



**Private Landlord-Tenant Relationship in British Coal
and American Oil
A Theory of Mineral Leases**

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EXECUTIVE SUMMARY

British coal and American oil are the only two, big examples of modern extractive industries that have been based on private leases. In both cases, depletion has played a decisive role in bringing about the convergence of the contractually defined groundrents towards certain minimum levels, which are called reservation groundrents in this paper. The central pieces of these reservation groundrents are, in both cases, clearly defined minimum level of royalties known as reservation royalties in this study. On the other hand, British coal and American oil were quite different in two aspects. Firstly, British landlords were politically very powerful but there was never a class of landlords in the USA. Secondly, coal is a solid mineral that is mined but oil is a liquid that is pumped. For the first reason, in the USA the general legal framework has been able to adapt to the economic and technological requirements of petroleum production, whereas this was not the case in coal mining in Britain. For the second reason, it was much easier to modernize and to keep up with new technologies in oil than in coal. Together, this caused the breakdown of the landlord-tenant relationship in British coal in 1938, when the natural resource was nationalized. However, there is no reason to expect something similar to happen in the case of American oil.

The two case studies make it clear that Ricardian rent theory as usually applied to mineral leases is not only inadequate but wrong. Yet this is also true of the conception of royalty as compensation for a wasting asset. Reservation royalties are neither Ricardian rents nor the counterparts of some kind of 'intrinsic value'. As the case studies show, the reservation royalties were determined by very different historical processes and represent what in game theory is called Nash equilibria.

In the Introduction and in the final chapter some hints are given as to the relevance of the findings in the case of public ownership of petroleum reservoirs and fiscal systems, especially as to the understanding of the tug-of-war that has been going on through the major part of the twentieth century between the oil-exporting countries acting as landlords, on the one hand, and the international tenants and consumer countries on the other.

1. INTRODUCTION

A very great and, at first glance, confusing variety of tenancy arrangements for mineral resources can be observed around the world. Substance and form may vary not only from one country to another, but even from one region to another within the same country. In addition, the type of tenancy may vary from one mineral to another, largely determined by an accident of history, possibly a history going back to ancient times. One basic and obvious distinction to be made, however, is between public and private ownership. Public ownership of mineral resources is the rule worldwide, private ownership the exception. Yet by far the most important examples of extractive industries in modern economic history, British coal and American oil, both developed under private mineral property although it was brought to an end, in the former case, by nationalization in 1938. This paper will deal with these two exceptions which will, incidentally, confirm the rule.

Modern British coal leases were the outcome of a historical process lasting several centuries whereas modern oil leases developed their basic features within a few decades after 1859. The long history of British coal will provide us with some important lessons which make much easier the understanding of American gas¹ and oil leases. Of course, British coal is of considerable interest both on its own and in comparison with American oil. One question to answer with this comparison is why the landlord-tenant relationship in British coal collapsed and came to a definitive end – with the ‘nationalization of royalties’ – in 1938, and why this did not happen, and is not expected to happen, in the case of American oil.

Relevance of the Subject

Interest in the private landlord-tenant relationship in British coal and American oil stems from the fact that the latter is still fundamental to an understanding of petroleum fiscal regimes in the United States on public (state or federal) lands or waters, and also of the international landlord-tenant relationship in world petroleum. Ultimately, petroleum fiscal regimes in the USA are a combination of lease contracts on public lands, designed according to the patterns developed by the private sector, plus general taxation. The fiscal regime on federal lands in the USA, in turn

¹ Gas became of commercial interest in the 1920s. Oil leases were then simply transformed into oil and gas leases.

spread throughout the world during the first half of the twentieth century. It served first as a reference to third world oil exporters and then became the starting point of the fiscal regimes in OPEC member countries. It evolved in the 1960s into a groundrent-maximizing machinery which ultimately led to the nationalizations of the transnational tenant companies in the 1970s.²

The oil nationalizations – effectively the breakdown of the international landlord–tenant relationship in the OPEC area – triggered a fundamental review of the landlord–tenant relationship in other countries; a slow process with very important long-term consequences. Outside the OPEC area exploration was intensified and new fiscal regimes developed – most notably in Britain – which were designed to boost investment and output. Here, too, the historical links with the traditional oil and gas leases and fiscal regimes in the United States were severed, but those involved were consumer countries interested in low prices and not like third world oil exporters in groundrent. In my opinion, this is one of the most important facts to explain the sustained growth of non-OPEC output since the mid-1970s. Recently, several OPEC member countries have reopened their lands to private, foreign investment. This implies the development of new fiscal regimes albeit, to start with, on a contract-by-contract basis. The question, however, is whether there is already a discernible trend? If the answer is affirmative, what are its long-term consequences on world petroleum markets?

Landlord–tenant relationships in world petroleum have been evolving fast over the century, and continue to do so at present. Hopefully, these two case studies of the private landlord–tenant relationship in coal and oil will contribute to a better understanding of its evolution in the case of public ownership.

² Bernard Mommer, *Die Ölfrage*, 1983.

2. THEORETICAL FRAMEWORK

Lease contracts are signed between groundrent-maximizing landlords and profit-maximizing tenants. Groundrent is defined in this paper as the payment landlords receive from their tenants for permission to invest in their lands for the purpose of agriculture, mining – including oil and gas – fishing, hunting, or transportation. I will begin by considering first-time leases (the renewal of leases will be considered later), and will assume that the mineral deposits or reservoirs are totally depleted within this first lease term. In other words, in this first part the lease term is irrelevant. Nevertheless, the leases are divided into two periods: a ‘primary’ period to search for the mineral – really an exploration permit with a lease option – followed, if successful, by a ‘secondary’ period of development and production. The tenants are supposed to do their best applying all available technologies; hence, success will depend entirely on nature.

Depletion is understood to be a relevant phenomenon, and for this reason new contracts are signed all the time. Indeed, as Adelman pointed out, whatever proven reserves may be, ‘exploration is needed *to prevent an otherwise inevitable rise in developing-operating costs*’.¹ This does *not* imply that prices are always increasing as the accumulation of geological knowledge and the development of technology are countervailing forces!²

Lease contracts are signed, of course, at the very beginning, before exploration is started. Hence they are completely based on *expectations*; and they are signed only if both parts are satisfied that their *expected utilities* – groundrents and profits – are adequately rewarding their inputs. Moreover, landlords and tenants will not agree to a lease unless the expected utilities are greater than, or equal to, certain positive minima, known as *reservation utilities* in the literature on the *theory of principal and agent*. Applied to the landlord–tenant relationship, the landlord is the principal and the agent is the tenant. Rees has pointed out the importance of the reservation utility of the agents ‘because at the solution to most models [the agent] receives only [the reservation utility], with [the principal] appropriating all the gains from trade’.³ Nevertheless, ‘this reservation utility is never discussed at any length in the literature. It is usually taken as “market determined” and left at that (...). Clearly what is required is some theory of the market

¹ Morris A. Adelman, *The World Petroleum Market*, 1972, p.74. Italics as in original.

² *Ibid.*, pp.16–17.

³ Ray Rees, ‘The Theory of Principal and Agent’, *Bulletin of Economic Research*, 37:1, pp.3–26, and 37:2, pp.75–95, 1985; Part 1, p.6n4.

interaction between principals and agents (...).⁴ In the case studies I am interested in the reservation utilities of both tenants and landlords. It will be seen, however, that the reservation utility of the tenants is not a great problem and attention therefore will be concentrated on landlords. To elucidate how their reservation utility – minimum groundrent – has been determined by market interaction between landlords and tenants is one of the central purposes of this paper.

Contractual Provisions Within the Reach of Market Forces

In this section I will define theoretically those basic features of British coal and American oil and gas leases which were essentially shaped by market forces. Yet contracts are signed within a broader legal framework, and even after signing they may be affected by new legislation. Those features that are dependent on the general legal environment will be dealt with later.

Reservation Utilities

Tenants' Reservation Utility (Minimum Profit). The agent is supposed to be an entrepreneur who has the choice of investing in coal or oil as well as in any other activity. His reservation utility – reservation profit – is thus defined by his opportunity costs, the profit he would make elsewhere with the same *effort and risk*. Hence, it is determined basically outside the landlord-tenant relationship. His profit is never mentioned in the lease contract; it accrues to him as a *residual*, what is left after all costs – including groundrent – have been paid.

To begin with, however, I will assume that there is no groundrent. So, to evaluate an investment project on a new piece of land, say L , the tenant has to take into account only expected real costs as given by expected capital expenditures, $Capex_L(t_n)$, and expected operation expenditures, $Opex_L(t_n)$, being $t = t_1, t_2, t_3, \dots, t_{End}$, the years the project is expected to last. If the expected prices are given by $P(t_n)$ and expected volumes by $V_L(t_n)$, the tenant's expected cash flow will be $\{CF_L(t)\} = \{CF_L(t_1), CF_L(t_2), CF_L(t_3), \dots, CF_L(t_{End})\}$, with $CF_L(t_n) = P(t_n) * V_L(t_n) - Capex_L(t_n) - Opex_L(t_n)$.

It may be assumed, reasonably, that $CF_L(t_1) < 0$ and $CF_L(t_{End}) > 0$; hence the expected internal rate of return, $IRR(CF_L)$, is well defined, and the assumption is that the tenants' reservation profit is given by an expected minimum internal rate of return IRR_{RUt} (on top of the usual interest payments, considered as part of real costs). The project breaks even if $IRR(CF_L)$

⁴ Rees, op.cit., Part 1, p.6n4.

= 0 and, as far as the tenant is concerned, it may be undertaken as soon as $IRR(CF_L) = IRR_{RU}$. At this point the project is competitive, with the development of new capacities within mineral deposits or reservoirs that have already been exploited. (It should be pointed out, however, that the reservation utility for developing new capacities on known mineral deposits or fields may be somewhat lower as the risk is usually much less in this case).

But it is only nature, given technologies, that decides the outcome. The venture may turn out to be a complete failure, or a great success, or just come up to expectations. It will be assumed in this paper that on *average* the outcome will be as forecast. Hence, even though *ex-post* economic rents emerge in some ventures, they will only make up for losses elsewhere. There is no economic rent in the system.⁵

*Landlords' Reservation Utility (Minimum Groundrent).*⁶ Contrary to the tenants' profit the landlords' groundrent is stated explicitly in the lease contracts although, of course, their reservation utility is not identified as such. The reservation groundrent can only be determined by comparing different leases. It should be pointed out, moreover, that in this paper the reservation groundrent is not assumed to be determined by any 'opportunity cost'. There is no alternative use for mineral deposits and reservoirs, and their exploitation only partially interferes with the use of the surface. To the extent that it does so, I assume that this is taken into account elsewhere. The reservation groundrent being discussed is paid strictly for the right to search for and to produce the mineral; if a tract of land cannot afford this reservation groundrent, it just remains idle as far as mining is concerned. Hence, the landlords' reservation utility has to be explained within the landlord-tenant relationship in coal or oil.

Let us suppose that the landlord of the aforementioned piece of land L claims a reservation groundrent given by an expected flow of payments $\{GR_L(t)\} = \{GR(t_1), GR(t_2), GR(t_3), \dots, GR(t_{End})\}$ such that $GR(t_n) \geq 0$ for all n, but strictly positive at least once. The tenant's cash flow is now given by $\{CF_L(t) - GR_L(t)\} = \{CF_L(t_1) - GR_L(t_1), CF_L(t_2) - GR_L(t_2), CF_L(t_3) - GR_L(t_3), \dots, CF_L(t_{End}) - GR_L(t_{End})\}$. Of course, $CF_L(t_1) - GR_L(t_1)$ continues to be negative in any case; and we may reasonably suppose that $CF_L(t_{End}) - GR_L(t_{End})$ is positive. Thus, there is still a well-defined

⁵ *Economic rent* (...) means any surplus in the income of a factor of production – land, labour, or capital – (...) over the minimum amount necessary to call forth its productive services.' Stephen L. McDonald, *The Leasing of Federal Lands for Fossil Fuels Production*, 1979, p.25. Italics as in original.

⁶ Marx called the landlords' reservation utility *absolute groundrent*. Karl Marx, *Das Kapital*, Bd. 3, Marx-Engels-Werke, Bd. 25, 1966, pp.756ff.

expected internal rate of return. Moreover, we suppose the reservation groundrent to be important, in the sense that it reduces the expected internal rate of return by some percentage points. Consequently, in the case considered above, the project will be delayed until it can afford to pay, on top of the reservation profit, the reservation groundrent even though the tenant will still be interested in undertaking it immediately. *In this case the reservation groundrent causes a delay until higher prices obtain.* If they do, the reservation groundrent will be paid for by consumers through the tenants acting as the landlords' groundrent collecting agents although, of course, producers will be affected, too, by the lower demand resulting from the price increase. If we assumed that the landlord is interested in leasing immediately as soon as his land can afford the reservation groundrent, *there will still be no economic rent in the system.* Both the reservation profit and reservation groundrent represent only the necessary minimum payments to the factors of production, capital and land.

Let $NPV_{RG}(L) = NPV\{GR_L(t)\}$ be the expected net present value of landlords' reservation utility on L, discounted at the expected long-term interest rate. The risk-averse landlords would be happy to cash in, selling their rights on the mineral deposits or reservoirs that might exist below their lands. Yet this would be a high-risk strategy for the tenants; for them it is much less risky to spend their money on a larger number of search permits with lease options than acquiring property rights on a single piece of land where mineral deposits or reservoirs might, or might not, exist. Therefore, the tenants would discount heavily the expected flow of groundrent. Under these conditions the landlords, too, will be better off leasing and not selling. Even agreeing on a predetermined and fixed flow of payments, equivalent to buying on the hire-purchase system those rights, would still be too risky for the tenants. They will want the landlord to share the geological risk. In the event of an outright failure, the only thing the lessees would really like to do is to surrender the leases and move on. If the failure is partial, they would feel entitled to a lower groundrent. Conversely they would be willing, too, to pay a higher groundrent if they were very successful in exploration. To satisfy all these desiderata, a groundrent is agreed that is proportional to the size of the mineral deposits or reservoirs discovered, to be paid according to their depletion: that is a *royalty*. The reservation royalty is the most resilient form of groundrent in mineral leases. With a royalty the landlords share, up to a certain point, with the tenants the discovery and future production risks. Moreover, the reservation royalty is the only payment made once production is started. For this reason a minimum payment is generally requested, according to an explicitly or implicitly assumed minimum level of production, in order

to prevent the tenant from keeping the lease idle. If production is higher than the assumed minimum – as is often the case – only the royalty will be paid.

