Compensation for Takings: Lessons from Civil Liability

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May 4, 2016

Abstract

This paper deals with efficient incentives for investments in property and for taking decisions that are sensitive to compensation requirements but suffer from fiscal illusion. The strategic interaction is shown to be isomorphic to a three party relationship where two active parties impose an external effect on a third passive party. Obligation-based transfer schemes are specified in line with principles from civil liability, generating efficient incentives for the investment and the taking decision. Such schemes are of trilateral nature, in contrast to compensation requirements under taking law, which are leading to bilateral transfer schemes only. In general, bilateral compensation schemes are not sufficient to generate efficient incentives if the taking decision suffers from fiscal illusion but remains sensitive to compensation requirements.

JEL classification: K11, K12, K13, H23

Keywords: civil liability, compensation for takings, externalities, compensation principle, obligation-based transfer schemes

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1 Introduction

In many countries, private property may be taken for public use but only with just compensation. In Germany, for instance, expropriation can be ordered by law but the level of compensation must also be governed by law.

The owner whose property is taken by the government perceives expropriation comparably to harm done to her property by a private debtor. Under civil law, the owner would be entitled to expectation damages or, in German terminology, to damages in line with the difference hypothesis, which make the creditor equally well-off as if the debtor had met her obligation. On economic grounds, full compensation is usually justified as it may generate efficient incentives.[1]

In striking difference to civil liability, taking law seems much softer on compensation requirements. Schäfer (2015) argues that, under the law of eminent domain, less than full compensation is the rule but for good reasons. The state cannot be incentivized by a damages award in the same way as a private actor because it will spread compensation requirements among millions of tax payers. This leads to a (downwards) bias in the perception of costs. Schäfer, however, does neither explore the effects of such a bias on investment and taking incentives nor what would be the desirable degree of undercompensation.

More than three decades earlier, Blume et al. (1984) had examined a model of a taking agency suffering from budgetary fiscal illusion, which they specified explicitly as a bias in the perception of costs. They showed that neither zero nor full compensation would generate efficient incentives, but they left it open, which transfer scheme would provide efficient incentives in the presence of budgetary fiscal illusion.

More puzzling, if full compensation distorts incentives under taking law, why should it provide efficient incentives under civil law? As it turns out, taking decisions under fiscal illusion can be seen as being guided by an objective function that differs from the benefit to the rest of society (every member except the current owner whose property is up for taking). There-

[1] Efficient incentives result, in particular, from compensation requirements if differences are taken relative to efficient obligations. But keep in mind that expectation damages relative to a non-contingent contractual obligation may lead to overreliance.

fore, to describe social welfare as a sum of individual objective functions, a third (virtual) party must be thought of in addition to the current owner of the property and the taking agency. While this virtual party remains passive, it is affected by the investment choice of the owner and the taking decision of the agency nonetheless.

Guided by this insight, the present paper examines a three-party relationship with two active parties whose decisions impose an externality on a third, otherwise passive party. The setting is general enough to capture cases under tort as well as contract law but also to deal with taking decisions suffering from budgetary fiscal illusion.

In particular, general trilateral transfer schemes will be studied that depend on the action profile as chosen by the two active parties. Such schemes give rise to a game in normal form with the two active parties as players. The scheme internalizes the external effect if the Nash equilibrium (all Nash equilibria if several exist) of this game are efficient. The present paper examines efficient transfer schemes from a compensatory perspective.

In civil law, transfer schemes result from the damages regime in place. Damages are awarded relative to obligations faced by the active parties, aiming at compensating creditors by debtors who have violated their obligations.

Under tort law, obligations are specified by courts at efficient levels (as scholars of law and economics regularly assume). Contractual obligations, however, need not necessarily be efficient. In fact, to economize on transaction costs, parties may specify obligations without anticipating all conceivable contingencies. In any case, particular attention will be paid to cases where one of the parties faces an inefficient obligation.

The research question concerns the exact specification of an obligation-based transfer scheme providing efficient incentives for the active parties A and B in the presence of an external effect and where one of these parties, say B, may face an inefficient obligation. The following three properties will turn out to be sufficient.

First, if party A deviates from her efficient obligation the she owes expectation damages to the other two parties. Second, if party B deviates from his (possibly) inefficient obligation, then he too owes expectation damages to the other parties based, though, on a reasonable person standard in the sense of damages being quantified as if A had decided efficiently, even if actually she has not. Third, if a party enjoys an enrichment due to a deviation from the obligation profile, this enrichment must be returned. The last two requirements ensure efficient incentives even if one of the parties is facing an inefficient obligation.

To establish the efficiency of obligation-based transfer schemes, the present paper generalizes findings of Schweizer (2016) from two to three party relationships. In a first step, referred to as compensation principle, transfer schemes compensatory relative to an efficient reference profile are shown to be efficient. In a second step, obligation-based transfer schemes are specified such that the scheme remains compensatory relative to the efficient reference profile in the presence of an externality and even if one on the parties faces an inefficient obligation.

To adapt these lessons from civil liability to compensation requirements for taking decisions guided by fiscal illusion, a third party would have to be thought of, which, in cases of takings, may be of virtual nature. Legal compensation practice under taking law neglects the external effect and, hence, should not be expected to internalize it.

In addition to the above insights, the present paper establishes the following claims. Taking decisions are modelled as sequential choice. By introducing complete contingent plans, the strategic interaction can still be expressed in normal form as needed for the compensation principle. The obligation-based transfer scheme ensures, not only, that the efficient reference profile forms a Nash equilibrium of the normal form game but also that all Nash-equilibria (sequential games typically have many of them) are payoff equivalent. In particular, the subgame perfect equilibrium (which is one of these Nash equilibria) must be payoff equivalent and, hence, efficient itself. This remains true even if, off the equilibrium path, ex post inefficient outcomes are renegotiated.

Moreover, bilateral transfer schemes (no virtual party is involved) are defined to be weakly compensatory relative to an efficient reference profile if, under no unilateral deviation from the efficient reference profile by one of the active parties, the rest of society (the coalition of all but this one party) is worse off. The efficient reference profile turns out still to be a Nash equilibrium under such a bilateral transfer scheme. Other Nash equilibria, however, need not be payoff equivalent anymore. An example is provided where the efficient reference profile is a Nash equilibrium of the normal form game but where the outcome under subgame perfect equilibrium (as the more plausible solution concept) fails to be efficient.

