MONASH University
Business and Economics

DEPARTMENT OF ECONOMICS

ISSN 1441-5429

DISCUSSION PAPER 09/06

HOW SHOULD A PUBLIC GOOD BE PROVIDED? A TRANSACTION COST APPROACH

Wenli Cheng and Dingsheng Zhang

ABSTRACT

This paper investigates how the trade-off between organization costs, transaction costs and economies of specialization may affect the way public goods are provided. In doing so, it considers two ways of providing a public good. One is collective provision where users organize themselves to jointly finance the public good which is produced by a specialized firm. The other is market provision with bundling where a firm produces the public good and a private good and sells them as a bundle. Both methods of public goods provision deal with the problem of non-excludability. The first method involves organization costs, but can take advantage of specialization economies; the second method avoids organization costs, but may incur some transaction costs and forgoes the benefit of specialization economies. Which method is superior depends on the relative magnitudes of organization costs, transaction costs, specialization economies as well as other features of the economy such as population size.

Key words: public good, transaction costs, organisation costs, specialisation economies

JEL classification: H41, L22

HOW SHOULD A PUBLIC GOOD BE PROVIDED? A TRANSACTION COST APPROACH

1. INTRODUCTION

Standard economic textbooks define a public good as a good that is both non-excludable and non-rival (see, for instance, Chapter 18, Pindyck and Rubinfeld, 2005). Non-excludability means that once a good is produced it is difficult to prevent people from using it (without paying); non-rivalry means that once a good is produced for one person, other people can use it at no additional costs. Focusing on the non-rival characteristic of public goods, Samuelson (1954, 1955) concluded that no decentralised pricing system can be relied on to achieve the optimal consumption levels of public goods, suggesting that public goods should be provided by the government. The literature provide further rationale for government provision of public goods due to its non-excludability – since users have an incentive to free-ride, private firms cannot profitably provide public goods or at least will not provide them to the optimal level (see an early synthesis by Bator, 1958).

Three main lines of arguments can be identified in the literature that challenges the idea that public goods should be provided by the public sector.

Firstly, even if private provision fails to reach the theoretical ideal of Pareto efficiency, it does not follow logically that government provision will be more efficient (Holcombe, 1997). There are numerous problems associated with public provision. For instance, the tax required for public good financing imposes an excess burden on the economy (Auerbach, A. J. 1985). Moreover, if a public good is financed by tax revenue, the government has no way of finding out the true value of the good to consumers (the problem of "revealed preference"). This is because in order for true preferences to be revealed, consumers must be given actual choices – whether or not to pay for the good, and if so, how much (Fielding, 1979).

Secondly, many public goods were successfully provided by the private sector. For instance, Coase (1974) showed that lighthouse services can be provided by private enterprises. In fact, historically in Britain, "lighthouses were built, operated, financed and owned by private individuals. … The role of the government was limited to the establishment and enforcement of property rights in the lighthouse." (p.375). Sechrest (2004) further provided some fascinating examples of private provision of public goods from maritime history. These include private armed ships during wartime (privateering), provision of ship registers and shipping intelligence (by Lloyd's of London), publication of navigation manuals, the development of private systems of signal flags, etc.

Thirdly, since some empirical studies have found that many goods/services provided by the government are really private goods (Gonzalez, et al., 1993), it has been argued that public goods are fictions, and that governments have been using the theory of public goods as a justification for unnecessary interventions (Pasour, 1981, Hoppe, 1989).

In this ongoing debate over how public goods should be provided, the focus of the literature appears to be investigating whether private provision or public provision is more likely to move closer to the ideal of "socially efficient level of production". What is missing is a somewhat obvious but nevertheless important point, namely, that different methods of provision are often associated with different organisational forms of production, each of which may involve different levels division of labor, different organisational costs and transactions costs. Consequently, in comparing the relative merits of public provision versus private provision of public goods, the differences in production organisations and their implications efficiencies must be taken into account. The purpose of this paper is to use a simple model to illustrate this point.

Take the familiar example of lighthouse service as a public good that is considered to be both non-excludable and non-rival. To focus on the feature of non-excludability, we assume that one lighthouse needs to be built to provide the optimal level of lighthouse service. There may be two ways of providing the lighthouse service. One way is collective provision (which may or may involve the government), where all the users of the lighthouse service (shipowners) commission a specialist for the construction and operation of the lighthouse, and share the total cost of the service. Alternatively, the lighthouse service may be provided in the market by a firm that also supplies a private good to the users of the lighthouse service, say port services at the port nearest to the lighthouse. To deal with the non-excludability problem of lighthouse service, the firm bundles port services with lighthouse service by charging shipowners a price for both services at the port.