In British coal, for example, there was a *tonnage* royalty of, approximately, $5\frac{1}{2}d.$ per ton. In American oil, however, the reservation utility has been a *percentage* royalty of one-eighth, or 12.5 per cent. With percentage royalties landowners have to share not only the volume but the price risk as well. Hence, at first sight at least, the risk-averse landlord should prefer a tonnage royalty to a percentage royalty. In my opinion, however, things are in reality somewhat different. Once inflation is taken into account (even for past centuries when inflation levels were much lower than in modern times), a percentage royalty may involve a lower risk to the landlord than a tonnage royalty. This is confirmed, I believe, by the fact that there was a trend in British coal – although never dominant – away from tonnage towards percentage royalties, but there was never a trend in American oil in the opposite direction. The question remains: why the difference? The answer is that at the time when the tonnage royalty developed in British coal, observation costs for pithead prices would have been very high; on the contrary, at the time the percentage royalty developed in American oil, well-head prices could be observed easily. And once a usual royalty has been established, as will be discussed later, only under extraordinary circumstances will there be a movement towards a new one.

We need, however, to raise a further question. Why should the landowner be interested in leasing his land immediately once it can afford a reservation utility? Why not wait and see? After all, he has already been waiting for some time to get the reservation utility; so why not wait longer? New and encouraging information may become available as externalities through explorations undertaken in the neighbourhood – promising, at last, *economic rents* on his plot. And even if the information that becomes available is disappointing, he would have lost nothing. Hence to ‘wait and see’ may be rational. But the tenants are interested in leasing as soon as possible. They are producers. Delays in acquiring new leases imply that their production costs in already existing leases will increase more sharply. In other words, delays are costly to the tenants. Therefore they are interested in as frictionless a flow of new leases as possible, and the best lubricant to reduce friction is cash up-front: in the form of a ‘signature bonus’ (American English) or a ‘fine’ (British English). To entice the landlord, part of the reservation groundrent has to be paid as a signature bonus or fine usually followed by rentals or annuities until the lease is surrendered or production takes off. The landlord has the option to take some money now, at no risk, or to take the risk of getting nothing at all. Moreover, during the ‘primary’ period there

are usually some surface-related rentals, or annuities, to be paid. As they are usually small in amount, even compared with signature bonuses or fines we will not consider them further for the sake of simplicity.

Hence, the reservation groundrent, the flow of payments $\{GR_L(t)\}$, consists of two distinct parts: the reservation bonus and the reservation royalty. We are left with the problem of determining the relative importance of these elements. The bonuses that the tenants may be willing to pay depend on the costs caused by delays. It is reasonable to assume that these costs are proportional to the expected size of the projects taking the expected net present value of reservation royalties as a proxy. It is also reasonable to assume that the equivalent of a certain percentage of the expected net present value of reservation royalties paid up-front as a bonus or fine will entice the landlords to sign as early as possible. Accordingly, let us suppose that reservation bonuses or fines represent some modest, albeit not insignificant, percentage of the expected net present value of reservation royalties.

Conclusions. As we have considered depletion to be a relevant phenomenon, producers have to move continually towards new mineral lands to compensate for and cope with increasing costs. Consequently, if we assume a smooth and predictable development of technology and geological knowledge, *all* leases would appear in the long run to have started as marginal whatever the economic rents that emerge ex-post. Seen ex-ante, landlords and tenants only receive their reservation utilities.

Reservation utilities in any form always cause higher prices. For example, the discount rate applied by the tenants evaluating new ventures affects the amount of new mineral reserves that will be available later for development. The future cost curve increases more sharply the higher the discount rate that was applied. The same is true of the reservation groundrent in the primary period. A tract of land may not be explored, and hence a reservoir may not be found, because bonuses and rentals have to be paid. As a result, marginal production costs are pushed to higher levels because the available resource base has been reduced. But the form of royalty is peculiar in one respect: it is a part of marginal production costs and, therefore, contributes directly to higher prices.

Economic Rents (Ricardian Rents)

In the real world the flow of investment into new mineral lands may be irregular for many reasons. Technological development and the increase of geological knowledge are not always smooth or predictable. Sudden and surprising improvements happen and lands which were submarginal

yesterday may be supramarginal today without ever having been marginal. Consider a different case: the landownership of a piece of land may be disputed, making it impossible to acquire a lease even if it is marginal or significantly supramarginal. (As already pointed out, the contrary can happen too. A tract of land can become once again submarginal because of disappointing results in the neighbourhood, changes in price expectations, and so on).

Yet there are always some pieces of land coming forth with expected internal rates of return higher than IRR_{RU_b} , even after allowing for the reservation ground-rent. These excesses are economic rents; more specifically, when these economic rents result from the exceptional richness and fertility of nature, they are called *Ricardian rents*. In a competitive market Ricardian rents will accrue to the landlord who appropriates them in the same way as his reservation utility – that is through higher bonuses, higher rentals, and higher royalty rates. Generally speaking, tenants and landlords prefer the first two devices. From the tenants' point of view bonuses and rentals have the advantage that they will be of no consequence in the 'secondary' period when they will not be at a competitive disadvantage as they will be paying then, like everybody else, only a reservation royalty. And risk-averse landlords always welcome cash up-front. However, if the expected Ricardian rents are very high, the arguments already mentioned against the buying of marginal lands also apply against very high cash bonuses or rentals. Then the obvious option is a higher royalty.

But higher royalty rates have an important drawback: as marginal costs they may obstruct the full development of the mineral deposits or reservoirs and, inevitably, will force an earlier closure of the mines or wells approaching exhaustion. To overcome this problem one might be tempted to consider more flexible devices of economic rent collection as, for example, a sliding royalty scale or a percentage of excess profits. However, these devices are almost never found in *private* leases⁷ which rarely mention profits. Furthermore to introduce any form of groundrent related to profitability would cause high surveillance and monitoring costs. Of course, *before* signing a contract both parts will have in mind the profitability of the venture – what else? – but when signing they would have agreed on a well-defined, clear schedule of groundrent payments with no leeway for the landlords to maximize groundrents in the future by stripping the tenants of ex-post economic rents, or for the tenants to maximize profits by reducing the agreed

⁷ As we are talking about a very large number of private leases – well into the hundreds of thousands – we should not say 'never' but 'almost never' to acknowledge the existence of a few exceptions.

groundrents.

However, more sophisticated economic rent-collecting devices have been used on public lands in the USA. For example, sliding scales were introduced in some leases, involving a wide range of royalty levels from high at one end down to the reservation royalty. The triggering events which bring about the application of a particular royalty are well defined in the contract. Usually, these events are specific output levels attained per well. However, with

a sliding scale (...) administrative costs are likely to increase substantially. The lessor may determine that the lessee is constraining output in order to reduce his royalty obligation and the lessor may want to introduce a production monitoring program to enforce production at a level that maximises current output, subject to physical constraints. All of these problems lead to disputes and to litigation resulting in higher administrative costs for both lessee and lessor, resulting in a reduction or dissipation of the economic rent.⁸

Not surprisingly, profit sharing performs even worse. As Mead points out:

The source of the heavy administrative costs is what economists call the 'agency problem'. Where there is a divergence between the interest of the lessor and the lessee as an agent, one must expect that the agent will behave in a manner that serves his own interest first. The agency problem leads to monitoring costs by the lessor in an effort to prevent the lessee from pursuing such opportunistic behaviour. The divergence of interest arises out of the fact that the cost of some projects is deductible from revenues, and, where a lease is profitable, the costs are shared according to the profit-share percentage. However, the benefits of the project may accrue primarily or entirely to the lessee firm.⁹

Mead concludes that a pure bonus system, without any royalty, would be optimal. He considers as a second-best system a bonus combined with rentals and a constant royalty. As a matter of fact, the first alternative is not a lease at all as property rights on the mineral deposits or reservoirs are effectively *sold* under it, the so-called bonus being the price. Hence, it is his second-best system, which was historically brought about by market forces in British coal and American oil, that represents the optimal form of mineral *leases*. Moreover, if more flexible economic rent-collecting devices cause high surveillance and monitoring costs on public lands, where some state office administers a great number of leases having at its disposal specialized personnel, it is no wonder that they are almost never found in private leases where landlords do not have the same administrative resources at their disposal.

To sum up: ex-ante expected economic rents are collected by higher bonuses, higher

⁸ Walter Mead, 'Oil and Gas Leasing Policy Alternatives' in Richard J. Gilbert (ed.), *The Environment of Oil*, 1993, p.241.

⁹ Mead, *Ibid.*, p.244.

rentals, and higher royalties. The excesses over the reservation bonus, rental, and royalty – but not the basic amounts or rates – then reflect economic or Ricardian rents.

At the Limits of the Contractual Relationship and Beyond the Reach of Market Forces

Reversion and Renewal of Leases

Ex-post Ricardian rents may be higher than expected but, at least while the first lease contract lasts, they will be pocketed by the tenants. For this reason the lease term is very important. As the tenants normally have the right to surrender the lease at any moment, they have much to win and nothing to lose with longer terms; their motto is ‘the longer the better’. By the same token landlords prefer shorter terms and, of course, they have no right to cut short the lease. Obviously, the lessee sinking his capital into the land needs a guarantee that he will have the time necessary to recover it with a profit. The necessary minimum term is, of course, technically and economically determined. Mining ventures frequently require high up-front investment and a number of years to start production, and once this is under way additional years are needed to recover the investment with a profit. Yet mineral deposits or reservoirs may last longer than that and, if they do, their efficient working is associated with an important and continuous flow of investment – which may be interrupted by the approaching end of the lease term. This is the second reason why the lease term really matters.

With the end of the term approaching, the question is what will happen to the capital sunk into the land by the tenant? Theoretically, at least, we can imagine that this question has been answered in the contract. However, when the contract was signed, reversion was far ahead, the possible circumstances difficult to foresee and, therefore, impossible to be translated into a set of simple rules. This means high transaction costs for a distant and very uncertain event. Generally speaking, therefore, in any contract of this kind ‘one would expect the part of the contract concerning the near future to be more complete than that concerning the distant future’.¹⁰ In practice the outcome is as follows. On one hand, the landlords will insist on a stipulation in the contract that their tenants will have to surrender the lease in good working condition. Accordingly, at the moment when the lease has to be renewed, they should be in a very strong

¹⁰ Jean-Jacques Laffont and Jean Tirole, *A Theory of Incentives in Procurement and Regulation*, 1993, p.3.

position to collect not only all ex-post Ricardian rents but, what is more, all economic rents actually created during the first lease term by the tenants. On the other hand, if the tenants are in a strong position at the time the first contracts are signed, they will *not* insist on a different wording of the contract but in longer lease terms. This is ex-ante the easiest and cheapest option; the problem will never be solved but postponed for as long as possible.

For this reason, with the approaching end of the lease term and mineral deposits and reservoirs still not depleted, a perverse incentive problem will arise. Several years earlier – maybe ten or even fifteen years – the lessee will stop making any long-term investment and run down the facilities to be handed over. The more derelict they are the day the lease falls in, and the more urgent new investments are needed, the more it is to his advantage. And there may not be very much the landlord can do about it, for he is not in a position to survey and to monitor those facilities effectively, a very costly and technically demanding task! Moreover, maintenance costs may be very high, and maintenance must be continuous even if production comes to a halt. Otherwise the remaining seams or reservoirs will soon be lost forever or at least it would be very expensive to restart production later. Consequently, to take advantage of the escheating of the lease and to collect, on top of the groundrent of the first lease term, all economic rents, the landlord must be in a position to guarantee the continuity of operations – but he is not. From this viewpoint, the landlord may even be worse off than with a first-time lease. The unworked mineral deposits or reservoirs are never at risk and do not require any maintenance; partially worked, however, they may be destroyed and lost if they are not worked continuously.

This results in a deadlock. The necessary continuous flow of investment is interrupted, causing serious inefficiencies and higher costs.¹¹ Since there is no solution within the reach of market forces, the answer to the problem must come from outside, from court rulings and legislation. This explains, in my opinion, the different outcomes in British coal and American oil. In America there were landowners but no real class of landlords. Consequently, court rulings and legislation brought about a radical solution to the problem: oil and gas leases became open ended, until the final exhaustion of the reservoir. There is no escheating of oil and gas leases! In Britain landlords were powerful enough to prevent any court ruling or legislative action that would strengthen the position of the tenants although lease terms became longer by the end of the

¹¹ This is known in economic literature as the problem of ‘second sourcing’. See Laffont and Tirole, *ibid.*, Ch. 8.

nineteenth century due to increasing mine depths. But it was too late. The unresolved problem of reversion was one of the reasons that led to the nationalization of the natural resource in 1938.

Yet even in the case of British coal, market forces were strong enough to prevent landlords from taking advantage of the escheating to increase the reservation royalty, although lucky landlords got a fine upon renewing the contract.

Co-operation and Fragmentation of Private Landed Property

Fragmentation of the surface by private landed property may become a very serious problem in mining as it generally bears no relationship whatsoever to the underlying geological structure. Yet optimal production methods require that this structure is dealt with as a unity. Hence, technical co-operation between lessors and lessees on the same structure is necessary for the efficient working of the mineral deposits or reservoirs. By not co-operating, or even by refusing to lease a strategically located piece of land, lessors may cause significant damage. Moreover, the fragmentation of the surface tends to generate a mirror image of tenants equally fragmented and unwilling, or unable, to co-operate.

There are differences from one mineral to another, but there is no more convincing case for co-operation than oil (and gas!). As a liquid, able to migrate even over large distances, frequently associated with gas, the disastrous consequences of not co-operating have been evident from the very beginning. Landowners and tenants on the same reservoir were tied together, willingly or unwillingly. Nevertheless, it took several decades of incredibly wasteful practice before the situation was confronted – by legislation, under the heading of petroleum conservation. A complex legislation developed, designed to overcome the drawbacks of private mineral property in the first place, and of competition amongst tenants in the second place. Of course, tenants were compelled to co-operate technically only as far as required by geology; beyond the limits of the fields, in the market place, they are supposed to compete.

In the case of coal, co-operation was less vital. Nevertheless water pumping, for example, was a major issue which could have been tackled much more efficiently with co-operation. And with increasing mine depths it became more and more costly to sink additional shafts just because of the property boundaries on the surface. (This argument applies also to drilling depths in petroleum). Co-operation became a necessity but, once more, the political power of British landlords prevented any sensible legal reform until it was too late. The natural resource was nationalized in 1938, putting an end to decades of obstruction by the landlords. As the state became the sole landlord, it was in a strong position to force the tenants to cooperate through new

leasing practices and contracts. However, as we shall see, it was too late to reorganize the tenants. The mines were nationalized in 1946, to be radically reorganized, modernized, and finally re-privatized in 1994.

