THE IMPACT OF A GOODS AND SERVICES TAX ON PRODUCT MARKET COMPETITION

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ABSTRACT

This paper explores the effects of a goods and services tax on the degree of competition in an oligopolistic industry and identifies a new mechanism through which the tax influences product market competition. The analysis focuses upon the effects of the tax in a concentrated industry and it is demonstrated that there exist circumstances under which the tax may promote competition by rendering tacit collusion more difficult.

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I Introduction

Proposals to introduce a goods and services (i.e. value added) tax in Australia have a long history. A broad based value added tax was first proposed by the Asprey Taxation Review Committee in 1975.[1] Thereafter, it has been championed by the Australian Treasury and advocated at irregular intervals over the past decade by both the Labor Party and the Liberal-National Party (Chessell (1994)). A goods and services tax will finally be introduced in Australia in July 2000. Each proposal for a goods and services tax has unleashed a wide ranging and vigorous political and economic debate on the merits of the tax. In general, the policy debates have focused on issues relating to the distributional impact of the tax, the allocative effects and the macroeconomic consequences of a switch from direct to indirect taxes (Head (1993)). However, an issue which has been largely ignored in the literature is the impact of the tax on the degree of competition in product markets. In policy terms, this is clearly an important issue. If a goods and services tax induces greater (lesser) competition, this in turn will influence the incidence, allocative effects and the macroeconomic impacts of the tax. This paper seeks to address this issue in greater detail. In particular, we present a model which isolates a hitherto unexplored mechanism through which a goods and services tax may alter the degree of competition in product markets.

In contrast to the policy debates, the theoretical literature on indirect taxes has been concerned mainly with determining the optimum design and coverage of indirect taxes. The conventional wisdom holds, that in a perfectly competitive economy, efficiency considerations dictate that goods with uniform elasticities should be taxed at the same rate (Atkinson and Stiglitz (1980)). The literature further suggests that, *ceteris paribus,* indirect taxes which are uniform in coverage are generally more efficient than partial taxes levied on particular sectors of the economy. More recent extensions have explored the impact of such taxes under imperfect competition and oligopoly. For instance, Atkinson and Stgilitz (*op cit*) demonstrate that these basic results are unaffected by the introduction of monopolistic competition. In an important development of the literature Davidson and Martin (1987) assess the effects

[1] Commission of Inquiry into Poverty (1975).

of various taxes in an economy with a tacitly collusive oligopolistic sector. They show that a value added tax may lead to greater collusion in an oligopoly if it lowers the industry discount rate. The tax therefore worsens the allocative distortions resulting from oligopolistic competition. However, as with the policy debates, none of the theoretical literature explicitly analyses the effect of a goods and services tax on competition in product markets. This paper attempts to fill this gap. It is demonstrated that in some circumstances the tax promotes competition in concentrated sectors of the economy.

We consider an oligopoly in which firms interact over an indefinite period of time, and hence have an incentive to tacitly collude by restricting output levels (Friedman (1989)). Collusion, however, gives rise to the familiar problem that each firm has an incentive to defect, when its rivals abide by the collusive agreement. To prevent such defection firms are assumed to employ the usual "grim trigger strategy". Specifically, if any firm defects, its rivals simply abandon collusion and revert to the Cournot-Nash equilibrium[2]. Clearly, this strategy will serve to deter defection if firms deviating from the tacitly collusive path suffer future losses due to retaliation, which exceed the immediate gains from defection. As is well known, if the players care sufficiently about future payoffs (i.e. have a relatively low discount rate), then this strategy supports tacit collusion.[3] In what follows, it is assumed that the discount rate is exogenously determined.

The analysis could be substantially complicated by introducing a variety of taxes, intermediate goods and extending the model to a general equilibrium context. However, we wish to argue that the existing literature has overlooked a fundamental property of a goods and services tax in an oligopoly. It is demonstrated that an increase in the tax may lead to greater competition in the oligopolistic sector and hence an expansion in output levels. To see why, observe that an *increase* in the tax rate lowers the payoffs a firm earns under both defection and tacit collusion.

[2] While Cournot punishments have the virtue of simplicity, Abreu (1986) has shown that these are not the most severe punishments. However, we ignore this issue since the basic results are unaffected when there is constrained collusion as is assumed here.
[3] Tirole (1990) suggests that it may be more accurate to refer to the equilibrium as being less competitive, rather than tacitly collusive.

