Governmental Failures in Evaluating Programs[1]

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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 the optimal decision rule for continuing the program, both when government can and 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.

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1 Introduction

Government often appears to cancel successful policies, and to continue failed ones. The first phenomenon, cancellation of policies that in hindsight would have been successful, is understandable when government has imperfect information at the time it must make a decision. The second phenomenon, however, is more complex. Government often appears to continue a program even though analysts using existing information would conclude that the program will likely fail.[2] Two explanations are most common:

(1) The goals of politicians are not those formally stated. For example, legislators may adopt dam projects not to control floods or to protect the environment, but to spend money in their districts. Thus, policy fulfills the unstated goals of politicians.

(2) Special interest groups deflect attention away from the purpose of the program originally proposed. The classic example is economic regulation.

Though both explanations say much about the world, we see them as incomplete in considering only politics. They do not recognize that in a world with imperfect information finding a good program can be difficult. Moreover, we shall see that when the success of a program depends on peoples' expectation about its continuation, the optimal decision rule may be to continue programs likely to fail.

Some issues we discuss here also apply to private firms. In that sense, our analysis is quite general. But government faces additional problems. First, a democratic government may be unable to assure economic agents that the program will

[2] Instances relating to technology policy are cited in Cohen and Noll (1991). For example, Congress continued funding a supersonic transport long after cost-benefit analyses showed such a plane would be a commercial failure.

be continued—it has limited rights to constrain the actions of a future government. A court may require a firm to pay damages arising from breach of contract, but will rarely uphold a claim of damages against a government that changed a policy. Government must then often use indirect methods to make credible commitments. Second, commitment is difficult when changes in government reflect changes in the preferences of political leaders.[3] In contrast, a succeeding chief executive of a private firm can share the goals of his predecessor of maximizing profits.

Central to our model is the assumption that the success of a program is greater if people think it will be continued. Expectations can affect the success of program in at least two ways. First, the success of a program may require firms or individuals to incur fixed costs of investment, so that a program expected to continue will induce more such investment. Second, the success of a program can depend on the degree of learning-by-doing. A firm engaged in learning-by-doing will tend to undertake those activities that it believes will generate the knowledge most useful under future conditions. Thus, the behavior of firms in a particular period depends on their expectations of policy in future periods.[4]

Consider the regulation of automobiles. In the wake of the energy crisis of 1973, the U.S. Congress adopted in 1975 the Energy Policy and Conservation Act, which mandated minimum corporate average fuel economy (CAFE) standards for new passenger vehicles sold in the United States. Auto manufacturers were in effect required to double the fuel-efficiency of their vehicles. Meeting these

[3]For an example of government inconsistency, consider the investment tax credit. Such a credit was enacted in the United States in 1962, repealed in 1969, reinstituted in 1971, abolished in 1986, and proposed again in 1993.

[4]Sometimes a program will be more successful when economic agents believe it will not be continued. A prime example is a tax amnesty. We shall not consider such policies here.

targets required costly research, development, and retooling. The firms would be unwilling to incur these expenses if they thought the regulations would later be relaxed. Indeed, in 1985 Ford and General Motors did not meet the standards, and faced penalties of up to $750 million.[5] The Secretary of Transportation reduced the standards from 27.5 mpg to 26.0 mpg. Furthermore, in June the Environmental Protection Agency revised its formula for measuring fuel efficiency, thereby substantially reducing the penalties Ford and General Motors faced.[6] Some of the support for relaxation of the standards came from studies which suggested that passengers in small cars were likely to suffer increased injuries in accidents, and from research which claimed that automobile emissions (which might be increased if fuel economy increased) could contribute to global warming. That is, one reason for the imperfect commitment to enforce the standards was the uncertain knowledge about the effects of the CAFE policy.

