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A Land Use Tax: greening the Property Tax System

von

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Designing a land use tax

Kilian Bizer[*]

1 Introduction

Up to now, the discussion on greening the tax systems focussed almost entirely on various forms of energy or carbon dioxide taxes. Other taxes were largely neglected. In this paper a different and supplementary tax proposal is outlined: It focuses on taxing land use in order to influence land use decisions towards more sustainable forms of utilization.

National concepts of sustainable development include policy goals for land uses. The more densely populated the country, the more detailed and sophisticated goals for land uses exist. In Germany, these goals originated in the last century, when certain landscapes began to influence the forming of the national identity. Later on, in the beginning of this century, youth movements emphasized living „out in nature“. Institutionally, this development was followed by the emergence of various acts in order to protect certain environments and landscapes. Similar developments took place in the US, France, Britain as well as in other European countries, although resulting in different land use patterns.

In the last thirty years this culturally embedded valuation of landscapes was supplemented by a growing awareness of ecological functions provided by an unimpaired soil. Soil protection, either as cleaning up of contaminated sites or as proactive protection of soil functions, received an increasing attention. The optimal level of preserving natural surfaces would be reached once the

[*] I am grateful for comments and critique from Dieter Ewringmann, Bodo Linscheidt and an anonymous referee.

marginal environmental cost of utilizing one additional unit of the surface equals the benefit. Unfortunately, this optimal level of land use is not easily determined empirically as the environmental cost function is unknown.[1] In Germany, recent political initiatives from the Federal Ministry for the Environment and the German Bundestag's Enquete-Commission „Protection of Humanity and the Environment" emphasize restricting suburban development and protection of open surfaces as policy goals and pose the question how such land use decisions can be effectively influenced. Taking the policy goals as the "standard" and investigating the kind of decisions which are taken in connection with land uses, this paper looks at the changes politically feasible "prices" could bring about (see Baumol / Oates 1988). It is important to note that results will show, how a given "price" will influence various land use decisions, but it will not give any indication whether the level of surface protection will be optimal in the sense of the welfare economics. In addition, the "price" is derived according to a set of institutionally determined factors among the most prominent being the revenue neutrality if the reform replaces the existing property tax.

In Germany the property tax is currently under review as the calculation of its tax base (Einheitswerte) is considered too costly in administrative terms and too unjust across property owners. It is generally agreed upon that the reform must lead to a simple, affordable system which results in the same overall revenue for local communities. In addition, the tax should allow local communities to set their own tax rates to increase revenues.

In this paper we propose to combine both reform projects by designing a local land use tax which addresses fiscal objectives of the local property tax as well as environmental objectives. The crucial question is, whether a tax proposal can be found which serves both sets of objectives sufficiently. In this paper, priority is given to the set of fiscal objectives, i. e. a revenue neutral reform, and fiscal independence of local communities. The second set of objectives consists of various environmental goals. Section 2 states fiscal goals as well as land policy goals and discusses arising conflicts. Section 3 outlines a design for a land use tax in Germany. Section 4 sketches

some major land use decisions of relevant agents, and how decisions could be influenced by the new tax. Section 5, finally, draws some conclusions for further research.

2 Fiscal Goals and Land Policy Goals

The primary objective of taxes is to gain revenues for the state. The property tax on buildings and land is a local tax in Germany as well as in most other countries. Although local communities currently determine tax rates within limits and are the sole recipients of the revenues, the tax is uniformly designed at the federal level. A revenue neutral reform which changes the tax base must allow local communities to adjust either the tax base or tax rates in order to achieve the same revenue as before. While some fiscal leeway for local communities is reasonable, a tax with environmental objectives at the federal and state level should not entirely leave the choice to local communities.

Fiscal independence of local communities can possibly lead to a ‘race to the bottom’ as capital will move to those communities which offer the lowest tax rate for a given infrastructure. Although evidence is ambiguous on this issue, the mere possibility would be an argument in favor of limiting local leeway in determining tax rates by introducing minimum tax rates at state or federal level. However, if the tax base is determined at a higher level, the introduction of minimum tax rates might lead to an revenue increase in some communities. This could constitute a conflict between fiscal and environmental objectives. Although fiscal and environmental objectives appear largely complementary this theoretical possibility should be noted.

