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STATE-FEDERAL RESOURCE RENT TAX RIVALRY:
THE QUEENSLAND RAILWAYS AND THE
FEDERAL EXPORT TAX

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STATE-FEDERAL RESOURCE RENT TAX RIVALRY:
THE QUEENSLAND RAILWAYS AND THE
FEDERAL EXPORT TAX*

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A B S T R A C T

This paper presents a stylised account and analysis of the implications of the intergovernmental tax rivalry which arises between the Queensland and Federal governments in their efforts to tax resource rents.

In particular, coal is taxed explicitly through the Federal export levy and implicitly through the Queensland railways "excess rail freight".

A game-theoretic environment thus arises. It is shown that if each government sets its tax rate optimally in reaction to the other government's tax policy, then less revenue is generated at a higher deadweight cost. The optimal co-operative solution is compared to the non-co-operative equilibrium and the resulting welfare gains are identified.

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I. INTRODUCTION

Australia's resources wealth provides an important tax base for both the State and Federal governments. Inevitably, however, two governments taxing the same base gives rise to a series of distortions. First, there are deadweight costs associated with any non-neutral tax policy adopted by either government. Second, there are additional deadweight losses generated when one government's tax policy takes into account the reaction of the other government. In such a game-theoretic setting the unco-ordinated fiscal policies of the two tax authorities can be doubly inefficient. In order to investigate this proposition in the Australian context, we focus upon a stylised account of the efforts by the Queensland and Federal governments to generate revenue from the Queensland coal industry.

There is an interesting rivalry here. The Constitution (sections 51, 88,90) gives only the Commonwealth the authority to tax exports and levy taxes on production. The federal excise tax on coal is a nominal 15¢ per metric tonne of coal sold locally or exported. However, the federal export tax ranges up to \$3.50 per metric tonne for hard coking coal. In the twelve months ended June 1981, revenue from the coal export duty on Queensland coking coal was \$71, 364, 478 on exports of \$148, 212, 522. (In comparison, the excise tax raised only \$477, 746.)⁽¹⁾

The local government is not permitted to impose a production tax or an export duty. However, coal must be transported and the Queensland government runs a railroad monopoly.⁽²⁾ Rail freight rates are negotiated separately for each mining project and consist of capital costs, operating costs, and the State's profit. The latter component - known as "excess rail freight" - is set by the Treasury as a flat rate per tonne. The government's policy seems to be to charge what the market

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Errata

Page 1 paragraph 2 should read as follows:

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will bear and, for example, over the twelve months to November 1980 profit to the state was more than 60 cents in the dollar for new export coal projects. And in 1979-80, the Queensland Government generated \$108,000,000 in excess rail freights from the mining industry. (In comparison, royalties generated \$72,000,000.)⁽³⁾

In this paper we utilise our stylised account of this environment in order to investigate theoretically the consequences of this particular tax rivalry. In section II we model the interdependence between state and federal tax policies. In particular we build a model in which there are some rents to be taxed away from a coal mining operation. Also, as a first approximation, we take the governments to be net revenue maximizers. Section III focuses on intergovernmental tax rivalry and sets out a non-co-operative equilibrium. We identify the deadweight costs associated with the non-co-operative solution and in section IV show that federal-state co-operation would reduce the efficiency losses. Finally we conclude with a few comments on resource rent taxes. Our focus, however, is on the implications of intergovernmental tax rivalry and not particularly on the design of an optimal resource tax program.⁽⁴⁾

II. THE INDIVIDUAL STATE AND FEDERAL REVENUE MAXIMIZING PROBLEMS

A. The State's Problem - The Railway as a Monopsonist

We consider a state government in a federal system which seeks to maximize revenue from the taxation of a given resource (coal) mined within its jurisdiction. The state is precluded constitutionally from directly taxing the resource. However, the local authority operates the railway which is the sole means of transporting the resource from the mine to the port and is thereby able to secure rents by the monopolistic provision of transportation services for the resource. Since the railway is a monopolist in transportation services, it is also in effect the monopsonistic purchaser of the resource from mine-owners.

