การใช้ภาษีตามมูลค่าควบคู่กับภาษีเฉพาะสามารถนำไปสู่ผลลัพธ์อันพึงปรารถนาในตลาดผู้ขายน้อยรายได้อย่างไร: บทสำรวจทางทฤษฎี

HOW AD VALOREM AND SPECIFIC TAXES COMBINATION CAN YIELD THE DESIRED OUTCOME IN AN OLIGOPOLY: A THEORETICAL EXPLORATION

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บทคัดย่อ

บทความวิจัยนี้นำเสนอผลการสำรวจทางทฤษฎีในการใช้ภาษีตามมูลค่า (Ad Valorem Tax) และภาษีเฉพาะ (Specific Tax) หรือ “ภาษีแบบต่อหน่วย” (Unit Tax) กับสินค้าในระบบตลาดที่มีการแข่งขันไม่สมบูรณ์ เช่น สินค้าในอุตสาหกรรมเครื่องดื่มมึนเมาและสินค้าสาธารณูปโภค ขั้นตอนแรกได้มีการสร้างกรอบทฤษฎีสำหรับการวิเคราะห์สถานการณ์จำลองที่สำคัญสองชุด แบบจำลองชุดแรกแสดงถึงกรณีของหน่วยผลิตผูกขาดที่รัฐเป็นเจ้าของ ซึ่งกำหนดราคาตามกฎของแรมซีย์ (Ramsey Pricing) แบบจำลองชุดที่สอง แสดงกรณีหน่วยผลิตที่เป็นของเอกชนภายใต้การควบคุมของรัฐ ผู้ซึ่งเป็นผู้กำหนดอัตราภาษีทั้งสองชนิด ผลการวิจัยชี้ให้เห็นว่ามีความเป็นไปได้ที่มาตรการภาษีแบบผสมผสานสามารถนำไปสู่ผลลัพธ์ที่ใกล้เคียงกับกรณีกำหนดราคาตามกฎของแรมซีย์เมื่ออัตราภาษีตามมูลค่าเข้าใกล้ 1 นอกจากนี้ การใช้ภาษีเฉพาะและภาษีตามมูลค่าแบบผสมผสานยังสามารถนำมาเป็นเครื่องมือสำหรับภาครัฐในการปรับสมดุลในระบบตลาดเพื่อให้เกิดราคาและปริมาณของสินค้าอันพึงปรารถนาและในขณะเดียวกัน ยังสามารถทำให้รายได้รัฐบาลจากการจัดเก็บภาษีบรรลุเป้าหมายด้วย

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Abstract

This paper presents a theoretical exploration, illustrating the consequences of employing various combinations of ad valorem and specific taxes on goods in imperfect competition, such as those of the brewery and utilities sectors. Having constructed a theoretical framework for analysis, two major sets of simulations are conducted. The first illustrated the case of state-owned single firm in an economy in which Ramsey pricing is obtained. The second diverts to the case of a privately owned business governed by the state, determining the tax rates. The results indicate that there can be possible outcome close to Ramsey in privately owned business as the ad valorem tax approaches unity. Moreover, a combination of specific and ad valorem taxes can provide a tool for the government to fine-tune the desired outcome of price, quantity and, simultaneously, achieve the revenue target.

Keywords: Specific Tax, Ad Valorem Tax, Corrective Taxes, Ramsey Tax

Introduction

In a competitive economy, a firm is a price-taker, selling at a price set at marginal cost and earning a zero profit. Thus, the only variable under control is the level of output. In such case, the effects of commodity taxes are simply passed forward by the firm onto the consumers. On the contrary, prices in imperfectly competitive markets, such as those of the brewery and utilities sectors, are set at a level above marginal cost. As a result, an increase in cost stemming from taxation may not necessarily be passed on to consumers. In addition to the price effects, imperfectly competitive firms may earn non-zero profits and, hence, the effects due to taxation need to be cautiously determined.

The effects of ad valorem and specific taxes in imperfect competition are, nonetheless, not identical[1]. The calculation of the effects of taxation on price and profits, therefore, requires comparative statics of the targeted industry. This leads to different levels of the revenue earned and the welfare effects when employing each of these taxes. Consequently, the paper takes into account, in accordance with the policy-oriented viewpoint, the revenue changes and the counter-distortionary effects on the distortions caused by non-competitive behaviours. The paper continues with an assessment of the idea that the combination of the two types of taxes are at the optimal level as suggested and mentioned in Delipalla and Keen [1], Myles [2-3] and Keen [4].

