

PUBLIC VALUE UNDER CHAOTIC CONDITIONS¹

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Abstract

Economic interpretation of public value was elaborated in welfare theory and public choice literature. Nowadays public value describes the value that an organization contributes to society (Moore 1995). The authors discuss this definition and look for a more focused concept of value.

The chaotic conditions can be defined according to chaos theory or as conditions of disorder. The authors show conditions for chaos' situations. Even in situations that are characterized by deterministic model, the model solutions and public value may become unpredictable because of non-linear relations between variables or of initial conditions prevailing. Disorder situations occur in case of natural disasters, extreme population changes, economic crises, transformation situations and a breakdown of unions and national states. The difficulty to formulate public values are discussed for different kinds of disorders and evaluation schemes.

Keywords: public value, investment criteria, chaotic conditions, welfare, net-benefit analysis, output maximization

JEL codes: D61, H3, H39, H42, H43, H44

1. Introduction

Since public organisations such as governments, jurisdictions and their public offices or public enterprises exist, the question of evaluating their activities and outcomes arises. Suggestions for evaluations are based on religion, philosophical and political doctrines, and thoughts about the desired results for society. In public finance and public management such evaluations are mainly based on the welfare theory and public choice literature (Mueller 2003, Sobel 2004), which refer to an **economic interpretation of public value**. For a long time, measurement tools have existed for determining the results of public actions for society. Net-Benefit Analysis based on Dupuit (1844) has been discussed and applied for these purposes. Today the public evaluation problem is reinvented under the name public value. **Public value** describes the value that an organization contributes to society (Moore 1995, 2013). However, public value is also interpreted in the sense of a management concept (Skidmore 2006; Bozeman 2007, O' Flynn 2007; Williams, Shearer 2011), an attitude which is not followed here. The authors concentrate not on management, but on the evaluation

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issue.

In the literature on public enterprises and on public management, three **dominating evaluation approaches** exist. The evaluations of output and outcome may be based on:

- **Welfare** achievement (Dasgupta, Sen, Marglin 1972; Rittig 1977; Bös 1989; Flores 2003; Adler, Posner 2006; Rees 2006; Dehme, Friedrich, Nam 2009) that leads to welfare-based decision criteria.
- **Fulfilment of single or multiple goals** (Friedrich 1969; Thiemeyer, 1970, 1975; Pelzman 1971; Edeling, Stölting, Wagner 2004; Dehme, Friedrich, Nam 2009; Finocchiaro, Briani 2010; Baldarelli 2010; KPMG 2015; Meynhardt 2015; Bareiß, Eichhorn, Fortunato, Merk, Rahmel 2017) result in goal- and utility-based decision criteria.
- A mix of activities of public and private economic units **securing the survival** of society (Ritschl 1925, 1970) lead to social sustainability-oriented criteria.

According to these approaches, different types of public value and decision criteria result. Their appropriateness as a public value measure for public management is debatable considering various aspects. The results are very important in identifying:

- the **public value measure**,
- the **decision alternative** and
- the **consequences** involved.

The aim of the article is to identify whether the public value criteria can and should be applied under chaotic conditions, which increasingly prevail in some parts of the world. Accordingly to the aim the authors have following research questions:

- What are chaotic conditions?
- Can risk considerations help to express public value under chaotic conditions?
- How do different conditions hamper the application of different public value measures and the resulting criteria?
- Which criteria should be chosen under chaotic conditions?

Chaotic conditions can influence the number and kinds of alternatives, consequences and public value itself. The alternatives may concern public management decisions on choices of rules and regulations, measures, public revenues and expenditures, etc., projects and investment alternatives. Sometimes the alternatives and consequences cannot be identified because of chaotic conditions. **Chaotic conditions** may refer to a strict **scientific definition (1)** or in a more general sense to **conditions causing confusion** and/or **disorder (2)**. Chaotic conditions create essential difficulties for identifying meaningful alternatives, consequences and evaluation schemes.

Ad (1): In economics and business administration, chaos describes a **system's development**, for which the analyst is not able to identify meaningful solutions (Kemp 1997; Vlad, Pascu, Moriariu 2010). This can happen also in the case of a deterministic model if non-linear relations exist, e.g. where roots occur.

Ad (2): Chaotic conditions in the sense of disorder (e.g. Ergetin, Bagci Banerjee 2014; Ergetin, Bagci 2016) might comprise:

- **Natural disasters** like draught, flood, earthquakes, pest invasions, e.g. grasshoppers, etc. (a);
- **Extreme changes in population:** increases and decreases, uncontrollable migration, epidemics, etc. (b);
- **Economic crises** such as hyperinflation, substantial underemployment, the breakdown of export markets or of infrastructure like electricity provision, traffic regulation, information provision and communication, etc. (c);
- **Uphaveals**, revolutions, wars, blockades, cyber-attacks, etc. (d);
- **Crises in management** and in government (e);
- The total **transformation** of society when it adapts to a new religion or an invader, or a change in the basic economic order, a currency reform, a property rights reform, an extreme redistribution of wealth, rationing of important goods, etc. (f);
- The **breakdown of a state-like organisation** such as the European Union when member states leave, blockage of essential decision-making, etc., thus changing the economic order on a basic level (g).

2. Chaos According to Chaos Theory

Chaos theory can deal with public value and the alternatives and consequences of a decision referring to a development if public value is related to the development of a system comprising non-linear relationships. The main attention concerns the development of alternatives and their consequences.

A **simple example** is as follows (Kemp 1997; Reich 1989):

Imagine that to fulfil a public goal (public value) a good is produced, where X shows the share of its maximal possible production. For sake of simplicity the maximum value is one. The share in period t: X_t is linked to the production share of this good X_{t-1} in period t-1 according to the non-linear difference equation

$$X_t = r * X_{t-1}(1 - X_{t-1}), \quad X_t = r * X_{t-1} - r * X_{t-1}^2,$$

The term r shows a reaction on the value (amount) of X_{t-1} . Such a reaction might be due to a legal stipulation, the reaction of producers, the growth rate of the determining variable, the reaction of the management of public offices, voting behaviour of clients in favour of higher and smaller output, and budgets necessary to finance producers (Friedrich, Feng 2002), and other conditions. The graph of the function is presented in Figure 1. It shows a quadratic form.

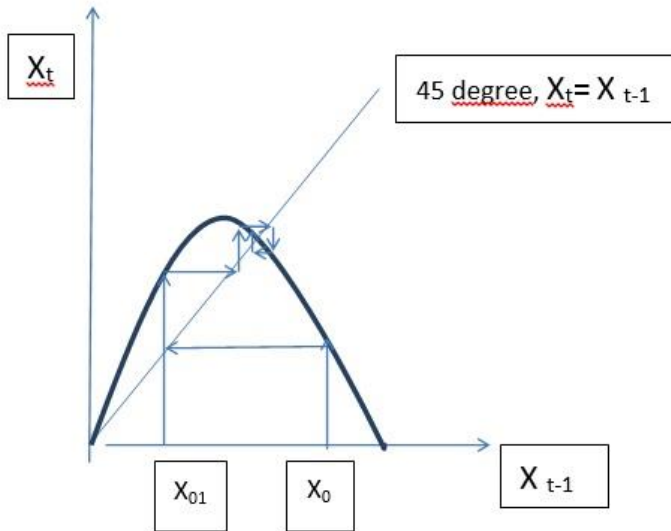


Figure 1: Development of attainment of public goal

Source: Kemp 1997

The **value of r** determines the particular form of the curve, and the higher r is, the higher is the hump of the curve. If X_t equals X_{t-1} an equilibrium or fixed point is reached at the origin with $X=0$ when in the origin the steepness of Figure 1 determined by r is smaller than the 45-degree line. That means the achievement of the public goal becomes zero. Another point of X where the development of X comes to an end is where the 45-degree line cuts the graph. There is $(r-1)/r$ equal to the positive X , where the developments ends. The arrows show the movements of X from period to period to reach such a point beginning at X_{01} or X_{02} . It is said the development has one attractor, where the development tends to. If r is between 1 and 2, the 45-degree line intersects the function before or at the maximum point. If r is bigger than 2, but smaller than 3 the attractor is right of the maximum point. However, if r is larger than 3, the fixed point becomes unstable and two attractors occur. This means that there are two cycles – two values – between which the values oscillate. There are two attractors and a so-called bifurcation takes place (see Figure 2).

