Coasean Bargaining in the Presence of Pigouvian Taxation: Revisiting the Buchanan-Stubblebine-Turvey Theorem

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Abstract

Coasean arguments against the Pigouvian perspective are well established. A central tenet in this criticism argues that a Pigouvian tax may be a source of inefficiency: if parties were to bargain in the presence of a Pigouvian tax, (allocative) inefficiencies would occur—the so-called Buchanan-Stubblebine-Turvey Theorem. By analyzing a Coasean environment where the appropriation of property rights is costly, we show—in contrast to the Buchanan-Stubblebine-Turvey Theorem—that Coasean bargaining in the presence of a pre-existing (Pigouvian) tax is Pareto improving. This has implications for policy where dual regulatory environments exist, such as regulation at the state and federal level, as well as environmental liability and litigation.

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1 Introduction

As is well known, the seminal work of Coase (1959, 1960) provides a rigorous rebuttal of the Pigouvian perspective. In particular, Coase (1960) argued that the Pigouvian prescription to externalities was entirely misguided as this perspective failed to take into account the reciprocal nature of harm. Further, Coase (1960) showed that if parties could costlessly bargain (and property rights were well defined), an efficient level of harm would be reached without the requirement of direct government action. As a result, the ‘Coase Theorem’ argued that efficiency is independent of the initial endowment of liability.

A central theme within the Coasean perspective is that Pigouvian taxation, instead of alleviating the problem of harm, actually creates additional distortions: a Pigouvian tax is sometimes the source of allocative inefficiency. This argument was first constructed within Buchanan and Stubblebine (1962) and interpreted and modified by Turvey (1963), whereby in a Coasean environment—where agents have the ability to costlessly bargain—the presence of a Pigouvian tax provides additional incentives to reduce harm, which leads to an allocatively inefficient equilibrium. We refer to this interpretation as the Buchanan-Stubblebine-Turvey Theorem.1 This theorem can be easily illustrated in a figure. Consider a Coasean environment where players bargain over the level of harm, h. Figure 1 represents the marginal damages of a player D(h) as well as the marginal benefits of another player B(h). In the traditional

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1We borrow this term from Mohring and Boyd (1971). Further, it is also stated in Turvey (1963) that the use of a tax can only be Pareto superior if there exists a double tax-subsidy scheme where the non-taxed player obtains full compensation.
Coasean argumentation, $h^*$ is the efficient equilibrium level of harm. What the Buchanan-Stubblebine-Turvey Theorem argues is that under the presence of a Pigouvian tax, marginal benefits adjust to $\hat{B}'(h)$ and—due to the ability to bargain—an alternative equilibrium level of harm is determined at $\hat{h}^*$. Thus Coasean bargaining in the presence of a pre-existing Pigouvian tax generates allocative inefficiencies.

This theorem is a conventional—and seemingly uncontroversial—Coasean perspective on the inefficiencies of Pigouvian taxation; accordingly, this has been frequently discussed in environmental economics textbooks and surveys (e.g., Baumol and Oates, 1988; Cropper and Oates, 1992). The implications of this result are significant. If players are likely to bargain over the level of harm then a tax should not be levied on the level of harm. This may be relevant to cases where, for example, a federal government levies a tax but players bargain over the level of harm at the state (local) level (e.g., local negotiation over property rights for air pollution, resource extraction, and so on). The Buchanan-Stubblebine-Turvey Theorem is indeed intuitive but does it hold? Is Coasean bargaining in the presence of Pigouvian taxation efficient?

In this short article we investigate the overall efficiency of Coasean bargaining under the presence of Pigouvian taxation when property rights attribution is costly. We analyze a two-stage Coasean environment, where—in the first stage—the initial endowment of property rights is costly to appropriate. In the second stage players bargain over the level of harm. Allowing property rights to be initially costly to appropriate diverges from the standard Coasean paradigm, but it is intuitive when one considers the processes of acquiring property rights—in reality say, through violent conflict, litigation, or lobbying—are far from costless. Our results are in contradiction to the Buchanan-Stubblebine-Turvey Theorem; namely, we show the presence of a pre-existing (Pigouvian) tax produces Pareto improvements over-and-above any allocative efficiency loss associated with distorted harm levels. The intuition is as follows. As property rights are now costly to appropriate, the presence of a (Pigouvian) tax reduces the value of Coasean bargaining and reduces the equilibrium effort used to appropriate property rights. What we show is that the reduction in appropriation efforts outweighs any reduction

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2 For a recent discussion on Coasean and Pigouvian perspectives see Anderson and Parker (2013) and Banzhaf et al. (2013). For an analysis of the ‘Coase Theorem’ applied to environmental economics see Medema (2014).