The organisation of this paper is as follows. The second section reviews the literature on taxation of goods in imperfect competition. The third section presents the theoretical framework. Section IV applies the theoretical framework to the simulations. The fourth section concludes and discusses the policy implications.

Background and Theoretical Development

The taxes on goods in the context of this paper comprise of the ad valorem and the specific taxes. The analysis and comparison of the two taxes reflect one of the oldest literatures in public finance, dating back to the earlier writing of a mathematical economic pioneer, Antoin Augustin Cournot, published in 1838. The issue has been of continuing intellectual interests due to its all-time policy relevance. This is reflected by a series of new theoretical development until the present days. The findings reveal the different effects of the two taxes on considerations such as consumer's welfare, firm's profits and product quality and variety. Before continuing further, it, therefore, proves crucial to sketch the fundamental differences according to how these two taxes are defined.

As generally defined, ad valorem tax is a tax proportional to the price of the object being taxed., for example, the value-added tax (VAT). [6] Hence, the calculation of

[1] Wicksell [5] originally shows that equivalence of ad valorem and specific taxes does not hold in monopoly under constant marginal cost. In such setting, with a given level of revenue, ad valorem tax leads to a lower level of consumer price and greater output.

ad valorem tax does not require a precise quantity of the good sold, so long as its value is reflected in the price. Ad valorem tax has its well-known multiplier effect. That is, should government require an increase in tax revenue by 1 Baht per unit of good, the consumer price must increase by the amount $1/(1-t_v) > 1$, where $0 < t_v < 1$ is the ad valorem tax rate. From the producer's perspective, however, product improvements become more costly as a result of this multiplier effect. Ceteris paribus, there are suppositions that ad valorem taxation encourages relatively low quality products. Nevertheless, ad valorem taxes are often viewed as relatively fairer, due to its proportionality as compared to the lump-sum specific taxes, the burden of which falls heavily on poorer consumers who buy cheaper and lower quality goods.

Specific tax is a tax levied as a fixed sum on each physical unit of the good taxed, regardless of its price [6], for example, an excise duty on alcohol and tobacco. Although specific taxes have the administrative advantage for the simplicity of measuring quantities, the specification of the one-unit of good may be debatable in practice. Being a lump-sum tax, it does not have any multiplier effect as does the *ad valorem*. Hence, a 1 Baht increase in tax revenue requires a 1 Baht increase in consumer price. As the taxable unit of good may be debatable, an increase in specific taxation may leave out some elements in the characteristics of the product untaxed. As a result, there are suppositions that consumption will shift to these untaxed characteristics, encouraging producers to upgrade their product quality. Another way of looking at this consumption shifting is to consider the price of high-quality brand relative to that of the low-quality brand. An increase in lump-sum tax on the consumer price would lower the relative price of the high-quality brand and hence induce higher consumption trend towards the high-quality brand. Another distinction is that, unlike the ad valorem tax, expressed as a percentage of the price, the real value of specific tax can be eroded by inflation.

When relaxing the assumptions of perfect competition, there are various settings between the two extremes of perfect competition and monopoly to be chosen as a starting point. Where the point of analysis begins is based on some of the major specifications to be considered. First, the nature of the product may be homogeneous or differentiated. Second, the firms in the selected industries may choose different strategic variables, namely the Bertrand price setting or the Cournot quantity setting. Third, the objective of the firms comprising the industry may be to maximise profit either individually or co-operatively. The fourth consideration is the possibility and difficulty of new entries. These specifications differ in the vast contributions throughout the literature.

