positions of landowners, heterogeneity of land, and the non-displaceability of the land.
The above mentioned government interventions are based on three presuppositions, related to the welfare economic approach, used so far (CPB, 1999). Firstly, an intervening government should know the socially optimal outcome of the market process and how to reach this. However, in practice, the social welfare optimum is often not known. Secondly, the government should use the social welfare as a norm in its actions. Even if the social welfare optimum would be known, it does not go without saying that the government will strive for it. Thirdly, the government should be able to effectuate the social optimum efficiently and effectively. Nevertheless, suitable instruments to reach the social optimum are not always available.
Although the possibilities to reach the desired allocation may be limited, government regulation could be a solution for some kinds of market failures. It can, for example, allow for externalities, deal with imperfect competition, provide public and collective goods, improve the mobility of resources, and redistribute income (Harvey, 2000, p. 175). However, planning control does have its own failures as well. Although planning seeks to improve the working of the price mechanism, it does have repercussions on the urban land market and on the local economy in the following ways (Harvey, 2000, p. 182-185):

1. The value of an individual site
Land prices could be influenced by government intervention. For example, a restriction on building density limits the amount of capital that can be applied to a given site. Figure 4 shows that such a restriction (number of capital units is OR instead of OC) reduces the value of the site from AIN to AIKL.

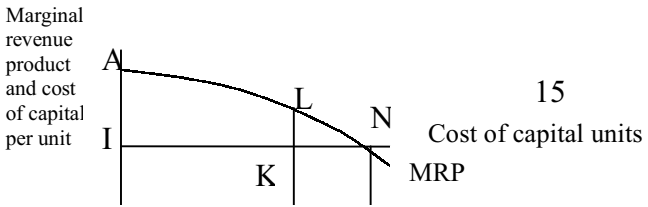

Figure 4: Effect of planning on the value of an individual site

2. The pattern of land values

Zoning of land use alters the pattern of land values. An example is the restriction of land available for offices, raising the value of existing office land and thus of any land which in the future is given planning consent for offices. Figure 5 shows that where government restricts the supply of land to OC, compared to the price of land in a free market (OP), the price would rise to OP'. However, the effect on land prices for other land uses is that those prices will decline.

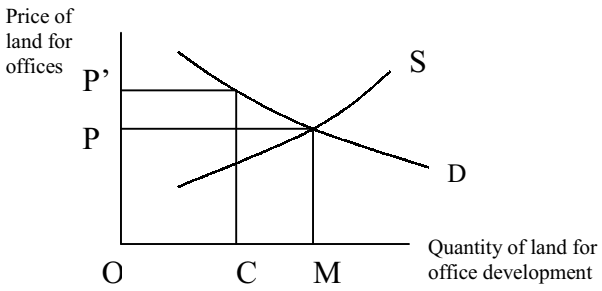

Figure 5: Effect of planning on the pattern of land use

3. Overall land values

If firms, by obligate moving from the CBD to other sites, lose important advantages of accessibility to customers and of complementarity with other firms, their efficiency could be harmed. In such cases, the increase in land values of the sites to which firms moved would be less than the loss of values in the centre of the town.

Next to this, this difference in value cannot be assumed to be automatically covered by increased social benefits. Moving firms out of the CBD might result in a loss of job opportunities for those that do not want to travel longer distances, or for those too old for retraining. On the other hand, also firms that stay in the CBD might encounter higher costs since they cannot rely on complimentary services anymore from the firms that moved. In such ways, planning control can affect aggregate value and hence allocative efficiency.

4. Distributional effects

Planning has direct and indirect distributional effects that may be incongruous with the economic efficiency objective. Owners of land obtaining planning consent for development receive windfall gains. However, in such cases where prices of land are forced up by restrictive land release policy, new purchasers (e.g., house-buyers) lose. Another example is that permission gained to develop a large supermarket could harm nearby shopkeepers.

5. Supplementary effects

Next to the repercussions of government planning as described above, there are other supplementary costs as well. Examples are:

a) With government intervention there is a huge bureaucratic machine which has to administer planning;
b) There is a growing practice of planning authorities to exact 'planning gain', even in the form of money payments, as a condition of granting consent.

7 The role of infrastructure in a free versus a regulated land market

The provision of infrastructure is generally different from the other land use functions, since the government instead of private investors usually provides it. This means that there is always a form of government regulation present in the market if infrastructure in involved. The main reason for government provision of infrastructure is that it is a public good. In The Netherlands, there is no private provision of roads yet, and also the rail infrastructure is property of the government. So in the analysis of infrastructure as one of the land use functions, the (sub)type of infrastructure analysed does not matter, since all kinds of infrastructure relevant for multifunctional land use projects are publicly owned.

The land market for infrastructure has some specific characteristics, which are related to the functions and the character of the 'product' infrastructure (CPB, 1999). First of all, infrastructure facilitates other land use functions (e.g., commuter traffic). This implies that the need for infrastructure is strongly dependent on developments in other land use functions. Second, possibilities to integrate infrastructure into the spatial organisation are limited. Third, in allocating infrastructure as well as its location, several forms of market failures can arise. However, in the development of infrastructure the presence of private parties is often desired.

The land market for infrastructure is different from the land market for other land use functions, since land for infrastructure is almost not substitutable. For example, infrastructure in residential areas has to be reserved at the same time as the land for housing. In other cases, government will have to gain land by buying out farmers or by dispossessing owners of land. This means that the supply of land is scattered and differs from case to case.

There are several forms of market failures to be recognised for investments in infrastructure (CPB, 1999). The first market failure is the spatial scale level. The lower the scale level, the easier it is to activate market parties; the easier it is to solve market failures. From a certain size, the co-ordination problems around infrastructure will become too big to be solved by individual market parties. The second market failure deals with the consequences of the construction of infrastructure. Positive as well as negative externalities which are difficult to internalise play a role in here.

To be completed.

8 Conclusions

To be completed

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Provided that clever use of scarce space in The Netherlands is the starting-point of multifunctional land-use, it seems plausible to have a look at the price of scarce space. If the spatial claims (from different functions) are high on a specific location, the readiness to pay of potential users (from the public as well as the private sector) will be high. Especially in case of zoning and regulations resulting in a regulated land market, it is useful to come to an efficient filling-in of functions by combining functions at one-and-the-same place.

This means that the land market will become less transparent. The land price is determined by a multitude of considerations, such that the price more or less reflects the development potential of a location rather then the direct scarcity proportions. The complexity of the price for multifunctional land-use is also caused by the huge number of actors involved (in the public as well as the private sector). For this reason, multifunctional land-use forms a suitable test case for public-private partnerships. The synergy derived from economic functions on the same location (leading to efficiency benefits) has to be traded-off against the higher transaction costs arising from the institutional complexity of multifunctional land-use initiatives.