

BASIC APPROACHES TO A LOCATION THEORY OF ONE PUBLIC FIRM¹

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Abstract

Public firms are public economic units that take location decisions or are involved in such decisions. There is a lack of location theories that consider this feature. The literature on public facility location theory mainly concerns location of real capital serving economic units. Attempts to formulate a public firm decision-making oriented location theory are offered. Typical location factors of public firms relate to the goals of public firms, their environment and the number of decision-makers involved in the location decisions. A theory of the public firm is presented, that enables to develop a theory of location for public firms. It is introduced to industrial location theory and to location criteria based on investment rules. Its application in relation to public firms achieving welfare or public objectives is also covered. Interventions by the owner lead to more than one decision-maker and to principal agent models. Public firms compete horizontally due to competition among the public owners or public firms competing against each other. The authors mention some results on location choices within the framework of our basic approach.

Keywords: location theory, public firm theory, industrial location theory, competition among public firms, principal agent, trust of public firms

JEL Classification: D61, D73, HO, H11, H42, H70, D61,D73, L32, N9, R14, R53

Introduction

Most of the interest in location theory concentrates on its relevance for the private sector. Only a few approaches to location theory for the public sector are available. There are some attempts to interpret public administrations as decision-making economic units (see Friedrich, Feng 2007) and very few applications of location theory for public firms. However, many approaches to determining optimal locations exist for **public facilities** (Tietz 1968; Massam 1993; Drezner, Hamacher 2002). They are often defined as installations and service units for firms and households. Sometimes they are located to fulfil public goals, but they are normally not treated

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as decision-making economic units. **Public firms**, however, are **decision-making units** by definition³.

A **public firm** shows some **characteristics** of a private firm, as public firms are oriented towards sales and markets (Friedrich 1969; Rees 1976; Turvey 1971; Thiemeyer 1975; Blankart 1980; Bös 1981; Püttner 1985; Eichhorn 1991; Friedrich 1992; 1992a). On the other hand, such firms are obliged to achieve public goals, which are fixed by the public owner, a regulatory agency or the law, or which are determined within the decision-making organs of the public enterprise.

The reasons for the **lack of public firm location theory** are twofold. The first is the lack of a location theory for public firms, and the second is that a suitable theory of the public firm that could be used to develop a specified theory of location for public firms is also missing. In this article we look to improve this situation by elaborating location theories for public firms and by referring to a theory of the public firm.

Therefore, we tackle the following **questions**:

- Which are the special location factors of public firms?
- How should we consider them in a theory of public firm?
- How can we apply and adapt traditional location theory to a public firm?
- What statements on the location of a public firm can be evolved?

In the second **section** we refer to important location factors. A simple model of a theory of the public firm considering location factors is elaborated and initial statements on optimal locations are put forth in the third section. The fourth section deals with the application of traditional location theories, some applicable findings from public facilities location theory and an adaptation of public firm investment theory. Location models concerning political goals, multiple decision-makers and principle agent relations between the public owner and the public firm are dealt with in the fifth and sixth section. The seventh section is devoted to the location model of a trust of public firms. The closing and concluding section points to some necessary extensions.

³ They belong to the group of public administrations, which are defined as economic units as follows. A **public administrative unit** at least partly in public ownership tries to achieve public goals by producing goods and services delivered to other economic units. It possesses a long-term stock of production factors and its management should be competent in regard to essential decisions concerning production and delivery. Public offices comprise legally dependent institutions fully integrated into budget planning. A **public firm** is separated from the owner's budget planning (Eichhorn, Friedrich 1976, p. 52, p. 76) decision making and managed partly autonomously. For public firms other expressions synonymously used are public enterprises or public companies. Here the public firm is defined as above and is a public decision making unit and organizational institutions. They can be federal, state or municipal firms of public or private law or public firms or belong to public corporate bodies.

I. Location Factors of Public Firms

Public firms are established, extended, resettled, contracted or closed. These changes comprise location decisions⁴ categorized as follows:

(1) **Development-oriented location decisions** stem from:

- The growth of the market-oriented public sector in order to improve service provision using the clients' ability to pay to finance activities. Examples include public highway-companies, railway companies, hospitals, public banks, airports, seaports, inland waterways companies, domains and public farms, wineries, public aircraft industries, public civil engineering, public trading companies, municipal housing firms and business promotion agencies. This growth can be due to economic development, settlement of private firms, public offices, other public firms or population growth.
- The growth of trusts related establishing new public firms such as firms for new industrial plants, founding subsidiaries such as convention and fair companies etc.
- The development of new administrative functions, which lead to new public firms such as magnetic trains, new media, toll collecting companies, new companies for energy production and provision, research firms etc.
- Founding public firms in the course of regional competition such as business promotion agencies, public banks for venture capital etc.

(2) **Location decisions** in the course of **public sector restructuring** refer to:

- The establishment of a public firm because of a change in ownership;
- The establishment of mixed public firms;
- The establishment of a mixed firm within the framework of public private partnership;
- The nationalization and municipalisation of private firms, and bailing out private firms;
- Trust building for public firms, and the concentration and decentralization of public firms;
- The reallocation of public firms because of changes in management concepts;
- The reallocation following from technological changes;
- The reallocation determined by a change in a public firm's enterprise goals;
- Territorial and functional reforms leading to establishing or closing down institutions;
- Spin offs from public offices for taxation, financial, organizational or other reasons;
- The privatization of public firms that may cause movements or closing down of public firms;

⁴ These decisions are mentioned in the literature on public firms cited above and in literature on public management, public finance and public choice, territorial reforms, functional reforms and public administration location.

- New co-ordination between public authorities that may lead to public mixed firms and associations;
- Changes in EU policies with respect to subsidisation and new competition policies that may lead to closing down public firms and reintegration into the public administration and government or to new public firms because of separation and regulation strategies.

(3) **Location decisions** following **political decisions** include:

- Decisions involving the transformation of an economy from people-owned (socialist) firms to public firms;
- The privatization of public firms;
- Political developments such as unification, integration of continental economies, military alliances;
- The goal of public policies such as preserving factors of production, environmental protection and development goals;
- Political goals to gain in votes, to strengthen the influence of parties over special industries and regions;
- A reallocation because of economic or military warfare.

As public firms are separated from the public owner's budget planning, they behave similar to private firms but their goals are public and they consider many specific restrictions and regulations. Therefore, location theory results for public firms differ from those for public administrations, public facilities and private firms. Public firms are established, extended, resettled, contracted or closed. They show **typical location factors** referring to:

- (1) The characteristics of finance, delivery, production and procurement;
- (2) The goals of the public firm;
- (3) The economic, political and national environment of the public firm;
- (4) The number of decision-makers.

Factor (1): Characteristics

Apart from those factors relevant for private firms, some factors are related to the **finance** of public firms such as the provision of equity capital by the public owner, grants and finance through sales under the conditions of public pricing. **Production** is often similar to production in private firms; however, it may consider special restrictions with respect to the equal treatment of customers, safety, production techniques, access capacities and the compulsory participation of clients in production. A production organization is sometimes governed by public law. The quality and other characteristics of goods are often specified in statutes and laws. There are special rules for public **procurement** and auctions, and special payment schemes for the staff.