Seade [7] studies the comparative static effects of changes in cost conditions, namely the uniform excise tax, in a symmetric Cournot or conjectural-variations model of oligopoly. The symmetry assumption is eventually relaxed to consider the general homogeneous-output case. The resulting movements in individual outputs, price, profits and market structure are derived and examined. Adapting from the case of pure monopoly, a conjectural-variations oligopoly, with linear cost curve for simplicity, is analysed by considering the equation, $p/= c'/(1-1/\varepsilon)$, where p is the price, c is the firm's cost function and ε is the firm's perceived elasticity (which must exceed 1 for profit-maximum). ε is constant along the demand curve and is equivalent to $n\varepsilon^*/\lambda$ where ε^* is the true market elasticity which is assumed to be constant, n is the number of firms and l is the conjectural-variation behavioural parameter. As noted in earlier papers such as Stern [8], and Salop and Scheffman [9], it is shown that, price and profit over-shifting in oligopoly is possible. In fact, de Meza [10] has shown similar results along this line by looking at the tax incidence of the change in unit production tax with an application of the theory of derived demand.

Seade [7] further questions the ambiguity of cost rises on prices and profits in oligopoly as he wrote, "A good explanation in theory, for profit-over-shifting of cost or tax rises, (then) seems to be lacking." The aim of his paper is to show the 'characterised outcomes' and not just the possibility of the over-shifting in oligopoly. He asserts that the elasticity of the slope of demand, $-Xp''/p'$ (X is the industry's output), which is the second-order elasticity, plays an important role[2]. This elasticity of the slope of demand is represented by E whose relation with the ordinary demand elasticity, e, can be expressed as $E = 1+1/\varepsilon+\eta_{\varepsilon X}$, where $\eta_{\varepsilon X} \equiv X(d\varepsilon/dX)/\varepsilon$. This E is later referred to as "Seade's E" in papers published thereafter. In the case of linear costs and isoelastic demand curve, $E = 1+1/\varepsilon$.

The result obtained in Seade [7] provides a general characterisation of the effects of specific tax increase on output, price and profit of oligopolistic firms. As excise tax rate rises, output falls unambiguously in all stable equilibria. The consumer's price rises to the extent greater than the shift in marginal cost (ie., more than 100% shifting of tax to consumers) if and only if the E exceeds 1, which is always the case for isoelastic demands. In stable equilibrium with n Cournot firms under the symmetric assumption, E only needs to be less than $n+1$. This is always the case in oligopolistic industry with whatever market structure, n, and the behavioural parameters, λ. Consequently, the profit of each firm in the industry rises due to the increase in price more than sufficient in offsetting the fall in sales volume if and only if E exceeds a firm-specific number, rounded up to 2, and exactly 2 under symmetry.

Myles [3] sums up Seade's results and illustrates the mechanism as can be viewed in terms of convexity of the inverse demand function. Having defined the shifting

[2] Relying essentially upon the fact that the market faces imperfect competition where prices are marked up above marginal costs, the extent to which tax changes are passed on to consumers depends on the size of the price mark-up factor. Under the assumption of isoelastic demand curve, it is determined solely by the elasticity of demand and the extent to which the elasticity of demand changes as output changes, that is, the elasticity of the slope of demand, E.

parameter, and using stability restriction as formally derived in Seade [11], it is shown that the first order derivative of inverse demand function, $\partial\phi i/\partial xi$, must exceed $-X_i\partial^2\phi/\partial X_i^2$. Hence, the second order derivative of inverse demand function with respect to output, $\partial^2\phi/\partial X_i^2$, should be positive. This implies convexity of the inverse demand function. Thus, the same results as in Seade [7] are obtained, with $E = -X_i\partial^2\phi/\partial X_i^2 / \partial\phi/\partial X_i$, $E>1$ causes over-shifting, $E = 1$ full shifting and $E< 1$ under-shifting. The same result as in Seade (1985) applies for the increase in profit level as a result of an increase in tax rate where $E>2$.

Referring to Myles [12-13], Myles [14] mentions about further effects following taxation under imperfect competition. One of them is the dependence of a firm's price on goods upon the prices of goods in other firms in its own industry and the prices of any complementary or substitutable goods. These are 'induced effects'. The major implication of the findings in this paper is that there is a plausible tax design which can exploit the different rates of tax-shifting amongst industries and the profit effects so as to raise welfare level. Accordingly, this may require taxes on intermediate goods and a differentiated labour tax across industries. Newbury [15] further demonstrates that if an optimal tax on a certain good should be positive, but the good cannot be taxed, then input taxes should be a partial substitutes for the missing final taxes. Ebrill and Slutsky [16] obtains similar results of regulated industries in developing countries.