As mentioned above, land use goals vary from country to country. This might partly be related to the level of resource stocks, i.e. population density. Then it would seem conclusive that more densely populated countries impose stricter land use regulation than countries with less population densities. Comparison of land use regulation in densely populated countries (e.g. Germany, Netherlands, Switzerland) with that in less densely populated areas (the United States of America, Canada) supports this notion. However, equally important are traditional land use values with regard to open landscapes, cities etc. In Germany, for example, development of rural

areas is highly restricted and settlements are concentrated whereas in England settlements are spread throughout the country. Land use goals could hardly be more opposed. For this reason the land use tax for Germany outlined below will not be applicable to any other country. It refers to specific goals in a specific institutional and cultural setting.

To construct an effective land use policy, goals must be determined. In Germany, the Enquete Commission on the „Protection of Humanity and the Environment“ initiated such a process by introducing ambitious land use goals with regard to settlements and traffic as well as agricultural land use, tourism, and sports. Independent from specific land uses, nature reserve areas, groundwater protection and soil protection enjoy a high priority within the Commission.

In order to design a tax which addresses at least some of the Commission’s targets for environmental action, targets were grouped into ‘agri- and silvicultural’ and ‘settlement uses’. For these uses, the existing institutional setting was reviewed in order to find administrative processes, the tax could build upon.

It transpired that agricultural uses conforming to EC regulation 2078/92 would uniformly meet all the agricultural action targets. A general criterion as certification according to EC regulation 2078/92 or qualification for financial aid for certain extensive uses would be sufficient for the Commission’s targets. Such a criterion would also have the advantage of being easily administered as there is already a sophisticated and regular check on the fulfillment of EC regulation. Despite this practical advantage, however, there is no consensus yet on granting tax relief to farms that operate according to ecologically sound standards. But such a tax relief would induce more farms to change their operating modus.

The same holds for silvicultural areas. As there is currently no regulation on extensive utilization or harvesting procedures of woodland, tax differentiation is not as easily administrated as it could be for farmland. Nevertheless, there is growing pressure to certify forests according to certain ecological standards, which could be a starting point. The standards currently applied in Germany certainly serve the environmental action targets of the Commission.

Nature reserve areas as well as protected landscapes should be increased in number as well as in area. While currently not even 2 percent of the total area is earmarked for special protection, an average of 10 percent should be achieved. The tax should provide an incentive to increase reserve areas.

Of crucial importance are the environmental action targets for settlement areas and traffic. As the transformation of goals into effective policy in this field will conflict with goals in home building policies, this field requires special attention. Goals suggested by the Commission are:

> "To decouple land consumption from economic and demographic growth; to achieve a considerable slowdown in the conversion of undeveloped land to settlement and traffic areas."
>
> To make use of existing options for removal of surfaces and increasing the quality of the soil.
>
> "To give priority to increasing the density of existing settlement areas instead of allocating new settlement areas." (Enquete Commission 1997, 32-33)

These goals imply, first, increased housing densities. This must lead to a conflict as long as the building of single individual homes with low densities is a goal as well. But as current policy is generally directed towards ownership regardless of the type of building, there is no fundamental conflict. Second, land conversion must be restricted. As the land use tax influences decisions of investors rather than of communities, the tax will only indirectly change land conversion rates. Communities are not given a direct incentive to reduce the planning of land conversion as they are the recipient of the tax. Therefore, additional instruments should be introduced to effectively restrict conversion by local planning, for example marketable development permits (Bizer et al. 1998, p. 44). Third, a dynamic path must be found which allows the strengthening of the incentives engendered by these instruments. As far as the land use tax is concerned, a reform of the local fiscal systems is required which upgrades local taxes as a source of revenue. At present, the property tax is of rather minor importance.

Table 1: Fiscal and Land Use Goals

fiscal goals	*land use goals*
steady and secure revenue for local communities	reduction of urban settlement growth
fiscal independence of local communities	reduction of growth rate of surfaced areas
	increase of sustainable land use in agri- and silviculture

Generally speaking, fiscal and environmental goals appear to be mutually supportive, if there is no 'race to the bottom'. But it will be crucial, whether tax rates will be sufficiently high to influence land use decisions effectively. We will come back to this question in Section 4 after drawing out the design of the land use tax in Section 3.

3 The Design of a Land Use Tax

Given the above mentioned goals, the aim is to design a tax which serves fiscal as well environmental goals. In order to do so, the land use tax applies higher tax rates to the uses that are classified as more harmful. However, this rule is somewhat arbitrary where surfaced areas are concerned. Ecologists frequently argue that any building activity outside urban areas does more harm to the environment than the same activity inside already developed areas. Contrary to this view, planners emphasize that within developed areas open spaces and unsurfaced areas are especially important while outside of developed areas an additional unit of surfaced area is not as harmful. In the remainder of this paper we will follow the latter view keeping in mind that economics cannot offer a solution to this conflict.