The higher the value of r turns out to be, more cycles, attractors and bifurcations take place. This means that **chaos develops**. One is not able to detect meaningful solutions because they significantly multiply after some period of time. Apart from non-linear relations between variables and the size of r , that leads to bifurcations as shown in Figure 2; different trajectories are caused.

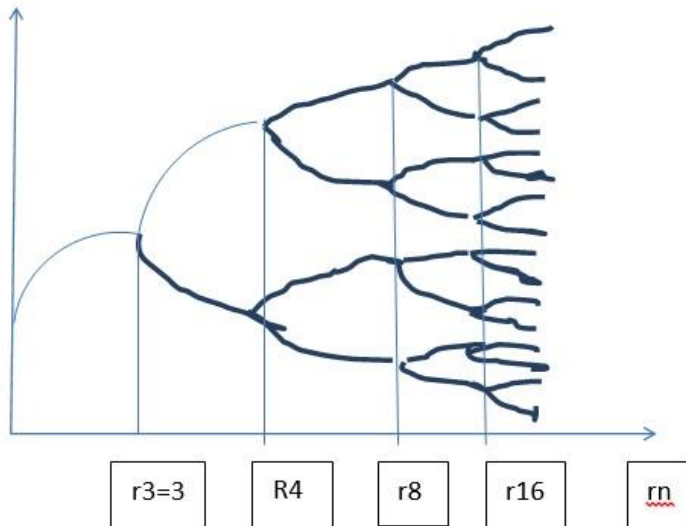


Figure 2: Bifurcations and number of attractors
 Source: Kemp 1997, Reich 1989

With high r the pattern of regular and irregular behaviour becomes unpredictable. Then deterministic chaos prevails and no reliable forecast is possible, although a deterministic model has been formulated. Moreover, with higher values of r the values of X become rather dependent on the size of initial value or volume of X_0 in period zero. Very small divergences of X_0 will lead to highly different trajectories and repercussions. This phenomenon is called the **butterfly effect** (Rouvas-Nicolis, Nicolis 2009). If such situations appear, public value cannot be determined because of the immense number of alternatives to be tackled. Then risk or subjective uncertainty might be introduced, but the question remains how to proceed as all situations might occur with equal probability. Public value might also vary if **evaluation goals develop** during the phases for which the consequences must be elaborated. Non-linear relations between goals may also lead to bifurcations in the evaluation part of decision-making. Moreover, the **size of r** may change depending on laws, budget rules, voting results, market development, managements' evaluations or changes in the top management of government. If r grows, the development may turn to various attractors or if it jumps over the critical value, then chaos may develop.

However, in economics there are also some **barriers to chaos**. There are substitutions and market gaps between goods. Then the distance between economic subjects creates gaps intensified by geographical conditions, climates and prevailing traffic systems. The same gaps stem from political borders, different social capital in terms of values, trust, networks (Westlund 2006), religion, different political organisation and class structures, different stages of human and economic development, etc. On the other

hand, such **gaps might be closed** suddenly by invasions, revolutions, wars, new religions, migration or a breakdown of long-term coalitions, disasters like epidemics, climate change, population growth or decline, the disappearance of social networks, basic changes in market forms or governments, etc. Then r may change, new non-linear relations may develop, and new lags must be considered. New deterministic but non-linear dependencies leading to chaos may appear.

As shown, a decision alternative cannot be clarified if a deterministic case is supposed. Therefore, the degree of achievement of a public goal cannot be detected. That can also happen if a part of the goal fulfilment indicator is based on a non-linear relation as is shown by Reich (1989) with respect to costs of atomic waste storage. This may concern many **investment alternatives** with respect to the time horizon, the number of periods included in the decision formula and the magnitude of the goal indicator within the periods to be considered. The impacts and goal values of the decision cannot detect whether one formulates a relative or a differential success indicator (Eichhorn 2000). Moreover, investment formulas to detect payoff and amortization are not applicable, because it is not known when the development induced by the decision reaches an end.

The danger of occurring chaos in the sense of chaos theory is especially large if complicated systems with lags in reaction are under consideration. To avoid such chaos implication in economic theory some ways out are used. Normally economics and business administration researchers look for equilibrium solutions. They are defined in such a way that in equilibrium the economic plans and the decisions of economic subjects are coordinated and fit together. Using this type of **equilibrium notion**, one supposes that all the relevant relations are linear or the reactions caused by lags are smooth (that means small r). These assumptions are mostly made when using CGE models (Borges 1986) to detect the consequences and impact of a policy decision or an essential change in infrastructure, political conditions, etc. Moreover, the solutions are driven by balancing markets while introducing very simple assumptions about public sector reactions, like the balance of revenues and expenditures in the budgeting of governments. CGE models are mostly applied to calculate long-term effects under the assumption that no additional basic economic or other environment change will happen and that market equilibria are reached, thus excluding chaos. Initial conditions are traced as adequately as possible using available statistical and other information on the present situation, which is used as the initial conditions. Some of the parameters of market behaviour are detected by econometric methods. Similarly, the location choice approach (Friedrich, Wonnemann 1985; Wonnemann 1989) used to identify impacts of public investment projects tries to detect economic and fiscal effects. Many effects are determined by crowding outs reflecting different market situations and budget situations. Parameters are specified by questioning and tracing business plans and determining additional measures to realize the planned investment reflecting the characteristics of the region of investment and those of the project. Several regions and the planning process as well as changes in relation to the investment are considered. However, both approaches are based on deterministic model formulations and do not take account of possible

existing chaos. Models which also try to model adaptation processes after leaving an equilibrium suppose that the adjustment processes lead to an attractor of zero. The system reaches an equilibrium. Solutions are gained by suppressing the chaos possibilities.

Other ways to express public value when dealing with chaos are:

- using simple indicators of success, e.g. profit or cost coverage,
- reducing the scope of decision alternatives in time, on the relatively short term, for example, looking at only ten years and
- taking the last change in year 10 as “reaching an attractor” situation.

For smaller projects where the consequences are restricted to several periods and a partial sector of economic and social development, e.g. for investments in the special production of goods for a special market, the danger of ending in chaos might be not so high. One should also have in mind that **another definition of equilibrium** is in use with chaos theory approaches. A solution is determined where all development becomes stable within a period in such a way as X_t equals to X_{t-1} . In investment accounting, the terminal value, which occurs at the end of the time horizon, is chosen as the end of development. This may fit cases showing one attractor only.

In addition, that investment accounting that looks for amortisation times or payback times cannot be applied in chaos situations, because which attractor will signal a solution might be unknown. Embarking on risk while considering techniques does not help in chaos because there is no probability distribution for special results and no randomness at all (Kemp 1976).

3. The Risk Consideration

The specified chaos definition applied in chaos theory does not express what is generally meant by chaotic conditions in economics, business administration sociology or politics. Therefore, the authors do not deliver an extension to chaos theory, but consider chaotic conditions in a more general sense as confusion and disorder, thus creating essential difficulties for a prognosis to identify meaningful alternatives, consequences and evaluation schemes.

