

# ACE and Expected Revenue Neutrality

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## **Abstract**

Online Appendix accompanying "The Intricacies Of Taxing Banks"

## 1 INTRODUCTION

We first repeat the part of the main text so that this supplementary material can be read independently. Subsequently, expected revenue equality for the government is studied in the third section.

## 2 ACE AND REVENUE NEUTRALITY

In the ACE regime there is an additional deduction from earnings before taxes apart from the interest on deposits. This is the deduction applied to the so called notional return on equity. At the same time the tax rate  $t$  is increased to finance this deduction. Let  $g$  denote the notional return on equity. The deduction from taxes is imputed as a tax refund on capital  $tgk$  in the good state. The objective function of the bank becomes,

$$\max_s p(s) \{(1-t)[s - i(1-k) - c(s)] + k + tgk\} \frac{1}{1+R} - k \quad (1)$$

The FOC reads

$$p'(s) \{(1-t)[s - i(1-k) - c(s)] + (1+tg)k\} + (1-t)p(s)[1 - c'(s)] = 0 \quad (2)$$

This implies that at the optimum

$$(s - i(1-k) - c(s)) + \frac{1+tg}{1-t}k = -\frac{p(s)}{p'(s)}[1 - c'(s)] \quad (3)$$

It is straightforward to check that the second order sufficient condition again only requires  $\Gamma(s) < 0$ , and that the positive left hand side of equation (3) implies that  $c'(s) < 1$ .

We consider changes in the notional rate  $g$  and tax rate  $t$  in such a way that at the margin the changes in the tax bill are profit neutral for the bank, so that banks are indifferent to the introduction to the ACE policy. Note that there is one variable  $s$  that the bank uses to maximize its profits and two government policy parameters  $t$  and  $g$  that the bank takes as given. For each combination of  $g$  and  $t$ , let  $s(t, g)$  denote the (expected) profit maximizing choice of  $s$  in equation (1). Write the resulting maximized bank profits as

$$\Pi(s(t, g); t, g)$$

Consider marginal changes in the two policy variables and how these affect profits  $\Pi(s(t, g); t, g)$ . By the envelope theorem we only need to consider the direct effects of (marginal) changes in  $t$  and  $g$ . This gives:

$$\frac{d\Pi(s(t, g); t, g)}{dt} = \frac{\partial\Pi(s(t, g); t, g)}{\partial t} = -[s(t, g) - i(1 - k) - c(s(t, g))] + gk$$

and

$$\frac{d\Pi(s(t, g); t, g)}{dg} = \frac{\partial\Pi(s(t, g); t, g)}{\partial g} = tk$$

Subsequently, impose that the ACE intervention should leave profits unaffected. Hence, we must have that

$$d\Pi(s(t, g); t, g) = \frac{\partial\Pi(s(t, g); t, g)}{\partial t} dt + \frac{\partial\Pi(s(t, g); t, g)}{\partial g} dg = 0$$

Rearranging, this yields the requirement that policy changes must be such that

$$\frac{dt}{dg} = \frac{kt}{[s - i(1 - k) - c(s)] - kg} > 0 \quad (4)$$

We are ready to investigate the effects of introducing a notional return on equity accompanied by a change in the corporate income tax rate. To this end differentiate the FOC (2) totally with respect to  $s$ ,  $g$  and  $t$  and use equation (3) as well as the Condition  $\Gamma(s) < 0$  on distributions to simplify the resulting expression

$$\begin{aligned} & \Gamma(s)(1 - t) ds \\ = & -p'(s) ktdg + [p'(s) \{[s - i(1 - k) - c(s)] - kg\} + p(s)(1 - c'(s))] dt \end{aligned} \quad (5)$$

Subsequently, impose profit neutrality by substituting equation (4) into equation (5)

$$\begin{aligned} \Gamma(s)(1-t)ds &= -p'(s)kt \frac{[s - i(1-k) - c(s)] - kg}{kt} dt \\ &+ [p'(s) \{[s - i(1-k) - c(s)] - kg\} + p(s)(1 - c'(s))] dt \end{aligned}$$

By cancelling terms on the right hand side, we obtain:

PROPOSITION 1. (*ACE regime*) *The introduction of a notional return deductibility on equity  $g > 0$  together with an adjustment in the tax rate  $t$  such that policy changes do not affect bank profits, reduces risk taking incentives, since*

$$\left. \frac{ds}{dt} \right|_{\text{profits}} = \frac{p(s)[1 - c'(s)]}{(1-t)\Gamma(s)} < 0 \quad (6)$$

A profit neutral introduction of a notional rate on return deductibility compensated by a change in the corporate tax rate  $t$  lowers the risk taking by the bank. The deductible  $gk$  comes with an increase in the tax rate  $t$  to finance the deduction. Both  $t$  and  $g$  reduce risk taking  $s$ .

