Gürtler, Marc; Sieg, Gernot

Working Paper

Crunch time: A policy to avoid the announcement effect when terminating a subsidy

Economics Department Working Paper Series, No. 1

Provided in cooperation with:
Technische Universität Braunschweig

Suggested citation: Gürtler, Marc; Sieg, Gernot (2008) : Crunch time: A policy to avoid the announcement effect when terminating a subsidy, Economics Department Working Paper Series, No. 1, urn:nbn:de:gbv:084-21506 , http://hdl.handle.net/10419/51310

Marc Gürtler and Gernot Sieg

„Crunch Time: A policy to avoid the „Announcement Effect“ when terminating a subsidy”

Braunschweig : Institut für Volkswirtschaftslehre, 2008

Working Paper Series / Economics Department ; No. 01

Veröffentlicht: 29.10.2008

http://www.digibib.tu-bs.de/?docid=00023543

TECHNISCHE UNIVERSITÄT
CAROLO-WILHELMINA
ZU BRAUNSCHWEIG

ECONOMICS DEPARTMENT
WORKING PAPER SERIES
NO 01/ MAY 2008

„Crunch Time: A Policy to avoid the "Announcement Effect" when Terminating a Subsidy“

by Marc Gürtler
and Gernot Sieg,
May 2008

Address
Institut für Volkswirtschaftslehre
Spielmannstraße 9
D38106 Braunschweig, Germany

Telephone
+49 531 391 2578

Website
http://www.tu-braunschweig.de/vwl

Fax
+49 531 391 2593

Crunch Time: A policy to avoid the "Announcement Effect" when terminating a subsidy

Marc Gürtler, Gernot Sieg

Technical University at Braunschweig, Germany[1]

Abstract

If the government announces the termination of a subsidy paid for an irreversible investment under uncertainty, investors might decide to realize their investment so as to obtain the subsidy. These investors might have postponed an investment if future payment were assured. Depending on the degree of uncertainty and the time preference, the termination of the subsidy might cost the government more *in toto* than granting the subsidy on a continuing basis. A better strategy would be to reduce the subsidy in parts rather than to terminate the subsidy in its entirety.

JEL-Classification: H3, D11

Keywords: Irreversibility, Investment, Announcement effect, Subsidy, Tax

---

[1] Corresponding author: Gernot Sieg, TU Braunschweig, Spielmannstr. 9, 38106 Braunschweig, Germany, E-mail: g.sieg@tu-bs.de, telephone +49-531-391-2592, fax +49-531-391-2593. We are grateful for useful comments from an anonymous referee and the editor Wolfgang Leininger.

1. Introduction

Governments that face tighter budget constraints or changing political majorities might consider cutting subsidies or increasing taxes for investments. Investment expenditures are largely irreversible (Henry, 1974); hence investment costs are mostly sunk costs. Furthermore, most investments can be delayed. Delay increases cash flows because new information improves the investment decision (McDonald/Siegel, 1986). In addition to the decision rule "invest when the present value of the future cash flows is at least as large as the costs" the firm should invest only if the net present value is at least as large as the net present value of the delayed investment (Pindyck, 1991).

Governments pay subsidies to redistribute income or to induce a project that is not realized without a subsidy. If the subsidy is offered steadily and is paid at the outset of the investment project, then the policy might induce investment at an earlier time because the net present value of the subsidy payment is larger if received earlier.

If the government announces a cut in subsidy, a firm has to choose between investing now, thereby receiving the subsidy, and investing later with better information but without a subsidy. Firms that would bring forward their investment if a subsidy cut were to be announced have been identified herein. That implies that these firms invest if and only if the subsidy is withdrawn. The announcement of a subsidy cut induces the hurried investment activity of these firms. This so-called *Announcement Effect* might be so large that the present value of subsidy payments for the government would rise with the announcement of the cut. A better strategy than cutting the subsidy completely at once is to cut the subsidy in parts small enough to prevent the Announcement Effect.

The option to delay an investment is valuable (McDonald/Siegel 1986). Teisberg (1993) showed that firms might delay the investment or choose smaller, shorter-lead-time technologies when faced with uncertain regulation. An industry that faces the uncertainty of frequent changes in regulation has been considered in her report. In this article, a different case, namely, that a rationally expected change of policy might occur once only, has been studied. There are numerous articles that deal with the possibility of trading off flexibility and commitment, based on Spence (1979) and Fudenberg/Tirole (1983); for example, Saloner (1987), Mailath (1993), Maggi (1996), and Sadanand/Sadanand (1996). However, this study analyzes investors who trade off subsidies and flexibility.

Subsidies for investment and their gradual reduction are discussed in this article. However, the reduction of a subsidy is in our model equivalent to a tax increase, and there is a literature that tax reforms have varied effects before they actually are put into practice. Abel (1982) showed that temporary cuts in the corporate tax rate could reduce investment even if permanent tax cuts were to stimulate investment.