Chaotic conditions – mentioned above, from (a) to (f) – are difficult to consider in the **evaluation** (public value) of a decision alternative. The decision maker does not even know which goals are necessary to express public value. They may completely change, and the evaluation of an alternative may become zero because of public value change or because of the consequences of alternatives under chaotic conditions. The decision maker may have no knowledge about the impacts of **alternatives** and might not know about their relations to other decisions. Under such circumstances, the consequences of an alternative cannot be traced sufficiently. Eventual chaotic conditions are often considered by applying risk measurement.

Especially in commercial (profit) or benefit-cost evaluations of public value, risk is considered by increasing costs or social costs by marking up a cost percentage. This

results from multiplying cost derivations from expected costs by the probability of their occurrence (Pfnür 2006). This approach does not consider that the same mark-up can be reached by a quite different standard deviation as shown in tables 1 and 2.

Table 1: Risk addition percentage for a project I

Scenario	Difference from expected costs	Probability of scenario	Damage in % of costs
Cost saving	- 5%	5%	- 0.25%
No difference	0 %	10%	0.00%
Small excess	10 %	30%	3.00%
Moderate excess	20 %	40%	8.00%
High excess	40%	15%	6.00%
Sum risk mark up		100%	16.75%
Standard deviation			3.64%

Source: (Pfnür 2006)

Therefore, the risk situation is with project I and II (see Table 1 and Table 2) quite different unless the decision maker is risk neutral.

Table 2: Risk addition percentage with project II

Scenario	Difference from expected costs	Probability of scenario	Damage in % of costs
High cost savings	- 40%	29.06%	- 11.63%
High cost excess	+ 40%	70.94%	28.38%
Sum risk mark up		100%	16.75%
Standard deviation			28.28%

Source: Pfnür (2006)

The same is true if the risk is considered as a mark down on the revenue or the social benefit side. Correcting by increasing the discount rate is also not helpful as it only expresses that future “unpleasant” situations are not as highly evaluated as the short-term ones. Most risk-considering approaches cannot be applied under chaotic circumstances if the alternatives to be considered underlay many influences. The risks stemming from chaotic conditions could be considered more sophisticated when deciding about an investment project, political measures, reforms, etc. (Bodea, Purnus, Huemann, Hadju 2016).

Risk refers to the probability of an event in the future, which might be in favour of or against the fulfilment of goals (values) of the decision maker. Some risk is associated with all actions and decisions (Otley 2014). However, under chaotic conditions, the risks may threaten the survival of the decision maker. There is often no ductile risks (König 2008), where the negative consequences can be reduced in order to limit possible losses. With ductile risks, different projects may be defined according to alternative measures in order to choose the one that serves the public goal best.

Chaotic conditions such as **disasters** (a) or **diseases** (b) may be expected to happen during a project's lifetime or in the future, or they already exist when the decision must be made. If chaotic decisions already prevail, time pressure may force the decision maker to escape to actions feasible in the short term that promise the best solutions for minimizing losses in terms of the same objective or to for other goals, e.g. to save lives. The time to elaborate risk considerations based on identified probability distributions gained from experiences with former similar situations may not be available. However, there might be preventive measures, actions and best practices available to determine appropriate public value changes, as well as ad hoc assumption about expected alternatives including the consequences, such as in security situations, upheavals (d), government crises (e), etc.

If the chaotic conditions mentioned, such as those stemming from environmental **destruction** (a), are expected in the future, developments and alternatives according to empirically specified probability distributions⁴ might be known. In the case of **natural disasters** (a) such as earthquakes, hurricanes, floods, droughts, etc. in certain regions, probability distributions are found or determined by probability generators, Monte Carlo methods (Pfnür 2006; Schlundt 2013) based on empirical experiences and experts' knowledge. Some probability-based experiences might be assigned to accidents, diseases, etc. in a given environment. The probability of different alternatives to achieve a public goal might be identified. For some of the other chaotic circumstances, such empirically based probability distribution might also be available, e.g. health, diseases (a). According to the risk preferences, the decision alternative allowing the most preferred probable fulfilment of public goal attainment might be chosen.

However, when developing decision alternatives, often the decision maker does not know when a disaster, etc. will take place, in which period within the chosen time horizon it may appear and which kind of volatility will occur. Sometimes the analyst uses an approach where he tries to determine the consequences as if the event will happen at a given point in time (Dixit et al. 2009). This approach enables more information about the possible impacts of a disaster to be gained, but does not help much to specify a clear decision alternative to determine public value.

When applying most of these methods dealing with natural disasters (a) and destruction (a) the analyst assumes that the **rest of society stays stable**, e.g. economic and political environments are not impacted or changed and do not exhibit chaotic conditions. Such assumptions are often not true, e.g. AIDS in some African countries

⁴ In financial analysis, empirical risk analysis is often associated with performance risk development. "The classic performance variability measures are standard deviation, *ex post* tracking error (i.e., the historical variability of performance relative to the benchmark), the Sharpe ratio, the information ratio, such variants on the Sharpe ratio as the Treynor ratio and Jensen's alpha, downside measures (e.g., the Sortino ratio and downside capture), and most beta measures. Beta calculations can represent either performance or risk measures depending on how they are calculated". (McCarty 2014: 42). The future oriented risk is expressed by risk measures (see their development: NYU-Stern [2017]).

or when chaotic circumstances are created by mass immigration, overpopulation and epidemics. In addition, general economic chaotic conditions like hyperinflation, extreme unemployment, breakdown of total demand and the traffic system, etc. or societies in abrupt transition and transformation show nationwide or continent-wide changes. Chaotic conditions are mostly tackled in public value determination if they appear regionally. If not, then public value in terms of evaluation might change too.

A risk analysis is especially difficult if the **economic crises (c)** mentioned above such as hyperinflation, substantial underemployment, or breakdown of export markets, infrastructure like electricity provision, traffic regulation, information provision and communication, etc. take place. Again, two situations are possible: **chaotic conditions have already appeared** or they may happen in future. In the first case, the usual determination and evaluation of public value might not serve anymore and risk analysis is not helpful. If chaotic conditions already prevail, the evaluation breaks down if the evaluation indicators, e.g. product prices, factor prices willingness to pay and their development, do not make sense anymore, e.g. with hyperinflation. In the case of unemployment and depression, the demand for products may break away, thus bringing down the alternatives nearly to zero. Other demands, which may increase in such a way cannot be satisfied, because of financial and other restrictions. Production might be reduced to zero, as traffic infrastructure, etc. is insufficient for elements in the production chain to gain access to each other. Often, public value must be changed to more short-term evaluations and new alternatives. It is difficult to detect which alternatives are feasible under such conditions as political turmoil and how to determine public value.

If such chaotic conditions can occur in the **future** it is hard to predict them. There might be economic indicators pointing to future difficulties like construction projects and construction permits planned far in advance, key sector development, prices such as long-term interest rates, etc. gained from experience and economic theory to predict economic recessions, etc. However, gaining a basic risk distribution from such information is rather difficult. Hoping that demands develop in the same way as before the chaotic events occurred is normally not realistic. Predicting future chaotic conditions is especially problematic if they are determined by various political decision makers who must work together.

This is even more complicated when **political chaotic conditions (d)** prevail as a consequence of war, civil war, upheavals, etc., because positive theories to explain such circumstances are not sufficiently developed in political science. Historical experiences give hints, but these exist few possibilities to develop risk distributions in order to predict the alternatives and their consequences. With respect to the alternatives in contrast to disasters, the assumption about a stable environment is not true anymore.