3 A common misconception is that this argument may be directly transplanted into the debate on hybrid market-based environmental regulation, where a cap-and-trade market is combined with a price mechanism (e.g., price ceiling). Thus hybrid mechanisms should be undesirable. Such a prima facie conclusion is unwarranted. As outlined by Medema (2014), there is little in common with the existence of a cap-and-trade market and the bilateral bargaining procedure discussed in Coase (1960).
in efficiency due to distorted equilibrium harm levels.

To model the appropriation of property rights we use contest theory (e.g., Congleton et al., 2008). In contest theory, players invest in sunk effort to obtain (in our case) property rights. In particular, we use a common appropriation mechanism—an all-pay auction—to represent the institutions governing the appropriation of property rights. We can consider cases where property rights are non-existent (such as common-pool resources) or where property rights need to be enforced. Thus the use of appropriation activities can be interpreted as a process where initially non-contractible levels of harmful activities can be explicitly defined (via a court, lobbying, violent force, and so on), which allows contracting and thus Coasean bargaining to commence.

Generally, advocates of the Pigouvian perspective have dealt with the Buchanan-Stubblebine-Turvey Theorem by simply conceding the argument when there are a small number of players, accepting that “where small numbers are involved, the imposition of a “corrective” Pigouvian tax may be too much of a good thing—it can produce a misallocation rather than eliminating it” (Baumol, 1972, p 308). Thus, only when the numbers involved are sufficiently large, Pigouvians argue that the Buchanan-Stubblebine-Turvey Theorem is irrelevant—this argument is similar to the conventional criticism of Coasean bargaining being unworkable for large numbers (Aivazian and Callen, 1981).

By relaxing the assumption on how property rights are appropriated in society, we are able to provide an argument that contrasts with the Buchanan-Stubblebine-Turvey Theorem in the small numbers case and, instead, favors a dual regulatory prescription. We can thus show that if property rights are costly to appropriate the presence of a pre-existing (Pigouvian) tax in a Coasean environment is beneficial to all. Although the level of equilibrium harm is similar to that discussed in Buchanan and Stubblebine (1962) and Turvey (1963), we show that overall efficiency improves with the establishment of a Pigouvian tax. Therefore we are able to defend Pigouvian taxation from the Buchanan-Stubblebine-Turvey Theorem and thus provide a stronger case for using the Pigouvian perspective as a policy instrument.

Due to the relative orthodoxy and prima facie intuition associated with the Buchanan-Stubblebine-Turvey Theorem, few have attempted to extend or even contradict this argument. Recently, however, Rosenkranz and Schmitz (2007) have attempted to investigate when Coasean bargaining can justify Pigouvian taxation. They find the use of Pigouvian taxation can help alleviate the hold-up problem in bargaining. In our analysis, however, we focus on the conventional Coasean bargaining institution but with the addition of costly property right appropriation. Thus our focus is on cases where the property rights can be de jure non-existent (e.g., common-pool resources), or where property rights are insecure (i.e., costly to enforce and/or ambiguously defined), where conflict, lobbying, and litigation can be used to obtain property rights. Costly appropriation is thus a method that resolves the non-contractibility of harm and allows exchange. The use of costly property right appropriation has been analyzed by Robson and Skaperdas (2008) and MacKenzie and Ohndorf (2013a,b). In Robson and Skaperdas (2008) they find, in some cases, going to court Pareto dominates bargaining whereas MacKenzie and Ohndorf (2013a,b) investigate the Pareto improvements that occur due to the a priori capping of transfers on tort law damages and the implementation of bargaining restrictions, respectively. This article is similar to Robson and Skaperdas (2008) and

4Glazer and Konrad (1999) have investigated levying taxes within contest structures. In particular, they focus on taxes levied on contest efforts as well as taxes on profits obtained from participating in the contest (net of contest efforts). For taxes on profit, they show that the tax structure is an important factor in determining how equilibrium contest efforts change. As we follow the Pigouvian tradition, our focus here is on levying a tax based on the marginal damage of harm at equilibrium (or some sub-optimal variant). In order to fully replicate the Buchanan-Stubblebine-Turvey Theorem, our taxation system is intentionally separated from the contest institution and, instead, levied on the player prior to participation in the contest.

