

Master thesis for the Master of Environmental and Development  
Economics degree

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# Finding Dales

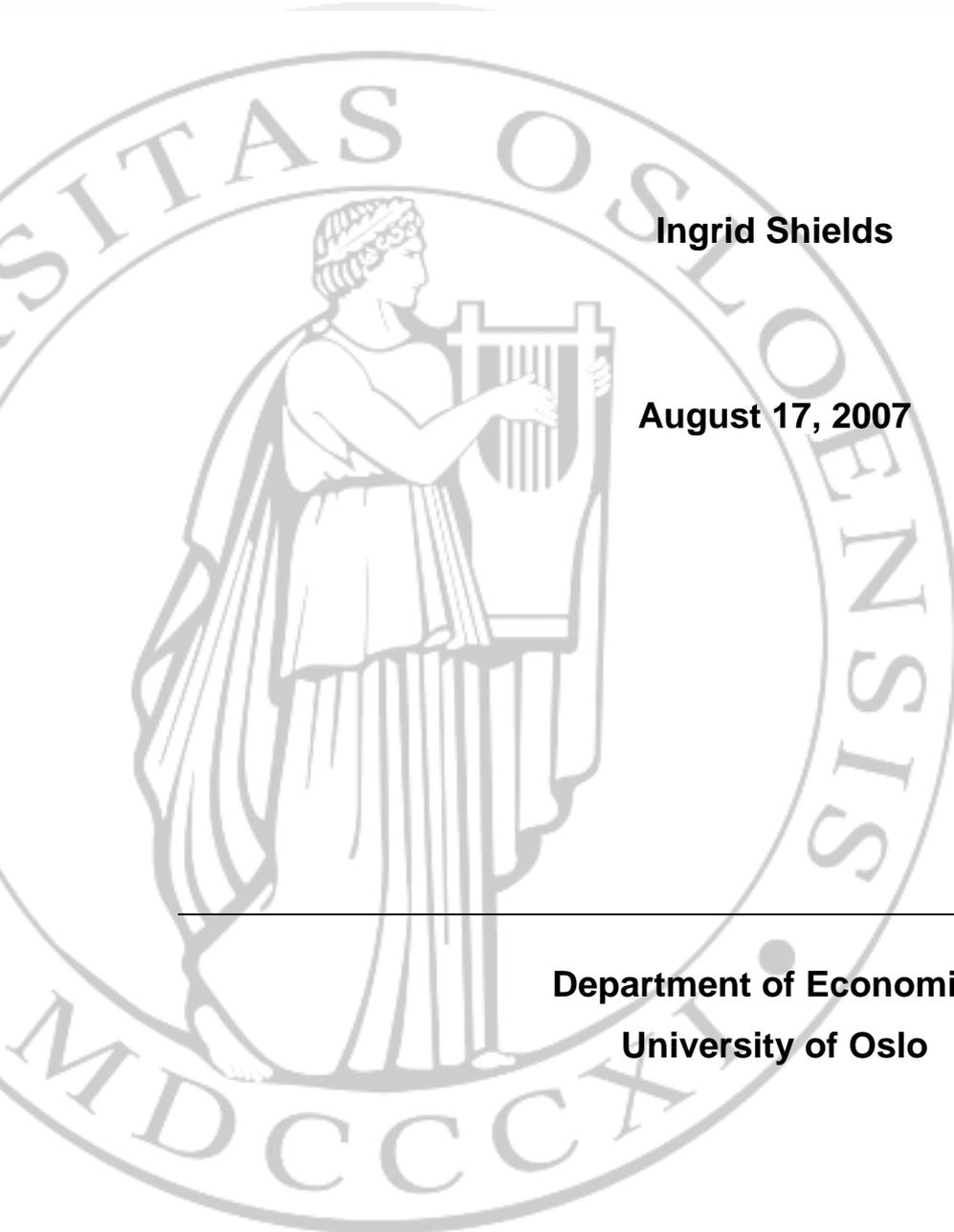
*The scholarly path from the Coase Theorem to today's tradable  
emission rights.*

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## **Preface**

I would like to thank Finn Førsund, my advisor at Økonomisk Institutt, for excellent feedback and guidance. Also, I would like to thank an old advisor of mine, Fernando Elichirigoity at the University of Illinois, for inspiring me to write within the field of history of economic thought.

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# 1. Introduction

## 1.1 A broad overview of the problem and its background

The Coase Theorem, so coined by George Stigler in 1966, based on Ronald H. Coase's oft-quoted 1960 article, "The Problem of Social Cost" has led to many different scholarly debates throughout the years. Its importance and validity has been argued, but it cannot be denied that it was a seminal article in the creation of the field of law and economics, as well as being one of the most quoted articles in economics. The Coase Theorem says, in brief, that allocation of resources will be Pareto-optimal no matter what the initial distribution of property rights, assuming no transaction costs (Fisher, 1981, Kolstad, 2000). Stigler (1966) himself stated it thus: "... under perfect competition private and social costs will be equal." (p. 113). Today, this theorem is one of the essential ideas taught in environmental economics textbooks. There are many scholars debating the validity of the Coase Theorem, and although I find it fascinating how many different things people have taken out of this theorem and this article, I will not be participating in this debate directly. Rather, I wish to look at the Coase Theorem in regards to the idea of tradable emission rights. Specifically, I aim to look at the scholarly process in the development of tradable emission rights, and my research question will be: Did Coase's 1960 article "The Problem of Social Cost", and the subsequent Coase Theorem lead to the development of tradable emission rights?

This thesis, then, will have a definitive historical perspective, specifically within the branch of the history of economic thought, as well as paying attention to scholarly processes in the field of economics since 1960. I will first emphasize Coase's contribution to the field of environmental economics, before I focus my concentration on the development of tradable emissions rights, while tying Coase into this discussion.

## 1.2 My claim

My research question can of course be answered by a hearty but subjective ‘yes!’ The basis for this answer would be that Dales, when he wrote *Pollution, property & prices* was very inspired by Coase’s article. My aim is to track this path from “The Problem of Social Cost” to today’s idea of tradable permits. This will include some of the debates in the 1960s and 70s, as well as some comparisons between some noteworthy economists such as Coase, Mishan, and Dales. I will also include some mention of what Montgomery, Tietenberg, Hahn and Stavins got out of Dales’ ideas. I have chosen Montgomery because he is so often cited for his 1972 article, Tietenberg because he has written the authoritative textbook on the subject of emissions trading, and Hahn and Stavins because they have both written many articles over the last few decades that have to do with emissions permits. Lastly I will also consider some of Adam Rose’s work, as he claims the Coase Theorem as the precursor to the idea of marketable permits.

## 1.3 A short outline of the thesis

In the next section I will discuss the development of the Coase Theorem, with a short account of externalities, as well as A. C. Pigou’s impact on the field of environmental economics. In the third and fourth sections I explain the history of pollution rights, emphasizing Dales’ initial work. I will attempt to show Dales’ influences, specifically when the influence seems to be Coase. In the fifth section I turn to how scholars have used Dales’ work to further develop the idea of tradable permits. Further I discuss whether today’s idea of emission rights can be connected to Coase and the Coase Theorem not only by following the scholarly path, but also through theoretical analysis. The last section concludes this thesis.

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## 2. Coase's "The Problem of Social Cost" and the Coase Theorem

### 2.1 Externalities and A. C. Pigou

To study environmental economics in regards to pollution, one must start with the concept of externalities. An externality is considered a source of market failure that takes place when one economic agent's activities negatively or positively impact another economic agent, when there was no intention to affect the other (Perman, 1996, p.134). This effect remains unpriced, and hence those impacted are not compensated. If they were compensated, we could say that the externality has been internalized (Kula, 1998, p. 68). The classic example is that of pollution, where pollution is the unintended effect of a firm's economic activity. The metaphor of internalizing an externality is most easily understood through the example of two firms, where one unintentionally affects the output of the other through some sort of byproduct of production such as dirty water or smoke. If the two firms are merged, the polluting firm will start taking account of the damage inflicted upon the second firm, and thus the externality will be internalized.

Although Marshall conceived of external economics and their benefits in 1890, Pigou in his *Economics of Welfare* (1920) was the first to discuss *negative* externalities and their potential solution (Kula, 1998, p. 69, Pearce, 2002a, p. 58, Medema, 1994, p. 64). Pigou pointed out the divergence between the private cost of firms and the social cost of pollution, and suggested an emission fee to correct this discrepancy, today known as a Pigovian fee or tax (Kolstad, 2000, p. 117). The idea is that, if firms do not have to abide by pollution constraints, they can pollute as much as they want, and will then have lower costs. In this unregulated situation, firms tend to pollute more than they would if they had to pay the external social costs of pollution such as sore throats and climate change. If the government introduces a tax that accounts for this social cost of pollution, this will induce firms to pollute less, and thus solve the problem, or internalize the externality. Pigou firmly believed that only government

intervention could solve this divergence, or problem of ‘uncompensated disservice’, as the parties affected were different from the parties causing the effect, and not in contractual obligations to each other (Pigou, 1932, p. 192).

The idea that pollution can be seen as an externality that causes market failure thus justifies governmental intervention (Pearce, 2002a, p. 58). This justification of government within the realm of welfare economics intervention is Pigou’s legacy.

## 2.2 Coase’s “The Problem of Social Cost” and the Coase Theorem

When Coase wrote “The Problem of Social Cost” in 1960, he referred back to Pigou and Pigou’s idea of market intervention to assuage external effects. Coase strongly believed that Pigou’s *The Economics of Welfare* molded welfare economics into this interventionist attitude (Coase, 1988, p. 20). As Coase himself wrote in a retrospective work: “In “The Problem of Social Cost,” I said that Pigou’s basic position was that, when defects were found in the workings of the economic system, the way to put things right was through some form of governmental action. This view is expressed with numerous qualifications, but it represents the central tendency in his thought” (Coase, 1988, p. 20). Coase does not like the idea of externalities, nor the term itself, as he claims this concept insinuates that fixing by the government is needed (Coase, 1988, p. 26-7). In many ways then, Coase’s 1960 article can be seen as a reaction and protest against the Pigovian tradition, in that he wrote (or so he claimed later, 1988, p. 27) *not* about externalities, but about “harmful effects,” that sometimes warrant elimination, and sometimes not. He believed that the true source of market failure need not be the externality, but rather the transaction costs that hinder bargaining between the parties (Coase, 1988, p. 13). Today, however, the term ‘externality’ is inextricably linked to both environmental economics and the Coase Theorem, and most often, Coase’s article is seen as a way to handle or think of externalities. This can be illustrated through a quick survey of three resource and environmental economics textbooks that all consider the Coase Theorem and properly defined property rights either as an alternative theoretical solution to externalities (Kolstad, 2000), or discuss Coase in their section about externalities

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(Fisher, 1981; Perman et. al, 1996). Thus, today it is safe to say that Coase's work is firmly planted in the part of environmental economics labeled 'externalities'.