Delipalla and Keen [1] looks at the comparative effects of *ad valorem* and specific taxation compared in two models of oligopoly, one with free entry (the generalised Cournot model) and the other without free entry (the model of free entry oligopoly). The paper carries out the analysis by varying conditions of homogeneous-product oligopoly. With respect to the concept of 'matched pairs' of ad valorem and specific taxes, they focus on the effects of tax reforms having no 'first round' effect on tax revenue. They consider a tax change in the form of $Pdt_v = -dt_s>0$, where t_v is the ad valorem tax rate and t_s is the specific tax rate. The change in tax favours the balance towards ad valorem taxation whilst leaving total tax payments at the initial equilibrium price unchanged.

The finding in Delipalla and Keen [1] shows that ad valorem taxation leads to relatively low consumer price and high tax revenue. Moreover, when free entry is precluded, it also leads to low profits. With free entry, *ad valorem* taxation dominates specific taxation in terms of welfare consideration. The condition for which specific taxation raises welfare are more restrictive. This proves to be so in both models. Regarding the optimal tax structure, they address three sets of welfare and policy-related issues, having relaxed the constraint that profits be non-negative. The first issue refers to employing the tax combinations as a corrective measure to meet the required revenue under a supposition that the government has unrestricted ability to employ lump-sum tax. It has been proven that the optimal corrective tax combination requires that one of the taxes being a subsidy so as to ensure marginal cost pricing. The second issue refers to that of Ramsey problem of maximising consumer welfare subject to revenue constraint. The third issue is that of a Leviathan model which requires a tax combination that maximises tax revenue. Restricted to be non-negative, it has been proven that the optimal specific taxation required for both Ramsey and Leviathan problems is zero.

Myles [2] asserts that more can be achieved by combining both *ad valorem* and specific taxes rather than employing either of these taxes individually. The derivations show that the optimal combination of both taxes can lead to Ramsey prices[3] in a private ownership with imperfect competition. The analysis is divided into two institutional settings: state ownership (when lump-sum tax instruments are unavailable) and private-ownership (when government imposes specific and *ad valorem* taxes). The labour input is assumed to be in competitive market. The ad valorem tax reduces the gradient of the marginal revenue curve, thus, the perceived influence of the monopoly on price falls. On the other hand, the specific tax adds to the marginal cost.

Theoretical Framework

This section sets up a theoretical framework applicable for the simulation in the next section. In perfectly competitive industry, there is only price effect since all firms earn zero profits. Therefore, consumer prices increase by just the amount of the tax in the case of horizontal long run supply curve and by less than the amount of tax in the case of upward sloping supply curve. Thus, it is not possible for the amount of price increase to be above that of the tax.

The effects in the case of perfect competition do not apply when there is imperfect competition. Complexity arises when considering different forms of taxation (ie., specific and ad valorem taxes). In perfect competition, both taxes have identical effects. This equivalence breaks down in imperfect competition. In such setting, there are both price and profit effects. Thus, an increase in cost due to a change in taxation need not be reflected in an identical increase in price. When price rises by more than the amount of the tax, there is over-shifting. When it rises by less than the amount of the tax, there is under-shifting. As illustrated in Seade [7], Stern [8] and Myles [14], assuming constant marginal cost, concavity of industry demand leads to under-shifting and sufficient convexity causes over-shifting. The theoretical framework of this section is developed based on the foundation laid by earlier ones. To make applicable to an oligopolistic industry, a modification and restructuring of the model is compulsory.

[3] Ramsey price is referred to a set of price set by the government in respect of maximising social welfare, whilst collecting a specified level of revenue, not allowing lump-sum taxes or subsidies. This represents the second-best condition, given marginal cost not feasible without lump-sum subsidies.