Compulsory deliveries, specified market areas and market segmentations, and delivery conditions as well as pricing rules are often specified in statutes or laws. Some public firms operate according to company forms of public law. With public

firms there is extensive **vertical co-ordination** with the public owners and with other tiers of government. Within the decision-making bodies of a public firm, different governments may cooperate horizontally in the case of a public institution. As public issues are important and some public firms are large, public authorities, such as the EU, national, state and local governments, intervene through the public firm.

Therefore, different **forms of co-ordination** exist, such as governmental decrees, legal provisions, moral suasion of management, taxation, subsidisation, profit transfer and loss compensation, pricing policies, financial arrangements etc. Oligopolistic price and quality competition prevails **horizontally in competition** among private and public firms. In vertical co-ordination, bilateral monopolistic negotiations (e.g. between the firm's management and its public owner) or several stage negotiations with different tiers of government exist. Public firms are often involved in regional and political competition. On the other hand, many location factors of private firms play a role as well.

Factor (2): The Goals of Public Firms

The goals of public firms are different from those of private firms. **The aims** are related to social goals, the goals of the constitutional state organization and forms of government, economic policy, public finance and budgeting, and political goals such as vote maximization, adequate political staffing or specific political goals. **Welfare maximization** is also considered to be one of the public firm's goals. Public enterprises serve as instruments of public policy, outsourcing administrative functions, and their aims are those of the firm's management, the public owner or other public institutions. Furthermore, these goals are closely linked to the desired or undesired **effects of location** choice. Especially if the goals express preferences for the delivery of specified clients, such as goals concerning full coverage, minimum distance access, or serving clients in assisted areas.

Factor (3): The Environment of Public Firms

This includes the **spatial distribution** of resources, clients, possible locations, sector activities, party members, etc. It also involves the cultural conditions, legal system, government structure, country size, landscape structure, environmental conditions and all kinds of external effects. In addition, the traffic network or continuous planes as location conditions play a role. Furthermore, location factors vary according to the number of public firms.

Factor (4): The Number of Decision-Makers

One decision-maker exists if a **decision-making council** of a public firm has no conflict resolution or there is only one decision-maker with the owner or with the public firm. Commonly, there are several decision-makers. There are boards and councils, which include decision-makers with different aims, taking decisions. Moreover there might be the **owner** of the public firm on the one hand, and the

managers of the public firm displaying different intentions, on the other. Political decision-making bodies could be involved as well as the administrative units of the owner. Then, because of the legal role of municipalities in urban planning or states (provinces), national governments and the EU in regional planning, or because of necessary conditioned grants or grant regulations of the EU, several players may be involved in **vertical competition** influencing the location decision for the public firm. These decision-makers may be partly involved in **horizontal regional competition**. This means that other representatives of other regions, such as state or provincial governments, play a role in location decision-making. Finally, the public firm may have competitors in other regions or with respect to sales and procurement markets.

II. A model of a public firm

A simple model of a public firm serves as a basis for a **theory of public firms** and allows us to integrate many of the location factors mentioned. The following simple model of a public firm (Friedrich 1988; Friedrich 1992; Friedrich, Feng 2000) at a given location comprises:

- The **utility** (goal) function U of the public firm's management showing management utility depending on output X and labour input L .

$$(1) \quad U = U(X, L), \quad \partial U / \partial X = U'_X, \quad \partial U / \partial L = U'_L$$

- A restriction concerning the **production function**. There is one fixed factor A and two variable factors of production L (labour) and C (materials).

$$(2) \quad X = A \cdot f(L, C), \quad \begin{aligned} \partial f / \partial L &= f'_L > 0 & \partial f / \partial C &= f'_C > 0 \\ \partial f'_L / \partial L &= f''_{LL} \leq 0 & \partial f'_C / \partial C &= f''_{CC} \leq 0 \\ \partial f'_C / \partial L &= f''_{CL} = f''_{LC} = \partial f'_L / \partial C > 0 \end{aligned}$$

- A **demand function** showing the dependency between the price P and volume X of sold output.

$$(3) \quad P = P(X), \quad \partial P / \partial X = P' < 0$$

- The **costs function** demonstrates fixed costs K_A and two types of variable costs. The factor price of labour is w and that of materials is i .

$$(4) \quad K = K_A + w \cdot L + i \cdot C$$

- A restriction, which equates **turnover to costs**, is introduced. We assume self-financing of the public firm.

$$(5) \quad P(X) \cdot X = K_A + w \cdot L + i \cdot C$$

- The maximization of the utility of management under the restrictions mentioned leads to the following LaGrange formulation:

$$(6) \quad \Lambda = U(X, L) + \lambda \cdot (P \cdot X - K_A - w \cdot L - i \cdot C), \text{ while} \\ X = A \cdot f(L, C)$$

- The following **first order conditions** of maximization

$$(7) \quad \frac{\partial \Lambda}{\partial \lambda} = P(X) \cdot X - K_A - w \cdot L - i \cdot C = 0, \\ \frac{\partial \Lambda}{\partial L} = U'_L + U'_X \cdot A \cdot f'_L + \lambda \cdot [P \cdot (1 - \frac{1}{\varepsilon}) \cdot A \cdot f'_L - w] = 0, \text{ while} \\ \frac{\partial \Lambda}{\partial C} = U'_X \cdot A \cdot f'_C + \lambda \cdot [P \cdot (1 - \frac{1}{\varepsilon}) \cdot A \cdot f'_C - i] = 0 \\ \varepsilon = - \frac{P/X}{P'}$$

yield to **two optimality conditions**. One concerns the equivalence of the relation of marginal utilities of marginal factor inputs to the proportion of respective marginal profits, and the other condition refers to the cost coverage of turnover.

$$(8) \quad \frac{U'_L + U'_X \cdot A \cdot f'_L}{U'_X \cdot A \cdot f'_C} = \frac{w - P \cdot (1 - \varepsilon^{-1}) \cdot A \cdot f'_L}{i - P \cdot (1 - \varepsilon^{-1}) \cdot A \cdot f'_C}$$

$$(9) \quad P = \frac{K_A + w \cdot L + i \cdot C}{X}$$

According to the utility functions, **different cost curves** result. An output maximizing public firm shows curves of minimal costs. If output and labour are evaluated positively, then a curve of higher costs results. If only labour has a positive weight, the cost curve is more unfavourable, and if management needs labour compensation in the case of higher production, the cost curve is even higher. In the first three cases, the resulting output is higher than with profit maximization.

The restriction may also refer to a given desired profit requiring a given difference between turnover and costs. The results do not change fundamentally. The result of the **model is shown graphically** in Figure 1.

