Transactions Costs and the Pricing of Public Sector Information

Technical Report for the Government 2.0 Taskforce

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The main contribution of this technical paper is to consider the implications for public sector information pricing of changes in the cost of information associated with the rise of Internet. Most importantly, while costs of distribution and access have declined markedly, the transaction costs of information services have remained high.

As the costs of disseminating and accessing information have declined, the transactions costs associated with charging for access to information, and controlling subsequent redistribution have come to constitute a major barrier to access in themselves. As a result, the case for free (gratis) provision of Public Sector Information is stronger than has already been recognised.

The analysis rests on two key points. First, as noted above, the welfare costs of raising revenue through above-marginal-cost pricing are higher, the higher is the elasticity or price-responsiveness of demand facing information owners. However, the effective price faced by information users includes the cost of access to information and the transaction cost of making a purchase. The net price received by information providers excludes these items.

The second, and critical, point developed in the report is that transaction costs of purchase are a fixed cost associated with levying any positive price. Hence, a price for information that is not substantially greater than the transactions cost of purchase cannot possibly yield net welfare benefits when access and distribution costs are low. But in these circumstances, and with high elasticity of demand, the welfare costs of high prices are likely to be significantly greater than the revenue generated.

Formal analysis of information pricing

Background - the theory of monopoly pricing

The theory of monopoly pricing is important in understanding the economics of pricing for public information even though, in practice, public information providers would rarely be permitted to act as profit-maximizing monopolies. The crucial idea in the theory of monopoly pricing is that of marginal revenue.

Consider a monopolist selling a good at price p. The amount sold will be determined by consumer demand which can be summarised by a demand function $q(p)$. So, the firm receives total revenue $r = pq(p)$. The monopolist could sell more by lowering the price a little. Suppose the monopolist sells one additional unit at a lower price p'. Revenue is increased by the extra p'. However, the price must be lowered for the $q(p)$ units previously sold at price p, so that the additional revenue from the additional sale is given by $p' - (p-p')q(p)$. Using the notation of the calculus, marginal revenue for a small change near $(p, q(p))$ is given by $p - q\ \partial q/\partial p$.

The second term, representing the loss of revenue from lower prices may be rewritten in terms of the concept of the price elasticity of demand $\varepsilon_p = -p/q\ q\ \partial q/\partial p$ which measures the proportional change in quantity demanded associated with a given proportional change in price, so that with an elasticity of 2, a 10 per cent reduction in price will produce a 20 per cent increase in quantity demanded.

Rewriting, we have

$$MR = p(1 - 1/\varepsilon_p)$$

A profit maximizing monopolist will set prices so that the marginal revenue from an additional unit of sales is equal to the marginal cost of producing the additional unit. In the cases considered here, where the marginal cost of producing information is assumed to be zero, this amounts to maximising total revenue, and can occur only where e=1.

So

$p(1 - 1/\varepsilon_p) = \text{MR} = \text{MC}$

Or

$p = \text{MC}/(1 - 1/\varepsilon_p)$

It is necessary to take account of the possibility that even monopoly pricing will result in a loss, since the total revenue from sales may not cover the fixed cost of production. Thus a monopolist with fixed costs and zero marginal cost will follow a two-stage rule

(I) produce nothing if maximum revenue is less than fixed costs

(Ii) set prices to maximize revenue if the resulting revenue exceeds fixed costs.

Monopoly pricing involves a welfare loss, since people who would be willing to pay the marginal cost of producing an additional unit of the good are excluded by the fact that the price is set higher than marginal cost.

In the case of information, the marginal cost of information itself is zero (though there may be costs associated with access or dissemination), leading to Stewart Brand's famous aphorism that 'information wants to be free'. Less widely quoted is the other half of the aphorism, that, since it is valuable and its initial production is costly, 'information wants to be expensive'. The tension between the obvious benefits, and difficulty of preventing, free sharing and the need to finance the production of information, is at the centre of public policy regarding information.

If revenue from the sale of output does not cover the cost of production, the difference may be made up by a public subsidy. In particular, if a good or service is provided free of charge, its provision may be financed through direct payments. In assessing the cost of this option, it is important to distinguish between the transfer from the public in general to consumers, associated with free provision and the cost to society as a whole, consisting of the administrative costs of raising and distributing tax revenue and the efficiency loss associated with the adverse incentive effects of taxation. Estimates of these adverse effects vary, but a commonly used assumption is that the deadweight and administrative costs are around 20 per cent of the amount raised for a marginal addition to revenue. Free market advocates prefer higher estimates, ranging from 33 per cent to 50 per cent.