5Also see Parisi (2003) and Robson (2012) for further discussions about Coasean bargaining in the large numbers case.
MacKenzie and Ohndorf (2013a,b) in that costly appropriation is taken into account when there exists the potential for Coasean bargaining, however, these works do not consider the efficiency of Coasean bargaining in the presence of Pigouvian taxation and thus the Buchanan-Stubblebine-Turvey Theorem—the main objective of this article. Thus by combining the theory of property right appropriation with the literature on Coasean bargaining we provide a new insight on the traditional argumentation presented in Coasean and Pigouvian perspectives.

This article is structured as follows. In Section 2 the framework of Coasean bargaining with Pigouvian taxation is described. In Section 3 the results are explained. In Section 4 implications of our results are discussed and in Section 5 we provide some concluding remarks.

2 The model

2.1 Preliminaries

Consider a situation in which player $X$ causes harm to player $Y$. The harm-producing activity generates a private benefit to player $X$, which we denote as $B(h)$ where $h > 0$ is the level of harm. Let $\bar{h}$ be defined such that $B'(\bar{h}) = 0$, that is, $\bar{h}$ is the level of harmful activity that player $X$ would choose in absence of any regulation or institutional influences. For all $h \in [0, \bar{h}]$ we assume $B'(h) > 0$, $B''(h) \leq 0$, $B(0) = 0$, and define $B(h) = \bar{B}$. Player $Y$ experiences harm denoted by $D(h)$ with $D(0) = 0$, $D'(h) > 0$, $D''(h) \geq 0$, and $D(\bar{h}) = \bar{D}$.

Following Coase (1960), we allow the creation of property rights over the level of harm, which is divisible over $[0, \bar{h}]$. In contrast to the standard Coasean paradigm, however, we do not assume that the property rights are provided in an ad hoc manner. Instead, we allow the initial endowment of property rights to be determined by players’ costly efforts, which we denote as $x, y \in \mathbb{R}_+$ for players $X$ and $Y$, respectively. Note that we assume these costs to be socially wasteful. This could, for example, represent litigation, conflict, or rent seeking. Thus by expending effort, player $j \in \{X, Y\}$ has a probability $p_j(x, y)$ of winning the property rights. Throughout this article we will assume that the initial endowment of property rights is given by the following assumption.\footnote{See the appendix for an alternative formulation.}

Assumption 1. Player $X$’s probability of obtaining the property rights is given by $p_X(x, y)$ where

$$p_X(x, y) = \begin{cases} 1 & \text{if } x > y \\ \frac{1}{2} & \text{if } x = y \\ 0 & \text{if } x < y \end{cases}$$

(1)

and $p_Y(x, y) = 1 - p_X(x, y)$ for all $x, y \in [0, \infty)$.

The process of initial property endowment is thus determined via an all-pay auction, where the agent with the largest level of effort has a probability of one of obtaining the property rights. In absence of Coasean bargaining, if the property rights are awarded to player $X$, then they will receive a benefit of $\bar{B}$ whereas player $Y$ will suffer harm relating to $\bar{D}$. Alternatively if player $Y$ obtains the property rights then it will initially experience zero harm and player $X$ will therefore also experience zero benefit (thus a loss of $\bar{B}$).\footnote{Alternatively, this structure could be framed in the converse of harm, i.e., harm avoidance. In such as case, Coasean bargaining occurs over player $X$’s abatement cost and player $Y$’s damages.} As argued in Coase (1960), the initial endowment of property rights creates an opportunity for players to benefit from exchange over the level of harm. Let us denote $h^* = \arg \max_{h \in [0, \bar{h}]} \{B(h) - D(h)\}$ as the efficient Coasean bargaining solution.

As our main objective is to investigate Coasean bargaining in the presence of a (Pigouvian) tax, let us now define a tax levied on player $X$’s harmful activity.
Definition 1. Let \( \tau \) be a tax levied on player \( X \)'s harmful activity such that
\[
\bar{B}(h) \equiv B(h) - \tau \cdot h
\] (2)

As standard, the tax distorts player \( X \)'s benefit function to internalize the harm generated. As a consequence, the domain of the benefit function reduces to the interval \([0, \bar{h}]\), where \( \bar{h} \) is implicitly defined by \( B'(\bar{h}) = 0 \). Although we will consider a general form of taxation, note that a Pigouvian tax is the special case where \( \tau = D'(h^*) \), and hence \( \bar{h} = h^* \).

