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Governmental failures in evaluating programs *

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Abstract. Consider a government that adopts a program, sees a noisy signal about its success, and decides whether to continue the program. Suppose further that the success of a program is greater if people think it will be continued. This paper considers outcomes when government cannot commit. We find that welfare can be higher when information is poor, that government should at times commit to continuing a program it believes had failed, and that a government which fears losing power may acquire either too much or too little information.

1. Introduction

It is well known that under some conditions a policy will be effective only if economic agents believe it will be continued.[1] An implication of this principle is that government may want to adopt a policy which continues failed programs. For such a policy can increase the confidence of investors that government will continue programs which make the investments profitable. Of course, if government knew beforehand which programs will succeed and which will fail, it would adopt only successful programs. The effects we have in mind can therefore appear only under imperfect information.[2] One notable result is that government may not benefit from improved information.[3]

Two examples of programs that were ultimately successful but were at risk of cancellation come to mind. First, the federal government induced automobile manufacturers to build cars with only 10 percent of the emissions they initially had. The reduction was achieved with catalytic converters. But after the Clean Air Act, requiring their use, was enacted, concern was raised that catalytic converters would increase emissions of sulfur. Had these concerns been taken seriously (they were eventually found to be false), firms would probalby have stopped investing in catalytic converters. The other example concerns fuel efficiency of automobiles. Concern was raised that smaller cars would increase fatality rates in highway accidents. The National Highway

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Traffic Safety Administration appeared to give little credence to the warnings, and continued enforcing regulations to improve fuel efficiency.

In other domains, we find that Congress requires regulators to ignore some information (e.g. cost-benefit considerations in environmental regulations). One interpretation is that Congress thereby indirectly controls the regulators.[4] Another is more in line with our arguments—the absence of further study lends credibility to regulations adopted.

2. Assumptions

2.1. *Technology*

Critical to our model is the assumption that a policy will be more successful if in period 1 a firm undertakes some irreversible investment, which reduces the marginal cost of compliance in future periods. The firm will be more willing to make the investment the greater its confidence that the regulatory policy will be continued in period 2.

2.2. *Information*

In period 1 government adopts a new program. In period 2 government continues the program with probability p. The program succeeds or fails. Success in period 2 yields a benefit $S(p)$; failure imposes a cost $-F(p)$. In line with the discussion in the introduction, we suppose that a program will give greater benefits the more likely people believe it will be continued. That is, $S'(p) > 0$, and $F'(p) < 0$. To be succinct we shall at times omit the argument p in the functions $S(p)$ and $F(p)$.

The prior probability that the program will succeed is π_0; the prior probability that it will fail is $1-\pi_0$. At the end of period 1 government gets information about success of the program in that period. After a success government sees a signal of success (a positive signal) with probability s; it sees a signal of failure (a negative signal) with probability $1 - s$. After failure government sees a signal of failure (a negative signal) with probability f; it sees a positive signal with probability $1 - f$. A program which succeeded in period 1 will also succeed in period 2; a program which failed in one period will later also fail. A government uses its priors and these signals to determine the posterior probability that the program is a success or a failure.

3. Equilibrium solution

Consider a second-best solution, where government must follow a time-consistent policy. That is, government will continue the program in period 2 only if the expected benefits of continuing are positive.

The inability to commit means that at the end of period 1, after observing the signal, government makes the choice that maximizes expected benefits in period 2. Let the probability that the state of nature is x when signal y is observed be P_{xy}, where $x \in \{S, F\}$ and $y \in \{+, -\}$. For example,

$$P_{S+} = \frac{\pi_0 s}{\pi_0 s + (1 - \pi_0)(1 - f)}. \tag{1}$$

Let the signal observed at the end of period 1 be i. Then maximizing expected utility in period 2 requires government to

$$\text{maximize } [0, S(p)P_{Si} - F(p)P_{Fi}]. \tag{2}$$

Consider an equilibrium probability (p), known to both the government and the public, that the government will continue the program. When government does not randomize, three equilibria in pure strategies can arise; they are described in the Appendix. Of most interest is the equilibrium which has government continue the program only after a positive signal. The probability of continuing is then the probability of a positive signal, $p^+ \equiv \pi_0 s + (1 - \pi_0)(1 - f)$. The condition for continuing only after a positive signal is then

$$R^+ \equiv \frac{(1 - \pi_0)(1 - f)}{\pi_0 s} \leq S(p^+)/F(p^+) \leq \frac{(1 - \pi_0)f}{\pi_0(1 - s)} \equiv R^-. \tag{3}$$