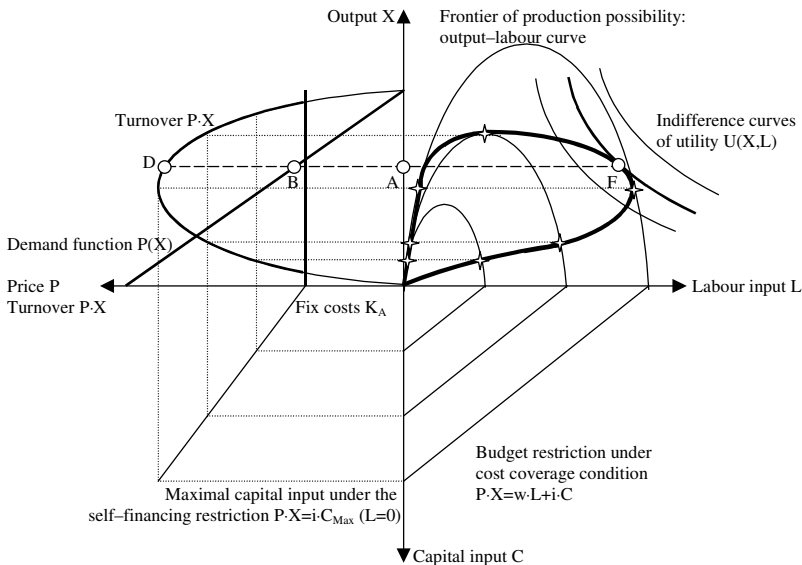


Figure 1. Theory of the public firm (Dehne, Friedrich, Nam 2009).

The second quadrant demonstrates the sales conditions of the public firm. For each volume of sale there follows turnover and the financial revenues that are used to cover the costs. After deducting fixed costs K_A , a financial amount is available to finance variable costs. The so-called output-labour curve illustrates all output-labour combinations that can be financed. However, for each sales volume, there is only one corresponding production volume X ; therefore, only two points on the output-labour curve shown in the second quadrant are relevant. One production is material-intensive and the other is labour-intensive. For alternative turnovers, the corresponding production volumes result in a set of output-labour curves and a set of relevant material-intensive and labour-intensive points. Their connection leads to a potential labour-output curve indicated as a thick curve in this quadrant. By introducing a set of indifference curves that correspond to the management utility function (1), the highest indifference curve the management can achieve touches the potential output-labour curve at point F. This determines optimal production A, optimal price B and optimal turnover D. Moreover, there is a path of points of tangency between alternative potential output-labour curves, which correspond to the alternative demand curves for the public firms. These are related to the cost curves mentioned above.

If the management utility function depends on output only, the management **maximizes output** (II) and the cost minimal cost function results. Utility functions depending on **output and labour** (I) lead to paths more to the right of the cost minimal path in the right hand quadrant. If the public firm is going to **maximize**

labour input (III), then a path results which connects points of tangency near the respective maximal turnover volumes.

If the utility function (1) depends on profit and the restriction (2) is not binding and just a profit definition, then we end up with a **maximum profit** (IV) solution along the cost minimal path. In rare cases the public firm owner tries to use its public firm to raise revenues (Friedrich 1998; Friedrich, Feng 2002). The respective solution leads to a higher price and a smaller output as in former solutions. A utility function depending on **profit and labour** (V) results in a solution between the profit maximal and the labour maximal price. Output and fee solutions are illustrated in Figure 1 and Figure 2.

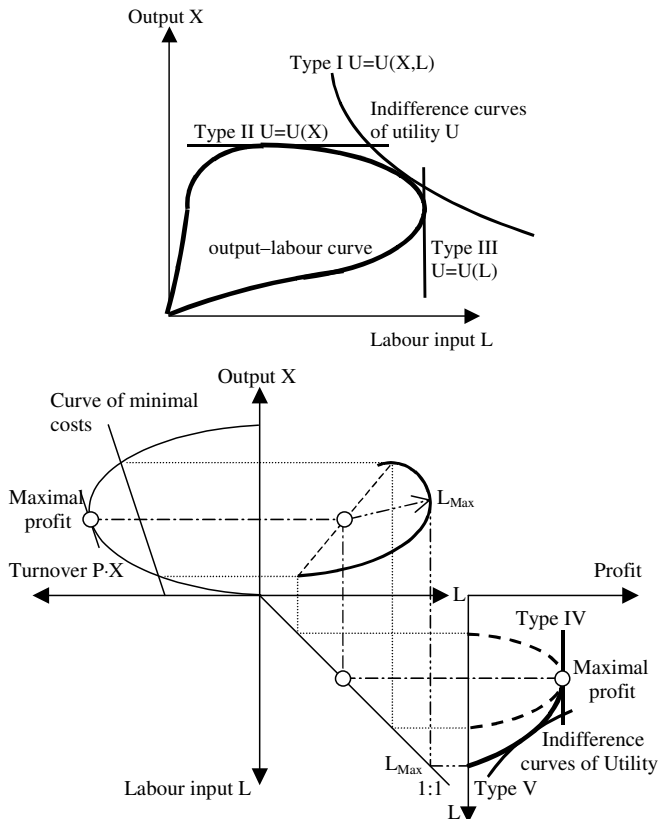


Figure 2. Solutions according to types of management (Friedrich 1998).

The model introduced above is also useful if there is another decision-maker at a higher level (e.g. the owner government), who has a utility preference (preference) function concerning the output and the financial means. In a first attempt, we

consider the owner government as a very powerful **principal**, e.g. the management of the public firm may need additional financial means from the owner, the legal form of the public firm guarantees the high competences of the owner government, the municipality's rights for urban planning, etc. So the principal is able to command the management of the public firm serving the principal as a dependent **agent**. However, it should not totally loose the cooperation of the public firm's management, for this management is needed to realize the location choice. Therefore, the public management of the firm has to receive a minimum utility to guarantee their willingness to perform.

This approach was applied to determine actions of municipal competition through municipal firms (Friedrich, Feng 2000). The utility function of the public firm is again dependent on output and labour. But now a profit F is allowed, which is transferred to the municipality. The utility function of the municipality shows the utility depending on the output of the firm and on the profit transfer. Moreover, minimum utilities are introduced for both players. For a given demand function and a production function there are combinations of pareto-optimal profit and output out, for which, a solution has to be chosen. These combinations lead to combinations of utilities, forming a utility frontier. The best solution in favour of the powerful principal is where the principal receives its maximum utility and the public firm achieves minimum utility.

However, the principal might not be as powerful for various reasons, such as the existence of dependencies of the local economy on the services and goods of the municipal firm in terms of electricity, transportation, water supply, tourism and culture and so on, or the knowledge and skills of the management of the public firm, a favourable relation of the management of the public firm to the management of a municipal savings bank or mutual political support. Then the players have to negotiate a solution including a combination of utilities and of output and profits.