Finally, the paper revisits the following literature, much of which deals with benevolent taking decisions guided by social welfare and totally insensitive to compensation requirements (mere redistribution does not affect welfare).

Blume et al. (1984) have proposed a general equilibrium setting where zero but not full compensation would be efficient if the taking agency is guided by benevolence in the above sense. In the game-theoretic setting of the present paper, zero compensation would, in general, not be efficient.

Miceli (1991) and Hermalin (1995) have also studied benevolent taking behavior but in a game-theoretic setting (which the present paper generalizes). Hermalin suggests to make the current owner residual claimant such that she would have efficient investment incentives for sure. This scheme would implicitly require the current owner to compensate the rest of society for not having invested efficiently while it totally neglects compensating her for the taking.

For the same setting of binary taking choice, Miceli (1991) claims that full compensation based on efficient investments of the party whose property is taken (even if she actually has invested at a different level) also generates efficient investment incentives. The present paper questions Miceli's claim. Hewer and Göller (2014), in fact, provide an explicit example for which the claim is wrong.

On behavioral grounds, I find taking decisions totally insensitive to compensation requirements rather implausible. While Blume et al. (1984) also mainly deal with takings guided by benevolence, they have one section on takings decisions under fiscal illusion, which will serve as an illustration of the more general externality perspective propagated by the present paper. The externality imposed by two active parties on a third one prevents that, in general, bilateral transfer schemes, aiming at compensation of the current owner, are sufficient to generate efficient incentives for both active parties.

Only in the absence of such an externality, bilateral transfer schemes of compensatory nature would exist, which provide efficient incentives for even two-sided investments as well as the taking decision. This has been shown by Göller and Hewer (2014) for a setting of binary taking decisions.

The present paper is organized as follows. In section 2, the investment of the current owner followed by the taking decision is modelled as sequential choice. Binary taking decisions under fiscal illusion serve as illustration. Section 3 introduces the notion of transfer schemes which are compensatory relative to the efficient reference profile and establishes the compensation principle involving three parties. Section 4 specifies obligation-based transfer schemes which are then shown being compensatory relative to the efficient reference profile in the normal form of the game. Section 5 considers efficient obligation profiles as usually presumed by the economic analysis of tort law. Under efficient obligations, enrichments may be kept for free without distorting incentives. Section 6 adapts the previous findings to sequential choice and the subgame perfect equilibrium outcome which, off the equilibrium path, is possibly renegotiated. Based on insights from the previous sections, section 7 returns to binary takings under fiscal illusion. In section 8, it is shown that payoff equivalence of Nash equilibria may be lost if the (bilateral) transfer scheme is merely weakly compensatory relative to the efficient reference profile. Section 9 revisits benevolent taking decisions, questioning the generality of some claims from the literature. Section 10 concludes.

2 The general model

Taking decisions are modelled as sequential choice. The current owner of the property (party A, she) decides on investments under uncertainty to raise the value of her property before the agency in charge (party B, he) reaches the taking decision. Party A's investment decision at stage 1 is denoted by $x \in X$. Uncertainty resolves itself at stage 2, where nature randomly draws the state $\omega \in \Omega$. At stage 3, finally, party B reaches the taking decision $q \in Q$. The choice $q^o \in Q$ refers to B's decision not to take A's property at all.

Party A's utility (ex post) as a function of her investments x, the state ω and party B's taking decision q amounts to $U_A(x, \omega, q)$. Similarly, party B's choice is based on the objective function $U_B(x, \omega, q)$. These functions need not add up to welfare. Rather, welfare is assumed to be of the form

$$W(x, \omega, q) = U_A(x, \omega, q) + U_B(x, \omega, q) - H(x, \omega, q)$$

where the two active parties A and B are guided by objective functions $U_A(x,\omega,q)$ and $U_B(x,\omega,q)$ and where a third party H is (negatively) affected by harm $H(x,\omega,q)$.

As an illustration of the above setting, let me revisit Blume et al. (1984) who have devoted one section to takings decided by an agency suffering from budgetary fiscal illusion. Party A chooses the level $x \in X \subset \mathbb{R}_+$ of investments to raise the value of her property (if not taken). Party B faces a binary taking decision $q \in \{0,1\}$. Party A's objective function is

$$U_A(x,\omega,q) = v_A(x,\omega)\cdot(1-q) - x.$$

The benefit $v_{BH}(\omega)$ to society from the taking is assumed independent of A's investments such that welfare amounts to

$$W(x,\omega,q) = v_A(x,\omega)\cdot(1-q) + v_{BH}(\omega)\cdot q - x$$

as a function of history (x,ω,q).

Given investments x and state ω, taking the property would be ex post efficient if and only if the benefit to society is higher than to the present owner of the property, that is, if $v_{BH}(\omega) \geq v_A(x,\omega)$ holds. Suppose B must pay c to A if he takes her property. Under (budgetary) fiscal illusion, party B consistently discounts A's net loss $v_A(x,\omega) - c$ from the taking. Let $\theta \in [0,1)$ represent the measure of the fiscal illusion. Then party B takes the property if and only if the condition $v_{BH}(\omega) - c \geq \theta\cdot[v_A(x,\omega) - c]$ or, equivalently,

$$v_B(x,\omega) = \frac{v_{BH}(\omega) - \theta\cdot v_A(x,\omega)}{1-\theta} \geq c$$

is met. Notice, $\theta = 1$ is ruled out as it would mean benevolent taking behavior.

Due to fiscal illusion, party B perceives the taking to be of value $v_B(x,\omega)$ and decides to take A's property if this value exceeds the compensation c that B owes in case of a taking. Therefore, under fiscal illusion, party B behaves in accordance with the objective function $U_B(x,\omega,q) = v_B(x,\omega)\cdot q$. This payoff, indeed, is different from the benefit $v_{BH}(\omega)\cdot q$ to society. The difference amounting to

$$\begin{aligned} H(x,\omega,q) &= U_B(x,\omega,q) - v_{BH}(\omega)\cdot q = [v_B(x,\omega) - v_{BH}(\omega)]\cdot q = \\ &= \frac{\theta}{1-\theta}\cdot[v_{BH}(\omega) - v_A(x,\omega)]\cdot q \end{aligned}$$

will be interpreted as harm inflicted by A and B on a (virtual) third party H. Only under fiscal illusion of degree $\theta = 0$, this externality would be absent.