2. The model

Following McDonald and Siegel (1986), we consider firms searching for the point in time, $0 \leq t < \infty$, in which it is optimal to invest sunk costs, I ,and receive a project worth V. After the project is realized, the firm achieves an uncertain cashflow, X_t , at each future point in time t. It is assumed that X follows a geometric Brownian motion

$$dX = \alpha \cdot X \cdot dt + \sigma \cdot X \cdot dz, \tag{1}$$

where dz is the increment of a Wiener process, α is the drift parameter, and σ the volatility. Furthermore, we assume the existence of a complete and arbitrage-free capital market with continuous and frictionless trading possibilities. Let μ be the expected return of an asset traded on the capital market, whose price process, F_t ,is perfectly correlated to X_t, i.e.

$$dF = \mu \cdot F \cdot dt + \sigma \cdot F \cdot dz. \tag{2}$$

In addition, we define $\delta = \mu - \alpha$ as the difference between the risk-adjusted rate of return, μ, (requested by the capital market) and the observed rate of return, α, of the real asset; and r as the risk-free rate of return. The assumed market environment assures the existence of a unique risk-neutral probability measure, Q , implying

$$dX = (r - \delta) \cdot X \cdot dt + \sigma \cdot X \cdot dz^{(Q)} . \tag{3}$$

Under the risk-neutral measure Q, it is easy to determine the value V_t of the project (Dixit/Pindyck, 1994, 182):

$$V_t = \frac{X_t}{\delta} . \tag{4}$$

Thus, the process $X_t = \delta \cdot V_t$ can be regarded as that of a financial asset with dividend yield δ. Furthermore, V_t follows a geometric Brownian motion

$$dV = (r - \delta) \cdot V \cdot dt + \sigma \cdot V \cdot dz^{(Q)} = (r \cdot V - X) \cdot dt + \sigma \cdot V \cdot dz^{(Q)} \tag{5}$$

The investor has the option to delay the project realization and uses all the available information to find the optimal point of investment in time τ by solving the problem:

$$C(V, I) = \max_{0 \le \tau < \infty} E^{(Q)} \left[\exp(-r \cdot \tau) \cdot (V_\tau - I)^+ \right] , \tag{6}$$

in which $Y^+ = \max\{Y, 0\}$ and $E^{(Q)}$ is the expectation operator under the risk-neutral probability measure Q. The investment opportunity is analogous to a perpetual American-call option on V with strike price I. The value of this option (Dixit/Pindyck, 1994, 136-144) is

$$C(V, I) = \begin{cases} A(I) \cdot V^{\beta}, & \text{if } V < \frac{\beta}{\beta - 1} \cdot I, \\ V - I, & \text{if } V \ge \frac{\beta}{\beta - 1} \cdot I, \end{cases} \tag{7}$$

where

$$A(I) = \frac{1}{\beta} \cdot \left(\frac{\beta}{\beta - 1} \cdot I \right)^{1-\beta} \text{ and}$$
$$\beta = \frac{1}{2} - \frac{r - \delta}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{r - \delta}{\sigma^2} \right)^2 + \frac{2 \cdot r}{\sigma^2}} > 1. \tag{8}$$

To investigate the effect of taxation or subsidization of the investment, we compare two cases. In case A, the investment is subsidized by the government forever. An investor gets a subsidy, S, at the outset of the investment project.

In case B, by reason of tighter budgetary constraints for example, the government considers the termination of the subsidy. Because of legal issues, the government has to announce that the subsidy is to be terminated. Thus, in case B, the government subsidizes the investment at time t_0 but not later. Investors do anticipate the cut and might bring forward their investment. For simplification, we do not consider the effects on market prices of government policy but assume X and I to be independent of the subsidy.

First of all, let us analyze case A. Investment at time $t_0 = 0$, which ensures receiving the subsidy, yields $V_0 - (I - S)$. The value of the project considering the option to wait is calculated using (7) and (8) as $C(V_0, I - S)$, and thus the investor invests at t_0 if $C(V_0, I - S) = V_0 - (I - S)$. If the government does not subsidize the investment at anytime, the necessary condition for an immediate project realization is $C(V_0, I) = V_0 - I$. A comparison of both the conditions shows that the subsidy induces investment if

$$\frac{\beta}{\beta - 1} \cdot (I - S) \leq V_0 < \frac{\beta}{\beta - 1} \cdot I . \tag{9}$$

The goal of a subsidy is to induce investment of firms that otherwise would never invest. Because this effect does not depend on the announcement of a policy change but on the payment of a subsidy, we do not consider them to constitute the Announcement Effect.