To begin with, consideration is focused on a conjectural variation model. In congruent with the previous contributions, the model in this paper encompasses a market structure ranging from competitive outcomes to monopoly as earlier described. It is assumed that the industry consists of *n* identical firms, each producing a homogeneous good. Since symmetry is assumed, x_i, which denotes firm *i*'s output, can be expressed in terms of the industry's total output, *X*, as $x_i = X/n$. Firm *i*'s total cost of production at a given level of output is represented by the cost function $C(x_i)$. It is assumed that there is increasing returns to scale. That is, there is a non- increasing marginal cost where $x(\partial C/\partial x_i) / C(x_i) < 1$. The consumer price is represented by an inverse demand function $q(X)$[4] as expressed in equation (1)

$$q_i = \phi_i\left(\sum_{i=1}^{n} x_i\right), \frac{\partial q}{\partial X} < 0 \qquad (1)$$

Existing theoretical models show that a typical firm, *i*, earns an after-tax profit as expressed in equation (2).

$$\pi_i = \{(1-tv)q(X) - ts\}x_i - C(x_i), \qquad (2)$$

The strategic interaction amongst firms, ie., the conjectural variation, is shown in equation (3).

$$\lambda = \frac{dX}{dx_i} \in [o, n]. \qquad (3)$$

Each firm conjectures that when it changes its output x_i, other firms' responses will be λ. The value of λ is zero in perfect competition (ie., Bertrand conjecture), unity when there is Cournot conjectures and $\lambda = n$ in tacit collusion when each firm believes that all other active firms will behave in the same way as it does. The analyses in this paper assume $\lambda \in (0,n]$, of which the case of perfect competition is omitted.

[4] Myles [2] also takes into account qk, the representative consumer price of some other good, so as to consider the 'indirect' or 'induced' effects of the changes in prices and profits in industry i as a result of tax changes in industries other than i.

Through maximising the profit function in (2), the first order condition can be obtained in equation (4).

$$\frac{d\pi_i}{dx_i} = (1-tv)\left(q_i + x_i \frac{\partial q}{\partial X}\frac{\partial X}{\partial x_i}\right) - ts - \frac{\partial C}{\partial x_i} = 0 \quad (4)$$

where *tv* and *ts* are the ad valorem and specific tax rates, respectively. From equation (4), the equilibrium price, q_i^*, can be calculated as in equation (5).

$$q^* = \left(\frac{\partial C/\partial x + ts}{1-tv}\right)\left(\frac{1}{1-\frac{\partial X/\partial x_i}{ne}}\right) - \left(\frac{\partial C/\partial x + ts}{1-tv}\right)\theta \quad (5)$$

where

$$e = -\frac{\partial X}{\partial q}\frac{q}{X}. \quad (6)$$

and

$$\theta = \frac{1}{1-\frac{\partial X/\partial x_i}{ne}} \quad (7)$$

By means of totally differentiating equation (4) through varying output and tax rate, equation (8) is obtained.

$$(1-tv)\left(\frac{\partial q}{\partial x} + \frac{\partial q}{\partial X}\lambda + x_i\frac{\partial^2 q}{\partial X}\lambda n - \frac{1}{(1-tv)}\frac{\partial^2 C}{\partial x^2}\right)dx - dts - \left(q_i + x_i\frac{\partial q}{\partial X}\lambda\right)dtv = 0 \quad (8)$$

From equation (1), $\partial q/\partial x_i = n(\partial\phi/\partial X)$, the effect of the changes in specific and ad valorem tax rates on consumer price can be expressed as in equations (9) and (10), respectively.

$$\frac{dq}{dts} = \frac{1}{(1-tv)(1+\gamma(1-E+A))} \quad (9)$$

and

$$\frac{dq}{dtv} = \frac{q_i + x_i\frac{\partial\phi_i}{\partial X}\lambda}{(1-tv)(1+\gamma(1-E+A))} \quad (10)$$

where

$$\gamma = \frac{\lambda}{n},$$

$$E = \frac{-X(\partial^2\phi/\partial X^2)}{\partial\phi/\partial X}$$

as in Seade [7], and

$$A = \frac{\partial^2 C/\partial x_i^2}{(1-tv)(\partial\phi/\partial X)\lambda}.$$

The numerator in equation (10) can be expressed as in equation (11).

$$q_i + x_i\frac{\partial\phi}{\partial X}\lambda = q_i\left(1-\frac{\gamma}{e}\right) = q_i\left(\frac{1}{\theta}\right) = \Phi. \quad (11)$$

Substituting equation (11) into equation (10), the effect of the change in ad valorem tax rate on consumer price can be expressed in terms of the effect of change in specific tax on the price as in equation (10.1). That is, the effect of ad valorem tax rate on the consumer price is Φ. times that of the specific tax.