III. Industrial location theory for a public firm with one decision-maker

We extend the basic model of the public firm by considering locations and applying a **Weber approach** (Launhardt 1882; Weber 1909; Palander 1935; Moses, 1958; Dredzner, Klamroth, Schöbel, Wesolowsky 2002, Mc Cann 2002; Mc. Cann, Sheppard 2003; Eiselt, Sandblom 2004) to determine the location of a newly established public firm. Points of delivery as well as deposits of factor supply are given and an ideal traffic system exists⁵. We consider location dependent and distance dependent on the cost of supply and delivery. Therefore, variable costs are influenced by the choice of location. Now we end up with three **optimality conditions**. One expresses that the proportion of the marginal utility changes caused by the factor changes must equal the change in marginal profits due to variations. The second concerns the equality of price and average costs. The third requires that marginal transportation costs must be the same in either direction. If fixed costs are location dependent as well, total marginal location-dependent costs must be the

⁵ Distances are not through traffic networks but the shortest way in the Pythagorean sense.

same in either direction. It is also possible that the production function is location dependent. Then the first condition still holds; however, the third condition varies. The proportion of marginal utility in either direction caused by respective movements equals the proportion of marginal profits resulting from these movements. Other typical location factors of public firms, such as external costs, agglomeration effects and so on, can be introduced through restrictions varying the optimality conditions for location (for public administrations see Friedrich (1976, pp.150). Only in the case of output maximization are locations selected as cost minimal.

As in cost minimization in **transportation networks** (Hakami 1964; Gülicher 1965; Beckmann 1999; Marianow, Serra 2002), public firms have to be located in nodes of the network as long as the points of delivery or factor supply are in the nodes and the transportation costs are linear.

More seldom than with the location of public administrative units or with public facilities, **several locations** have to be determined simultaneously. When introducing the extension of the market area, a Lösch market area results, based on the assumption of zero profit and the cost curve determined above. This area increases with higher fixed costs as well as a population increase, and decreases with more labour-intensive costly production, as well as higher transportation costs. For this optimal sales district, approximately expressed by a hexagon, a system of public firms can be traced and their locations and number determined. The central place theories from Christaller, Lösch and other types can be applied (Christaller 1933; Lösch 1944; Bos 1965; Tinbergen 1968; Beckmann 1999; Parr 2002).

As the functions of the model introduced above normally lead to non-linear solutions, **operations research** methodologies to account for optimal locations are not so easily applied. Warehouse problems, covering⁶ problems, assignment problems (Beckmann 1999; Drezner, Hamacher 2002; Marianow, Serra 2002) must be solved by non-linear programming methods or interpreted by referring to Kuhn-Tucker conditions.

Optimal locations can be found via the application of **investment rules** (Friedrich 1969), if discrete locations are available. For each location the model above can be solved. In Figure 3, different sizes of a charging public firm are shown, and the resulting cost curve and turnover curve are depicted. Because of a positive evaluation of output (output maximization or output and labour dependent utility maximization as above), the intersection of turnover and the cost curve turns out to be a solution that determines output and price. For a given management utility function the best solution is always to the right; that is, the solution that allows for the higher output. The point and the respective output where the location oriented cost curves cross is called the critical output.

⁶ E.g. locating a facility to serve customer demand for a pre-specified period.

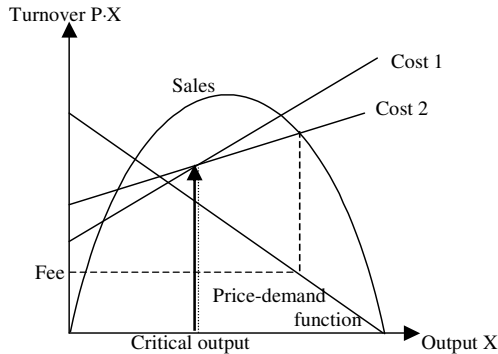


Figure 3. Fees corresponding to different sizes of public firm (Compiled by the authors).

From this we can derive the **following rules** for the optimal location of a public firm:

- if the critical output can be sold at a profit, that location is the best
- if the relevant cost curves show smaller marginal costs than at other locations (c.f. Figure 3).
- if the critical output, which is smaller than that at maximal turnover cannot be sold at a profit, the location with the lower marginal costs is the best one (c.f. figure 4, left).
- if the critical output, which is larger than that at maximal turnover cannot be sold at a profit, the location with the highest marginal costs turns out to be the best one (c.f. Figure 4, right).

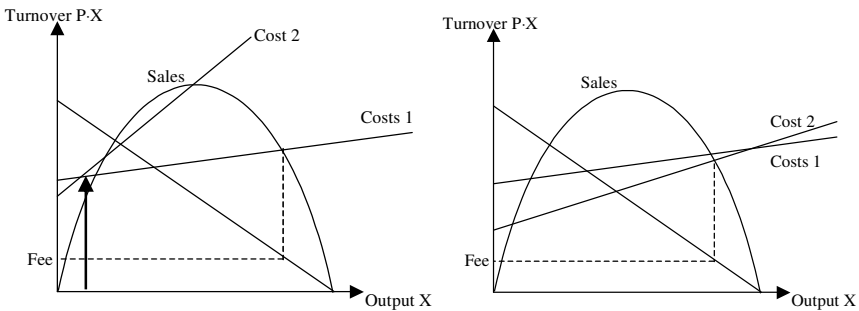


Figure 4. Different fees according to different critical outputs (Compiled by the authors).

This solution can also be applied, if an absolute profit has to be achieved. The cost curves get marked up according to the profits and the rules apply to the resulting curves.

To determine rules for selecting the best locations one can refer to models concerning the **accumulation and growth of capital** (Friedrich 1969, pp. 251; Friedrich 1976, pp. 251). Each location is interpreted as a capital stock assigned to maximize the management utility function above. Without a special restriction on the investment finance the following simple rule results. Capital should be accumulated at the locations until the marginal gain in utility through investment is as high as the marginal utility loss caused by additional payments of interests. If a special budget restriction for investments prevails in a period, the accumulation has to take place until the proportion of marginal net utility changes at two locations equal the proportion of the acquisition costs multiplied by marginal profit at the respective locations.

In the case of a principal agent relation for each location a Nash solution might result. By ordering the locations according to the utility combinations, a frontier of pareto-optimal distributions may result. Out of them a second round Nash solution might result, or the best Nash solution is determined using an additional welfare function concerning the two parties.

IV. Welfare and political goals with one decision-maker

The goal function of the decision-maker must not refer solely to the utility of the management of the public firm. The goals of public firms or the aim of localization are also of public interest. Therefore, economists tend to assume that the public decision-maker wants to maximize **social welfare**.

Welfare can be expressed by a welfare function, a **net-benefit formula**, a utility function as part of a utility analysis, or a vote function (e.g. majority voting). Single goal realization, such as output maximization (Friedrich 1976), employment increase, turnover or fiscal revenues maximization (Thiemeyer 1975) or the realization of fair or predetermined rates of return (within the framework of commercial rules (Shepherd 1965; Friedrich 1976; Friedrich 1978)), marginal-cost price solutions (Oort 1961; Lösenbeck 1963; Nelson 1964; Thiemeyer 1964; Thiemeyer 1970, Krelle 1976; Bös 1981), peak-load-pricing (Turvey 1971; Bätz 1979; Blankart 1980; Bös 1981; Wirl 1991) or péage solutions (Allais 1984; Hutter 1950; Boiteux 1951) might also serve the evaluation of locations. When just a few alternative locations exist, the **net-benefit of investment** at the various places has to be calculated to determine the optimum net-benefit location when realizing marginal-cost-price, peak-load-price and péage solutions. The application of commercial rules sometimes needs additional criteria to determine the optimum site. If two locations show the same desired rate of return, the profits may turn out different. Therefore, that with the higher profit or higher output might be preferable.