As a matter of interest, the problem of fragmented private landed property causing waste, inefficiency, and obstructing the development of productivity was historically at the origin of modern, public ownership of mineral resources as it emerged in revolutionary France. Mirabeau's address to the National Assembly in 1791 arguing in favour of public ownership of mineral resources underground is still worth reading.¹² His arguments have been completely corroborated by the later development of the British coal industry.¹³ Once coal was taken into the public domain, nobody ever proposed to re-privatize the natural resource. And the only remaining important example of private mineral property, American oil, as we shall see in more detail, is the kind of exception that confirms the rule.

Landlord–tenant Relationship and Consumers

The question of the quantitative determination of the reservation groundrent remains to be considered. It will be found in both case studies that it was the result of a historical process representing the outcome only one point within a larger range of possibilities. The market interaction between landlords and tenants only determines, theoretically, a range within which the specific reservation utility is to be explained by historical accidents and circumstances. But once it has been established, it is extraordinarily stable. It is a Nash equilibrium, an equilibrium where 'no player has incentive to deviate from his strategy given that the other players do not deviate'.¹⁴ In other words, the same argument applies to the determination of the reservation ground-rent generally as to the reservation bonuses or fines. On the one hand, the reservation ground-rent must be high enough to entice the landlords to supply new lands. On the other hand, however,

¹² Mirabeau l'aîné, *Collection complète des travaux de M. Mirabeau l'aîné, à l'assemblée nationale*, vol. v, 1792, pp.424–93.

¹³ Notwithstanding the curious fact that Mirabeau was completely ill-informed about the situation in England: 'Un auteur français a prétendu qu'en Angleterre les mines sont des propriétés privées; il s'est trompé: on les considère comme un droit national; aucun particulier ne peut fouiller une mine sans une permission du roi, que ne la donne que moyennant une redevance appelée *realty*.' Mirabeau, *op.cit.*, p.449. Italics as in original.

¹⁴ Eric Rasmusen, *Games and Information. An Introduction to Game Theory*, 1990, p.33.

it must be low enough to be within the range of costs the tenants would have to bear when negotiating a lower ground-rent.

The landlords' reservation utility is mainly paid for by consumers, the tenants acting only as intermediaries, the landlords' groundrent collecting agents, and it establishes a level playing field for competition. The individual tenant is not under competitive pressure from that side. On the other hand, sticking to the well-established reservation groundrent brings transaction costs down and facilitates a continuous and smooth flow of new leases. To offer no bonus at all, or a lower royalty, will certainly imply much longer delays in negotiating the lease, and there is the danger of competitors turning up and willing to pay the usual groundrent. Moreover, if expectations are not sufficient to justify the reservation groundrent, the venture would probably be a small one. In this case the question arises whether it is worthwhile to engage in specially demanding negotiations. Consequently, from the tenants' viewpoint, once the reservation groundrent has been established by the market, it will come under downward pressure only in exceptional circumstances.

The reservation groundrent also establishes a level playing field for competition amongst landowners, and as far as transaction costs are concerned, it is even more important to them. For producers to acquire leases is a matter of course. They may even maintain special land departments or, at least, they will rely on brokers they are acquainted with. But for landowners this is an exceptional event which may happen to them only once in a lifetime. For them to be sure that they will get at least the usual and publicly well-known groundrent makes things a lot easier. The negotiation will normally concentrate on a higher or lower signature bonus, which is easy to handle and to understand. The landlords will certainly be reluctant to deviate downwards from the reservation groundrent, and will generally prefer a higher cash bonus to a higher royalty rate. It is easy to explain to them the drawbacks of exceptionally high royalty rates. On the other hand, only in exceptional circumstances will landlords be able to ask for a general increase of groundrents, that is for a new and higher reservation utility. In the case of British coal this might have happened because of the continuously eroding purchasing power of the tonnage royalty. It is likely that a new, usual percentage royalty would have emerged if the natural resource had not been nationalized beforehand. In the case of American oil, the percentage royalty has been extraordinarily stable. All in all, the whole system is normally self-adjusting, by means of variable prices and not groundrent.

The case studies suggest that the critical issue in *private* landlord-tenant relationships is

not groundrent but the potentially crippling effect it has on productivity. Subject to market forces the reservation groundrent will always be more or less acceptable – that is *acceptable to consumers*. Landlords create a reservation groundrent by not renting their lands below a certain minimum, but experience shows that consumers can depend on the market for a reasonable outcome. What consumers ultimately do not accept is obstruction, and it has been seen that the market is much less able to cope with that problem. Whereas depletion brings about a constant reservation groundrent, it may be associated with private landed property becoming more and more obstructive. Obstruction means waste, inefficiency, and a hampered development of productivity; it implies higher costs and higher prices. If obstruction becomes really important – and that has been the case for British coal as well as American oil – and it cannot be dealt with through legislative action, then nationalization is a realistic option. Even if full indemnities are paid to the landlords, i.e. the capitalized reservation groundrent, for consumers there are still huge gains to be made in bringing costs down, and with the unfettered development of productivity. However, if reform is successful, there is no point in nationalizing – which is more or less the situation in the USA. Successful reform consists in restricting the power of private mineral property to obstruct. Ideally, private mineral ownership and the payment of reservation bonuses and royalties is then equivalent to public mineral ownership and the payment of registration fees and severance taxes, the only remaining difference being the beneficiaries of the levies.

3. RICARDIAN RENT THEORY AND ROYALTIES

Before proceeding to a discussion of the actual case studies, it is necessary to make some comments on the way in which economic literature on British coal or American oil deals with the landlord–tenant relationship.

On the one hand, there is Ricardian rent theory looking at the relationship from the viewpoint of the tenants. As Adelman put it: ‘A development is undertaken if it promises at least some profit over and above the costs, including the necessary minimum return on investment. The landlord may get some or all the excess, but he cannot take any more or there will be no project. Therefore (...) his rent has no effect on supply and price.’¹ From the viewpoint of the tenant, the idea of a reservation groundrent seems inconceivable as, whatever the landowners may get, there is ‘no investment or risk’ in the first place.² Therefore, ‘so long as any profit expected after rent or royalty is less than enough to induce a private company to make the investment, it is to the landlord’s benefit to take a lower royalty. For his alternative is no operation, and no royalty. *The landlord, as residual claimant, simply gets what is left, much or little.*’³ Hence, only the viewpoint of producers is considered relevant; they are tenants, too, but this is considered to be irrelevant. The landlord–tenant relationship really doesn’t matter.

On the other hand, Ricardo himself was careful to define ‘rent’ in such a way that royalty was not to be considered a ‘rent’: ‘Rent is that portion of the produce of the earth, which is paid to the landlord for the use of the original and indestructible powers of the soil.’⁴ Consequently, a royalty was not a ‘rent’ but ‘the compensation given for the mine or quarry (...) paid for the value of coal or stone which can be removed from them’.⁵ Therefore, he argued – against Adam Smith – that royalty should not be called a ‘rent’. This viewpoint was restated more explicitly by Marshall a century later:

A royalty is *not* a rent, though often so called. For, except when mines, quarries, etc., are practically inexhaustible, the excess of their income over the direct outgoings has to be

¹ Morris A. Adelman, ‘The World Oil Outlook’, in Marion Clawson (ed.), *Natural Resources and International Development*, 1964, p.107.

² *Ibid.*, p.107.

³ *Ibid.*, p.107. Italics added.

⁴ David Ricardo, *On the Principles of Political Economy and Taxation*, in *The Works and Correspondence of David Ricardo*, edited by Piero Sraffa, vol. 1, 1951, p.67.

⁵ *Ibid.*, p.68.

regarded, in part at least, as the price got by the sale of stored-up goods – stored-up by nature indeed, but now treated as *private property*; and therefore, the marginal supply price of minerals includes a royalty in addition to the marginal expenses of working the mine.⁶

Here royalty appears as the price of privately owned exhaustible resources. Consequently, landlords are not considered to be residual claimants but sellers who, like all others, ask for a ‘fair’ price. From that viewpoint, the landlord–tenant relationship becomes simply a seller–buyer relationship, and nothing more. As to the price, in Marshall’s opinion:

the royalty itself on a ton of coal, when accurately adjusted, represents the diminution in the value of the mine, regarded as a source of wealth in the future, which is caused by taking the ton out of nature’s storehouse.⁷

This argument is completely circular as the ‘value of the mine’ is nothing other than the capitalization of the future income stream given by royalty payments. Nonetheless, the point is that landlords are not conceived as residual claimants. Their mineral deposits or reservoirs are regarded as a ‘wasting asset’ and, therefore, their ‘right to receive compensation for the intrinsic value’ of their mineral is considered ‘incontestable’.⁸

In the economic literature on British coal, given the nation-wide debate on the nationalization of royalties, both viewpoints are widespread, albeit alongside each other and without being integrated. The fact that the reservation royalty caused higher-than-otherwise coal prices is explicitly, though reluctantly, acknowledged. Yet it is an astonishing fact that this is definitely *not* the case in American oil, although the existence of a minimum royalty of one-eighth is not questioned:

If marginal royalty and marginal operating costs were the only marginal prime costs; and since short-run profit maximisation would require the firm to equate the sum of these marginal costs to price, then the short-run supply function for the firm would be obtained by elevating the marginal operating cost curve by $1/7$, or $14\ 2/7$ per cent, so as to include marginal royalty costs in the supply price.⁹

Nevertheless, in the opinion of Paul Davidson: ‘Oil lands are obviously analogous to the

⁶ Alfred Marshall, *Principles of Economics*, vol. 1, p.483. Italics as in original.

⁷ *Ibid.*, p.483.

⁸ OPEC Resolution IV.33.

⁹ Paul Davidson, ‘Public Policy Problems of the Domestic Crude Oil Industry’, *The American Economic Review*, vol. 53, March, 1963, p.91.

Ricardian case of agricultural lands of differing fertilities.¹⁰ He also considered that, ‘the lease bonus and royalty payments are (...) Ricardian rent payments.’¹¹ Ricardo would certainly not have agreed on that point. Finally, in a *footnote* Davidson argued:

Royalties are an important component of the short-run supply function. Nevertheless, since royalties provisions are fixed at the outset and depend upon expectations of the future income stream from the well, royalties are, in the long run, price-determined rather than price-determining.¹²

The expected future income stream depends, of course, on prices. Prices are determined, in the long term, by the long-run marginal costs which, in turn, necessarily include the reservation royalty. Hence, the argument presented in the quote is completely circular. This debate, however, refers to private lands and never had any practical consequence whatsoever, nor was it ever intended to have one. The existence of a reservation royalty was an unexplained curiosity and, as such, even in the two-volume history celebrating the first century of the American oil industry, sponsored by the American Petroleum Institute, it only merited a mention in a footnote.¹³

Writing several years later, Stephen McDonald is a little more careful. Under the title of ‘The Contractual Form of Rent Payment’ he states:

Up to this point we have implicitly assumed that land rent is paid in cash as it is earned. Under conditions of perfect competition, which assumes perfect knowledge, this is a reasonable assumption (...).

In the real world of imperfect knowledge, however, the rent payment may take another form, that of a share in output. In minerals production this share is ordinarily called a royalty (...). If the royalty is fixed, regardless of the cost of minerals production in relation to price, then the royalty affects the margin of land use for minerals extraction and also, to a degree, the price of extracted minerals. This seems to contradict our earlier repeated assertion that rent is price determined, not price determining, but it does so only by appearance. Pure economic rent (...) does not affect price, but a fixed royalty as a contractual rent form (...) does not coincide precisely with pure economic rent. It is the nature of the contract, not the nature of economic rent, that causes the rent payment to affect price.¹⁴

¹⁰ Paul Davidson, ‘Public Policy Problems of the Domestic Crude Oil Industry: A Reply’, *The American Economic Review*, vol. 54, April, 1963, p.126.

¹¹ Davidson, vol. 53, p.104.

¹² Davidson, vol. 53, p.90n.

¹³ *The American Petroleum Industry* sponsored by the American Petroleum Institute, Vol. I: *The Age of Illumination 1859–1899* by Harold F. Williamson and Arnold R. Daum, 1959. Vol. II: *The Age of Energy 1899–1959*, by Harold F. Williamson, Ralph L. Andreano, Arnold R. Daum, and Gilbert C. Klose, 1963, Vol. I, p.374n.

¹⁴ McDonald, *The Leasing of Federal Lands for Fossil Fuels Production*, op.cit., p.36.

Here royalty appears as a proxy for Ricardian rents and, of course, as a proxy it is not perfect. A ‘perfect’ economic rent-collecting device would have no consequence whatsoever on prices. Yet the usual royalty of one-eighth in the USA is not an economic rent at all but a reservation groundrent.

In any event, whatever tenants and landlords believe, in order to produce oil with a profit and a groundrent they have to establish a relationship signing a contract. It then turns out that the residual claimants are the tenants, not the landlord. What is more, tenants are keen to play that part because it is the leading role. By agreeing on fixed bonuses, rentals, and a reservation price for the mineral extracted, the interference of the landlords in their business is reduced to the inevitable minimum: to check the volume extracted. This form of contract provides tenants with a maximum of leeway to maximize their profits – and to perform best their social role as producers. Being residual claimants in reality, and optimally being the claimants of the full residual, producers have an incentive to operate efficiently and to develop productivity.¹⁵ The landlord, on the other hand, is satisfied to receive a reservation price, linked to market prices in the case of a percentage royalty and constant in the case of a tonnage royalty. This price will be paid, ultimately, by consumers, the tenants acting as the landlords’ groundrent collecting agents.

Conclusions

Generally speaking, in the economic literature on British coal or American oil there is no theory of landlord–tenant relationships but only fragmentary discussions in which the viewpoint of the tenants prevails. They are mostly conceived not as tenants but simply producers, although the situation varies from one author to the other. W. Stanley Jevons’ *Coal Question*,¹⁶ first published in 1865, considered the landlord–tenant relationship to be completely irrelevant to the point that words like ‘leases’, ‘rents’, or ‘royalties’, are not mentioned once, nor is there any reference to Ricardo. On the contrary, Ben Fine’s *Coal Question*,¹⁷ published in 1990, gives a summary of the classical debate on (ground-)rent theory, the following political debate on coal royalties in Great Britain, as well as the inconclusive (and confusing) state of the art in modern economics on the

¹⁵ See Laffont and Tirole, *A Theory of Incentives in Procurement and Regulation*, op.cit., p.40.

¹⁶ W. Stanley Jevons, *The Coal Question*, 1865, 1965 reprint.