The expected benefits in period 2 are

$$V^+ \equiv S(p^+)\pi_0 s - F(p^+)(1 - \pi_0)(1 - f). \tag{4}$$

3.1. *Comparative statics*

The comparative static properties of V^+ are sometimes surprising. The partial derivative of V^+ with respect to f (the probability that failure generates a negative signal) is

$$\frac{\partial V^+}{\partial f} = \{-S'(p^+)\pi_0 s + F'(p^+)(1 - \pi_0)(1 - f) + F(p^+)\}(1 - \pi_0). \tag{5}$$

This derivative can be negative, since by assumption $S' > 0$ and $F' < 0$. Intuitively, an increase in f reduces investment in period 1, thereby reducing benefits in period 2.

Recall that an increase in f means that when the program fails the signal is more reliable. We can interpret this as improved information, and conclude that improved information can reduce the benefits to government.

4. Commitment by ignorance

We so far viewed the informativeness of signals as exogenous. But since we found that the government's utility may be higher when its information is worse, government may want to limit the information it receives. Recall that the government's action in period 2 depends on the informativeness of the signal (on the values of s and f). The design of a program in period 1 which determines the values of s and f thus affects decisions in period 2. So a requirement that firms report on their activities may induce high values of s and f, causing the government to continue the program only after a positive signal. Not imposing such requirements, or designing an experimental program with poor sampling procedures, induces low values of s and f; the poor information will cause the government either always to stop or else always to continue the program.

To see the benefits of poor information, consider an example where $s = f = 1/2$. In other words, the signal at the end of period 1 contains no information. Without commitment, the possible equilibria are $p = 0$ and $p = 1$. The condition for $p = 1$ to be an equilibrium is $\pi_0 S(1) > (1-\pi_0)F(1)$, or $S(1)/F(1) > (1 - \pi_0)/\pi_0$. Expected welfare is $V^1 = \pi_0 S(1) - (1 - \pi_0)F(1)$.

Suppose government can improve information, so that $s,\ f > 1/2$. The improvement makes $R^- > R^+$; with a proper $S(p)/F(p)$ function, $p = p^+$ may be an equilibrium. Expected benefits are then $V^+ = S(p^+)\pi_0 s - F(p^+)(1 - \pi_0)(1 - f)$. If $S(1)$ is much larger than $S(p^+)$, while $F(1) \approx F(p^+)$, then $V^+ < V^1$. The improved information can reduce welfare.

Welfare may be reduced even if better signals can be obtained costlessly, and even if perfect information (expressed by $s = f = 1$) is attainable. Under perfect information expected benefits are $\pi_0 S(\pi_0)$. This value may be greater than, smaller than, or equal to V^1. Of course, such a phenomenon cannot appear when government can commit.

Suppose instead that $V^+ > V^1$, or that

$$\pi_0[sS(p^+) - S(1)] - (1 - \pi_0)[(1 - f)F(p^+) - F(1)] > 0. \qquad (6)$$

Then government prefers an equilibrium with $p = p^+$ (continue only after a positive signal) to an equilibrium with $p = 1$ (alway continue).

5. Politics

Often one person or agency determines whether to continue a program, but a different party controls the quality of information that will be provided. Thus, firms developing a new technology may make it difficult or easy to evaluate the effectiveness of their products. They may give specific or vague estimates of future prices. They may report profits accurately or inaccurately, promptly or with delay. The question then arises what information firms would want to provide.