Assume that resource extraction takes place competitively under conditions of increasing marginal cost. Choose units such that one unit of the resource requires one unit of transportation services in order to be shipped from the mine to the port, and let the unit cost of transportation be a constant, α . That is, if transportation services were provided competitively, then α would be the equilibrium price of transportation. There is however no substitute for the state owned railway as a means of transporting the resource to the port. On arrival at the port, the resource may either be sold to domestic consumers or exported.

If exported, the resource is subject to a federally imposed export tax at a rate τ . We abstract from the possibility of monopoly power in the world market and take the world price P^* of the resource as exogenous. The price received upon delivery of the resource to the port is $P^*(1-\tau)$. This is also the domestic price of the resource and, of course, is lower than the world price as a consequence of the export tax.

Denote by Q the quantity of the resource mined and shipped via the monopolistic railway to the port, and let P_m be the price received by mine-owners. The (inverse) supply function for the resource is $P_m(Q)$, where because of increasing marginal cost of extraction $P'_m(Q) > 0$. The railway exploits its captive market by choosing the quantity of coal to be shipped so as to maximize net revenue,

$$R = [P^*(1-\tau) - P_m(Q) - \alpha] \cdot Q \quad (1)$$

The usual monopsonistic profit maximizing condition obtains in that Q is chosen such that

$$P^*(1-\tau) - \alpha = MC(Q) \quad (2)$$

where $MC(Q)$ is the marginal cost of the railway's acquiring a unit of the resource from mine-owners.

Figure 1 depicts the railway's equilibrium diagrammatically. Since $P'_m(Q) > 0$, $MC(Q)$ exceeds $P_m(Q)$. $D(\cdot)$ is the domestic (inverse) demand function for coal at the port. The state authorities confront the given federal export tax τ . The equilibrium described by (2) is at the point d , where the landed price at the port of the resource net of the true transport cost α is equal to the railway's marginal cost of acquisition of the resource. The railway is then monopsonistically acquiring and shipping $\tilde{Q}$ units.

Now revert momentarily to the view of the railway as a transportation monopoly. The profit maximizing price of transportation services is $\{(1-\tau)P^* - P_m(\tilde{Q})\}$, of which α constitutes actual costs incurred in transportation and the remainder

$$t \equiv (1-\tau)P^* - P_m(\tilde{Q}) - \alpha \quad (3)$$

is an implicit resource rent tax per unit levied by the state authorities. The announced transport charge is $(t+\alpha)$.

In Figure I total resource rents potentially available at $\bar{Q}$ are given by the area $abeP^*$ less area C, of which area M accrues to mine-owners and area S is secured by the state authorities via their railroad monopoly (coal monopsony). The railroad's actual transportation costs are C.

B. The Federal Government's Problem

The rectangle F in Figure I is the federal government's revenue from its export tax. If the tax rate τ is chosen to maximize revenue receipts, then τ is the solution to

$$\max_{\tau} F = \tau P^* \{ Q [(1-\tau)P^* - t - \alpha] - D [(1-\tau)P^*] \} \quad (4)$$

where the federal government takes the state government's implicit resource tax t as given. It follows that the federal government's revenue from the export tax is maximized by choice of τ such that

$$\tau P^* [D' - Q'] + [Q - D] = 0 \quad (5)$$

That is, τ is selected so that marginal export tax revenue is zero.

III. INTERGOVERNMENTAL TAX RIVALRY

With the state and federal governments each individually seeking to maximize revenue from the common resource tax base, a game-theoretic situation arises. Each government must take into account in setting its own tax the tax levied by the other. In order to investigate the outcome of this game we must impose a solution concept.

Assume initially that the governments behave as would Cournot duopolists and so find a non-co-operative Nash equilibrium. The railway then takes the export tax as given in determining its optimal implicit resource tax and the federal government takes the railway freight charges as given in determining its optimal export tax. This behaviour is reflected in the state and federal governments' reaction functions. That is, from

equations (2) and (5) we find $t(\tau)$ and $\tau(t)$.