Components of these goal formulations may be distance dependent, distance independent and location dependent. The models mentioned above for numerous locations on a plane can be applied as well. The optimal location of a public firm, as a result, requires that distance dependent marginal social welfare, marginal net-benefit or marginal utility (in the sense of one goal or a utility analysis) be equal in

each direction. The same is true for voters. If location-dependent items like location-dependent production functions, location-dependent demand functions and location-dependent factor prices occur, the conditions for optimal production must be considered. The relationship between marginal welfare increases or marginal net-benefits, marginal vote increases and marginal goal changes caused by marginal factor inputs must equal the relationship between marginal profits.

Approaches applied in public facilities location theory (Massam 1993) to locate near clients (or voters), to minimize total average distance to clients (or voters), or minimizing the distance to the most remote client (or voter) known as Rawls solution can also be used.

V. Location theory for a public firm in the case of principal-agent-relations – more decision-makers competing vertically

The principal agent relation introduced above can also be useful in another instance. Another decision-maker exists at a higher level (e.g. the owner government) with a utility preference (preference) function concerning the location. In a first attempt we consider the owner government as very powerful **principal**.

A new utility function of the principal is introduced and the former utility function (1) of the management equals a minimum level; therefore, for some locations the management must be compensated by allowing for higher output and labour input. Because of the minimum utility guaranteed to the agent, the principal has to cope with a reduction of his potential utility with each possible location. The **best location** is where the net utility of the principal achieves its maximum. There the marginal utility of the principal **equals the marginal utility loss** of the principal caused by the requirements of the minimum utility of the agent.

Another approach that is also linked to a powerful principal was applied to determine actions of municipal competition through municipal firms (Friedrich, Feng 2000). The utility function of the public firm is again dependent on output and labour. But now profit F is allowed, which is transferred to the municipality. The utility function of the municipality shows utility depending on the output of the firm and on the profit transfer. In addition, the profit transfer demanded from the municipality is location dependent; if the management agrees to a location highly preferred by the municipality, then the city government achieves a higher utility. Moreover, minimum utilities are introduced for both players. For a fixed location and a non-location-dependent production function there are combinations of profit and output from which a solution has to be chosen. These combinations lead to combinations of utilities forming a utility frontier. A Nash solution can be determined. If there are several locations, different utility frontiers result. The minimum utilities also move. The point where the frontier touches the highest indexed Nash indifference curve yields the **optimal solution**.

However, for various reasons mentioned above the **principal might not be so powerful**. If both utility functions are location dependent and the municipality

prefers locations enabling higher F and the public firm locations enabling higher output, then for each location a Nash solution results and a combination of utilities and also of output and profits. However, there is a sequence of such solutions depending on the location, which again forms a utility frontier. A Nash solution can be derived from these to provide **the optimal location** of the public firm.

Normally, there are not many locations available for public firms. This could be considered according to alternative evaluation parameters in the models above. The results in such cases are not changed fundamentally.

However, in this situation the game is reduced to a **one-shot game**. This may be demonstrated through a payoff matrix. The utility mentioned could be used, and one solution would be to find a location nearest to a Nash solution.

There are other options as well if the utilities are expressed using **indicators** such as profits, output or labour. According to the characteristics of the game, **solutions** correspond to equilibrium points, absolute equilibrium points, solutions in dominant strategies, or very occasionally, in minimax strategies if the owners and the managers have to agree on a location. The strategies used might be locations on the side of the owners and the sizes of the firm as well as activity volumes according to the management of the public firm; such models are developed for location choices concerning the location of public administrative units (Friedrich 1976).

Further models may refer, on the part of the principal, to **political goals**, such as winning votes or maximizing votes. There is also a little-known model by Sam **Pelzman** (1971; 1976), which was extended by Ziemes (1992), where the principal is interested in vote maximization and the public firm in profit maximization. However, this model concerns price policies and comprises price fixing in two markets referring to different voters. In this paper, we adapt this model to the location issue. Although profit maximization is restricted for public firms (Friedrich 1969; Püttner 1985; Detig 2004), some public firms especially in the industrial sector try to achieve profit goals. We analyse one public firm that sells on monopolistic markets (Dehne, Friedrich, Nam 2009). The profit of the public firm increases with price reductions until a profit maximum is achieved and decreases if price cuts follow. This is demonstrated in Figure 5 by curves G1 and G2 referring to profit. Indifference curves that reflect price combinations are also derived. **Curve P** shows all price combinations that yield the same profit.

Voters dislike high prices from public firms. Therefore, in Figure 6, curves A1 and A2 result with respect to votes. For votes, **curve V** is delineated to show all price combinations on both markets leading to the same amount of votes.

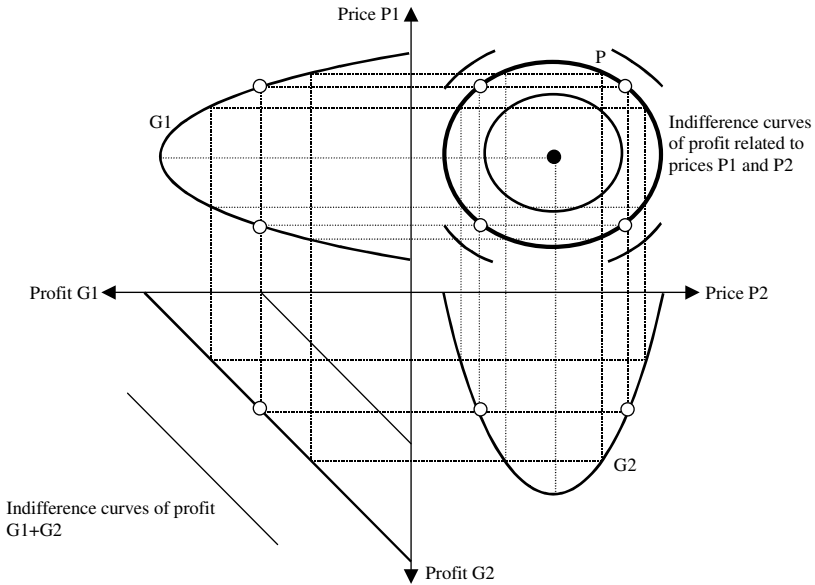


Figure 5. Profit indifference curves (Dehne, Friedrich, Nam 2009).