When considering the case of a tax, we will assume that the tax has been implemented prior to the commencement of Coasean bargaining (and any costs of establishing this tax are sunk). We, therefore, have the Coasean bargaining solution under the presence of a tax, \( h^* = \arg \max_{h \in [0, \bar{h}]} \{ \bar{B}(h) - D(h) \} \). Hence, for Coasean bargaining to occur \( \bar{B}(h) > D(h) \) for \( h \in [0, \bar{h}] \) has to hold, which we assume throughout. Note that given our assumptions on players’ benefit (damage) functions it follows that \( \bar{h} \leq \tilde{h} \) and \( \bar{h}^* \leq h^* \). Thus, in the presence of taxation the equilibrium harm level will be lower than that experienced in the Coasean bargaining game without a tax. In other words, there is an inefficiently high level of precaution from player \( X \) due to the presence of the tax: the so-called Buchanan-Stubblebine-Turvey Theorem (Buchanan and Stubblebine, 1962; Turvey, 1963).

The conventional Coasean argumentation—as expressed by Buchanan and Stubblebine (1962) and Turvey (1963)—states that in a Coasean environment the existence of a Pigouvian tax is the source of allocative inefficiency. In absence of Pigouvian taxation players would mutually agree on \( h^* \), yet a Pigouvian tax distorts the bargaining outcome to an inefficient level of harm \( \bar{h}^* \). Thus (Pigouvian) taxation actually becomes the source of inefficiency in a Coasean environment. What we will show, under more relaxed assumptions, is that overall efficiency improves under a Pigouvian tax. Namely, when the distribution of initial property rights is assumed to be influenced by costly effort, we show the presence of Pigouvian taxation—in an otherwise similar Coasean environment—actually generates Pareto improvements. Let us begin in a Coasean environment where there is a pre-existing (Pigouvian) tax.

2.2 Coasean bargaining in the presence of (Pigouvian) taxation

In our analysis, the all-pay auction will provide an initial endowment of property rights to a player at one of the domain extremes \( \{0, \bar{h}\} \). Specifically, if player \( X \) obtains the property rights the initial starting point for bargaining is \( h = \bar{h} \). Alternatively, player \( Y \) may obtain the property rights and therefore \( h = 0 \). With property rights being distributed to either player, gains from exchange are feasible, as a positive internalization rent can be shared via a bargaining process. We denote this rent with \( I_j \) for \( j \in \{X, Y\} \), which is defined as:

\[
I_X \equiv \bar{D} - ((\bar{B} - \bar{B}(h^*)) + D(h^*)) \quad \text{if agent } X \text{ wins the property rights,} \tag{3}
\]

\[
I_Y \equiv \bar{D} - ((\bar{B} - \bar{B}(h^*)) + D(h^*)) \quad \text{if agent } Y \text{ wins the property rights,} \tag{4}
\]

where \( \bar{D} \equiv D(\bar{h}) \) and \( \bar{B} \equiv B(\bar{h}) \). From (3) and (4), the total internalization rent that can be obtained by the winner of the contest is their opponent’s total possible loss minus the costs (reductions in benefits) that are payable as compensation to the party holding the property right in order to achieve the post-bargaining equilibrium. It is indeed within the Coasean logic that the total equilibrium cost \((\bar{B} - \bar{B}(h^*)) + D(h^*))\), i.e. own cost plus compensation, must always be borne by the party not holding the property right in order to reach the bargaining outcome \( h^* \). Given \( I_j \) is the maximum internalization rent possible, we allow players’ bargaining powers to influence the distribution of the internalization rent. In particular,
rents acquired by the winning players $X$ and $Y$ are given by

$$
\hat{R}_X \equiv \mu_X \cdot I_X \geq 0, \quad (5)
$$

$$
R_Y \equiv \mu_Y \cdot I_Y \geq 0, \quad (6)
$$

respectively, where $\mu_j \in [0,1]$ is a share parameter determined by the bargaining power of the winning player $j$. This representation of the bargaining powers is general enough to allow for any bargaining game, such as the Nash bargaining solution or the alternating-offers game. Also note that we make no assumption on the relationship between $\mu_X$ and $\mu_Y$, thus if player $X$ is able to secure a larger share of rent when winning, this does not preclude player $Y$ doing the same when winning the contest.