In the next section, transfer schemes are specified which internalize the external effect imposed by two active parties on a third, passive one quite generally. The specification follows from the compensation principle.

3 Compensatory transfer schemes

To spell out the compensation principle, strategic interaction must be expressed in normal form. The two active parties A and B simultaneously choose actions $x \in X$ and $y \in Y$ leading to (expected) payoffs $u_A(x, y)$ and $u_B(x, y)$. A third party called H, while being passive, suffers from harm $h(x, y)$ as a function of the chosen action profile (x, y). The strategy sets X and Y of A and B could be one- or multidimensional and may be of discrete or continuous nature.

As a special case, the sequential choice setting from the previous section can also be described in normal form. The first moving party A still decides on investments x such that her strategy set remains to be X. Party B, however, chooses a complete contingent plan $y \in Y = Q^{X \times \Omega}$ which maps any investment choice $x \in X$ and state $\omega \in \Omega$ into a (taking) decision $q = y(x, \omega) \in Q$. At strategy profile $(x, y) \in X \times Y$, the (expected) payoffs of party A and B in the normal form amount to

$$u_A(x, y) = E\left[U_A(x, \omega, y(x, \omega))\right] \text{ and } u_B(x, y) = E\left[U_B(x, \omega, y(x, \omega))\right]$$

whereas party H suffers from expected harm $h(x, y) = E\left[H(x, \omega, y(x, \omega))\right]$. Here and elsewhere, expectations are taken with respect to the exogenously given distribution of the state $\omega \in \Omega$.

The findings of the present section hold beyond the normal form derived from sequential choice. As the only restriction, a profile $(x^*, y^*) \in X \times Y$ must exist, which maximizes welfare $w(x, y) = u_A(x, y) + u_B(x, y) - h(x, y)$. This efficient profile (or one of them if several exist) serves as reference point.

A trilateral transfer scheme $t = (t_A, t_B, t_H)$ is a mapping from the set $X \times Y$ of action profiles into $\mathbb{R}^3$ where $t_i(x, y)$ denotes the payment to party $i \in \{A, B, H\}$ at profile (x, y). Only self-contained transfer schemes will be considered, that is, $t_A(x,y) + t_B(x,y) + t_H(x,y) = 0$ is assumed to hold at any profile (x, y).

Such a transfer scheme induces a two-person game in normal form with players A and B, strategy sets X and Y and payoff functions

$$\pi_A(x,y) = u_A(x,y) + t_A(x,y) \text{ and } \pi_B(x,y) = u_B(x,y) + t_B(x,y). \qquad (1)$$

The passive party H is affected by the strategy profile as expressed by the payoff function $\pi_H(x,y) = t_H(x,y) - h(x,y)$.

The transfer scheme t is called compensatory relative to the efficient reference profile (x^*, y^*) if the following three conditions are met:

$$\pi_A(x^*,y) \geq \pi_A(x^*,y^*) \text{ and } \pi_B(x,y^*) \geq \pi_B(x^*,y^*) \qquad (2)$$

for all unilateral deviations $y \neq y^*$ by party B and $x \neq x^*$ by party A and

$$\pi_H(x,y) \geq \pi_H(x^*,y^*) \qquad (3)$$

for any action profile (x, y), including two-sided deviations, from the efficient reference profile.

Condition (2) requires that no active party will be worse off under unilateral deviations from the reference profile by the other active party whereas condition (3) requires that the passive party will be worse off under no deviation whatsoever from the reference profile by the active parties.

If a transfer scheme t is compensatory relative to the reference profile then, in particular,

$$\pi_A(x^*,y) + \pi_H(x^*,y) \geq \pi_A(x^*,y^*) + \pi_H(x^*,y^*) \qquad (4)$$

and

$$\pi_B(x,y^*) + \pi_H(x,y^*) \geq \pi_B(x^*,y^*) + \pi_H(x^*,y^*) \qquad (5)$$

must hold for all unilateral deviations. Condition (4) requires that the coalition of A and H will not be worse off if B unilaterally deviates from the reference profile. Condition (5) allows for a similar interpretation with respect to the coalition of B and H. A transfer scheme fulfilling (4) and (5) is called weakly compensatory. If a transfer scheme is compensatory then, a fortiori, it is weakly compensatory but, not necessarily, vice versa.

Compensatory transfer schemes generate efficient incentives as the following proposition, referred to as compensation principle, establishes.

Proposition 1 *(compensation principle) If the trilateral transfer scheme t is weakly compensatory relative to the efficient reference profile (x^*, y^*), then this reference profile is a Nash equilibrium of the normal form game with payoff functions (1). Moreover, if the transfer scheme is compensatory then all Nash equilibria (if more than one exists) must be payoff equivalent.*

Proof. To establish the first claim, it follows from (5) and the efficiency of the reference profile that

$$\begin{aligned} \pi_A(x, y^*) &= w(x, y^*) - \pi_B(x, y^*) - \pi_H(x, y^*) \leq \\ &\leq w(x^*, y^*) - \pi_B(x^*, y^*) - \pi_H(x^*, y^*) = \pi_A(x^*, y^*) \end{aligned}$$

and, hence, x^* is a best response by party A to y^*. Similarly, it follows from (4) that y^* is a best response by party B to x^* and, hence, (x^*, y^*) must be a Nash equilibrium indeed.

