ECONOMICS AND ITS APPROACH TO CAUSATION

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1. INTRODUCTION

1.1 Social relationships

Given the social context of our analysis of *causation*, we shall confine to:

causes represented by activities of agents A, B, C - see arrows $\boldsymbol{a}^2$, $\boldsymbol{b}$ and $\boldsymbol{c}^1$ in Fig. 1

effects represented by changes in a well-being (satisfaction) of an agent X – by his benefits or losses (damages)

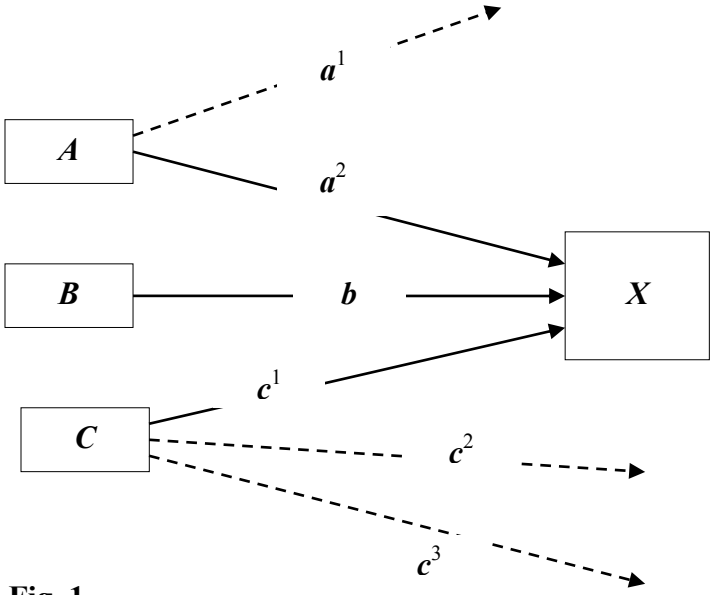

Fig. 1

Thus defined *cause-effect* relationship will be further referred to as *interference*: agents A, B, C will be said to *interfere* with X, with his affairs.

For methodological reasons, *inter-action*, as another type of a social relationship, will be further compared to *interference*.

1.2 Decision-making theory

As the key word here is *satisfaction*, we will briefly sketch its operational contents.

1.2.1 Satisfaction (well-being)

It may be of interest to various students, legal scholars in particular, that there exists a well-established *decision-making theory*[1] ("DMT"), according to which an agent X, if rational, is able to:

a) identify his *actual* situation $\boldsymbol{x}^{akt}$,

[1] See, e.g., Nash (1950), Arrow (1951), Debreu (1959), McGuire, Radner (1972), Sen (1979), Tříska (1983).

b) define all other *feasible* situations ($\boldsymbol{x}^{\alpha}, \boldsymbol{x}^{\beta}, \ldots$), i.e. a set of (*feasible*) alternatives to $\boldsymbol{x}^{akt}$,

c) valuate the situations ($\boldsymbol{x}^{akt}, \boldsymbol{x}^{\alpha}, \boldsymbol{x}^{\beta}, \ldots$), i.e. establish their (ordinal or even cardinal) *preference ordering*,

d) select (choose) exactly one optimum $\boldsymbol{x}^{*}$ from the set of alternatives ($\boldsymbol{x}^{akt}, \boldsymbol{x}^{\alpha}, \boldsymbol{x}^{\beta}, \ldots$).

1.2.2 Utility funkciton

DMT has developed the *preference ordering* concept to the highest possible rigor[2] and, among other achievements, succeeded in representing X's valuation by a *utility function*

$$\boldsymbol{u} = U(\boldsymbol{x})$$

so that:

$U(\boldsymbol{x}^{+}) = U(\boldsymbol{x}^{++})$ says that X regards $\boldsymbol{x}^{+}$ as good as $\boldsymbol{x}^{++}$, that X is indifferent to the two situations

$U(\boldsymbol{x}^{+}) > U(\boldsymbol{x}^{++})$ says that X regards $\boldsymbol{x}^{+}$ as better than $\boldsymbol{x}^{++}$, that X prefers $\boldsymbol{x}^{+}$ to $\boldsymbol{x}^{++}$

In sum, a particular value $\boldsymbol{u}^{+}$ at a particular situation $\boldsymbol{x}^{+}$ clearly identifies which of the other *feasible* situations are seen by X as good as $\boldsymbol{x}^{+}$, or better or worse than $\boldsymbol{x}^{+}$. The situation valued highest is referred to as X's *optimum* and denoted as $\boldsymbol{x}^{*}$.

