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BEQUESTS, PROPERTY RIGHTS AND COST-BENEFIT ANALYSIS

Amihai Glazer

Vesa Kanniainen

Esko Niskanen

Valtion taloudellinen tutkimuskeskus

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Abstract: Consider a public project which produces a consumption good and which benefits future generations. Let a conventional cost-benefit analysis find that it gives higher benefits than projects it would displace in the private sector. Voters may nevertheless oppose the public project. The cause of the opposition arises from the absence of property rights and from the bequest motive of parents. Private projects have owners, allowing parents to control whether their children will receive the benefits from such projects. Parents can therefore pay for services from their children by giving them title to private projects. In contrast, public projects yield benefits to future generations independently of the care children give their parents.

Keywords: public project, bequests, property rights, cost-benefit analysis

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Tiivistelmä: Tarkastellaan julkista hanketta, joka tuottaa kulutushyödykettä ja hyödyttää tulevia sukupolvia. Tavanomainen kustannus-hyötyanalyysi osoittaa, että hanke antaa suuremman hyödyn kuin sen syrjäyttämät yksityiset hankkeet. Silti äänestäjät voivat vastustaa hanketta. Vastustuksen syynä on omistusoikeuksien puuttuminen ja perinnönjättömotiivi. Se, että yksityisillä hankkeilla on omistajat, sallii vanhempien kontrolloida lastensa mahdollisuuksia saada hankkeista hyötyä. Vanhemmat voivat erityisesti vaatia lapsiltaan palveluita yksityisten hankkeiden tuottoja vastaan. Julkisen hankkeen tapauksessa tuotot ovat tulevien sukupolvien vapaasti nautittavissa lasten vanhemmilleen antaman huolenpidon määrästä riipumatta.

Asiasanat: julkinen hanke, perinnöt, omistusoikeudet, kustannus-hyötyanalyysi

Bequests, Property Rights, and Cost-Benefit Analysis*

Amihai Glazer
Department of Economics
University of California, Irvine
Irvine, CA 92717

Vesa Kanniainen
Department of Economics
University of Helsinki
Helsinki, Finland

Esko Niskanen
Government Institute for Economic Research
Helsinki, Finland

June 5, 1996

Abstract

Consider a public project which produces a consumption good and which benefits future generations. Let a conventional cost-benefit analysis find that it gives higher benefits than projects it would displace in the private sector. Voters may nevertheless oppose the public project. The cause of the opposition arises from the absence of property rights and from the bequest motive of parents. Private projects have owners, allowing parents to control whether their children will receive the benefits from such projects. Parents can therefore pay for services from their children by giving them title to private projects. In contrast, public projects yield benefits to future generations independently of the care children give their parents.

1 Introduction

A large literature discusses the discount rate government should use in evaluating public projects. Most analyses implicitly assume that the same discount rate per period can be used for projects that impose costs and generate benefits to the current generation as for projects that impose costs on one generation but give benefits to future generations. Programs with such delayed benefits

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are increasingly important, particularly in the environmental area. Thus, reductions in carbon or CFC emissions impose costs on persons now alive, and will benefit (or reduce costs) on persons not yet born.

When capital and other markets are perfect, the question of who will be alive when benefits appear is irrelevant. We shall show, instead, that generational differences do matter when considering public projects that yield benefits to a future generation.

We follow Bernheim, Shleifer, and Summers (1985), Cox and Rank (1992), Cremer, Kessler, and Pestieau (1992), and Cremer and Pestieau (1991) in supposing that parents leave bequests to their children because they want to obtain services (such as care) from their children. We focus on an important difference between private and public investments. The owner of a private investment can control the conditions under which her heirs will receive the proceeds from that investment. In particular, she can deny a bequest to a child who takes no care of her. In contrast, an individual cannot control who will receive the benefits from a public investment. The benefits may be a non-excludable public good, so that all members of a future generation receive the benefits. In other words, parents cannot use a public investment to purchase care from children.

Sections 2 and 3 describe basic assumptions concerning bequests and care, and the basic model. Section 4 extends the model to include a conventional consumption good. Section 5 considers a public project that yields a consumption good. Section 6 investigates another type of public project, an investment in infrastructure, that does not directly produce a consumption good but instead increases the rate of return on private investments (projects).

2 Assumptions

For simplicity we consider asexual reproduction—each mother has one daughter; neither sons nor fathers are considered. Each person lives for two periods. In the first period she serves her mother. In the second period she consumes services provided by her daughter. Payment for the services comes from an inheritance.