According to Coase's biographer Steven G. Medema, the four central tenets of "The Problem of Social Cost" are: 1) the reciprocal nature of harmful effects (or, as they are often called despite Coase's dislike of the name, externalities); 2) that in solving said effects, the aim should be to maximize the value of production; 3) what later was coined the Coase Theorem; 4) the need to study real institutions in order to come up with actual solutions (Medema, 1994, p. 81-82). To structure the following discussion of the article, I will use these tenets.

### *2.2.1 The reciprocal nature of harmful effects*

Coase first and foremost broke with what he called the "Pigovian tradition" (1960, p. 39) through his assertion that it is not necessarily given who is the injurer and who is the victim. When reading Pigou's *The Economics of Welfare*, it is easy to always presuppose that the polluter is the injurer. However, hypothetically, if there were no people living around the factory emitting smoke, there would be no victims, and if people were to move to the vicinity of the factory and then demand its shutdown, as Coase posits in section IX, it would be unclear who was the victim, and one could certainly claim that in this case, the polluter was the victim. Coase used many examples to illustrate this point in his article; the real 1879 court case of a doctor needing quiet for his practice and a neighboring confectioner who had worked longer in the neighborhood, but made more noise, and the famous invented example of a farmer whose crops are eaten by the herds of a cattle rancher. Coase called this pivotal aspect of externalities "The reciprocal nature of the problem" (Coase, 1960, p. 2).

Seen from today's vantage point consisting of climate change and environmental crises in abundance, this viewpoint of pollution only being a problem if a present person notices that it is a problem is an extremely time-discriminating anthropocentric attitude, as qualities inherent in nature might be diminished by smoke, and future inhabitants of the earth might suffer from today's pollution (as we are suffering from the pollution of Coase's time today). However, Coase's point is an important one, at least for structuring a fair argument that can become a policy that might actually be

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agreed upon by as many people as possible. Industrialists as well as ecological economists (who cannot be claimed to be anthropocentric in any way) have used this argument. Among ecological economists, this idea has been re-coined as 'interdependence' and cast as a sort of new alternative to the idea of externalities. (Paavola, 2005)

### *2.2.2 Maximizing the value of production*

Coase further emphasized that in order to solve the problem of harmful effects in an economic way, the objective should be to maximize the value of production, hence letting the market decide what is the most efficient solution to the problem. This is also a reaction to the Pigovian tradition, in that the measures suggested by Pigou (taxes, subsidies, or regulation) were not market-based. "The economic problem in all cases of harmful effects is how to maximize the value of production." (Coase, 1960, p. 15). By focusing only on maximizing the value of production and efficiency, it is possible to come to the conclusion of what is now known as the Coase Theorem.

Although Coase's arguments against Pigovian taxes most clearly rely on efficiency, where Coase believes that the government-interventionist solutions offered by Pigou lead to further distortions and should be not assumed to be the best measures, this debate is not *only* structured around the impartial measurement of efficiency. It is also based on ideology; on beliefs of how involved a government should be in the market. Is the government an intrinsic part of the economic system? Within the Pigovian tradition, despite its underpinnings in neoclassical economics, externalities, or the divergence between social and private cost, are viewed as a market failure that can only adequately be fixed by the authorities, because it is in no one else's economic interest to fix the problem. With his 1960 article, Coase shifted this debate. Whereas before the assumption was that government intervention to eliminate externalities was necessary, Coase removed this assumption, no doubt to the great joy of his cohorts at the University of Chicago. However, not only did he provide a strong argument for less government intervention, his argument also provided space for more varied scholarly debate on the subject of externalities. And, although Coase's argument certainly appears to be based on ideology as well, this varied debate it generated has provided for stronger "objective" theories to solve the

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problems of pollution (Dales' Pollution rights, for example!). Coase thus altered the basis upon which we gauge externalities, and how to solve the problems they pose.

To summarize, Pigou believed that the economic system had distinct flaws that needed fixing through certain measures such as taxes, today known as Pigovian taxes. Coase believed that these measures might just be distorting the market even more, and constructed an alternate solution based on bargaining and maximizing the value of production, that ultimately, although it only has theoretical significance due to the imposition of transaction costs, showed us the importance of property rights as far as externalities are concerned.

### 2.2.3 *The Coase Theorem*

Most focused on in Coase's 1960 article is of course the Coase Theorem. This theorem, not named so by Coase himself, but rather by George Stigler, can be determined most readily from a statement on page 8 of Coase's article: "But the ultimate result (which maximizes the value of production) is independent of the legal position if the pricing system is assumed to work without cost" (Coase, 1960). Also, the basic assertion of the Coase Theorem, that an efficient allocation will be reached whoever has the property right, is illustrated several times through the article's example of the cattle rancher and the farmer. It is very important to note that the Coase Theorem, and Coase in his article, assumed no transaction costs, so that bargaining between people such as the rancher and the farmer could come about costlessly. Criticism of the Coase Theorem will be discussed directly below, and other aspects will also be discussed in regards to emission permits in the sixth section.

The Coase Theorem has been heavily criticized and its real meaning frequently debated. There is not agreement among economic scholars whether Coase meant that *any* efficient allocation would be reached, or whether he meant that the *same, identical* efficient allocation would be reached, whatever the initial property rights. Steven Medema claims that "...there is little question that Coase is asserting that invariance holds in the sense of identical efficient outcomes" (1994, p. 90), mostly due to Coase's cattle-raiser and farmer examples arriving at the same allocation, and Coase's statements in his paper (although they are somewhat ambiguous, they are clarified in his 1988 collection of essays where he provides notes to his articles).

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However, since I am also investigating how scholars have used the Coase Theorem, I cannot only rely on what Coase actually meant, but what his readers took him to mean:

*If* economists assume that Coase meant that *any* efficient allocation would be reached, despite initial property rights, it has been noted that this is simply the definition of Pareto-optimality (Samuels, 1974, p. 2). Coase himself wrote that this idea is very similar to Edgeworth's concept (1988, p.160), made so famous through the obligatory first year microeconomics course topic of the Edgeworth box; the gist of which is that two individuals will end up on the Pareto-optimal contract curve if they are free to bargain.

On the other hand, if economists assume that Coase meant that the *same* efficient allocation will be reached, despite whatever the initial property rights are, then there are other objections, among them Mishan's point that income effects matter (1971). This can be explained through Mishan's own enlightening example of airport noise pollution as an externality. Since there is a difference in equivalent and compensating variation, people might be willing to pay a different sum to be able to avoid airport noise than they are willing to accept to live with airport noise. People's preferences might change with changing levels of wealth or income. Mishan sees this, analogous to Coase, as two different property regimes: one in which the victims of noise pollution have to pay to avoid air pollution, the other one in which the airport has to pay to make noise. Since there are differences in the prices both groups are willing to pay or accept, the allocation of rights matter, contrary to Coase's claim (Mishan, 1971, p. 18-20). This is because, even with no transaction costs (and thus free bargaining), the bargain will not be made when the parts are not willing to pay, and thus the non-bargaining solution will be seen as the optimal solution, when it would not necessarily be so, were the prices constant. This argument was compelling enough for most economists (and especially writers of textbooks) to include another assumption of "no income or wealth effects" when presenting the Coase Theorem (Kolstad, for example). In the textbook by Perman et al., the authors explicitly state that the Coase Theorem just indicates an efficient allocation, and that it could be any efficient allocation (1996, p. 138). This position is justified by the existence of wealth effects, since with different initial endowed property rights, in a model context, actors'

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marginal benefit curves might change, thus changing the end-allocation reached through bargaining.

There is also the often-heard objection that the assumption of no transactions costs is too strong, and renders the theorem useless. Since this in retrospect seems to have exactly been Coase's point, this might come across as an unfair objection, but I will discuss it briefly anyway, as it helps to clarify what Coase meant in his seminal article, and what he was criticizing. According to D. McCloskey, the "real" Coase Theorem, or rather, the main point of Coase's 1960 paper, is that "...one cannot in general efficiently internalize an externality by taxing/subsidizing whoever is generating the negative/positive externalities, because (in light of transaction costs) this would generally not result in the right to the resource affected going to the person who values it the most" (McCloskey, 1998, p. 369). Medema also clarified this further when he explains that Coase used the assumption of no transaction costs to show the importance of transaction costs, and in this way also criticized Pigou's analysis, which, since it is grounded in a neoclassical framework, contains many of the same assumptions that renders this theory so useless in real life (Medema, 1994, p. 80).

The Coase Theorem, then, is certainly not as straightforward as it can seem when presented in economics textbooks, and its interpretation is in many ways up to the scholar interpreting it. This is certainly due not only to the interpreting scholar, but also to Coase, who was neither succinct nor particularly clear in his 1960 article. However, the value of this article and the resulting Coase Theorem cannot be denied, as it has caused many great scholarly debates, and has certainly inspired many scholars in different ways.

#### *2.2.4 The need to study real institutions*

We have arrived at Coase's perhaps most important point: the need to study real institutions, rather than abstract models, in order to come up with actual solutions. Coase's argument that economists should reduce the time spent on 'blackboard economics', and rather focus on the importance of transaction costs and the creation of institutions to lessen these costs is the economic contribution he has later proclaimed as his legacy (Coase, 1992). As he himself emphasized: "The world of zero transaction costs has often been seen as a Coasian world. Nothing could be

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further from the truth. It is the world of modern economic theory, one which I was hoping to persuade economists to leave” (Coase, 1988, p. 174). The Ronald Coase Institute of New Institutional Economics, where Coase is advisor, also illustrates in action that he, at least in later years, has come to see the comparative study of real institutions as most important.