1.2.3 Feasibility constraint

As a maximizer of $U(\boldsymbol{x})$, the optimum $\boldsymbol{x}^{*}$ is formally defined as a solution to the following maximization problem:

$$\left.\begin{array}{l} \max U(\boldsymbol{x}) \\ \text{s.t. } \boldsymbol{x} \in (\boldsymbol{x}^{akt}, \boldsymbol{x}^{\alpha}, \boldsymbol{x}^{\beta}, \ldots) \end{array}\right\} \quad \text{MAX 1}$$

that can be read as the following instruction to X:

Find a maximum of $U(\boldsymbol{x})$ such that the maximizer $\boldsymbol{x}^{*}$ is *feasible*!

In his search for maximum satisfaction, X is thus formally *constrained* by the required *feasibility* of what he is looking for.

1.2.4 Plans of action

Investigations of any human behavior thus rests in a search for concrete forms of MAX 1, its $U(\boldsymbol{x})$ and *feasibility* constraint – one such example will be discussed further.

In the meantime, we will only briefly comment the following two solutions to MAX 1:

$\boldsymbol{x}^{*} = \boldsymbol{x}^{akt}$ states that it is X's *actual* situation that he values highest, as his optimum; X's plan is then to preserve "what he has got" - defend it against external forces, if necessary

$\boldsymbol{x}^{*} \neq \boldsymbol{x}^{akt}$ states that X has identified at least one *feasible* way how to improve his *actual* situation; X's plan then is to launch the corresponding action with the objective to bring forward a transition $\boldsymbol{x}^{akt} \rightarrow \boldsymbol{x}^{*}$

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[2] Some of the above authors, John Nash in particular, could be sometimes conceived of as mathematicians rather than economists.

1.3 Goals and scope of our analysis

1.3.1 Simplifications

With the help of Fig. 1 we may illustrate the potential richness and complexity of the problem under study:

1) agents A, B and C may simultaneously *interfere* with many agents, not only X,
2) in the roles A, B, C and X may be the same person, if, e.g., C = X, X *interferes* with himself – X's own activity may bring him benefits and-or losses (damages),
3) if $\boldsymbol{a}^2$, $\boldsymbol{b}$ and $\boldsymbol{c}^1$ add up into one aggregate *cause*, the respective relative contributions (weights, powers) of A, B and C become of a great analytical interest and legal relevance,
4) an agent X (and similarly A, B, C) may be an organization whose members are, again, decision-makers maximizing their own utilities.

Given that *causation* is our major topic, we may abstract from the above complexities and strictly confine to a bi-lateral (one-to-one) relationship between only one *interfering* agent, let it be the agent C, and one *affected* agent X. Also, when the forces of nature such as floods and hurricanes appear to have destroyed X's property, we interpret this *interference* as the above case 2), C = X, and thus blame X himself for having settled down in a wrong area.

1.3.2 Economics

This paper seeks to inform the broader audience, legal scholars in particular, that the best corroborated applications of DMT can be found in the realm of *economics*. In particular, the so-called *micro-economic* theory[3] has developed:

- decision-making models for two types of agents - firms (producers) and households (consumers),
- models of *inter-actions* among the two types of agents - their *general equilibrium*.