$$\frac{\partial q}{\partial tv} = \Phi\frac{\partial q}{\partial ts} \quad (10.1)$$

In order to compare the effect of ad valorem tax with that of the specific tax in the same scale, the impact on price of a unit change in tax revenue with respect to the change in ad valorem tax at initial price, ie., *qdtv*, is considered in equation (10.2).

$$\frac{\partial q}{q\partial tv} = \frac{\Phi}{q}\frac{\partial q}{\partial ts} \quad (10.2)$$

Under perfect competition, where $\theta = 1$ and $\gamma = 0$, there is a full shifting of both taxes. However, under imperfect competition, where $\theta > 1$ and $\gamma > 0$, it is possible to have under-shifting, full shifting or over-shifting. Hence, considering equations (9), (10.2) and (11), the effect of ad valorem tax becomes relatively less than that of the specific tax as the values of γ and θ increases since $\Phi/q = (q(1/\theta))/q$ which is less than 1 when $\theta > 1$ under imperfect competition . From the formula in (10.2), one could expect the results of the regressions of the price of good as dependent variable in such a way that the coefficient of specific tax should exceed that of the ad valorem tax.

It can be observed in the solutions of equations (9) and (10.2) that the effects of both ad valorem and specific taxes on price are dependent upon the ad valorem tax rate. As this paper employs the conjectural variations oligopoly model based on the previous literature, whether there is tax over-shifting or under-shifting depends on the shape of the market demand curve relative to that of the firm's marginal cost curve. Existing literature has already shown that sufficient convexity of market demand leads to over-shifting and concavity leads to under-shifting. It is now crucial to investigate each of the elements comprising the solutions of the equations (9) and (10.2). The term *A*, which is negative, is the change in the firm's marginal costs (with respect to the change in market price) caused by a change in its own output. The term *E* is referred to Seade's (1985) elasticity of the slope of demand. In the simplest case where there is constant returns to scale, ie., *A* = 0, established results show there will be over-shifting when *E* exceeds 1, irrespective of λ and *n* . In other cases, with non-linear cost curves, the degree of shifting depends on how the values of *A* and *E* will offset each other. Lastly, the term γ, defined as λ/n, represents the extent of competition perceived by the firms in the industry. The two extreme cases are when firms conjecture that the total industry output and, thus, price will not be affected by their output changes (λ = 0, γ = 0) and when the firm's elasticity of demand is identical to that of the whole market, resulting in tacit collusion and joint profit maximisation (λ = *n*, γ = 1). The role of γ is to determine the extent of over-shifting or under-shifting effect of the market elasticity of demand. This *g* becomes important when firms perceive that they have some degree of market power in which they may be able to exploit the market demand curve.

To see the effect of the tax changes on producer price in equation (12), the equation is differentiated with respect to *ts* and *tv* as in (13) and (14), respectively.

$$p = (1 - tv)q - ts \tag{12}$$

$$\frac{dp}{dts} = \frac{\partial q}{\partial ts}(1 - tv) - 1 \tag{13}$$

and

$$\frac{dp}{dtv} = \frac{\partial q}{\partial tv}(1 - tv) - q \tag{14}$$

Using equations (5), (9) and (10), equations (13) and (14) can be solved. There is under-shifting when the expressions (13) and (14) are less than zero, and over-shifting in the opposite case. When the expressions are equal to zero, full shifting results.

From equation (2), the aggregate profit function for an industry is represented in equation (15).

$$\Pi = \big((1-tv)q(X) - ts\big)X - C(x_i)X \qquad (15)$$

Thus, the effects of the change in tax rates on the aggregate profit are shown in (16) and (17).

$$\frac{d\Pi}{dts} = (1-tv)\frac{dq}{dts}X - X \qquad (16)$$

$$\frac{d\Pi}{dtv} = (1-tv)\frac{dq}{dtv}X - q(x_i)X \qquad (17)$$

By substituting the values in (5), (9) ad (10), equations (16) and (17) can be solved. Ad valorem tax rate has a direct influence on the change in the industry profit as a result of the change in both taxes. Hence, it can be observed that the ad valorem tax rate is inversely related to the industry profit. In line with the the revenue-neutral approach in Myles (1996), as ad valorem tax rate increases, consumer price is lowered.