There is ample evidence of this position in his article. At the end of section VI of “The Problem of Social Cost”, Coase wrote that it is necessary to study the real world. Then he did just that in section VII, in that he looked through old court cases and analyzed them from an economic perspective, consistently considering the benefits of harmful effects up against their costs. At the end of section VII he critiqued other economists, and how they have not looked at real institutions: “Most economists seem to be unaware of all this. When they are prevented from sleeping at night by the roar of jet planes overhead (publicly authorized and perhaps publicly operated), are unable to think (or rest) in the day because of the noise and vibration from passing trains...they proceed to declaim about the disadvantages of private enterprise and the need for governmental regulation.” (1960, p. 27). Coase then, emphasized heavily (and still does) the importance of doing empirical economic research, rather than constructing theoretical models with many assumptions.

These main points in Coase’s article do not perhaps readily point to emission permits, but as other scholars (both economists and law scholars) read Coase’s article in the 1960s, they caught on to the property right aspect of it, as well as the reciprocal nature of pollution, and the results of this can be seen in Dales’ 1968 essay, through his emphasis on property rights, how theories fare in the real world, and thus also the need to take account of institutions.

### 3. Pollution rights' history: outline

The concept of tradable emission rights, or “Pollution rights,” as J. H. Dales named them (1968a), is an instrument to manage harmful emissions. A maximum amount of acceptable emission is decided on, and then rights or quotas that together sum to this amount, are distributed or auctioned off to emitters. In this way property rights for emissions are determined, and a market is created (Dales, 1968, Tietenberg, 1980). Tradable emission rights are, along with emission fees, instruments that employ economic incentives rather than direct regulation. In contrast with emission fees, however, tradable emission rights are a “quantity instrument”, that is, they allow policymakers to set the quantity of pollution, whereas with emission fees, the price must be set (Oates, 2000). This idea of permits is also attractive because new firms to an area can be accommodated without any necessary reaction from the policymakers' side (Oates, 2000). This will happen through the market; if new firms also want to buy permits to pollute, the demand and thus the price for such permits will increase, and it will become worthwhile for some firms to reduce emissions in order to sell some of their permits. Less used initially, emissions trading schemes are now gaining traction globally through the United Nations Framework Convention on Climate Change of which the Kyoto protocol is the best-known amendment ([http://unfccc.int/essential\\_background/items/2877.php](http://unfccc.int/essential_background/items/2877.php)). On a national scale they have also been used to some degree in the United States from the mid-seventies on, in combination with other policy tools.

#### 3.1 A disclaimer

Although Dales is usually credited with the idea of pollution rights (Woerdman, p. 8, Pearce, 2002b, p. 941, Perman et al., p. 239), Thomas Tietenberg (1980) points out that Thomas D. Crocker had this idea for air pollution in 1966 (p. 391). Tietenberg also asserts that the gist of this idea originated with Alfred Marshall and Henry George (1980, p. 391). Bruce Yandle and Andy Barnett also put forth this claim in 1974. In the article “Henry George, Property Rights, and Environmental Quality”, the

two authors argued for and explained how George's solutions for land scarcity from 1881 should be the basis for the current analysis of environmental resources (p. 393). They illustrated how George focused on property rights, and the line of reasoning now familiar from Coase and Dales, that ownership entails certain property rights, and how these are dynamic (p. 396). In other words, one cannot do with one's property exactly what one wishes, and what one is allowed to do, might change over time as society evolves. Yandle and Barnett also mentioned Dales' essay, and put this in the context of the "Georgian" tradition (p. 399).

Dales himself mentioned that Mishan recommended property rights to *clean* air in his book *The Costs of Economic Growth*. Dales, however, believed it more practical to establish property rights that let agents make the air and water dirty (Dales, 1968a, p. 110). Hence, even though the creation of a market solution to pollution problems through the use of property rights perhaps did not originate with Dales, I will take Dales' essay as the tipping point argument, the significant contribution to the larger discussion that actually in the end had an effect on policymakers' actions. I also believe and intend to show that Dales could not have cemented his argument in the way that he did had it not been for Coase's 1960 article.

As T. D. Crocker is not quoted as extensively in the emissions trading literature as Dales is (as an example, Crocker had 46 citations when I did a cited reference search in Science Citation Index, whereas Dales had 115), I will not be studying Crocker's contribution to the field as thoroughly, although indirectly I will be, as many of the authors that cite Dales, also cite Crocker. Also, Dales and Crocker were working independently of each other, Crocker in 1966 with air pollution, and Dales in 1968 with water pollution (Gorman and Solomon, 2002, p. 297), and I therefore even further find it a valid endeavor to pursue the scholarly path set out by Dales rather than Crocker. However, as support for my argument, I will mention that Crocker also was inspired by Coase, specifically Coase's emphasis on institutions: "...Coase was apparently one of the few who thought the problem [institutional forms] to be worthy of analytical attention...One might... argue that Coase's major and lasting contribution is his analytical refurbishing of the economics of institutional design from the dustbin it had been relegated to...after WWII"(Crocker, p. 563-564n5). From this article by Crocker it can further be gleaned that Crocker believed politics cannot be

separated from economics, in which case he is closely aligned with both Coase and Dales, who, respectively, thought the study of real-world institutions and the inclusion of pollution as a social science were imperative endeavors.

## 4. J. H. Dales' Pollution, property & prices

In the essay *Pollution, property and prices*, published in 1968, Dales provided the reader with an “‘economico-legal’ proposal for dealing with pollution problems.” (p. vi) Dales first discussed the impact of waste and pollution on the environment. He further considered a simple water pollution problem through cost benefit analysis, before he deflated his own simplified problems and solutions, and went on to show what a complex problem this actually is. He included hypothetical ‘real’ examples, which, although they certainly do abstract away from many of the aspects of real life, take into account politicians, policy-makers and the electorate. He then discussed the aspect of property rights, inspired by Coase, and laid out his suggestion for a Pollution rights regimen. In his article “Land, Water, and Ownership”, also published in 1968, Dales in brief, and with many more references and more of an academic and ‘economic’ structure and tone, discussed the same ideas as in the much longer essay mentioned above. I will be referring to both works as it is convenient. First I will make clear Dales’ general points, before I focus in on those aspects of his work that are plainly motivated by Coase’s 1960 article.

### 4.1 Dales’ general points

In order to build a more extensive depiction of Dales and his work I will in brief mention some of Dales’ thoughts that are not directly related to Coase, before I begin comparing and analyzing these two economists.

Dales was adamantly against economists attempting to estimate *how much* pollution should be an appropriate amount, and thought that economists rather should aid in deciding *how* to meet the standards after they have been set by politicians (presumably helped along by natural scientists). As he wrote in his essay: “The main purpose of this chapter has been to show that economic analysis, which is all but useless in helping us to decide on a policy, is all but indispensable in helping us to decide on the best way of implementing a policy once it has been chosen. The

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criterion is simply that the best way of implementing a policy is the least costly way, counting *all* costs..." (1968a, p. 99). Dales was, as any respectable economist, focused on least-cost methods, but only after those decisions that have a moral facet have been decided. Whereas this attitude, reminiscent of John Neville Keynes' idea of positive economics, serves to make many economists seem more interested in their models than in their surroundings, (note Milton Friedman's encouragement of momentous and simplifying assumptions) when Dales explains himself, it is clear that he is a social scientist as well as an economist. Throughout his writing he was acutely aware of and often mentioned the social system within which economics must work, and how many aspects of the problems considered could not actually be solved by economists. In this way, Dales might have constrained his own working area, but he also in this way was able to focus on the parts of the pollution problem he believed he could help solve. Although I will not venture to claim that Dales had this from Coase, Coase also mentioned that policy choices were a moral issue, not to be tackled by positive economic tools: "the choice among different social arrangements ... must ultimately dissolve into a study of aesthetics and morals."(Coase, 1960, p. 43).

Dales further wrote that "The system of low pollution charges for a low pollution level tends to spread pollution evenly over the countryside. I prefer the opposite system of high pollution charges for a low pollution level..." (1968b, p. 803). Dales believed this was important because, even though it might seem fairer and more cost-efficient to attempt to charge polluters evenly for their damage done, rather than simply per emissions, this might lead to a state of slight pollution damage everywhere, as polluters in areas with low pollution could then pay less to pollute per unit than those in high pollution areas, and therefore might end up polluting more. Dales pointed out that 'clean' areas become more valuable as the areas next to them become more polluted, and that people often do not have the same environmental standards in regards to different areas, depending on how they use these areas. He used the example of the city of Toronto, and the more rural area of Belleville: "As a Torontonian I sometimes go to Presqu'ile, near Belleville, to swim, and I don't *want* the swimming near Belleville to be as bad (or good) as it is near Toronto.." (1968a, p. 89).

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Dales' opinion that areas with low levels of pollution should be able to remain such was actually later reflected in US policy. By the Clean Air Act, a mechanism was developed so that areas that were less polluted than the ambient standards set by policy-makers did not become more polluted than really necessary (Tietenberg, 1980, p. 392). This was done through regional levels of air quality standards, where pollution ceilings or amount of pollution increase allowed was based on said regional levels (Tietenberg, 1980, p. 392). This policy was implemented together with quasi-market emissions trading instruments.

Today in environmental economics this opinion is also often acknowledged. By setting different standards at different receptors, different ecosystems can be accounted for. In the RAINS (Regional Acidification INformation and Simulation) model, for example, the amount of deposition different receptors can take without significant damage is assessed, and then this measure of deposition, the critical load, is used to attempt to reduce emissions that result in acidity, eutrophication and ground level ozone (Førsund, 99, p. 6, 12). In this model, then, an environmental standard is decided on a receptor-by-receptor basis. These standards are set according to damage to health and vegetation ([www.iiasa.ac.at](http://www.iiasa.ac.at)), which is slightly different from Dales' idea, who thought not of an objective measurement of damage, necessarily, but of how different areas, or receptors, have different use values to people, and therefore should have different levels of pollution. Dales' wish, however, is far harder to implement than the environmental standards in the RAINS model, because it requires that everybody living in an area agree on what sort of environmental standard said area should have. The method used in the RAINS model seems more scientific and objective, and can thus be agreed on easier.

Dales in his article also stressed the artificialness of tradable permits. Since supply is set, this market of Pollution rights is not a "natural market"—Dales called it a market of "...one-way communication..." (p. 803). This is of course a reflection of the fact that the amount of pollution allowed, based on environmental standards, is set by the policymaker when the market is created. Hence, the supply of permits cannot be increased when more are demanded, only the price can increase.