The core of the tax is based on seven land use categories which are roughly distinguished by their ecological impacts. The more ecologically valuable the actual land utilization is the lower is the tax burden. For example: Intensively used farmland will be taxed by hectares in land use category IV, while a change to organic farming practices would lead to an application of category II. Similarly, a private house owner is taxed by the amount of square meters which are sealed by asphalt, concrete or covered by buildings in category VI, and the remaining open space is taxed

by category IV. If the owner decides to dig up two parking lots and recultivate the area, it is transferred to category IV which is taxed at a lower rate than VI. The simple logic of the tax is to give a general incentive towards ecologically sounder uses.

Category I includes all areas characterized by non-utilization of high natural value of the area. For tax purposes it is important that theses areas are legally registered and effectively protected. As these areas serve the environmental goal exclusively they could be tax exempted, though the fiscal objective could justify low tax rates. Various legally defined forms of protection qualify as nature reserves, for example, nature protection areas, national parks and core areas of biosphere reservations.

Category II includes all environmentally sound uses. As mentioned above this could include organic farming and extensive use according to EC regulation 2078/92 as well as similar standards for silviculture yet to be officially laid down. Such a classification, of course, carries some injustices as conventional agriculture may serve environmental purposes as well if modified. But successful implementation depends largely on a classification which relies on easily defined criteria. Such criteria could be the licensing and control procedures according to EC regulation 2078/92.

Category III includes silvicultural areas as long as they do not fulfill the criteria of the second category. Generally speaking, woodland is of greater service to natural functions than farmland, and it entails less degradation such as erosion, groundwater contamination through nitrates and pesticides, etc. Category IV consists of conventionally farmed lands as well as open surfaces within urban areas, such as gardens. Category V includes all surfaced areas outside urban areas as long as they are not classified as environmentally especially harmful (category VII). In Germany almost all building activities require a local development plan, and therefore category V is of little relevance. As soon as a development plan is passed, the area covered by it will be taxed according to category IV (open surface) and category VI which covers all sealed surfaces within urban areas.

Again, those uses which are characterized as especially harmful are excluded, i.e. surfaces used by traffic, high buildings, etc. Those are included in category VII.

The general tax base is area measured in hectares. Despite its ecological goals, the land use tax will also serve as a local tax source. While local governments will continue to set actual tax rates, the general design of the tax will be determined at the federal level. The states (Länder) will have limited influence on allocating certain uses to land use categories and to specific tax rates. This recognizes the fact that protection of open landscapes and natural environments are public goods of varying degrees and should therefore be treated accordingly by the fiscal system at different levels of government.

Tax rates at a revenue neutral level were calculated on the basis of the total (national) revenue and present uses. As Germany's local property tax is divided into a tax on agri- and silvicultural land (Property Tax A) and a tax on other uses (Property Tax B), tax rates were calculated for categories I to V on the basis of the revenue of Property Tax A, and for categories VI and VII with Property Tax B's revenue.

Table 2: Tax Rates on the Basis of the Current Local Property Tax A (revenue neutral)

	I	II	III	IV	V
tax rate in DM/ha	0	0,38	3,80	38,00	380,-

Source: Bizer/Lang 1998, p. 75.

Tax rates displayed in Table 2 are calculated on the current revenue of Property Tax A and B and the current land use data for each respective category.[2] The relative proportion of the tax rates is calculated so that conventional farming is taxed approximately the same as with the property tax. The same holds roughly for silvicultural uses and also for surfaced areas within category VI and VII the latter two roughly carry the burden of the current Property Tax B. Beyond this the tax ratios are chosen deliberately. While Table 2 displays tax rates in DM per hectares, Table 3 switches to DM per square meter.

Table 3: Tax Rates on the Basis of the Current Local Property Tax B (revenue neutral)

	VI	VII
tax rate in DM/m^2	0,86	1,72

Source: Bizer/Lang 1998, p. 77.