Each method of providing the lighthouse service has its own benefits and costs. Collective provision can take advantage of economies of specialisation as a specialist firm carries out the construction and operation of the lighthouse. In addition, since lighthouse service is not bought and sold in the market, there is a saving in market transaction costs. However, there may be a high organisation cost since shipowners need to reach an agreement on collective funding and other related operational issues and to ensure that the agreement is adhered to. In comparison, market provision with bundling avoids high organisational costs, but incurs some market transaction costs. Moreover, since a firm produces both services in the bundle, it foregoes

economies of specialisation.[1] To assess whether a public good is better provided collectively or in the market, we need to consider, among other things, organisational features of different methods of provision and their implications such as the trade-offs among transaction costs, organisation costs and economies of specialisation illustrated in the above example.

The rest of the paper proceeds as follows. Section 2 sets out the model and compares two ways of providing a public good: collective provision and market provision with bundling. Section 3 concludes.

2. THE MODEL

Consider an economy with *M* identical consumers, who gain utility from consuming a single consumption good (*z*). Their utility function is,

$$u = z$$

We further assume that the consumers derive their income from labor services. Each consumer is assumed to have one unit of labor, and the wage rate is normalized to be one.

On the production side, assume that there are *n* firms producing good *z,* and that the production function for good *z* is

$$z = \begin{cases} \alpha y, if \ x = 1 \\ 0, if \ x = 0 \end{cases}$$

where x is a public-good-input, y is a private-good-input. Obviously, if the z-producers decide to produce good z at all, they will choose to obtain 1 unit of input *x*. Since input x is, by assumption, a public good input, it is non-rival and therefore the optimal total quantity of input x is also 1.

We assume that a single firm produces input *x* and the production function is

$$x = l_{mx} l_x$$

where l_{mx} is the amount of management labor, l_x is the amount of general labor. Since there is only one manager in a firm, we assume $l_{mx} = 1$ if good *x* is produced by a specialised firm, and $l_{mx} = 1/2$ if the *x*-producing firm also produces good *y.*

The production function for input *y* is

[1] It may be argued that the firm can outsource the lighthouse service to take advantage of specialisation economies. However, as we argue in the model below, an important source of specialisation economies is that management can focus on the production of a single good/service. Even if one product is outsourced, management time will still need to be diverted to managing the processes of outsourcing.

$$y = (l_{my} - B) l_y^{\gamma},$$

where l_{my} is the amount of management labor, B is a fixed learning cost, $\gamma > 1$ is a parameter, l_y is the amount of general labor. We assume $l_{my} = 1$ if input *y* is produced by a specialised firm and $l_{my} = 1/2$ if the *y*-producing firm also produces input *x*. Due to increasing returns to scale, the number of the firm producing good *y* is also assumed to be 1.

These production function specifications assume that when a firm produces two inputs instead of specialising in a single input, the manager needs to spend time managing two separate production processes. As a result, the firm fails to take advantage of economies of specialisation, and there is a loss in production efficiencies in producing both inputs.

Now we compare two ways in which the public-good-input *x* is provided: (1) collective provision; and (2) market provision with bundling.

Method 1: Collective provision

The non-excludability problem of the public-good-input *x* can be solved by collective provision of input *x*. Specifically, all users of input *x* (i.e., firms that produce the consumer good *z*) can form a club to jointly fund the production of *x* and commission a specialist firm to produce input *x*. Apart from the cost of producing input *x*, there will be an organisation cost to form the club. We assume that the sum of production cost and organisation cost is shared equally among the *z*-producing firms, and each firm's share is $p_x + t$, where p_x is the share of production cost (which is the Lindahl price of *x*), and *t* is the share of organisation cost. Moreover, we assume that each firm recovers its share of the cost associated with input *x* through a fixed charge to consumers of good z so that

$$p_x + t = \frac{MT}{n} \qquad (1)$$

where M is the number of consumers and T is the fixed charge paid by each consumer.

We assume that each *z*-producing firm maximises profit in a competitive market, so that its decision problem is:

$$\max_y \; p_z \alpha k_1 y - p_y y$$

where k_1 is transaction efficiency coefficient of input *y*, p_y is the price of input *y*. k_1<1 implies that there is an ice-berg type transaction cost, that is, for each unit of input y bought, there is a fraction (1- k_1) lost in transit, so that the firm only receives k_1 unit.