However, the payoffs from collusion decline more rapidly than do the profits from defection. This occurs because prices are higher under collusion, hence firms pay more tax per unit of output when they collude, than when they defect.[4] The incentive to collude declines, and there is therefore an expansion in output levels. Hence, the tax acts as a device which generates competition. An immediate implication of this finding is that there will be an expansion in production levels which may promote efficiency and raise consumer welfare.

The remainder of this paper is organized as follows. Section II outlines the oligopoly model and describes the manner in which a goods and services tax affects the degree of competition. Section III discusses some of the empirical implications of this result and concludes the paper.

II The Oligopolistic Sector

For simplicity the analysis is restricted to a duopoly. Thus, there are assumed to be two firms labeled i and j who produce a homogenous good (denoted X) and compete using quantities as the strategic variable. The price which consumers confront is given by $P(X, t)$[5]; where $X = x_i + x_j$; x_i is the output of firm i (i = 1, 2), ($i \neq j$) and t is the goods and services (i.e. value added) tax. It is assumed that the inverse demand function $P(X, t)$ is twice continuously differentiable and that:

$$\frac{\partial P(X,t)}{\partial x_i} < 0 \qquad (i = 1,2)\ (i \neq j) \qquad (1a)$$

$$\frac{\partial^2 P(X,t)}{\partial x_i^2} < 0 \qquad (i = 1,2)\ (i \neq j) \qquad (1b)$$

Good X is produced using two inputs denoted K and L, which are purchased in competitive factor markets at prices v and w, respectively. Production is assumed to

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[4] This outcome is driven by the same factors which lead to the familiar result that, the greater the price, the greater the revenue per unit of output raised by a value added tax. Similarly, if a quantity based tax and a value added tax affect output in the same way, the value added tax raises greater tax revenue when price exceeds marginal cost (Varian (1992)).

[5] P(X,t) is the price paid by consumers of the good. The price received by the duopolists is therefore P(X,t)(1- t).

involve constant returns to scale. The cost function of firm i (i = 1, 2) can thus be expressed as:

$$C_{xi} = c_x(v,w)x_i \qquad (i = 1,2)\ (i \neq j) \qquad (2)$$

It is assumed that $c_x(v,w) > 0$ and that the government levies a tax at rate $t > 0$. The profit function is therefore given by:

$$\Pi_i = (P(X,t)(1-t) - c_x(v,w))x_i \qquad (i = 1,2)\ (i \neq j)\ (3)$$

Profits are concave in each firm's output: $\partial^2\Pi_i/\partial x_i^2 < 0$.

For future reference we begin by defining the symmetric one-shot Cournot Nash equilibrium output level, denoted x_i^n:

$$x_i^n \in \text{Arg}\max \Pi_i^n \qquad (4a)$$

where $\Pi_i^n \equiv [P((x_i^n + x_j^n),t)\ (1-t) - c_x(v,w)]\, x_i^n$; (i = 1,2) (i ≠ j).

As noted earlier it is assumed that firms interact repeatedly over an indefinite period of time and hence have an incentive to tacitly collude by restricting output levels (see Friedman (1989)). Collusion, however, gives rise to the familiar problem that each firm may defect, when its rival colludes.. Specifically, suppose that firm i (i = 1, 2) sets some collusive output level $x_i^c < x_i^n$. Then its rival $j \neq i$ maximizes its one period profits by defecting and producing at an output level:

$$x_j^d \in \text{Arg}\max \Pi_j^d \qquad (4b)$$

where $\Pi_j^d \equiv [P((x_j^d + x_i^c),t)\ (1-t) - c_x(v,w)]\, x_j^d$; superscript d denotes defection and c collusion.

As is well established in the literature, such defection can be deterred by adopting a credible threat of future retaliation. We assume that firms employ the familiar “grim trigger strategy” to deter cheating. This strategy requires that both firms abide by the collusive agreement so long as there is no defection. If any firm defects, collusion is abandoned and the firms revert to the one-shot Cournot-Nash equilibrium. For tacit collusion to be sustainable the following incentive compatibility constraint must hold for each firm:

$$\Pi_i^d - \Pi_i^c \leq \frac{1}{r}(\Pi_i^c - \Pi_i^n) \qquad (5)$$

where: r denotes the discount rate; Π_i^d is defection profits, Π_i^c is collusive profits and Π_i^n is Cournot -Nash equilibrium profits.

The left hand side of (5) represents the one-period gains to a firm from defection, while the right hand side defines the net present value of future collusive profits foregone when the punishment is delivered. Clearly when equation (5) is satisfied, the discounted gains from collusion are no less than those from defection and firms therefore have no incentive to defect. Tacit collusion is therefore sustainable.