Players’ expected payoffs are therefore:

$$
\hat{U}_X(x,y) = p_X(x,y) \cdot (\hat{R}_X) - (1 - p_X(x,y)) \cdot \left( (\hat{B} - \hat{B}^*(\bar{h}^*)) + D(\bar{h}^*) + \hat{R}_Y \right) - x, \quad (7)
$$

$$
\hat{U}_Y(x,y) = p_Y(x,y) \cdot (\hat{R}_Y) - (1 - p_Y(x,y)) \cdot \left( (\hat{B} - \hat{B}^*(\bar{h}^*)) + D(\bar{h}^*) + \hat{R}_X \right) - y. \quad (8)
$$

With probability $p_j(x,y)$ player $j$ wins the property right and captures $\hat{R}_j$. With a probability of $(1 - p_j(x,y))$, however, player $j$ loses and has to compensate their opponent with an internalization rent $\hat{R}_{-j}$ as well as compensating for the costs (to both parties) to arrive at the Coasean equilibrium $(\hat{B} - \hat{B}^*(\bar{h}^*)) + D(\bar{h}^*)$. Note for the case of player $X$, if they lose, total losses amount to $\hat{B}$, therefore, reaching the Coasean equilibrium $\bar{h}^*$ they continue to suffer the (lower) loss $(\hat{B} - \hat{B}(\bar{h}^*))$ and compensate player $Y$ accordingly with $D(\bar{h}^*) + \hat{R}_X$. Following the Coasean logic, even if a player loses, they still have an incentive to bargain as the losses will always be greater without bargaining.

In the first-price all-pay auction with complete information, the party with the largest appropriation effort secures the property rights with certainty. We allow both players to play mixed strategies. The expected payoff functions in (7) and (8) can hence be written in the general form $p_j(x,y)W_j + (1 - p_j(x,y))L_j$, with $j \in \{X,Y\}$ where $W_j$ and $L_j$ are the respective awards and losses. Collecting $p_j(x,y)$ and defining $v_j = W_j - L_j$, this can be re-arranged to:

$$
p_X(x,y)v_X - L_X - x, \quad (9)
$$

$$
p_Y(x,y)v_Y - L_Y - y. \quad (10)
$$

In this format, it is well known (e.g., Hillman and Riley, 1989) that if $v_X \geq v_Y$, then the equilibrium is indeed in mixed strategies. In equilibrium, the agents’ optimal cumulative bid distribution function are given by

$$
G_X = \begin{cases} 
\frac{1}{v_X} & \text{for } x \in [0,v_Y] \\
1 & \text{for } x > v_Y 
\end{cases} \quad (11)
$$

and

$$
G_Y = \begin{cases} 
\left[ 1 - \frac{v_Y}{v_X} \right] + \frac{v}{v_X} & \text{for } y \in [0,v_Y] \\
1 & \text{for } y > v_Y 
\end{cases} \quad (12)
$$

\[8\text{Correspondingly, the loser will receive an internalization rent: } (1 - \mu_X) \cdot I_X \text{ for (losing) player } Y \text{ and } (1 - \mu_Y) \cdot I_Y \text{ for (losing) player } X.\]
For these strategies, the expected payoffs of both players are therefore:
\[
\begin{align*}
\tilde{U}_X & = -L_X + G_Y v_X - x = -L_X + v_X - v_Y, \\
\tilde{U}_Y & = -L_Y + G_X v_Y - y = -L_Y.
\end{align*}
\] (13)

(14)

Noting from (7) and (8) that
\[
\tilde{v}_X = \tilde{v}_Y = (\tilde{B} - B(h^*)) + D(h^*) + \tilde{R}_X + \tilde{R}_Y.
\] (15)

It follows that both players have an identical valuation of the property rights, and the expected utilities of players \(X\) and \(Y\) are \(\tilde{U}_X = -L_X\) and \(\tilde{U}_Y = -L_Y\), which can be rewritten as:
\[
\begin{align*}
\tilde{U}_X & = -\tilde{B} + (1 - \mu_Y) I_Y, \\
\tilde{U}_Y & = -\tilde{D} + (1 - \mu_X) I_X.
\end{align*}
\] (16)
(17)