Politically chaotic conditions are also related to chaotic situations in **government and sometimes management (e)**. Governmental chaotic conditions can occur if for one jurisdiction several governments develop and are in conflict for governance and

power. There may also be changes in the majorities in parliament, the blockage decisions in parliament or between jurisdictions, or overruling the segregation of powers, changing laws and orders, no decisions on goals. They lead to variations in public value management, blockage of alternatives and their consequences and even the development of alternatives. No decision can be made or in the past introduced programs are evaluated according to public value evaluations applied in a past period. Inadequate alternatives and consequences may be realized or partly changed. Even in terms of new public value or the traditional one, public value is not realized. It is quite difficult to find an adequate risk distribution if politically chaotic conditions must be considered in the future. Historical experience can also provide some information about critical developments because of voting behaviours, changes in the power of parties, the variation of political members in decision-making bodies, etc. Again, the assumption of a stable social environment is in the case of politically chaotic circumstances rather artificial.

For **some types of production and sectors** as well as single public enterprises, there may exist chaotic conditions in management when the decision-making orders do not formulate public value-oriented decisions and if decision makers are not willing to evolve adequate decision alternatives. Managers might be more interested in following purely profit-oriented goals, personally oriented goals and aims, privatisation-oriented policies or even non-legal goals and criminal actions, or they may just want to avoid commercial failures of the enterprises not allowed by company law. Then alternatives and consequences of minor public value are realized. Sometimes management bodies do not make adequate decisions. Reasons may be power struggles between managers, failure to coordinate with the owning or subsidizing jurisdictions, conflicts with private owners in public-private partnerships, conflicts with the staff and trade unions, etc. A probability distribution when such situation will occur is seldom attained. This may happen although in cases when the firm has an early-warning indicator system, a long firm history and established experience in the sector the public enterprise belongs to. At least the assumption that the surrounding conditions concerning the sector or enterprise are stable may be correct.

A difficult task is to determine public value and the alternatives in times of **transformation (f)** from one order of economics to a different one. From the example of transformation of a centrally planned socialist economy one learnt that because of lack of public value consideration, many times public value was substituted by purely private value with the consequence of changing activities to short-term trade and production or that production which could be backed by FDIs. The establishment of very basic economic units, such as a less government-dependent central bank, the establishment of democratic institutions (like the parliament, central governments, jurisdictions, courts, stock exchange) and the formulation of social rules, property rights and laws (like the constitution, civil law such as company laws, and basic public laws) took place on the existing belief that they are necessary and not on sophisticated public value measurement. Privatization was dominated by private value argumentation. Therefore, the type of considered alternatives was also shorter term, since long-term investments seem rather risky for foreign investors. As different

conditions prevailed in different countries, the tendencies of how much the decisions were driven by public value were different.⁵ Special management tools to measure public value were applied seldom. There have been used employment arguments, environmental necessities, restitution in favour of public owners, and considerations of legal requirements. Risk played a role with respect to environmental conditions of real estate, industrial ruins, former military sites, and some future demand estimations, e.g. in industrial district development, public water works, electricity production and clustering.

Conducting a risk analysis to predict transformation events is challenging. Also, some hints based on political, economic, and social indicators may point to catastrophic transformations, a currency reform, struggles between classes and about wealth distribution, nationalization, rationing of important goods, etc. However, forecasting developing alternatives and public value to be applied are problematic.

Other chaotic conditions emerge when a **country or a union, like the European Union, finds itself breaking up** (g). Then public value changes because it no longer refers to the whole country or Union. As Brexit shows, the changing alternatives and consequences are not known even for political bodies and decision makers. It is not possible to detect the consequences or predict when they may occur. Probabilities for following events are difficult to identify. For projects which are not much connected with other events and which are related to basic needs, the alternatives may not change much (e.g. the demand for energy). If several countries exit the European Union take place accompanied by border closures and a euro breakdown, other chaotic conditions may unpredictably follow with respect to public value, alternatives and consequences. Public value identification possibilities and main assumptions are summarized in Table 3.

Table 3: Public value in chaotic conditions

Chaotic conditions	Risk identification	Public value	Alternatives, consequences at present	Alternatives, consequences in future	Stability assumption around a project
Natural disasters, environmental destruction (a)	Probability generators. Monte Carlo methods, some empirical experiences	May change	Alternatives change considering rescue measures	Unpredictable when disaster occurs, consequences known from past experiences	Often valid

⁵ In Germany, the transformation in the new states was linked to the unification and the accession to the European Union. There were various obligations to apply public value to form the states and to establish jurisdictions, public enterprises, public offices according to the constitution, federal law and a unification treaty. The need to staff the new public sector with similar public offices and public enterprises as in the old states rose, enabling the new states to compete with old states within the federation, but also with other regions in the EU. Therefore, public value played a considerable role in keeping industrial cores alive and developing them and to keeping migration to the West low.

Population development, migration, epidemics (b)	Risk difficult to detect although empirical experiences may exist	May change	Alternatives change	To some extent predictable, to some event develops slowly	Often not valid
Economic crises (hyperinflation, unemployment, breakdown of exports, infrastructure) (c)	Risks are difficult to detect, although crises indicators and economic theory exists	May change	Alternatives change	To some extent predictable	Not valid
Upheavals, revolutions, wars, blockades (d)	Difficult to detect a probability distribution, but historical examples	May change	Alternatives change	Alternatives are nearly unpredictable, although there is knowledge from the past	Not valid
Crises in Management, Government (e)	Different risks according to type of crisis, detection of risk distribution difficult	May change	Alternatives change	Some predictions due to types of crisis seem possible, normally not	Partly valid
Total society transformation (f)	No risk distributions available	Changes	Alternatives change	Predictions nearly impossible	Not valid
Collapse of a state or EU (g)	No risk distribution available	Changes	Alternatives change partly	Predictions are only partly possible	Partly valid

Source: Compiled by authors

The expectation of public value changes, and variations of alternatives and predictability problems are overwhelming if **several types of chaotic conditions** mentioned come together.

4. Criteria for Public Value Evaluation under Chaotic Conditions of Disorder

4.1. Welfare Criteria

In this section, the authors discuss how the welfare criteria are influenced by the chaotic conditions. Alternatives and consequences are of minor consideration.

Analysts who account the welfare orientated public value mostly apply an individualistic welfare concept and the **willingness-to-pay approach** for evaluations.⁶ There are doubts about welfare-oriented public value in the case of market failures and poorly functioning public-sector activities (Bozeman 2003).