Despite this market being artificial, its construction relies on genuine economic

incentives in order to reduce pollution, in that Pollution rights encourage the development of more emission/effluent-reducing production procedures, as the emissions reduced from this innovation can be sold on the market as permits. Dales mentioned this in his article and in his essay, but the concept of economic incentives to reduce pollution has been emphasized much stronger later, by, among others, Tietenberg and Stavins.

## 4.2 Dales' work motivated by Coase

Now, to show the connection between Dales' work and Coase's article, I will be discussing these of Dales' points further: 1) Dales put great emphasis on the combination of economics and law, through the pricing of property rights, a development that Coase helped instigate with his 1960 article. 2) Dales used Coase's point that most pollution problems have a reciprocal nature when he emphasized the importance of property rights, and how the existing legal situation affects events. 3) Dales also believed, like Coase, that people, if they have the ability, will attempt to come to a pareto-optimal point, through bargaining, or as Dales stressed, through moving. 4) Reminiscent of Coase, Dales used simplifying assumptions not as a tool to find an answer, but rather as a means to finding out what made his problem complex. 5) Like Coase, Dales emphasized the value of studying real institutions in a comparative manner.

### 4.2.1 *Economics and Law*

It is not an exaggeration to say that the economic analysis of law began with Coase. The Journal of Economics and Law was founded in 1958 at the University of Chicago, and Coase's articles "The Federal Communications Commission", and "The Problem of Social Cost" were both published in this journal, of which Coase was editor of from 1964 until 1983 (Landes et al., 1983). Both articles, and especially "The Problem of Social Cost" have been important in the development of the field of Law and Economics, with extensive citations in the law literature. By showing that factors of production and goods are property rights, Coase extended the idea of what can be bought and sold in a market, specifically to solve the problem of externalities. As he wrote on the last page of his 1960 article:

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A final reason for the failure to develop a theory adequate to handle the problem of harmful effects stems from a faulty concept of a factor of production. This is usually thought of as a physical entity, which the businessman acquires and uses (an acre of land, a ton of fertilizer) instead of as a right to perform certain (physical) actions. We may speak of a person owning land and using it as a factor of production, but what the land-owner in fact possesses is the right to carry out a circumscribed list of actions...If factors of production are thought of as rights, it becomes easier to understand that the right to do something which has a harmful effect (such as the creation of smoke, noise, smells, etc.) is also a factor of production...The cost of exercising a right (of using a factor of production) is always the loss which is suffered elsewhere in consequence of the exercise of that right—the inability to cross land, to park a car...to enjoy a view...to breathe clean air. (p. 44).

This idea was enthusiastically reflected in Dales' work, when he first wrote, "“Property rights” form interfaces between law and several social sciences, especially economics..." (1968a, p. 58), and then went on to describe how ownership of a car is not the right to do anything you wish to the car, but rather it is a set of property rights, a bundle of rights in connection with the ownership of the automobile. Thus, economics can be seen as the study of the market for property rights (Dales, 1968a, p. 59). This separation of a good or a factor of production from its traditional constraint as a tangible thing or a service, defined instead now rather as a bundle of property rights, can be seen as an important step in the development of the idea of marketable permits. For Environmental Economics, Coase's perspective was instrumental in that he considered the right to pollute a factor of production, as also echoed in Dales' work.

#### *4.2.2 The reciprocal nature of externalities*

Coase's point that the problem of externalities has a reciprocal nature was also readily adopted and further explicated by Dales. By incorporating the idea of property rights and the idea of there being two sides to every story (perhaps already done by Coase, but certainly not as clearly), Dales showed how two actors (a factory owner in Toronto and a child who likes to swim in Lake Ontario) both can suffer from the other's wishes of how to use the lake. He also (contrary to Coase) pointed out why, perhaps, we traditionally like to think of the swimming child as the victim of pollution. He posited that this often has to do with technology. Whereas the swimming child cannot harm the factory's ability to produce through his actions, the factory can

certainly impact the child's possibility of swimming in the lake (1968a, p. 67). This can of course also be compared to the established and oft-mentioned definition of freedom, which is that everybody should be able to do as he chooses, as long as it does not infringe on another person's wish to do as he chooses. From this point of view, the factory owner is infringing on the swimming child's ability to do as he wishes.

Dales also stressed that the strict demarcation between polluters and 'pollutees' was misleading (1968b, p.799), as in many cases, most people can be seen as both perpetrators and victims of environmental degradation. For example people who drive cars in the city center might also be bothered by smog. This is an important point when one considers what political action must be taken to solve the problem. Even though this was not exactly Coase's point, it is reminiscent of his point of questioning the traditional set up of a polluter-perpetrator and a pollutee-victim, and it is not far-fetched to think that Dales considered this more extensively than if he had not read Coase's argument of the reciprocal nature of harmful effects.

#### *4.2.3 Belief in the possibility of Pareto-optimal situations*

Coase's claim that a Pareto-optimal situation can always occur if there are no transaction costs is also echoed in Dales' writing. This idea has been greatly criticized by E. J. Mishan, who called it a 'Panglossian'<sup>1</sup> attitude towards the problem of externalities (Mishan, 1971b). In other words, this belief in Pareto-optimal situations conveyed to Mishan the tautological argument that current regulation was the best of all possible worlds and thus not worth changing. Coase and Dales, on the other hand, both emphasized that people will do as they see best; vote with their feet and thus live where their preferences are best met; bargain to find the best solution if they are able to, and so on. As Dales wrote: "If I valued swimming more highly than I do I would probably live in Belleville. And if a resident of Belleville valued big-city life more than he did swimming he would probably move to Toronto" (1968a, p. 89). Even though this certainly is reminiscent of Coase, it mainly harks back to the idea of 'voting with the feet', an idea credited to Tiebout (1956).

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<sup>1</sup> From the character Pangloss in Voltaire's *Candide*.

Dales further mirrored this ‘best of all possible worlds’ philosophy by writing that “People who move to a city, or do not move out of it, may be those whose aversion to pollution is not very great; if this is so, it might help to explain why city electorates seem so reluctant to elect politicians who will spend more money for pollution control” (Dales, 1968a, p.25). This argument, although perhaps valid, seems a bit simplistic. Do people really keep on living in polluted areas because they do not mind pollution? In Mishan’s article “Pangloss on Pollution” (1971b) the author pointed out, in a highly entertaining and satirical fashion, that this might not be so. People might be stuck in their current situation, and even though they do not like airport noise or other pollution, they might not have the possibility to move away from it. The Environmental Justice movement has caught on to this, especially in regards to pollution permits. In later years the connection between poverty and pollution hot spots has been pointed out by many authors, notably among them Lily Chinn (1999). Although people might certainly move away from pollution if they do not like it, it has become more common in recent years to assume that there are also other factors at play (most notably, poverty), and even though there are many residents close to a polluting factory, this does not necessarily mean that these residents accept this pollution.

#### *4.2.4 Assumptions as rhetorical tools*

Dales also used something of the same rhetorical tool as Coase when constructing his argument in his essay. In section III, he tackled a complex problem such as pollution by “...assuming away all their complexities and then solving the artificially simplified problems that remain. The value of the technique lies *not* in the answer to the artificial problem... but in the making of the assumptions that allow us to solve it, for these assumptions help us to identify exactly what features of the original problem make it complex and difficult” (1968a, p. 27). Dales thus used a simplified numerical example to illustrate how a community could weigh damages of pollution with the costs of cleaning up or preventing said pollution. This is reminiscent of Coase’s arithmetical example of the cattle-raiser and farmer (Coase, 1960, p. 3). Where Coase used the assumption of no transaction costs to show how important transaction costs are, Dales used a gross simplification of the problem at hand to be able to use a cost-benefit analysis, which he then undermined by saying that: “..But do not be deceived! The problems were *not* solved by the benefit-cost machine; they

were solved because we took great pains to adopt assumptions that *made* them solvable” (1968a, p. 36). Dales’ critical assumptions assumed away the *social* aspect of the pollution problem, as he supposed all the inhabitants were of the same mind and rational, that they only cared about their own community, and not so much about the future. Dales was thus able to conclude that this problem of pollution is inherently a social problem, (p. 38) which must be solved through a political process that might not lead to the same outcome as an economist’s carefully constructed example. Both Coase and Dales (Dales more explicitly than Coase) thus focused on their assumptions as the main point in their arguments, the aspect of the problem they wanted to highlight. In this way they are similar; they are both economists that wish to get away from what Coase termed “blackboard economics”, instead of using simplifying assumptions to solve problems, they use assumptions to show why the problem at hand is complex. In this way, they also indirectly comment on economists’ use of assumptions.

#### 4.2.5 *The need to study real institutions*

In addition to his use of assumptions as critical points in his argument, Dales also wrote in a way that seemed to take seriously Coase’s challenge that economists should do research in real institutions, in a comparative manner. Much like Coase, Dales drew the reader out of the blackboard economics mode, and into a world more real. Here Dales echoed Coase: “The economist, *from his Olympian heights*, says that what we should do, obviously, is to allocate costs between pollution prevention, damage avoidance, and welfare damage in such a way as to minimize the social costs...But the economists cannot tell us how to allocate our costs... because he cannot measure welfare damages” (1968a, p. 104, emphasis added). In order to devise his suggested system for a market for pollution rights, Dales envisioned the political structure needed in his region to make this system work, further stressing that the work of natural scientists would be needed to establish standards (1968a, p. 78), and that each effort would more or less be a “social experiment, as conditions are always different wherever and whenever policies are carried out (1968a, p. 77). As Dales also said: “I feel very strongly that social scientists have not devoted nearly enough effort to the discussion of implementation problems, and that it will be some time before anyone can write on this question with much confidence. The question is complex because it is an amalgam of legal, economics, and administrative matters,

and lawyers, economists, and students of public administration have not yet coordinated their attacks on it" (1968a, p. 105). This statement clearly shows that Dales also had the opinion that comparative, multidisciplinary research was what was needed to solve these problems. Specifically, Dales seemed to indicate that multidisciplinary research within the social sciences was needed. Later economists would take an interdisciplinary approach to further investigate the issue of marketable permits, especially through policy studies. I will be discussing these economists in the fifth section.

This broader emphasis on the social sciences is of course not unique to Dales and Coase, but it is a noteworthy similarity, as many economists in this time were busy further specializing economics into a more mathematized, statistical science. For example, Ragnar Frisch received the Nobel Prize in 1969, thus showing the acclaim that the four-decade old field of econometrics had by then amassed. Although econometrics also certainly is a very interdisciplinary field, it is not interdisciplinary within the social sciences, but rather attempts to use the tools of various hard sciences.