As for the second claim, suppose that (x^N, y^N) is any other Nash equilibrium. Then

$$\pi_A(x^N, y^N) \geq \pi_A(x^*, y^N) \geq \pi_A(x^*, y^*))$$

and, similarly,

$$\pi_B(x^N, y^N) \geq \pi_B(x^N, y^*) \geq \pi_B(x^*, y^*)$$

must hold as follows from the Nash property of mutually best responses and (2). Due to (3),

$$\pi_H(x^N, y^N) \geq \pi_H(x^*, y^*)$$

also holds. By adding up the above inequalities, it follows that $w(x^N, y^N) \geq w(x^*, y^*)$ must hold. Yet, as the reference profile already maximizes welfare, the above inequalities must all be binding and, hence, payoff equivalence under compensatory transfer schemes is established as well. ■

The intuition behind the first part of the above proof is rather simple. Suppose an active party considers to deviate unilaterally from the welfare maximizing reference profile. As the rest of society would not be worse off (the scheme is weakly compensatory) and as the deviating party would receive whatever is left from welfare, such a deviation cannot improve the position of the deviating party.

4 Obligation-based transfer schemes

In civil law, transfer schemes result from the damages regime in place. Damages are quantified relative to an obligation profile. I assume that party A's obligation consists of choosing the efficient action $x^o = x^*$ whereas party B faces a possibly inefficient obligation $y^o \neq y^*$. Damages owed by A to B and H are derived from the differences

$$d_{AB}(x,y) = u_B(x^*,y) - u_B(x,y) \text{ and } d_{AH}(x,y) = h(x,y) - h(x^*,y)$$

whereas damages owed by B to A and H are derived from

$$d_{BA}(x,y) = u_A(x,y^o) - u_A(x,y) \text{ and } d_{BH}(x,y) = h(x,y) - h(x,y^o).$$

In fact, if the difference $d_{AB}(x,y)$ is positive, then it corresponds to expectation damages owed by A to B for the deviation $x \neq x^*$ from her obligation to invest efficiently. If $d_{AB}(x,y)$ is negative, then B enjoys an enrichment of size $-d_{AB}(x,y)$ due to A's deviation. The other differences are interpreted analogously.

Under the obligation-based transfer scheme, the payoff functions amount to

$$\begin{aligned}\pi_A^o(x,y) &= u_A(x,y) + d_{BA}(x^*,y) - d_{AB}(x,y) - d_{AH}(x,y) = \\ &= w(x,y) - w(x^*,y) + u_A(x^*,y^o),\end{aligned}$$

$$\begin{aligned}\pi_B^o(x,y) &= u_B(x,y) + d_{AB}(x,y) - d_{BA}(x^*,y) - d_{BH}(x^*,y) = \\ &= w(x^*,y) - w(x^*,y^o) + u_B(x^*,y^o)\end{aligned}$$

and

$$\pi_H^o(x,y) = d_{AH}(x,y) + d_{BH}(x^*,y) - h(x,y) = -h(x^*,y^o)$$

for party A, B and H, respectively. Notice, damages owed by B (the party facing an inefficient obligation) are based on efficient investments x^* of A (the party facing obligation x^*) even if A has deviated from it. On legal grounds, such a quantification may be justified as a reasonable person standard because a prudent copy of party A would have met her obligation and would have invested efficiently.[2]

The virtue of the obligation-based transfer scheme stems from being compensatory relative to the efficient reference profile (x^*, y^*). In fact, if A meets her efficient obligation, her payoff $\pi_A^o(x^*, y)$ even remains independent of y, amounting to

$$\pi_A^o(x^*, y) = u_A(x^*, y^o) = \pi_A^o(x^*, y^*).$$

Similarly, party B's payoff $\pi_B^o(x, y)$ remains independent of x, amounting to

$$\pi_B^o(x, y) = u_B(x^*, y) - d_{BA}(x^*, y) - d_{BH}(x^*, y) = \pi_B^o(x^*, y)$$

whereas H's payoff amounts to

$$\pi_H^o(x, y) = -h(x^*, y^o) = \pi_H^o(x^*, y^*)$$

independent of the action profile (x, y). Therefore, at the obligation-based transfer scheme, the conditions (2) and (3) for being compensatory relative to the efficient reference profile are met even as equalities. It then follows from the compensation principle that the efficient reference profile is a Nash equilibrium of the two-person game with payoff functions $\pi_A^o(x, y)$ and $\pi_B^o(x, y)$ and all Nash equilibria (if more than one exists) must be payoff equivalent and, hence, efficient as well. Notice, $y = y^*$ is even a dominant strategy for player B.

Under the obligation-based transfer scheme, enrichments due to deviations must be returned by definition. If, however, both parties face efficient obligations, returning enrichments is not needed to maintain efficient incentives as will be shown in the next section.

5 Efficient obligations under tort law

In tort cases, obligations are defined by courts. The economic analysis regularly presumes that courts do so at efficient levels or, in the language of the present paper, the efficient reference profile and the obligation profile coincide. For this case, consider the modified differences $d_{ij}^m(x, y) =$

[2] If damages were based on actual investments, then $\pi_B(x^*, y) = w(x^*, y) - u_A(x^*, y^o) + h(x^*, y^o)$ and, hence, y^* remains to be a best response to x^*. Yet, since $\pi_A(x, y^*) = w(x, y^*) + u_A(x, y^o) - u_A(x, y^*) - u_B(x^*, y^*) + h(x^*, y^*)$, x^* regularly fails to be a best response to y^* (unless $u_A(x, y^o) - u_A(x, y^*)$ is constant).

$\max[0, d_{ij}(x, y)]$ (enrichments no longer need be returned) leading to payoff functions

$$\pi_A^m(x, y) = u_A(x, y) + d_{BA}^m(x^*, y) - d_{AB}^m(x, y) - d_{AH}^m(x, y),$$

$$\pi_B^m(x, y) = u_B(x, y) + d_{AB}^m(x, y) - d_{BA}^m(x^*, y) - d_{BH}^m(x^*, y)$$

and

$$\pi_H(x, y) = d_{AH}^m(x, y) + d_{BH}^m(x^*, y)$$

for parties A, B and H, respectively.

Since both active parties face an efficient obligation, the modified transfer scheme remains compensatory relative to the efficient reference profile and the efficiency claim of the compensation principle remains valid.