To analyze case B, we consider the announced cut of the subsidy S. The Announcement Effect occurs if investment at t_0 is more profitable than using the option to delay, i.e. if

$$V_0 - I + S > C(V_0, I) . \tag{10}$$

Assuming $V_0 < [\beta / (\beta - 1)] \cdot I$ (otherwise immediate investment is optimal, independent of S) the option value is

$$C(V_0, I) = A(I) \cdot V_0^{\beta} , \tag{11}$$

and the firm invests at t_0 if

$$V_0 - I + S > A(I) \cdot V_0^{\beta} \quad \Leftrightarrow \quad S > \frac{1}{\beta} \cdot \left(\frac{\beta}{\beta - 1} \cdot I \right)^{1-\beta} \cdot V_0^{\beta} - V_0 + I . \tag{12}$$

Using the definition

$$f(V,S) := \frac{1}{\beta} \cdot \left(\frac{\beta}{\beta - 1} \cdot (I - S) \right)^{1-\beta} \cdot V^{\beta} - V + I \tag{13}$$

the Announcement Effect occurs if and only if

$$f(V_0, 0) < S < I - \frac{\beta - 1}{\beta} \cdot V_0 . \tag{14}$$

It is not difficult to prove (also see Figure 1):

Lemma 1:

(a) For a given subsidy S, the function f(V,S) is unimodal with the minimum at $\hat{V}(S) = \beta \cdot (I - S)/(\beta - 1)$.

(b) $f(V=0, S) = I$ *and* $f(\hat{V}(S), S) = S$ *for all given subsidies S.*

(c) $\hat{V}(S)$ *is a decreasing function (for all* $S \leq I$*).*

(d) $0 < V_0 < \hat{V}(0)$ *implies* $f(V_0, 0) < I - \frac{\beta - 1}{\beta} \cdot V_0$.