To be more precise, consider a person born in year t. In period 1 of her life she provides services to her mother in the amount z_1^t. In period 2 she receives services from her daughter in the amount z_2^t, which equals z_1^{t+1}. The utility function of a person born in period t is

$$U^t(z_1^t, z_2^t), \tag{1}$$

where $\partial U^t/\partial z_1^t < 0$ and $\partial U^t/\partial z_2^t > 0$. The notation U^t clarifies the identity of the person under discussion. We assume, however, that all persons, in all generations, have the same utility function.

We assume that a mother receives services from her daughter, and does not purchase any services on the market. Market purchases may be ruled out because the daughter can give her mother better care than can anyone else. Or the child can give a specified quality of care at lower cost than can anyone else. Because of such efficiency gains, a selfish mother would not want to hire a nurse for care, but would instead want to induce her daughter to provide care.

3 The basic model

The basic model considers neither consumption nor saving nor investment. A person born in year t inherits a bequest of $\$B$ in year $t+1$. She can use this bequest to buy services from her daughter in year $t+1$ when she is old.

Consider a steady-state solution in which each person provides services z^* to her mother and receives services z^* from her own daughter. In Figure 1, we measure z_1 along the horizontal axis and z_2 along the vertical axis. Since z_1 is a bad and z_2 is a good, the indifference curves slope upward. The usual assumptions of decreasing marginal utility of services received, and increasing marginal disutility of effort provided, mean that the indifference curves are strictly convex (steeper as we move to the right).

In Figure 1 the indifference curve through the origin is flatter than the 45^o line. Alternatively, the indifference curve through the origin can have a slope greater than 1; that is, consumers can demand large services when they are old in return for providing services when they are young.

Clearly, one possible value of z^* is 0; in this equilibrium there are no bequests ($B = 0$) and no services. This equilibrium is the only possibility if the indifference curve through origin is steeper than the 45^o line. This equilibrium also determines the reservation utility $U(0,0)$, relevant when considering possible equilibria with positive bequests and services.

Figure 1 shows a different solution, where z^* is determined by the intersection of a 45^o line through the origin with the indifference curve through the origin. The intersection is shown as point X on indifference curve U^X. This point represents a possible steady-state equilibrium, where a typical person's utility is the same as the reservation utility: no net benefit is obtained from the trade between a mother and her daughter.

A third, and more efficient, steady state is also possible. This is represented by the point on the 45^o line through the origin that is tangent to an indifference curve, shown as Y on indifference curve U^Y. This point represents a higher utility than obtains at points X and 0. The efficient solution, however, need not be an equilibrium solution.

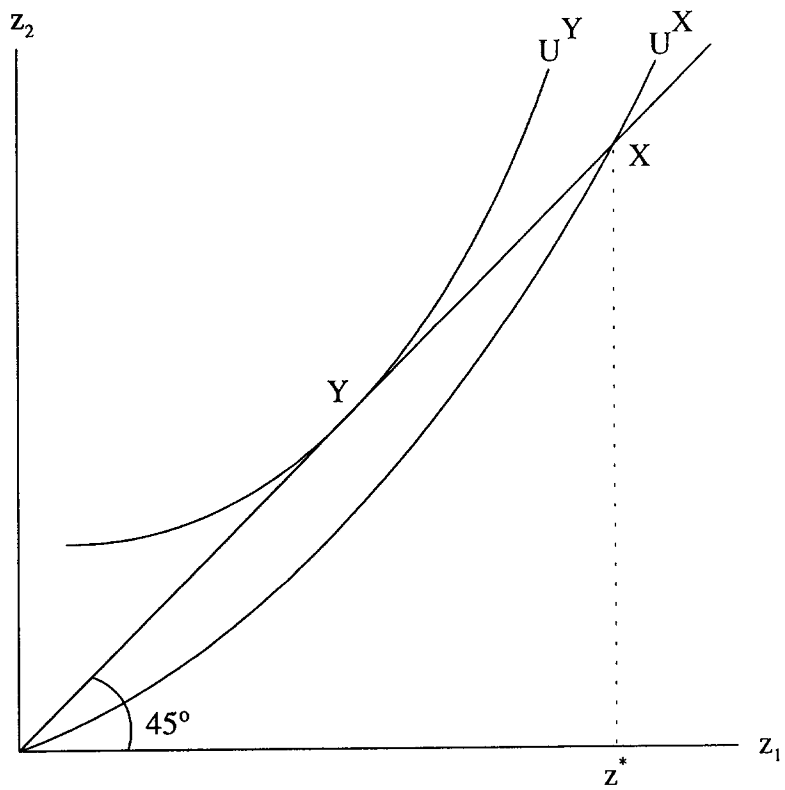

Figure 1.