A. The Reaction Function of the Railway

In order to investigate the reaction function of the railway for a change in the federal government's export tax, we observe from (1) and (2) that $R_{Qt} = -P^* < 0$ and that $R_{QQ} < 0$ by the second-order condition for maximum railroad net revenue. Therefore,

$$\frac{dQ}{d\tau} = \frac{-R_{Qt}}{R_{QQ}} < 0 \quad (6)$$

That is, the railroad reduces the quantity of coal which it ships to the port, and hence reduces exports, as the export tax is increased. Furthermore, since $\partial MC/\partial Q > \partial P_m/\partial Q$ it follows that $dt/dQ > 0$, and accordingly (5)

$$\frac{dt}{d\tau} = \frac{dt}{dQ} \cdot \frac{dQ}{d\tau} < 0 \quad (7)$$

The state authority's reaction function is therefore negatively sloped and the state's revenue - maximizing implicit resource rent tax therefore decreases as the federal government increases the export tax. There is in this sense intergovernmental rivalry for the tax base. By increasing the export tax the federal government induces the state government to reduce its 'freight rate'. But the federal government also reacts to any change in the implicit resource rent tax.

B. The Reaction Function of the Federal Government

Intergovernmental rivalry for the tax base is also captured in the federal government's reaction function. From (4) and (5),

$$F_{\tau t} = \tau P^* \left\{ \frac{\partial (D - Q)}{\partial t} \right\} + \left\{ \frac{\partial (Q - D)}{\partial t} \right\} \quad (8)$$

But since domestic demand is determined by the price $P^*(1-\tau)$ which is independent of t , equation (8) reduces to the expression

$$F_{\tau\tau} = \tau P^* \left(\frac{-\partial Q}{\partial \tau} \right) + \left(\frac{\partial Q}{\partial \tau} \right) < 0 \quad (8')$$

The slope of the federal reaction function is

$$\frac{d\tau}{dt} = -\frac{F_{\tau\tau}}{F_{\tau\tau}} \quad (9)$$

$F_{\tau\tau}$ is negative as a consequence of federal revenue maximization and so equation (8') indicates that the federal government's reaction function is also negatively sloped.

C. Non-co-operative Equilibrium

The reaction functions are shown in Figure 2. Stability requires that the slope of the federal reaction function exceed that of the state reaction function in absolute value in the neighbourhood of equilibrium. The equilibrium values $\tilde{\tau}$ and $\tilde{\tau}$ respectively of the state's implicit resource rental tax and the federal export duty define the Nash equilibrium for intergovernmental rivalry with respect to the resource rent tax base. A non-co-operative equilibrium has the character of the solution depicted in Figure 1.

Since the state's application of monopsony power through the railroad and the federal government's use of an export tax are both distortionary, the procurement of revenue by either device gives rise to a deadweight loss.

In Figure 3, we essentially reproduce Figure 1 except that the true transport costs per unit, α , are now added to the P_m and MC curves. The extent of the deadweight loss is then depicted in Figure 3 if we assume that $\tilde{\tau}$ and $\tilde{\tau}$ have been determined as a non-co-operative Cournot equilibrium. The total deadweight loss associated with the state's raising of revenue R by taxing resource rents via monopoly power and the federal government's simultaneously raising revenue F with the export tax is given as $(a+b) + (A+B)$. Of this total deadweight loss $(a+b)$ is

attributable to the federal government's tax policy and the remaining loss (A+B) is attributable to the state's monopolistic determination of freight rates.

IV. FEDERAL-STATE CO-OPERATION

We now consider the consequences of co-operative behaviour between the federal and state governments in the taxation of resource rents. The instruments remain the implicit tax imposed through the railroad and the export tax.

Co-operative behaviour should, of course, dominate the non-co-operative solution. The export tax makes it less profitable for the railroad to ship coal and the railroad's effective monoposonistic pricing of the resource secured from mine-owners (or monopolistic pricing of the transportation services) reduces the quantity of the resource which reaches the port, so reducing the tax base for the federal export tax.