Similar credibility problems arose with the Clean Air Act Amendments of 1970 in the United States, which required automobile manufacturers to reduce emissions by 90 percent by 1975.[7] The Act was explicitly technology-forcing, requiring manufacturers to make large investments in new equipment. Under pressure from the automobile companies the U.S. government delayed imposition of the standards until 1977. In that year the manufacturers could not meet the standards either, so Congress amended the law to further temporarily relax the standards. One argument for delay was concern that catalytic converters, required to reduce emissions of carbon monoxide, hydrocarbons, and nitrous oxides, would generate sulfite pollution. Later studies showed the concern to be misplaced. But

[5]“Should car mileage limits be kept?" *New York Times*, June 17, 1985 I, 16:1.
[6]“U.S. ready to cut auto mileage standards." *New York Times*, July 9, 1985 I, 18:3.
[7]See White (1982).

the existence of some earlier studies cast doubt on the wisdom of the emission standards, and thus reduced the credibility that they would be enforced.

The following sections consider government policy when it can and cannot commit. If government can commit, our problem is to find the optimal actions of government in the second period. If government cannot commit, our problem is to find an equilibrium which describes peoples' beliefs that government will continue the program.[8]

2 Assumptions

We analyze a two-period model. In period 1 government adopts a new program. In period 2 let government continue the program with probability p. The program succeeds or fails. Success in period 2 yields a benefit of $S(p)$, and failure imposes a cost of $-F(p)$. 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 $F'(p) < 0$. Where appropriate we shall consider the results when $F'(p) > 0$. To be succinct we shall at times omit the argument p in the functions $S(p)$ and $F(p)$.

If adoption of the program requires no fixed cost, and if even under failure the benefits are positive, then the program will be adopted in the first period and continued in the second period. Thus, the model is interesting only if there exists a fixed cost, or, equivalently, if F is positive.[9] We henceforth assume

[8] Our discussion of commitment in public policy relates to work by Strotz (1955-56), Kydland and Prescott (1977), Barro and Gordon (1983), and Persson (1988). They show that current decisions of economic agents depend, in part, on their expectations of future policy. 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.

[9] Let the fixed cost be K. Instead of S and F consider $S - K$ and $F + K$ and ignore fixed costs.

that F is positive. The values of F and S in the first period are relevant only in determining whether government undertakes the program in that period. The values are irrelevant for any decisions made in period 2. We shall thus assume that S is sufficiently large, or F sufficiently small, to make adoption of the program in period 1 worthwhile.

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 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 which does not have perfect information about the program could use its priors and these signals to determine the posterior probability that the program is a success or a failure.

The main question we address is whether the program should be continued in period 2. If the program is continued, then the benefits obtained depend on whether the program succeeds or fails. If the program is stopped, then in period 2 no benefits are obtained. For simplicity we let the intertemporal discount rate be zero.

We then require that $S - K > 0$ and $F + K > 0$.

3 Optimal solution with commitment

This section considers the government's optimal strategy when it can commit to any action it desires. In particular, we allow it to continue a program in period 2 even if maximizing its utility from that point on would call for stopping the program. In other words, we do not require government to follow time-consistent solutions. Time-inconsistent strategies are attractive because an increase in the probability of continuing the program in period 2 can increase the gains from the program—S increases and F decreases.

The choice variable of interest is the probability, p, that government will continue a program. We make the natural assumption that a positive signal makes it always beneficial to continue the program. Thus, the government can be viewed as choosing the probability that it will continue the program after a negative signal.[10]

Note incidentally that it can be worthwhile to adopt the program in period 1 even if in that period expected benefits are negative. For adopting the program in period 1 yields information about the program, and thereby leads to a better decision in period 2. That is, adopting the program gives an option value, which can be greater than the expected loss in period 1. An example will illustrate. Let the program have $S = 10$ and $F = 11$. Each outcome has probability 1/2. In period 1 expected gains are $1/2(10 - 11) = -1/2$. But at the end of period 1, government

[10] Another policy is to stop the program with some probability after a positive signal. However, either always continuing or always stopping the program after a positive signal dominates any randomized policy of this type. The reason is that an increase in the probability of continuing after a positive signal increases both the benefits and the probability of getting those benefits. In contrast, an increase in the probability of continuing after a negative signal increases the probability of a loss.

learns something about the program's success. Suppose that at the end of period 1 it gets perfect information about the program. Government continues only a successful program. Since success occurs with probability 1/2, the expected gain from the program over the two periods is $-1/2 + (1/2)(10) = 4.5$.