More formally, the most collusive sustainable level of output is defined by the solution to the problem:

$$\underset{x_j}{\mathrm{Max}}\, \Pi^c \equiv \Pi_i^c + \Pi_j^c \qquad (6a)$$

$$\text{subject to: } \Gamma_i \equiv \Pi_i^d - \Pi_i^c - \frac{1}{r}(\Pi_i^c - \Pi_i^n) \leq 0 \quad (i = 1, 2)\ (i \neq j) \qquad (6b)$$

Equations (6a) and (6b) suggest that each firm chooses the most collusive output level which is consistent with the absence of defection by its rival. Define $x_j^m \equiv \frac{X^m}{2} \in$ Argmax Π^c, as each firm's share of output at the unconstrained joint profit maximising output level. In what follows, we focus only on those equilibria in which the constraint in equation (6b) binds and holds as an equality. In the parlance of Friedman (*op cit*) this is referred to as a “balanced temptation equilibrium”. Observe that when the constraint binds as an equality, production is at the most collusive *sustainable* level.[6] For future reference we define the critical discount rate r* at which the constraint in (6b) binds:

[6] With a binding constraint it is possible to explore the impact of marginal tax changes on the incentive to collude. The approach adopted here and the assumption of a binding incentive compatibility constraint is widely employed in the supergame literature. Some examples include Davidson and Martin (1985), Shapiro (1990), Damania (1994). The rationale for this follows from Lemma 1.

$$r^* \equiv \frac{\Pi_i^c - \Pi_i^n}{\Pi_i^d - \Pi_i^c} \tag{6c}$$

In what follows we focus only on the properties of the constrained equilibrium when collusive output levels lie in the interval $x_i^c \in (x_i^m, x_i^n)$ (i = 1,2), (i ≠ j).

Lemma 1 below outlines an important property of the equilibrium which is used extensively in what follows. The proof is in the Appendix.

Lemma 1 $\quad \frac{\partial \Gamma_i}{\partial x_j^c} < 0 \;\; \forall\, x_j^c \in (x_j^m, x_j^n) \quad (i = 1,2),\; (i \neq j).$

Recall that Γ_i represents firm i's (relative) incentive to defect. Lemma 1 informs us that an increase in firm j's output level lowers its rival's incentive to defect. To see the significance of this result consider some exogenous event (say a change in taxes), which makes defection more attractive. Lemma 1 reveals that each firm can counter its rival's greater incentive to defect, by raising its own output levels. This is because each firms' incentive to defect is negatively related to its rival's output level. Hence, in equation (6a) each firm sets output levels to maximize collusive profits subject to the condition that its rival does not defect. The solution to this problem yields the most collusive sustainable output level.

Having outlined the manner in which output levels are determined, we now investigate the effects of varying the tax rate. Lemma 2 reveals that higher taxes make defection relatively more attractive for firms. The proof is in the Appendix.

Lemma 2: $\frac{\partial \Gamma_i}{\partial t} > 0 \;\; \forall\, x_i^c \in (x_i^m, x_i^n) \quad (i = 1,2),\; (i \neq j).$

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This result can be seen to arise from the following intuitive argument. Recall that, *ceteris paribus,* collusion is only feasible if future collusive payoffs are sufficiently high. An increase in taxes, lowers the scope for earning future collusive profits. Firms therefore have a greater incentive to defect and this makes collusion less attractive. More formally, Lemma 2 suggests that when the tax rate is increased, collusive payoffs decline more rapidly than do defection payoffs.[7] This occurs because prices are higher under collusion so that, on the margin firms pay more tax per unit of output under collusion, than when they defect.

An immediate implication of Lemma 2 is that an increase in the tax leads to a less collusive equilibrium with higher output levels. This result is proved in the Appendix and summarized in the following Proposition.

Let x_i^c be the solution to the problem in (6a) and (6b). Then:

Proposition 1: $\dfrac{dx_i^c}{dt} > 0.$

Intuitively, this outcome reflects the fact that in a repeated game a value added tax has two effects. First there is the usual cost effect. The tax drives a wedge between the price paid by buyers and that received by sellers. It therefore lowers effective demand and leads to a decline in output levels. However, in an infinitely repeated game the tax also has a strategic effect. By lowering the relative payoffs from collusion, the tax increases the incentive to defect and leads to a more competitive equilibrium, with higher output levels. Proposition 1 reveals that the strategic effects outweigh the cost effects. This suggests that a value added tax imposed on a tacitly collusive industry may partially correct oligopolistic price distortions and promote allocative efficiency.