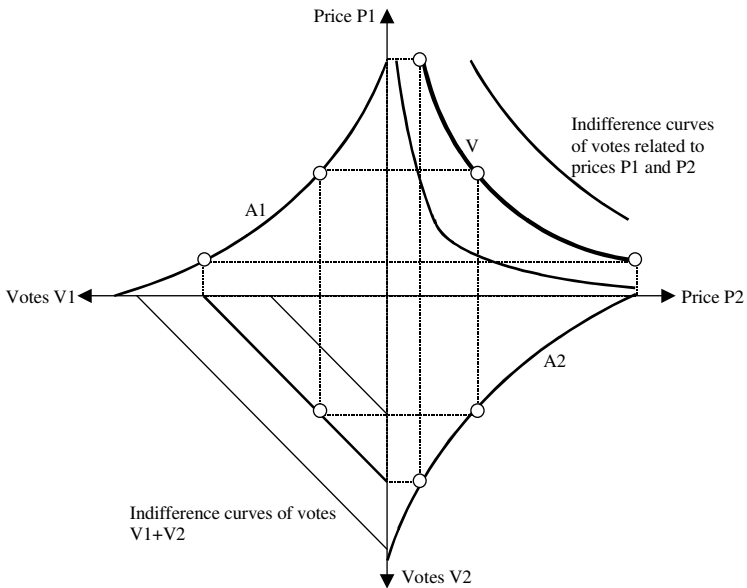


Figure 6. Indifference curves of votes (Dehne, Friedrich, Nam 2009).

Points of tangency between curves V and P in Figure 7 show the **path of the pareto-optimal combination of prices ZM** for the principal (politically interested owner) and the agent that gives maximal profit for the given votes or maximal votes for the given profit.

The respective combinations of utilities are shown in Figure 8, where the votes are depicted vertically and the profits horizontally. If a very powerful principal (owner) is assumed, he determines a low profit (eventually zero) and maximum votes at point Z. If the agent is overwhelmingly powerful, he asks for maximum profit at point M leaving the principal with the resulting votes. We can introduce a minimum profit in order to ensure the activities of the public firms or minimum votes for the principal necessary to avoid privatization, and so on. Again, a **Nash solution** can be achieved at point N. In this case the political influence of the owner leads to relatively low prices.

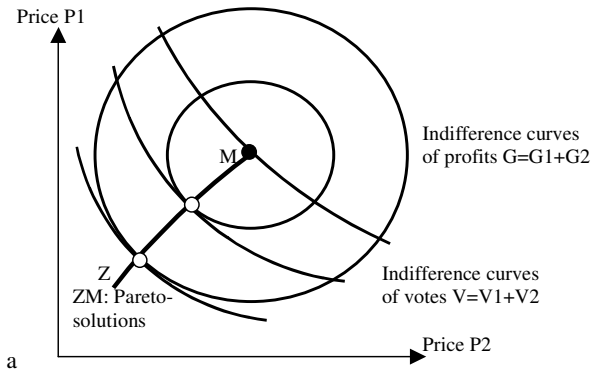


Figure 7. Pareto-optimal path of fees (Dehne, Friedrich, Nam 2009).

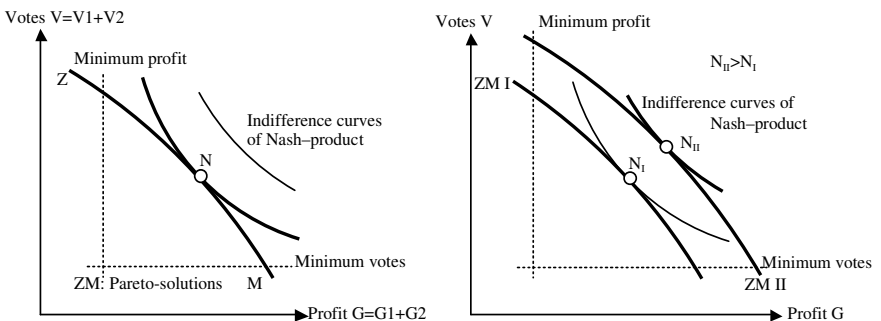


Figure 8. Nash solution for prices for one and two locations (Compiled by the authors).

This was a pricing solution, analogous to Pelzman, that may prevail at **one location**. Voting behaviour or profits may be different at other locations, then for each

subsequent location a different pricing solution results. According to different ZW curves different N points result if the minimum conditions are the same. That N point is the best when it is situated on a higher Nash indifference curve (c.f. Figure 8 point NII in the left graph). The location is best when the Nash product is the highest. To consider fixed costs, P curves can be re-indexed by deducing fixed costs. Therefore, the ZW curve is more to the left in Figure 2. Points NI and NII change; however, the statements elaborated are still valid.

We can also combine the **extended Pelzman approach with our model**. Then the G curves are utility curves for the management of the public firm (c.f. Figure 9) with a given location. Formally the solutions are the same, instead of profits the management utility is used (c.f. Figure 9). According to Figure 8, the solution with the utility curve with the highest N is chosen.

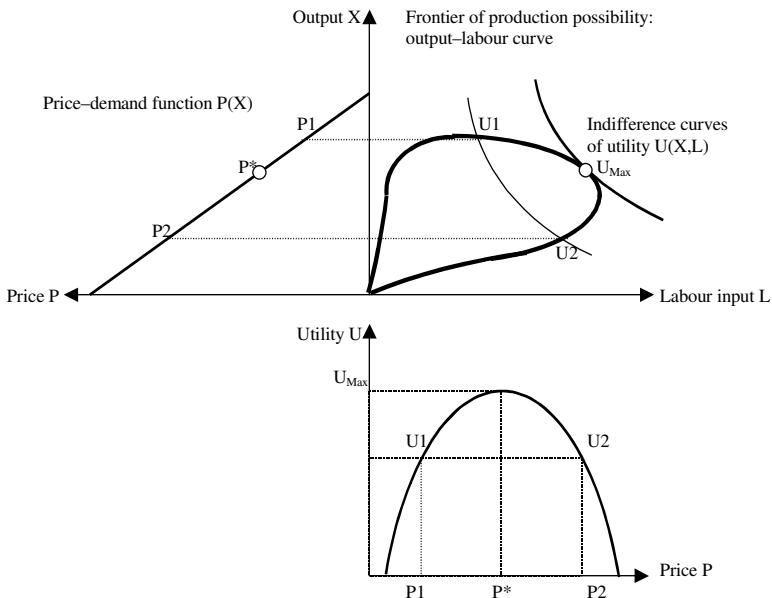


Figure 9. Utility curve of management (Compiled by the authors).

Conclusions

The discussion showed that **public firms** are public economic units that have to make many **location decisions** or are involved in such decisions. There is a lack of location theories that consider this feature. The literature on public facility location theory mainly concerns investment decisions for infrastructure projects that involve instalments and real capital serving economic units.

We categorized and identified the **location factors** of public firms. There are numerous occasions in the course of the individual development of public firms when the location decisions of public firms are linked to developments resulting from public sector restructuring and political changes. Therefore, there are many specific location factors, which get allocated to the delivery, production, procurement and financial spheres and types of coordination public firms are involved in. Typical location factors are related to the goals of public firms. As the firms are embedded in their environment and many of their goals refer to this environment – a group of location factors refer to the economic, traffic and natural environment. In recent developments, location decisions differ according to the number of decision-makers involved in the location decisions.