If, however, party B is facing an inefficient obligation $y^o \neq y^*$ then returning enrichments from deviations may be needed to provide incentives for efficient breach. To establish this claim, I allow for modifications only, where no party meeting her or his obligation owes any damages, that is,

$$d_{Aj}^m(x^*, y) = d_{Aj}(x^*, y) = 0 \text{ and } d_{Bi}^m(x, y^o) = d_{Bi}(x, y^o) = 0$$

is assumed to hold for all x and y and for $j = B, H$ and $i = A, H$. Moreover, to avoid distortions for sure, I require the modified transfer scheme to remain compensatory relative to the efficient reference profile. In particular, the compensation requirement (3) at the unilateral deviation (x^*, y^o) from the efficient reference profile (x^*, y^*)

$$d_{AH}^m(x^*, y^o) + d_{BH}^m(x^*, y^o) - h(x^*.y^o) \geq d_{AH}^m(x^*, y^*) + d_{BH}^m(x^*, y^*) - h(x^*, y^*)$$

must be met . As the obligation-based transfer scheme satisfies the analogous compensation requirement

$$d_{AH}(x^*, y^o) + d_{BH}(x^*, y^o) - h(x^*.y^o) = d_{AH}(x^*, y^*) + d_{BH}(x^*, y^*) - h(x^*, y^*)$$

with equality, it follows that $d_{BH}^m(x^*, y^*) \leq h(x^*, y^*) - h(x^*, y^o) = d_{BH}(x^*, y^*)$ will hold. In other words, if party H must return an enrichment $d_{BH}(x^*, y^*) < 0$ before the modification then, a fortiori, it must do so after the modification to ensure that the modified transfer scheme remains compensatory relative to the efficient reference profile.

6 Sequential moves

Let me now return to the setting of sequential moves as introduced in section 2. The efficient reference profile is constructed by backward induction. The ex post efficient (taking) decision solves $y^*(x, \omega) \in \arg\max_{q \in Q} W(x, \omega, q)$ as a function of investments x actually chosen ex ante and the true state ω whereas efficient investments maximize expected welfare while anticipating the ex post efficient decision, that is,

$$x^* \in \arg\max_{x \in X} E\left[W(x, \omega, y^*(x, \omega))\right]. \tag{6}$$

For notational convenience, let $q^*(\omega) = y^*(x^*, \omega)$ denote the ex post efficient response to efficient investments even if A has deviated. Then $x^* \in \arg\max_{x \in X} E\left[W(x, \omega, q^*(\omega))\right]$ must also hold. The pair $(x^*, q^*(\omega))$, in fact, will serve as efficient reference profile.

Transfers are calculated ex post and, hence, they are functions of x, ω and q leading to ex post payoffs $\Pi_i(x, \omega, q)$ for party $i \in \{A, B, H\}$. Such a transfer scheme is compensatory relative to the efficient reference profile $(x^*, q^*(\omega))$ if, for all x, ω and q, the compensation requirements

$$\Pi_A(x^*, \omega, q^*(\omega)) \leq \Pi_A(x^*, \omega, q) \text{ and } \Pi_B(x^*, \omega, q^*(\omega)) \leq \Pi_B(x, \omega, q^*(\omega)) \tag{7}$$

as well as

$$\Pi_H(x^*, \omega, q^*(\omega)) \leq \Pi_H(x, \omega, q) \tag{8}$$

are met.

Under sequential choice, subgame perfect equilibrium as the plausible outcome is calculated by backward induction. At stage 3, investment decision x and state ω are given and party B chooses a best response

$$y^s(x, \omega) \in \arg\max_{q \in Q} \Pi_B(x, \omega, q). \tag{9}$$

Anticipating these best responses, party A invests

$$x^s \in \arg\max_{x \in X} E\left[\Pi_A(x, \omega, y^s(x, \omega))\right]$$

at stage 1 of the game.

Since B's best response need not be ex post efficient, scope for voluntary renegotiations may arise. Let $\Pi_i^r(x, \omega)$ denote party i's post-renegotiation payoff. If the consent of all parties is needed (think of a contractual relationship), the participation constraints

$$\Pi_i^o(x,\omega,y^s(x,\omega)) \leq \Pi_i^r(x,\omega) \tag{10}$$

must be fulfilled for $i \in \{A,B,H\}$ and for all states ω as renegotiations take place ex post and as party B credibly threatens with decision $y^s(x,\omega)$ if renegotiations would fail. At that stage, investments x are sunk and, hence, the maximum welfare will form an upper bound of the sum of payoffs, that is,

$$\Pi_A^r(x,\omega) + \Pi_B^r(x,\omega) + \Pi_H^r(x,\omega) \leq W(x,\omega,y^*(x,\omega)) \tag{11}$$

must hold for all x and ω.

Most of the renegotiation literature assumes renegotiations to be ex post efficient, in which case (11) would be binding. But I make no use of such a binding constraint and, in particular, I do not rule out the case where parties abstain from renegotiating altogether.

Anticipating the (possibly renegotiated) outcome, party A has the incentive to choose investments

$$x^r \in \arg\max_{x\in X} E\left[\Pi_A^r(x,\omega)\right]. \tag{12}$$

With and without renegotiations, the outcome remains efficient as the following proposition establishes.

Proposition 2 *Under the obligation-based transfer scheme ex post, it is optimal for A to invest efficiently, that is, x^* solves (12) whether inefficient subgame perfect continuations are renegotiated or not. Moreover, for any solution x^r of (12), expected payoffs amount to $E\left[\Pi_i^r(x^r,\omega)\right] = E\left[\Pi_i^o(x^*,\omega,q^*(\omega))\right]$ for all parties $i \in \{A,B,H\}$.*

Proof. It follows from (7) and (10) that

$$\Pi_A(x^*,\omega,q^*(\omega)) \leq \Pi_A(x^*,\omega,y^s(x^*,\omega)) \leq \Pi_H^r(x^*,\omega)$$

and from (8) and (10) that

$$\Pi_H(x^*,\omega,q^*(\omega)) \leq \Pi_H(x,\omega,y^s(x,\omega)) \leq \Pi_H^r(x,\omega)$$

as well as from (7), (9) and (10) that

$$\Pi_B(x^*,\omega,q^*(\omega)) \leq \Pi_B(x,\omega,q^*(\omega)) \leq \Pi_B(x,\omega,y^s(x,\omega)) \leq \Pi_B^r(x,\omega)$$

must hold and, hence, from (11), (6) and the above inequalities, that the chain of inequalities

$$\begin{aligned} E\left[\Pi_A^r(x,\omega)\right] &\leq E\left[W(x,\omega,y^*(x,\omega)) - \Pi_B^r(x,\omega) - \Pi_H^r(x,\omega)\right] \leq \\ &\leq E\left[W(x^*,\omega,q^*(\omega)) - \Pi_B(x^*,\omega,q^*(\omega)) - \Pi_H(x^*,\omega,q^*(\omega))\right] = \\ &= E\left[\Pi_A(x^*,\omega,q^*(\omega))\right] \leq E\left[\Pi_A^r(x^*,\omega)\right] \end{aligned}$$

is satisfied. Therefore, efficient investments x^* maximize party A's objective function and the first claim is established.