Let p^- be the probability that government will continue the program after a negative signal. For a given p^- the probability of continuing the program is

$$p = \pi_0 s + (1 - \pi_0)(1 - f) + p^- \pi_0(1 - s) + p^-(1 - \pi_0)f. \tag{1}$$

Expected benefits over the two periods are

$$V(p^-) = (\pi_0 s)S(p) - (1 - \pi_0)(1 - f)F(p) + p^- \pi_0(1 - s)S(p) - p^-(1 - \pi_0)fF(p). \tag{2}$$

The government chooses p^- to maximize $V(p^-)$.

Let

$$p' \equiv \frac{\partial p}{\partial p^-} = \pi_0(1 - s) + (1 - \pi_0)f > 0. \tag{3}$$

Then

$$\begin{aligned}\frac{\partial V}{\partial p^-} &= \pi_0 s S'(p)p' - (1 - \pi_0)(1 - f)F'(p)p' \\ &+ \pi_0(1 - s)S(p) + p^- \pi_0(1 - s)S'(p)p' \\ &- (1 - \pi_0)fF(p) - p^-(1 - \pi_0)fF'(p)p'.\end{aligned}$$

The optimal value of p^- can be 0, 1, or an interior value satisfying $\partial V/\partial p^- = 0$.

4 Equilibrium solution without commitment

Consider next a second-best solution, where government must follow a time-consistent policy. That is, it will continue the program after seeing the signal at the end of the first period only if the expected benefits of continuing are positive. As before, $S'(p) > 0$, and $F'(p) < 0$. Where appropriate we shall consider the results when $F'(p) > 0$. The realized values of the signals and the values of S and F determine whether government will continue the program in period 2.

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,

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

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

$$\text{maximize } [0, S(p)P_{Si} - F(p)P_{Fi}]. \tag{4}$$

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. (As seen in the previous section, this need not be a first-best solution.) Continuation of the program only after a positive signal is an equilibrium if the government's optimal choice is to continue after a positive signal and to stop after a negative signal. The probability of continuing is 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

$$R^+ \equiv \frac{(1 - \pi_0)(1 - f)}{\pi_0 s} \leq S(p_+)/F(p_+) \leq \frac{(1 - \pi_0)f}{\pi_0(1 - s)} \equiv R^-. \tag{5}$$

The expected benefits in period 2 are

$$V^+ \equiv S(p_+)\pi_0 s - F(p_+)(1-\pi_0)(1-f). \tag{6}$$

The comparative static properties of V^+ are then sometimes surprising. The partial derivative of V^+ with respect to π_0 is

$$\frac{\partial V^+}{\partial \pi_0} = \frac{\partial p_+}{\partial \pi_0}[S'(p_+)\pi_0 s - F'(p_+)(1-\pi_0)(1-f)] + S(p_+)s + F(p_+)(1-f). \tag{7}$$

If $F' > 0$ this derivative can be negative: an increase in the prior probability of success makes it less attractive to continue after a positive signal. The effect arises because an increase in π_0 which leads to an increased probability of continuing the program increases the loss when the program fails.

The partial derivative of V^+ with respect to s (the probability that success generates a positive signal) is

$$\frac{\partial V^+}{\partial s} = \{S'(p_+)\pi_0 s + S(p_+) - F'(p_+)(1-\pi_0)(1-f)\}\pi_0. \tag{8}$$

If $F' > 0$ this derivative can be negative: the more accurate is a signal when the program succeeds, the lower the benefits from continuing the program after a positive signal. This effect arises because even with high values of s the program may be continued when it fails. An increase in the probability of continuing the program can increase the loss when a failed program is continued.

The partial derivative of V^+ with respect to f (the probability that failure generates a negative signal) is

$$\frac{\partial V^+}{\partial f} = \{-S'(p_+)\pi_0 s + F'(p_+)(1-\pi_0)(1-f) + F(p_+)\}(1-\pi_0). \tag{9}$$

This derivative can be negative both when $F' < 0$ and when $F' > 0$. An increase in f reduces the probability that the program will be continued. When $F'(p) < 0$, the reduced probability of continuing the program increases the costs of failure. Since a failed program may be continued, the expected benefits in period 2 may decline, and the derivative can be negative. When $F'(p) > 0$ and $S'(p) > 0$, the value of $\partial V^+/\partial f$ can nevertheless be negative: the reduced probability of continuing the program reduces the benefits of continuing a successful program.