As location decisions are related to general decision-making in public firms, a **theory of the public firm** is necessary, and therefore presented, that enables us to develop a theory of location for public firms, which is depicted initially to cover costs, but can be also applied if the owner wants to achieve a specified profit. This public firm model is the basis for subsequent approaches to public firm location theory.

The model is introduced to **industrial location theory** and provides the conditions for the optimal location of one public firm. The relationships between the model and traditional location theories are mentioned. Location criteria based on investment rules are directly linked to the model and the resulting cost functions, albeit using locations connected to different production processes. The application of the basic model in relation to public firms achieving welfare or public objectives in the case of one decision-maker is also covered.

As the public firm is related to the public owner through organs of the public firm, such as the assembly of owners, supervisory boards and so on, essential questions, such as location choices, are also influenced by the owner. Therefore, there is **more than one decision-maker** and vertical coordination prevails. This leads to **principal agent models**, where the principal might be very powerful and the public firm as an agent can only accept or reject location proposals, or if the firm is more powerful, the public owner has to negotiate a solution with the firm's management. The model can be used for such situations as well. How the political model by Pelzman (1971, 1976) can be extended to function as a location model by applying the basic model is also indicated.

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GRUNDLEGENDE ANSÄTZE ZUR STANDORTTHEORIE EINES ÖFFENTLICHEN UNTERNEHMENS

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Die Standorttheorie ist weitgehend auf private Unternehmen ausgerichtet. Eine **spezielle Standorttheorie für öffentliche Unternehmen** wurde kaum entwickelt. Allerdings besteht eine umfangreiche Literatur über Standorte von **public facilities**. Sie beinhalten meist Anlagen oder Infrastrukturteile, die dazu dienen, private Haushalte und Unternehmen mit Leistungen zu versorgen. Obwohl manchmal Standorte in Verfolgung öffentlicher Ziele bestimmt werden, interpretiert man sie nicht als selbst entscheidende ökonomische Einheiten und Wirtschaftssubjekte mit eigenem Management. Öffentliche Unternehmen sind aber laut Definition eigene selbst entscheidende Wirtschaftseinheiten.

Ein **öffentliches Unternehmen** besitzt Eigenheiten eines privaten Unternehmens, denn es verkauft marktorientiert seine produzierten Güter und Leistungen. Andererseits sind solche Unternehmen verpflichtet öffentliche Ziele zu verfolgen. Diese Ziele sind in Satzungen, Gesellschaftsverträgen, Gesetzen und Verordnungen und seitens der Eigentümer, einer Regulierungsbehörde festgelegt oder werden vom Management des öffentlichen Unternehmens beschlossen².

Die Gründe für das Fehlen einer adäquaten Standorttheorie sind zweifach. Zum einen fehlt eine solche Theorie und zum anderen ist eine entscheidungstheoretisch ausgerichtete Theorie der öffentlichen Unternehmung, die sich in Standorttheorien integrieren lässt, wenig entwickelt. Deshalb wird in diesem Beitrag versucht, beide Theoriengebäude zu verbinden.

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² Ein öffentliches Unternehmen ist ein öffentliches Wirtschaftssubjekt, das Güter im Sinne öffentlicher Ziele produziert und anderen Wirtschaftssubjekten zur Verfügung stellt. Es befindet sich überwiegend in öffentlichem Eigentum. Das Management besitzt einen auf Dauer gewidmeten Bestand an Produktionsfaktoren und besitzt Entscheidungsspielräume zumindest bezüglich der Produktion und der Leistungsabgabe. (Eichhorn, Friedrich 1976, S. 52, S. 76). Eine Verwaltung ist in die Finanzplanung des Trägers (Eigentümers) voll integriert. Ein öffentliches Unternehmen ist aus dem Haushalt des öffentlichen Eigentümers herausgelöst und erscheint im Budget des Trägers nur mit Gewinnabführungen oder Zuwendungen des Eigentümers.

Zu diesem Zweck werden zunächst die **Standortentscheidungs-situationen** und die Standortfaktoren öffentlicher Unternehmen angesprochen. Standortentscheidungen fallen im Zuge der Gründung, der Expansion, der Umsiedlung, der Schrumpfung und der Schließung eines öffentlichen Unternehmens an. Die **Standortentscheidungen** sind entwicklungsbezogen im Falle des Aufgabenwachstums, etwa von Nachfragesteigerungen, der Gründung von Tochterunternehmen und der Beteiligung an Clustern sowie der Entwicklung neuer Aufgaben oder im Zuge regionalen Wettbewerbs. Andererseits können auch Nachfragerückgänge, Finanzkrisen usw. Standortentscheidungen bewirken. Ferner fallen Standortentscheidungen an, wenn der öffentliche Sektor restrukturiert wird, etwa bei Eigentümerwechsel, Public Private Partnerships, Nationalisierungen und Kommunalisierungen, Konzentrationen, Veränderungen von Führungskonzeptionen, Funktional- und Territorialreformen, Veränderungen von Koordinierungen und EU-Regulierungen, usw. Standortentscheidungen als Folge politischer Veränderungen treten infolge von Transformationen, Vereinigungen, Europäischer Integration, militärischen Allianzen, Regierungswechseln, Wahlergebnissen, der Änderung öffentlicher Ziele und von Kriegszuständen auf. **Typische Standortfaktoren** öffentlicher Unternehmen betreffen die Charakteristika ihrer finanziellen Sphäre, z.B. Kapitalausstattung und -zufuhr seitens des öffentlichen Trägers. Standortfaktoren der Leistungssphäre betreffen die Produktion, z.B. vorgeschriebene Produktionsfunktionen, Produktionsvorschriften, das Marketing, z.B. Liefer- und Bedienungszwang, sowie die Beschaffung, z.B. Ausschreibungen, die teilweise Beschäftigung von Beamten, usw. Besondere Koordinationsverfahren sowie die regionale Konkurrenz bei Standortentscheidungen sind bezüglich des Eigentümers und anderer öffentlicher Träger zu beachten. Ferner bilden die öffentlichen betrieblichen, ökonomischen, sozialen und politischen Ziele wichtige Standortfaktoren, z.B. Wohlfahrtsmaximierung, Wählerzustimmung. Darüber hinaus beinhalten ökonomische, soziale, politische, administrative und natürliche Umweltbedingungen wichtige Standortfaktoren. Dabei spielt auch die Lokalisierung einer oder mehrerer öffentlicher Unternehmen eine Rolle. Zu unterschiedlichen Standortfaktoren führen auch Mitentscheidungskompetenzen von Managern oder von Entscheidungsträgern in Gremien sowie vertikale Koordinierungsformen mit dem Eigentümer und anderen Trägern, z.B. in Finanzierungs- und Planungsverfahren, oder die Wettbewerbs- und Marktformen, mit denen die öffentlichen Unternehmen konfrontiert sind. Die Standortentscheidungen fallen je nach der Zahl der Entscheidungsträger öfters unterschiedlich aus.