¹⁷ Ben Fine, *The Coal Question*, 1990.

royalty issue.¹⁸

Not surprisingly, the general theoretical confusion has led to a confusing terminology. To Adam Smith the word 'rent' meant what we call in this paper *groundrent*. Today, the word 'rent' is mainly used by economists as a shorthand for economic rent generally. In the special case when its existence is due to nature and different fertilities or locations, an economic rent is called a Ricardian rent. Moreover, until Mill's time, the term 'royalty' was still reserved for mining groundrents paid, indeed, to the royalty; Ricardo never used the term 'royalty' in his chapters on rent. The modern use of the term, applied to private leases as well, was found first towards the end of the eighteenth century, and became common only in the nineteenth century.¹⁹ Even more confusingly, today it is usual in economic literature to use the expression 'rents and royalties', where the term 'royalties' denotes a specific form of groundrent related to output – the definition we adopted in this paper – while other forms of groundrents are denoted as 'rents'. In addition, this is frequently shortened just to 'rents' or to 'royalties', both embracing all forms of groundrent payments. The reader of the following chapters must be aware of this confusing terminology whenever it turns up, inevitably, in quotes.

¹⁸ Ibid., Part Two.

¹⁹ J.U. Nef, *The Rise of the British Coal Industry*, vol. 1, p.318f.



4. BRITISH COAL

The long history of the landlord–tenant relationship in British coal¹ started at the surface, with the working of outcrops. Only later, with depletion, was coal extracted at ever greater depths. Against this background the relationship developed slowly over the centuries. First, there was the development of royalties. Although an ancient form of groundrent in mining, royalties in coal were *not* a legacy of ancient times; they developed independently, as a modern groundrent-collecting device in mining.² Moreover, royalty rates at first varied with location and natural fertility, reflecting Ricardian rents which were then as obvious in coal mining as in agriculture. Where there were no Ricardian rents, landlords themselves worked the coal. With depletion, however, coal mining became a modern industry, ex-ante Ricardian rents disappeared, landlords withdrew from the business, and a usual royalty-rate developed, no longer a Ricardian rent but a reservation ground-rent.

Early Coal Leases

Outcrops of coal used to be widespread in Britain. Nevertheless, as long as there were abundant supplies, wood was preferred as a fuel. Gradually it became scarce and was displaced by coal, initially on a local basis. Although the costs for digging surface coal were small, transportation costs were very high. Eventually a regional and national market for coal developed. Simultaneously, private landed property extended to minerals, with the general exception of silver and gold, and with some other regional exceptions. On the Continent the situation evolved exactly in the opposite direction, towards public ownership and a system of concessions or

¹ For the history of British coal see J.U. Nef, *ibid.*, and the five-volume-study sponsored by the National Coal Board, *The History of British Coal Industry*. Vol. I: *Before 1700: Towards the Age of Coal* by John Hatcher, 1993. Vol. II, 1799–1830: *The Industrial Revolution* by Michael W. Flinn with the assistance of David Stoker, 1984. Vol. III: *Victorian Pre-eminence* by Roy Church with the assistance of Alan Hall and John Kanefsky, 1986. Vol. IV: 1913–1946: *The Political Economy of Decline* by Barry Supple, 1987. Vol. V: 1946–1982: *The Nationalized Industry* by William Ashworth with the assistance of Mark Pegg, 1986.

² “Though it is possible to trace the influence of the medieval lead and tin miner in certain colliery practices – (...) to discover, in the fixing of a royalty rent at a certain proportion of the profits or product of the mine, a connection with the medieval compact by which the owner was entitled to a definite percentage of the metal extracted; to refer back a clause in a sixteenth or seventeenth-century lease, requiring continuous mining, to the ancient rule that the miner forfeited his title if he abandoned work for longer than a specified period – still, these are survivals largely of academic interest.” Nef, *op.cit.*, vol. I, p.298.

licences. In Britain surface diggings, and coal mining generally, became based on leases which initially followed the patterns of agricultural leases. But:

It was usual in letting coal mines (...) to limit the number of pits that could be worked, and the number of hewers (...) to be employed in each pit. Thus a maximum limit was set upon output (...).³

In other cases there were outright volume restrictions. These primitive restrictions were acceptable to both sides within a traditional environment, short lease contracts of a few years, producers supplying only local markets. But once coalmining became a modern, market-oriented activity, they had to disappear.

Royalties

The volume restrictions disappeared under circumstances where landlords were in a very weak position due to the privatization of Church and Crown land: 'the common lease during the period from 1580 to 1640 stipulated for a fixed payment, regardless of the quantity of minerals extracted.'⁴ Simultaneously, twenty-one years became the minimum as well as the usual period of tenure. This happened at the very moment when demand for coal was about to take off. Consequently, the profits arising from the revolutionary expansion of the coal industry at the end of Elizabeth's reign were not immediately shared by the landlords. They had no means of bettering their position until the lease expired. Meanwhile, in some cases, their groundrents went down to the equivalent of less than half of 1 per cent of the selling price of a ton. Those who signed later, might have been comparatively well off. Wide variations were the rule, and it was the most fertile, or best situated, mines which tended temporarily to pay the smallest royalties per unit of coal extracted, as they were covered by the oldest leases.

Conditions so unsatisfactory to the landlord naturally could endure only until the lease fell in, when he demanded a higher 'rent'. Everywhere royalties increased (...). By means of high rents, frequently by even higher fines, the owners sought to recoup what they no doubt regarded as their losses during the period when the industry had expanded so rapidly. In the period of relative depression that followed (...) some mine owners found themselves unable to make sufficient profits to pay the high royalties.⁵

³ Ibid., p.320.

⁴ Ibid., p.321.

⁵ Ibid., pp.322-4.

Fixed Royalties

Only when both landlords and tenants had realized that the uncertain terms of the Elizabethan lease might turn to their disadvantage, were they in a mood to adopt a different method of reckoning which would establish some definite relation between the groundrent paid and the volume of coal extracted, a royalty per unit of output.⁶

The system of assessing royalties at a fixed sum per unit of coal produced (...) apparently originated in the English coal mines. Before 1700 many landlords throughout the country had adopted it. (...) And, while the new system was not general at the end of the seventeenth century, it was everywhere gaining ground.⁷

Royalties were combined with the traditional system of fines and annuities. The latter were now called *certain rents*. This was a minimum to be paid in the event that royalty payments were less.

Percentage Royalty

Fixed royalties were overwhelmingly predominant, but in some regions – in South Wales and Scotland, for example – percentage royalties were reported from the middle of the eighteenth century. In my view, the reason for percentage royalties appearing later and then being on the increase,⁸ can be explained by the development of a more perfect market which facilitated the observation of prices. Regional differences may be explained, partially at least, by the force of tradition – actually different regional Nash equilibria. Where coal production and leases developed first, a fixed royalty became traditional, and where they developed later, the percentage royalty appeared first. This explanation seems to fit well into the cases of Scotland, where landowners were involved in coal mining much later than anywhere else, and of South Wales, a region that became an important producer relatively late.

Fixed v. Percentage Royalty

In a fully developed and competitive market a percentage royalty entails only a moderate increase in monitoring costs and, as already pointed out, has the advantage of adjusting automatically to inflation as well as to differences in quality and location. Although historically inflation was low by modern standards, there is no denying that the average royalty per ton tended to diminish in

⁶ Rougher proxies, for example linking rent to the number of pits worked, the number of hewers employed, and so on, were earlier versions. See Nef, *op.cit.*, vol. 1, p.321; Flinn, *op.cit.*, pp.43–4; and Hatcher, *op.cit.*, p.273ff.

⁷ Nef, *op.cit.*, vol. 1, pp.324–5.

⁸ *Ibid.*, p.324.

terms of real purchasing power during the eighteenth and nineteenth centuries.⁹ Thus, landlords everywhere should have been interested in switching to a percentage royalty. Actually percentage royalties progressed very slowly and, I suspect, this may have been due to the opposition of the tenants. Indeed, the most powerful tenants of the North-east, historically by far the most important producing region of the country, had been operating a cartel since the sixteenth century – the Company of Hostmen of Newcastle-upon-Tyne, later giving way to the Grand Alleys. As a cartel they were certainly not interested in disclosing their pricing policy, and with a fixed royalty per unit of output inflation worked to their favour.

Yet as inflation became more and more important in the twentieth century, one can safely assume that a fixed royalty per unit of output would have become simply unacceptable to any landlord and percentage royalties would eventually have displaced fixed royalties – if they had not been nationalized before this could happen.

Evolution of Royalty Rates

According to Nef, in British coal mining history royalties were at their highest in the century following the Restoration. In the second half of the eighteenth century they started to fall. In Adam Smith's days a royalty equivalent to one-tenth of pit-head prices was common.

Since that time the fall has been marked. In Durham and Northumberland between 1824 and 1834 comprehensive statistics of the Coal Trade Committee of 1836, the royalties average about one-fifteenth of the selling price; in 1889 the average was about the same; during the last two years of the Great War about one thirty-sixth.¹⁰

Yet the very low percentage at the end of the First World War was due to exceptional price levels.

As to percentage royalties, a consultant, or a viewer as they were known in the coal industry, while at Leslie in Fife in 1773, found that it was usual 'to pay a forth part of gross output for level free coal near the sea or city that affords constant sale or a good price, one fifth for level free coals that have not the above advantages, one seventh for coals wrought by a water engine and one tenth when wrought by a fire engine'.¹¹ In the late eighteenth and early nineteenth centuries the most frequent percentage royalty seems to have been one-eighth.¹² Although they were originally more or less in line with the fixed royalties, it is clear that they became much more

⁹ Ibid., p.327.

¹⁰ Ibid., pp.326–7. See also Hatcher, *op.cit.*, p.280, and Flinn, *op.cit.*, p.46.

¹¹ Flinn, *op.cit.*, p.45.

¹² Ibid., pp.44–5.

advantageous for the landlord towards the end of the nineteenth century.

In earlier times different royalties reflected, partially at least, Ricardian rents. Nevertheless, they did so very poorly. Mining conditions evolved fast and the state of the market for coal fluctuated from month to month, while leases were drawn for long periods during which the royalties were fixed at a definite sum per unit of coal extracted.

Reservation Royalty

However, it is most important to note that there was no trend towards finer devices of rent collection.¹³ On the contrary, the historical trend went in exactly the opposite direction, towards a reservation royalty:

(...) during the last two centuries, there is (...) a tendency for the tonnage royalties at all British mines to approach a common level. At the end of Elizabeth's reign, the (...) rents (...) charged probably ranged from one half per cent to as much as twenty per cent of the pithead price, some mine owners paying 5*d.* or 6*d.* a ton, others less than 1/4 *d.* During the seventeenth and eighteenth centuries this margin was narrowed considerably; since 1800 it has been narrowed further. In 1836 the maximum royalty in Durham and Northumberland amounted to 1*s.* 3*d.* per ton, in 1889 the maximum was 10*d.*, to-day it is 9*d.* All the representatives for the mineral owners, who testified before the Coal Commission of 1925, agreed that, at the overwhelming majority of mines throughout the country, royalties ranged between 5*d.* and 7*d.* a ton. Thus the average has tended more and more to become the usual charge.¹⁴

The remaining differences were mostly due to quality. The shrinking interval of royalty rates and their ultimate convergence was a complex process, i.e. the disappearance of ex-ante Ricardian rents, was a process essentially driven by depletion, but it went hand in hand with a sharp reduction in transportation costs and with the retreat of landlords from coal mining.

Transportation

In earlier times the ease of communication with markets and the size of those markets were frequently more important than the costs of raising the coal.¹⁵ If coal was not to be consumed locally, it had to be produced *and* consumed next to the sea or rivers. This explains the early development of Newcastle with its Tyneside collieries as the most important producing centre,

¹³ However, Nef reports an example, in the early seventeenth century, where thicker seams paid a higher royalty rate than thinner ones. Nef, *op.cit.*, vol. 1, p.324.

¹⁴ *Ibid.*, vol. 1, p.327.

¹⁵ Hatcher, *op.cit.*, p.14.

and that of London as the most important consuming centre. Thus, one of the most significant developments in the later seventeenth century, the spectacular growth in the output of collieries located some distance from the south bank of the Tyne, was only made possible by the provision of wooden waggonways along which the coal could be cheaply transported.¹⁶

The development of waterways, and finally railways, followed. Yet with the strengthening of private landed property it did not suffice that coal was technically well located. Neighbouring landlords asking for wayleaves became extremely important in the second half of the seventeenth century, partly as a consequence of the exhaustion of coal mines along the rivers and the sea.¹⁷ Not surprisingly, the coal owners¹⁸ and their landlords wanted wayleave rents to be paid only according to the damage actually sustained by the transit-landlords, whereas the latter defended the point of view that they were entitled to participate in the profits of the collieries. Wayleaves became extremely oppressive. 'Even the most slothful of conservative landowners could derive a handsome income from the coal trade without dirtying his hands if his land was strategically placed.'¹⁹ The increase of productivity in transportation could be absorbed completely by the well-placed landlords maintaining by the same token well-located collieries to their advantage.

The problem of transportation was of special importance to coal, but it was one that faced all trade, and obviously tended to divide even the landlords. For this reason it had to be tackled at a global level. In the eighteenth century legislation developed giving the constructor of a public utility like a canal, a turnpike road, or a railroad, rights of compulsory purchase of land.²⁰ Therefore, calculated by the ton mile wayleaves 'tended to reach a peak at the end of the seventeenth or the beginning of the eighteenth century, since which time they have absorbed a

¹⁶ Ibid., p.90.

¹⁷ The most common method of leasing a wayleave was then much the same as leasing any plot of land, whether for coal mining or other purposes: for a fixed annual rent and a fine. The former was frequently related to the extension of the surface granted. In the case of wayleaves this form of lease proved more enduring than in the case of coal leases, and 'until the nineteenth century wayleaves were rarely assessed by (...) unit of output'. Nef, *op.cit.*, vol. 1, p.332.

¹⁸ The reader should be aware of the somewhat confusing terminology. 'The term 'owners' (or coalowners) in the coal industry was applied to the active owners and senior managers of coalmining enterprise. The owners of the actual coal before it was mined were known as 'royalty owners' or occasionally 'mineral owners'.' *Supple, op.cit.*, p.23n.1.

¹⁹ Hatcher, *op.cit.*, p.254.

²⁰ Flinn, *op.cit.*, p.159. See also Nef, *op.cit.*, vol. 1, p.332.

steadily diminishing portion of the selling price. Their importance has been largely reduced (...) by the introduction of (...) railroad transport, the right of way now being secured by the railroad (...).²¹ By the mid-eighteenth century wayleave rents had lost their importance. 'The advent of public railways had the effect of diminishing the need to negotiate rights of way. By 1890, outside the North-east, where relatively lengthy private wayleave lines which had preceded public railways continued to offer cost effective service to colliery owners and merchants, only a small proportion of coal output was subject to wayleaves.'²²

The drastic fall in transportation costs and wayleaves reduced Ricardian rents for well-located collieries, and brought new collieries into a regional, and eventually a national market.