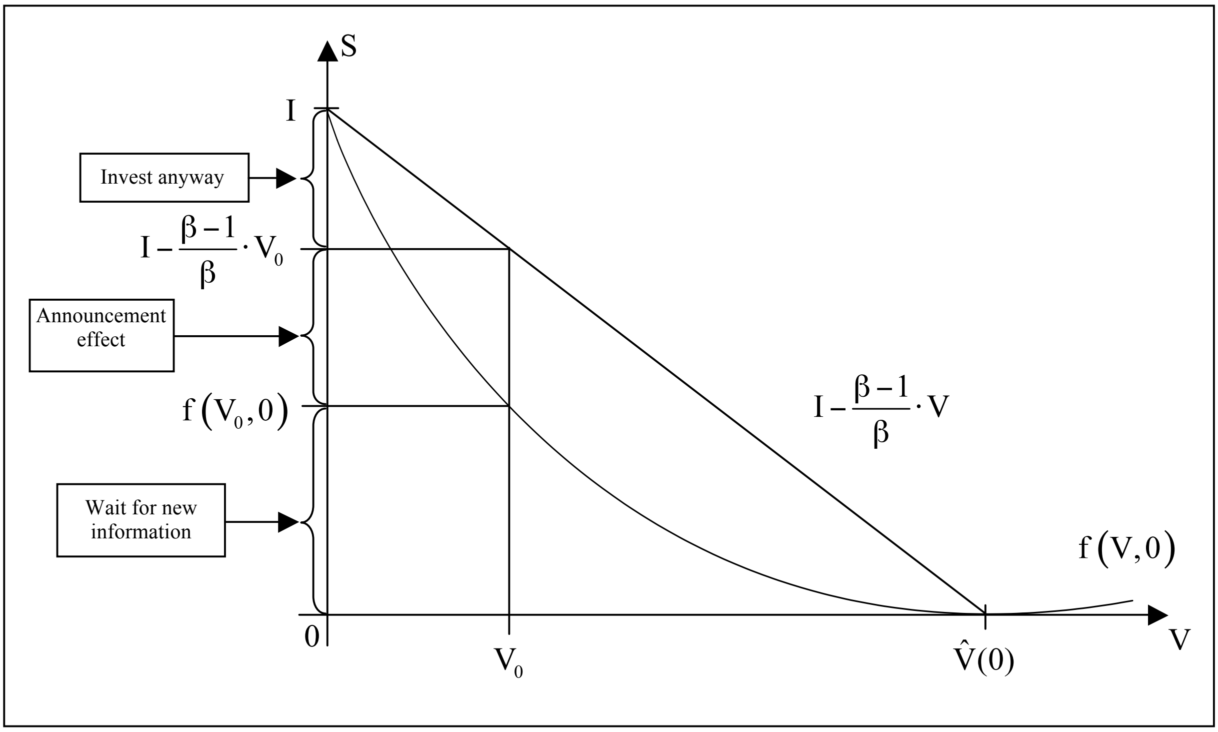

Figure 1: Characterization of function f and the Announcement effect interval

Figure 1 shows the Announcement Effect interval. Depending on S and V_0, the firm chooses one of the following options: invest independent of the policy change if S is large; wait for new information if S is small; or invest if and only if the subsidy is cut when S belongs to the Announcement Effect interval $[f(V_0,0), I-((\beta-1)/\beta)\cdot V_0]$. Inequality (d) of Lemma 1 shows that for all $0 < V_0 < \hat{V}(0)$, there exists a subsidy S such that (14) is fulfilled, and the Announcement Effect occurs. To summarize, there exist parameter combinations, which induce investors to bring forward their investments if a subsidy cut is announced.

Let us assume that there is exactly one investment opportunity for all investors and subsidy S fulfills (14). The investment is realized because the cut is announced, and the government pays each investor S at time t_0. If the cut is not announced, the government pays either S at some time in the future or no subsidy at all, depending on the unknown movement of V. To summarize, the announcement of the policy change enhances the net present value of the subsidy payments. Cutting the subsidy is thus not a policy to improve the budget.

If there are heterogeneous investment opportunities, the occurrence of the Announcement

Effect depends not only on the size of the subsidy S but also on different values V_0. Consequently, some of the investments are affected by the Announcement Effect whereas others are not. Against this background, the announcement of the subsidy cut might improve the budget even if the Announcement Effect occurs for some investments.

3. A Policy to prevent Announcement Effects

This section shows that a government that faces the Announcement Effect problem can cut the subsidy completely without causing preventing the Announcement Effect. We assume that at time t_0, the parameters V_0 and S fulfill (14) such that cutting the subsidy increases government expenditures. Figure 2 shows the extent to which it is possible to scale down the subsidy without inducing an Announcement Effect. The maximum cut in an indefinitely paid subsidy without causing the Announcement Effect is made by $\hat{S}_1^* < S$, which is implicitly defined by

$$S = f(V_0, \hat{S}_1^*) . \qquad (15)$$

Because $S > f(V_0, 0)$ and $S = f(\hat{V}(S), S) < f(V_0, S)$, the existence of $\hat{S}_1^*$ is assured.