Joint revenue maximization by the state and federal governments entails choosing the railroad's freight rate and the export tax to maximize

$$J [Q(t), \tau] = R [Q(t), \tau] + F [\tau, Q(t)] \quad (10)$$

Consider first the equilibrium choice of the quantity of coal Q to be shipped on the railroad. This then implicitly determines the freight rate to be set. From (10),

$$J_Q = R_Q + F_Q \quad (11)$$

From equation (2) we know

$$R_Q = P^* (1-\tau) - \alpha - MC(Q) \quad (2')$$

and equation (4) indicates that

$$F_Q = \tau P^* \quad (12)$$

Consequently, substituting (2') and (12) into (11), we obtain

$$J_Q = P^*(1 - \tau) - \alpha - MC(Q) + \tau P^* \quad (11')$$

However, at the maximum, (11') reduces to

$$P^* - \alpha = MC(Q) \quad (11'')$$

This implies that for joint revenue maximization the railroad should make purchases from mine-owners until the world price net of the per unit cost of transportation from the mine to the port is equal to the marginal cost of acquisition of the resource at the mine.

In contrast to the non-co-operative equilibrium condition (2), the joint revenue maximization condition (11') encompasses no response to an export tax. This suggests that the export tax associated with joint revenue maximization should be zero. This is confirmed by the first order condition from (10),

$$J_\tau = R_\tau + F_\tau \leq 0, \tau J_\tau = 0 \quad (13)$$

F_τ is given by the federal government's non-co-operative export tax revenue maximization condition (5). From the state's revenue function, we have

$$R_\tau = -QP^* \quad (14)$$

Combining (5) and (14) in (13) yields

$$J_\tau = \tau P^*[D' - Q'] + [Q - D] - QP^* \leq 0, \tau J_\tau = 0 \quad (13')$$

Whence it follows from condition (5) that

$$J_\tau = \tau P^*(D' - Q') - [Q - D] - QP^* < 0, \tau = 0 \quad (13'')$$

characterises the solution. Consequently, joint revenue maximization requires that the export tax be dispensed with as an instrument and that all revenue be raised through the railroad monopoly.

It is evident that the co-operative solution yields higher revenue than the sum of the state and federal revenues secured in the non-co-operative equilibrium. In Figure 3, total revenue secured in the non-co-operative equilibrium is given by the sum of the areas $(R+F)$. The co-operative equilibrium, with the export tax instrument not applied, yields additional revenue $(a+c)$ even if Q remains unchanged. That is, collusive behaviour by the state and federal governments converts some of the deadweight loss incurred in the non-co-operative equilibrium on account of the federal export tax into revenue proceeds. Also, the area c which in the non-co-operative equilibrium was consumer surplus to domestic consumers is transformed into government revenue.

But there is an additional welfare gain to be gleaned. Not only would the state and federal governments do better with respect to revenue objectives if state-federal fiscal rivalry were to cease and some revenue-sharing scheme adopted, but also the deadweight loss due to revenue seeking would be reduced in the co-operative equilibrium. In Figure 4, $\bar{Q}$ is the quantity of the resource shipped by the railroad in the state-federal Nash equilibrium and $\tilde{Q}$ is the quantity shipped in the co-operative equilibrium. Removing the export tax encourages more coal to be shipped. Given the world price, the deadweight loss in the co-operative equilibrium consists of the area ϕ , while the non-co-operative equilibrium yields the additional deadweight loss $(a+b+c+d)$. In particular, $(a+b)$ is the loss due to the use of the federal export tax and $(c+d)$ is the loss due to the contractionary effect of the export tax on the equilibrium quantity of the resource shipped to the port.