Grundlage für eine entscheidungsorientierte Standorttheorie öffentlicher Unternehmen ist ein **einfaches Modell der öffentlichen Unternehmung**. Das Modell umfasst Nutzenfunktionen des Managements, eine Produktionsfunktion, die Beschaffung von Produktionsfaktoren und die Absatzverhältnisse sowie Selbstfinanzierung im Sinne von Kostendeckung. Die Maximierung des Nutzens ergibt folgende Aussagen. Das Verhältnis der Grenznutzenänderungen des Managements bei Änderung unterschiedlicher Faktoreinsätze muss dem Verhältnis der Grenzgewinne bei Änderung der Faktoreinsätze gleichen. Der Produktpreis hat den Durchschnittskosten zu gleichen. Je nach dem ob das Management Leistung maximiert, Leistung und Arbeitseinsatz vergrößern möchte, den Arbeitsaeinsatz

maximiert, maximalen Gewinn anstrebt oder seinen Nutzen aus Gewinn und Arbeitseinsatz maximiert, resultieren unterschiedliche Lösungen für Preise, Ausbringungsmengen usw. Nur die Leistungsmaximierung und die Gewinnmaximierung führen zu „effizienten“ Lösungen.

Das Modell wird anschließend in die **traditionelle industrielle Standorttheorie** mit einem Entscheidenden integriert. Ein Launhardt Weber Ansatz, wo verschiedene Orte beliefert und Produktionsfaktoren von etlichen Orten beschafft werden, Transportkosten anfallen. bei dem die Produktionsfunktion des öffentlichen Unternehmens standortabhängig ist, und Kostendeckung besteht, erlaubt folgende Aussagen. Falls das Management des öffentlichen Unternehmens seinen Nutzen maximiert, entspricht das Verhältnis der Grenznutzen aus Faktoreinsatzänderungen dem Verhältnis der Grenzgewinne, die aus den Faktoreinsatzänderungen resultieren. Der Preis gleicht der Höhe der Durchschnittskosten. Das Verhältnis der Änderung der Grenznutzen des Managements bei Verschiebung des Standortes in unterschiedliche Richtungen gleicht dem Verhältnis der Grenzgewinne bei diesen Standortverschiebungen. Standortabhängige Kosten und externe Effekte lassen sich im Modell berücksichtigen. Die Verbindung zum Hakimi Gülicher Theorem über Standorte in Transportnetzwerken kann hergestellt werden. Auf die Möglichkeiten mehrere Standorte zu belegen und die Brücke zu den Landschaftsstrukturmodellen zu schlagen, wird verwiesen. Verschiedene Operations Research Verfahren sind ebenfalls anwendbar. Allerdings hat man mit nicht-linearen Funktionen infolge der Nutzenfunktionen des Managements und der Kostendeckungsbedingung zu kämpfen. Gezeigt wird, wie sich Investitionsregeln für mengenmaximierende öffentliche Unternehmen übertragen lassen, wenn die Manager die standortabhängigen Kostenfunktionen gemäß ihren eigenen Zielen wählen. Falls Kapital an unterschiedlichen Standorten als differierende Kapitalstöcke aufgefasst wird, kann man Theorien des Kapitalaufbaus an Standorten entwickeln. Ohne Restriktionen bezüglich der Investitionsfinanzierung wird an einem Standort Kapital akkumuliert bis der Grenznutzenzuwachs des Managements so hoch wie der Grenznutzenverlust des Managements infolge erhöhter Zinszahlungen ausfällt. Mit komplizierteren Nebenbedingungen, fallen auch die Regeln für optimale Standorte diffiziler aus.

Gleicht die Nutzenfunktion des öffentlichen Unternehmens einer Net-Benefit-Funktion so lassen sich **wohlfahrtsmaximale Standorte** bestimmen. Der optimale Standort liegt dort, wo die entfernungsabhängigen sozialen Grenzbefits den entfernungsabhängigen sozialen Grenzkosten bei Verschiebungen in unterschiedlichen Richtungen gleichen. Ferner muss das Verhältnis der Grenz-Netbenefits bei Faktorvariationen jenem der Grenzgewinne bei Faktorvariationen gleichen, Analoge Aussagen resultieren für den Fall von Wählerstimmenmaximierungen.

Das Modell des öffentlichen Unternehmens kann man zu einem **Principal Agent Modell** ausbauen, das die vertikalen Auseinandersetzungen zwischen dem Eigentümer und dem öffentlichen Unternehmen beschreibt. Übliche Prinzipal Agent Lösungen resultieren, falls ein mächtiger Eigentümer unterstellt wird, der dem

Management nur seinen Mindestnutzen lässt. Bei ausgeglichenen Machtverhältnissen lassen sich Lösungen mithilfe von Verhandlungstheorien bestimmen. Mehrere Entscheidungsträger sind tätig. Im ersteren Falle liegt der günstigste Standort dort, wo der marginale Nutzenzuwachs des Prinzipals der Mindestnutzenänderung des Agenten gleicht. Eine Verbindung zwischen Standorttheorie und Prinzipal Agent Theorie mag ebenfalls hergestellt werden. Für jeden Standort soll sich ein möglicher Standortkompromiss einstellen. Die Standorte werden nach den Nutzenverteilungen geordnet, eine Nutzenmöglichkeitskurve bestimmt und mittels einer weiteren Nutzenfunktion, z.B. eines weiteren Entscheidungsträgers, der optimale Standort gefunden. Ansonsten dienen Standortspiele zwischen Prinzipal (öffentlichem Träger und Management) zur Auffindung von Verhandlungslösungen, die je nach den Zielfunktionen, z.B. politische Ziele, ökonomische Ziele) und entsprechenden pay-offs zu unterschiedlichen Resultaten der Standortwahl führen.

Ferner haben die Autoren das **Pelzman Modell** der politischen Theorie des öffentlichen Unternehmens mit dem einfachen Modell der öffentlichen Unternehmung integriert. Jedoch unterstellen sie, dass der Prinzipal (Träger) Wählerstimmen erzielen möchte und das öffentliche Unternehmen Gewinne anstrebt. Für zwei Märkte, in denen das öffentliche Unternehmen engagiert ist, werden Preise festgelegt sowie Indifferenzkurven des Managements und des Trägers abgeleitet. Man bestimmt die pareto-optimalen Nutzenverteilungen und findet über eine Nashlösung eines Nicht-Konstant-Summenspiels eine Lösung. Anschließend erfolgte eine Anwendung dieses Modells auf die Standorttheorie. Für unterschiedliche Standorte eruiert man derartige Lösungen. Der beste Standort ist jener bei dem das höchstwertigste „Nashprodukt“ erzielt werden kann.

Die Anwendung der vorgestellten Ansätze auf einen öffentlichen Konzerns erfolgt in einem weiteren Aufsatz über „Location Theory of a Trust Public Firms under Horizontal and Vertical Co-ordination“.