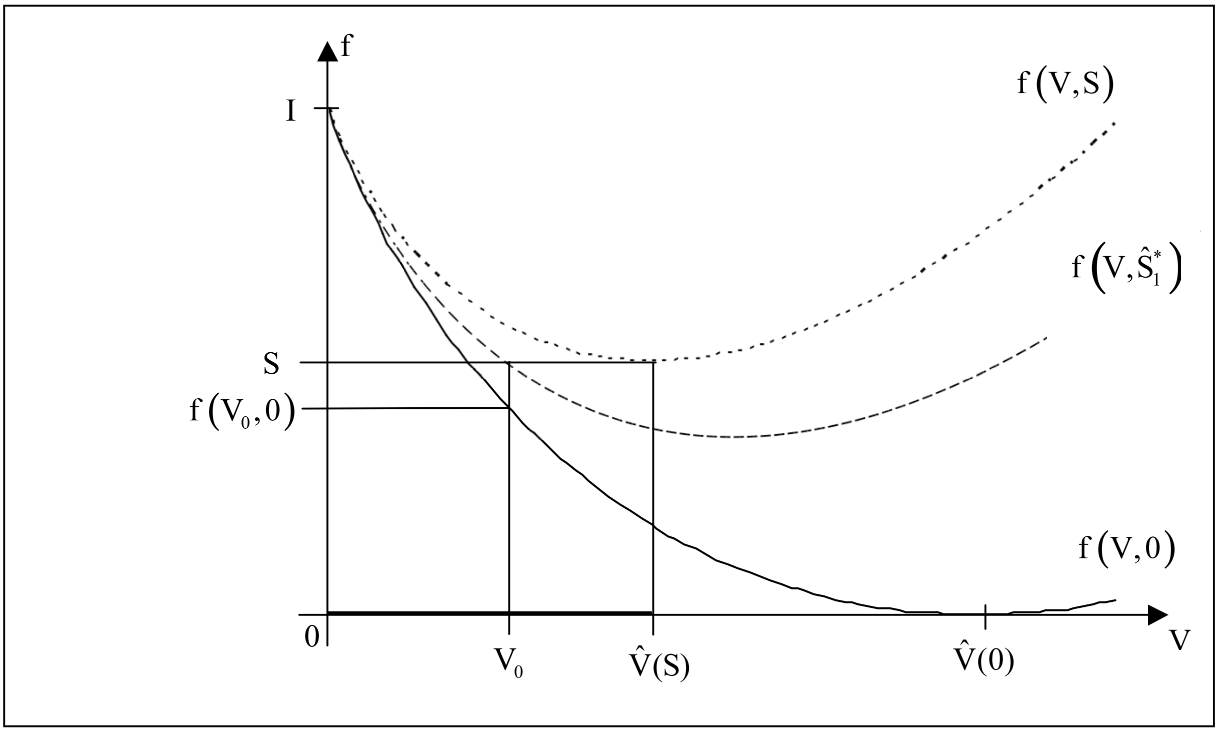

Figure 2: Subsidy $\hat{S}_1^*$ to prevent the Announcement Effect

Cutting the subsidy to $\hat{S}_1^*$ is just the first step if the government aims for a complete cancellation. However, the government cannot easily take the next step following (15) because further cuts are rationally anticipated and therefore change the Announcement Effect condition (15). Because there might be multiple changes in the subsidy, we have to generalize the Announcement Effect definition. The Announcement Effect occurs at time t if an investor, who does not invest at time $\tau \le t$, if the subsidy S is paid indefinitely, invests at time t under the cutting policy regime. If $V_\tau \ge \hat{V}(S)$ for a point in time $\tau \le t$ then it is optimal to invest at time τ if the subsidy S is paid. Therefore, we can label an investment as *induced by the announcement of the subsidy cut* only if $V_\tau < \hat{V}(S)$ for all $\tau \le t$. Consequently, we only consider situations in which

$$V_\tau < \hat{V}(\hat{S}) \text{ for all } \tau \le t \text{ and } \hat{S} < S. \tag{16}$$

The remainder of this section deals with the development of a policy that ensures complete cancellation of the subsidy without inducing any firm to bring forward their investment. The policy we develop is not optimal in terms of minimizing the subsidy payments of the government. The optimal policy depends on the realized values of V and is therefore difficult to implement. Usually, laws that define the conditions for subsidy payments do not refer to future values of investment opportunities. By contrast, our policy depends on time only and is easier to both implement and communicate. Even though the government is unable to commit to a special policy of taxation or subsidization, we assume that the policy is correctly anticipated by the concerned firms. Therefore, there is no problem of time inconsistency in our model.

We do not assume that a policy change is possible at each point in time but assume that there is a sequence $\{\tau_0, \tau_1, \tau_2, ...\}$ ($\tau_0 = t_0$ denotes the present point in time) of equidistant points in time, where $\tau_{i+1} - \tau_i = d > 0$, when the government is able to cut subsidies, as for example, each first day of a year or each last day of the quarter. On this basis, we develop a cutting policy ($S = S_0 > S_1 > ... > S_n = 0$ in which the government pays the subsidy S_i for all time intervals $t_{i-1} < t \leq t_i$ ($i \in \{1, ..., n-1\}$) and, for $t > t_{n-1}$, the subsidy is completely faded out, i.e. $S_n = 0$. Considering the assumption above for each "subsidy time interval" $t_{i-1} < t \leq t_i$, there exists a natural number m_i that implies the length of the time interval such that $t_i - t_{i-1} = m_i \cdot d$.

In the following section, we calculate S_i and the length $t_i - t_{i-1} = m_i \cdot d$ of the "subsidy time intervals" by backward induction (i.e. $i = n, n-1, \dots$) as long as the initial subsidy $S_0 = S$ is met. Subsequently, the number n and the points in time t_i can be identified by starting at t_0 and by using the calculated length of the time intervals.

By starting with $S_n = 0$ and $m_n \cdot d \to \infty$, the case $i = n$ is easily treated. Now consider an arbitrary $i \leq n-1$ and assume the induction hypothesis that the cutting rule ($S >$) $S_i > \dots > S_{n-1} > S_n = 0$ is given and that there is no Announcement Effect at t_i or later. Against this background, we have to determine the subsidy S_i and the length $m_i \cdot d$ of the time interval in which this subsidy S_i is valid.

Obviously, the investment opportunity at a point in time, t, $t_{i-1} < t \le t_i$, corresponds to a perpetual American option, with n–i+1 increasing strike prices $I-S_i < ... < I-S_n$ over the time intervals under consideration.[2] In an analogous manner as in (6) the corresponding option value $C_t^{(n-i+1)}(V, I-S_i, ..., I-S_n)$ at time t, $t_{i-1} < t \le t_i$, can be calculated by

$$\begin{aligned} & C_t^{(n-i+1)}(V_t, I-S_i, ..., I-S_n) \\ & = \max\{\max_{t \le \tau \le t_i} E^{(Q)}[\exp(-r\cdot\tau)\cdot(V_\tau - I + S_i)^+], ..., \max_{\tau \ge t_{n-1}} E^{(Q)}[\exp(-r\cdot\tau)\cdot(V_\tau - I + S_n)^+]\}. \end{aligned} \tag{17}$$