For any other maximizer x^r, all constraints of the above chain evaluated at $x = x^r$ must be binding and, hence, $E\left[\Pi_i^r(x,\omega)\right] = E\left[\Pi_i(x^*,\omega,q^*(\omega))\right]$ must be binding as well (for $i = B, H$). This establishes the second claim. ■

The above proposition is the sequential version of the compensation principle. It applies, in particular, for the obligation-based transfer scheme ex post, which is constructed along the same lines as in section 4.

Damages are determined ex post, when investments x, the state ω and the decision q are known. I assume that party B faces the non-contingent obligation q^o. In the contractual interpretation of the model, parties may have specified a non-contingent obligation for the second moving party B to economize on transaction costs. In the taking interpretation of the model, the taking agency B is assumed to face the obligation q^o not to take the property. This convention ensures that, under the obligation-based transfer scheme, B owes compensation payments to nobody as long as he abstains from taking A's property.

Under this scheme, party A owes payments $D_{AB}(x,\omega,q) = U_B(x^*,\omega,q) - U_B(x,\omega,q)$ and $D_{AH}(x,\omega,q) = H(x,\omega,q) - H(x^*,\omega,q)$ to parties B and H if A has actually invested x, the state is ω and B has reached the decision q. Similarly, party B owes payments $D_{BA}(\omega,q) = U_A(x^*,\omega,q^o) - U_A(x^*,\omega,q)$ and $D_{BH}(\omega,q) = H(x^*,\omega,q) - H(x^*,\omega,q^o)$ to parties A and H as a function of state ω and taking decision q but independent of A's actual investments x. Instead, as in section 4, efficient investments serve as reasonable person standard to quantify damages owed by B because it is party B who faces the non-contingent and, hence, possibly inefficient obligation q^o.

Under the obligation-based transfer scheme ex post, the three parties A, B and H receive payments

$$T_A^o(x,\omega,q) = D_{BA}(\omega,q) - D_{AB}(x,\omega,q) - D_{AH}(x,\omega,q),$$

$$T_B^o(x,\omega,q) = D_{AB}(x,\omega,q) - D_{BA}(\omega,q) - D_{BH}(\omega,q)$$

and

$$T_H^o(x,\omega,q) = D_{AH}(x,\omega,q) + D_{BH}(\omega,q),$$

respectively, as functions of x, ω and q. It is easily seen that this transfer scheme is compensatory relative to the efficient reference profile such that the above proposition applies indeed.

7 Budgetary fiscal illusion

For illustration, let me now discuss the obligation-based transfer scheme ex post within the model of binary taking decisions under fiscal illusion of degree $\theta \in [0,1)$ as introduced in section 2. Recall, $q^o = 0$ corresponds to the decision not to take A's property.

Moreover, as the difference $U_B(x,\omega,q) - H(x,\omega,q) = v_{BH}(\omega) \cdot q$ is independent of investments, the identity

$$D_{AH}(x,\omega,q) + D_{AB}(x,\omega,q) = 0 \tag{13}$$

must hold. This allows to realize the obligation-based transfer scheme as follows. In principle, party A owes $D_{AH}(x,\omega,q)$ to H. This is equivalent to party H owing $-D_{AH}(x,\omega,q) = D_{AB}(x,\omega,q)$ to A which, however, is exactly what A owes to B. Instead, the difference $D_{AB}(x,\omega,q)$ could directly be deducted from H's claims against B such that B owes the net amount

$$N_{BA}(x,\omega,q) = D_{BH}(\omega,q) - D_{AB}(x,\omega,q) = \frac{\theta}{1-\theta} \cdot [v_{BH}(\omega) - v_A(x,\omega)] \cdot q$$

to H. Party A no longer owes anything to H and B but A is still entitled to receive

$$D_{BA}(\omega,q) = v_A(x^*,\omega) \cdot [(1-q^o) - (1-q)] = v_A(x^*,\omega) \cdot q$$

from B. Under this scheme, no payments are due in the absence of a taking.

If, however, B takes the property it must pay $v_A(x^*,\omega)$ as compensation to A, based on efficient investments even if A has deviated, and B must pay the net sum $N_{BA}(x,\omega,1)$ to H. Notice, this sum is positive if taking the property is ex post efficient whereas, if taking the property were inefficient, then the taking agency B should be even granted a budget increase for not taking the property.

This is the lesson to be learnt from civil liability for relationships involving two active parties whose actions affect a third passive one. Budgetary fiscal illusion comes with such an externality. Under taking law, however, compensation practice is of bilateral nature, not involving payments to or from a third party. In general, it is rather unlikely that bilateral compensation schemes generate efficient incentives for, both, the investment and the taking decision if the taking agency suffers from budgetary fiscal illusion. This view is reinforced by the analysis of the next section.

8 Weakly compensatory transfer schemes

No doubt, as long as the lesson from civil liability suggests installing a virtual party whenever compensation for takings is at stake, legal practice will hardly comply with such advice. For that reason, weakening the compensation requirement seems desirable if it would lead to a transfer scheme of bilateral nature but still providing efficient incentives for both parties.