As taxes are primarily an instrument to bring in revenues for the state a broad tax base is always desirable. While it allows tax rates to be set relatively low another advantage is that tax avoidance is rather difficult. In particular, in the debate on greening the tax system it was repeatedly suggested that eco-taxes are contradictory in design: It was argued that they loose their function as a source of revenue if they are effective in reaching their environmental goal, and that they are environmentally worthless if they fulfill fiscal intentions. The land use tax is faced with a different difficulty. Conflicts between environmental and fiscal goals will not arise in the sense of an eroding tax base as surfaced areas are unavoidable for many uses. Even accounting for technological progress, the tax base will not be reduced to zero within any reasonable time horizon. In addition, as will be shown below, incentives to change usage will be rather low if a revenue amounting to that of existing low property tax is aimed for. As soon as the fiscal role of local taxes is improved and the tax rates increase, effects will be more noticeable. In order to reach environmental goals in the long run, the land use tax must grow considerably in revenue and become a major source of income for local communities.

4 Potential Effects on Major Private Land Use Decisions

The broad tax base will give incentives to all uses of land. The most important uses in terms of environmental effects are agriculture, private homes, and commercial buildings.[3] The relevant agents include agricultural producers who receive an incentive to change to more sustainable land uses, private home builders as well as commercial builders of private homes and of commercial and industrial buildings.

The design of the tax suggests three basic reactions of the relevant agents:

1. They can avoid higher tax bills by changing locations according to Tiebout's „voting by foot". As this requires relatively high transactions costs, the tax differentials must be sufficiently large to bring about major movements. If the land use tax is revenue neutral, incentives are likely to be insufficient to induce such decisions.
2. Another possibility for reducing the tax bill is to change uses in order to be classified in a lower land use and tax category. Farmers may change production methods according to EC regulation 2078/92, and owners of buildings can reduce surfaced areas on their estates.
3. Finally, home builders can fully exploit building densities allowed by local development plans and thereby reduce tax bills per surfaced square meter. In Germany building densities of local development plans are not fully exhausted. The potential to intensify utilization of already developed areas is rather large.

In the following subsections some evidence is collected which shows whether effects on land use decisions can be expected. Except for new private home building where the modeling of land use decisions could be partly backed by statistical material, the examples consist of cost comparisons with and without the tax reform.

Agriculture

Agricultural use according to EC regulation 2078/92 is already subsidized by the German states. Subsidies are between 200 and 450 DM/ha per year. These subsidies along with basically favorable sales conditions induce on the average 500 farmers per year since 1990 to change utilizations which is rather few. The land use tax only represents a small additional fiscal incentive to this subsidy.

In a revenue neutral form the land use tax would impose a rate of 38,- DM/ha in category IV which includes conventional agriculture. The current property tax is estimated at 33,- DM/ha on average. If the farmer switches to sustainable farming according to EC regulation 2078/92 the tax rate will be 0,38 DM/ha. The different tax bills would certainly strengthen the incentive

already given by subsidies, but they neglect that an actual change of production mode will only occur if the overall sales situation for the individual farm is positive. Sales are viewed as the crucial bottleneck for further increasing organic production in agriculture (Hamm 1996). Therefore, the incentive can only be effective to the extent that further sales possibilities are discovered and mobilized.

As EC regulation 2078/92 also funds extensive farming there might be another effect as well: to extensify farming does not impose transaction costs that are as high as a change to organic farming. An additional tax reduction might therefore lead directly to an increase of extensified land.

Private home building

It is reasonable to expect that an introduction of a tax on surfaced areas would result in an albeit small reduction on new building sites at least. The effect will depend on the price elasticity of demand for surfaced area. But as surfaced areas are not demanded in themselves, such a price elasticity is difficult to ascertain. In addition, the building of private homes can react in other ways to such a tax. It is quite possible, for instance, that the household prefers to reduce the overall lot size because open space is less valuable to them than extra garages, porches, driveways etc.[4] But households can also react by reducing actual construction costs. Current efforts to reduce construction costs already result in leaving out basements, balconies, expensive staircases etc. It is extremely difficult to estimate the potential for reducing surfaced areas of new buildings. Technically the potential is estimated at 10 to 15 percent of the overall surfaced areas for already developed areas (Dosch 1996). But there is no indication what tax rate would mobilize this technical potential.

In order to estimate the impact of a land use tax on private home building a simple model was developed. It is assumed that agents are faced with a fixed budget, that demand functions are normal, and that agents are able to react to the introduction of a specific tax in only three possible ways:

1. They react to cost increases by reducing the lot size (lot size effect).
2. They react to cost increases by lowering overall construction costs by choosing less expensive material, leaving out basements, balconies, etc. (construction cost effect).
3. They react to cost increases by actually reducing surfaced areas (surfaced areas reduction effect).