Information pricing with access and transactions costs

We consider a situation where a fixed cost c_0 is incurred to produce an item of information and make it available for access at marginal cost c.

Information users incur an access cost a, the cost of locating and retrieving the information item, and storing it in a usable form. If, in addition, the information provider charges a positive price p, the information user incurs a transactions cost t. The price p charged by the information provider may be written as

$p = c + m$

where m is a margin.

The information user's demand for information may be written as a function (assumed linear) $q(p^*)$ where

$p^* = a + t + c + m \quad \text{for } p > 0$

$p^* = a \quad$ for $p = 0$

is the gross cost of acquiring the information, faced by the user.

By assuming linear demand and adopting a suitable normalization, this problem, can be made tractable enough to yield sharp results using elementary geometry. We normalize by setting $a + t + c + m = 1$, for the profit maximizing choice of m so that each of a, t and c can be interpreted as a proportion of total revenue, and by setting $q(a+t+c + m) = 1$, which simplifies calculations involving elasticities.

For numerical calculations, we will focus on the case where the elasticity of demand wrt gross price $\varepsilon^*_{p^*} = 2$. This estimate is consistent with the evidence provided by Pollock (2009) and is discussed further in the Appendix.

Hence, if the information owner charges a positive price $p = c + m$, the amount of information demanded is $q(a + t + c + m)$. This yields the following welfare outcome

The information provider receives net income $R - c_0$, where $R = mq(a + t + c + m)$ is revenue net of marginal costs, and is represented by rectangle CDFG in Figure 1.

Consumer surplus is the area DEF in Figure 1, which may be expressed, in general, as an integral. For the case of linear demand, DEF is a triangle. The marginal cost borne by the information provider is $cq(a + t + c + m)$ is revenue net of marginal costs, and is represented by rectangle BCGH in Figure 1.

Transaction and access costs are given by $(a + t)q(a + t + c + m)$, the area OBHJ in Figure 1.

Elasticity with access and transactions costs

Where access and transactions costs are important it is necessary to distinguish between the gross (or transactions-cost inclusive price) $p^* = a + t + c + m$ paid by the buyer and the net (exclusive of transactions costs) $p = c + m$ received by the seller.

Now if we define the elasticity of demand with respect to net price

$$\varepsilon_p = -\partial q/\partial p \;\; p/q$$

And the elasticity of demand with respect to gross price

$$\varepsilon^*_{p^*} = -\partial q/\partial p^* \;\; p^*/q$$

And assume that, provided $p > 0$, transaction costs are independent of prices, we have

$$-\partial q/\partial p = \partial q/\partial p^*$$

So $\varepsilon_p/\varepsilon^*_{p^*} = p/p^*$

or

$$\varepsilon_p = \varepsilon^*_p p/p^*$$

Profit-maximizing pricing

Standard analysis of monopoly shows that net revenue is maximized when

$$m/p = 1/\ \varepsilon_p$$

so, from the analysis above, we have the optimality condition

$$m/p = p^*/\ \varepsilon^*_p p$$

$$m/p^* = 1/\ \varepsilon^*_p$$

In particular, for the plausible case $\varepsilon^*_p = 2$, we obtain

$$m/p^* = 1/\ 2$$

or

$$m \approx a + t + c.$$

Referring back to Figure 1, we therefore have CDFG ≈ OCGJ, We may also derive an approximation for consumer surplus, given by the area DEF, assuming linear demand. As noted above, we normalize so that, at the profit-maximizing point F, $p^* = q(p^*) = 1$. With this normalization, the areas CDFG and OCGJ are each equal to 0.5. More importantly, with this normalization, the slope of the demand curve is equal to $1/\varepsilon^*_{p^*}$ elasticity of demand with respect to gross price. Hence, for $\varepsilon^*_p = 2$, the area of the triangle DEF is 0.25. That is, for $\varepsilon^*_p = 2$ (and independently of normalization) consumer surplus DEF is equal to $0.25qp^*$, which is equal to half of the information provider's revenue net of variable cost, and also to half of sum of the variable costs incurred by producers and those incurred by consumers.

