Perfect Competition, Monopoly, Derived Demand and Free Trade.

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1 Introduction

It has been suggested that growth in South Africa is only going to be sustained if the movement towards less protection is maintained. An interesting feature of the South African economy is its market structure in many industries exhibits a bias towards monopoly. Plus there are monopsonistic elements at work complicating industrial relations within these market structures. An interesting empirical question arises in the South African context as to the effect of freer trade, with greater competition at the level of production but assuming an exogenous real wage. To this end, this paper examines the elasticity of the derived demand for labour in a calibrated model with a production function satisfying the Inada conditions. From this analysis, a conclusion can be drawn as to the impact of the nature of product demand on the difference in the elasticity of the derived demand for labour as market structure changes, given a new round of tariff reductions.

As a general rule, for a perfectly competitive firm, the optimal output level must be higher than is the case for monopoly. This means that with regular production conditions, the monopolist must use less of the variable input. As the input amount is lower for a monopolist, the elasticity of derived demand must be lower for the monopolist. In this paper we examine to what extent this general rule is true as the structure of the demand curve changes.

This is an important exercise in the context of trade liberalization and market structure as many of the theoretical models rely on linear demand structures. In the linear case, it seems intuitive that the general rule applies. However much of this research relies on the linearity assumption. Examples are Alston, Edwards and Freebairn (1988), Bean (1986) and Ross (1988). An exception would be Sauernheimer (1986). In addition, the hopes of discussions for freer trade that began in 2001 in Doha seem to have failed. Plus those currently vying for political nomination are taking the side of labour and retreating from support for free trade. The analysis here provides a reason for this in that for some demand structures, labour may be able to exploit the monopolist's inability to alter labour requirements in the face of wage demands.

2 Market Structure and Elasticities

Like Foran (1976) we begin with an inverse demand function

$p(q)$.

The production function has one variable input,

$q = f(k)$.

The response of output, as the variable input changes is

$\chi = df/dk\ k/q$.

In order for the firm to maximize profits the following condition must be met,

$r_c/p(q) = f'(k)$.

Using the above we can work out how the wage responds to changing the single variable input and is:

$dr/dk = p'(f(k))f'(k)^2 + p(f(k))f''(k)$.

The ultimate goal of this analysis is to compare the response of the derived demand for the variable input under conditions of perfect competition to monopoly. So define the response for perfect competition as ω and we have:

$\omega = r_c/k\ dk/dr_c$.

Making the necessary substitutions from the expressions for r_c and dr/dk we obtain,

$\omega = (p(f(k))f'(k))/(kp'(f(k))f'(k)^2 + p(f(k))f''(k))$.

This is the derived demand elasticity for perfect competition. We need to compare ω with the counterpart elasticity for a monopolist. However the form of the elasticity is different as the monopolist equates marginal revenue:

$\epsilon = p(q)+q\,p'(q)$,

and more specifically marginal revenue product $((p(q)+f(k)p'(q))f'(k))$ with the wage r_m. This gives the wage as

$r_m = (p(q)+f(k)p'(q))f'(k)$.

Then for monopoly the derived demand elasticity, τ, is

$\tau = r_m/k\ dk/dr_m$,

and $r_m\ dk/dr_m$ can be obtained from $r_m = (p(q)+f(k)p'(q))f'(k)$ to give the inverse elasticity for the monopolist and is,

$\tau = (f'(k)(p(f(k))+f(k)p'(f(k))))/((p'(f(k))f'(k)^2+(p(f(k))+f(k)p'(f(k)))f''(k))k)$.

The analysis above is based on Foran (1976) but differs as we derive the elasticities directly and make them a function of a single variable input. In addition, the nature of production for most of the results in Foran does not satisfy the conditions proposed by Inada (1963) and as a result the Cobb-Douglas structure is unimpeached. What is new here is the focus on the nature of the curvature of the demand curve following Malueg (1994) but tracing out the effects for the elasticity of derived demand. We now calibrate the model by specifying the production function and demand conditions.

3 Calibration of the Elasticities

To compare the elasticities ω and τ one has to know the optimal output level under each market structure. This requires specifying a production function (we use Cobb-Douglas), with the associated marginal cost. We assume constant returns to scale and this ensures that short-run marginal costs are a function of q or output. The inverse demand curve takes the following specific form;

$p(q) = a - bq^c$.

As a first step assume that c can take on the values 1,2 or 3 corresponding to the linear, quadratic and cubic cases. By way of example, the optimal levels of q under perfect competition for each of the three integer values of c are:

a/b+1, −1-√4ab+1/2b, $(2/3)^{(1/3)}/(-9\ a\ b^{(1/2)}+\sqrt{3}\ \sqrt{4\,b^3+27\,a^2\,b^4}\ )^{(1/3}$ (-9 $a\ b^{(1/2)}+\sqrt{3}\ \sqrt{4\,b^3+27\,a^2\,b^4}\ )^{(1/3)}/(2^{(1/3}\ 3^{(2/3}\ b)$.

.

One can show that all these solutions increase in a, so that one can fix a at an arbitrary level and solve for the difference in the elasticities of the two market structures, namely,

$|\tau| - |\omega|$ as we vary b *for* each of the three values of c. Notice that τ is now defined as positive value by having $|\tau|$ we must make a subtraction from $|\omega|$, giving us the possibility, depending on the value of b, that the derived demand elasticities could switch from more elastic to less elastic when comparing perfect competition and monopoly. We have one added dimension in that we consider three values of c in the inverse demand curve: $p(q) = a - bq^c$.

The next section presents the results of these procedures.

4 Results

In this section we provide the results of our calibration of the model for the various demand structures keeping track of how those structures affect $|\tau| - |\omega|$. At an intuitive level we know this expression should be negative. The question we pose here is how does $|\tau| - |\omega|$ change as we change the structure of demand. Fixing a at an arbitrary level and varying b for each of the three values of c it is possible to generate a relationship between the curvature of the demand curve and the comparative derived demand elasticities. The relationship between b and $|\tau| - |\omega|$ for each of the linear, quadraticc and cubic cases are as follows:

$a - bq$

$0.0276577\,b^4 - 0.302963b^3 + 0.977135b^2 - 0.310509b - 1.86764$

$a - bq^2$

$0.0217533b^4-0.2012b^3+0.411784b^2+0.7626b-2.04818$

$a - bq^3$

$0.00591366b^4-0.0149904b^3-0.320263b^2+1.76492b-2.15449.$

An examination of the last two terms of the above results shows that as b varies from unity to higher values the ranking of the demand structure according to $|\tau| - |\omega|$ is cubic (closest to zero), quadratic and then linear. This accords with both our intuition as the monopoly output level is closer to the competitive level and the results of Malueg (1994). Thus it is possible for an analysis of free trade to overstate the gains from trade when assuming linearity if indeed the demand curve is more concave.

5 Conclusions

We note that recently there has been a move against freer trade despite recognition in South Africa that sustained growth may require even less local protection. Indeed a neglected reason for this is the return to the variable factor, where protection maintains firm monopoly power, can rise without substitution away from that factor. Despite the obviousness of this effect, this paper links the effect to the nature of the demand curve in the industry. We find that this effect that favours, say, labour is reduced as the demand curve becomes more concave. Any analysis of trade policy in South Africa, given that growth in South Africa is only going to be sustained if the movement towards less protection is maintained, must take into consideration the nature of product demand before drawing any firm conclusions. Finally we note that a possible avenue for future research is the behaviour of firms and labour market effects when product demand departs significantly from the quadratic case.

6 References

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