Indeed, lot sizes do vary according to prices as normal demand functions suggest. Regression analysis revealed a relatively strong correlation between prices of land and lot sizes (Bizer/Lang 1998, chapter 9). Unfortunately it was not possible to estimate construction cost effects based on actual demand patterns. Assuming normal demand functions, the cross price elasticities of lot size as well as construction to the cost increase of surfaced areas are lower than their own price elasticities. Work on estimating price elasticities is limited to date such that these figueres are tentative. Table 4 displays an example of a possible reaction.

Table 4: Potential Effects of the Land Use Tax in the Case of an Individual Private Home

	Tax rate		
	0.86 DM/m²	1.29 DM/m²	1.72 DM/m²
Lot size	500 m²	500 m²	500 m²
Price per m²	150 DM/m²	150 DM/ m²	150 DM/m²
Surfaced area	200 m²	200 m²	200 m²
Tax rate per m² per year	0.86 DM/ m²	1.29 DM/ m²	1.72 DM/ m²
Discounted tax rate (at 5 %)	17.20 DM/ m²	25.80 DM/ m²	34.40 DM/ m²
Price per m² surfaced area	57.20 DM/ m²	65.80 DM/ m²	74.40 DM/ m²
Total cost	3,440 DM	5,160 DM	6,880 DM
Lot size effect			
Cross price elasticity (estimated)	-0.01	-0.01	-0.01
Absolute reduction (in m²)	-2.15	-3.23	-4.30
Relative reduction (in %)	-0.43	-0.65	-0.86
Construction cost effect			
Cross price elasticity (estimated)	-0.015	-0.015	-0.015
Absolute reduction (in value units)	-22.9	-34.3	-45.8
Relative reduction(in %)	-0.65	-0.97	-1.29
Surfaced area reduction effect			
Absolute reduction (in m²)	-14.46	-18.94	-22.24
Relative reduction(in %)	-7.2	-9.5	-11.1

Source: Bizer/Lang 1998, p. 129. Note: An infinte time horizon is used for discounting.

This hypothetical example shows for an assumed lot size of 500 m^2, costing 150 DM/m^2, with 200 m^2 surfaced, the resulting effects at various tax rates. For tax rates ranging from 0,86 DM/m^2

to 1,72 DM/m^2 the area that is surfaced is reduced by 7 to 11 percent. Lot size, however, is reduced by less than 1 percent.

Parking alternatives – a segmented choice

Aside from analyzing entire projects as above, it is also possible to look at segmented choices which can reveal advantages for specific alternatives. The provision of private parking spots constitutes such a segmented choice.

The relevant alternatives for private parking are individual garages, ground-level parking spots, raised parking (two levels) and underground parking spots. Construction costs of these alternatives vary significantly and are shown in Table 5 in relation to different tax rates. The standard tax rate is 0.86 DM/m^2. In perpetuity and at a 5 per cent discount rate this is equal to down payment of 17.20 DM/m^2. In addition the double and quadruple tax rate of 1.72 DM/m^2 and 3.44 DM/m^2 are given.[5] Table 5 shows how total cost reacts to different tax rates.

Table 5: Costs of private parking (in DM per parking spot)

	Surface requirement (in m^2)	Total costs for the lot at 500 DM/m^2 (without construction)	Annual tax bill at 0.86 DM/m^2; 1.72DM/m^2 3.44 DM/m^2	Construction costs	Total costs
Ground-level parking spot	25	12,500	425 850 1,700	4,275	17,200 17,625 18,475
Individual garage	35	17,500	595 1,190 2,380	7,980	26,075 26,670 27,860
Raised parking (two levels)	15	7,500	255 510 1,020	18,200	25,955 26,210 26,720
Underground parking (one level)	-	-	-	25,000 – 28,000	25,000 – 28,000

Source: Weeber/Weeber 1996, p. 52. Underground parking requires additional variable costs of 500 – 600 DM/year and per unit.

At a real estate price of 500 DM/m^2 and a tax rate of 1.72 DM/m^2 raised parking turns out to be financially more attractive than individual garages, and also underground parking could turn out to be a cost saving alternative. Of course, such a simplified cost calculation cannot take into account how car owners value the alternative parking options. Individual garages can also be used for locking up bicycles, spare tires etc.

However, the example shows that a segmented choice such as private parking can be influenced by relatively low tax rates. Nonetheless it is not possible to estimate the overall reduction potential.