Similar issues arise when the government that establishes the program in the first period fears losing power to a new government with different preferences. The first government determines the reliability of the information that will be revealed at the end of period 1. The second government decides in period 2 whether to continue the program.[5] The manipulation of information as described above can be considered to determine the values of s and f. To see the effects of such changes, let the government in period 1 evaluate success at S_1 and failure at $-F_1$. In period 2 a different government will be in power. It evaluates success at S_2 and failure at $-F_2$. The first government chooses s or f. The second government decides whether to continue the program.

An increase in the value of s or of f makes it more attractive for government to continue the program in period 2 after a positive signal, and to stop the program after a negative signal.[6] An increase in s or f may thus change a government's criteria of when to continue the program. With unreliable signals government may continue the program regardless of the signal. With reliable signals it may choose to continue only after a positive signal.

To determine how the first government can manipulate information to its benefit, suppose the second government (in power in period 2) is less favorable towards the program than is the first government (in power in period 1). That is, $S_2 < S_1$ and $F_2 > F_1$. Two opposite situations are possible:

1. The second government would only continue the program if success is very likely. The first government then prefers that the program generate a reliable signal of success, that is a high value of s.
2. The second government would continue the program even with no further information (that is, even if $s = f = 1/2$). Given, however, a sufficiently informative negative signal, the second government would cancel the program while the first government (if it stayed in power) would not. The first government then has an incentive to make the signals unreliable.

The preferences of the second government may also affect the first government's decision about adopting the program. Suppose that s and f are fixed, and that the second government more strongly favors the program: $S_2 > S_1$, and $F_2 < F_1$. The first government may then adopt the program only if it has the option of stopping the program once it thinks the program likely failed.

But if the second government would continue the program even when the first government would prefer that it not, then the benefits to the first government of adopting the program are reduced. We have the paradoxical result that the fear that a future government greatly favors the program makes the first government less inclined to adopt it in the first place.[7]

Finally, the discussion in the previous section implies that a possible change in power may increase the expected benefits of the program as measured by the first government. A belief by the public that the second government is more favorable to the program (that is, has higher values of S and lower values of F) can generate a higher value of p, and thus higher benefits to the first government. In other words, a change in government can have the same effects as a commitment by the first government either to continue or to stop the program. Thus, a political party that cares about policy may have higher utility in the second period if people expect it to lose reelection.

6. Notation

F Loss if program fails

f Probability signal is negative if program fails

p Probability that government continues program

p^+ Probability that government continues program, given that it continues only after a positive signal

p_I^+ Value of p for which $S(p)/F(p) = R^+$, so that government is indifferent about continuing the program following a positive signal

p_I^- Value of p for which $S(p)/F(p) = R^-$, so that government is indifferent about continuing the program following a negative signal

P_{xy} Probability of outcome x (Success or Failure) given signal y (+ or −)

R^+ $\frac{(1-\pi_0)(1-f)}{\pi_0 s}$; critical value for determining whether to continue after positive signal

R^- $\frac{(1-\pi_0)f}{\pi_0(1-s)}$; critical value for determining whether to continue after negative signal