### 3 REVENUE NEUTRALITY

In the above we analyze the case in which we consider marginal changes in  $t$  and  $g$ , while holding the bank's profits fixed. But as Proposition 1 shows such a policy also lowers  $s$ . One can also ask the following question: is it possible to devise an ACE policy mix such that risk is lowered, i.e.,  $s$  decreases, while the expected government revenue does not change. To consider the effect of the ACE on the government budget, one needs to evaluate how the policy affects the expected net revenue intake

$$p(s)t[s - i(1-k) - c(s) - kg] = p(s)b(s; t, g) \quad (7)$$

say. For marginal changes keeping equation (7) constant, requires

$$\left[ p'(s) b(s; t, g) + p(s) \frac{\partial b(s; t, g)}{\partial s} \right] ds + p(s) \frac{\partial b(s; t, g)}{\partial t} dt + p(s) \frac{\partial b(s; t, g)}{\partial g} dg \quad (8)$$

to be zero.

Note that there are two opposing effects due to a change in  $s$  as  $p'(s) b(s; t, g)$  is negative while  $p(s) \partial b / \partial s$  is positive. These two terms do not necessarily cancel, implying that  $(\partial b / \partial t) dt + (\partial b / \partial g) dg$  cannot be zero if the net revenue intake has to be kept constant while simultaneously aiming to reduce the risk  $s$ . Hence, profit neutrality for the bank in general is not compatible with revenue neutrality for the government. Below we show how  $t$  and  $g$  need to be adjusted to achieve expected revenue neutrality. In the end it depends on the level of risk  $s$  as well as on the type of distribution how the two instruments  $t$  and  $g$  have to be combined.

### 3.0.1 Analysis of the revenue neutrality case

We analyze how to combine a marginal change in the notional return deductible  $g$  with a tax rate change in  $t$  such that the expected net contribution to the government budget  $p(s) b(s; t, g)$  is held constant, while risk taking  $s$  is reduced.

In the case at hand, the marginal changes in  $s$ ,  $t$  and  $g$  need to be such that equation (7), i.e.,  $p(s) b(s; t, g)$ , is held constant. Subsequently, fill in the details to equation (8)

$$\left[ p'(s) b(s; t, g) + p(s) \frac{\partial b(s; t, g)}{\partial s} \right] ds + p(s) \frac{\partial b(s; t, g)}{\partial t} dt + p(s) \frac{\partial b(s; t, g)}{\partial g} dg$$

and set it equal to zero:

$$\begin{aligned} & [p'(s) t [s - i(1 - k) - c(s) - gk] + p(s) t (1 - c'(s))] ds \\ & + p(s) [s - i(1 - k) - c(s) - gk] dt - p(s) tkdg \\ & = 0 \end{aligned}$$

Substitute this into the total differential of the FOC (5):

$$\begin{aligned} & \Gamma(s)(1-t)ds \\ = & -p'(s)kt dg + [p'(s)\{[s-i(1-k)-c(s)]-kg\} + p(s)(1-c'(s))]dt \end{aligned}$$

to obtain

$$\begin{aligned} & \Gamma(s)(1-t)ds \\ = & -p'(s)[s-i(1-k)-c(s)-gk]dt \\ & -p'(s)\left\{\frac{p'(s)}{p(s)}t[s-i(1-k)-c(s)-gk] + t[1-c'(s)]\right\}ds \\ & + [p'(s)\{[s-i(1-k)-c(s)]-kg\} + p(s)(1-c'(s))]dt \\ = & -p'(s)\left\{\frac{p'(s)}{p(s)}t[s-i(1-k)-c(s)-gk] + t[1-c'(s)]\right\}ds \\ & + p(s)(1-c'(s))dt \end{aligned} \tag{9}$$

Combine the two  $ds$  terms in equation (9) and use equation (3) from the FOC to rewrite the combined  $ds$  term:

$$\begin{aligned} & \Gamma(s)(1-t)ds + p'(s)\left\{\frac{p'(s)}{p(s)}t[s-i(1-k)-c(s)-gk] + t[1-c'(s)]\right\}ds \\ = & \Gamma(s)(1-t)ds \\ & + p'(s)\left\{\frac{p'(s)}{p(s)}t\left[-\frac{p(s)}{p'(s)}[1-c'(s)] - \frac{1+tg}{1-t}k - gk\right] + t[1-c'(s)]\right\}ds \\ = & \Gamma(s)(1-t)ds - \frac{(p'(s))^2}{p(s)}\frac{t}{1-t}(1+g)kds \end{aligned}$$