Desealing of surfaced areas that are already developed

Basically, there are two different kind of decisions which would be influenced by the land us tax. The previous section analyzed the situation where a new building is build. In this section we will look at the situation where a lot is already built upon. Usually in this case it is only possible to uncover surfaces such as driveways, verandas etc. Again, it is not possible to estimate overall reductions relative to tax rates. Instead cost figures for desealing indicate whether there is any potential effect at all.

Assuming that the technical potential for desealing consists of surfaces that are not used anymore, decisions to deseal, i.e. to take off non- and semipermeable coverings, depend primarily on costs. Desealing costs consist of labor as well as machinery costs and disposal costs, including transport.[6] Costs vary according to the sealing material as this may require more or less labor as well as higher disposal costs. Most expensive is the desealing of asphalt surfaces.

Desealing options can be subdivided into three cases (see Bizer/Lang 1998, p. .131-133):

- A: The owner of a small surface covered only with paving stones deseals it himself. Per square meter this will result in 0.08 m^3 building rubble, which can be disposed of at the recycling facilities of local communities. Generally, these facilities take up to 1 m^3 free of charge, so that 6 m^2 can be taken off before disposal costs accrue aside from transport costs. Total desealing costs in this case largely depend on the opportunity costs for labor of private home owners.
- B: Surfaces larger than 6 m^2 will require a disposal by containers. In addition to labor costs a container will cost 420 DM for 7-8 m^3. As building rubble will be bulky, one container will roughly hold 50 m^2 of surface material. This results in 8

DM/m^2. Additional labor costs of 15 DM/m^2 would raise the cost to almost 25 DM/m^2.

- C: Larger surfaces as well as bituminous surfaces will mostly be desealed by building companies. For material containing bitumen the current price for desealing including disposal is around 200 DM/m^3. For gravel the price is estimated at 100 DM/m^3. Under the assumption that complete desealing must take off sublayers of approximately 0,25 m, total desealing costs will be 25 to 50 DM/m^2.

At a tax rate of 0.86 DM/m^2 the land use tax could induce desealing only in cases similar to A and some of B. However, desealing in case C would not occur. As cases of type A are certainly of less relevance with regard to a total reduction of surfaced areas than those of type C, expected effects are rather low as well. Cases similar to C would be fully mobilized at a tax rate of 2.50 DM/m^2 in category VI.

Parking lots for businesses

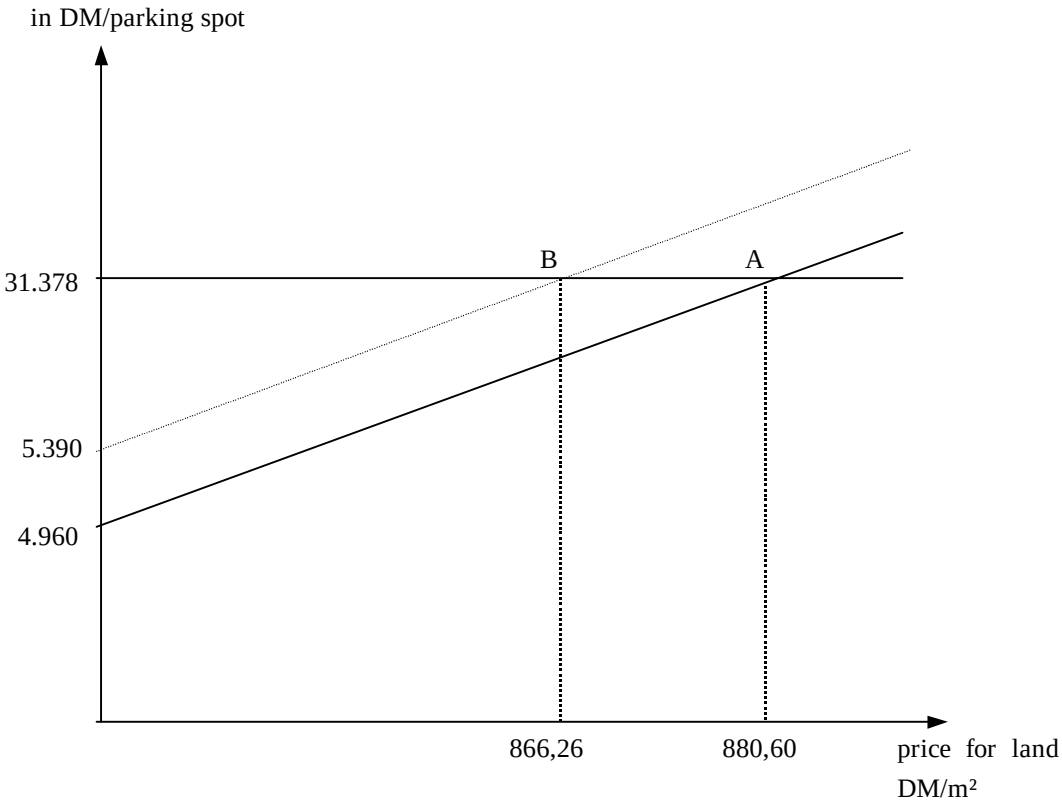
In the 1990s commercial buildings, especially retail centers, were spread further and further around urban development centers.[7] As traditionally urban centers were also the shopping centers for entire regions, it was feared that this development would cause cities to become deserted. Retail centers on the outskirts of urban centers or well within rural areas but in close connection to highways were especially land intensive, taking huge areas for ground level parking lots.