S Benefit in each period if program succeeds

s Probability signal is positive if program succeeds

V^1 Expected benefit if the program is always continued

V^+ Expected benefit if the program is continued only after a positive signal

π_0 Prior probability program will succeed

Notes

1. The result is prominent in the literature on monetary policy. See Strotz (1955-56), Kydland and Prescott (1977), Barro and Gordon (1983), and Persson (1988). Cukierman and Meltzer (1986) show that a government seeking reelection will prefer to follow a discretionary policy rather than a rule which could lead to higher social welfare.
2. Gilligan and Krehbiel (1990) examine informational problems that arise in the design of insitutions. They do not consider how information affects credibility and the success of programs. Lindsay (1976) considers the effects of imperfect information by Congress, but views the imperfection as exogenous rather than endogenous, as we do.
3. The literature on principal-agent problems shows that sometimes information can reduce profits. See, for example, O'Keefe, Viscusi, and Zeckhauser (1984), who show that imperfect monitoring may be desirable if agents otherwise spend too much effort. Baiman and Demski (1980), Kanodia (1985), Reinganum and Wilde (1985), and Border and Sobel (1987) examine the optimal monitoring strategy. Spence and Zeckhauser (1971), Shavell (1979), Harris and Raviv (1979), Holmstrom (1979), Baron and Besanko (1984), and Laffont and Tirole (1986) consider imperfect monitoring. In a different vein, Reinganum and Wilde (1988) show that tax compliance can be higher when taxpayers are uncertain about the level of cheating that brings forth penalties.
4. See McCubbins, Noll, and Weingast (1987) and (1989).
5. Recent related work shows that expectations of a change in power can greatly influence the policies the current government will pursue. Glazer (1989) shows that collective choices will show a bias towards durable projects. Other work considers the macroeconomic implications of coalitional instability (see Alesina (1989) for a survey). Alesina and Tabellini (1990) and Tabellini and Alesina (1990) show that a government may increase debt to reduce expenditures by a later government. McCubbins, Noll, and Weingast (1989) show that if Congress fears that an agency will have different preferences from the current congressional majority, then Congress may limit an agency's freedom of action.
6. This need not mean that reliable signals increase the chances that the program will be continued – if success is unlikely, then an increase in f can reduce the chances that the program will be continued.
7. A similar effect may arise when the first government favors the program more than the second government does. The higher probability that the program will be stopped reduces the benefits of adopting it in the first place. Here, however, it is not surprising that the existence of a future government that does not favor the program reduces the benefits to the first government of adopting the program.

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Appendix: Derivation of equilibria

When government cannot commit, three equilibria in pure strategies can arise.

1. The program is never continued.
   For $p = 0$ to be an equilibrium, the government's optimal action must be to stop the program even after a positive signal. That is
   $$S(0)P_{S+} - F(0)P_{F+} \leq 0,$$
   or
   $$S(0)/F(0) \leq \frac{(1-\pi_0)(1-f)}{\pi_0 s} \equiv R^+. \tag{7}$$
   The expected benefits in period 2 are 0.
2. The program will be continued only after a positive signal.
   The probability of continuing is the probability of a positive signal, so that
   $$p = p^+ \equiv \pi_0 s + (1-\pi_0)(1-f). \tag{8}$$
   Continuation of the program only after a positive signal is an equilibrium if the government's optimal action is to continue after a positive signal and to stop after a negative signal. Thus, the following two conditions must be satisfied:
   $$S(p^+)P_{S+} - F(p^+)P_{F+} \geq 0,$$
   $$S(p^+)P_{S-} - F(p^+)P_{F-} \leq 0.$$
   These conditions can be written as
   $$R^+ \equiv \frac{(1-\pi_0)(1-f)}{\pi_0 s} \leq S(p^+)/F(p^+) \leq \frac{(1-\pi_0)f}{\pi_0(1-s)} \equiv R^-. \tag{9}$$
   The expected benefits in period 2 are
   $$V^+ \equiv S(p^+)\pi_0 s - F(p^+)(1-\pi_0)(1-f). \tag{10}$$
   Note that
   $$\frac{\partial p^+}{\partial \pi_0} = s + f - 1 > 0. \tag{11}$$
   The inequality follows from the assumption that s and f are each greater than 1/2. We thus find that the equilibrium probability of continuing the program is greater the greater the prior probability of success. We also note that this partial derivative is larger the greater the accuracy of the signals, that is the more likely success generates a positive signal, and the more likely failure generates a negative signal.

3. The program is always continued.
   For $p = 1$ to be an equilibrium, the government's optimal choice must be to continue the program even after a negative signal:

$$S(1)P_{S-} - F(1)P_{F-} \geq 0,$$

or

$$S(1)/F(1) \geq \frac{(1-\pi_0)f}{\pi_0(1-s)} \equiv R^-. \tag{12}$$

The expected benefits in period 2 are

$$V^1 \equiv S(1)\pi_0 - F(1)(1-\pi_0). \tag{13}$$

The equilibrium need not be unique. In particular, suppose that

$$S(p)/F(p) \ is\ monotone\ increasing.$$

That is, an increase in the probability of success increases the relative benefits of success more than the costs of failure. Then any combination of the possible solutions can apply.