Marginal cost pricing

Now consider marginal cost pricing, that is, $m = 0$. In this case, consumer surplus is given by the triangle ECK, while the producer incurs the fixed cost c_0 and receives no net revenue. Relative to the case of profit maximization, there is a net social gain measured by the triangle GFK. This gain from marginal cost pricing is the focus of the standard economic analysis of monopoly.

For the case $\varepsilon^*_p = 2$, the triangle GFK has area 0.5. That is, the social cost of monopoly pricing is 50 per cent of the net revenue received by the information provider. . Since estimates of the social loss associated with tax revenue rarely exceed 50 per cent of the gross revenue, the standard economic analysis suggests that marginal cost pricing of public sector information will normally be preferable to monopoly pricing. The analysis presented here shows that this conclusion is valid in the presence of access and transactions costs borne by the information user.

For any given value of ε^*_p the elasticity of demand with respect to net price, the existence of access and (if prices are charged) transactions costs is to reduce $\varepsilon_p = \varepsilon^*_p p/p^*$, the elasticity of demand with respect to net price.

Optimal pricing with costly tax-financed provision

Where the fixed costs of providing information must be funded through socially costly tax revenue, and where no other externalities are present, the standard analysis suggests that the optimal price will be above marginal cost *c*, but below the profit-maximising monopoly price.

Let τ denote the welfare cost of raising one unit of revenue through taxation. A typical estimate is $\tau = 0.2$. A range from $\tau = 0$ to $\tau = 0.5$ is used in policy evaluations. The higher the value of τ, the less favorable is the evaluation of any policy requiring net public expenditure.

For any positive margin *m,* the welfare cost of foregone consumer surplus may be approximated by

$$\Delta = 0.5\, \varepsilon^*_p\, (m/(c + a + t))\, m$$

and hence, differentiating with respect to *m,* the marginal cost associated with an increase in *m* is given by

$$\partial\Delta/\partial \mathrm{m} = \varepsilon^*_p\, m/(c + a + t).$$

For an interior (positive price) solution, optimality therefore requires

$$\varepsilon^*_p\, m/(c + a + t) = \tau$$

For the preferred estimates, $\varepsilon^*_p = 2$, $\tau = 0.2$, this yields

$$m/(c + a + t) = 0.1$$

That is, assuming a positive price is charged, the optimal margin over variable costs, including access and transaction costs borne by information users is estimated at 10 per cent.

However, when transactions cost are present, the positive price solution may be inferior to the alternative of free provision of information, whereby transactions cost are avoided. We turn next to this case.

Analysis of free information

Now consider the case when the information is provided free of charge. The amount of information demanded is $q(a)$. This yields the following welfare outcome

The information owner incurs cost $c_0 + cq(a)$ and receives no revenue

Consumer surplus is the area AEN in Figure 1. Transaction cost is equal to zero, while access cost is given by $aq(a)$, the area OANP in Figure 1.

It is hard to obtain sharp comparative results between cases of free and priced information in the general case when $c, a, t > 0$. However, we can consider a number of special cases.

Special cases

To compare the welfare effects of free access, marginal cost pricing and monopoly pricing, and to understand the impact of the Internet, it is useful to consider some special cases.

***Case**:* $a = t = 0, c > 0$ (Zero access and zero transactions costs)

This is the standard case of monopoly pricing considered by economists. Costs borne by information users are disregarded and transaction costs are assumed equal to zero (more generally, small in relation to the variable costs borne by the information provider).

The case is illustrated in Figure 2. Transactions and access costs have been removed. To facilitate comparison with Figure 1, the same labelling has been retained, with the effect that some points that were distinct in Figure 1 coincide in Figure 2.

The analysis of profit-maximizing pricing and the marginal cost pricing is similar to that of the general case. Under profit maximizing pricing, consumer surplus is DEF and the information provider's revenue, net of marginal cost is CDFG as before. Under marginal cost pricing, consumer surplus rises to ECH, while the producer incurs the fixed cost c_0 and receives no net revenue. Relative to the case of profit maximization, there is a net social gain measured by the triangle GFH, reflecting the fact that information is supplied to all users whose valuation is greater than the marginal cost of provision *c*.

Free provision of information yields consumer surplus OEN, while the producer receives zero revenue and incurs variable costs measured by OBMN. Relative to the case of marginal cost pricing there is a net loss, given by the triangle KMN, reflecting the fact that information is supplied to users whose valuation is positive but less than the marginal cost of provision *c*.