Which solution—point 0, X or Y—will be the actual equilibrium depends, among other things, on the relative "negotiating power" of a mother and her daughter. Such power can depend on the order in which a mother and her daughter make their decisions, as well as on the possibility of shirking.[1] Negotiating power may also refer to the power to extract the consumer surplus generated by the trade between a mother and her daughter. One possibility is to assume that the mother gets all the surplus or benefits. That is, the mother gives the bequest B only if the daughter devotes such effort to services that makes the daughter indifferent about providing the service. We make that assumption in the rest of the paper.

Our analysis so far determines possible equilibrium values of z. But a given equilibrium can arise for different values of B; that is, the size of the bequest is no issue here. The following section extends the model by considering an alternative use of assets a mother holds—consumption. A model with consumption is more realistic and also generates a unique equilibrium value for the bequest.

4 Bequests with consumption

We now extend the model by allowing for consumption of a conventional good. We assume that a typical individual gets utility from consumption of a conventional good, x, when young. In addition, the individual still gets utility from services from her daughter when old. The utility of a person born in year t is then

$$U^t(z_1^t, z_2^t, x_1^t), \tag{2}$$

where $\partial U/\partial x_1^t > 0$.

A person born in year t gets a bequest B in year $t+1$. She consumes x units of it in year $t+1$, and invests $B - x$. In one period this investment grows to $(B - x)(1 + r)$, where r is the market interest rate; she bequeaths this amount to her daughter.

Let the steady-state value of care or services be z^*. Steady-state levels of B and x, B^* and x^*, must satisfy $(B^* - x^*)(1+r) = B^*$, so that $x^* = rB^*/(1+r)$.

To characterize an equilibrium, note that utility-maximization requires that a person's utility from a marginal increase in consumption must equal the disutility from decreased services from her daughter, induced by the marginal reduction in bequest.

Consider a mother who increases her consumption by Δ. The increased

[1] These considerations are related to work on the Good Samaritan Paradox (see Bruce and Waldman (1990) and Lindbeck and Weibull (1988)). That literature assumes that the recipient shirks and thereby makes herself poorer.

consumption directly increases her utility by

$$(\partial U^t/\partial x)(\Delta). \tag{3}$$

Her daughter gets a bequest which is smaller by $\Delta(1+r)$. Therefore (by the envelope theorem) the daughter's utility decreases by $\Delta(1+r)(\partial U^{t+1}/\partial x)$.

To maintain the daughter at the reservation utility level, the mother must reduce her demand for services by

$$ds = \Delta(1+r)\frac{\partial U^{t+1}}{\partial x}/\frac{\partial U^{t+1}}{\partial z_1}. \tag{4}$$

The reduced services reduce the mother's utility by

$$ds\frac{\partial U^t}{\partial z_2}. \tag{5}$$

Equating (3) to (5) gives the condition

$$\frac{\partial z_2}{\partial z_1} = 1 + r. \tag{6}$$

We find, as we did in Section 3 above which considered no consumption good, that one possible equilibrium has no bequests, no services and no consumption: $(z^*, z^*, x^*) = (0, 0, 0)$. Another possible equilibrium has positive bequests, services and consumption, but with no net gain as compared to the reservation utility $U(0, 0, 0)$ That is, the utility of each person must satisfies

$$U(z^*, z^*, rB^*/(1+r)) = U(0, 0, 0). \tag{7}$$

Finally, analogously to point Y in Figure 1, a third candidate for a steady-state solution is the one which maximizes steady-state welfare. But that need not be an equilibrium solution.

We shall later be interested in comparing discount rates used in evaluating public and private projects. For that purpose, we observe that a mother would be willing to pay $\Delta/(1+r)^2$ for an investment that will return Δ two periods in the future. That is, the usual rules for discounting apply for changed endowments (induced by bequests) across generations. To see this, consider a mother who bequeaths the title to the investment. Then the asset allows the daughter to reduce her own direct bequest to the granddaughter by $\Delta/(1+r)$. In turn, the mother can reduce her direct bequest to her daughter by $\Delta/(1+r)^2$, which proves our claim.