Simulations and Results

This section presents a numerical illustration of the consequences of employing various combinations of ad valorem and specific taxes. The simulation models an economy which comprises of a government, a consumer and an industry with *n* firms producing a homogeneous output *x* and using labour as the only input. The consumer's welfare is represented by a utility function in (18).

$$U = gX - h\frac{X^2}{2} - L, \qquad (18)$$

where *U* is the consumer's utility function, *L* is the labour employed and *g* and *h* are constant. It is assumed that the labour market is competitive and the wage rate is set as a numeraire. Using the same notations as indicated earlier in this Chapter, the industry's inverse demand function is expressed in equation (18).

$$q_i = \frac{a}{b} - \frac{1}{b}X, \qquad (19)$$

where *a* and *b* are constant. It is assumed that the cost function of each firm in the industry, shown in equation (19), has constant marginal cost.

$$C(X) = C + kX, \qquad (20)$$

where *C(X)* is the cost function, *C* represents the fixed cost for which it is assumed that $C = 0$ in this simulation, and *k* is a constant marginal cost.

The working of the simulation is divided into two institutional settings. The first consideration refers to an economy in which there is a single firm owned by the government. It is assumed that the government chooses the optimal Ramsey pricing, being unable to employ lump-sum tax instruments. This represents an optimal public sector pricing of which no other policy would yield a higher welfare level. Hence, the outcome obtained from the first institutional setting can be treated as an index for considering whether the second institutional setting, discussed later in this section, could yield an outcome close or equivalent to the optimal level obtainable.

Under the state-ownership setting, the government chooses the optimal Ramsey price for the good *x* by maximising the indirect welfare utility function in (21).

$$\text{Max}_{\{q\}} V(q, Y) \text{ subject to } R + C(X) = qX(q), Y = 0 \qquad (21)$$

where *V(q, Y)* is the consumer's indirect utility function, *Y* is the lump-sum income set to be zero due to the inability of the government to levy lump-sum tax, R is the government's required revenue and the other variables carry the same notation as indicated above. By substituting (18) and (19) into equation (20), the indirect utility function that the government has to maximise in equation (21) can be expressed as a Lagrangian function in (21.1).

$$\ell = g(a-bq) - \frac{h}{2}(a-bq)^2 - L + m\big(R - C - k(a-bq) - q(a-bq)\big), \qquad (21.1)$$

where *l* is the Lagrangian function and *m* is the Lagrangian multiplier. By differentiating (21.1) with respect to *q* and *m*, the optimal consumer price, *q**, for the Ramsey model is obtained. Consequently, the equilibrium level of industry output, *X*, and consumer welfare, *V*, can be solved. Table 1. shows the results of Simulation I for Ramsey model.

Table 1. Result of Simulation I: Ramsey Pricing

Required Revenue = 1200

Parameters: $a = 185$, $b = 0.04$, $g = 1200$, $h = 0.7$, $k = 1$, $L = 70$

*Q**	*X**	*V**
7.3896	184.7044	209634.8

The second institutional setting refers to the same economy in which there is a single industry and firms are privately owned.[5] The government determines the level of *ad valorem* and specific tax to be levied. Using the previous tax model, firms in the industry will maximise the profit function expressed in (2). As for application to the beer model, the profit function in (2) will be maximised. The optimal consumer prices obtained from maximising (2) are dependent upon the values of t_v and t_s and, hence, they are denoted by $q = q(t_v, t_s)$. Consequently, the optimal profit level is represented by $\pi = \pi(t_v, t_s)$, and the consumption level $X = X(t_v, t_s)$.

In a private ownership economy with a government setting tax rates, the Ramsey price which is a solution in (4.36) can be obtained in the two models under the condition that there exists a combination of *ad valorem* and specific taxes, t_v* and t_s*, such that: (*i.*) the firm's profit is non-negative, $p(t_v*, t_s*)$ ณ 0, (*ii.*) $q* = q(t_v*, t_s*)$, and (*iii.*) $[t_v*q(t_v*, t_s*) + t_s*]X(t_v*, t_s*) = R*$, where $R*$ is the government's revenue target. [2] In simulation II which models an economy in which firms are privately owned, the combinations of *ad valorem* and specific taxes that satisfy these conditions are obtained. The results of simulation II are reported in Table 2. Table 2 shows the results of applying the original tax model to simulation II.