So, for this case, the optimal policy in the absence of externalities and social costs of tax revenue is marginal cost pricing. As in the general case, a price greater than marginal cost will be optimal if provision is financed by socially costly tax revenue. The estimates of the previous section, suggesting an optimal markup of 10 per cent are applicable here.

Case: $a = c = 0, t > 0$ (Zero access and zero marginal costs)

Now consider the case where marginal costs of information provision, including access costs for information users, are negligible in relation to the transaction costs associated with buying information, which may be approximated by $a = c = 0, t > 0$. This case is illustrated by Figure 3. Since marginal cost is zero, free provision and marginal cost pricing coincide. [1]

[1] It would be possible to analyse marginal cost pricing as involving a trivially small, but positive, charge for information. Such a policy would clearly be suboptimal, since the transactions costs would greatly exceed the net price. However, casual observation suggests that pricing policies where the net price is small in relation to the transaction cost do arise.

The consumer surplus for the the free information policy $p = 0$ is now the entire area under the demand curve, given by OEP.

Under profit-maximising pricing (compared to free provision), information users lose

(i) the rectangle CDFG, paid to the information provider

(ii) the rectangle OBGJ consisting of transactions costs

(iii) the triangle JFP, reflecting the exclusion of information users with a positive value of information

As noted above, under the assumption $\varepsilon^*_p = 2$, the area OBGJ will be equal to the revenue obtained if the information owner sets the revenue-maximizing price . For any lower price, transactions costs will exceed revenue. Thus, even without considering foregone consumer surplus, the net social loss associated with priced access to information will be at least equal to the total net revenue. Since estimates of the social loss associated with tax revenue rarely exceed 50 per cent of the gross revenue, transaction costs alone provide a strong argument for free provision.The assumption of a linear demand curve is not required to derive this conclusion.

Turning attention to consumer surplus, the linear demand with $\varepsilon^*_p = 2$ implies that the foregone consumer surplus has an area four times that of the provider's revenue CDFG. On this analysis the social loss from non-zero pricing may be as much as five times the revenue obtained from sales. This is equivalent to a social deadweight cost equal to over 80 per cent of gross (cost-inclusive) revenue, which exceeds any reasonable estimates of the social cost of tax revenue.[2]

[2] The class of 'reasonable' estimates empirically unsustainable Laffer curve-style claims suggesting that revenue could be increased with lower tax rate. Such claims imply that the social cost of tax revenue exceeds 100 per cent.

But a linear demand curve may *underestimate* the consumer surplus lost through priced access to information. A characteristic feature of demand in the Internet economy is skewness of demand distributions, sometimes referred to as the 'long tail'.[3] That is, a large proportion of total value may be derived from information users with very low willingness to pay, simply because there are so many potential users (and so many different possible uses) of a given piece of information.

Some rules of thumb

* In any problem of information pricing, it is necessary to consider two choices

(a) whether to charge a positive price, or to provide information free of charge seek funding elsewhere (for example, from tax revenue)

(b) if a price is to be charged, how to set the price

* If transactions costs are greater than 20 per cent of the price charged, free provision, financed by tax revenue, will generally be preferable to any positive price

* If transactions costs are small, the optimal pricing policy will be to set price equal to the marginal cost of provision with a surcharge (typically about 10 per cent) reflecting the social cost of tax revenue

[3] The interpretation of the 'long tail' differs from that popularised by Chris Anderson, who focuses on the distribution of demand for heterogeneous products such as books. A demand curve for information may be regarded as representing the value of heterogeneous uses of the same information.

Concluding comments

For most kinds of publicly-provided information, including many, but not all forms of information produced by cultural institutions, the effect of the Internet has been to reduce both the access costs *a* faced by information users and the marginal cost *c* faced by information providers, while leaving unchanged (or even, when multiplier effects are taken into account, increasing) the transactions costs associated with charges for access to information. In such cases, the analysis presented above yields a strong case for free provision of information.

On the other hand, where the marginal cost of provision is high enough to necessitate a non-zero price, the existence of access and transactions costs borne by information users tends to reduce the elasticity of demand with respect to the net price paid to information providers, and therefore the welfare loss associated with prices that exceed marginal cost.,

Appendix: The elasticity of demand

Estimation of the elasticity of demand for Internet services is difficult for a number of reasons. These include which the most important is the difficulty of defining quantity measures, the speed with which new services are being introduced and prices of existence services are declining, and, conversely, the relatively slowness with which some changes in Internet usage diffuse through the population.

