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General-equilibrium effects of investment tax incentives

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ABSTRACT

A new-Keynesian model with a nominal tax system is developed and used to study the macroeconomic effects of temporary tax-based investment incentives. Two claims regarding the effects of these incentives are examined: first that they are overstated in partial-equilibrium frameworks; and second that repeated use of such incentives by policymakers can ultimately be destabilizing. The results contradict the first claim and imply that the second claim is not general. The model is also used to compute the predicted effects of an investment tax incentive that has figured prominently in recent fiscal stimulus packages.

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1. Introduction

The past two U.S. recessions have been characterized by a shift towards more active countercyclical fiscal policy (see Auerbach, 2009). In each case, temporary partial expensing allowances on business equipment investment (also called bonus depreciation allowances) have been important components of the policy response. Despite this increased reliance on temporary expensing allowances as an instrument of countercyclical fiscal policy, virtually no attempt has been made to assess the impact of these provisions in a fully specified structural forward-looking general-equilibrium model, such as the new-Keynesian framework that now serves as the workhorse specification for analyzing macroeconomic stabilization policies. Elmendorf and Reifschneider (2002) use a forward-looking macromodel (the FRB/US model) to examine the effect of a *permanent* investment tax credit, but are unable to use their model to analyze the effect of a temporary credit. House and Shapiro (2006) consider the effect of a temporary bonus depreciation allowance; however, they do not analyze rational-expectations solutions, but instead use an approximation whereby a variable's future expectations are set equal to its steady-state value. In addition, their model is fully real, with no nominal rigidities.

This paper adds a tax system with nominal depreciation allowances to an otherwise-standard new-Keynesian model, and uses the resulting framework to analyze the effect of temporary partial expensing allowances on investment and real activity. The paper investigates two generally accepted views concerning the effects of temporary tax-based investment incentives that have emerged from earlier analyses. First, Auerbach and Summers (1979) and Judd (1985) argue that partial-equilibrium analyses overstate the computed impact of temporary tax-based investment incentives. This conclusion turns out to be a property of purely real models—in which the real interest rate rises to offset some of the stimulus from partial expensing—and does not necessarily extend to models with nominal rigidities. In particular, with sticky prices and wages, the effect of a temporary expensing allowance on investment is *larger* in general equilibrium than it is in partial equilibrium.

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The second view—advanced by Auerbach and Summers (1979) and later analyzed by Christiano (1984)—is that such investment incentives can ultimately be destabilizing. Intuitively, if agents come to expect that such incentives will be put into place whenever the economy enters a recession, they will postpone their capital expenditures when a negative shock hits the economy—thereby weakening the economy further—until the incentives are enacted. Such instability can in fact emerge, although its existence depends on how adjustment costs are specified in the model.

The model's quantitative predictions are also compared with the estimates obtained by House and Shapiro (2006, 2008) in their study of temporary bonus depreciation over the 2001–2005 period. The larger effects found by our model highlight the potential importance of nominal rigidities in driving responses to investment tax incentives.

2. A new-Keynesian model with nominal taxation

The model economy consists of a government, a household sector, and a production sector. In the government sector a central bank sets interest rates according to a Taylor rule and a fiscal authority levies taxes that are rebated to households as lump-sum transfers. In the household sector a continuum of households consume output and supply labor services, over which they have monopolistically competitive wage-setting power. The production sector produces two final goods—for consumption and investment—in three stages.

The first stage of production involves a single competitive firm that produces an *undifferentiated* preliminary output using all of the economy's differentiated labor types and a capital stock that it accumulates by purchasing investment goods. The second stage of production consists of two continua of monopolistically competitive intermediate-goods producers; firms in each continuum purchase the undifferentiated preliminary output to produce either a differentiated intermediate consumption good or a differentiated intermediate investment good. The third stage of production consists of two competitive firms that produce either the final consumption good or the final investment good by aggregating the differentiated intermediate goods for that sector. This multi-stage production specification, which follows the entrepreneur/retailer setup in Bernanke et al. (1999), allows firms to accumulate the economy's capital stock directly while avoiding the complications that arise when price setters must also choose the size of their capital stocks.[1] In addition, the two-sector production setup allows consumption and investment goods prices to differ from each other, and allows different types of capital or investment adjustment costs to be modeled. (Of course, only one type of adjustment cost will be present at any given time in each variant of the model.)

With the exception of the multi-stage production setup and treatment of taxation, the model is similar to the framework used by Woodford (2003) and others to analyze monetary policy. The following sections therefore focus on these nonstandard features.[2]

2.1. The undifferentiated preliminary-goods producer

The competitive firm in this stage of production chooses each type of differentiated labor $\{H_t^z\}_{z=0}^1$ and investment spending I_t to maximize post-tax net receipts, taking as given the wage rates set by each household $\{W_t^z\}_{z=0}^1$, the price of final investment goods P_t^i, the price of its undifferentiated output P_t^u, the current and expected tax system, the technology for producing its output U_t, and the technology for accumulating capital K_t. Profits are taxed at the rate τ^k; post-tax net receipts in period t are therefore given by

$$P_t^u U_t - \int_0^1 W_t^z H_t^z\, dz - P_t^i I_t - \tau^k \left(P_t^u U_t - \int_0^1 W_t^z H_t^z\, dz - X_t P_t^i I_t - \sum_{v=1}^{\infty} \delta(1-\delta)^{v-1}(1-X_{t-v}) P_{t-v}^i I_{t-v} \right). \tag{1}$$

The last term of Eq. (1) represents the taxes paid by the firm after its wage bill and capital deductions. Two types of capital deductions are permitted against income: expensing allowances and depreciation charges. An expensing allowance, denoted by X_t, represents a (partial) rebate of the purchase price of a new capital good; it is applied to the firm's time-t nominal expenditure on new capital goods, $P_t^i I_t$. Depreciation allowances recognize the loss the firm incurs as the capital stock depreciates from being used in production; the dollar value of depreciation at time t from all previous purchases of capital is given as $\sum_{v=1}^{\infty} \delta(1-\delta)^{v-1} P_{t-v}^i I_{t-v}$. However, because expensed capital cannot receive a depreciation allowance, each term $P_{t-v}^i I_{t-v}$ in the summation in Eq. (1) is multiplied by $(1-X_{t-v})$. Under the U.S. tax code, depreciation is computed using *historical* cost; hence, the investment price in the depreciation term has a $t-v$ subscript.[3]

The production technology for the undifferentiated preliminary good U_t is given by $((\int_0^1 H_t^{z(\psi-1)/\psi}\, dz)^{\psi/(\psi-1)})^{1-\alpha}(K_t)^{\alpha}$, where ψ is the elasticity of substitution across the economy's differentiated types of labor and α is the elasticity of output with respect to capital.

[1] In the interests of parsimony the model does not also include the Bernanke–Gertler–Gilchrist financial accelerator. This would be an interesting extension, however, given that real-world policymakers might wish to enact investment tax incentives in situations where weakened firm balance-sheet positions were raising the cost of capital and restraining investment spending.

[2] The model's complete derivation is available in an online appendix on the journal's website.

[3] In practice, depreciation allowances are based on a legislated schedule of depreciation rates, not the true (economic) depreciation rate δ. Extending the model in this way complicates interpretation of the resulting first-order conditions for investment while leaving the model's key qualitative results unchanged (see Section 3.4.3).

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