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The Inefficiency of Seigniorage from Required Reserves

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Seigniorage from required reserves is shown to lead to lower capital accumulation than a tax on investment raising the same revenue. The result is obtained in an infinitely lived representative agent model to avoid the intergenerational wealth transfers found in Freeman's (1987) study of seigniorage from required reserves in an overlapping generations economy.

I have benefited from conversations with Joseph Haslag and Gregory Huffman. The views expressed are not necessarily those of the Federal Reserve Bank of Dallas or the Federal Reserve System.

Expansion of the fiat money stock taxes fiat money balances held by the public. Black (1970), Fama (1980), Calvo and Fernandez (1983), and Romer (1985) have all noted that requiring banks to hold reserves of fiat money then functions as a tax on banking. Freeman (1987), using an overlapping generations model, demonstrated that the tax on banking implied by required reserves and a finite rate of money expansion leads to lower holdings of capital and lower steady-state welfare than would a direct tax on banking yielding the same revenue.

Replacing reserve-requirement seigniorage with a direct tax on banking in an overlapping generations model hurts the initial generation by rendering worthless its initial holding of fiat money. This intergenerational transfer of wealth makes welfare comparisons difficult to interpret.[1] To avoid intergenerational wealth transfers this paper takes up the optimality of reserve requirements in an infinitely lived representative agent framework. Seigniorage from required reserves is shown unambiguously to generate lower steady-state capital and welfare than a direct tax on banking.

The model: There exists a continuum of infinitely lived agents whose population is normalized to 1. Each has preferences over consumption at date $t \geq 1$ described by the function $\sum_{t=0}^{\infty} \beta^t u(c_t)$. The function $u(c)$ is increasing, concave, and twice-continuously differentiable with $\lim_{c \to 0} u'(c) = \infty$.

The economy's sole good can be consumed or made into capital that lasts a single period. If k_t goods are made into capital at t, $f(k_t)$ goods will be produced at $t+1$. The

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[1] An alternative approach, taken by Bacchetta and Caminal (1990), retains the overlapping genrations model and requires the government to fund intergenerational transfers to the initial old with distortionary taxation.

production function $f(k)$ is increasing, concave, and twice-continuously differentiable with $\lim_{k\to 0} f'(k) = \infty$. In the initial period each agent starts with $f(k_0)$ goods.

In the initial period the agent also owns M_0 units of fiat money. The nominal stock of fiat money in any period t is M_t, which is expanded at a constant rate $z > 1$, implying that $M_t = zM_{t-1}$. Fiat money is held to satisfy a legal requirement that an agent owning k_t units of capital at t must also hold fiat money balances worth ϕk_t goods. The goods value of a unit of fiat money at t will be denoted v_t and an agent's nominal demand for fiat money balances at t will be denoted m_t. The seigniorage from the expansion of the fiat money stock is used to help finance a fixed level of wasteful government expenditures g. The government's only revenue alternative is a tax collecting τ_t goods for each good made into capital at t. Like seigniorage, this tax is a distorting tax that discourages investment. Because it does not tax existing capital, it introduces no time-consistency issues.

(To keep the analysis as straightforward as possible, I have assumed that the reserve requirement and investment tax are applied to all capital. The real world case of reserve requirements imposed only on some forms of intermediated capital is a trivial extension of this analysis.)

Equilibrium: Equilibrium is defined to be a sequence $\{c_t,k_t\}$ for $t \geq 1$ and given values of g, z, τ, and ϕ such that each agent maximizes his utility subject to his budget constraints and the reserve requirement, taking as given the price sequence $\{v_t\}$; each agent has perfect foresight; the market for fiat money clears; and the government budget constraint is met with equality.

An individual's budget constraint in each period $t \geq 1$ is

$$f(k_{t-1}) + v_t m_{t-1} = c_t + k_t + v_t m_t + \tau_t k_t \,, \tag{1}$$

which with the legal requirement $v_t m_t = \phi k_t$ can be written

$$f(k_{t-1}) + (v_t/v_{t-1})\phi k_{t-1} = c_t + k_t + \phi k_t + \tau_t k_t \,. \tag{2}$$

The resulting first order condition for the maximization of utility by an individual is

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(v_t/v_{t-1})\phi + f'(k_t)}{1 + \phi + \tau_t} \quad (3)$$

The clearing of the market for fiat money requires that

$$v_t M_t = \phi k_t \quad (4)$$

which in a steady state ($k_t = k$ for $t \geq 0$) implies that

$$\frac{v_{t+1}}{v_t} = \frac{1}{z} \quad (5)$$

The government's budget constraint in period t is

$$\begin{aligned} g &= \tau_t k_t + v_t[M_t - M_{t-1}] \\ &= \tau_t k_t + v_t M_t [\, 1 - 1/z \,] \\ &= \tau_t k_t + \phi k_t [\, 1 - 1/z \,] \end{aligned} \quad (6)$$

Comparing steady states: To compare investment taxation to seigniorage from reserves let us examine the steady-states of two benchmark policies. First suppose that there is no reserve requirement ($\phi = 0$) so that all revenue comes from investment taxation. The steady-state first-order condition simplifies to

$$\frac{1}{\beta} = \frac{f'(k)}{1 + \tau} \quad (7)$$

When the government budget constraint (6) is also included, we find

$$\frac{1}{\beta} = \frac{f'(k)}{1 + g/k} \quad (8)$$

Now suppose that all revenue somes from seigniorage ($\tau = 0$).The steady-state equilibrium conditions now simplify to

$$\frac{1}{\beta} = \frac{\phi/z + f'(k)}{1 + \phi} \quad (9)$$

where the government budget constraint (6) implies that the reserve requirement be such that

$$\phi = \frac{g}{(1 - 1/z)k} \quad (10)$$

Notice from (9) and (10) that for any finite rate of fiat money creation, seigniorage from required reserves is not equivalent to investment taxation. Solving (10) for $1/z$ and substituting the expression into (9) we find

$$\frac{1}{\beta} = \frac{\phi - g/k + f'(k)}{1 + \phi} \tag{11}$$

Comparing (8) with (11) [and noting from (6) that $\phi > g/k$], we see that the steady-state marginal product of capital is greater with required reserves, implying a lower steady-state capital stock for any given revenue. Notice that even when there is no seigniorage[$z = 1$ and $g = 0$], a reserve requirement lowers steady-state capital. By requiring investors to hold unproductive reserves of fiat money in order to invest, a reserve requirement discourages investment even more than does a direct tax on investment. To understand this, combine (9) and (10) for an expression in z.

$$\frac{1}{\beta} = \frac{\frac{g}{(z - 1)k} + f'(k)}{1 + \frac{g}{(1 - 1/z)k}} \tag{12}$$

As z increases (and ϕ decreases) the steady-state marginal product of capital decreases and steady-state capital increases. As z goes to infinity, the equilibrium condition approaches that of a tax on investment. The larger is z, the more that a given level of reserves is taxed and the less that it is used for saving. This reveals that the social cost of a reserve requirement comes from those reserves that are held but not taxed away.

The welfare implications of reserve requirements follow directly from the steady-state analysis. In a steady-state with positive reserve requirements, the marginal product of capital exceeds the marginal rate of substitution. Therefore, a policy that increases the stock of capital in every period while raising the same revenue increases welfare.

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