By awarding damages $d_{BH}(x^*, y)$ to A and $d_{AH}(x, y)$ to B (instead of to H as under the trilateral obligation-based scheme), a bilateral transfer scheme emerges with payoff functions

$$\pi_A^b(x, y) = \pi_A^o(x, y) + d_{BH}(x^*, y) \text{ and } \pi_B^b(x, y) = \pi_B^o(x, y) + d_{AH}(x, y)$$

whereas $\pi_H^b(x, y) = -h(x, y)$ as H receives no payment anymore. This bilateral transfer scheme is weakly compensatory relative to the efficient reference profile (x^*, y^*). In fact, as the obligation-based transfer scheme is compensatory, the payoff $\pi_{AH}(x, y) = \pi_A^b(x, y) + \pi_H^b(x, y)$ of coalition A and H satisfies

$$\pi_{AH}(x^*, y) = \pi_A^o(x^*, y) - h(x^*, y^o) \geq \pi_A^o(x^*, y^*) - h(x^*, y^o) = \pi_{AH}(x^*, y^*)$$

and, similarly, the payoff of coalition B and H satisfies

$$\pi_B^b(x, y^*) + \pi_H^b(x, y^*) \geq \pi_B^b(x^*, y^*) + \pi_H^b(x^*, y^*)$$

for all x and y and, hence, (4) and (5) are both fulfilled.

It then follows from the compensation principle that the efficient reference profile remains to be a Nash equilibrium under the above bilateral transfer scheme. Unfortunately, other Nash equilibria may exist, which fail being payoff equivalent, as the following example demonstrates. It is framed as sequential choice (but, for simplicity, without move of nature) where the subgame perfect equilibrium is inefficient in spite of the fact that the transfer scheme is weakly complementary relative to the efficient reference profile.

Parties A and B both take a binary decision $x \in X = \{x^o, x^*\}$ and $q \in Q = \{q^o, q^*\}$. Parameter values are specified such that

$$\max\left[W(x^o, q^o), W(x^o, q^*), W(x^*, q^o)\right] < W(x^*, q^*)$$

and, hence, (x^*, q^*) can serve as the efficient reference profile. Moreover, the difference $H(x^*, q^o) - H(x^*, q^*)$ is chosen such that

$$W(x^*, q^o) - W(x^o, q^o) < H(x^*, q^o) - H(x^*, q^*) \tag{14}$$

whereas the difference $H(x^o, q^o) - H(x^o, q^*)$ is chosen such that

$$W(x^*, q^*) - W(x^*, q^o) + H(x^*, q^o) - H(x^*, q^*) < H(x^o, q^o) - H(x^o, q^*) \tag{15}$$

both hold.

Given this parameter constellation, party B's payoff under the bilateral transfer scheme amounts to $\Pi_B^b(x, q) = \Pi_B^o(x, y) + D_{AH}(x, y)$ and, hence (see the end of section 6), to

$$\Pi_B^b(x, q) = U_B(x^*, q^o) + W(x^*, q) - W(x^*, q^o) + H(x, q) - H(x^*, q)$$

whereas A's payoff amounts to $\Pi_A^b(x, q) = W(x, q) - \Pi_B^b(x, q) + H(x, q)$ and, hence, to

$$\Pi_A^b(x, q) = W(x, q) - U_B(x^*, q^o) - W(x^*, q) + W(x^*, q^o) + H(x^*, q).$$

The efficient reference profile (x^*, q^*) remains to be a Nash equilibrium of the normal form game as follows from the compensation principle. In particular, $y^s(x^*) = q^*$ is the subgame perfect continuation as chosen by party B in response to party A's efficient decision x^*.

It follows from (15), that $\Pi_B^b(x^o, q^o) > \Pi_B^b(x^o, q^*)$ and, hence, $y^s(x^o) = q^o$ is the best response to x^o by B. Finally, since A anticipates the subgame perfect response of B and since $\Pi_A^b(x^o, q^o) > \Pi_A^b(x^*, q^*)$ as follows from (14), party A invest x^o in subgame perfect equilibrium and, hence, the subgame perfect equilibrium fails to be efficient (even though the efficient profile is a Nash equilibrium in the normal form game).

To sum up, while the bilateral version of the obligation-based transfer scheme would be attractive as it does not involve a (virtual) third party, the subgame perfect equilibrium outcome need no longer be efficient.

9 Taking decisions guided by benevolence

Some literature on takings has considered benevolent taking behavior in the sense of party B taking the property if and only if it is ex post efficient to do so. The compensation principle can easily be adapted to examine taking behavior of such benevolent kind.

Benevolent taking decisions $y^*(x,\omega) \in \arg\max_{q\in Q} W(x,\omega,q)$ maximize welfare as a function of actual investments x and state ω, independent of the transfer scheme in place. Anticipating the ex post efficient taking decision, expected welfare and party A's expected utility are functions of investments x only, amounting to

$$w(x) = E\left[W(x,\omega,y^*(x,\omega))\right] \text{ and } u_A(x) = E\left[U_A(x,\omega,y^*(x,\omega))\right].$$

As the taking decision remains efficient independent of compensation requirements, generating efficient investment incentives for the current owner A of the property is the only goal left from the efficiency perspective. To achieve this goal based on the compensation principle, A must compensate the rest of society for deviations from her obligation to invest efficiently, no matter, whether her property is taken or not.

More precisely, consider a self-contained bilateral transfer scheme $t = (t_A, t_B)$ leading to $\pi_A(x) = u_A(x) + t_A(x)$ as party A's expected payoff (where A anticipates the ex post efficient taking decision $y^*(x,\omega)$ if she invests x). Let $\pi_{BH}(x) = w(x) - \pi_A(x) = w(x) - u_A(x) - t_A(x)$ denote the payoff as expected by the rest of society. The bilateral transfer scheme t is called unilaterally compensatory relative to efficient investments if

$$\pi_{BH}(x) \geq \pi_{BH}(x^*) \tag{16}$$

holds for any deviation $x \neq x^*$ from efficient investments.

Whenever the compensation requirement (16) is satisfied then, as follows from the compensation principle, efficient investments x^* maximize the private benefit $\pi_A(x)$ of party A and any other such maximizer (if more than one exists) must also maximize welfare. In other words, if the bilateral transfer scheme is unilaterally compensatory relative to the efficient reference profile then

$$x^* \in \arg\max_{x \in X} \pi_A(x) \subset \arg\max_{x \in X} w(x)$$

must hold. This is the unilateral version of the compensation principle.