5 Public investment that yields a consumption good

We now extend the utility function of the previous section to allow for the output of a public project, g. The utility of a person born in year t is now

$$U^t(z_1^t, z_2^t, x_1^t, g_1^t), \tag{8}$$

where $\partial U/\partial g_1^t > 0$. The output of the public project is a consumption good, which is an imperfect substitute for the private consumption good x. We also assume that the daughter can only enjoy, but not bequeath, the output of the public project; the output lasts only for one period.

One might think that voters would always want government to adopt a public investment with a higher rate of return than the private investment it displaces. The conclusion is false, because individuals cannot fully control the allocation of goods provided by public projects. More concretely, and in terms of our model, a mother cannot use the output of a public project to buy services from her daughter when old.[2] It may therefore be possible that if a public project which yields consumption good, rational voters may support less public investment than is called for by a first-best solution.[3]

To highlight the point, consider a public project with zero monetary costs for the current generation,[4] that generates output Δ next period. This public project does not change the mother's endowment, but increases her daughter's endowment by Δ. We shall consider a steady state with no public investment, and show that a person's utility may decline if government adopts a one-time public project that would benefit her daughter. An alternative analysis can show that a steady state with public projects need not be an equilibrium: a mother in year t can increase her utility by voting against the project which benefits her daughter. The two analyses differ only in that one evaluates utility of the mother with no endowment from the public project, and the other evaluates the mother's utility starting from a point with the public endowment.

Let the steady-state solution with no public project have $z_1 = z_2 = z^*$. A

[2] Bernheim, Shleifer, and Summers (1985) make related points. They note the absence of Ricardian equivalence when bequests are made to purchase services. They also note that social security benefits parents less than private bequests do. A similar distinction appears in our examination of public projects.

[3] Our result corresponds to Kotlikoff and Rosenthal's (1993) conclusion that each generational government may underprovide a durable public good. They consider how public investment may change asset values; they do not, however, consider the intergenerational transfers and services we do.

[4] The project may require expenditures this period. It may, however, be financed by borrowing from abroad in the current period, with repayment in the following period made from proceeds of the investment. This investment is thus costless to the current generation.

person can vote in year t for a public project that gives her daughter in year $t+1$ an endowment of Δ.

The maximum utility of the mother is determined by the condition that her daughter is indifferent between (a) caring for her mother and receiving a bequest, and (b) not caring for her mother and not receiving a bequest:

$$U(z_1^{t+1}, z^*, rB/(1+r) + \Delta) = U(0, 0, \Delta). \tag{9}$$

The question is whether $z_1^{t+1} \equiv z_2^t$ which satisfies this equation is greater than z^*. When $z_1^{t+1} > z^*$ the mother's utility increases if

$$\frac{\partial U(z^*, z^*, rB^*/(1+r))}{\partial x} > \frac{\partial U(0,0,0)}{\partial x}. \tag{10}$$

When this inequality holds, a mother can increase her utility by demanding increased services, z_1^{t+1}, from her daughter who received Δ in public benefits. When the inequality is reversed the mother suffers from the costless public investment.

Either condition may hold. Let care improve health. Private goods may be complements to good health: money is worth little to a person so ill she cannot enjoy it. In that case $\partial U(z^*, z^*, rB^*/(1+r))/\partial x$ can be greater than $\partial U(0,0,0)/\partial x$. Parents would benefit from an increased endowment that a public investment gives their children. But it is also plausible to believe that a sick person has high marginal utility of income. The inequality in (10) would be reversed: an increased endowment to children will reduce the utility of the current generation of parents.

We summarize with

Proposition 1 *A mother may lose from an increase in her daughter's endowment.*

The result has implications for the intertemporal discount rate to use in evaluating public projects. Consider an extension of our model which has a person live for four periods. In the first two periods she is a child; in the last two periods she is a mother. A person saves in the first period of motherhood to increase consumption in the second period. Consider a public project made in the first period of motherhood which generates a return in the second period of motherhood. A utility-maximizing mother would favor such a project if the rate of return is greater than on a private investment. In contrast, we saw that even a costless public investment which generates returns after a person's death may reduce that person's utility. (Of course, the gain may also be positive but small.) A rational person would therefore use different discount rates in evaluating a public project with returns during her lifetime and in evaluating a private project with returns after her lifetime.[5]

The rational bias against public projects is inconsistent with standard results showing that government should never reject projects with a rate of return higher than the market rate. Instead, in their notable work, Arrow and Lind (1970) argue that government should use a discount rate lower than the market rate. Others claim that government uses inappropriately *low* discount rates because of the influence of special interest groups, or because legislators view construction costs as benefits to their constituents (Weingast, Shepsle, and Johnsen (1981)). Yet our result is consistent with evidence showing that the rate of return from public infrastructure is higher than for capital in the private market (see Aschauer (1989)).