Equilibria also exist which make government just indifferent between continuing and stopping the program after a positive or negative signal. Suppose that some p in $(0, 1)$ satisfies $S(p)/F(p) = R^+$; call this value p_I^+. Similarly, suppose that some p in $(0, 1)$ satisfies $S(p)/F(p) = R^-$; call this value p_I^-. If the public believes that $p = p_I^+$, then government is indifferent between continuing and stopping the program after a positive signal. If the public believes that $p = p_I^-$, then government is indifferent between continuing and stopping the program after a negative signal. In such cases of indifference we could view government as randomizing in a way that conforms with p. Specifically, suppose that equation (3) holds (and p^+ is an equilibrium). Then the assumption that $S(p)/F(p)$ is monotone increasing implies that $p_I^+ \leq p^+$.

If government randomizes after a positive signal (and stops the program after a negative signal), then $p = p_I^+$ may result. Then by definition of p_I^+, government is indeed indifferent about continuing the program after a positive signal. Hence, such randomization after a positive signal is an equilibrium. Similarly, $p = p_I^-$ may be an equilibrium. Nevertheless, an equilibrium with p_I^+ or p_I^- is unlikely. Such equilibria require government to be indifferent between continuing and stopping the program, and require government to randomize in the particular ways which support these equilibria.

These possibilities are illustrated in Figure 1 with the curve $S(p)/F(p)$. We suppose that $S(p^+)/F(p^+)$ lies between R^+ and R^-, that $S(1)/F(1)$ is greater than R^-, and that $S(0)/F(0)$ is less than R^+. Thus, $0 < p_I^+ < p^+ < p_I^- < 1$: p^+, p_I^+ and p_I^- can all be equilibria. Figure 2 illustrates a case where

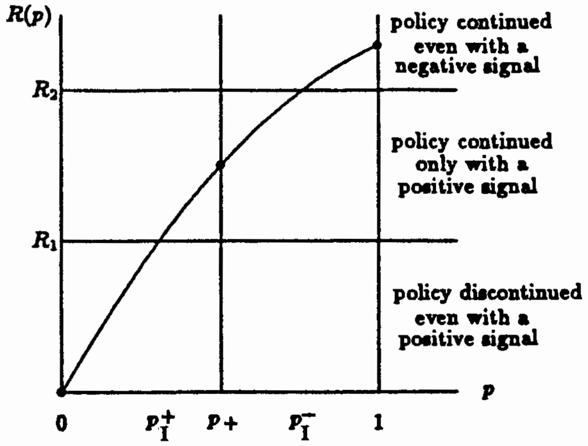

Figure 1.

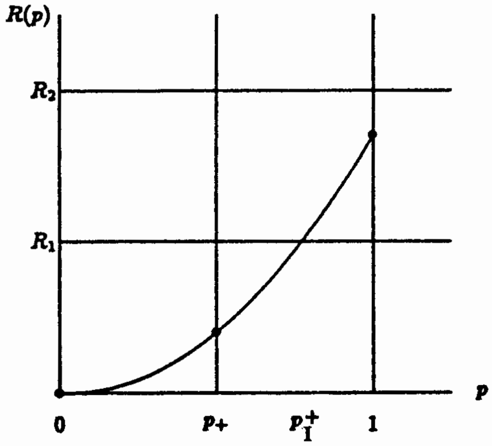

Figure 2.

$p_I^+ > p^+$ and p_I^- is not defined (since $S(p)/F(p) < R^-$ for all $p \in [0, 1]$). The only possible equilibrium is then 0. Other possibilities exist, depending on the relation between the curve $S(p)/F(p)$ and the critical values R^+ and R^-.