Much of the analysis to be presented here depends critically on the conclusion, supported by a wide range of evidence, that demand is elastic. The precise value of the elasticity, which will typically depend on the way outputs and prices are measured, is of rather less importance.

Qualitative assessment of demand elasticity is straightforward. For any good or service for which demand is elastic, a decline in price will produce, other things equal, and increase in total expenditure. Conversely, where demand is inelastic, declining prices will result in declining expenditure.

Expenditure on Internet services has grown steadily since such services became available in the early 1990s. Expenditure has increased on all margins - the number of households subscribing to such services, the number of services per household (many subscribing both to fixed-location and mobile services) and the expenditure per service. Since prices have declined steadily, the evidence supports the view that demand is elastic.

With the qualifications given above, it is useful to consider some estimates of the elasticity of demand for Internet services in general and for information. Numerous estimates, including ACMA studies for Australia suggest that the total volume of traffic on the Internet approximately doubles each year. The rate of price decline is harder to measure, but a plausible midrange estimate is that prices have declined by 30 per cent a year on average. This implies an elasticity of demand close to 2, which is consistent with a variety of estimates derived by Pollock (2009).

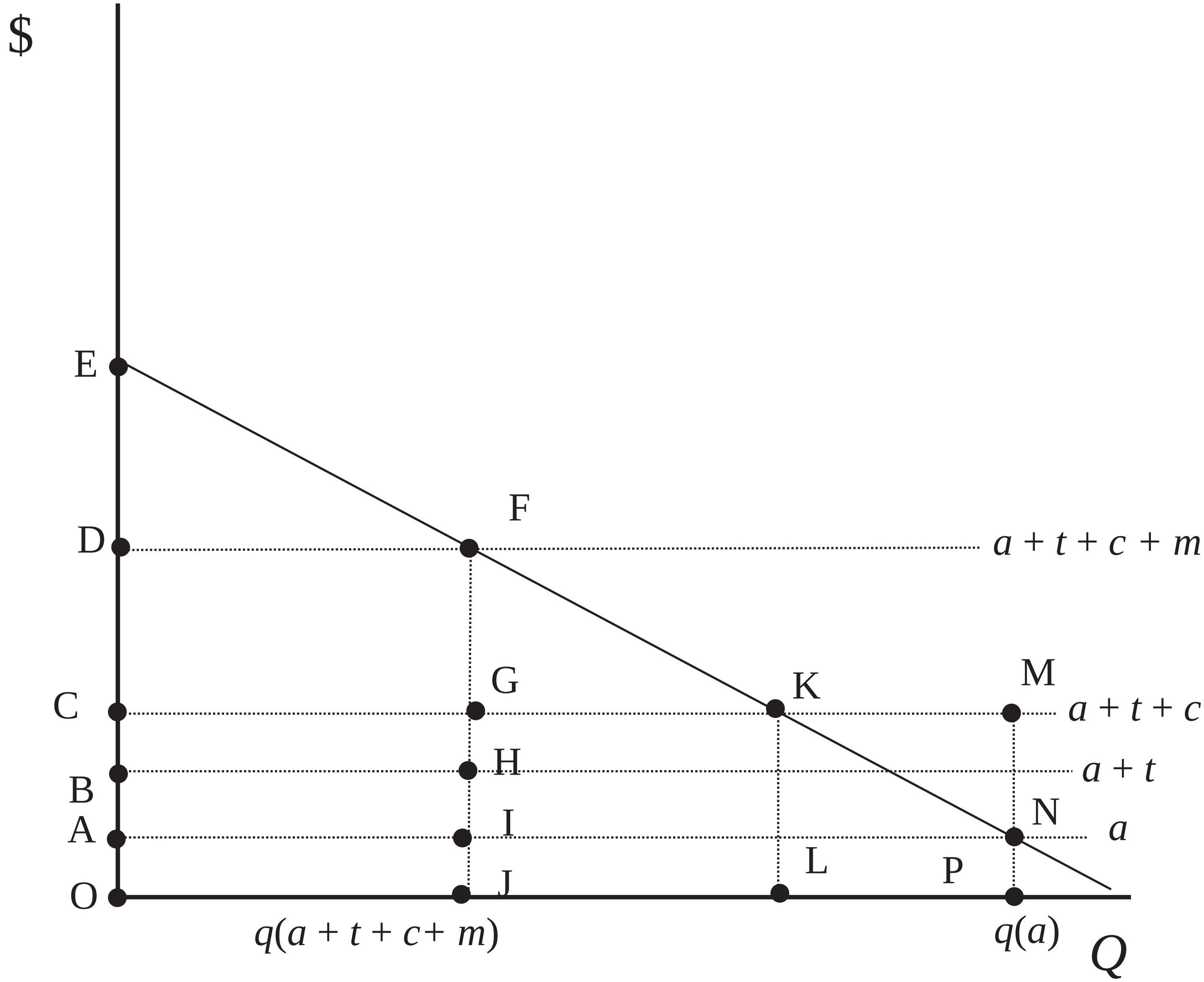

Fig 1: Linear demand for Information with access and transaction costs

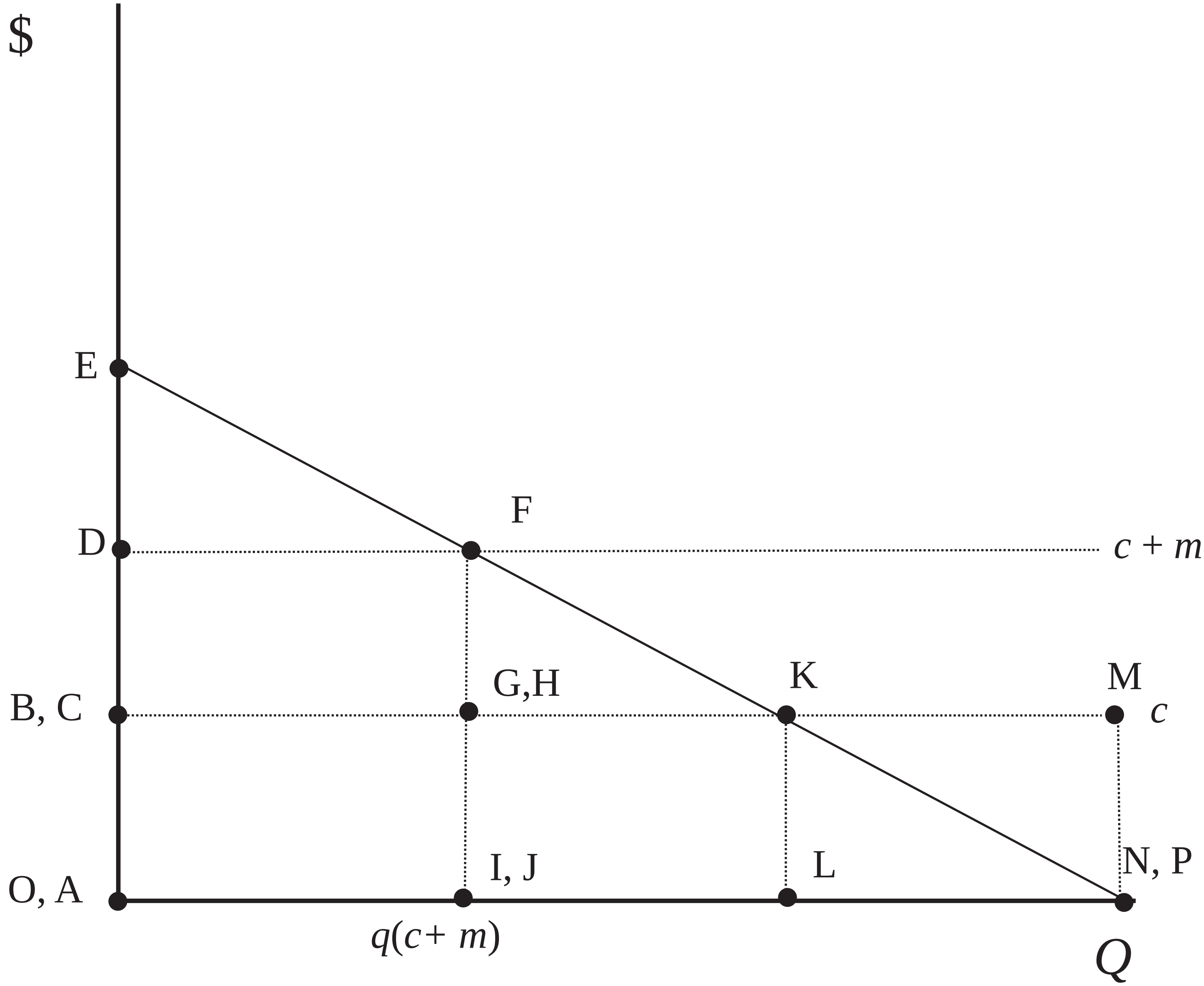

Fig 2: Linear demand for Information with zero access cost and zero transaction costs