It will be the model a firm (producer) that will, hopefully, well serve our purpose to represent both C and X in their above defined roles. With its help we will:

in Chapter 2 discuss more concretely the concept of X's satisfaction and its increases (benefits) or decreases (losses, damages)

in Chapter 3 present how *economics* may approach *interference* (cause-effect relationship) between two firms (producers) C and X

in Chapter 4 compare in more detail the two types of social relationships - *interference* and *inter-action* – with the possible conversion of one into the other

[3] The author himself devotes some of its time and energy to post-graduate micro-economics at the Prague University of Economics.

2. BENEFITS AND LOSSES OF AN INDIVIDUAL AGENT

As already noted, our analysis should further specify MAX 1, namely its U($\boldsymbol{x}$) and *feasibility* constraint; here, we shall begin with the latter.

2.1 Feasibility constraint

2.1.1 Resources and products

In *economics*, a situation $\boldsymbol{x}$ of a firm X is structured as:

$$\boldsymbol{x} = (\boldsymbol{x}^{res}, \boldsymbol{x}^{pro})$$

where:

$\boldsymbol{x}^{res}$ represents *resources* (*inputs* in the narrow sense), e.g. the so-called production factors - typically capital $\boldsymbol{K}$ and labor $\boldsymbol{L}$

$\boldsymbol{x}^{pro}$ represents *products* (*outputs* in the narrow sense), i.e. the specific goods and services that X supplies to the market (TV sets, automobiles, …)

2.1.2 Production function

Fig. 2 shows the obvious fact that *resources* are being transformed into *products*. Less trivial may be that the specifics of the transformation are here given by a so-called *production function* F($\boldsymbol{x}^{res}$), whose concrete form determines

maximum amounts of a product $\boldsymbol{x}^{pro}$

that can be, *technologically*, produced by a given combination of resources $\boldsymbol{x}^{res}$.

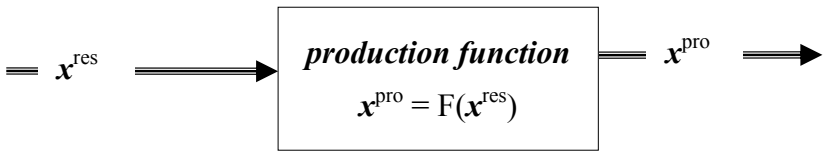

Fig. 2

Put differently, should X's situation $\boldsymbol{x} = (\boldsymbol{x}^{res}, \boldsymbol{x}^{pro})$ be *feasible*, the respective *resources* and *products* must conform the following *technological* constraint

$$\boldsymbol{x}^{pro} \leq F(\boldsymbol{x}^{res})$$

2.1.3 Cobb-Douglas production function

In *economics*, various types of F($\boldsymbol{x}^{res}$) are investigated so as to best represent this or that institutional frame of the economy concerned. Here, strictly for our illustrative purposes, we shall apply the well known *Cobb-Douglas production function*

$$\boldsymbol{x}^{pro} = \mathbf{r}.\boldsymbol{K}^{s}.\boldsymbol{L}^{t}$$

where

$\boldsymbol{K}$, $\boldsymbol{L}$ are two specific resources $\boldsymbol{x}^{res}$ - already mentioned capital and labor, respectively

$\mathbf{r}$, $\mathbf{s}$, $\mathbf{t}$ are parameters representing, among others, relative weights with which the two factors $\boldsymbol{K}$ and $\boldsymbol{L}$ contribute to the production

2.2 Utility function and the model

2.2.1 Profit maximization

As to the concrete form of X's satisfaction, we shall, for illustrative purposes again, assume that X is a *profit maximizer*, that his utility function is given as

$$U(\boldsymbol{x}) = \boldsymbol{p}.\,\boldsymbol{x}^{pro} - \boldsymbol{w}.\,\boldsymbol{x}^{res}$$

where:

$\boldsymbol{p}$	are the product prices
$\boldsymbol{p}.\,\boldsymbol{x}^{pro}$	stands for *production returns* or the value of the overall products
$\boldsymbol{w}$	are the resource prices, e.g. the prices of capital $\boldsymbol{K}$ and labor $\mathbf{L}$
$\boldsymbol{w}.\,\boldsymbol{x}^{res}$	stands for *production costs* or the value of the overall resources product; in our case $\boldsymbol{w}.\,\boldsymbol{x}^{res} = (\boldsymbol{w}^{L}.\boldsymbol{L} + \boldsymbol{w}^{K}.\boldsymbol{K})$

This assumption simply states that the higher is the profit of X, the better-off he is. If two different situations yield the same profit, X treats them as *indifferent*; these two situations have the same value for X.