This section analyses the incentive given by a land use tax on such projects. Again it is important that the tax discriminates between open and surfaced areas. Assume a company is planning to build a shopping center on the outskirts of an urban development but has not yet decided whether parking lots should be at ground level or underground. The decision will be determined by comparing overall costs of both alternatives. In such a calculation real estate prices play a central role. Figure 1 displays the costs per parking spot on the y-axis, and the real estate

costs per square meter. The line parallel to the x-axis is the cost function of underground parking under the simplifying assumption that no additional land is necessary. The slope of the lower one of the upward sloping functions, intersecting at y = 4.960 DM/parking spot, represents the cost function of ground level parking. The slope is determined by the required area of 30 m^2 per parking spot. This function intersects with the horizontal cost function of underground parking at 880.60 DM/m^2 which is the break-even. To the left of this point A in figure 1 ground-level parking is the less costly alternative, to the right of A underground parking is preferred.

With a land use tax of 0.86 DM/m^2 per year (yielding in perpetuity at 5 percent interest a down-payment of 17,20 DM/m^2) the intersection of the upward sloped line with the ordinate will be shifted by 430 DM (25 m^2 per parking spot are surfaced) to 5.390 DM. The break-even point between the alternatives is shifted inwards to 866.26 DM/m^2, i.e. at a price of 866 DM/m^2 the investor will be indifferent. Above this price he will prefer underground parking, below it he will stick to ground level parking. Comparing this break-even price and the respective shift caused by the land use tax with actual land prices of developed commercial areas reveals that the tax would have only very few opportunities to change this specific investment choice.