2.3 Benchmark: the elimination of taxes

Let us now consider a Coasean environment where there does not exist a (Pigouvian) tax. In such a case bargaining yields allocative efficiency, which also implies that the respective internalization rents are larger. Setting \(\tau = 0\) the expected utilities of players \(X\) and \(Y\) are given by:
\[
\begin{align*}
U_X(x, y) & = p_X(x, y) R_X - (1 - p_X(x, y))((\tilde{B} - B(h^*)) + D(h^*) + R_Y) - x, \\
U_Y(x, y) & = p_Y(x, y) R_Y - (1 - p_Y(x, y))((\tilde{B} - B(h^*)) + D(h^*) + R_X) - y.
\end{align*}
\] (18)
(19)

Again, we assume that property rights allocated via an all-pay auction which takes place prior to the Coasean bargaining process. Note that for the standard Coasean environment, players’ net gains \(v_j\) are also identical, as
\[
v_X = v_Y = (\tilde{B} - B(h^*)) + D(h^*) + R_X + R_Y.
\] (20)

Hence, we can solve the game, with simple Coasean bargaining, analogously to the tax case. The expected utilities of players \(X\) and \(Y\) in equilibrium are then given by:
\[
\begin{align*}
U_X & = -\tilde{B} + (1 - \mu_Y) I_Y, \\
U_Y & = -\tilde{D} + (1 - \mu_X) I_X,
\end{align*}
\] (21)
(22)

where
\[
\begin{align*}
I_X & = \tilde{D} - ((\tilde{B} - B(h^*)) + D(h^*)), \\
I_Y & = \tilde{B} - ((\tilde{B} - B(h^*)) + D(h^*)).
\end{align*}
\] (23)
(24)

3 Results

We are now ready to compare the expected utilities of players in our Coasean environment when there exists a (Pigouvian) tax. For player \(X\), comparison of (16) with (21) shows that the presence of a tax actually improves expected utility as
\[
\tilde{U}_X - U_X = \mu_Y (\tilde{B} - \tilde{B}) + (1 - \mu_Y) \left[ (\tilde{B} - B(h^*)) - (\tilde{B} - \tilde{B}(h^*)) + D(h^*) - D(h^*) \right] > 0.
\] (25)
Similarly, for Player Y, comparing (17) with (22), player Y improves their expected utility in the presence of tax, as:

$$
\bar{U}_Y - U_Y = \mu_X(\bar{D} - \bar{D}) + (1 - \mu_X) \left[ \left( \bar{B} - B(h^*) \right) - \left( \bar{B} - \bar{B}(h^*) \right) \right] + D(h^*) - D(h^*) \right] > 0. 
$$

Using (25) and (26), the following proposition is immediate.

**Proposition 1.** The introduction of a (Pigouvian) tax in a Coasean environment is Pareto improving.

Proposition 1 shows that in a Coasean bargaining game where property rights are appropriated via an all-pay auction, the existence of a (Pigouvian) tax results in Pareto improvements. The socially wasteful cost from appropriation under the standard Coasean setting is hence larger than under the case with taxes. The difference in these costs more than offsets the inefficiency caused by the over-internalization of harm identified within the Buchanan-Stubblebine-Turvey theorem.

The analysis above has assumed that tax revenue collected is not recycled or used in any form, thus our findings are, in fact, quite conservative. If one were to consider what happens to the tax revenue generated, then it is clear that additional benefits can be achieved by, say, investing in public goods, which is outside the realm of this model. It follows that if an all-pay auction represents the allocation of property right endowments, the existence of a Pigouvian tax may result in improvements over-and-above those discussed here.

A natural question to pose is: how sensitive is our result to the use of an all-pay auction, which has the property of full rent dissipation? In the appendix, we show the result of a similar Coasean environment but where the appropriation mechanism is now modeled by another popular contest mechanism: an imperfectly discriminating ‘Tullock’ contest (Tullock, 1980). The Tullock contest differs from an all-pay auction in that the probability of winning is now not discrete; instead, the probability is based on a player’s effort relative to total effort outlays. As a result, equilibrium efforts in a Tullock contest are smaller than that of an all-pay auction. When our Coasean environment is modeled in such a way, we show that a similar result occurs. In fact, in this case, if the bargaining power of the winning party is not particularly large, there exist not only Kaldor-Hicks improvements, but again also genuine Pareto-improvements. Hence, having a tax in place can be preferable to both parties.