2.2.2 The model

Given the above assumptions about X, MAX 1 can be re-written as:

$$\left.\begin{array}{l} \max\ (\boldsymbol{p}.\,\boldsymbol{x}^{pro} - (\boldsymbol{w}^{L}.\boldsymbol{L} + \boldsymbol{w}^{K}.\boldsymbol{K})) \\ \text{s.t. } \boldsymbol{x}^{pro} \le \mathbf{r}.\boldsymbol{K}^{s}.\boldsymbol{L}^{t} \end{array}\right\} \quad \text{MAX 2}$$

The full set of the model parameters thus is

$$(\boldsymbol{x}^{pro}, \boldsymbol{K}, \boldsymbol{L}, \boldsymbol{p}, \boldsymbol{w}^{K}, \boldsymbol{w}^{L}, \mathbf{r}, \mathbf{s}, \mathbf{t})$$

and their relevance can be expressed so that changes in them (and only them) may bring up changes in what may become X's optimum, i.e. in X's satisfaction.

As a final step of this analysis, we will now differentiate among the parameters according to their endogenity, or exogeneity.

2.3 Exogenous interference

2.3.1 Endogenous parameters

For the sake of this analysis, let us assume, that ($\boldsymbol{x}^{pro}$, $\boldsymbol{K}$ and $\boldsymbol{L}$) are the only *endogenous* parameters. By this *endogenity* we will understand that X, as a decision-maker, believes to have the respective parameters "under control", that he feels capable of executing whatever he may decide about them.

2.3.2 Exogenous parameters

The remaining parameters $\boldsymbol{p}$, $\boldsymbol{w}^{K}$, $\boldsymbol{w}^{L}$, $\mathbf{r}$, $\mathbf{s}$, $\mathbf{t}$ of MAX 2 are, therefore, *exogenous* – assumed to be beyond the control of X. To support this *exogeneity*, the following *text-book* arguments may be in order:

$\boldsymbol{p}$, $\boldsymbol{w}^K$, $\boldsymbol{w}^L$ are prices and therefore set either by the *invisible hand* of the market or the *visible hand* of the respective government (its price regulator)

r, s, t represent the actual level of the technological development of X; its improvements, therefore, require large investments and thus can be rarely implemented *in the short run* or in the "real time" of X's every-day decisions

2.3.3 Externalities

Let us stress again, that it is not our goal here to convince the reader that exactly MAX 2 is the most adequate model of an agent under study. All we are after is to demonstrate that:

- whatever model is applied, its *endogenous* and *exogenous* parameters must be identified and strictly selected,
- the *exogenous* parameters (and only them) constitute the corridor between X and the outside world – the corridor through which various (external) forces may *cause* changes in X's satisfaction,
- among the (external) forces may also be agent C's behavior, decision making and activity.

The concept of *interference* is thus fully based on a well-defined concept of *exogeneity* or, put differently, *externality*. Given the latter terminology, if it is C who brings up changes in $\boldsymbol{p}$, $\boldsymbol{w}^K$, $\boldsymbol{w}^L$, **r, s, t** of MAX 2, we, as economists, will say that

C produces *externalities* (with respect to X)

For the sake of completeness we should also repeat that thus defined (external) *effects* or *externalities* may take up the form of both benefits and losses (damages) of X. In *economics*, both *positive* and *negative* externalities are analysed.