Landlords Become Exclusively Rentiers

Until the sixteenth century it was not unusual for landowners to work their own mines, and even to lease additional ones. Indeed, landowners could be lessors in some cases and, at the same time, lessees in other cases.²³ Even during the lifetime of Adam Smith there were still marginal mines worked by the landlords themselves:

There are some of which the produce is barely sufficient to pay the labour, and replace, together with its ordinary profits, the stock employed in working them. They afford some profit to the undertaker of the work, but no rent to the landlord. They can be wrought advantageously by nobody but the landlord, who being himself undertaker of the work, gets the ordinary profit of the capital which he employs in it. Many coal mines in Scotland are wrought in this manner, and can be wrought in no other. The landlord will allow nobody else to work them without paying some rent, and nobody can afford to pay any.²⁴

Yet an increase could be observed as early as the seventeenth century in the proportion of mineral owners in all parts of Great Britain who leased their mines instead of working them themselves. This eventually became the rule. 'By the 1830s perhaps no more than 10 to 15 per cent of coal production came from collieries worked by landed proprietors, a share which was probably half that figure by the 1870s and fell to a negligible proportion by 1913.'²⁵ Definitively, the landowners had turned rentiers, and at the beginning of the twentieth century many of the largest

²¹ Nef, vol. 1, p.334.

²² Church, op.cit., pp.14-15.

²³ Hatcher, op.cit., pp.240-3.

²⁴ Adam Smith, *The Wealth of Nations*, 2 vols, 1950, vol. 1, p.166.

²⁵ Church, op.cit., p.12; see also p.762.

mineral owners knew 'almost nothing about the origin of their incomes from royalties'.²⁶

Leases became the rule as coalmining went deeper and deeper, and collieries became more and more capital-intensive, modern enterprises requiring, to start with, significant investments in exploration. In earlier times when coalmining was limited to outcrops or coal seams close to the surface, the existence of coal, its quality, and the ease of operation, was almost as well known to the landowners and the tenants as in the case of agricultural land. Later, however, some exploration was required. In the early nineteenth century this was still done by consulting viewers engaged by the landowner.²⁷ The landowner's choice then lay between financing a colliery himself or, more likely, offering a lease at a royalty, hoping to attract risk capital on the strength of the viewer's report.²⁸

However, as mine depths increased exploration became a specialized, expensive, and risky undertaking:

Thus, from the 1860's, when coal was being sought in Fife, and especially in the concealed parts of the coalfield extending from Yorkshire across the East Midlands, a new class of specialised surveying and boring contractors began to emerge. By 1913 several such firms were in operation, obtaining leases or options from landowners and boring and proving the coal before attempting to persuade a colliery company to take over the actual winning of the colliery.²⁹

By the end of the nineteenth century the landowners not only had retreated from production, but were even unable to assess the value of their lands. A class of entrepreneurs specialized in exploration arose:

The pioneering company's income generally came from reimbursement of its costs by the colliery company, to which was added a tonnage payment on coal raised, calculated on the difference between the royalty paid and that which would have been asked had the coal already been proved; sometimes shares were substituted for cash payments.³⁰

The average costs of one borehole in the two decades prior to the First World War have been estimated at £10,000, and normally several boreholes were necessary for a proper assessment of the seam, its richness, inclination, quality, and so forth. The landowners were not willing

²⁶ Nef, *op.cit.*, vol. 2, p.8.

²⁷ Hatcher, p.193; Flinn, pp.20, 71, *op.cit.*

²⁸ Church, *op.cit.*, pp.311-12.

²⁹ *Ibid.*

³⁰ Church, *op.cit.*, p.312.

anymore, or were not able, to invest and risk such amounts of money. They had become, definitively, rentiers. Thus, a positive minimum royalty rate had to develop reducing the interval of royalty rates from below.

Reservation Royalty: The Historical Average

Increasing mining depths indicated depletion and the necessity to sign continually new leases on unexplored lands or on deeper unexplored strata, and closing down older mines. These new, mostly marginal leases had to pay just a minimum groundrent, a reservation utility still to be determined. The minimum in question turned out to be the average rate of royalties. This average was common knowledge and, as such, could easily become a *focal point*. 'In repeated games, focal points are often provided by past history' generating equilibria 'which for psychological reasons are particularly compelling'.³¹ Since the landlord was already out of the business and thus uninformed, sticking to the average was a good way to reassure him that he was offered a 'fair' deal. Generally, at this stage all ex-ante Ricardian rents had disappeared.

Period of Tenure and Renewal

Early leases had been for a few years, or even only one year, sufficient for small medieval diggings.³² Yet this was not long enough for more capital-intensive coal mining. Investment in infrastructures – shafts, underground layouts, water pumping, ventilation, and so on – requires a greater number of years to accomplish and to recover. It was only after the privatization of Church and Crown lands that the necessary longer lease terms became available. Twenty-one years became the usual period of tenure. It was never less, but it could be more: thirty, thirty-one, forty, forty-one, forty-two years, and even ninety-nine years. As the 'initial sinking of a major pit could take up to four years in the late eighteenth and early nineteenth centuries,'³³ a period of twenty-one years as a minimum and usual period of tenure seems not to have been too generous. Up to the final quarter of the nineteenth century most leases fell within the range of twenty-one and sixty-three years, with an overall trend for leases to become shorter on average. Thereafter they tended to become longer. The new trend 'was clearly associated with increasing

³¹ Eric Rasmusen, *Games and Information. An Introduction to Game Theory*, 1989, p.36.

³² Hatcher, op.cit., pp.274–5; Nef, op.cit., vol. 1, pp.138–9.

³³ Flinn, op.cit., pp.48, 191.

mine depths accompanied by the greater capital expenditure necessary for deep mining operations, developments which led colliery companies to insist upon leases of sufficient duration to justify the heavier capital investment associated with long-term mining development'.³⁴ By the mid-nineteenth century, however, forty-two years was more normal, and sixty-three years was not uncommon, though there were still plenty of leases for the old terms of twenty-one years.³⁵ The contracts usually included a provision to release the lessee from his annual payments if production was delayed for reasons outside the control of the tenant, or if the mine proved unworkable.³⁶

Whatever the period of tenure, however, the question is what happened when leases fell in? If the seams were already exhausted at this point, the tenants were usually required to restore the surface for agricultural or other uses, and to seal off the shafts to prevent accidents. The lessees would then take with them what viewers used to call the 'live stock', all their capital which was removable and saleable, whereas the 'dead stock' like permanent buildings would usually become the property of the lessors without any payment.

If the seams were not exhausted at the time of the escheating of a lease – as happened quite frequently even with periods of tenure of forty-two years or more³⁷ – the renewal of the contract could be the opportunity for the landlord to collect, at last, ex-post Ricardian rents and, generally, all economic rents created by their lessees. There was no geological uncertainty and risk any more. The 'dead stock' which the lessees had to hand over included not only permanent buildings but the shafts and the underground layouts as well, and the lessees were required by contract to mine the colliery in a workmanlike manner to protect the long-term future of the leased properties.³⁸

Hence, the landlord could claim not only for fines reflecting Ricardian rents but also for interest on the capital invested by his lessee during the previous lease term. In some cases, at least,

³⁴ Church, *op.cit.*, p.13. This author mentions an example where mine depth reached 715 metres (p.8).

³⁵ B.R. Mitchell, *Economic Development of the British Coal Industry 1800–1914*, 1984, p.253; Nef, *op.cit.*, vol. 1, p.322n6.

³⁶ Nef, vol. 1, p.322. Hatcher, *op.cit.*, p.273.

³⁷ By 1925 'about half the work-force was employed in mines more than 40 years old'. *Supple*, *op.cit.*, p.401. In 1980, on the other hand, 'well over a quarter of the operating collieries had been sunk before 1880'. Ashworth, *op.cit.*, p.113.

³⁸ Hatcher, *op.cit.*, p.206ff.

he did so successfully. 'It was possible for a landowner's revenue from fines to swell to become a significant proportion of his whole revenue from mines.'³⁹ What is more, fines could be agreed on earlier than the end of the lease. This happened, for example, in the North-east in the late eighteenth and early nineteenth centuries, by 'building into the initial lease provision for renewal every seven years, allowing for the levying of a fine on the occasion of the renewals. With what were called "filling-up" renewals, the expired term was added to the end of a lease to allow, on payment of renewal fines, for "leap-frogging" extensions.'⁴⁰ This system could become very oppressive to the tenants.⁴¹

Yet with growing mine depths, leases became longer and, moreover, in my opinion, the landlords' ability to enforce favourable conditions upon renewal was considerably weakened. Indeed, to maintain deeper mines is extremely costly – for example water-pumping must be permanent – and if maintenance is not done, the mines may be lost forever within a few months or even weeks; at best, they can be reopened later only at a very high cost. Thus, the landlord himself could no longer afford to avoid reaching a timely agreement with his lessee to renew the contract; otherwise he had to find another lessee to take over immediately. Obviously, under these circumstances it must have been very easy for the lessee to undermine, and even to sabotage, any intent of the lessor to squeeze out high fines which he considered unfair, or to replace him with a new lessee.

Although information available is relatively scarce on this point, as those 'substantial fines payable on renewals of leases (...) are not often revealed in surviving records',⁴² overall information is sufficient to ascertain that the reservation royalty represented the overwhelming part of groundrent payments in modern coal leases. Ex-post Ricardian rents remained with the tenants even upon renewal:

(...) it is clear that in our time the major portion of the additional return from the better situated and more productive mines no longer goes to the landlord, who tends to receive royalties at the same rate in all parts of Great Britain, but to the investors in colliery enterprises.⁴³

³⁹ Flinn, *op.cit.*, pp.46–7.

⁴⁰ *Ibid.*, p.47.

⁴¹ *Ibid.*, pp.47–8.

⁴² Hatcher, *op.cit.*, p.279.

⁴³ Nef, *op.cit.*, vol. 1, p.328.

Nevertheless, this does not allow us to jump to the conclusion that the definite period of tenure did not cause serious harm. On the contrary, the perverse incentive problem caused by the approaching end of the lease, by threatening to interrupt an activity which required by its very nature a steady flow of investment and long-term planning, seems to have caused considerable damage. It implied higher production costs and, more important, a short-term investment policy.⁴⁴ Its accumulated effects were amongst the principal causes of the crisis faced by the British coal industry in the twentieth century. Although leases became longer towards the end of the nineteenth century, it was too little and too late. The fundamental problem of reversion was never addressed. Ultimately, there was a deadlock; landlords were unable to get hold of Ricardian rents upon renewal of the leases, and tenants were unable to develop and to impose a device allowing a steady and unhampered flow of investment for the whole lifetime of the mines.

Fragmentation of Private Landed Property

Optimal exploration strategies, the location of shafts, and the design of underground outlays have to ignore completely the fragmentation of the surface by private landed property. In Great Britain, however, private property prevailed. As Nef pointed out, the exceptional concentration of landed property made tolerable in Britain the system of privately-owned royalties. But that was all – it made private landed property on minerals *tolerable*. Because even in the eighteenth century ‘in most collieries (...) the length of levels was determined (...) not so much by the difficulty or cost of underground hauling as by the acreage of coal legally accessible to the operator.’⁴⁵ Regionally things could be worse:

(...) highly fragmented land holdings at the northern end of the Warwickshire coalfield around Wilnecote prevented mining on all but the smallest of scales during the first half of the eighteenth century. Many leases laid down a strict limit to the number of acres that might be worked, and it is worth bearing in mind that a shaft sunk in the centre of a square twenty-five-acre coal lease would permit levels driven to meet the sides of the square at right angles of no more than 175 yards.⁴⁶

For technical reasons – to prevent subsidence – pillars of coal had to be left underground.

⁴⁴ For a discussion of the related problem of ‘second sourcing’ in the case of regulated natural monopolies, see Laffont and Tirole, *op.cit.*, Ch. 8.

⁴⁵ Flinn, *op.cit.*, p.81.

⁴⁶ *Ibid.*

Additionally, however, coal had to be left to form barriers to separate mines on adjacent properties in order to prevent water flowing between the two. The resulting waste for these and other reasons related to the fragmentation of the surface 'involved the loss of great quantities of coal'⁴⁷ even in the seventeenth century. Moreover, those barriers implied significant losses in productivity. The drainage of the mines, a problem that 'dwarfed all others (...) in importance, and determined to a large extent the structure of the seventeenth-century colliery,'⁴⁸ should have been tackled co-operatively. Yet 'disputes without number could arise where several mine owners depended surreptitiously, and without written agreement, upon the drainage system of a rival. (...) [A coal owner] estimated [in the second half of the seventeenth century] that, if all the collieries about Newcastle had been operated as a single enterprise, the expense for drainage would have been only one-sixth of what it was.'⁴⁹ By the same token, underground layouts were poor and, according to the Reid Committee Report in 1945, 'had crippling effects on labour productivity'.⁵⁰

The fragmentation of landed property became more and more serious a problem with the growing depth of mines. In the words of a famous viewer at the beginning of the nineteenth century: 'Where a pit costs from £10,000 to £20,000 sinking, we cannot afford to sink a shaft every ten or twenty acres.'⁵¹ Levels had to become longer crossing beneath several properties. By 1925–6 the Samuel Commission estimated that on average each mine had to secure leases from five mineral owners,⁵² a time and money consuming enterprise as the following example shows:

(...) when the Staveley Coal and Iron Company was formed (...) in 1864 the directors commissioned the leading viewer from Newcastle, William Armstrong, to examine the firm's resource position. The result was his plan to acquire extensive leases on coal bearing land in the Midlands, which became the basis of company policy patiently pursued for some twenty years through tedious and protracted negotiations with a handful of landowners.⁵³

⁴⁷ Nef, *op.cit.*, vol. 1, p.341. See also Church, *op.cit.*, pp.15–16, and Fine, *op.cit.*, p.61.

⁴⁸ Nef, vol. 1, p.353.

⁴⁹ *Ibid.*, p.338.

⁵⁰ *Supple, op.cit.*, p.616.

⁵¹ Quoted by Flinn, *op.cit.*, p.88.

⁵² *Supple, op.cit.*, p.405.

⁵³ Church, *op.cit.*, p.16.

The ‘planning of the mines is influenced continuously by surface boundaries. (...) But surface boundaries have no relevance at all (...) to the proper organisation of the industry underground.’⁵⁴

Nef believed that litigation, engendered by multiple management of the same drainage area, may have been a significant part of the additional drainage costs. Validating private property rights on minerals underground always implies significant legal costs, and coal was no exception: ‘Coal mining in all ages appears to have been a peculiarly fertile source of litigation.’⁵⁵ The situation in Great Britain, however, was made much worse by a lack of an adequate legal framework:

The more we consider the state of mining law in Great Britain in the seventeenth century, the more we are likely to conclude that the coal industry expanded in spite of it. Nor is this impression offset by a consideration of the probable effects of the private ownership of minerals.