6 Public investment in infrastructure

Consider next a public project that does not directly produce a consumption good. Instead, the public investment increases the rate of return on private investment. We can think of an infrastructure investment as an example.

In this case the lack of property rights related to the output of the public project creates no problem. This is so because parents still have full control of the benefits of the public project, i.e. the increased output of the private projects.

We again analyze the issues by supposing that the investment costs nothing. Consider first a public investment in year $t+1$ that increases the rate of return earned on the mother's investment in year $t+1$, which becomes her daughter's bequest in year $t+2$. The mother clearly gains from this public project. To see this, suppose that the rate of return increases from r to $r+\delta$. A mother who wants to give the same bequest can increase her consumption of the private good by $dx \equiv B/(1+r+\delta) - B/(1+r)$. The mother's utility increases by $[\partial U/\partial x]dx$.

More interesting is a public investment made in year t that raises the rate of return on an investment made in year $t+1$. Would a mother benefit from an increase in the rate of return earned on the bequest made by her daughter to her granddaughter?

Let a public investment of g be made in year t. The rate of return on a private investment made in year $t+1$ and which generates benefits in year $t+2$ is $r(g)$, with $r' > 0$. To analyze the effects of the public investment we

[5]Glazer (1989) examines the effects of public investments on the equilibrium interest rate. He shows that, because of this effect, voters may want government to use a discount rate different from the private rate of return.

use the following terminology. The person born in year t is the mother, the person born in year $t+1$ is the daughter, and the person born in year $t+2$ is the granddaughter. We ask whether, starting from a steady state with no public investment, the mother can gain from an increase in the rate of return her daughter will earn.

The initial steady-state equilibrium (with no public investment) had

$$U[z^*, z^*, r(0)B^*/(1+r(0))] = U(0,0,0). \tag{11}$$

Consider first a costless investment that increases by $r'dg$ the rate of return the daughter earns on the bequest she gives the granddaughter. The daughter can therefore increase her consumption of the private good by

$$-\frac{d(B/(1+r)}{dr}r'dg = \frac{B}{(1+r)^2}r' \equiv \Delta. \tag{12}$$

The daughter's increased utility from consumption of the private good is $\Delta \partial U/\partial x$. The mother can then demand increased services from the daughter of $-\Delta\frac{\partial U}{\partial x}/\frac{\partial U}{\partial z_1}$. The mother's utility thus increases by $-\Delta\frac{\partial U}{\partial z_2}\left(\frac{\partial U}{\partial x}/\frac{\partial U}{\partial z_1}\right)$. The value of this expression is necessarily positive.

This leads to

Proposition 2 *A (costless) public investment which produces a substitute to a private good may reduce the mother's utility. But a (costless) public investment in infrastructure always benefits the mother.*

Now suppose the investment is costly, reducing the mother's endowment. The mother maximizes her utility by choosing the value of g satisfying

$$-\Delta\frac{\partial U}{\partial z_2}\left(\frac{\partial U}{\partial x}/\frac{\partial U}{\partial z_1}\right) = \frac{\partial U}{\partial x}, \tag{13}$$

so that

$$\frac{B}{(1+r)^2}r'(g) = -\frac{\partial z_2}{\partial z_1}. \tag{14}$$

In contrast, maximizing steady-state consumption of the consumption good requires maximizing

$$\frac{Br(g)}{1+r(g)} - g. \tag{15}$$

Taking the derivative with respect to g gives the first-order condition

$$\frac{Br'}{[1+r(g)]^2} = 1. \tag{16}$$

We saw from equation (6) that $\partial z_2/\partial z_1 = 1+r$. Making this substitution in (14) and comparing to (15) shows that the conditions for maximizing steady-state consumption and for maximizing the mother's welfare differ. We have:

Proposition 3 *A mother will invest too little in (costly) infrastructure.*[6]

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[6] Drazen (1978) has a related discussion of education, but assumes that parents are altruistic. He concentrates on showing that Ricardian equivalence does not hold when parents do not own a child's earning.

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7 Notation

B Bequest

g Investment in infrastructure, which raises r

r Rate of return on private investment

U^t Utility of person born in year t

x_2^t Consumption of good by person born in year t in period 2 of her life

z_1^t Services provided by person born in year t in period 1 of her life

z_2^t Services received by person born in year t in period 2 of her life