3. INTERFERING AGENT

3.1 By-products

Recall that, for simplicity, also the *interfering* C is presented here as a firm (producer) - his situation is thus, again, a combination of resources and products

$$\boldsymbol{c} = (\boldsymbol{c}^{res}, \boldsymbol{c}^{pro})$$

The previous discussion can then be extended so that real-world activities of any agent, C and X included,, bring up not only *products* but also (unintended) *by-products*, such as, e.g., carbon dioxide, dirty water, heated and smoggy air, etc.

These unintended elements of C's overall *output* are denoted by $\boldsymbol{c}^{byp}$ in Fig. 3; the picture for X would be perfectly analogous.

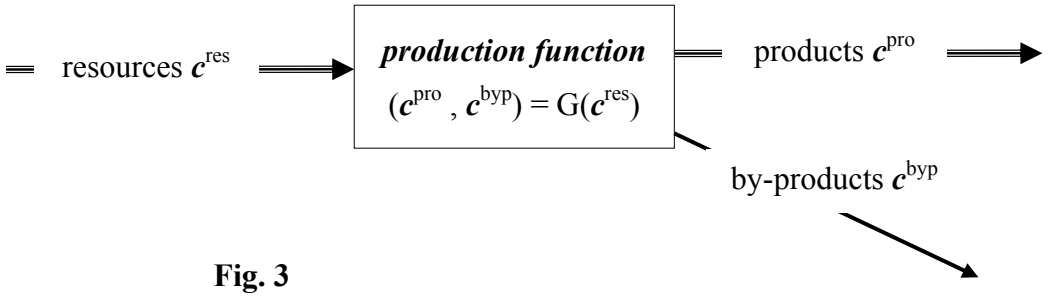

Fig. 3

3.2 Cause-effect, interference

3.2.1 Input-output relationship

Fig. 4 summarizes our previous, highly simplified discussion as follows:

$\boldsymbol{c}^{\text{out}} = \boldsymbol{x}^{\text{in}}$ represents the contents and "orientation" of the relationship between C and X; C's complete *output* is assumed to be the only *input* of X

$\boldsymbol{x}^{\text{in}} = \boldsymbol{x}^{\text{in-ext}}$ states for the assumption that only *externalities* constitute X's *input* and that all the *externalities* are produced exclusively by C

$(\boldsymbol{c}^{\text{pro}} + \boldsymbol{c}^{\text{byp}}) = \boldsymbol{c}^{\text{out}}$ shows that also by-products (not only products) are components of C's *output*; both products and by-products of C produce *externalities*

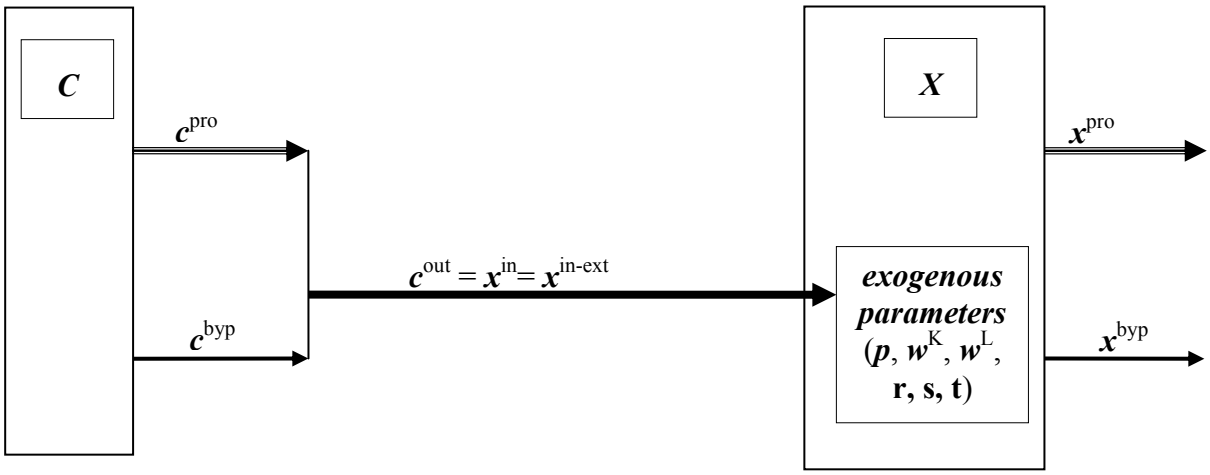

Fig. 4

3.2.2 Examples

Example 1:

The prime minister of a government C may affect prices $\boldsymbol{p}$ of X's products $\boldsymbol{x}^{\text{pro}}$ in two ways:

- deliberately, by his government's price regulation policy, e.g., rent control,
- by negligence, when he, e.g., recklessly reveals his subsidy plan for young families.