From his analysis that in so many ways is reminiscent of Coase, Dales thus assembled his suggested solution to the pollution problem; the creation of a market for Pollution rights.

### 4.3 Explication of Dales' "Pollution rights"

Dales set up his idea for a discharge-trading scheme for water pollution through permits that he named Pollution rights. In his article "Land, Water, and Ownership" he first discussed some aspects of 'common' property, and problems inherent in these sorts of ownership structures (p. 794). He then laid out the possible instruments governments can use to implement pollution reduction: a waste quota for each waste discharger; a regulation to lessen emissions by a specific amount; a subsidy either to individual dischargers or uniformly; or a charge (today commonly referred to as an emission tax or fee), also individually ("point-by-point") or uniformly (p. 800). He then discarded the individual solutions, as it probably would not be cost-efficient for the government to know all the information needed to individually subsidize or tax a firm.

Finally he introduced the possibility of a market for pollution rights (p. 801). He categorized this market as a charging (effluent/emission tax) scheme, since it can be said that a firm is charged the price of a permit. However, even though he put a market for pollution rights in this category, he did emphasize that the advantage of a market is that the quota can be set initially, whereas in the charging or subsidy schemes, to get to a certain level of emissions, the government would need to experiment with various fee-levels (p. 801). He also highlighted the benefit of the market setting the price of the permit, and this thus taking into account economic growth or decline without policymakers having to keep track of this (1968b, p. 802).

Dales' essay contains much the same idea for a market in pollution rights, with additional details as to how one would go about establishing this market. These details might seem unnecessary to some (deciding that a water control board that is freed from party politics will be in charge of the market... and so on), but these suggestions lend the construction of the idea a certain authenticity that it might otherwise lack. In many ways, then, this essay is not written for fellow economists, but for the public, and for policymakers. To many economists, the idea of tradable emission permits may seem like the ideal solution to problems of pollution. This because it is a system based on economic incentives, and hence efficient, but also ideal for policymakers, as there is a cap on pollution. Therefore it might be difficult for an economist today to understand what people could have against this excellent solution. However, it is important to remember that to environmentalists, tradable permits might seem a way for firms to buy their way out of polluting less, or as a license to pollute (as Dales wrote: "Property and prices still raise ancient fears that "the rich will eat out the poor"" (1968b, p. 797) and, at the other end of the ideological spectrum, tradable permits could still be considered excess government intervention by conservatives and libertarians. That Dales wrote with many details and examples, and directed not only towards economists, but also towards policymakers as well as the public, might help to explain why it is Dales' essay that often is quoted as the initial, seminal work in emissions trading. This, even though Crocker wrote an article two years before, and Mishan suggested an idea a year prior to create rights to a *clean* environment. Dales' essay can thus be seen as the 'tipping point' for this idea, as his work is most often quoted (by among others Pearce, Woerdman, Godal, Sorrel et al. p. 3), and he himself often seen as the initiator of tradable permits. I would

claim that Dales thus became the father of this idea because of his writing style, which clearly showed his wide inclusion of this as a social problem, with a social science solution, as well as his attention to policy processes. This helped make the idea of tradable permits seem possible in the real world, and thus more worthy of further study. To see how incredulous an idea this must have seemed in the 60s, we only have to look at Wolozin's 1970 reaction to it: "...a market for pollution rights, an imaginative although impractical suggestion." (Wolozin, p. 297) He further wrote: "This is an original suggestion! Even if it is impractical, it serves to dramatize the intractability and complexity of the pollution problem, in societies like the Canadian and American, which have not yet faced up to pollution costs." (p. 299). It is fascinating that an environmental economist deemed an emissions trading scheme impractical only six years before such a scheme was implemented.

#### 4.4 Dales' sources of inspiration: Coase versus Mishan.

Dales himself wrote that the parts of his book that relate to property, where the idea of Pollution rights is developed, owe much to three articles: Coase's "The Problem of Social Cost", Gordon's 1954 article on the fishery as a common-property resource, and Charles A. Reich's article "The New Property" (Dales, 1968a, p. 111). Coase's ideas can be detected throughout Dales' essay; from his treatment of how property rights can provide a way to look at social problems (1968a, p. 65-67) to his assertion that we cannot easily classify one party as polluters, and the other as "pollutees" (p. 101), as was already discussed in the section prior.

However, it is interesting that the economist most prominently exhibited in Dales' 1968 essay is actually not Coase, but rather E. J. Mishan, to whose opinions Dales devotes his essay's concluding paragraph (1968a, p.108, 110). Mishan can almost be seen as an adversary to Coase, especially through his ironic and humorous "Pangloss on Pollution", an article indirectly critiquing Coase and more specifically, the Coase Theorem. So how could it be that Dales, who seems to most readily identify with the economist Mishan, (Dales, 1968, p.110) in retrospect still seems closer connected to Coase's "The Problem of Social Cost"? I think this might have to do with Dales' and Mishan's shared ideology. Both Dales and Mishan have some outright statements and many hints that allude to their positions. Mishan, of course,

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published a book called *The Costs of Economic Growth* in 1967, and thus firmly positioned himself in the Galbraith spectrum of the economic universe. Dales also expressed some traditional left-leaning views, as he supported higher taxes and commodity prices in exchange for a cleaner environment, as he stated on page 71 of his essay (1968a). Mishan believed that *choice* was critical in protecting the environment, as he hypothesized that people would not choose polluted air if they had the choice, and that it is the lack of choice that is causing a non-optimal amount of pollution (1967, p. 85-86). Mishan further advocated that the way to obtain this choice was not within a market framework, but rather by assigning “legal recognition of amenity rights” (1967, p. 86). As far as Coase considered non-defined property rights another transaction cost, one could say that both Mishan and Coase are arguing for somewhat the same thing. However, the significant difference is that, according to the Coase Theorem, the initial distribution does not matter. Of course, Coase and his followers meant that the initial distribution does not matter for an efficient allocation. Mishan, however, is of the opinion that the initial distribution *does* matter, and that the right to decide pollution should not necessarily rest with the highest bidder, but with ‘the people’, for equity purposes. Thus, Mishan and Dales are both clearly not the strong pro-market economists that Coase seems to be. It is interesting that a solution such as marketable permits seems to have come from both a conservative, more libertarian starting place, as well as from a more liberal, left-leaning scholar. This would certainly lend such a solution more credence among a wider audience and thus more potential for success.

## **5. How have scholars used Dales? Montgomery, Tietenberg, Hahn and Stavins.**

Now I will examine a few prominent authors within the field of Pollution rights / marketable permits. This is done on an author-by-author basis to illustrate how each of these authors have and have not followed in the footsteps of Dales, and how they have further developed and modified Dales' initial Pollution rights proposition. As an idea matures and steps from the realm of theory into the practical, it seems a good idea to see what happens to it, and what consequences this might have. That is what I attempt to do.

I chose these authors based on their seeming prominence in the field: the times they have been cited and the number of articles they have published on this topic. I will discuss each author and his contribution generally, then I will target in on how Coase and Dales are reflected in their work, as well as what, preliminarily, can be considered these scholars' legacies. In this part of the thesis, then, the focus will be squarely on marketable permits and the development of this idea, explained through these authors' contributions. When looking at the scholarly path in this way, it is important not only to look at the articles themselves, but also in which journals they have been published. These authors have been published in land and resource economics journals, environmental economics journals, and law journals. This is undeniably of some importance, and will be discussed briefly.

### **5.1 W. David Montgomery**

Dales' idea of Pollution rights was further developed and turned from a narrative form to a more rigorous analysis by Montgomery in 1972. As Montgomery himself wrote when referring to new schemes to make markets for licenses to pollute: "The purpose of the present article is to provide a solid theoretical foundation for such proposals." (p.396). Montgomery's paper has been highly influential, since Montgomery in a rigorous way proved the efficiency of an emissions trading scheme (Woerdman, p. 8, Perman et al., p. 391). In the literature, Dales and Montgomery are often cited as a

pair, where Dales is seen as initiator of the idea, and Montgomery the one who proved its least-cost feature (Rezek et al., 2007, p. 503; Andersen et al., 2007, p. 105; Ellerman, 2005, p. 123, Perman p. 239). Although, as I have already discussed, Dales was not in reality necessarily the sole initiator of the idea of emissions rights, he is the only person Montgomery quotes when he refers to this idea: “Dales has discussed a wide variety of such arrangements [in emission licenses]” (Montgomery, p. 395). In particular, as Montgomery’s main interest and Ph.D. thesis is on air pollution, it is interesting that he did not quote Crocker in this article. This further leads credence to my conjecture that Dales’ work was more influential than Crocker’s.

Montgomery built on Arrow’s work in market versus non-market allocation, as well as on an unpublished study by Jacoby and Schaumberg that attempted to show how a market specifically for the Delaware estuary could be made (Montgomery, 1972, p. 395-396). Most importantly, however, he built on Dales’ work. There are many aspects of his model that he clearly got from Dales, and then there are some aspects he further developed. The main idea of an artificial market in emission licenses is of course based upon Dales’ essay from 1968. He further used exogenously set environmental standards, and also developed a cost function that in essence is very similar to Dales’ informal discussion of firms’ modified costs.

Like Dales, Montgomery assumed that the government, or the ‘management agency’, would set a standard of environmental quality. This standard would mean a certain amount of emissions, and a market mechanism would then uphold the standards through regulating emissions at least cost. Dales emphasized that this standard could not be decided through an artificial market, and Montgomery followed this assumption. Montgomery set up a formal cost function for the polluting firms (p. 398), but Dales also implicitly illustrated this in simpler terms, by explaining what and how firms would have to increase costs with a market for permits (Dales, 1968b, p.801). Montgomery further developed the idea of pollution rights into a more generally applicable economic model, in that he in his article devised “a decentralized system for... a number of different locations..” (1972, p. 396). Dales mostly spoke hypothetically about one receptor, a lake, whereas Montgomery generalized this to many receptors.

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Hence, it is safe to presume that Montgomery used Dales extensively, as his thorough and rigorous analysis contains most of the basic elements included in Dales' analysis, with the addition of many receptors.

Also, although Montgomery does not quote Coase, he does come to the Coasian conclusion that the initial distribution of permits has no effect on the equilibrium allocation of permits, and hence, on cost-efficiency. (This is also mentioned in Hahn, 1984, p. 756n3, and Stavins, 1995, p. 140.)