Returning to equation (9), then yields

$$\left\{\Gamma(s)(1-t) - \frac{(p'(s))^2}{p(s)}\frac{t}{1-t}(1+g)k\right\}ds = p(s)(1-c'(s))dt$$

We find

$$\left. \frac{ds}{dt} \right|_{\text{revenues}} = \frac{p(s)(1-c'(s))}{(1-t)\Gamma(s) - \frac{(p'(s))^2}{p(s)} \frac{t}{1-t} (1+g)k} < 0 \quad (10)$$

Thus by this change in  $t$ , government revenue is held constant, while risk  $s$  is reduced.

How does  $g$  have to accompany this change in  $t$ ? From the above and inserting  $ds/dt$  we obtain

$$\begin{aligned} & -tkdg \\ = & -[s - i(1-k) - c(s) - gk] dt \\ & - \left\{ \frac{p'(s)}{p(s)} t [s - i(1-k) - c(s) - gk] + t [1 - c'(s)] \right\} ds \\ = & -[s - i(1-k) - c(s) - gk] dt \\ & - \left\{ \frac{p'(s)}{p(s)} t [s - i(1-k) - c(s) - gk] + t [1 - c'(s)] \right\} \times \\ & \frac{p(s)(1-c'(s))}{\Gamma(s)(1-t) - \frac{(p'(s))^2}{p(s)} \frac{t}{1-t} (1+g)k} dt \end{aligned}$$

Note that by equation (3) from the FOC

$$\begin{aligned} & - \left\{ \frac{p'(s)}{p(s)} t [s - i(1-k) - c(s) - gk] + t [1 - c'(s)] \right\} \\ = & \frac{p'(s)}{p(s)} \frac{t}{1-t} (1+g)k \end{aligned}$$

So that

$$\begin{aligned} & -tkdg \\ = & -[s - i(1-k) - c(s) - gk] dt \\ & + \frac{p'(s)}{p(s)} \frac{t}{1-t} (1+g)k \frac{p(s)(1-c'(s))}{\Gamma(s)(1-t) - \frac{(p'(s))^2}{p(s)} \frac{t}{1-t} (1+g)k} dt \end{aligned}$$

Again we can rewrite  $[s - i(1 - k) - c(s) - gk]$  using equation (3):

$$[s - i(1 - k) - c(s) - gk] = -\frac{1 + g}{1 - t}k - \frac{p(s)}{p'(s)}[1 - c'(s)]$$

to obtain

$$\begin{aligned} -tk \frac{dg}{dt} &= \frac{1 + g}{1 - t}k + \frac{p(s)}{p'(s)}[1 - c'(s)] \\ &\quad + \frac{p'(s)}{p(s)} \frac{t}{1 - t} (1 + g) k \frac{p(s)(1 - c'(s))}{\Gamma(s)(1 - t) - \frac{(p'(s))^2}{p(s)} \frac{t}{1 - t} (1 + g) k} \\ &= \frac{1 + g}{1 - t}k + \frac{p(s)}{p'(s)}[1 - c'(s)] \left\{ 1 + \frac{\frac{(p'(s))^2}{p(s)} \frac{t}{1 - t} (1 + g) k}{\Gamma(s)(1 - t) - \frac{(p'(s))^2}{p(s)} \frac{t}{1 - t} (1 + g) k} \right\} \\ &= \frac{1 + g}{1 - t}k + \frac{p(s)}{p'(s)}[1 - c'(s)] \left\{ \frac{\Gamma(s)(1 - t)}{\Gamma(s)(1 - t) - \frac{(p'(s))^2}{p(s)} \frac{t}{1 - t} (1 + g) k} \right\} \end{aligned}$$

Rearranging gives how  $g$  has to be adjusted as  $t$  is raised we find

$$\frac{dg}{dt} = -\frac{1 + g}{(1 - t)t} - \frac{p(s)}{p'(s)} \frac{[1 - c'(s)]}{tk} \left\{ \frac{\Gamma(s)(1 - t)}{\Gamma(s)(1 - t) - \frac{(p'(s))^2}{p(s)} \frac{t}{1 - t} (1 + g) k} \right\} \quad (11)$$

The second term is positive and the first term is negative. So it depends on the level of  $s$  and the type of distribution how  $g$  has to be adjusted. This is similar to the conclusion reached in section 3.3.2. of the main paper.