While the transfer of mineral property at the time of the Reformation undoubtedly contributed to the expansion of the coal industry in the Age of Elizabeth, the private ownership of minerals which became a principle of English law at this time was hardly an advantage to the subsequent development of mining.⁵⁶

The losses of synergy and, thus, of productivity, were everywhere apparent even in older times. In lieu of co-operation as required by geology, private landed property fostered litigation. Surface boundaries were as arbitrary to coalmining as those imposed by the period of tenure. Both caused serious obstructions to the development of productivity, and more so with growing mine depth, and both required an appropriate legal framework to be tackled. What is more, the problem caused by one was reinforced by the other. Co-operation required a long-term time horizon, common to all participants. Indeed, leases became longer as mine depths increased, yet the legal framework was, and remained, hopelessly inadequate.

Nationalization of Royalties

Nevertheless, even in these conditions the technological development of productivity was vigorous enough not only to make up for depletion, but even for a slow and steady growth of

⁵⁴ Samuel Report quoted in *Supple*, op.cit., p.405n3.

⁵⁵ Nef, vol. 1, p.286.

⁵⁶ Nef, vol. 1, p.341.

productivity (measured by yearly output per employee) – up to the early 1880s. Then productivity started to decline. At the eve of the Second World War productivity was back to the level of 1830. What is more, British coal production peaked definitively in 1913, with 287.5 million tons, and employment peaked in 1920, with 1.25 million people.

The decline of productivity in the British coal industry since the early 1880s was in stark contrast with the development of productivity elsewhere in Europe and the United States.⁵⁷ With the exception of the United States, the British resource base remained superior, but the advantage of public ownership on the Continent made up for the difference with growing mine depths.

For some decades prior to 1914 the demand for coal grew world-wide at about 4 per cent annually but only 2 per cent in the UK. Between 1913 and 1937 the growth of world demand slowed down to a mere 0.3 per cent.⁵⁸ In the UK production actually decreased. Domestic consumption, in 1913, was 183.8 m. tons; in 1946 it was nearly exactly the same: 183.5 million tons. Overseas shipment, however, declined from 97.7 million tons to a mere 9.2 million tons. The British coal industry was no longer competitive internationally and had lost its share in world markets.

Private mineral property became critical. The almost complete lack of a satisfactory legal framework is not difficult to explain. Whatever the legal reforms that might have been envisaged, one thing is clear: they would always have entailed some kind of restriction to private landed property rights moving towards a situation more similar to public mineral ownership. The shape and extension of licences, or concessions, may be adjusted according to technical criteria. Where different licensees or concessionaires cover the same mineral deposit, seams, reservoirs, or geological structure, the concentration of the mineral ownership in one hand makes co-operation easier, or even legally binding. Yet in the British parliament landlords were very strong, and even dominant in the House of Lords, able to block any initiative to restrict their property rights. What is more, to make co-operation compulsory under certain circumstances encountered difficulties not only among the landlords but also the tenants. This is inevitably the case wherever producers are required by a new law or regulations to cooperate, but it was particularly difficult in the case of British coal as the entrepreneurship was as fragmented as private landed property.⁵⁹

⁵⁷ For some data see Church, *op.cit.*, p.774, and Supple, *op.cit.*, p.192.

⁵⁸ Supple, p.280n3.

⁵⁹ In 1913, there were over 1400 firms and over 2600 mines. Supple, *op.cit.*, p.361.

Furthermore, it was short-term oriented, and it could not be otherwise with leases about to fall in, on average, within fifteen to twenty years. No industrial leadership developed. Tenants, too, failed to promote adequate legislation.

For this reason, initiatives finally had to come from outside. This implied that they had to come very late, only after the problem had become critical even to third parties, i.e. consumers and governments,⁶⁰ too late, indeed, given the long lead-times of structural adjustments. It is the lack of evolution in the legal framework of coalmining that eventually led to *nationalization*, or *unification of royalties*, the take-over of unworked coal into public ownership.

The nationalization of royalties became part of the Liberal Party's programme in the 1880s,⁶¹ and in 1891 the Trade Union Conference called for the nationalization both of royalties *and* the mines.⁶² But only after the poor performance of the coal industry during the First World War and its inability to increase supply even after the war with extraordinary high price levels, was it finally generally recognized that private mineral ownership had become a serious problem. In 1919, the government appointed a Royal Commission of Inquiry 'equally representative of miners and owners',⁶³ which agreed unanimously on the nationalization of royalties 'on the grounds that the fragmentation of private ownership and decision-making led to inefficiency in the use of a natural resource'.⁶⁴ Prime Minister Lloyd George, a Liberal, announced that the government would seek public ownership of royalties and foster regional mergers of colliery companies.⁶⁵

There was still a last minute attempt to reform. But landlords and tenants resisted successfully all compulsory measures, without which nothing serious could be done. Reform had definitively failed. Finally, in 1935 the Conservative government committed itself to the 'unification' of royalties, as the nationalization of coal royalties was officially called. It was enacted in 1938. To handle the very complex process, 1 January 1939 was established as

⁶⁰ W. Stanley Jevons in his book *The Coal Question*, first published in 1865, already foresaw the decline of productivity in British coal and discussed in detail its consequences on the competitiveness of the national economy.

⁶¹ Church, *op.cit.*, pp.506-7.

⁶² Fine, *op.cit.*, p.52.

⁶³ Supple, *op.cit.*, p.124.

⁶⁴ *Ibid.*, p.136.

⁶⁵ *Ibid.*, p.137.

'valuation date' but 1 July 1942 as 'vesting date'. Compensation payments amounted to £80.888 million.⁶⁶ Over half of the sum went to 114 claimants who received more than £100,000 each; of the rest, almost 8000 drew less than £1000 each, and only 1300 were paid more than £5000, there being 13,482 claimants in total.⁶⁷

By the Coal Act of 1938 the unworked coal was vested in a Coal Commission. Leases continued in force as before, but it was to the Commission that the groundrent had to be paid and which would re-negotiate or renew the leases. Being thus the only lessor, theoretically it was in a strong position to promote amalgamations, concentration, and the modernization of British mines.

Nationalization of Mines

In the event, before the Coal Commission was able to act, it was obliged by the outbreak of the Second World War to concentrate on output. The industry's performance was even worse than in the earlier war and this time seriously threatened the war effort. The potentially disastrous decline in production during the war motivated the Ministry of Fuel and Power to appoint in 1944 a Technical Advisory Committee (Reid Committee). It reported in March 1945 concluding that 'the thorough reorganisation of the Industry requires the examination of the problems on a coalfield basis rather than mine by mine'.⁶⁸ In addition, it continued:

it is not enough simply to recommend technical changes which we believe to be fully practicable, when it is evident to us, as mining engineers, that they cannot be satisfactorily carried through by the Industry organised as it is today. (...) it is evident to us that it is not possible to provide for the soundest and most efficient development and working of an area unless the conflicting interests of the individual colliery companies working the area are merged together into one compact and unified command of manageable size.⁶⁹

All the members of the Committee were mining engineers, most of them with senior managerial experience in the coal industry. Strong public action was certain to follow. What is more, the general backwardness of the industry affected working conditions as well, and coal mining was a highly labour-intensive industry. Industrial relations had been appalling for decades, but had deteriorated further during the inter-war period after big strikes and lockouts. The victory

⁶⁶ Ashworth, *op.cit.*, p.25.

⁶⁷ Fine, *op.cit.*, p.56.

⁶⁸ Quoted by Supple, *op.cit.*, pp.617-8.

⁶⁹ Quoted in *Ibid.*, p.618.

of the Labour Party in the General Election of July 1945 made inevitable the nationalization of British coal, then still the most important industry in the country. Royalties had been nationalized too late.

Global compensation payments accorded in 1946 amounted to £394 million. The industry's assets, however, excluding ancillary or subsidiary investment, were officially estimated at £164.66 million.⁷⁰ Thus the capital invested in coalmines was, in nominal terms, just twice the amount of the capitalized ground-rent, estimated a few years earlier at £80.888 million. In real terms the difference was somewhat less. This is roughly in line with the distribution of profits between landlords and tenants. In the mid-nineteenth century the profit split was still favouring the landlords by a significant margin: 60:40; but on the eve of the First World War it had already come down to 40:60.⁷¹

Conclusions

The essential features of British coal leases were a reservation royalty, fines, certain rents, and rental payments. In spite of having evolved over centuries, by 1938 this process was still not complete. In the long run the tonnage royalty would have had to be displaced by a percentage royalty. Moreover, the problem of reversion was never directly addressed at all.

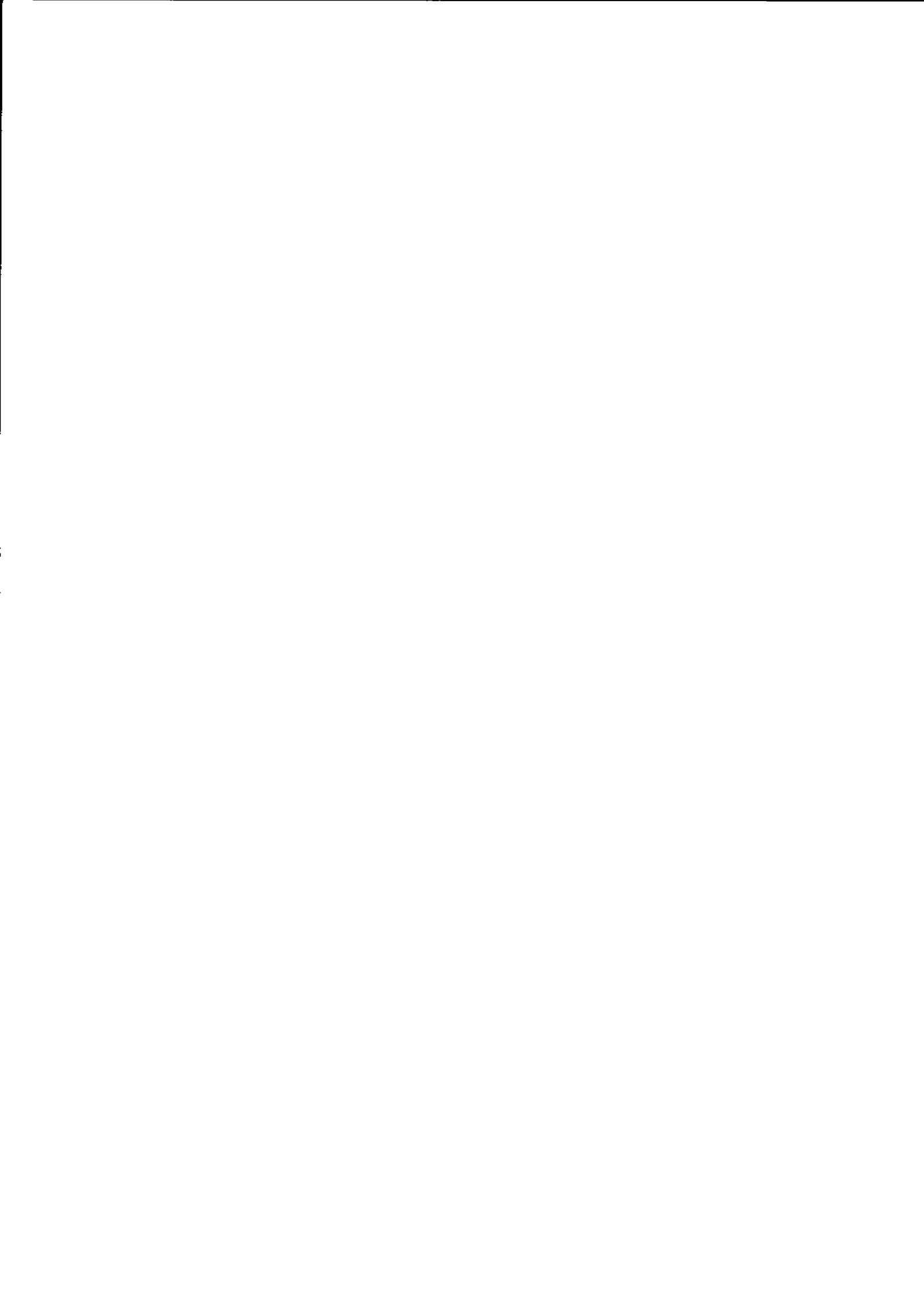
Towards the end of the nineteenth century the reservation royalty represented, as we have seen, approximately one-fifteenth of pithead prices, that is 6.7 per cent. According to one author, 'even had royalties been abolished completely (...) the elasticity of demand for coal (...) suggests that the long-term consequences would have been unlikely to have afforded an appreciable stimulus to the industry, either by increasing the volume of mineral extracted or by expanding the supply of capital.'⁷² From this viewpoint, then, the outcome would have been lower prices and a slight increase in demand. Yet royalties represented only the tip of the iceberg. A successful evolution of the landlord-tenant relationship in British coal would have required a coal industry able to generate, in a process parallel to the evolution of the contracts, the necessary legal changes required by depletion and increasing mine depths. It is in that political dimension that the

⁷⁰ Ashworth, *op.cit.*, p.28.

⁷¹ Church, *op.cit.*, pp.54, 530-2.

⁷² *Ibid.*, p. 15.

landlord–tenant relationship in British coal ultimately failed. Over many decades, and even centuries, inefficiencies accumulated at the economic, legal and political level. Perhaps the most important of those accumulated inefficiencies was a short-sighted entrepreneurship as fragmented as private landed property, and as unable and unwilling to promote innovations and reforms as the landlords themselves. The British coal industry, radically reduced but thoroughly modernized, was re-privatized by a Conservative government in 1994. Of course, public mineral ownership was maintained and *never* questioned again. Today, the private industry is based on a licensing system, a licence extending over 99 years, the natural resource being a free gift of nature – or should we say of government? – although, the licensees have to pay, symbolically, a peppercorn rent.



5. AMERICAN OIL¹

The history of the landlord-tenant relationship in American oil is not only much shorter than that of British coal, but it is also much more clear-cut. American petroleum production started all of a sudden as a modern industry with exploration and depletion being essential features from the beginning. For this reason the development of a reservation royalty, a process that took several centuries in British coal, took less than two decades in American oil.