Although Montgomery's elaboration on the idea of pollution rights still is highly theoretical, he evolved this idea further. If not necessarily into something that policymakers could use directly, Montgomery's contribution, by proving efficiency, laid the foundation for other economists to work further on this idea and develop it for 'the real world'. Montgomery also significantly extended this idea in that he considered tradable permits for non-uniform dispersion of emissions. Although Montgomery himself claimed that this extension; that he generalized this idea to many locations, was the most important aspect of his article (p. 396), he is still most often quoted for proving the least-cost efficiency claim of marketable permits. Seen from today's perspective, then, this is probably his most important contribution to posterity.

## 5.2 Basics of Emissions Trading as it was initially practiced in the United States

Now that I turn from the theoretical to the practical aspects of marketable permits, I will stop briefly to explain some of the different methods and concepts used initially to employ a limited version of tradable permits in the United States. This was the first implementation of the theoretical idea of marketable permits, and although no full market was put into practice, this first attempt shows the practical constraints that needed to be overcome in order to implement a more total permit market. This is also important as the scholars discussed below, all influential within the field of emissions trading, started writing significant contributions after the United States had already started using emission permits as a method of pollution reduction, and thus

their research often hinges critically on these initial attempts at tradable permit programs.

Emissions trading began in 1976, as several states faced non-attainment of the Clean Air Act (Tietenberg, 2006, p. 6). Emissions trading became a viable solution as the other option faced by the Environmental Protection Agency (EPA) was prohibiting new business (Tietenberg, 2006, p. 7). The EPA defined a standard for each source of emissions, and created the system of **emission reduction credits**, where firms who reduced emissions received credits that could be sold so that new firms could open and economic growth could be continued (Tietenberg, 2006, p. 7). This then, was not a total market, but rather a market in the reduction of emissions. The EPA further created the **offset policy** by making new firms collect 120 percent of the emissions reduction credits they needed to produce, rather than just 100 percent. This led to a further decrease of 20 percent in air pollution, and made “the problem [of economic growth] part of the solution” (Tietenberg, 2006, p. 7). The “**bubble**” concept let a single plant (with multiple facilities) trade emissions within itself, and **banking** meant that a plant could ‘save’ emissions credits and use or sell them later (Noll, 1982, p. 120). **Netting** allowed a single plant the possibility of reducing from another source within the same plant, resulting in the same net emission increase (Hahn, Hester, 1989, p. 371). Although these policies were relatively successful as to both maintaining environmental quality and lessening control cost for the state they were still far more costly than the ideal emissions trading scheme, as the credit trades were often endorsed on a case-by-case basis (Tietenberg, 2006, p. 7, Hahn and Hester, 1989, p. 374). Hence, as Noll pointed out in 1982, these programs only used some aspects of economic incentives, but were not fully implemented market solutions (Noll, 1982, p. 120). Today, of course, the most attention to emissions trading is that garnered by the Kyoto Protocol, as it is a global attempt at a complete emissions trading market for greenhouse gases.

### 5.3 Thomas Tietenberg

Thomas Tietenberg, a professor at Colby College, Mass., has written one of the most cited books on tradable permits: *Emissions Trading: Principles and Practice* (first edition 1985). Since Tietenberg has also written a textbook in environmental and

resource economics, he tends to be widely cited in this field in general (The first edition of this work was published in 1984). His initial *significant* contribution to the emissions trading debate was his article from 1980, which firmly established the idea of permits in environmental economics (per, for example, Woerdman, 2004, p.8-9). Most other articles cited until Tietenberg's 1980 article on transferable discharge permits are either narrowly focused case studies (as Jacoby and Schaumburg's work on the Delaware estuary, an unpublished work that Montgomery used as a source), or more economically theoretical works, such as Montgomery's 1972 article, which although valuable, did not grapple with the disorderliness of the real world. Tietenberg, with his focus on what regulators were then already doing as well as the theoretical literature, provided a proper grounding for further work both in creating solutions to make tradable permits work, as well as a more realistic foundation for further theoretical study within the field of environmental economics. The aim of his 1985 article, called "Transferable Discharge Permits and the Control of Stationary Source Air Pollution: A Survey and a Synthesis" was to provide all available literature on this topic in order to support the government transition towards a total emissions trading market, rather than, for example, one that only allows trading on reductions above the standard, referred to as the "bubble" concept (Tietenberg, 1980, p. 3-4). This emphasis on combining actual policy work with environmental economics can also be seen from his earlier work in the 1970s; in an article from 1974 ("Derived Decision Rules for Pollution Control in a General Equilibrium Space Economy"), he discussed pollution control in light of policy to date.

Tietenberg is also widely cited for his comparison between various command-and-control schemes with a least cost marketable permits scheme (Tietenberg, 1985). This can be seen as a sort of real-world extension/application of Montgomery's 1972 article, in that it "proves" that a hypothetical marketable permit scheme would be more cost-efficient than the command-and-control schemes already employed by government. This work of Tietenberg's has been cited in a few different contexts. First and foremost it has been cited in order to bolster support for marketable permits. However, it has also been used as an example of how economists have tended to jump on marketable permits as the best alternative (since it is the cheapest alternative, theoretically), without considering real world constraints carefully enough (Stavins, 1995). Tietenberg himself later (1991) wrote an empirical survey with

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Atkinson showing how cost savings for marketable permits programs indeed were lower than expected by theoretical models (Atkinson and Tietenberg, 1991).

Thus, Tietenberg has had a significant impact on this field. Although it is always difficult to say whether one scholar has been a significant influence on another just by gauging their work, one can certainly see if a scholar follows the trend of other scholars. In this respect, Dales' work is reflected in Tietenberg's writing, especially through the focus on real world problems and policy solutions. Also, although Coase's 1960 article does not pop up in Tietenberg's individual work, he must not be in disagreement with Adam Rose that the Coase Theorem was a sort of precursor for emissions trading, as Tietenberg is a co-author on an article from 1993 that says so.

#### 5.4 Robert W. Hahn (and his co-authors)

Dr. Hahn is the Executive Director of the AEI-Brookings Joint Center, a Senior Fellow at American Enterprise Institute (AEI), and an economist. (Coase, by the way, also received support from this right-of-center think tank when writing his article "How should Economists Choose"). Robert Hahn was also senior staff economist on the Council of Economic Advisers under George Bush Senior (Gorman and Solomon, 2002, p. 308). In his work he continued in the tradition of Tietenberg, in that he wrote economic analysis based on public policy, with a heavier and heavier focus on policy and empirical studies as his career progressed. He wrote his Ph.D. thesis on the viability of marketable permits in 1981, and wrote profusely on the subject until the mid-1990s<sup>2</sup>. A selection of his work, some co-authored, respectively, with Hester, Stavins, and Noll, since 1984 will show how he moved from writing theoretical articles building on the idea of marketable permits, to work where he analyzed the implementation of marketable permits. He also wrote some articles on a sort of meta-level; articles that addressed and analyzed aspects of earlier articles about marketable permits.

In one of his first articles written, published in the *Quarterly Journal of Economics*, Hahn discussed market power in regards to tradable permits (1984). He did not cite

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<sup>2</sup> This is according to the list of published articles on his CV, which can be found on <http://www.aei-brookings.org/about/advisorybio.php?id=1>

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Dales in this article, but he did cite Montgomery's 1972 article. This article will also be touched upon in the seventh section, as it shows that the initial distribution of permits *does* matter for the resulting allocation in situations of market power. In this article, there were no empirical aspects; Hahn purely developed a theory of what would happen if market power were introduced into a model of transferable property rights.

In 1989, Hahn wrote an article in the *Journal of Environmental Economics and Management*, where he cited Montgomery's 1972 article as his main source, but also mentioned Dales, Baumol and Oates and Tietenberg as important predecessors (p. 195). In this article, Hahn used the theoretical underpinnings for transferable rights, proven efficient by Montgomery (1972), to develop a theoretical model that can be utilized in decisions that involve trade-offs because of numerous objectives. Hahn's example was that of automobile production, where different regulations require both a sturdy safe car (that thus uses more gasoline due to weight), and fuel efficiency (that is most easily achieved through a lighter car). Hahn's model was a tool devised to help balance these trade-offs (p.195-196). Another application would be in the case of trade-offs between different pollutants that cause similar damage (p. 206). If there were a combined market for two pollutants, (assuming linearity) firms could themselves find the most efficient trade-offs between pollutants using the market mechanism of transferable permits. Although this article's main point is somewhat to the side of the topic of transferable permits, the main idea is reminiscent of Coase's position that people that are free to bargain/transact are able to find the most efficient allocation. This article thus aids in illustrating the connection between the Coase Theorem and transferable permit schemes, in that Hahn could come to a Coase-esque conclusion while citing Montgomery and Dales.

Concurrently, Hahn and Hester published an article in *Ecology Law Quarterly* about the performance of marketable permit programs: "A more careful examination of the actual application of market-based approaches will suggest important lessons for extending existing theory and designing new applications." (p. 366). This article brings up such aspects as transaction costs, enforcement problems and potential distortion of incentives due to the actual implementation of various marketable permit programs in the US. The programs studied are the emissions trading program under the Clean Air Act, the lead trading program that lasted from 1985 to 1987, and two

programs that involved the trading of water pollution rights in Wisconsin and Colorado. As far as these authors were concerned, the permit systems for air, as well as for water in Wisconsin, were in general too restricted to encourage a large amount of trading (1989, p. 380, 392). The lead trading program owed its success to its relatively few restrictions, and that there was no uncertainty about the permits' length of life, which was short, as the goal was to phase out all lead in gasoline entirely (1989, p. 389). Dales in his article also emphasized the need for a clear policy in regards to a permit's shelf life, in that he said that the government should have "inflexible resolve" in regards to the amount of pollution rights and their time of validity (Dales, 1968b, p. 801). This article by Hahn and Hester featuring these case studies in marketable permits and the challenges in implementation and operation, moved away from a theoretical, smoothly functioning market, and into the hazards of the real world. The authors emphasized how politics were of momentous importance in actually being successful; if restrictions were too tough, or informational and other transaction costs too high, there would be far less trading (p. 404). These findings are in agreement with Dales' opinion of 1968; that pollution is a *social* problem, and must be dealt with as such, involving policy- and political strategy, as well as knowledge from the other social sciences. Although these aspects are politically based and decided, these findings do also accord with economic theory, especially in the Coasian sense that transaction costs matter, and that restrictions that make property rights less clear, lead to inefficiencies. Clearly, then it is important for successful implementation that an interdisciplinary approach is utilized.