Example 2:

If C regulates rents, its policy is likely to be perceived differently by different Xs, for example:

tenants X^T will regard the policy as *positive* and the government C as their *sponsor*

landlords X^L will view the same government as a *tort-feasor*

Example 3:

A restaurant C may feed fish in the river by its waste and thus act as a *sponsor* of a downstream fishery X. All this, regardless of whether the two agents C and X ever know about each other.

3.3 Asymmetries in interference

3.3.1 Major characteristics

The *interference* from Fig. 4 can be summed up as follows:

1) it is a one-way relationship – from C to X,
2) C and-or X need not be aware of what is going on between them,
3) even if C and-or X have the information 2), none of them has explicitly agreed to the effects - X's benefits, or losses (damages),
4) under specific conditions a compensation for the effects 3) may be legally *enforced* by C and X, respectively.

In sum, the one-way *interference* may have legal (one-way) continuation when X has to "give back" to C the *unjustified enrichment*, or, conversely, C is to compensate X's damages.

3.3.2 Asymmetric information

It is, for various reasons, important, whether or to what degree C and X are (could be, should be) informed that:

- C ever exists and produces specific $\boldsymbol{c}^{pro}$ and-or by-products $\boldsymbol{c}^{byp}$,
- $\boldsymbol{c}^{pro}$ and-or $\boldsymbol{c}^{byp}$ have external *effect* on X,
- the external *effects*, externalities are *positive*, or *negative*.

Apparently, C and X may be differently informed about what is going on between them.

In *economics*, such *information* asymmetries belong to the most prominent analytical problems, as they are believed to be strongly correlated with the asymmetries in bargaining (voting) powers of the agents concerned.[4]

3.4 Summary and extensions

The above described concept of *interference* and externality is what we actually sought to demonstrate in this paper - how *economics* would approach *causation*, should it become its explicit topic. Thus, our paper could be concluded at this point.

However, as the most natural extension we will continue and briefly discuss the following:

- externality (interference) may bring up *inefficiency* or even "unfairness" to the system concerned,
- institutional adaptations to the *inefficiency* may rest in converting external *interferences* into internal (contractual) *inter-actions*.

[4] As noted in, e.g., Triska (2003), George J. Stigler received his Nobel Prize in 1982 for introducing "information" as a commodity; James A. Mirrlees and William Vickrey got the Prize in 1996 for their analyses of information asymmetries and, again, this type of analysis was awarded in 2001 (George A. Akerlof, Michael A. Spence and Joseph E. Stiglitz).

4. INTERNALIZATION OF EXTERNALITIES

4.1 Contractual inter-action

4.1.1 Input/output relationship

Fig. 5 extends upon Fig. 4 and is to be interpreted as follows:

$\boldsymbol{x}^{in} = (\boldsymbol{x}^{res} + \boldsymbol{x}^{ext})$ shows that both resources and *externalities* may be components of X's *input*

$\boldsymbol{c}^{out\text{-}res} = \boldsymbol{x}^{res}$ represents the part of C's *output* that is converted into X's resources

$\boldsymbol{c}^{out\text{-}ext} = \boldsymbol{x}^{ext}$ represents the part of C's *output* that produces *externalities* - has an external effect on the exogenous variables of X