V. CONCLUDING REMARKS

In this paper we have portrayed the consequences of state-federal fiscal rivalry for a resource rent tax base. In particular, we have provided a stylised account of the fiscal interaction between the state government operated Queensland railway as an instrument for setting an implicit state resource rent tax and the federal government's export tax levied on the coal which the railway transports to the port. The account is stylised in that we abstract from other tax considerations and because of the assumption that optimizing behaviour underlies the determination of both the implicit state resource rent tax and the federal export tax. Rivalry in seeking revenue from the one resource rent tax base has been shown to reduce the tax revenues which could otherwise be achieved by co-operative utilization of tax instruments. The rivalry has also been shown to increase the deadweight efficiency loss associated with taxation. So fiscal rivalry leads to less revenue being raised at a greater loss in terms of economic efficiency. Moreover, and this is important, when the instruments are the implicit tax determined through railroad freight rates and an export tax, collusive behaviour dictates that the federal export tax be abolished and that all revenues be secured through the state government's instrument of the railroad tax. What the federal export tax does is to bestow a benefit on domestic consumers due to a lower domestic price (the consumer surplus e in Figure (4)) and to tax the Queensland railway of some portion of its resource rent revenue (the area F) which is transferred to the federal government. But the additional deadweight loss incurred in generating export tax revenue lowers the aggregate tax revenue which would have been available for distribution between federal and state governments in the absence of the export tax.

So, if Queensland railway charges and the export tax are the only available tax instruments, then the federal government ought to withdraw from

fiscal confrontation and-- with an appropriate revenue - sharing agreement-- leave taxation of resource rents to the Queensland railways. But, of course, other tax tools may be superior. A resource rent tax designed to capture the entire rents associated with the mining of coal dominates the co-operative (railway tax only) solution. This is because the resource rent tax avoids the deadweight loss ϕ in Figure 4 which is due to the railway's monopolistic determination of the freight rate or, symmetrically, the loss due to the railway's exploitation of monopsony power with respect to the mine-owners. The resource rent tax converts the deadweight loss ϕ into tax revenue and captures in the form of revenue the rents in Figure 4 which remain with mine-owners in the co-operative equilibrium (Area xyz. Whether such an ideal non-distorting resource rent tax can in practice be instituted is not a matter which we shall pursue here. There is a substantial literature on this topic.⁽⁶⁾ Our focus has been only on the inefficiency of intergovernmental tax rivalry.