Again, in an article by Hahn and Stavins from 1991, also published in *Ecology Law Quarterly*, these economists wrote for a non-economist /lawyer audience, in that they explained and made clear various forms of environmental regulation from an economically theoretical standpoint, then described the situation within politics, based on experiences using marketable permits as well as interest groups that might affect what policies were followed. "Charges, like other market-based mechanisms, also provide ongoing incentives for firms to develop and adopt newer, better pollution control technologies." (p. 8). They also pointed out that "No single approach will be ideal for all problems. The real challenge is to identify the right policy for each specific situation." (p. 15). Often, in economic literature, the emphasis is on finding the most efficient method. This is of course a valid (and valiant!) effort, but it can also lead to

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inflexibility about what is 'right', because what is right according to economic efficiency might not work in a policy setting. This article thus can be said to stress the need to adopt a more flexible attitude.

Hahn and Stavins also pointed out that professional resistance from lawyers working in EPA bureaucracy sometimes poses as a problem when attempting to initiate market-based approaches (p. 21). It is therefore probably a strategically well-chosen decision to publish in a law journal, as they chose to.

In an article from 1991, titled "Environmental Markets in the Year 2000", Hahn and Noll surveyed the marketable permit programs to date, then, as the title indicates, forecast how the development and use of these types of programs would progress. Under the subtitle "If economists are so smart, why is everyone else so slow to catch on?" (p. 356), the authors explained why it might be difficult to implement a program using marketable permits. The reasons included distributional issues, issues of information and information lags, as well as political control and all its potential effects. An important distributional issue was distributive politics, where politicians try to make sure that their constituents receive gains from potential marketable permit programs (p. 357). Problems of information largely incorporate issues of obsolescence—policies implemented today might be made obsolete tomorrow through new knowledge about pollutants. In general, the authors claimed that uncertainty about information or lack of information can lead to a less efficient market, or a market with less willing actors, and this is the case in a market for pollution permits as well (p. 359). This article, then, used a combination of political science, policy studies and economics to explain why permit markets had yet to be completely implemented.

Hahn for a while made it his specialty to look at comparisons of command-and-control regulatory schemes with incentive-based schemes such as marketable permits, to assess which is more cost-effective. He did this by looking at other scholars' work (Tietenberg's seminal 1985 article, Oates, Portney and McGartland's 1989 article), and adding some of the aspects that were taken away to simplify the problem. For example, in an article from 1993, "Comparing Environmental Markets with Standards", published in the *Canadian Journal of Economics*, he analyzed

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Oates, Portney and McGartland's model from 1989, and attempted to reassess their work if the assumption of full information to the regulator was taken away, and if political constraints were added (p. 348). This can be seen as a way to bolster marketable permits for the real world, and to further see if this idea, so great in theory, could also work successfully in practice, and in the instances it had worked, why it had worked.

Hahn, then, as we can see from looking at this selection of his published articles, is clearly in the 'second generation' of scholars writing about Pollution rights. He first attempted to expand the model of marketable permits to a situation including market power, and this was published in an economics journal. He then published a few articles in law journal, so as to explain this concept to a non-economist audience. He then attempted to explain why marketable permits have not succeeded as rapidly as an economist would have expected them to. His analysis of real world constraints signaled a more pragmatic approach as the idea of marketable permits became known to a wider audience. His emphasis on developing a "...deeper understanding of how politics is likely to affect environmental goals, the definition of property rights, the design of institutions, and transactions costs associated with different institutional designs..." Hahn, 1993, p. 353), is still clearly in the spirit of Dales.

## 5.5 Robert N. Stavins

Robert Stavins is a professor at the John F. Kennedy School of Government, and a Resources for the Future (RFF) University fellow. Through his work at the Environmental Defense Fund in the 1980s he became an important figure in the environmental movement (Gorman and Solomon, 2002, p. 308). Here I will analyze a selection of his articles pertaining to this topic to illustrate how the scholarly development of tradable permits has gone from theoretical to practical.

In the article "Transaction Costs and Tradable Permits" from 1995, Stavins attempted to analyze how transaction costs affect the market for pollution control. He put up a model including transaction costs, and came to the conclusion that transaction costs will lower the amount of trades that occur. Also, depending on the nature of the transaction costs, their existence might result in an overturning of Montgomery's

(1972) claim that how permits are distributed initially does not matter for efficiency (Stavins, 1995, p. 142-143). Hence, Stavins' claim has a potentially strong effect on policy, as it shows that regulators are not as free to choose whichever method of initial distribution they consider most politically feasible, as Montgomery's 1972 article indicated. This is reminiscent of one of Hahn's first articles (1984), where he also came to the conclusion that initial distribution of permits did matter for the resulting allocation in situations of market power. The difference, however, between the two articles, is that Hahn's was purely theoretical, whereas Stavins' article included empirical research to prove the existence of transaction costs in permit markets, before he delved into developing a theoretical model. This article was of course written 11 years after Hahn's article, and therefore there was far more data to use for empirical research than before.

In an RFF-published article from 1997, Stavins tackled the issue of which policy instrument(s) to choose in order to combat global warming. He emphasized the *theoretical* advantage of marketable permits, but then pointed to the institutional and political constraints not considered theoretically, and how these constraints should not be ignored (Stavins, 1997).

In 1998, Stavins analyzed the US SO<sub>2</sub> allowance trading program (Stavins, 1998), and according to Perman et al., gave an "...authoritative appraisal[s]..." of it (Perman, p. 344). In this paper, Stavins attempted to analyze the state of the SO<sub>2</sub> trading program in light of the policy history of market-based environmental regulation (1997, p. 70). In this attempt to explain the occurrence of tradable permits at this point in time, Stavins entered the field of political economy, or even political science, as the reasons he supplied took into account political actors. This interdisciplinarity is natural, as he is not only an economist, but also has a Ph.D. in Public Policy.

Stavins tends to cite the same trail of scholars as those before him; he cites Dales and Crocker as the initiators of the idea of an artificial market in emission rights, Montgomery as the one who structured and proved its efficiency, and Tietenberg as the one who began emphasizing its policy aspects (Stavins, 1995, p. 134). In the article from 1997 mentioned above, Stavins in a footnote explained how: "The initial proposal for a system of tradable permits to control pollution was by Dales (1968),

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and first formalized by Montgomery (1972), although much of the literature can be traced back to Coase (1960)” (p. 6n10). Clearly, the development of the idea of tradable permits is becoming a process where policy now interacts with and affects this idea. Stavins, then, can be seen as an important part of this development. He clearly uses and refers back to the theory provided, initially, by Dales and Coase, and especially by Montgomery, but then also uses actual policy and practice to further analyze transferable emission rights.

It can be seen, then, that the economists working with the idea of marketable permits today tend to be from various political camps, as well as multi- or interdisciplinary, with a strong focus on policy and the effects of policy implemented. My selection of economists is of course biased; I chose these scholars based on their number of publications, as well as number of citations of them, and I also found their work interesting. Most likely, interdisciplinarity stimulates the potential of publishing more, as relatively similar work can be published in both law and economics journals, for example. Also, interdisciplinarians are perhaps more readily cited by a larger number of various scholars. There are certainly other economists that analyze marketable permits from a more stringently theoretical standpoint. That said, the economists chosen also embody the beliefs set forth by both Coase and Dales, and in this way, show the strong imprint that Dales (and Coase through Dales) has had on this field. As Dales said, the issue of pollution *is* inherently a social problem, to be solved by government, policymakers, and social scientists.

## 6. Is the claim that marketable permits for emissions are based on the Coase Theorem *theoretically* sound?

Lastly I will briefly investigate, on the background of the above-mentioned scholars, as well as selected economics textbooks, whether it is economically sound to say that Coase's work and the Coase Theorem is the foundation for tradable permits. Although it is not exactly clear *what* the Coase Theorem actually is (see above discussion), and whether Coase would agree with what most economists recognize as the Coase Theorem, I will use as my basis here the definitions of the Coase Theorem put forth in three textbooks on environmental economics, Kolstad's *Environmental Economics* (2000), Perman et al.'s *Environmental and Resource Economics* (1996), and Fisher's *Resource and environmental economics* (1981). I chose to use these as benchmarks, since they are textbooks, and thus often how budding economists encounter the Coase Theorem. I will, however, try to keep in mind what Coase wrote in his 1960 article, so that I am not only considering the Coase Theorem, but also Coase's work as well.

Adam Rose has written many articles on tradable emissions permits, and he consistently cites "The Problem of Social Cost" and the Coase Theorem as the theoretical basis for tradable permits. In a paper written with Tietenberg in 1993, for example:

The tradable permits approach stems from the work of Ronald Coase, the 1991 Nobel Laureate in Economics. What has become known as the Coase Theorem states: externalities (e.g., pollution) **can** be eliminated effectively through market transactions if property rights can be assigned, regardless of who receives the rights (assuming no significant transaction costs or income effects). (Rose, 1993).

Although this is certainly a somewhat bold statement, one can clearly see the parallels between the Coase's work and the idea of tradable pollution rights. In an article from 1998 Rose et al. further claim that "Following Coase (1960), a marketable

permits scheme will be cost-effective irrespective of how the permits are distributed” (p. 26). The economic intuition behind this is Coase’s, but the application to marketable permits, as well as the rigorous proof is actually Montgomery’s. However, we must be careful that we remember the assumptions needed to make this claim true, both in regards to the Coase Theorem and in regards to tradable permits. Rose also extends the theoretical result of least-cost trait of permits to the real world, which is a bit like mixing oranges and apples. He is eager to apply marketable permits, but he does not consider the real world in his analysis, at least not as rigorously as Hahn and Stavins.

In order to structure my argument, I will examine the idea of a permit market for emissions in light of Kolstad’s<sup>3</sup>, Perman et al.’s (1996, p. 137), and Fisher’s definitions of the Coase Theorem. This will bring up various nuances of both the Coase Theorem and the idea of marketable permits, and although it will not be a perfectly streamlined approach, I believe it will be productive.

## 6.1 Kolstad’s Coase Theorem

I first begin with Kolstad’s definition:

Assume a world in which some producers or consumers are subject to externalities generated by other producers and consumers. Further, assume (1) everyone has perfect information, (2) consumers and producers are price-takers, (3) there is a costless court system for enforcing agreements, (4) producers maximize profits and consumers maximize utility, (5) there are no income or wealth effects, and (6) there are no transaction costs. In this case, the initial assignment of property rights regarding the externalities does not matter for efficiency. If any of these conditions does not hold, the initial assignment does matter. (2000, p. 108)

Through each numbered point, I will comment on how this applies to a permit market, and how the characteristics of a permit market helps make this theorem true.