The criteria gained for the public value of a service, measure, or project is (Eerma, Friedrich 2017):

$$\begin{aligned} \text{Net Benefit} = & \text{Social Benefits (Consumer Surplus + Turnover + Money Value of} \\ & \text{Positive External Effects) -} \\ & \text{Social Costs (Producer Surplus in terms of procurement} \\ & \text{advantages + Costs + Money Value of Negative External} \\ & \text{Effects)} \end{aligned}$$

To identify the **net benefit**, the **group** for which welfare must be maximised and for which willingness to pay must be identified, must be stable during the time horizon of the project, measure, etc. It is normally assumed that prices and payments reflect willingness to pay. Therefore, for fixing public value the population of a country is normally chosen as a welfare reference group. If the EU-wide welfare public value is to be determined, the population of all member countries should comprise the welfare group. Under chaotic conditions the reference group may change. This may happen as a consequence of a disaster (a), drastic population changes (b), the exit and break down of a country (d), partly if transformation is connected with population movements and changes of citizenship (e) or when, due to revolution, welfare is determined by a new class in power (f). We encounter similar difficulties if we want to measure the welfare of sub-national jurisdictions. Only the willingness to pay of the new group should be considered when determining the willingness to pay. Then on the social benefit side the consumer surplus must be split, and only that of the elected population has to be identified (Friedrich 1971), e.g. the demand curves of the relevant population must be verified. Turnover must also be measured with reference to this group, and only the willingness to pay to achieve positive effects for that group must be evolved. For social cost evaluation, only market power producer advantages against the new reference group must be deducted and only their costs must be counted. Analogously, the willingness to pay against negative external effects concerns only the reference group. A very complicated solution causes the identification of welfare-oriented public value for different groups of persons, which

⁶ This approach is based on a rather restrictive view of society and the decision-making power expressed in willingness to pay in monetary terms. Prices are stable and known within the assessment period, activities and effects are known and accessible, as well do, the short and long lasting effects, the stocks and flows, the (Eerma, Friedrich 2017). So-called tools of isolated welfare measurement (Friedrich 1971) are not yet developed. The willingness to pay is developed to measure public value for citizens, but it is still discussed how firms, public offices, etc. should be treated, who in reality also influences public value and expresses willingness to pay.

might appear over the course of time.⁷ The methods for doing these adaptations to identify so-called isolated welfare have not been developed sufficiently.

With other chaotic conditions like economic ones (c), e.g. hyperinflation or currency crises, or in times of extreme underemployment, prices lose their function as willingness-to-pay indicators on the social benefit side or both sides. The **prices** do not reflect the effects of changes in extreme wealth variations, either. Other chaotic conditions, e.g. government crises (d), might also change prices. Especially in transformation (f) and economic crises, nearly all economic conditions and prices change, and the basic assumption of general constancy is no longer valid.

Apart from the evaluation of public value, the **alternatives and consequences** may vary too, e.g. changes of service and production volumes. In addition, the formulation of a reference project according to the “with and without principle” does not make sense under chaotic conditions because both the public value of the reference project (e.g. no project) and the new project cannot be elaborated.

Therefore, typical welfare-based public value cannot be determined when chaotic conditions prevail. That means that public value measured by welfare-based social accounting (Eerma 2014; Eerma, Friedrich 2017) loses its meaningfulness and functions as a management tool as well. Moreover, all first-order or second-order based welfare-maximising **price fixing rules** like marginal cost pricing and so-called **commercial rules**⁸ are not feasible for public welfare value determination in order to decide on pricing and investments.

4.2. Single Goal-Based Criteria or Multiple Goals-Based Criteria

If public value is expressed in terms of single goals or multiple goals in the form of a **utility analysis**, the problem caused by chaotic conditions might be of less importance. The kind of dominating goals and kind of economic units determine economic, social, and political goals public value (The public value interest group 2016).

For centuries there has been an intensive debate on which goals should be chosen and which **goals serve the public interest** (Frisch, Strohm 2004), which is dominated by the interpretation of the features and powers of the state and fields of priority of public and private law (Sodan 2016). A recent debate in Anglo-Saxon literature focuses on aims related to the core goals of the constitution determining public value and to criteria for public failure, e.g. public offices losing their monopoly power to regulate

⁷ Who is able to predict the willingness to pay for services of a future European generation consisting of Asians with Islamic beliefs and Asian values and a majority of integrated people of European roots?

⁸ They refer to relations between profit percentages in private and public industries, *péages* (mark ups) on marginal costs, a special relation between marginal costs and price, rules which require a special return to invested capital, and rules to achieve a demanded profit (Friedrich 1969; Rothengatter 2001).

private countervailing actions, where public value must be attached too (Bozeman 2003) in the sense of better achieving the public goal. There will be a never-ending debate about the goals determining public value. Decision makers must agree on which project, situation, action, executing laws to which problem solutions in public law and public management are relevant.⁹

$$PV = u1 * goal1 + u2 * goal2 + u3 * goal3 + u4 * goal4$$

The weights $u1$ to $u4$ must be introduced and the goals attendance must be determined as well, e.g. goal 1 might be a contribution to cover costs, goal 2 might be a reduction of emissions, goal 3 might refer to the wellbeing of the staff and goal 4 to the promotion of other firms. The $u1$, $u2$, $u3$, $u4$ are gained from a hierarchy of goals. Many other goals might be considered as well (Zangemeister 1976; Guarneri 2015).

If a **goal function** in accordance with the **existing constitution** exists for which measurements are available, the problem remains whether it is an appropriate instrument to express public value under chaotic circumstances. One advantage could be that those goals which are very sensible to chaotic conditions are not considered among the goals. Public value will be much more stable, e.g. an epidemic may not influence some important constitutional environmental goals. A further advantage is that, according to expected catastrophic circumstances, the social weighting of the goals in the resulting utility analysis may be changed and adopted, e.g. in the case of unfavourable population aging and decrease and insufficient birth rates. A simulation with different social weights will show the dependence of public value on chaotic conditions. This might be done through simulating different types of goal attainment and through varying the social weights. However, public value is still accounted for on the basis of the existing constitution, which might not be relevant under future conditions.¹⁰

In the case of disasters and environmental destruction (a), public value may disappear when the disaster happens near the location of a project, public office or public enterprise. Public value may vanish because the alternatives and consequences are no longer available, and contributions to goal fulfilment become zero. There might also be a priority change in favour of avoiding dangerous emissions (e.g. $u2$). If the disaster does not take place in the host region, even greater public value may occur if production must be increased in order to make up for losses in other regions.

⁹ But this is already happening with the execution of laws, programs, and projects, etc. and concerns practical problems in public law and public management.

¹⁰ Under chaotic circumstances the constitution changes and the core goals get substituted by others. One may try to construct alternative types of public value for future societies by making assumptions about such elements future constitutions and societal conditions. However, without knowing in advance which chaotic conditions might appear, the choice of a possible core constitution is rather difficult. There might be a retreat to goals which should be attained to allow any human being to live, e.g. environmental conditions with respect to air, sea levels or available land for food production.

The problem of accounting for public value in favour of a special **interest group** arises again when chaotic mass immigration and population developments (b) take place. There might be a reshuffling of demand, also influencing the goal attainments when public value is accounted for on the basis of the existing constitution. However, the **constitution might not be relevant under future conditions, constitution** changes (e.g. under the influence of Islamic groups) and the development of parallel societies. Under chaotic circumstances the constitution change and the core goals are substituted by others.

The economic catastrophic conditions (c) like hyperinflation might be considered by taking into consideration some of the types of **goal attainment in real terms** at constant prices. However, the demand side or production might break down because of infrastructure difficulties as well. It also might be that goals like goal 3 gain importance and u_3 increases. Upheavals, revolutions, wars, blockades (d), etc. again change the groups in power and, therefore, the kinds of goals. The volume of public value is also reduced because demand is reduced and production is hampered. Some goals like goal 3 and the weight u_3 may gain in importance.

If chaotic conditions in management or government prevail (e), the decision makers do not end up with an adequate public value formulation. They **do not agree on the goals** or on the social weights (u). They might not adapt the weights and goals, thus using the old public value measurement. Negative impact on public value may stem from demand changes or hindering production activities.

In the course of transition of society and economy (f) the **goals change** and the u's variate as well. Moreover, the demands and the production conditions vary. There is the danger that public value will be substituted by private value, which means in favour of goal 1 and in favour of goal 4. The respective u's might increase as well. The measurement of goals will be rather difficult.

The collapse of a state or the EU (g) brings again into play the definition of the **group**, whose wellbeing should be considered. However, the effects, e.g. of new borders, tariffs, hampered cross-border cooperation, or new currencies, might be longer term. The adaptation of public value needs time; therefore, in the short run public value may not change much.