Early Oil Leases²

Before the 1850s there was already a market for crude oil used for medical purposes. A very small market, it was supplied from surface leakages. But in the 1850s a new market developed: kerosene for lighting. It was first derived from coal-oil, an intermediate product derived, in turn, from coal. Yet kerosene derived from crude oil was of much better quality. Hence, there was a potentially big and fast growing market for crude oil if it could be produced on a large scale. It was with that market in sight that the first commercial oil well was completed in 1859 in Pennsylvania.

The oil reservoirs were privately owned. The settlers in their advance westwards appropriated with the surface the minerals as well.³ Until 1909 anyone could pre-empt a tract of land on the public domain to search for and produce oil, and after spending a minimum amount on the land could then become the proprietor.⁴ But where oil production began, close to the populous East Coast, private property was already well established. In more remote regions the problem was transportation. Up to 1879, when long-distance pipelines were introduced, only short gathering lines were in use. The oil was barrelled and brought to the next railway station on horse carriages.

All in all, the new industry was based on leases. 'Of the total of 1.56 million acres of oil

¹ This chapter draws heavily on Mommer, *Die Ölfrage.*, op.cit., Ch. 1.

² For the history of American oil see Williamson *et al*, *The American Petroleum Industry*, op.cit.

³ Robert Peele, *Mining Engineer's Handbook*, 1918, pp.1468-74.

⁴ Lester Charles Uren, *Petroleum Production Engineering*, vol. 3: *Petroleum Production Economics*, 1950, p.188ff.

property in 1890 (...) approximately four-fifths was leased.⁵ The remaining one-fifth was bought privately or acquired from the public domain. Farmers or other landowners engaging in oil production were rare.⁶ The first reported oil lease was signed in Pennsylvania in 1853, on a property where oil was leaking to the surface. A really speculative undertaking, the lease provided for a 50:50 split of profits.⁷ The lease with the first successful oil well, signed in 1859, established a fixed royalty of \$4.20 per barrel.⁸ Its success triggered a run on all potential oil lands in the neighbourhood:

The amount paid for a lease at this time depend upon the size of the tract and locality. For a two-acre lease on Oil Creek near Titusville, a landowner received a \$200 cash bonus and one-fourth to one-half the oil. At less desirable points, the owner received a bonus of \$25 to \$50 and one-third to one-eighth royalty. Many secured leases during the winter of 1859 for one-tenth of the oil and, in some cases, a still smaller percentage, and no bonuses; but such advantageous terms could not be made after the spring of 1860, for prices quickly and steadily advanced in the better localities.

While the terms of leases varied, a leaseholder usually agreed to commence drilling at once and proceed with all due diligence to drill a hole, possibly a four-inch one, 200 feet deep unless he found a vein before reaching that depth (...). Leases ran for as long a period as the parties might agree; many of them expired in twenty years; some extended to forty, and a few were granted in perpetuity.⁹

Moreover, the royalty had to be delivered to the landowners free of any charge in barrels, but this practice was declared illegal in 1862.¹⁰ In the first year, the price of a barrel of oil varied wildly, from as high as \$20.00 a barrel to as low as \$0.10(!); the latter price caused an acute shortage of storage and transportation facilities. Bonuses and royalty rates varied accordingly. But in the following decade a royalty of 50 per cent seems to have been the usual rate, and even at that rate it was highly profitable to produce oil. According to an estimate made in 1865, a pumping well yielding twenty barrels per day still broke even at \$2.37 per barrel. Taking into account dry holes (at that time four out of every five wells drilled) and the average life expectancy of producing wells (eighteen months), the break-even price rose to about \$6.35. Actually, prices ranged in

⁵ Williamson, *op.cit.*, vol. 1, p.760.

⁶ *Ibid.*, p.89.

⁷ Paul H. Giddens, *The Early Petroleum Industry*, 1975, Part II, p.2.

⁸ *Ibid.*, Part I, p.51f.

⁹ *Ibid.*, Part I, p.63.

¹⁰ Williamson, *op.cit.*, vol. 1, p.93.

1865 between a low of \$4.00 and a high of \$10.00 a barrel.¹¹ There was enough room for high bonuses on promising prospects, and even higher royalties. In some cases royalty rates reached 75 per cent, with bonuses as high as \$2000 per acre. Later, with royalties fixed at 50 per cent, bonuses went up to \$4000 and even \$10,000 per acre. Furthermore, typical leaseholds were progressively reduced from one to eight acres in the early years, to one-half acre, containing as many as three wells, at mid-decade.¹²

A few years later productivity had increased significantly. By 1871 the average life expectancy of producing wells was about three years and only five out of eight wells drilled were dry. Average production costs had fallen sharply. 'Thus on a 20-barrel-a-day pumping well with royalty still at a 50 per cent, the owner could recoup all expenses, including his "share" of the incidence of dry holes, with crude selling at \$2.20 per barrel, compared to \$6.35 (...) in 1865.'¹³ Prices at this time ranged between \$3.25 and \$5.25. Hence, it paid to pump wells yielding sometimes less than four barrels per day. As a matter of fact, the average daily yield of some 3275 producing wells in that year was only between five and six barrels.¹⁴

Producing oil was becoming an ordinary business. Prices, around \$20 a barrel in 1859, came gradually down. 'From 1874–85 the average yearly price of crude per barrel ranged from a high of \$2.58 to a low of 78¢; average for the period was approximately \$1.25.'¹⁵ Lower transportation costs and new techniques increased competition between landowners; the usual royalty rate came down to one-eighth. Moreover, the average life of a well during this period increased to seven years, and dry holes averaged only 12.5 per cent. Now, even wells of small yields – the average was 3.5 barrels a day – could be profitable.

Reservation Royalty

The first reported lease agreed on a 50:50 profit-sharing. Given the absolutely speculative nature

¹¹ Ibid., pp.158–9.

¹² Ibid., pp.123, 161n.

¹³ Ibid., p.159.

¹⁴ Ibid., p.159.

¹⁵ Ibid., p.375.

of the venture, this is hardly surprising. 'If we split a pie once, we are likely to agree on 50:50.'¹⁶ Some kind of 50:50 split remained the focal point during the following years. As the production of oil turned out to be extraordinarily profitable, a 50 per cent royalty became the standard in the 1860s – a 50:50 split, not of profit but of gross produce, with all costs paid by the lessee. But supply of oil-bearing lands increased steadily, and so did productivity, forcing prices and royalty rates down. By 1880 a one-eighth royalty had become well established.

Leases were, and still are, often executed on standard printed forms available from stationers in most oil-producing regions.¹⁷ The first printed forms of oil leases were published in Oil City, Pennsylvania, around 1870, and it already contained the one-eighth royalty.¹⁸ It has been claimed that this royalty rate was an overall proxy for a 50:50 profit split: 'Experience shows that a one-eighth royalty takes about half of the profits in the average case (...).'19

While a standard royalty of one-eighth developed in Pennsylvania, in other regions, of higher natural productivity – in Ohio and Indiana, for example – a standard royalty of one-sixth prevailed. American experts, acting as advisors to the Venezuelan government in 1942, have claimed that this royalty rate was intended, too, as a proxy for an overall 50:50 profit split.²⁰ Nevertheless, although the royalty rate of one-sixth survived, up to the present, as regional Nash equilibria, the one-eighth royalty eventually displaced nation-wide the idea of 50:50 as a focal point. This happened notwithstanding the fact that the western Pennsylvania wells, where the reservation royalty of one-eighth developed, were small high-cost producers, and the wells of Oklahoma or Texas, where oil was discovered much later, were much more prolific.²¹

In the early 1960s the landlords' share of profits in American oil and gas production was

¹⁶ Rasmusen, *op.cit.*, p.36.

¹⁷ Uren, *op.cit.*, p.165.

¹⁸ S.H. Glassmire, *Law of Oil and Gas Leases*, 2nd ed., 1938, p.56.

¹⁹ Uren, *op.cit.*, p.170.

²⁰ Preamble of the 1943 Hydrocarbon Law, quoted by Luis González-Berti, *Ley de Hidrocarburos*, 1967, p.16.
'Según los numerosos y esmerados cálculos hechos, ese 16 2/3% sobre la explotación..., equivale, en nuestro país, aproximadamente, por término medio al 50% de los beneficios.'

²¹ Harvey O'Connor, *The Empire of Oil*, 1955, p.61.

estimated, including *all* groundrent payments, at about one-third.²² Of course, on lands which at first appear more promising, things could be different:

Although the typical royalty is 12½ per cent, both the royalty percentage and the lease bonus are open to negotiation. Royalties as high as 50 per cent and bonuses of \$1000 an acre have been offered on property where production is assured by surrounding development. (...) the lease bonus depends on 'how promising the prospect looks to the lessee, and on competition from other parties' (...), while, it is often claimed, the royalty rate appears to be 'extraordinarily rigid' (...).²³

A reservation royalty of one-eighth had developed as a practicable groundrent-collecting device. The vague guiding principle in the background, some kind of a 50:50 split, fell into oblivion.²⁴

Period of Tenure

But what happened when leases fell in before the reservoirs were depleted? This question found an immediate and radical answer with the escheating of the first leases. The landowners were prevented from taking advantage of reversion by court rulings in the 1880s. Contractual provisions providing that the lessee might not remove machinery and equipment from the land in order to maintain the property in good working condition were declared unlawful:

The courts held that all machinery, as well as the casings of the wells, were trade fixtures and removable by the lessee within the term. Therefore, while the lessor had the lessee at a disadvantage in contracting for renewal, the lessee might in turn remove all fixtures and well casings, and leave the property in such a condition that the lessor would have to grant a second lease of the premises on terms approximately the same as if the wells had not been

²² Alfred A. Kahn, 'The Depletion Allowance in the Context of Cartelization', *The American Economic Review*, vol. 54, June, 1964, p.290.

²³ Davidson, vol. 53, op.cit., pp.103-4.

²⁴ The 50:50 principle can be found everywhere in the history of leases. For example, the sharecropping by equal parts was once predominant in Medieval Europe and experienced the most diverse interpretations and specifications throughout its history: 'The most common division has been that into two equal parts, whereof one belonged to the Peasant and the other to the Proprietor. It is this that has given rise to the name of *Métayer* (*medietarius*) or Peasant with equal share. In the arrangements of this kind which are to be found in the greater part of France, the Proprietor makes all the advances of the cultivation; that is to say, he furnishes at his own expense the labouring cattle, the ploughs and other instruments of husbandry, the seed and the maintenance of the Peasant and his family from the moment when the latter enters on the *métairie* until the first harvest.' Anne Robert Jacques Turgot, *The Formation and the Distribution of Riches*, 1898, p.22. In Germany the commonest surname is Mayer (also written as Meier, Maier or Meyer) which derives from *metayer*. On the other hand, the 50:50 principle became very important in the international landlord-tenant relationship. See Mommer, *Die Ölfrage*, op.cit., *passim*.

drilled.²⁵

The court ruling which outlawed the practice of landlords claiming their royalty barrelled free of charge has already been referred to. This ruling on reversion points in the same direction: landlords might claim whatever groundrent they wanted but were not allowed to put their hands on the capital of their tenants. Yet this is precisely what would have been necessary to make reversion effective! Backed by the courts, the tenants were in a position to impose an indefinite period of tenure. Moreover, they were strong enough to remove from the contracts any specific obligation actually to explore the land. Thus, they could succeed in leasing lands at no cost at all, or at very low rentals, and then monopolizing them in perpetuity. In 1900 the Supreme Court declared this practice illegal; for a contract, to be lawful, must satisfy the legal requirement of mutuality. Lease contracts were modified accordingly. Now a fixed term, called a 'primary term' or 'exploration period' – usually between ten and fifteen years – became usual. If operations for the drilling are not commenced within a specified period, for example one year, a 'delay rental' has to be paid. If oil is found and production actually is started, a 'thereafter' clause provides for a 'secondary term': the lease will remain in force as long as oil is produced in 'paying quantities'. If production is not started before the end of the primary term, or if production is suspended on a later date, the lease falls in.²⁶ Hence, leases are normally never renewed and remain in force until the definitive depletion of the reservoirs.

Fragmentation of Private Landed Property

Groundrent

In the early 1860s landowners were in an extraordinarily strong position as oil was believed to exist only within a small area where it had been leaking to the surface. They were strong enough not only to get a 50 per cent royalty and high bonuses, but to subdivide their properties in pieces as small as half an acre. Leasing only one of them, for example, once oil was struck they benefited from keen competition on those remaining. But when it became clear that oil could be found elsewhere their position weakened and they were forced to rent their entire property.

²⁵ W.L. Summers, *The Law of Oil and Gas*, 8 vols., Kansas City, Vernon Law Book Co., 1938–39; as quoted by Williamson, *op.cit.*, vol. 1, p.762.

²⁶ Robert E. Sullivan, *Handbook of Oil and Gas Law*, 1955, p.69ff.

Even so, however, the existence of oil beneath a property can be proved by exploration on neighbouring lands. The landowner who has not yet leased his lands is then in a strong position:

Once a discovery well has been drilled in a new area, competition is keen for 'open leases', not yet signed. The owner of well-situated acreage, who has refused to lease until this stage, may then be in a position to exact a large bonus and a high royalty.²⁷

For this reason, the tenants would normally not start exploration without covering the whole area with leases in order to benefit fully from a discovery:

(...) most of the larger oil companies are well organised toward this end. Usually this responsibility is delegated to a land department (...) well versed in the techniques of leasing practices (...). When the geological department recommends an area for testing, the land department will be commissioned to negotiate the necessary leases. Landowners in the area will be approached with circumspection in order to avoid undue excitement tending to inflate land values and making the task for negotiating leases more difficult. The landowner being as a rule more or less unfamiliar with the oil business and susceptible to the popular belief that huge profits are the rule is apt to be unappreciative of the risks involved and the great cost of making a test. Accordingly, he is inclined to ask more than his lease is worth. The oil-company agent must patiently explain to the owner the financial risks that are involved and the advantages gained by completing an agreement on terms that will justify a test and, if successful, encourage efficient exploitation.²⁸

This explains why in 1935, for example, 93.5 million acres were under lease, but only 9.9 million were 'proven acreage'.²⁹ There was a permanent flow of new acreage leased and old acreage surrendered, but at that time 4 or 5 million more acres were leased each year than were surrendered. Such a leasing strategy also made it possible to locate exploratory wells optimally according to geology and ignoring surface boundaries. It implied the payment of delay rentals over huge areas but this was the only way to guarantee that the lessors would fully benefit from any discovery. Thus, while ex-ante Ricardian rents were normally next to nil, ex-post Ricardian rents fell to the tenants and not to the landowners. On the other hand, a landowner not renting his land at this stage had to take the risk of never receiving any groundrent at all if explorations on neighbouring lands proved unsuccessful.