III Conclusions

This paper has analyzed a hitherto unexplored mechanism through which a goods and services tax may influence the degree of competition in an oligopoly. It was demonstrated that in a repeated oligopoly where there is constrained tacit collusion, such a tax induces firms to expand output levels. This result follows from the fact that when firms tacitly collude, they set higher prices than under defection. Hence, more tax is paid on the marginal unit of output under collusion than under defection. The tax therefore lowers the relative payoffs from collusion and leads to a more

[7] This can also be verified from the following: $|\partial\Pi^d/\partial t| > |\partial\Pi^c/\partial t|$ and $|\partial\Pi^n/\partial t| > |\partial\Pi^c/\partial t|$.

competitive equilibrium with higher output levels. This suggests that the tax may have the surprising effect of encouraging competition and promoting efficiency. This issue has been ignored in both policy and theoretical discussions of the goods and services tax. The results suggest that economies which are dominated with concentrated industries are most likely to experience the competitive efficiency gains identified in this paper. Moreover, this finding may partly explain the ambiguous results found in econometric tests of the macroeconomic effects of a switch from direct to indirect taxes (Porterba, Rotemberg and Summers (1986), Damania and Madsen (1996)). For instance, the regressions reported in Damania and Madsen (1996) reveal that a revenue neutral shift from direct to indirect taxes induces an output expansion in some OECD countries, but not others. The results presented in this paper suggest that the mixed results could derive from the competitive effects of indirect taxes in concentrated sectors. These effects could be empirically estimated by including average industry concentration as an explanatory variable to proxy for the degree of collusion.[8] This appears to be an issue which warrants further empirical research.

[8] It is, however, recognised that it is difficult to obtain consistent data on concentration measures across OECD economies.

APPENDIX

Proof of Lemma 1

Suppose that Lemma 1 is not true (i.e. $\frac{\partial \Gamma_i}{\partial x_j^c} \geq 0$). Then a decline in output levels by firm j does not induce its rival to defect. However, since output levels exceed the joint profit maximizing level x^m, it follows that this raises collusive profits (Π^c). Moreover, since $\frac{\partial \Gamma_i}{\partial x_j^c} \geq 0$, the reduction in output is sustainable. This, however, contradicts the assumption that x_j^c is the level of output at which the constraint in (6b) binds. Thus $\frac{\partial \Gamma_i}{\partial x_j^c} < 0$.

Proof of Lemma 2:

From equation (3) we know that:

$$\Pi_i^u = (P(X^u)(1-t) - c_x(v,w))x_i^u \qquad (u = n,d,c) \qquad \text{(A1)}$$

where $X^u = x_i^u + x_j^u$ = industry output

Partially differentiate with respect to t:

$$\frac{\partial \Pi_i^u}{\partial t} = -P(X^u)x_i^u \qquad \text{(A2)}$$

In a constrained equilibrium we have:

$$\Gamma_i \equiv \Pi_i^d - \Pi_i^c - \frac{1}{r}(\Pi_i^c - \Pi_i^n) = 0 \qquad \text{(A3)}$$

Thus:

$$\frac{\partial \Gamma_i}{\partial t} = P(x_i^c, x_j^c)x_i^c(1+\frac{1}{r}) - P(x_i^d, x_j^c)x_i^d - \frac{P(x_i^n, x_j^n)x_i^n}{r} \qquad \text{(A4)}$$

Rearranging (A4) observe that $\frac{\partial \Gamma_i}{\partial t} > 0$ if :

$$r = r^* > \tilde{r} \equiv \frac{P(x_i^n, x_j^n)x_i^n - P(x_i^c, x_j^c)x_i^c}{P(x_i^c, x_j^c)x_i^c - P(x_i^d, x_j^c)x_i^d} > 0 \qquad \text{(A5)}^{9}$$

where from (6c):

$$r^* \equiv \frac{\Pi_i^c - \Pi_i^n}{\Pi_i^d - \Pi_i^c} \qquad \text{(A6)}$$

Comparison of (A5) and (A6) reveals that:

$$\tilde{r} - r^* = \frac{c_x(w,v)[(p(X^n)x^n - p(X^c)x^c)(x^d - x^c) + p(x_i{}^d, x_j^c)(x^c - x^n)]}{(p(X^c)x^c - p(x_i{}^d, x_j^c)x_i^d)(\Pi_i^c - \Pi_i^d)} < 0 \quad \text{(A7)}$$

Thus (A7) implies that r = r* > $\tilde{r}$, and hence $\frac{\partial \Gamma_i}{\partial t}$ > 0.

