Optimal tax policy under habit formation and capital utilization

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ABSTRACT

Our objective is to investigate, how the combination of habit formation with endogenous capital utilization decisions affects the process of economic growth. We find that in the presence of positive productivity growth, habit formation in consumption reduces the rate of capital utilization while increasing the long run stock of capital. We show in the Chamley–Judd result of zero income capital taxation is robust to the presence of endogenous capital utilization. The result even extends to the short-run as long as there are no depreciation allowances, but breaks if those are present. Our policy simulations show that steady state level of capital utilization is not affected by changes in income tax, but its reduced on impact to accommodate for the constance of capital stock Our numerical simulations also show important differences in the time adjustment followed by key variables, as a response to tax policy.

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1. Introduction

Recently, Solow (2005) advocated for the considerations of demand-side and supply-side interaction in the study of economic growth. According to Solow:

> "...some sort of endogenous knitting-together of the [short-run] fluctuations ad growth contexts is needed, and not only for the sake of neatness: the short-run and its uncertainties affect the long-run through the volume of investment ... and the growth forces in the economy probably influence the frequency and amplitude of short-run fluctuations."

The standard Ramsey growth model is certainly at odds with this argument. On the preference (demand-side) it assumes agent's utility functions, at any point in time, depend only upon contemporaneous variables such as current consumption (sometimes leisure). On the production side (supply-side) it generally assumes production depend on physical capital (sometimes labor or human capital) with full utilization of the installed capital. Therefore, in order to address Solow's suggestion we need to depart from the standard Ramsey model.

The current work, tries to account for the interaction between demand-side and supply-side forces by departing from the Ramsey model in two distinct ways. On the preference side we recognize the limitations of this time-separable specification of utility, and thus allow current utility to depend not only on current consumption, but also on *past* consumption levels, which provide a benchmark against which current consumption can be assessed. This type of model are generally called models of habit-formation and were first introduced by Ryder and Heal (1973), and recently have been applied to a variety of issues, incuding but not limited to: asset pricing (Constantinides, 1990; Campbell and Cochrane, 1999), consumption behavior (Osborn,

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1988;Ferson and Constantinides, 1991 ; Dynan, 2000), short-run macroeconomic stabilization (Uhlig and Ljungqvist, 2000; Fuhrer, 2000), exchange rate behavior (Mansoorian, 1998) and economic growth (Carroll et al., 1997, 2000; Alvarez-Cuadrado et al., 2004; Alonso-Carrera et al., 2005; Turnovsky and Monteiro, 2008).

On the production side we use the Keynes' (1936) idea that firms increase the intensity of capital usage during a certain working period, and this leads to accelerated depreciation, thus affecting future capital accumulation.[1] Contrary to what happens with the habit formation, the idea of higher wear and tear on equipment resulting from higher utilization rate, has received little interest by economic growth theory contrasting with what happens in the business cycle literature. An explanation for this behavior may be that while it seems natural to include capital utilization as an optimal decision variable to explain cyclical variation in output, it is less evident that the underutilization of capital would persist in the long-run, and thus play a key role in explaining economic growth. Dalgaard (2003), however, shows, non-negligible long-run productivity differences can arise from plausible changes in the capital utilization rate, thus making this inclusion in the economic growth relevant.

A few notable exceptions to the neglect mentioned above are: Licandro et al. (2001), who analyze the equilibrium dynamics of an optimal growth model with endogenous depreciation, variable capital utilization and maintenance costs and they conclude that in the long-run capital is optimally underutilized and maintenance activities are optimally undertaken. Rumbos and Auernheimer (2001), introduce a variable rate of capital utilization into a modified Ramsey model, whereas Dalgaard (2003) introduces endogenous capital utilization decisions into the standard neoclassical model. Both conclude that this reduces the speed of convergence. Aznar-Márquez and Ruiz-Tamarit (2004) extend the AK model by introducing adjustment and maintenance costs. The most recent and "extensive" work belongs to Chatterjee (2005), which accounts for the optimal choice of capital utilization in a growth model employing a general production function (that accounts for the Ramsey, the AK and the semi-endogenous growth models), and shows that capital utilization plays a crucial role slowing down the speed of convergence.

In spite of the empirical support for capital utilization and habit formation, the combination of these two concepts has only been done (to our knowledge) by Marc-André Letendre (2004) in the very different context of a small open economy model calibrated to replicate the Canadian economy. It is our view that combining this two ideas is in line with Solow (2005) suggestion, but more importantly considering endogenous capital utilization decisions under time separable utility may yield misleading conclusions if in fact preferences are characterized by a high degree of complementarity between consumption at successive moments, as the empirical evidence suggests (see Fuhrer, 2000). On the other hand, it is also true that considering habit formation in consumption, while ignoring capital utilization decisions, may yield misleading conclusions if in fact the rate of capital utilization falls substantially below the full utilization rate.

Of the studies cited, our analysis is closest to Chatterjee (2005) whose conclusion is that incorporating capital utilization decision into the Ramsey model helps to resolve the discrepancy between theory predictions and actual speed of convergence. Our paper objectives are a bit broader than the speed of convergence debate; the goal is to investigate the effects combining endogenous capital utilization with habit formation in consumption, on the predictions of the Ramsey growth model. Therefore, we expand the Ramsey growth model to account for the presence of a reference benchmark on consumption, as well as endogenous capital utilization decisions. In particular, we consider the implications of habit formation on the optimal decisions of capital utilization using a one sector neoclassical growth model in which labor experiences positive productivity growth. In addition, we proceed to do some optimal tax policy analysis as well as some numerical simulations of the effect of tax policy instruments. It is worth mentioning that the model is general enough to allow for a comparison of our results not only with the capital utilization model, but also with the model of habit formation and the traditional neoclassical model. Therefore, we extend this comparison whenever it is relevant.

There are several key results that we wish to stress at the outset: the first and possibly most general result is that the steady state of capital utilization and depreciation are only affected by the weight of habits in the utility function, in the presence of labor productivity growth. In the presence of labor productivity growth, the presence of habits raises (reduces) the steady state of capital (rate of capital utilization) relative to the time separable preferences case, presented in Chatterjee (2005). A possible explanation could be that agents do not like negative consumption shocks, and their effect increases with the weight (γ) assigned to the consumption reference. To guard against these shocks, a more addicted (higher gamma) agent will lower the rate of his firm's capital utilization in order to lower the rate of capital depreciation and increase the pool of available capital just in case he experiences a negative shock and must consume more of his capital stock to maintain his habit.

Second, the introduction of endogenous capital utilization has implications for the optimal tax analysis. An immediate implication is, we must distinguish between the intertemporal (on capital accumulation) and the intratemporal (on capital utilization) effects of optimal tax policy. The Chamley–Judd result of zero long-run optimal income holds even in the presence of depreciation allowances. Third, the result of zero long-run income taxation extends to the short-run income taxation only if there are no depreciation allowances.

There are also some important results coming from the tax policy analysis. First, an increase in the income tax rate reduces utilization in the short-run, but has no effect on the long-run. Second, increases in depreciation allowances increase the utilization rate by a larger percentage in the short-run than in the long-run. The intuition is simple and is just a response to the fact that capital cannot adjust in the short-run.

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[1] Detailed theoretical and empirical discussions on the implications of capital utilization can be found in Marris (1964), Shapiro (1986) and more recently Betancourt and Clague (2008).