All in all, in 1959–60, for example, about 18.5 per cent of total capital expenditure in oil and gas was merely payment to landowners for the right to probe beneath their soil, or some 10

²⁷ Uren, *op.cit.*, p.172.

²⁸ *Ibid.*, pp.168–9.

²⁹ *Ibid.*, p.156.

to 15 per cent of gross revenues. They were thus nearly as important as royalties averaging 15 per cent.³⁰ Yet these 10 to 15 per cent include signature bonuses paid beyond the reservation groundrent and, therefore, only a fraction represents actual reservation utilities for the search permits. That still means that the reservation utility in exploration is quite important! This is somewhat surprising because usually they are considered to be low and, as far as I know, no study pays attention to them. The problem is, I believe, that there is a bias resulting from the fact that in *successful* leases the reservation utility in exploration may be, indeed, of minor consequence.

Productivity

Fragmentation of private landed property is a much more serious technical problem in petroleum production than in any other extractive industry. There are huge savings to be made searching for oil according to geology and ignoring property boundaries. Even more is to be gained by exploiting the reservoirs, once discovered, as a geological unit. What makes oil different is that it is a liquid, frequently driven by gas pressure, able to migrate over long distances if reservoirs are properly treated. Under these circumstances oil produced on one property may come from a neighbouring property miles away.

As nobody knew where the oil was actually coming from, the courts upheld the 'rule of capture'. In other words, when it was stated earlier in this paper that oil reservoirs in the USA were privately owned, this was not entirely correct. The landowners actually did not own the oil underground but had a right of appropriation. As a result, the owners of properties covering the same reservoir and their tenants were competing to produce as fast as possible and as long as there was any profit. It was even out of the question to locate wells optimally, according to technical criteria, within a property. They were to be located close to the boundaries to prevent the oil from flowing to the neighbouring lands as well as to siphon off the oil from them. In lieu of co-operation there was destructive competition. In lieu of low costs and high recovery factors, there were high costs and low recovery factors. Only a small percentage of the oil underground was actually recovered.

Yet in the earlier days this was largely due not only to fragmentation of private surface property but to ignorance as well. But scientific and technological development, most prominently in the field of geology, made it possible to assess with an ever increasing precision

³⁰ Kahn, *op.cit.*, p.290. The average royalty includes public lands and waters where generally a royalty rate of one-sixth prevails.

the characteristics of every reservoir. It was then possible to exploit it optimally, that is, to locate the producing wells according to geology minimizing costs and maximizing profits. It became, too, more important to do so as drilling depth increased, and deep wells were more costly.

Incidentally, the percentage of oil recovered from each reservoir was maximized as well or, to put it differently, the percentage of oil definitively lost was minimized. It is from this perspective that the unitarian approach to oil production became known as oil or petroleum *conservation*.³¹ The issue became prominent when the USA, after the First World War, became an oil-importing country for a short period after decades of being the world's biggest oil exporter.³² An important oil producer, Henry L. Doherty, campaigned for legislation to make unitization compulsory. But the fear of an oil shortage vanished with big discoveries in California, Oklahoma, and East Texas. Now prices collapsed as the 'rule of capture' typically generated boom-and-bust cycles. The waste of the natural resource was most conspicuous in East Texas where small landed property prevailed. The economic waste of wells drilled like fences along property boundaries was well publicized by the press (documented with photographs) as well as the damage caused to the reservoirs by overdrilling. The effectiveness of *petroleum conservation* as a political slogan was thus boosted by the unambiguous interest of big producers in 'price stabilization'.³³ Legislation developed in the most important oil-producing states. Its centrepiece was prorationing, and the most famous committee in charge of executing such a policy was the Texas Railroad Commission. Although prorationing was aimed in the first place at price stabilization, its legality was upheld by the Supreme Court in 1932 on the ground of its efficiency as a method of petroleum conservation.

What this legislation basically did, was to determine maximum efficient rates (MER) for every well, a maximum not allowed to be exceeded. What is more, the output for non-marginal wells could be reduced according to market demand. At the same time legislation developed establishing, for example, minimum acreage for new wells. In 1948 this was held to be about 20 acres, but double this figure in 1970. Thus, on small properties no well may ever be drilled but

³¹ See Wallace F. Lovejoy and Paul T. Homan, *Economic Aspects of Oil Conservation Regulation*, 1967; and Stephen L. McDonald, *Petroleum Conservation in the United States: An Economic Analysis*, 1971.

³² The USA became definitively a net importer of petroleum and products in 1947.

³³ It is a well-known fact that this was part of a world-wide set-up. See Paul H. Frankel, *Essentials of Petroleum*, 1946, p116ff.

the landlord would still get the royalty. Indeed, the 'rule of capture' was gradually abandoned and royalty paid according to the origin of the oil, as established by experts.

Although unitization was promoted, it was not made compulsory. Moreover, as marginal wells were exempt from prorationing, there was an in-built tendency towards replacing, wherever this was possible, a more productive well for a number of marginal wells. What could have been done with a more radical approach to conservation can be seen from the following example. In the mid-1950s about 9 per cent of US petroleum production came from unitized fields. It was estimated that the recovery factor of these fields was increased, on average, from 27.5 to 46.3 per cent. Pressure maintenance techniques were crucial, but they could only be applied with unitization. It was estimated that compulsory unitization would have increased the nation-wide average recovery factor of one-third by about 40 per cent.³⁴

Two big producers of the East Texas giant field proposed in 1962 to reduce the number of producing wells, with unitization, from 17,200 to 1500, being 15,700 wells, technically speaking, superfluous. The proposition was turned down by the Texas Railroad Commission. The same fate suffered a more modest proposition in 1965 to reduce the number of wells to 9500.³⁵ Adelman estimated that half of the 200,000 oil wells in Texas were superfluous.³⁶ In 1956, according to estimates made by Standard Oil of New Jersey, \$370 million were spent in new and superfluous wells in Texas alone, equivalent to 35¢ per barrel.³⁷ As the average wellhead price that year was \$2.79, this was precisely as much as the one-eighth royalty. In other words, the waste of money due to the fragmentation of private landed property, and of producers, was as important as royalty. This does not take into account, however, the accumulation of inefficiencies. Globally and nation-wide, Adelman estimated the waste at about 80¢ per barrel.³⁸ This was about 30 per cent of average wellhead price and thus similar to total groundrent

³⁴ Melvin G. de Chazeau and Alfred Kahn, *Integration and Competition in the Petroleum Industry*, 1959, pp.230-44.

³⁵ Lovejoy and Homan, *op.cit.*, p.121.

³⁶ Adelman, 'The World Oil Outlook', *op.cit.*, p.56.

³⁷ de Chazeau and Kahn, *op.cit.*, pp.230-44.

³⁸ Morris A. Adelman, 'Efficiency of Resource Use in Crude Petroleum', *The Southern Economic Journal*, vol. 31, no. 2, October, 1964, p.122.

payments estimated, in 1959–60, at 25 to 30 per cent of the industry's gross revenues.³⁹ In other words, for every dollar paid as groundrent, about another dollar was lost by higher production costs to be attributed to private landed property – the existing legislation on conservation notwithstanding.

Conclusions

The success of reform in the case of oil is to be explained, too, by the peculiarities of oil and gas production. Landowners and tenants working on the same reservoirs were inevitably tied together, whether they liked it or not. A landlord refusing to rent his land could not prevent his neighbours from producing and, hence, siphoning off *his* oil. On the other hand, structural changes of the industry were relatively easy to achieve. The 'life-index' of an oil well in Texas, between 1947 and 1962 for example, was only 12.5 years. This is short compared with the life-index of a coal mine! What is more, whereas in coal mining the inefficient underground outlay entails long-term consequences, there is nothing like this in oil and gas. Once a well is abandoned and sealed, that is that. Thus, conservation legislation could be relatively effective within a few years.

But there were also the court rulings and legal reforms, which all in all favoured the tenants and made it possible to resolve radically the problem of reversion and renewal of leases. Moreover, there was an industrial leadership in petroleum production – of world-wide importance – able to promote legislation to contain the damage that fragmented private landed property might otherwise have inflicted and, too, strong enough to confront small producers opposing prorationing.

The story ends in about 1970, when American crude oil production peaked with 9.6 million barrels daily. It is now down by some 30 per cent, due to depletion on *private* lands. Production on public lands and waters actually increased and now represents one-third.⁴⁰ In the USA nobody has ever seriously challenged private mineral property in oil and gas; the question has always been one of reform. Nevertheless – as the history of British coal tells us – this does

³⁹ Kahn, *op.cit.*, p.290.

⁴⁰ American Petroleum Institute, *Basic Petroleum Data Book*, vol. XV, no. 2, July, 1995; Section IV.

not exclude new reforms, even radical ones, in the long-term future. After all, according to technological development and necessity, there may still be a significant amount of oil to be recovered from the reservoirs under private lands if private mineral property rights are restricted accordingly.

6. CONCLUSIONS

To adapt private landed property rights to the dynamics of coal production was certainly much more difficult a task than in oil, not only politically but also technically. With the benefit of hindsight it is clear that the British coal industry required significant reforms decades before the 1870s when productivity began to decline. But there was very little discussion on reform until output started to decline forty years later. In oil, on the other hand, conservation legislation developed forty years ahead of the peak of production in 1970. This was not simply due to political differences; in the case of oil, problems were obvious, immediate, general, and easy to observe by everybody on the surface. Nevertheless, it took seventy years to develop legislation on conservation. It was much more difficult to know what was going on in coal with increasing mine depths! Furthermore, reforms had a relatively immediate effect in the case of oil, but not coal. Even after nationalization of the mineral *and* the mining companies, it still took decades to modernize British coal mines. In fact, many were never completely modernized, they were simply closed down. Only the modern ones were finally re-privatized.

It is precisely due to this kind of problem that public mineral ownership has generally been upheld world-wide. Wherever it has become part of private landed property for historical reasons, society has to pay twice. Not only groundrent, but also increased production costs are significant – indeed, according to the case studies in this paper, they are much more important than groundrent itself. This is definitely the case in oil, conservation legislation notwithstanding, where detailed studies and estimates of unitization v. fragmentation exist. In the case of coal there are only isolated observations and no systematic study, although detailed records do exist of the problems which the nationalized industry inherited from the era of private mineral property. However, there is the experience of public ownership on the Continent where coalmining was successful despite a much poorer natural endowment. All the evidence suggests that fragmented landed property was finally much more of a problem in British coal than in American oil. The creation of groundrent by private mineral property only represents the tip of the iceberg; its crippling effect on productivity may be much more important.

Reservation groundrents developed under very different historical circumstances. Nevertheless, the outcome was basically the same. Once established, it was and is extraordinarily stable. The inertia of a large and complex structure of long-term contracts embedding reservation groundrents guarantees an equilibrium able to resist even strong disturbances over longer periods.



7. OUTLOOK: PUBLIC LANDS AND FISCAL SYSTEMS IN OIL

Until the mid-twentieth century over 50 per cent of world petroleum production came from the United States, and almost all of it from private leases. At present the USA contributes only 12 per cent to world output and, as already mentioned, one-third comes nowadays from public lands. As virtually all production outside the United States comes from public lands as well,¹ they possibly supply as much as 92 per cent of world petroleum today and this percentage is still increasing. Thus, the future of private oil leases is of limited interest. The interesting case today is public lands with their fiscal systems, politics thus playing a central role in the determination of ground-rent in international oil.

As a matter of fact, the instability of ground-rent has characterized events on world petroleum markets over the last forty years and, in my opinion, will continue to do so in the foreseeable future. During the twentieth century new, huge findings of low-cost oil have concentrated increasingly in Third World countries. With falling transportation costs they have generated very high Ricardian rents. Nevertheless, what these countries finally got after the Second World War was the same ground-rent as landowners in the USA and, on top of the royalty, an income tax of the same level as was then usual in America. By chance, the total, quite neatly, amounted to a 50:50 profit split. In other words, the most productive oil fields in the world paid the same ground-rent and the same taxes as marginal oil fields in the USA. Not surprisingly, the oil-exporting countries asked for higher ground-rents. After joining OPEC they succeeded in creating their own level of reservation ground-rent, basically through a system of tax reference prices. As Adelman put it, they created a 'price floor'.² What is more, in the early 1970s they used this structure as a powerful lever to lift up the floor radically.³ This came as a complete surprise to petroleum economists who had all accepted Adelman's verdict that the 'whole problem of rents and royalties is superfluous to the determination of price'.⁴ Accordingly, they never

¹ Private mineral ownership existed in two other important producing countries: Romania and Mexico. The latter country nationalized the reservoirs in 1917, and the former in 1947.

² Adelman, *The World Petroleum Market*, op.cit., p.211.

³ For a detailed description see Mommer, *Die Ölfrage*, op.cit., Chs 6, 7, and 8.

⁴ Adelman: 'The World Oil Outlook', op.cit., p.109.

included the landlord/tenant relationship and OPEC in their price models.⁵ They could afford to do so in the past because this relationship had been extraordinarily stable, but now it had become the most volatile and important element of prices. As late as the beginning of 1970, Adelman still predicted falling prices over the next fifteen years – based on low marginal production costs in the Persian Gulf.⁶

With the nationalization of the international tenant companies after the events of 1973 the fiscal system in OPEC countries became largely irrelevant, and the access of private investors to the land was completely blocked. The power of the cartel of landlord states was temporarily magnified by its power as a cartel of producers. OPEC tried to impose price levels far above what the market could ever accept. At present oil-exporting countries are forced to re-open their lands to private – foreign – investment and, in some cases at least, they may even be on the verge of re-privatizing their national oil companies. Consequently, new fiscal systems have to emerge. The central questions of course, concern the reservation ground-rent these systems will define implicitly or explicitly, and the amount of land that will be supplied. At this moment consumer countries and international oil companies are in a very strong position to ask for large plots of land and zero marginal rents. So far one outstanding success has been the licensing round in Venezuela in January 1996, where 18,000 km² were on offer.⁷

I believe that the turmoil caused by an unstable international landlord–tenant relationship in the world petroleum market over the last forty years will continue. A stable relationship would require some kind of agreement, whether formal or not, on a reservation groundrent for oil-exporting countries. And regardless of any diplomatic side-shows, there is not the slightest evidence that anything of this kind will happen in the foreseeable future. At present international tenants and consumer countries are as uncompromising over minimizing groundrent as OPEC was formerly over maximizing groundrent.

⁵ For example, 'The various types of rental payments will not be included in this study as part of the cost of crude because they are not causative elements in the establishment of price.' Paul G. Bradley, *The Economics of Crude Petroleum Production*, 1967; p.10.

⁶ Adelman, *The World Petroleum Market*, p.77.

⁷ See my forthcoming paper on the new Venezuelan oil policy.

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