Competition in the market for good z ensures that in equilibrium, z-producing firms obtain zero economic profit, *i.e.,*

$$\alpha k_1 p_z = p_y \qquad (2)$$

Since the production of input x is commissioned to a specialist firm, the production of input x and input y are separately carried out in different firms. The production functions for them are therefore:

$x = l_x$

And the production function for good y is

$$y = (1-B) l_y^{\gamma}$$

Assuming contestability in both markets for inputs *x* and *y*, we also have the following zero-profit conditions for both the x-producing firm and the y-producing firm:

$$np_x x^s = l_x + 1 \qquad (3)$$

$$p_y y^s = l_y + 1 \qquad (4)$$

On the demand side, a representative consumer of good *z* in effect face a two-part tariff; and his decision problem is as follows:

$$Max\ z$$
$$s.t.\ p_z z = 1 - T$$

where *T* is the fixed charge, p_z is the variable part of the tariff of good *z.*

Solving this decision problem, we get the demand function for good *z*:

$$z = \frac{1-T}{p_z} \qquad (5)$$

In equilibrium, markets for all inputs clear, thus we have

$$x^d = x^s \qquad (6)$$

$$ny^d = y^s \qquad (7)$$

$$M = l_x + l_y + 2 \qquad (8)$$

Solving equations (1)-(8), we can get the equilibrium prices and input allocations as follows:

$$l_x = 1,\ l_y = M - 3,\quad p_x = \frac{2}{n},\ p_y = (1-B)^{-1}(M-2)(M-3)^{-\gamma},\ T = \frac{2+nt}{M},$$

$$p_z = \alpha^{-1} k_1^{-1} (1-B)^{-1} (M-2)(M-3)^{-\gamma}.$$

In equilibrium, each consumer's utility is

$$u_1 = \alpha k_1 M^{-1}(1-B)(M-2-nt)(M-2)^{-1}(M-3)^{\gamma} \quad (9)$$

Method 2: Market provision with bundling

The public-good input *x* can also be provided through the market. To deal with the non-excludability problem, a single firm can provide input *x* and a private-good-input *y*, and sell both in a bundle.

In this case, the production function for good *x* is

$x = 0.5 l_x$

And the production function for good y is

$$y = (0.5 - B) l_y^{\gamma}$$

As noted earlier, these production function specifications imply that when a firm produces two inputs instead of one, it foregoes the economies of specialisation since limited management input has to be split to two separate production activities.

Assuming contestability of the market for inputs, the input-producing firm would set a price for the bundle such that it earns zero economic profit, i.e.,

$$p_b y^S = l_x + l_y + 1 \quad (10)$$

where p_b is the price for the bundle of input *y* and input *x*, y^S is the total supply of input *y*. Note that *x* is no-rival, and that one bundle in effect includes one unit of *y* and access to the total supply of *x* (which is one by assumption).

For a representative firm that produces the consumption good *z,* the following decision problem applies:

max $p_z a k_2 y - p_b y$

where k_2 (<1) is the transaction efficiency coefficient of good *y*, p_b is the price of the bundled input *x* and *y*.

Competition in the consumption good market also ensures zero economic profit in equilibrium, thus we have

$$\alpha k_2 p_z = p_b \quad (11)$$

On the demand side, a representative consumer's decision problem is as follows:

$$Max\ z$$
$$s.t.\ p_z z = 1$$

where p_z is the price of good *z*.

Solving this problem, we obtain the demand function for good *z*:

$$z = \frac{1}{p_z} \tag{12}$$

In equilibrium, markets for all clear, thus we have,

$$x^d = x^s \tag{13}$$
$$ny^d = y^s \tag{14}$$
$$M = l_x + l_y + 1 \tag{15}$$

From equations (10)-(15), we obtain general equilibrium prices and allocation of inputs as follows

$$l_x = 2,\ l_y = M - 3,$$
$$p_b = M(0.5 - B)^{-1}(M - 3)^{-\gamma},$$
$$p_z = \alpha^{-1}k_2^{-1}M(0.5 - B)^{-1}(M - 3)^{-\gamma}.$$

A representative consumer's utility in equilibrium is

$$u_2 = \alpha k_2 M^{-1}(0.5 - B)(M - 3)^{\gamma} \tag{16}$$

Now we examine the relative efficiencies of the two ways in which the public-good input is provided. Comparing with equations (9) and (16), we have the following results.