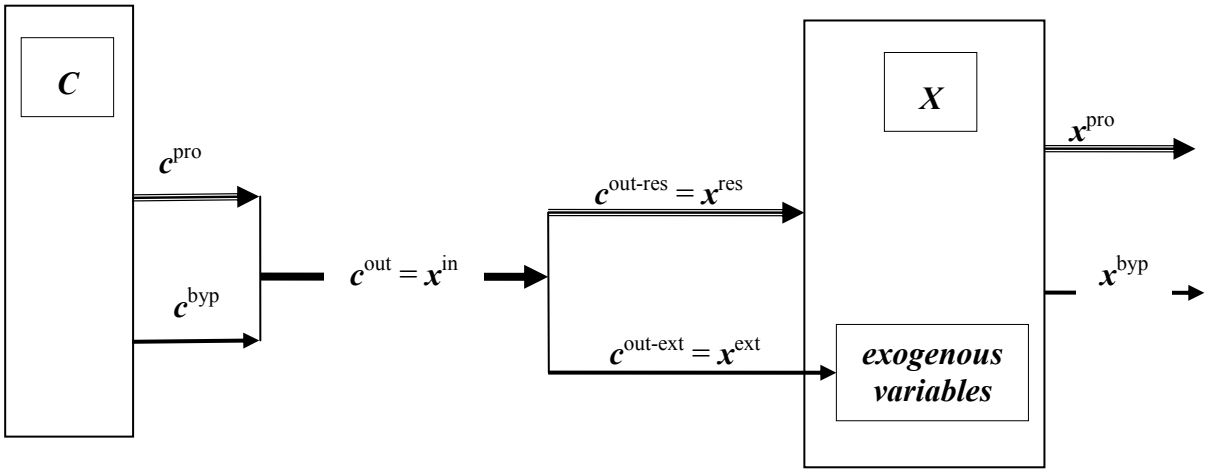

Fig. 5

It will be the two types of X's *inputs*, $\boldsymbol{x}^{res}$ and $\boldsymbol{x}^{ext}$, that will allow for the looked-for differentiation between *interference* and *inter-action*.

4.1.2 Exchange of deliveries

Suppose that C is a supplier of cars and X is a taxi driver. Then the most obvious method of how C's output may become a resource of X, $\boldsymbol{c}^{out\text{-}res} = \boldsymbol{x}^{res}$, is a

contract for sale and purchase

according to which C will be obliged to "deliver" a car to X. This very contract, however, will typically establish also a "counter-delivery" of money - a payment from X to C. The taxi-driver X will "deliver" the purchasing price $\boldsymbol{P}$ to C so that this monetary output of X may become C's input.

The delivery of $\boldsymbol{P}$ obviously decreases satisfaction (profit) of X; by paying $\boldsymbol{P}$, X incurs loss (cost, "damage").

4.1.3 Major characteristics

Major characteristics of the above described contractual *inter-action* can be summed up so that – unlike in the case of *interference*:

1) it is a two-way relationship; both C a X become "suppliers" of their products to the counter-party,
2) both C and X are fully aware of what is going on between them, as the two counter-deliveries are, by definition, outcomes of a joint decision (agreement),
3) X explicitly approves the negative contribution of ***P*** to its overall profit, voluntarily incurs the respective loss (cost, "damage"),
4) a "compensation" for the "damage" ***P***; is not *enforceable* - X is to search for the "monetary compensation" in the open market, on the basis of voluntary, contractual *inter-actions* with other agent, his potential customers.

4.2 Institutional adaptation

4.2.1 Inefficiency

It has been said already that *externalities* may be conceived of (by C and-or X) as inefficient, or even "unfair". In this section we shall briefly sketch techniques of an institutional adaptation to the inefficiency.

As an example, we shall take the above mentioned waste-producing restaurant C and the downstream fishery X. Consecutively, we shall analyze the *positive* and *negative* effects of the waste.

The kind reader may thus notice a nice methodological analogy between the two cases.

4.2.2 Sponsors and free-riders

Suppose that one day C realizes it is his waste that makes the fishery X rich.