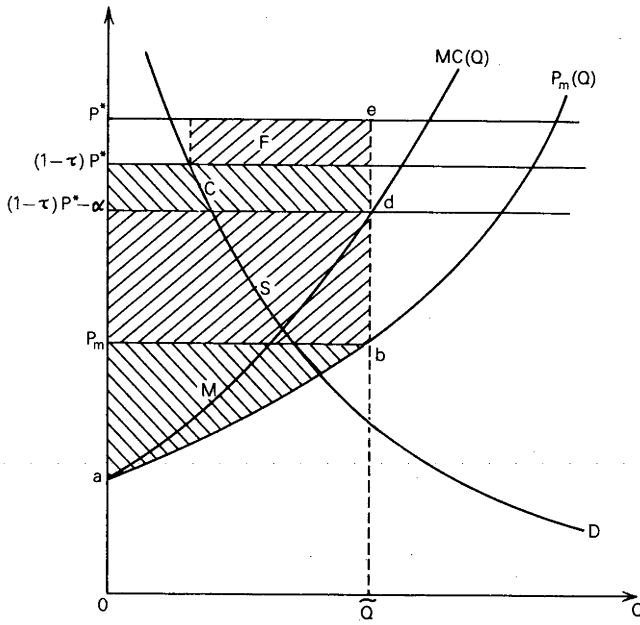


FIGURE 1

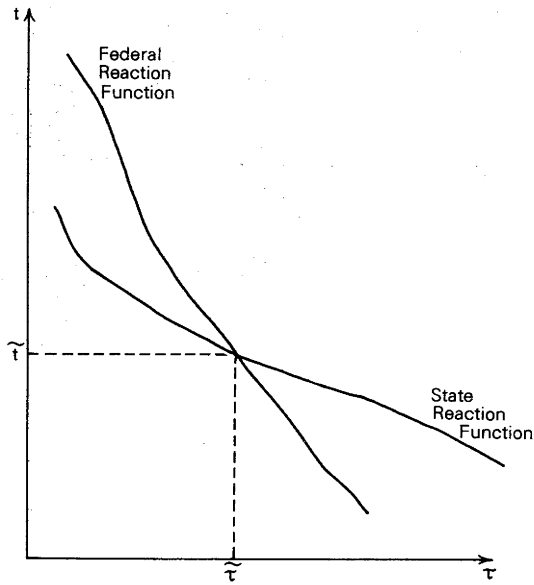


FIGURE 2

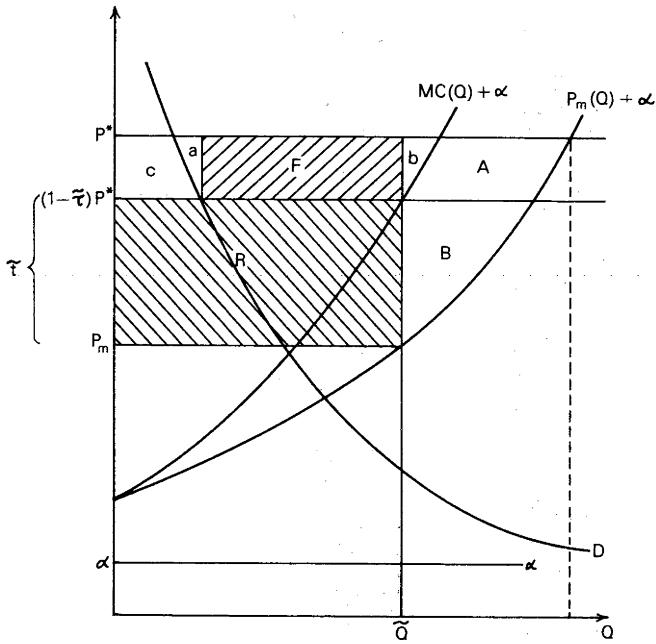


FIGURE 3

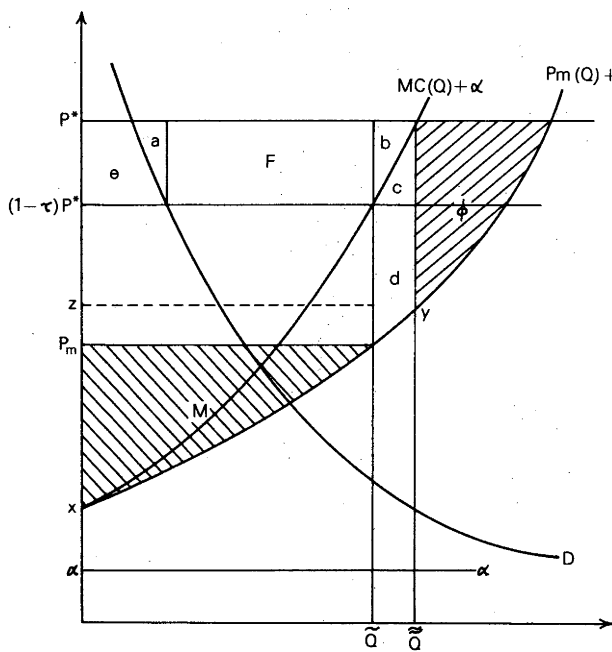


FIGURE 4

FOOTNOTES

* We are grateful for the competent research assistance of Lynne Gallagher.

- (1) See, for example, ABS (1981), Tables 10 and 8.
- (2) The railroad has the appearance of monopoly in that rail competition is forbidden and there are no closely substitutable alternatives. On the conduct and performance of the Railways Department see, for example, Sturgess (1980).
- (3) These figures may be compiled from ABS (1981) and Sturgess (1980).
- (4) For a discussion of the issues, see for example Lloyd (1981).
- (5) In monopsony analysis, a marginal expense of input curve (MEI) which rises more rapidly than the supply of input curve is usually posited as the typical case. If we write the (inverse) input supply function $w = g(x)$ then the slope of this curve is $g'(x)$ while the slope of the MEI curve is given by $2g'(x) + xg''(x)$.
- (6) In the Australian context, see for example Smith (1979). Also, see Gaffney (1967).

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