First, if $\frac{k_1}{k_2}\frac{1-B}{0.5-B}\frac{M-2-nt}{M-2} < 1$, then $u_1 < u_2$. In words, no general statement can be made as to whether collective provision or market provision is preferred. Either method of provision can be more efficient depending on specific circumstances. This can be illustrated with the following numerical examples:

(i) If we set $k_1 = 0.9, k_2 = 0.8$, $B = 0.1$, $M = 100, n = 10, t = 1$, we have $\frac{k_1}{k_2}\frac{1-B}{0.5-B}\frac{M-2-nt}{M-2} = 2.69 > 1$, so $u_1 > u_2$.

(ii) If we set $k_1 = 0.9, k_2 = 0.8$, $B = 0.1$, $M = 100, n = 10, t = 6$, we have $\frac{k_1}{k_2}\frac{1-B}{0.5-B}\frac{M-2-nt}{M-2} = 0.9815 < 1$, so $u_1 < u_2$.

(iii) If we set $k_1 = 0.7, k_2 = 0.8$, $B = 0.1$, $M = 100, n = 10, t = 1$, we have $\frac{k_1}{k_2}\frac{1-B}{0.5-B}\frac{M-2-nt}{M-2} = 1.366 > 1$, so $u_1 > u_2$.

Second, if we denote $f(k_1, k_2, t, B, n, M) = \frac{k_1}{k_2}\frac{1-B}{1/2-B}\frac{M-2-nt}{M-2}$, we have $\frac{\partial f}{\partial (k_1/k_2)} > 0$, $\frac{\partial f}{\partial n} < 0$, $\frac{\partial f}{\partial t} < 0$, $\frac{\partial f}{\partial B} > 0$. In words, market provision is more likely to dominate collective provision if

(i) Transaction efficiency of bundled input (k_2) sale improves relative to that of a single input (k_1) ; and/or

(ii) The number of firms (n) producing the final good increases or the organisation cost of collective provision (t) for each firm increases (both of which lead to higher total organisation costs); and/or

(iii) The level of economies of specialisation associated with the production of input y decreases (lower learning cost B).

Conversely, collective provision is more likely to dominate market provision in conditions opposite to those listed above.

3. CONCLUSION

In this paper, we have presented a simple model to illustrate a neglected point, that is, the method in which a public good is provided have production efficiency implications, and these implications need to be taken into account when assessing the relative merits of collective versus market provision of public goods. In the example provided, we have shown that collective provision of a public good is able to take advantage of specialisation economies, but incurs higher organisational costs. In comparison, market provision avoids organisational costs, but incurs higher market transaction costs, and sacrifices some specialisation economies. Thus to identify a more efficient method of public good provision will depend on, *inter alia*, the optimal trade-off among specialisation economies, transaction costs and organisational costs.

A novel aspect of our model is that it examines the effect of specialisation economies on the choice of methods for public good provision. As Houthakker (1956, p.182) wrote 50 years ago, “There is

hardly any part of economics that would not be advanced by a further analysis of specialisation". Our paper may serve as an illustration that perhaps the same can still be said today.

REFERENCES

Auerbach, A. J. (1985), 'The theory of excess burden and optimal taxation', in *Handbook of Public Economics*, vol. 1, eds, A. J. Auerbach and M. Feldstein, Elsevier, Amsterdam.

Bator, Francis M. (1958), "The Anatomy of Market Failure", *Quarterly Journal of Economics*, 72(3), 351-379.

Coase, R. H. (1974), "The Lighthouse in Economics", Journal of Law and Economics, 17(2), 357-376.

Fielding, Karl, "Nonexcludability and Government Financing of Public Goods", *Journal of Libertarian Studies*, 293-298.

Holcombe, Randall (1997), "A Theory of the Theory of Public Goods", Review of Australian Economics, 10(1), 1-22.

Hoppe, Hans-Hemann (1989) "Fallacies of the public goods theory and the production of security", *Journal of Libertarian Studies*, 9(1), 27-46.

Houthakker, H. (1956), "Economics and Biology: Specialization and Speciation", *Kyklos*, 9, 181-187.

Pasour, E. C. Jr. (1981), "The Free Rider as a Basis for Government Intervention", *Journal of Libertarian Studies*, 5(4), 453-463.

Pindyck and Rubinfeld (2005), *Microeconomics*, 6th edition, Upper Saddle River, New Jersey: Pearson Education, Inc.

Samuelson, Paul (1955), "A diagrammatic Exposition of a Theory of Public Expenditure", *Review of Economics and Statistics*, 36, 387-89.

Samuelson, Paul (1954), "The Pure theory of public expenditure", *Review of Economics and Statistics*, 36, 387-89.

Sechrest, Larry (2004), "Public goods and private solutions in maritime history", Quarterly Journal of Australian Economics, 7(2), 3-27.