Andricopoulos et. al. (2003) showed the method for determining the right side of (17) numerically, and thus we regard the value of this type of option as ascertainable. To get a connection to the valuation formula (6) and consequentially an easier characterization of the situation, we define a (fictitious) subsidy, $\hat{S}_i(t_i - t)$, in such a way that the value of the perpetual American option with constant strike is identical to the perpetual American option with decreasing strike prices, i.e.

$$\begin{aligned} & C_t(V_t, I-\hat{S}_i(t_i-t)) = C_t^{(n-i+1)}(V_t, I-S_i, ..., I-S_n) \\ \underset{(7),(8)}{\Leftrightarrow} \ & \frac{1}{\beta}\cdot\left(\frac{\beta}{\beta-1}\cdot(I-\hat{S}_i(t_i-t))\right)^{1-\beta}\cdot V_t^\beta \\ & = \max\{\max_{t \le \tau \le t_i} E^{(Q)}[\exp(-r\cdot\tau)\cdot(V_\tau - I + S_i)^+], ..., \max_{\tau \ge t_{n-1}} E^{(Q)}[\exp(-r\cdot\tau)\cdot(V_\tau - I + S_n)^+]\}. \end{aligned} \tag{18}$$

From (18), it is easy to deduce some characteristics of the "fictitious" subsidy $\hat{S}_i(t_i - t)$:

Lemma 2:

(a) $\hat{S}_i(t_i - t)$ *is an increasing function in* t_i–t,

(b) $\lim_{t_i - t \to \infty}(\hat{S}_i(t_i - t)) = S_i$, *and*

(c) $\hat{S}_i(0) < \hat{S}_i(t_i - t) < S_i$ *for all* $t < t_i$.

Because (from the induction hypothesis) there is no Announcement Effect in t_i and (from (c)) $\hat{S}_i(t_i - t) > \hat{S}_i(0)$, we have no Announcement Effect at any point in time t where $t_{i-1} < t \le t_i$

[2] The points in time t_i are initially unknown. At this point we only need these points in time to give explanations and characterizations.

because the option to wait is of more value at time $t < t_i$ than at time t_i. Consequently, we only have to analyze the Announcement Effect at the "changeover" point in time $t = t_{i-1}$ and to determine the subsidy S_{i-1} on this basis. Obviously, we avoid the Announcement Effect if the subsidy S_{i-1} satisfies the following condition:

$$V_t - I + S_{i-1} \le C_t(V_t, I - \hat{S}_i(t_i - t)) = A(I - \hat{S}_i(t_i - t)) \cdot V_t^\beta$$
$$\Leftrightarrow \; S_{i-1} \le A(I - \hat{S}_i(t_i - t)) \cdot V_t^\beta - V_t + I = \frac{1}{\beta} \cdot \left(\frac{\beta}{\beta - 1} \cdot (I - \hat{S}_i(t_i - t)) \right)^{1-\beta} \cdot V_t^\beta - V_t + I \tag{19}$$
$$= f(V_t, \hat{S}_i(t_i - t)).$$

Inequality $V_{t_i} \le \hat{V}(S)$ and property (a) of Lemma 1 directly imply $f(V, \hat{S}_i(t_i - t)) \ge f(\hat{V}(S), \hat{S}_i(t_i - t))$, thus leading (under consideration of (19)) to a prevention of the Announcement Effect if

$$S_{i-1} := f(\hat{V}(S), \hat{S}_i(t_i - t_{i-1})) = f(\hat{V}(S), \hat{S}_i(m_i \cdot d)). \tag{20}$$

Since the duration $m_n \cdot d$ of subsidy $S_n = 0$ tends to infinity it immediately results from Lemma 2 (b):

$$S_{n-1} = f(\hat{V}(S), 0) < f(\hat{V}(S), S) = S. \tag{21}$$

In addition, we have to determine the duration $t_{i-1} - t_{i-2} = m_{i-1} \cdot d$ of subsidy S_{i-1}. For this reason, we need the following statement (see the appendix for details):

<u>Theorem 1:</u>

Consider $\overline{S}$, where $0 < \overline{S} < S$. Using the definition $c(\overline{S}) := f(\hat{V}(S), \overline{S}) - \overline{S}$, the following statements are true:

(a) $c(\overline{S}) > 0$.

(b) If for any length $t_i - t$ the inequality $0 \le \hat{S}_i(t_i - t) < \overline{S}$ holds, then there exists, for all $\varepsilon > 0$, a point in time $t < t_i$, such that $f(\hat{V}(S), \hat{S}_i(t_i - t)) > c(\overline{S}) + S_i - \varepsilon$.