Hermalin (1995) has considered transfer schemes where party A receives, up to a constant residual r, all of welfare such that A's payoff amounts to

$$\pi_A(x) = u_A(x) + t_A(x) = w(x) - r.$$

Obviously, this scheme generates efficient incentives and it also is unilaterally compensatory relative to efficient investments. Yet, it does not aim at compensating the current owner for taking her property and, on this account, it hardly reflects fair compensation as requested by laws of eminent domain.

Blume et al. (1984) have also dealt with benevolent taking behavior in the above sense. For a general equilibrium setting, they have shown that zero compensation would generate efficient investment incentives for party A. In my game-theoretic setting, zero compensation would be unilaterally compensatory if and only if

$$\pi_{BH}(x) = w(x) - u_A(x) \geq w(x^*) - u_A(x^*) = \pi_{BH}(x^*)$$

holds for all x. For binary taking decisions as introduced in section 2, the benefit to the rest of society amounts to

$$\pi_{BH}(x) = w(x) - u_A(x) = E\left[v_{BH}(\omega) \cdot y^*(x, \omega)\right].$$

It is easy to construct parameter configurations where this term does not attain a minimum at efficient investments x^* and where, hence, zero compensation cannot be unilaterally compensatory. In principle, efficient incentives may still prevail as the compensation requirement is a sufficient condition only for efficiency. Yet, in my game-theoretic setting, examples may also be constructed where zero compensation fails even generating efficient incentives.

Blume et al. have also considered full compensation but dismissed it as being inefficient. In my game-theoretic setting, full compensation means expected transfer payments $t_A(x) = E[U_A(x, \omega, q^0)] - u_A(x)$ to A. This scheme would be unilaterally compensatory if and only if

$$\pi_{BH}(x) = w(x) - E\left[U_A(x, \omega, q^0)\right] \geq w(x^*) - E\left[U_A(x^*, \omega, q^0)\right] = \pi_{BH}(x^*)$$

holds for all x. For binary taking decisions as introduced in section 2, the benefit to the rest of society amounts to

$$\pi_{BH}(x) = w(x) - E\left[U_A(x, \omega, q^0)\right] = E\left[(v_{BH}(\omega) - v_A(x, \omega)) \cdot y^*(x, \omega)\right].$$

It is again easy to construct parameter configurations where $\pi_{BH}(x)$ does not attain a minimum at x^* and, hence, where the compensation requirement (16) is violated. Therefore, in my game-theoretic setting too, full compensation cannot be expected to generate generally efficient investment incentives.

Miceli (1991), finally, has proposed to grant full compensation but based on efficient investments even if party A has deviated. Under his scheme, the expected payment of A amounts to

$$t_A(x) = E\left[U_A(x^*, \omega, q^o) - U_A(x^*, \omega, y^*(x, \omega))\right]$$

after having invested x.

Göller and Hewer (2014) have specified a counterexample where Miceli's rule fails providing efficient incentives. In their example, Miceli's transfer scheme must, a fortiori, fail being unilaterally compensatory because compensation requirement (16) is a sufficient condition for efficient incentives.

To exclude inefficient incentives under zero and full compensation from benevolent takings, restrictive assumptions on the shape of objective functions would be needed. The compensation requirement (16), in contrast, is more robust as it ensures efficient incentives without restrictive assumptions.

10 Concluding remarks

This paper deals with compensation requirements as sufficient conditions for efficient incentives. If compensation requirements are violated, under the appropriate assumptions, efficient incentives may still prevail. In fact, the informational setting implicitly underlying the compensation principle would allow for many transfer schemes (including bilateral ones not in need of a virtual party), which provide efficient incentives without aiming at compensating parties. In this sense, compensation requirements cannot be a necessary ingredient for generating efficient incentives.

Rather, compensation is a legal desideratum under civil law and, to some degree at least, also under the law of eminent domain. The present paper restricts transfer schemes to those, which reflect the legal principle of compensation in a way that ensures efficient incentives.

In legal practice, compensation for takings gives rise to a bilateral transfer scheme involving payments from the taking agency to the owner if her property is taken. If the objective function of the agency coincides with the benefit to the rest of society (all but the owner) and if the agency takes compensation requirements unbiasedly into account, then obligation-based and bilateral transfer schemes exist, generating efficient incentives for all active parties, independent of equilibrium selection.

If the agency is benevolent and, hence, totally insensitive to compensation requirements, bilateral transfer schemes would also exist, which provide efficient investment incentives, independent of equilibrium selection. In fact, by making the current owner residual claimant, she would face efficient incentives. This scheme holds her liable for inefficient investments, no matter, whether her property is taken or not. It hardly reflects fair compensation of the owner as required by taking law.

Moreover, on behavioral grounds, taking decisions totally insensitive to compensation requirements as well as taking decisions sensitive to compensation requirements in an unbiased way seem rather implausible. More likely, taking agencies are sensitive to such requirements but with a biased perception of costs. As a consequence, the objective functions of the current owner and of the agency do not add up to welfare. The difference has been interpreted as external effect imposed on a third party.

Under the civil law interpretation of the model, this third party would be real and the civil law solution would consist of a damages regime involving all three parties. As its main contribution, the present paper designs damages regimes in line with principles from civil liability and sufficient for incentivizing the active parties efficiently.

Taking decisions sensitive to compensation requirements but with a biased perception of costs can be captured by an isomorphic model and, on purely logical grounds, it would be possible to adapt the efficient solution from civil liability. But this would require to think of a third party which absorbs any difference arising, for incentive reasons, between mutual claims of the owner and the agency against each other. The agency taking the property may have to transfer money, not only, to the current owner of the property but also to an account of some other agency which is not involved in the taking decision. Moreover, the current owner must also have to be held liable unless she has invested at the welfare maximizing level.

By relying on transfer schemes of bilateral nature instead, legal practice of compensation for takings neglects the external effect and, is unlikely to generate efficient incentives whenever takings are decided under budgetary fiscal illusion. This insight is a second contribution of the present paper.

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