Figure 1: The decision between ground level parking and underground parking

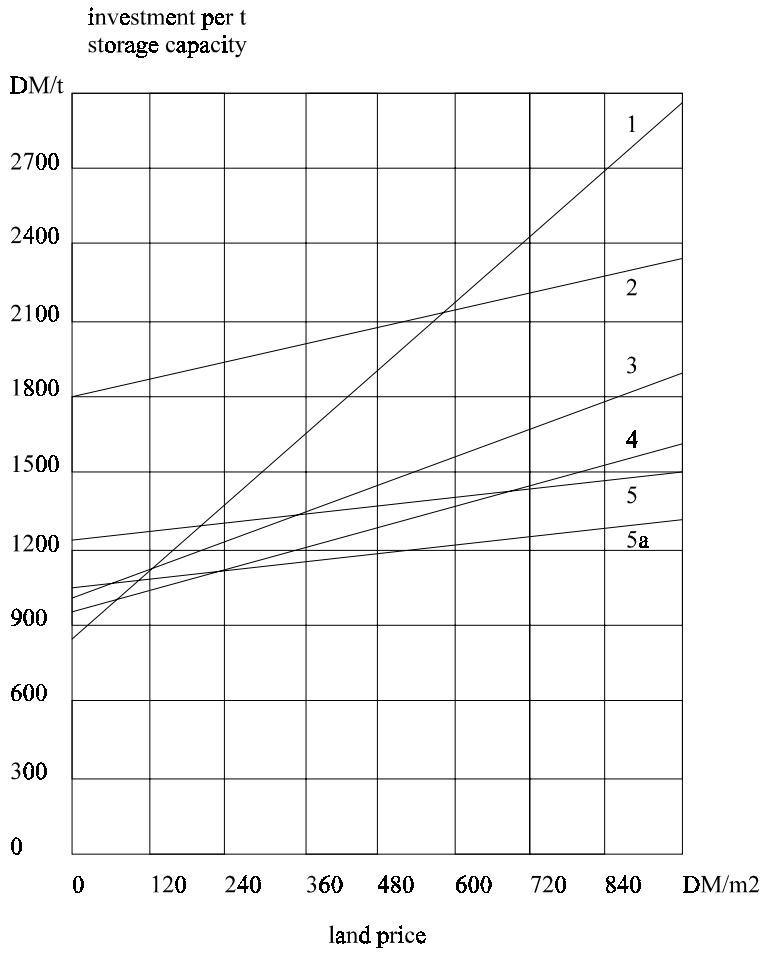


Source: See Bizer/Lang (1998), S. 145 with different tax rates.

Industrial and commercial storage systems

As with parking, storage is also characterized by relatively high area intensity. Figure 2 compares investment costs per tonne of storage capacity of various storage systems depending on land prices in DM. As can be seen, steel storage systems with 11 m usable height are preferable to all other alternatives at land prices between 80 DM/m^2 and 660 DM/m^2, if we exclude concrete storage without proper fire extinguishing systems. Naturally, one storey warehouses react most sensitively to land prices. In Figure 2 this is expressed by the different slopes of the cost functions.

Figure 2: Comparison of Storage Systems: Investment per tonne of storage capacity in relation to land prices



1: one-storey warehouse (5 m usable height); 2: five-storey storage system; 3: warehouse (11 m usable height); 4: steel storage system (11 m usable height); 5: concrete storage system (33,5 m usable height); 5a: see 5 without fire extinguishing system
Source: Dolezalek/Warnecke (1991), Bonny (1996). This example was calculated for Switzerland. Here, Swiss Francs are converted at 1.2 in DM.

For investors in storage buildings technical possibilities to avoid higher tax bills are not only available but, at higher land prices, they are already feasible. This implies a high substitutability of land by capital (Bonny 1996, p. 94). In the literature there is no doubt about the price elasticity of commercial and industrial demand for land where new investments are concerned. But it is more than doubtful whether the land use tax could influence investors as current land prices for commercial and industrial uses appear much too low to induce a change in storage systems.

5 Conclusion

As the design of the tax follows the main aim of fulfilling fiscal objectives, environmental goals will not be reached to a significant extent. However, the land use tax is a viable reform proposal as it fulfills revenue goals of local communities while allowing as much leeway for fiscal independence as the current property tax. At the same time, the design of the land use tax serves environmental goals as it gives new incentives to change land use decisions.

The condition of revenue neutrality results in an average tax rate of below 1 DM/m^2 in category VI. Although this may induce marginal changes in uses of developed areas, major effects will require at least a doubling preferably a tripling of tax rates. It was shown, for example, that cost data on desealing of surfaced areas call for a tax rate of 2.50 DM/m^2. Nonetheless, the tax reform would have a structural impact on land use decisions even in the revenue neutral version.

Similarly, land use decisions within agriculture will be influenced towards more sustainable uses. Although organic farming is probably restricted by other than purely fiscal bottlenecks, using farmland more extensively would be favored by the tax.

In order to reach the entire set of environmental goals, additional measures must be introduced. The land use tax can influence land conversion decisions by local communities only indirectly. Additional instruments could be marketable development permits or severe statutory restrictions on local development decisions.

The land use tax itself can be strengthened by reform of local public finance. Such a reform should aim towards giving more importance to local sources of revenues instead of continuing to share revenues between the local, the state and the federal level. This would lead to an increase of local tax rates which, in turn, would have a greater influence on land use decisions.

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[1] See for a detailed analysis of soil functions and the possibility to evaluate them in monetary terms Fromm 1997.

[2] For the entire calculation see Bizer/Lang 1998.

[3] We will exclude decisions of local and state agencies with regard to road construction as incentives within state agencies and between different federal levels are even more difficult to assess. State activities are nevertheless subject to the tax.

[4] Of course, it is also possible that households postpone buying a new car, cut expenses on vacations abroad etc. We assume that effects materialize within the project concerned.

[5] The tax rate of 1.72 DM/m^2 per year is equivalent to 34 DM down payment and a tax rate of 3.44 DM/m^2 amounts to 68 DM down payment. The calculation is based on an indefinite time horizon at a discount rate of 5 per cent.

[6] We neglect transaction costs.

[7] This accompanied a general suburban growth and 'disintegration of cities'. The current debate on this issue is documented in Bose 1997.