It is then only natural if C accuses X of parasitism - *free-riding*, as said in *economics*. C's arguments would point out that also waste production is costly and hence, his should be also the corresponding benefit. Therefore, his claim would be that

X should share C's costs and-or C should share X's profits.

To achieve this objective, C has the following institutional options:

a) He may propose to X a contract, according to which X will pay for the service of pouring C's waste into the river (and nowhere else).
b) If, as expected, X declines the proposal a), C may sue X for *unjustifiable enrichment*.
c) If the charge b) does not work, C's final option is to acquire (buy) the fishery and, as its new owner, enjoy the waste-created profits.[5]

In *economics* options a) and c) are often referred to as *internalization of externalities*.

4.2.3 Tort-feasors and victims

Suppose now the opposite case - that it is the fishery X who complains - namely that the restaurant's (poisonous) waste negatively affects X's profits. In the eyes of X it is now C who is the parasite, *free-rider* as C's prosperity is at the expense of X. The arguments would be that C should either regularly de-poison its waste, or pay X for the necessary de-poisoning.

[5] Thus defined *vertical integration* is due namely to Coase (1937).

Therefore, the claim would be that

C should share X's costs and-or X should share C's profits

To achieve this objective, X has the following institutional options:

a) He may propose to C a contract, according to which C will pay for the service of de-poisoning C's waste and-or the river.

b) If, as expected, C declines the proposal a), X may sue C on the *liability grounds*.

c) If the charge b) does not work, X's final option is to acquire (buy) the restaurant and as its new owner enjoy the poison-created profits.

As in the above case of the *positive externality*, options a) and c) are often referred to as *internalization of externalities*.

5. SUMMARY AND CONCLUSIONS

The paper attempts to show, to legal scholars in particular, how one branch of social research, *economics*, might approach the concept of *causation*. The analysis confines to bi-lateral *cause-effects* relationships between only two agents C and X and is organized as follows:

1) *causes* are investigated as specific outputs of C's activities; *effects* are defined as changes in X's *satisfaction* (well-being),

2) C's satisfaction and its changes are represented by a *maximization* (*optimization*) *problem*, i.e., a search for a maximum of a well-defined *utility function*, constrained by a well-defined set of *feasible* situations,

3) the maximization (optimization) problem is, for a higher concreteness, demonstrated on the text-book *profit maximization model* of a firm (producer),

4) the model is presented in its full parameterization and the *parameters* are shown to be of two types - *endogenous* and *exogenous*,

5) the exogenous parameters are taken to fully represent the corridor between X and the outside world, through which the *external forces* may affect X's satisfaction,

6) the external forces are taken to be the causes of the changes in X's satisfaction as, by definition, they affect at least one exogenous parameter of the maximization (optimization) model concerned; among such external forces may be also *C's activity*,

7) the activity of C thus imposes *positive* and-or *negative externalities* upon X – the *externalities* are the *causes* of increases, or decreases in X's satisfaction – the looked-for *causes* of X's benefits and losses (damages).

As an extension to the main course of discussion, a potential inefficiency (or even injustice) of *externalities* is discussed and a recommendations for their *internalization* is sketched out.

6. LITERATURE

Arrow, K. J., 1951, Social Choice and Individual Values, New York, John Wiley and Sons.

Coase, R. H., 1937, The Nature of the Firm, Economica 4, 386-405

Debreu, G., 1959, Theory of Values, New York, John Wiley and Sons.

McGuire, Radner (eds), Decision and Organization. North-Holland, Amsterdam 1972

Nash, J. F., 1950, The bargaining problem, *Econometrica 18* , 155–162

Sen, A. K., , 1979, Collective Choice and Social Welfare, 1970, San Francisco: Holden-Day Amsterdam: North-Holland

Tříska, D., 1983, On Two Axioms of Decision Theory, Ekonomicko-matematický obzor 4/1983.

_____ 2003b, Asymetrie informací odměněna (již podruhé). Ekonomické teorie a česká ekonomika. II. Sborník příspěvků ze série ekonomických seminářů, editoři L. Komárek a P. Mezerová, Česká společnost ekonomická, Praha.

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