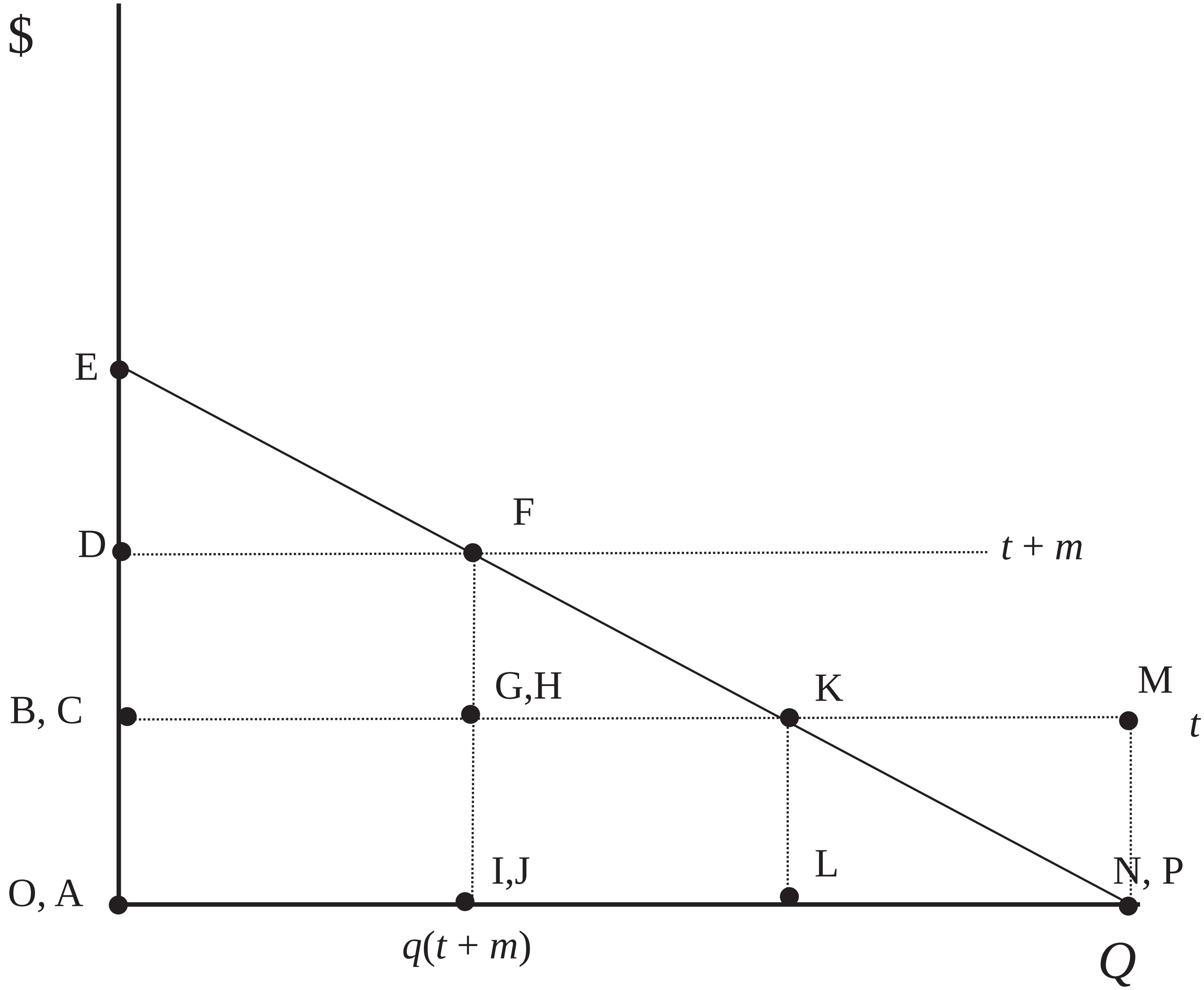

Fig 3: Linear demand for Information with zero access and zero marginal costs