Compared with the welfare-oriented public value management, utility analysis-based public value reveals under chaotic conditions a wider **spectrum of applicability**.

4.3. Survival-Oriented Criteria for Public Value

Ritschl's approach leads to a quite different solution. His orientation is not on a given constitution, but towards the survival of society. Different goals become relevant according to which society should be secured. In addition, goals which improve the conditions of survival must be attained. Both types of goals serve as a basis for measurement of public value. As a society is rooted in its culture, history and the

sequence of generations, the goals refer often to an **already existing society**. Therefore, goals to stabilize the population and to enable future generations to proliferate, thus providing good conditions for families, preserving the cultural characteristics of the population, and its religion and self-esteem become relevant. Goals to ensure the population's future existence, e.g. competitive knowledge and avoidance of internal conflicts, might be of essential importance. Ritschl's orientation is more on how to prevent society from experiencing chaotic conditions than to change public value when chaotic conditions have developed.

Therefore, external conflicts should be avoided and the geographical conditions of survival may determine the goals to be chosen. The society may agree to allow only such goal changes which do not lead to chaotic conditions or which prevent chaotic events. In Ritschl's opinion, such society needs adequate **private and public activities** to achieve the public goals (Ritschl 1925, 1970; Hirsch 1992). Various sub-goals might be relevant for legislators of jurisdictions, governmental public offices, and public enterprises when determining public value and appropriate measurements of public value. Even private activities are necessary to realize the goals to secure survival. Therefore, goals of private co-ordination and survival of private economic units guided by their private value may be in the public interest. These kinds of public or private value are supposed to strengthen society by protecting it against turmoil, e.g. by ensuring technical knowledge and innovations to survive invasions, epidemics, disasters, and economic attacks. That means that a couple of public value measurements considering these preconditions should be chosen and oriented to goals and conditions to avoid and withstand chaotic conditions. They partly refer to existing goals:

- Goals and public value measurements already in use;
- Private value measurements applied for market coordination tolerated by public goals;
- Already existing public values restricting and supplementing private value driven activities;
- Goals and public value to prevent chaotic conditions.

It might also happen that there are **visions about a future society**, e.g. a multi-cultural society, which should be secured.¹¹ Difficulties stem from the lack of sufficient sociological theories to detect the conditions and goals as a basis for public value, which then allows survival.

According to Ritschl public value concerns also measures that are necessary to prevent society from **chaotic conditions** like disasters and, correction environmental destruction (a). Therefore, measures to cope with disasters and environmental destruction gain a high preference with respect to goal 2 and u2. The alternatives concern now the anti-disaster measures and the reduction of emissions (environmental

¹¹ The examples of the French Revolution, the Soviet October Revolution, the religious mixed society in medieval Sicily, the national socialist society, the late Roman society, the society in Lebanon, South Africa, etc. show that it is very difficult to define appropriate public value enabling such societies to survive.

sustainability). Other chaotic conditions, concerning population developments and mass immigration (b) must be fought as well. There might even be new goals introduced such as family-friendly income payment and working conditions. U3 and goal3 gain in importance or a goal concerning employment restrictions for people of another cultural heritage who are not willing to integrate. If economic crises such as hyperinflation, unemployment, and breakdown of infrastructure (c) take place, public value may be expressed in real terms, or public value turns in favour of higher production or in stabilizing infrastructure. Whether changes in goals increase public value is questionable as there might be a drop in demand at the same time. How the countervailing of upheavals, revolutions, etc. wars (d) influences public value is difficult to estimate. Public value may change in the direction of higher evaluation of staff wellbeing and higher evaluation of production. However, whether this can compensate for drops in demand and difficulties in production is not easy to detect. Difficulties stemming from management and government weakness (e) might not be able to compensate. One way might be to increase the weight w_1 to strengthen the goal1. However, there might be only a few chances to improve the results in terms of public value. If the society and economy is in transformation (f), the goals that determine public value might change in favour of employment, and in favour of investments, of a fiscal result and of reduction of environmental destruction. However, whether under such chaotic transformation conditions a contribution in the direction of greater public value is possible seems doubtful because many economic relations are skipped and many economic units die off. The collapse of a state or the EU (g) turns public value to smaller groups, the public value of which should be detected. If it is a slow process the impact on goal attainment through new borders, etc. is smaller. However, if a free trade area vanishes and a common currency is lost, public value might also shrink for the smaller population group.

Generally, **public value increases** in favour of measures reducing the impact of chaotic conditions. The problem is to identify the appropriate measures to reduce the effects of chaotic conditions.

4.4. Criteria to Increase Output as Public Value Indicator

Under chaotic conditions, at least some foundations for public value are available. They concern **production**, goals and conditions which are relevant for any human being to survive such as:

- Basic products which are necessary for every society, e.g. materials such as iron and minerals, animals, cereals, energy sources, etc.;
- Geographical and infrastructure conditions concerning forests, agricultural land, rivers, water, seas and waterways, transportation ways, etc.;
- Some climate conditions like temperature, air consistency, etc.

Public value increases if more of these basic products are available. Then public value PV depends on output x , which means: $PV = PV(x)$

If a producing public unit faces a given budget and available production processes the situation is demonstrated in Figure 3. The process with the lower variable costs allows for higher output, and thus for greater public value.¹²

For an output maximising firm that should cover its costs, the criteria shown in Figure 4 result. If the critical volume between two processes is right of the turnover maximum, the process with the higher variable costs is the better one, leading to higher output and public value. If the critical volume can be sold with a profit, the process with the lower variable costs leads to higher output and greater public value. If the critical volume – where costs of the processes are the same – is higher than that of the turnover maximum, the process with the higher variable costs allows a higher output and public value.

These criteria are not influenced much by **chaotic conditions**. Disasters (a) might destroy production, and the budget might be shortened or the turnover shrink. However, that may not touch the production activities under observation. Other chaotic conditions like population movement and mass immigration (b) might even ask for higher output, thus increasing public value. Economic crises (c) normally increase the demand for output, which covers fundamental needs. Hyperinflation might be considered by accounting in real terms. Also in times of war (d) basic needs must be covered and higher output for such goods is urgent. That means greater public value becomes necessary.

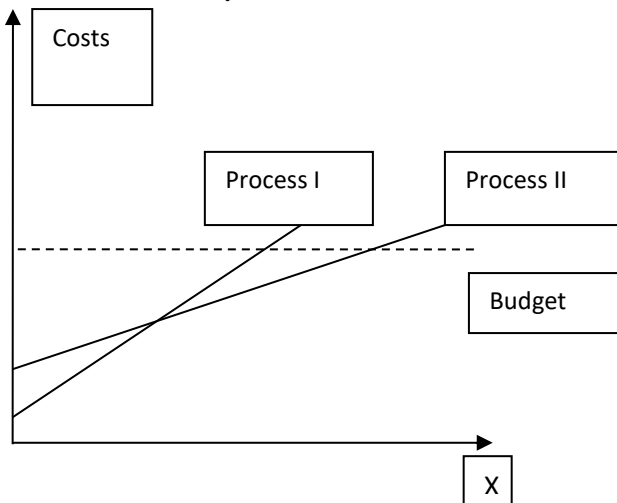


Figure 3: Output Maximising Public Value

Source: Friedrich, Ukrainski, Timpmann 2016

¹² There are also criteria for machine parks and a growth model for an output maximising firm (Friedrich 1969).