4 Implications

The above-presented efficiency results provide a new perspective on the interaction of green taxes and Coasean bargaining. Once the social costs of property right appropriation are taken into account, it turns out that, in many cases, the overall efficiency implications of the Buchanan-Stubblebine-Turvey Theorem are reversed. A pre-existing tax, combined with post-equilibrium bargaining is in fact often preferable to Coasean bargaining without such a tax. In the following we discuss two types of stylized situations where taxes and post-equilibrium bargaining might coincide.

Endogenizing the appropriation cost of property rights via a contest almost naturally lends itself to an interpretation as rent seeking within the political process. This political process might be represented as some form of Coasean bargaining (Yandle, 1991; Parisi, 2003). In this case, issue linking or logrolling is a means for post-equilibrium bargaining where the group of polluters could be bribed to reduce pollution beyond the first-best amount. Yet, it is reasonable to assume that a considerable amount of rent seeking is exerted in order to gain the superior initial bargaining point, which would correspond to the attribution of property rights in the classical Coasean framework. Parisi (2003), for example, interprets the formation of a majority coalition in the political process as the analogon to property right attribution within the Coase
Theorem. In order to form such a coalition, smaller groups of pollutees would have to spend resources, for example, via awarding political favors to other groups or to influence neutral parties in the political game. Such rent-seeking activities are traditionally represented as a contest (e.g., Congleton et al., 2008). Further, Yandle (1991), exogenously introducing some rent-seeking costs, argues that political influence on the part of the pollutees can reduce, but not eliminate, the efficiency losses of the Buchanan-Stubblebine-Turvey result. Yet, as shown above with endogenized rent seeking, depending on the degree of rent dissipation within the underlying contest, having green taxes in place can ultimately improve the efficiency of such political Coasean bargaining.

An even stronger case in favor of pre-existing green taxes can be established within the original application of the Coase Theorem, which is litigation. Within Coase (1960), property rights are attributed via the establishment of liability through a court order. The actual bargaining process can then be interpreted as some sort of settlement between plaintiff and defendant. Note, however, that due to the assumption of zero transaction costs, costs of litigation are generally not considered in the original formulation of the Coase Theorem. Within models in the field of Law and Economics, these costs are generally derived by modeling the lawsuit as a contest (Farmer and Pecorino, 1999; Bernardo et al., 2000). When integrating the cost of litigation into the Coasean framework, several established efficiency implications of the Coase Theorem tend to change (Robson and Skaperdas, 2008; MacKenzie and Ohndorf, 2013a,b). As shown above, this also holds true for the Buchanan-Stubblebine-Turvey result. Hence, when it comes to environmental liability and litigation, it is quite likely that a pre-existing tax is efficiency enhancing, as it ‘dampens’ the controversy and hence overall spending in litigation. An example for such a situation might be the consent decree between the US EPA and several diesel engine manufacturers on emission restrictions, which resulted after a settlement in the ‘Not-To-Exceed standard’ for newly introduced Diesel engines. As laid out in Morriss et al. (2005, 2009), the cost for additional emission reductions imposed on the manufacturers (and hence the matter of controversy) was significant. Yet, it can be argued that these costs would have been higher if pre-existing fuel taxes and other incentive mechanisms had not put additional pressure on emissions per mile driven.

It is to be noted that fully internalizing taxes are mainly a theoretical construct as, in reality, green taxes tend to be too low to yield the first-best level of emissions (e.g., Ciocirlan and Yandle, 2003). This is mainly due to the political economy of green taxes. Interestingly, the Buchanan-Stubblebine-Turvey result continues to hold for lower levels of taxes, as the marginal benefits of the polluter—and hence its intersection with the marginal damages of the pollutee—are still shifted to the left, only to a lesser extent than with a truly Pigouvian tax. Note that in our model, we do not assume the tax level to be necessarily fully internalizing. Hence, the above-presented results also hold for lower (or even higher) levels of green taxes. As a consequence, with large enough rent dissipation Coasean bargaining with pre-existing taxes will always be preferable to the same bargaining without taxes, independent of their level.

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9 See Skaperdas and Vaidya (2012) for a formal argument on when a lawsuit is best to be represented via an all-pay auction or a Tullock contest, respectively.

10 In 1991 an emissions trading system for NOx emissions of Diesel engines was introduced (Morriss et al., 2009).

11 Another example for internalization of external cost via a lawsuit with settlement and pre-existing taxes is the Tobacco Master Settlement Agreement, see Sloan and Trogdon (2004), Sung et al. (2005), and Morriss et al. (2009).