First, we consider situations in which $S_i < \hat{S}_1^*$ (with $\hat{S}_1^*$ as defined in (15)) and thus Theorem 1 is applicable using $\overline{S} = \hat{S}_1^*$. Second, using Theorem 1 (b), we elect an arbitrary parameter 0 < ε < $c(\hat{S}_1^*)$ -which exists since $c(\hat{S}_1^*)$ is positive on the basis of Theorem 1 (a)- and define

$$m_{i-1} := \min\{m \in \{1, 2, ...\} \mid f(\hat{V}(S), \hat{S}_i(m \cdot d)) > c(\hat{S}_1^*) + S_i - \varepsilon\}. \quad (22)$$

To summarize, (20) and (22) define the cutting rule. The purpose of (22) is to guarantee the minimum step size $S_{i-1} - S_i > c(\hat{S}_1^*) - \varepsilon > 0$, because we search for a *finite* cutting rule.

We finally have to obtain a prescription for the termination of the procedures (20) and (22). As long as $S_i < \hat{S}_1^*$, the inequality $S_{i-1} > c(\hat{S}_1^*) + S_i - \varepsilon$ holds, which in turn implies the existence of a number i*, where $S_{i^*-1} > \hat{S}_1^* > S_{i^*}$.[3] We define i*:= 2. Because Lemma 2 (b) leads to the convergence $\lim_{t_1 - t \to \infty} (\hat{S}_1(t_1 - t)) = S_1 > \hat{S}_1^*$ we get the existence of a minimal length $m_1 \cdot d \geq 0$ of the time interval that satisfies $\hat{S}_1(m_1 \cdot d) \geq \hat{S}_1^*$. With these parameter specifications, the Announcement Effect is prohibited because

$$f(V_0, \hat{S}_1(m_1 \cdot d)) \geq f(V_0, \hat{S}_1^*) = S. \quad (23)$$

Repeated application of the induction procedure (20) yields the number n. Adding up all the lengths of time intervals, $t_i - t_{i-1}$ (i = 0, …, n−1), yields the entire length $(m_1 + \ldots + m_n) \cdot d$ of the cutting period.

Finally, for a better understanding, the whole policy is presented in a nutshell:

$$\begin{aligned} &S_n = 0;\ m_n \to \infty; \\ &S_{i-1} := f(\hat{V}(S), \hat{S}_i(m_i \cdot d)); \\ &m_{i-1} := \min\{m \in \{1, 2, ...\} \mid f(\hat{V}(S), \hat{S}_i(m \cdot d)) > c(\hat{S}_1^*) + S_i - \varepsilon\}; \\ &S_1 := \min\{S_{i-1} \mid S_{i-1} = f(\hat{V}(S), \hat{S}_i(m_i \cdot d)) > \hat{S}_1^*\}; \\ &m_1 := \min\{m \in \{1, 2, ...\} \mid \hat{S}_2(m \cdot d)) > \hat{S}_1^*\}. \end{aligned} \quad (24)$$

This policy avoids the Announcement Effect completely.

[3] Actually, we have $S_{i^*-1} \geq \hat{S}_1^* > S_{i^*}$. If $S_{i^*-1} = \hat{S}_1^*$ will be realized, we change the parameter ε to get $S_{i^*-1} > \hat{S}_1^*$.

4. Summary

If governments want to cut subsidies, they might fear the Announcement Effect: Investors realize an investment they would otherwise have postponed if the cut were not announced only to get a subsidy. This article identifies the parameter constellations when the cut of a subsidy, instead of improving the budget, enlarges the deficit.

The Announcement Effect interval is relevant from a political economy point of view. Voters are in favor of a subsidy because they seek windfall gains. However, if the subsidy is so large that anybody invests even without adequate information, the subsidy results in inefficient investment. This results in negative publicity such that a political majority is at risk. Therefore, from the rent seekers point of view the optimal permanent subsidy has to be as large as possible but small enough to prevent obviously inefficient investment. The politically optimal grant is hence prone to the Announcement Effect.

Accordingly, it is better not to cut the subsidy completely. However, the government is able to avoid the negative effects of the announcement and to improve the budget by following the cutting rule (24). The government cuts the subsidy incrementally and abolishes it in finite time.

Appendix

Proof of Theorem 1:

Because

$$c(\overline{S}) = f(\hat{V}(S), \overline{S}) - \overline{S} = f(\hat{V}(S), \overline{S}) - f(\hat{V}(\overline{S}), \overline{S}) \qquad \text{(A.1)}$$

result (a) follows from Lemma 1 (a) and (c).