(1) Although everyone certainly does not have perfect information in a permit market, many aspects of emissions abatement are illuminated through the construction of a

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<sup>3</sup> The definition that Kolstad uses is actually Hoffman and Spitzer’s (1982) definition.

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permits market: some sort of monitoring of emissions must occur, in order for the market to work. Through this, then it becomes known how much agents are emitting. Since permits are traded, individual actors' willingness to pay for permits will indicate their control costs. Thus, perfect information is actually not needed through the creation of this market.

(2) Whether agents are price-takers of course depends on the size of the market and the market power of the individual actors. However, as with the Coase Theorem, a permit market cannot be guaranteed to be efficient if the agents are not price-takers. If there is a situation of market power, Hahn (1984) has shown that the initial distribution does matter for cost-efficiency (Hahn, 1984, p. 755-756), and in this case, the Coase Theorem cannot be applied to a permit market. However, as the Coase Theorem assumes perfect competition, this point does not directly apply.

(3) Although agreements cannot be enforced costlessly, a market for permits, ratified and agreed upon by all emission producers, will lead to a situation where the cost of enforcing contracts is a built-in mechanism, although it is not costless, it should certainly be relatively low, and also known. This of course depends on the market, and as with (2), if the cost of enforcing agreements is too high, it will not be a successful permits market.

(4) In a market it is also safe to assume that agents will maximize profit, as we are dealing with firms.

(5) Income or wealth effects must also play a role in distorting the overall market within which the permit market is located, as they distort the Coase Theorem. Some scholars have pointed out how situations of market power might ruin the efficiency of a permit market, and if market power were created by initial distribution of permits, wealth effects would matter. However, in general, Mishan's point that income or wealth effects do matter for the Coase Theorem, are not quite as relevant for a permit market, as the quantity of permits is already set in this market, and cannot be compensated. In this way, as Dales pointed out, this is not a two-way market.

(6) By creating a market, emissions bargaining can be done, if not without cost, then certainly at a far lower cost than were there no market. This market is thus a sort of solution to transaction costs. This is similar to Coase's point in his article from 1937 titled "The Nature of the Firm", where the firm is the market's solution to lowering certain costs of doing business (later named transaction costs). Also, seen from an entirely different perspective, *if* a permit market has significant transaction costs, Stavins has proven theoretically (Stavins, 1995), and Hahn and Hester empirically (Hahn and Hester, 1989) that efficiency in this case goes down due to increased control costs.

With these assumptions in place, then, the initial assignment of property rights, or in our case, permits, does not matter for efficiency. This version of the Coase Theorem does partially account for how efficiency is reached, but in order to reach a fuller conclusion, we shall have to look at some other definitions.

## 6.2 Fisher's Coase Theorem

Fisher's (1981) version of the Coase Theorem is as follows: "With a clear definition of property rights, resources will be put to their highest-value (Pareto-optimal) use without any need for government intervention." (p. 179-180). A system of permits, of course, designates defined property rights, and these defined property rights are necessary in order to be able to bargain to get rid of externalities/harmful effects, as according to Coase's 1960 article. As emitters trade permits among themselves, an optimal allocation of permits will be achieved, no matter the initial distribution. This is because, ideally, each firm will buy permits at the price where their marginal purification cost is equal to the price of one permit. Since firms are free to choose their individual least-cost option, either through buying more permits, or reducing emissions, over all emission reduction happens at least-cost. Of course, it is important to remember that permit markets *are* put in place by governments. However, when these markets are put in place, they provide the framework for less government intervention in the future, and in this sense can be seen to align with Fisher's version of the Coase Theorem.

### 6.3 Perman et al.'s Coase Theorem

Perman et al.'s Coase Theorem is rather informal, and goes like this: "Given a suitable assignment of property rights, private bargaining between individuals can correct externality problems and lead to efficient outcomes...an efficient outcome can also be attained by vesting the property rights in the generator of the external effect." (1996, p. 137). Perman's version of the Coase Theorem is more closely linked to Coase's 1960 article than many other Coase Theorems. This is why it explicitly mentions '*private bargaining between individuals*'. Since this is a far narrower view of the Coase Theorem, it is more difficult to extend it to a market for permits. This version does, however, include an important and interesting aspect in the second part. Presumably, this part, about 'vesting property rights in the generator' refers to Coase's point of the reciprocal nature of harmful effects (as discussed in the second section). As long as property rights can be traded, it is not that important *who* holds the right initially. In this part of Perman et al.'s Coase Theorem, then, we can see that giving (or selling) polluters the right to pollute (or produce external effects) so that they can trade them, can lead to an efficient outcome, like in a market for permits.

### 6.4 So, is the idea of a permit market based on the Coase Theorem?

My claim that Coase's article from 1960 *led* to the idea of marketable permits still stands, in my opinion. When examining the scholarly path, one can see how Dales built on Coase's work, and how Montgomery built on Dales, and how most of the scholars writing about this topic built on these authors, if not always directly on Coase, then always on the other two. However, to claim that the logic of marketable permits follow directly from the Coase Theorem *theoretically* is, as seen above, harder to fully justify, although there certainly are strong connections.

## 7. Conclusion.

### 7.1 Short summary

In an attempt to find and analyze the scholarly path from Coase's 1960 article "The Problem of Social Cost" to the idea of tradable permits, I have analyzed a series of works and their connection to each other. This thesis can thus be seen as a non-traditional literature review, in that I survey the literature in the field on this topic, but only along this path that I have designated. I have shown that the ideas contained in Dales' essay *Pollution property & prices* are reminiscent of and can be said to be taken from Coase's article. I have discussed why Dales' essay should be seen as the tipping point work, the work that made the idea of tradable emission rights seem like a viable option. After that, I have acknowledged and discussed the importance of Montgomery's 1972 article "Markets in licenses and efficient pollution control programs", and I have shown how it is cited consistently as the work that rigorously proved the efficiency of marketable permits. I further looked at some prominent scholars within the field, to see where they align with Coase's, Dales' and Montgomery's work, and to see how they have moved the idea of tradable permits forward.

### 7.2 Results

In this thesis, I asked a question that I would be interested in discussing, but that to a certain extent I believed already had a given answer. In this sense, it was not a traditional scientific study, in that I sought my given answer from the start. However, I was still somewhat surprised by the end. I did not expect that Dales would become the main star, the most discussed and important element of this thesis, but indeed that he has become. He explained the economic idea of marketable permits well, but he really excelled at foreseeing issues and hurdles to be overcome in implementation of this idea. This is impressive, as he did not have any empirical results to help him make these judgments when he wrote his seminal work in 1968, as later scholars did.

Although it is not a literature review in the conventional sense of the word, this thesis does give the reader a narrow path, if not a broad picture, of the literature that the idea of marketable permits is based on. Although I'm relatively sure there are a few different paths that could have been followed to get to the today's marketable permits, this path seemed the clearest, not only in view of citations from Coase to Dales to Montgomery, but also in view of the ideas expressed.

This idea of marketable permits seems to have gone full-circle, beginning with Dales as a product of Political Economy, jumping through the hoops to prove itself as a worthy economic concept with Montgomery's highly theoretical, rigorous proof of its least-cost efficiency, and finally ending up again among the policy-minded and political economists of Hahn's and Stavin's caliber. The subtitle in Dales' essay was "an essay in policy-making and economics," which illustrates Dales' consistent focus on this as a problem that needed to be solved not only economically, but also in a policy-context. This focus (at least along my path) was lost for a few years with Montgomery, who showed rigorously that emission permits indeed were theoretically efficient, but who had no practical policy focus whatsoever. Also, in the early careers of Hahn and Stavins, there was an emphasis on economically theoretical research, which then has been slowly replaced by scholarly work on tradable permits within a policy context. Tietenberg can in many ways be seen as a bridge from the theoretical and back again to the practical, as he wrote a paper that synthesized theory and practice as early as 1980. This idea, then, started out with a solid focus on policy and an emphasis on pollution as a social problem that needed a social solution, a focus that it in later years has regained. This newer research has of course benefited greatly from the fact that emission permits have now been in use since the 1970s, and thus policy has been able to shape research, and not only the other way around.

### 7.3 Limits to this study and areas for further research

The obvious limit to this study was time. First and foremost, with more time, I would have chosen to do an assessment of my current analysis of the scholarly path in light of the development of the whole field of environmental economics. This would have required a more thorough investigation into the research of the some essential scholars within environmental economics, such as, for example, William Baumol,

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Wallace Oates, Robert Ayres and Allen Kneese. This research would have provided a fuller picture for my thesis, as these scholars aforementioned are very important for the field, but not directly linked to my narrower topic.

To extend this study, one could include more nuances on Coase and the Coase Theorem (the literature on the subject is seemingly endless). One certainly could have read and incorporated more of the scholarly work that lies within environmental economics as a whole. Further areas for future research include analyzing and including more current issues in emissions trading.

#### 7.4 Why, might the reader ask, is finding this scholarly path important?

How scholars build on each other's work is worthy of investigation. The wealth of information and research available to us is simply staggering, and to be able to not lose track of it all is a valuable exercise. The field of economics seems to be in need of more retrospection, and it is thus valuable to take a meta-view of the mass of research work available. If we as scholars are all building on each others' work, what happens when we're building inaccurately, or at least not as the scholar you just quoted intended? In the case of Coase, it seems he has been misquoted through his whole career, but nevertheless, good research has come out of it.

This thesis also highlighted the difference between theory and practice, and how crucial it is to distinguish between the two. The theory of marketable permits is only important insofar as it can be successfully implemented. As a theory it only has validity as an academic exercise. Many authors investigated in this thesis have wrestled with the difference between theory and practice (notably, Hahn and Stavins), and through their work, we can see that one should be careful to assume that what works in theory will work in practice.

Not only is it important to distinguish between theory and practice, it is also important to bridge the gap between the two. This has been emphasized. Dales' opinion that "...lawyers, economists, and students of public administration..." should work together to solve this issue (1968a, p. 105), is as true today as it was in 1968, and

the increased cooperation and work within cross sections of these and the fields of natural science is the evidence that, at least in academia, interdisciplinarity is becoming widespread.



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