12 Interestingly, Pigou himself was aware of this, as he stated: "we cannot expect that any public authority will attain, or will even wholeheartedly seek, that ideal. Such authorities are liable alike to ignorance, to sectional pressure and to personal corruption by private interest. A loud-voice part of their constituents, if organized for votes, may easily outweigh the whole" (Pigou, 1932, p. 332).
5 Concluding remarks

The purpose of this article is to investigate if Pigouvian taxation levied in a Coasean environment may result in Pareto improvements. From the early literature on Coasean bargaining, the Buchanan-Stubblebine-Turvey Theorem (Buchanan and Stubblebine, 1962; Turvey, 1963) argues that the existence of a Pigouvian tax in an environment where players can bargain will result in distortions in the level of harm. For example, federal taxation over harm-producing activities—where the level of harm is negotiated at the local level—is a highly undesirable scenario.

In this article we take a fresh look at the Buchanan-Stubblebine-Turvey Theorem. By relaxing the assumption on how property rights are allocated in society we show that Pareto improvements exist if a Pigouvian tax is levied. We allow players to expend costly effort in order to appropriate property rights. This can, for example, be interpreted as violent conflict, litigation as well as lobbying activities. Property rights can be de jure non-existent or costly to enforce/define. By providing a realistic environment within which property rights are allocated we show the Pigouvian tax reduces the gains from Coasean exchange. As a result, this reduces equilibrium appropriation effort more than the loss from allocative inefficiency.

Our article thus provides a formal argument in favor of taxation when there is a potential for negotiation in the level of harm. Our analysis can provide insights to the separation of regulatory responsibilities, such as in environmental federalism as well as environmental liability and litigation issues.
Appendix: Tullock contest

The Tullock contest success function is given by $p_X(x, y)$ where

$$p_X(x, y) = \begin{cases} \frac{x}{x+y} & \text{if } \max\{x, y\} > 0, \\ \frac{1}{2} & \text{otherwise,} \end{cases} \quad (A.1)$$

and $p_Y(x, y) = 1 - p_X(x, y)$. In this ‘Tullock’ contest, the player with the highest effort now has a probabilistic chance of obtaining the property rights. It can be shown that the difference in players’ expected utility gain when a tax is introduce is as follows:

$$\bar{U}_X - U_X = \frac{1}{4} \mu_X(\Delta - \bar{D} + \bar{D}) + \frac{3}{4} \Delta (1 - \mu_Y) + \frac{3}{4} \mu_Y (\bar{B} - \bar{B}) \quad (A.2)$$

$$\bar{U}_Y - U_Y = \frac{1}{4} \mu_Y(\Delta - B + \bar{B}) + \frac{3}{4} \Delta (1 - \mu_X) + \frac{3}{4} \mu_X (\bar{D} - \bar{D}) \quad (A.3)$$

where $\Delta = (\bar{B} - B(h^*)) - (\bar{B} - \bar{B}(h^*)) + D(h^*) - D(\bar{h}^*) > 0$. Summation of (A.2) and (A.3) shows a pre-existing Pigouvian tax in a Coasean bargaining game generates Kaldor-Hicks improvements.

One can also consider the Pareto improvements associated with implementation of a tax. Using (A.2) and (A.3) it is clear that there will be Pareto improvements when:

$$\mu_X < \frac{3 [\Delta(1 - \mu_Y) + \mu_Y (\bar{B} - \bar{B})]}{\bar{D} - \bar{D} - \Delta} \quad (A.4)$$

and

$$\mu_Y < \frac{3 [\Delta(1 - \mu_X) + \mu_X (\bar{D} - \bar{D})]}{\bar{B} - \bar{B} - \Delta} \quad (A.5)$$

Substituting one into the other and vice versa, we get a pre-existing Pigouvian taxation in Coasean bargaining is always Pareto superior when:

$$\mu_X < \frac{3 \Delta}{2 \bar{D} - \bar{D} - \Delta} \quad (A.6)$$

$$\mu_Y < \frac{3 \Delta}{2 \bar{B} - \bar{B} - \Delta} \quad (A.7)$$

where $\Delta = (\bar{B} - B(h^*)) - (\bar{B} - \bar{B}(h^*)) + D(h^*) - D(\bar{h}^*) > 0$.

References