In order to verify result (b) let $0 \leq \hat{S} < \overline{S} (< S)$ be an arbitrary real number. According to the mean value theorem of differential calculus, there exists a real number S' such that

$\hat{S} < S' < \overline{S}(< S)$ and

$$f(\hat{V}(S),\overline{S}) - f(\hat{V}(S),\hat{S}) = \left.\frac{\partial f(\hat{V}(S),\sigma)}{\partial\sigma}\right|_{\sigma=S'} \cdot (\overline{S}-\hat{S})$$

$$= \frac{1-\beta}{\beta}\cdot\frac{\beta}{1-\beta}\cdot\left(\frac{\beta}{\beta-1}\cdot(I-S')\right)^{-\beta}\cdot V^{\beta}\cdot(\overline{S}-\hat{S}) = \left(\frac{\beta}{\beta-1}\cdot(I-S')\right)^{-\beta}\cdot V^{\beta}\cdot(\overline{S}-\hat{S}) \tag{A.2}$$

$$\underset{S'<S}{<}\left(\hat{V}(S)\right)^{-\beta}\cdot V^{\beta}\cdot(\overline{S}-\hat{S}) \underset{V\le\hat{V}(S)}{\le} \overline{S}-\hat{S}.$$

Consequently,

$$f(\hat{V}(S),\hat{S}) - \hat{S} - c(\overline{S}) = f(\hat{V}(S),\hat{S}) - \hat{S} - [f(\hat{V}(S),\overline{S}) - \overline{S}] \underset{(A.2)}{>} 0. \tag{A.3}$$

Thus, we also get for all $t_i - t > 0$ and $0 \le \hat{S}_i(t_i - t) < \overline{S}$

$$f(\hat{V}(S),\hat{S}_i(t_i - t)) > c(\overline{S}) + \hat{S}_i(t_i - t). \tag{A.4}$$

From Lemma 2 (b) and the continuity of f, the convergence

$$\lim_{t_i - t\to\infty}(f(\hat{V}(S),\hat{S}_i(t_i - t))) = f(\hat{V}(S),S_i) \tag{A.5}$$

is true and (A.4) in turn implies

$$f(\hat{V}(S),S_i) \ge c(\overline{S}) + S_i. \tag{A.6}$$

Consequently (under consideration of (A.5) and (A.6)) the postulated statement (b) has been proved to be true.

References

Abel, A. 1982, Accelerated depreciation and the efficacy of temporary fiscal policy, Journal of Public Economics 19, 23-47.

Akerlof, G. A. 1970, The Market for “Lemons”: Quality Uncertainty and the Market Mechanism, Quarterly Journal of Economics 84, 488-500.

Andricopoulos, A. D./Widdicks, M./Duck, P. W./Newton, D. P. (2003): Universal Option Valuation Using Quadrature Methods, in: Journal of Financial Economics, Vol. 67, pp. 447-471.

Dixit, A. and R. S. Pindyck 1994, Investment under Uncertainty, Princeton University Press.

Fudenberg, D. and J. Tirole 1983, Capital as a Commitment: Strategic Investment to Deter Mobility, Journal of Economic Theory 31, 227-250.

Henry, C. 1974, Investment decisions under uncertainty: the "irreversibility effect", American Economic Review 64, 1006-1012.

Maggi, G. 1996, Endogenous Leadership in a New Market, RAND Journal of Economics 27, 641-659.

Mailath, G. J. 1993, Endogenous Sequencing of Firm Decisions, Journal of Economic Theory 59, 169-182.

McDonald, R. and D. Siegel 1986, The Value of Waiting to Invest, Quarterly Journal of Economics 101, 707-728.

Pindyck, R. S. 1991, Irreversibility, Uncertainty, and Investment, Journal of Economic Literature 29, 1110-1148.

Sadanand, A. and V. Sadanand 1996, Firm Scale and the Endogenous Timing of Entry: A Choice Between Commitment and Flexibility, Journal of Economic Theory 70, 516-530.

Saloner, G. 1987, Cournot Duopoly with Two Production Periods, Journal of Economic Theory 42, 183-187.

Spence, A.M. 1979, Investment Strategy and Growth in a New Market, Bell Journal of Economics 10, 1-19.

Teisberg, E. O. 1993, Capital investment strategies under uncertain regulation, RAND Journal of Economics 24, 591-604.

TU Braunschweig, Economics Department, Working Paper Series

For a complete list of Working Papers published by TU Braunschweig, Economics Department, please visit the Department's website (http://www.tu-braunschweig.de/vwl)

01 „Crunch Time: A Policy to avoid the "Announcement Effect" when Terminating a Subsidy"
by Marc Gürtler and Gernot Sieg, May 2008

02 „Eine ökonomische Analyse einer Ausweitung des Arbeitnehmer-Entsendegesetzes"
by Uwe Kratzsch, June 2008

03 „Bread, peace and the attrition of power: Economic events and German election results"
by Irem Batool and Gernot Sieg, October 2008

04 „Grandfather rights in the market for airport slots"
by Gernot Sieg, November 2008