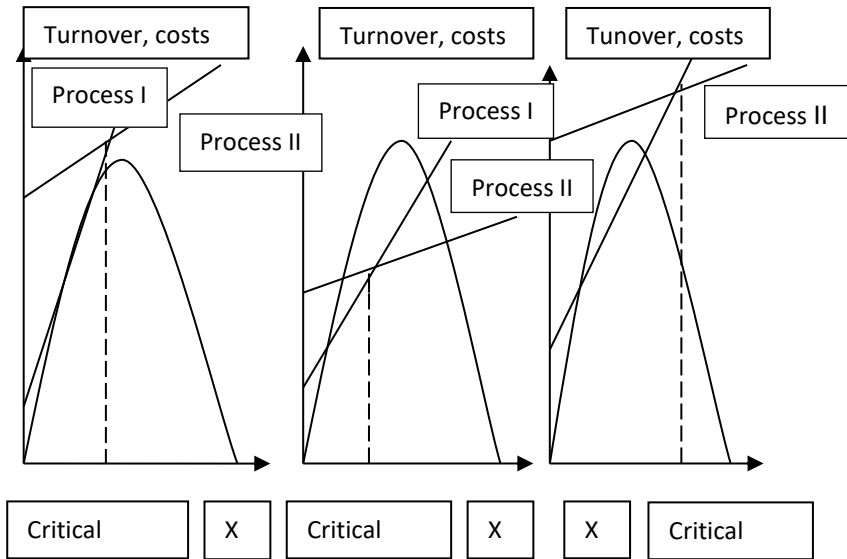


Figure 4: Output maximising and cost covering public value (Source: Friedrich 1969)
 If management and government are in crisis (e), at the very least, outputs to ensure the survival of economic units are necessary, and the criteria can be applied, although the budget might be smaller. With the economy and society in transformation (f), these criteria might be the only ones which can be applied easily. Even turnover changes, and cost movements keep the criteria applicable. Less touched are those criteria that result from the collapse of a state and the EU as these basic needs must always be met. The output criteria signalling public value are less sensible to chaotic conditions than the other ones.

5. Conclusions

The authors pointed to **three basic definitions of public value** in the sense of a welfare increase, a maximisation of a utility function and of public value to ensure the survival of society. Decisions are characterized by the public value measurement, the alternatives and the consequences. If there are several alternatives available, that with the greatest public value should be chosen.

Increasingly the development of society is hidden by shocks and **chaotic conditions**. Therefore, it is necessary to analyse how public value becomes influenced by such conditions. The authors turn to the **scientific definition of chaos**. In deterministic situations, because of non-linear relations, the analyst might not be able to find a solution for his decision because there are too many solutions possible. Therefore, the public value cannot be determined.

However, chaotic conditions can be also defined as **general disorder** and confusion. The authors elaborate a list of such situations. Then the authors point to the difficulties which are associated with these chaotic conditions, asking whether there is a risk analysis available to predict the influence on public value, the alternatives and consequences. The results referring to an appropriate risk analysis are not very promising. Only in limited cases an appropriate risk analysis is available.

The **welfare-oriented public value** cannot be applied under chaotic conditions. **Multiple public goals** expressing public value is less sensible to chaotic conditions. The approach of **Ritschl** to public value shows increases of public value when fighting against chaotic conditions. Under chaotic conditions, it seems that output increasing public value is less influenced by these conditions than the other criteria for public value.

Much **impact analysis** must be evolved to show the influence of chaotic conditions on public value, alternatives and consequences. However, this is a quite demanding task because positive theories about society's development, political development, disaster theories, and management theories are lacking.

References

1. **Adler, M., Posner, E.** (2006). *New Foundations of Cost-Benefit Analysis*. Cambridge: Harvard University Press.
2. **Baldarelli, M., G.** (Ed.), (2010). *Civil Economy, Democracy, Transparency and Social and Environmental Accounting Research Role*. Milano *et al.*: McGraw-Hill.
3. **Bareiß, A., Eichhorn, P., Fortunato, E., Knocke, M., Merk, J., Rahmel, A.** (2017). SRJ (Social Returns to Investment) – A Case Study about Social Profit. *International Journal of Business Administration and Management Research*, ISSN Online 24124346.
4. **Bodea, C.N., Purnus, A. Huemann, M. Hadju, M.** (Eds.) (2016). *Managing Project Risks for Competitive Advantage in Changing Business Environments*. Hershey: IGI-Global.
5. **Bös, D.** (1989), *Public Enterprise Economics*, Amsterdam: North Holland, Elsevier.
6. **Bozeman, B.** (2003). *Public Value Mapping of Science Outcomes: Theory and Method*. Washington, DC: Center for Science, Policy and Outcomes.
7. **Bozeman, B.** (2007). *Public Value and Public Interest*. Washington: Georgetown University Press.
8. **Dasgupta, P., Sen, A., Marglin, S.** (1972). *Guidelines for Project Evaluation*. New York: United Nations.
9. **Dehme, A., Friedrich, P., Nam Ch.W.** (2009). Determination of Fees for Local Services under Consideration of Private and Public Management Objectives. *Zeitschrift für öffentliche und gemeinnützige Unternehmen*, 32, 1-18.
10. **Dixit, A., Pokhret, A., Moench, N.** (2009). Qualitative Assessment of the costs and Benefits of Flood Mitigation. Moench, M., Fajber, E., Dixit, S., Caspari, E.,

- Pokhrel, A. (Eds.), *Catalyzing Climate and Disaster Resilience*. Kathmandu ISET, 223-250.
11. **Dupuit, J. (1844)**. De la mesure de l'utilité des travaux publics. *Annales des ponts et chaussées*, 8 (2 sem), 332-375.
 12. **Edeling, Th., Stölting, E., Wagner, D. (2004)**. Öffentliche Unternehmen zwischen Privatwirtschaft und öffentlicher Verwaltung, Eine empirische Studie im Feld kommunaler Versorgungsunternehmen. *Interdisziplinäre Organisations- und Verwaltungsforschung*: Springer VS.
 13. **Eerma, D. (2014)**. A bookkeeping approach to social accounting for a university faculty: the case of the University of Tartu. Tartu: Tartu University Press.
 14. **Eerma, D., Friedrich, P. (2017)**. Welfare-oriented Social Accounting. Andeßner, R., Greiling, D., Vogel, R. (Eds.), *Public Sector Management in a Globalized World*. Wiesbaden, 59-94: Springer, Gabler. (NPO Mangement).
 15. **Eichhorn, P. (2000)**. *Das Prinzip Wirtschaftlichkeit*. Wiesbaden: Gabler, Springer.
 16. **Ergetin, S.S. Banerjee, S. (Eds.) (2014)**. *Chaos and Complexity in World Politics*. Hershey: IGI Global.
 17. **Finocchiano, E., Briani, M. (2010)**. Applying the Index of Sustainable Economic Welfare (ISEW) for a Sustainable Province of Rimini. Baldarelli, M., G. (Ed.), *Civil Economy, Democracy, Transparency and Social and Environmental Accounting Research Role*. Milano et al. 349-362: McGraw-Hill.
 18. **Ergetin, S.S., Bagci, H. (Eds.) (2016)**. *Chaos and Complexity Theory in the Social Sciences*. Hershey: IGI Global.
 19. **Fisch, R., Strohm, K. (2004)**. Wandel in der Kontinuität? Überlegungen zum Begriff Gemeinwohl. Brink, S./Wolff, Heinrich Amadeus (Hrsg.), *Gemeinwohl und Verantwortung: Festschrift für Hans Herbert von Arnim zum 65. Geburtstag*. Berlin, S. 73-78.
 20. **Flores, N.E. (2003)**. Conceptual Framework for Nonmarket Valuation. Champ, A.P., Boyle, K.J., Browns, F., C. (Eds.), *A Primer on Nonmarket Valuation*. Dordrecht: Kluver.
 21. **Friedrich, P. (1969)**. *Volkswirtschaftliche Investitionskriterien für Gemeindeunternehmen*. Tübingen: Mohr Siebeck.
 22. **Friedrich, P. (1971)**. Die Nutzen-Kosten-Analyse als Entscheidungshilfe für Industrieansiedlungen aus der Sicht der Maximierung der isolierten Wohlfahrt. Schneider, H. K. (Ed.), *Die Nutzen Kosten Analyse öffentlicher Investitionen*. Münster, Beiträge und Untersuchungen des Instituts für Siedlungs- und Wohnungswesen der Universität Münster, 76, 163–224: Institut für Siedlungs- und Wohnungswesen der Universität Münster.
 23. **Friedrich, P., Feng, X. (2002)**. The Role of Public Institutions in Regional Competition. Atalik, G., Fischer, M. (Eds.). *Regional Development Reconsidered*. Berlin, Heidelberg, 79–113: Springer.
 24. **Friedrich, P., Wonnemann, G. (1985)**. Financial Effects of Public Enterprises. *Papers and Proceedings of the Regional Science Association*, 53, 229–247.
 25. **Friedrich, P., Dehme, A., Nam, C.W. (2009)**. Determination of Fees for Local Services under the Consideration of Public and Management Objectives. *Zeitschrift für öffentliche und gemeinwirtschaftliche Unternehmen*, 32 (1), 1–18.

