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Fiscal policy, entry and capital accumulation: Hump-shaped responses

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ABSTRACT

In this paper we consider the entry and exit of firms in a Ramsey model with capital and an endogenous labour supply. At the firm level, there is a fixed cost combined with increasing marginal cost, which gives a standard U-shaped cost curve with optimal firm size. The costs of entry (exit) are quadratic in the flow of new firms. The number of firms becomes a second state variable and the entry dynamics gives rise to a richer set of dynamics than in the standard case: in particular, there is likely to be a hump shaped response of output to a fiscal shock with maximum effect after impact and before steady-state is reached. Output and capital per firm are also likely to be hump shaped.

1. Introduction

Stephen Turnovsky developed the Ramsey (1928) continuous time representative agent model to include an endogenous labour supply[1] in order to explore the effects of fiscal policy[2] (Brock and Turnovsky, 1981; Turnovsky, 1990, 1995; Turnovsky and Sen, 1991). When applied to fiscal policy, this model is essentially Ricardian in nature: for every government expenditure flow there is an equivalent tax shadow in the form of current or future taxes. This is an income effect which serves to reduce consumption (crowding out) and increase the labour supply (when leisure is normal). If we look at the dynamics, we find that the impact on consumption is greater in the short-run than the long-run: consumption falls a lot on impact and then increases gradually to the new steady-state (this increasing pathway is determined by the fact that the marginal product of capital exceeds the discount rate, but the gap is diminishing as capital is accumulated). This "overshooting" of consumption is also present in the response of output: there is a big initial response, with output falling to its new higher level. If we look at empirical studies of macroeconomic time-series in the form of VARs, we find a

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[1] The model with an exogenous labour supply is often known as Cass–Koopmans model after Cass (1965) and Koopmans (1965)—see Takayama (1994) for a discussion and exposition.

[2] This mirrored what was also being done in the discrete time real business cycle approach, although fiscal policy was not incorporated until (Baxter and King, 1993).

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different story.[3] The impulse-responses implied by VARs indicate that output follows a hump shaped response: the maximum effect on output is not on impact, but some time later (3–4 quarters)—see for example Mountford and Uhlig (2009). This sort of response is ruled out in the standard Ramsey model, which is clearly missing some vital ingredient. In this paper, we argue that if we include a process of entry (and exit) then we can keep the basic structure of the Ramsey model and move towards understanding the processes giving rise to the sorts of behavior we find in the data as represented by empirical VARs. More specifically, we find that output can have a hump-shaped response to a fiscal shock with the peak effect being after some time. Furthermore, this is not a special case at all, but a general (although not universal) feature. Whilst we do find that consumption can have a non-monotonic path, this is more exceptional.

In this paper we analyze a continuous-time model of entry in which firms produce output with capital and labour. The creation or destruction of firms (both flows) is determined endogenously as in Das and Das (1996) and Datta and Dixon (2002): the cost of entry (exit) is determined by the flow of firms into (out of) the market, so that the equilibrium price of entry (exit) equals the net present value of incumbency. The marginal cost of entry may vary with the flow due to a congestion effect involved in setting up new firms. We use this to explore the response of the economy to fiscal policy in terms of a permanent unanticipated change in government expenditure. We find that the presence of an endogenous labour supply allows for a variety of local dynamics. In particular, the stable eigenvalues can both be real or complex. With real eigenvalues, the adjustment path of either or both capital and the number of firms can be hump-shaped. With complex eigenvalues, the adjustment path of both capital and the number of firms are oscillatory. However, when we analyze the effects of fiscal policy, we find that only the number of firms can be non-monotonic. This is because the "initial position" also matters, and there is a linear relation between the number of firms and the capital stock as Government expenditure varies which restricts the dynamics to be monotonic for capital. However, whilst the dynamics of consumption and capital are monotonic, we find that there can be a non-monotonic "hump shaped" response of output and employment to fiscal policy, taking the form an initial jump response, followed by a smooth hump shaped overshooting of the new steady-state. Moreover, we find that in addition the impact effect of fiscal policy can be greater than or less than the long-run effect. Hence the introduction of entry into the Ramsey model enables a theoretical understanding of output and consumption responses that are more in line with the empirical evidence than the classic Ramsey model.

In the classic Ramsey model, all that matters for determining aggregate output and productivity is the aggregate labour and capital: how it is organized at the firm level does not matter. This approach is justified if there are constant returns to scale at the firm level. However, in this paper we assume an explicit firm-level technology which gives rise to the text-book U-shaped average cost with strictly increasing marginal cost. In the long-run with zero-profits, the aggregate economy will display constant returns in capital and labour.[4] However, in the short-run as we move towards steady-state, output at the firm level will deviate from the efficient minimum AC output. This is important, because it means that capacity[5] utilization and hence the marginal products of labour and capital will vary: for a given level of capital, more firms means less capital per-firm which increases the marginal product of capital. With entry, the dynamics of the number of firms can act to counteract the effect of capital accumulation on reducing the marginal product of capital. It is this crucial difference which enables the model in this paper to display behavior which is more in line with the broad outline of the empirical data.

The model of entry we employ can be contrasted with Melitz (2003) model used in trade. In the Melitz model, the cost of entry is constant and does not depend on the flow of entry. However, there is post-entry heterogeneity in the productivity of firms, unlike in the Ramsey framework we adopt where all firms have access to the same technology. Another important difference is that there are increasing returns to scale at the firm level in the Melitz model, not the U-shaped average cost curves in this paper. In our steady-state, all firms are efficient irrespective of the number of firms: inefficiency occurs out of steady-state as (all) firms operate at an output above or below efficient capacity. In the Melitz model, the steady state is not optimal in efficiency terms: there is excess entry due to the monopolistic post-entry equilibrium, and the model is incompatible with perfect competition. The entry model also differs from Jaimovich and Floetotto (2008), where there are no sunk entry costs and there is a zero profit condition that flow operating profits cover the flow overheads. As in Yang and Heijdra (1993) and Linneman (2001), the elasticity of demand varies due to the effect of market share on firm elasticity. Again, this is an essentially monopolistic framework which is not generally efficient in equilibrium: in the absence of love of variety, there will be excess entry and each firm has an increasing returns to scale technology.

It should be stressed that we are providing a *theoretical* framework and not an empirical model: we present numerical calibrations merely to illustrate the general results. If we look at empirical DGSE models that are currently popular, they have many ingredients that are absent in our theoretical model. In Smets and Wouters (2003), Burnside et al. (2004), Christiano et al. (2005) there is a combination of factors determining the dynamic response of policy: habit formation in consumption, capital adjustment costs, capital utilization as well as new Keynesian price and wage nominal rigidity. Indeed, as Woodford (2011) points out, the reaction to monetary policy may be a crucial factor, something which is totally absent in our real model. However, theory is still useful in providing a general understanding that calibrated numerical models cannot

[3] Of course, the VAR methodology is inherently reduced form and in that sense it has proven very problematic to uncover and differentiate between exogenous and endogenous fiscal shocks as well as across shocks.

[4] Since zero-profits in the long-run means that the number of firms rises proportionately with capital and labour, so firms remain at efficient scale with average and marginal cost equalized.

[5] Note that we use capacity utilization in its standard sense to mean the level of actual output relative to the reference level of efficient output. Some authors have used this to mean capital utilization, which has to do with the intensity of how capital is used.