Proof of Proposition 1:

Totally differentiating the incentive compatibility constraint for firms i and j (i = 1,2, i ≠ j):

$$\frac{\partial \Gamma_i}{\partial x_i^c} dx_i^c + \frac{\partial \Gamma_i}{\partial x_j^c} dx_j^c + \frac{\partial \Gamma_i}{\partial t} dt = 0 \qquad \text{(A8)}$$

$$\frac{\partial \Gamma_j}{\partial x_j^c} dx_j^c + \frac{\partial \Gamma_j}{\partial x_i^c} dx_i^c + \frac{\partial \Gamma_j}{\partial t} dt = 0 \qquad \text{(A9)}$$

Solving:

$$\frac{dx_i^c}{dt} = \frac{(\partial \Gamma_i / \partial t)((\partial \Gamma_j / \partial x_j^c) - (\partial \Gamma_i / \partial x_j^c))}{(\partial \Gamma_j / \partial x_j^c)((\partial \Gamma_i / \partial x_i^c) - (\partial \Gamma_j / \partial x_i^c)((\partial \Gamma_i / \partial x_j^c))} > 0 \qquad \text{(A10)}$$

To ensure that the system is stable it is supposed that the denominator:

$(\partial \Gamma_j / \partial x_j^c)((\partial \Gamma_i / \partial x_i^c) - (\partial \Gamma_j / \partial x_i^c)((\partial \Gamma_i / \partial x_j^c))$ >0;

Differentiating (A3):

$$\frac{\partial \Gamma_i}{\partial x_j^c} = (1-t)(\frac{\partial P(x_i^d, x_j^c)}{\partial x_j^c} x_i^d - (1+\frac{1}{r})\frac{\partial P(x_i^c, x_j^c)}{\partial x_j^c} x_i^c) < 0 \qquad \text{(A11)}$$

(where the sign of (A11) follows from Lemma 1). Similarly:

$$\frac{\partial \Gamma_j}{\partial x_j^c} = -(1+\frac{1}{r})[(P(x_i^c, x_j^c) + \frac{\partial P(x_i^c, x_j^c)}{\partial x_j^c} x_j^c)(1-t) - c_x] \qquad \text{(A12)}$$

Noting that in a symmetric equilibrium $x_i^c = x_j^c$:

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[9] The sign follows from the fact that $P(x_i^n, x_j^n)x_i^n < P(x_i^c, x_j^c)x_i^c$ and $P(x_i^c, x_j^c)x_i^c < P(x_i^d, x_j^c)x_i^d$.

$$\frac{\partial \Gamma_j}{\partial x_j^c} - \frac{\partial \Gamma_i}{\partial x_j^c} = -(1+\frac{1}{r})(P(x_i^c, x_j^c)(1-t) - c_x) \text{ - } (1-t)(\frac{\partial P(x_i^d, x_j^c)}{\partial x_j^c} x_i^d) \qquad \text{(A13)}$$

Upon rearrangement observe that $\frac{\partial \Gamma_j}{\partial x_j^c} - \frac{\partial \Gamma_i}{\partial x_j^c} > 0$ iff:

$$r^* = r > \hat{r} \equiv \frac{P(x_i^c, x_j^c)(1-t) - c_x}{-P(x_i^c, x_j^c)(1-t) + c_x - (1-t)\frac{\partial P(x_i^d, x_j^c)}{\partial x_j^c} x_i^d} \qquad \text{(A14)}$$

Clearly since net collusive price must exceed marginal cost for production to occur, $P(x_i^c, x_j^c)(1-t) > c_x$. Moreover equation (4b) implies that:

$\frac{\partial \Pi_i^d}{\partial x_i^d} = P(x_i^d, x_j^c)(1-t) - c_x + (1-t)\frac{\partial P(x_i^d, x_j^c)}{\partial x_i} x_i^d = 0$. Since collusive price must exceed the price under defection (i.e. $P(x_i^c, x_j^c) > P(x_i^d, x_j^c)$) then it follows that:

$-P(x_i^c, x_j^c)(1-t) + c_x - (1-t)\frac{\partial P(x_i^d, x_j^c)}{\partial x_j^c} x_i^d < 0$. Thus the denominator of (A14) is negative. Hence: $\hat{r} \equiv \frac{P(x_i^c, x_j^c)(1-t) - c_x}{-P(x_i^c, x_j^c)(1-t) + c_x - (1-t)\frac{\partial P(x_i^d, x_j^c)}{\partial x_j^c} x_i^d} < 0$. Since r = r* > 0 then (A14) always holds. Finally by Lemma 2 $\partial \Gamma_i / \partial t > 0$. Hence the numerator of (A10) is positive. Thus, $\frac{dx_i^c}{dt} > 0$.

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