Table 2. Result of Simulation II: Private Ownership Economy

Required Revenue = 1200

Parameters: a = 185, b = 0.04, g = 1200, h = 0.7, k = 1, L = 70, λ = 1, n = 5

t_v	t_s	Q	X	Π	V
0.01	0.068	771.732	154.131	117593.6	176572.2
0.05	-29.559	745.784	155.169	114367.2	177705.3
0.15	-94.301	679.362	157.826	105862.8	180602.5
0.25	-145.185	610.628	160.575	96691.1	183595.4
0.5	-206.783	427.861	167.886	70463.9	191527.7
0.55	-207.03	389.296	169.428	64588.3	193196.7
0.65	-194.549	310.003	172.600	52133.8	196623.1
0.75	-163.944	227.688	175.893	38672.7	200172.6
0.85	-144.158	142.177	179.313	24114.8	203851.9
0.9	-81.720	98.164	181.073	16393.8	205742.5
0.91	-74.610	89.259	181.430	14812.5	206124.7

[5] This can be treated as an extension of Myles' [2] simulation for monopoly, with a further application on the brewery industry tax model.

Table 2. (Continued)

t_v	t_s	Q	X	Π	V
0.95	-44.053	53.279	182.869	8360.3	207668.3
0.98	-18.878	25.919	183.963	3384.2	208841.0
0.995	-5.552	12.117	184.515	851.1	209432.3
0.999	-1.915	8.422	184.663	170.5	209590.6
0.99999	-1.009	7.510	184.700	1.7	209629.6

Table 2. shows that the outcomes tend towards Ramsey pricing in Table 1 as $t_v \rightarrow 1$. That is, as t_v approaches unity, consumer prices become closer to 7.39, the corresponding welfare levels are approaching 209634.0 and the profit levels are approaching zero as in Table 2. Therefore, it is possible to obtain a combination of ad valorem and specific taxation which leads, in the limit, to Ramsey pricing and zero profit. Hence, the welfare loss caused by imperfect competition can be eliminated. The ad valorem tax reduces the gradient of the marginal revenue curve and thus, reduces the effect of imperfect competition on consumer price. On the contrary, the specific tax reduces the marginal cost at the optimal. Thus, simultaneously employing both taxes enhances flexibility for manipulating the marginal cost and marginal revenue curve to intersect at the desired level of price and quantity.

Conclusions and Discussion

The literature on ad valorem and specific taxation reveals that, despite a sufficient amount of theoretical discussion on the subject, there is relatively a small number of empirical analysis due to the difficulty to obtain micro level industry data. Moreover, the paper presents some simulation results as a theoretical exploration and exercise. This can be treated as a modification so as to make applicable for the analysis of certain industry of interest, such as those of the brewery and utilities sectors. The research shows the possibility of obtaining an outcome close to Ramsey in privately owned business of using taxes combination as ad valorem tax approaches unity. The analysis indicates several implications for the equations to be estimated for policy applications.

Nevertheless, ad valorem taxes are often viewed as relatively fairer, due to its proportionality as compared to the lump-sum specific taxes. The burden of specific taxes falls heavily on poorer consumers who buy cheaper and lower quality goods. However, there are suppositions that ad valorem taxation encourages relatively low quality products. Regarding the specific taxes, although they have the administrative advantage for the simplicity of measuring quantities, the specification of the one-unit of good may be debatable in practice. An increase in specific taxation may leave out some elements in the characteristics of the product untaxed. As a result, there are suppositions that consumption will shift to these untaxed characteristics, encouraging producers to upgrade their product quality. Another distinction is that, unlike the ad valorem tax, expressed as a percentage of the price, the real value of specific tax can be eroded by inflation. Overall, the simulations reflect the conceptual possibility that a combination of ad valorem and specific taxes can provide a tool for the government for fine-tuning the desired outcome of price and quantity and, simultaneously, achieve the revenue target in imperfectly competitive markets such as those of the brewery and utilities sectors.

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