26. **Friedrich, P., Ukrainski, K., Timpmann, K.** (2014). Teaching Public Management: Between Academic Disciplines, A Teaching Methodology for Students in Public Administration. Tartu: E-book, Primus Program Project in 21.01-31-5. 2014, Tartu, Retrieved from <http://primus.archimedes.ee/trykised>.
27. **Guarnieri, P.** (2015). Decision Models in Engineering and Management .Cham: Springer.
28. **Hirsch, H.** (1992), Hans Ritschls Theorie der öffentlichen als Element einer Theorie der Staatswirtschaft im Vergleich mit den von Dieter Bös und Charles Blankart vorgelegten Theorien. Friedrich P. (Ed.), Beiträge zur Theorie öffentlicher Unternehmen. Zeitschrift für öffentliche und gemeinnützige Unternehmen, Beiheft 14, 20-44.
29. **Kemp, J.** (1997). New Methods in Economic Dynamics? An Introductory Guide to Chaos and Economics. Economic Issues, 2, 1-26.
30. **König, D. R.** (2008), The Human Reaction to Risk and Opportunity. Olson, D. L., Desheny, W. (Eds.), New Frontiers in Enterprise risk Management. Berlin, Heidelberg, 7-21: Springer.
31. **KPMG International** (2015). The KPMG Survey of Corporate Responsibility Reporting. Zürich: KPMG.
32. **McCarthy, M.** (2014), Utilizing Downside Risk Measures. CFA Conference Proceedings Quarterly, 42-48.
33. **Meynhardt, T.** (2015).Public Value – Turning a Conceptual Framework into a Scorecard. Bloomberg, L. Bryson, J. M., Crasby, B. (Eds.), Public Value and Public Administration. Washington, 147-169: Georgetown University Press.
34. **Moore, M.** (1995). Creating Public Value: Strategic Management in Government. Cambridge, MA: Harvard University Press.
35. **Moore, M.** (2013). Recognizing Public Value. Cambridge: Harvard University Press.
36. **Mueller, D.** (2003). Public Choice III. Cambridge: University of Cambridge Press.
37. **NYU-Stern** (2017). How do we measure risk? New York, 1-37. Retrieved from www.stern.NYU/~adamodar/pdf/valrisk/ch4.pdf.
38. **O' Flynn, J.** (2007). From New Public Management to Public Value Paradigmatic Change and Managerial Implications. The Australian Journal of Public Administration, 66, 353-366.
39. **Otley D.T.** (2014). Management Control under Uncertainty: Thinking about Uncertainty. Otley, D.T., Soins, K. (Eds.) Management Control and Uncertainty. Basinstoke, Hants, 83-96: Palgrave, MacMillan.
40. **Peltzman, S.** (1971). Pricing in Public and Private Enterprises: Electric Utilities in the United States. Journal of Law and Economics, 14 (1), 109-147.
41. **Pfnür, T.** (2006). Allokation und Bewertung von Risiken in immobilienwirtschaftlichen Public Private Partnerships. Budäus, D. (Ed.), Kooperationsformen zwischen Staat und Markt. Schriftenreihe der Gesellschaft für öffentliche Wirtschaft, 54, Baden-Baden, 159 – 136: Gesellschaft für öffentliche Wirtschaft.
42. **Rees, R.** (Ed.). (2006). The Economics of Public Utilities. Cheltenham, UK: Edward Elgar.

43. **Reich, J.** (1989). Finanzierung nuklearer Entsorgung. Wiesbaden: Gabler.
44. **Ritschl, H.** (1925). Theorie der Staatswirtschaft und Besteuerung. Bonn: K. Schroeder.
45. **Ritschl, H.** (1970). Zur Theorie der Staatswirtschaft. Heinz Haller, et al. (Eds.), Theorie und Praxis des finanzpolitischen Interventionismus. Tübingen, 47–66: Mohr.
46. **Rittig, G.** (1977). Gemeinwirtschaftsprinzip und Preisbildung bei öffentlichen Unternehmen unter volkswirtschaftlichen Gesichtspunkten. Frankfurt a. M.: Europäische Verlagsanstalt.
47. **Rouvas-Nicolis, C., Nicolis G.** (2009). Scholarpedia, 4(5), 1720.
48. **Rothengatter, W.** (2003). How good is first best? Marginal Cost and other Pricing Principles for User Charging in Transport. Economic Papers on Transport Policy, 2, 121-130.
49. **Schlundt, J.** (2013). Monte Carlo Simulation, Vortrag an der Universität Hamburg, 1-11: Retrieved from <http://wr.informatik.uni-hamburg.de-schluchtmontecarlosimulation-ausarbeitung> (6) pdf.
50. **Skidmore, P.** (2006). Public Value and Policing. London: The Work Foundation.
51. **Sobel, R. S.** (2004). Welfare economics and Public Finance. Backhaus, J., Wagner, R. (Eds.), Handbook of Public Finance. Boston, Dordrecht, New York, London, 19-52: Kluwer.
52. **The Public Value Interest Group** (2016). The concept of Public Value an Overview: Retrieved from <http://utas.edu.au>.
53. **Thiemeyer Th.** (1970). Gemeinwirtschaftlichkeit als Ordnungsprinzip: Grundlegung einer Theorie gemeinnütziger Unternehmen. Berlin 1970: Duncker und Humblot.
54. **Thiemeyer, Th.** (1975). Wirtschaftslehre öffentlicher Betriebe. Reinbek bei Hamburg: Rowohlt.
55. **Vlad, S., Pascu, P., Moriariu, N.** (2010). Chaos Models in Economics. Journal of Computing, 2, 79-83.
56. **Westlund, H.** (2006). Social Capital in the Knowledge Economy. Theory and Empirics: Springer.
57. **Williams, I., Shearer, H.** (2011). Appraising Public Value: Past, Present and Futures. Public Administration, 89, 1367 – 1384.
58. **Wonnemann, H.G.** (1989). Budgeteffekte der Standortwahl für Verwaltungen. Baden-Baden: Nomos.
59. **Zangemeister, Ch.** (1976). Nutzwertanalyse in der Systemtechnik – Eine Methodik zur multidimensionalen Bewertung und Auswahl von Projektalternativen. München: Wittmann.