Recall that an increase in f means that when the program fails the signal is more reliable. We can interpret this as improved information. Suppose $p = p_+$, so that social welfare is V^+. We saw that $\partial V^+/\partial f$ can be negative—an increase in f reduces social welfare. The paradox arises not because of the improved information. The problem is that the increased reliability of the signal makes government less likely to continue the program. This reduced probability can reduce benefits when a failed program is continued.

5 Commitment by ignorance

Though commitment is often problematic, it may be easier in our setting. 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 to either always stop or else always 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

$$\pi_0[sS(p_+) - S(1)] - (1 - \pi_0)[(1 - f)F(p_+) - F(1)] > 0. \qquad (10)$$

Then government prefers an equilibrium with $p = p_+$ (continue only after a positive signal) to an equilibrium with $p = 1$. This inequality will be satisfied if one of the following conditions is satisfied:

1. f is large;

2. s is large;

3. $S(p)$ increases slowly with p;

4. $F(p)$ decreases slowly with p.

6 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 of 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.[11]

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 project.

An increase in the value of s or of f makes it more attractive for government to

[11] 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 the 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.

continue the program in period 2 after a positive signal, and to stop the program after a negative signal. Note that 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. An increase in s or f may also 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.

Analogous incentives to manipulate signals appear when the second government benefits more from the program than does the first government. The preferences of the second government may also affect the first government's decision about adopting the program. Suppose that $S_2 > S_1$, that $F_2 < F_1$, and that s and f are fixed. 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.[12]

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 to either continue or stop the program. Thus, a government that cares about policy may have higher utility in the second period if people expect it to lose reelection.

7 Conclusion

President Clinton said in his 1993 State of the Union message that "Our every effort will reflect what President Franklin Roosevelt called 'bold, persistent ex-

[12] A similar effect may arise when the first government favors the program more than the second government. 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 of to the first government of adopting the program.

perimentation,’ a willingness to stay with things that work, and stop things that don’t." We agree with the first principle. But stopping programs that do not work can be bad policy.

8 Appendix: Equilibria without commitment

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

   $$S(0)/F(0) \leq \frac{(1-\pi_0)(1-f)}{\pi_0 s} \equiv R^+. \tag{11}$$

   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

   $$p = p_+ \equiv \pi_0 s + (1-\pi_0)(1-f). \tag{12}$$

   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

   $$R^+ \equiv \frac{(1-\pi_0)(1-f)}{\pi_0 s} \leq S(p_+)/F(p_+) \leq \frac{(1-\pi_0)f}{\pi_0(1-s)} \equiv R^-. \tag{13}$$

The expected benefits in period 2 are

$$V^{+} \equiv S(p_{+})\pi_0 s - F(p_{+})(1-\pi_0)(1-f). \tag{14}$$

Note that

$$\frac{\partial p_{+}}{\partial \pi_0} = s + f - 1 > 0. \tag{15}$$

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

$$S(1)/F(1) \geq \frac{(1-\pi_0)f}{\pi_0(1-s)} \equiv R^{-}. \tag{16}$$

   The expected benefits in period 2 are

$$V^{1} \equiv S(1)\pi_0 - F(1)(1-\pi_0). \tag{17}$$

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

$$S(p)/F(p) \textit{ is monotone increasing}. \tag{18}$$

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 (5) holds (and p_+ is an equilibrium). In this case 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. In this case, by definition of p_I^+, government is indeed indifferent about continuing the program after a positive signal. Hence, this 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 $p_I^+ > p_+$ and p_I^- is not defined (since $S(p)/F(p) < R^-$ for all $p \in [0, 1]$). The only possible equilibrium in this case is 0. Other possibilities exist, depending on the relation between the curve $S(p)/F(p)$ and the critical values R^+ and R^-.

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9 Notation

F Loss if program fails

f Probability signal is negative if program fails

p Probability that government continues program

p^- Probability government continues program when it observes a negative signal

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