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Life-cycle savings, bequest, and a diminishing impact of scale on growth

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ABSTRACT

The present paper shows that the savings motive critically affects the size and sign of scale effects in standard endogenous growth models. If the bequest motive dominates, the scale effect is positive. If the life-cycle motive dominates, the scale effect is ambiguous and may even be negative.

1. Introduction

An important difference between the two workhorse models in macroeconomics, the Diamond model and the Ramsey–Cass–Koopmans (RCK) model, is that they emphasize different motives for saving. In the Diamond model the bequest motive is absent, whereas life-cycle considerations play no role in the RCK framework. If we turn to data for present-day developed economies, the relative importance of bequest and life-cycle savings for capital accumulation remains unresolved (Dynan et al., 2002). Hence, from this perspective it is not obvious which framework is a better stylized representation of the process of capital accumulation. Moreover, the difference is far from trivial because it translates into different links between wage and capital income on the one hand, and the rate of capital accumulation on the other. In an RCK framework all wage income is consumed (along a steady state trajectory), whereas all capital income is consumed in the Diamond model (Bertola, 1993, 1996).

From this emanates radically different answers to questions of first-order importance. Consider the impact of taxes on growth, whereas a capital income tax reduces growth (or long-run income) in an RCK model, it can raise growth in the Diamond model (Uhlig and Yanagawa, 1996; Caballe, 1998). Likewise, the two models hold different predictions with respect to the prospect for cross country income equalization, whereas the steady state is unique in the RCK model, supporting the Conditional Convergence hypothesis, multiple steady states may arise in the Diamond model, supporting the Club Convergence hypothesis (Galor, 1996). Finally, whereas endogenous growth is feasible in convex RCK growth models (Jones and Manuelli, 1990), the same is not true in a Diamond environment (Jones and Manuelli, 1992).

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The present paper demonstrates that the relative importance of bequests and life-cycle savings is crucial for another important issue: the impact of scale on growth. Within a standard endogenous growth framework the scale effect is positive if the bequest motive for savings is paramount. But as we show, this conclusion is potentially overturned if life-cycle considerations influence savings decisions. Then the scale effect is ambiguous, and under plausible conditions it may be absent and even negative.

According to UN projections global population growth will continue to decline in the years to come. Indeed, according to some projections global de-population can be expected after 2040. What will be the implications for economic growth? Naturally, the answer is narrowly connected to how scale impacts on productivity growth. The analysis demonstrates that understanding the savings motive will help provide an answer; if savings mainly are based on life-cycle considerations the growth prospects for the future are far brighter than if savings mainly are undertaken in order to fund bequests.

The analysis employs a one sector overlapping generations model featuring endogenous growth. For ease of exposition the (baseline) analysis invokes an externality from the aggregate stock of capital yielding a simple "AK" production technology in reduced form.[1] People live for two periods. They derive utility from consumption in both periods, and from passing on bequest (i.e., "joy-of-giving"). This specification allows us to parameterize the strength of the bequest motive, relative to the life-cycle motive. Within this setup we demonstrate that unless the bequest motive is sufficiently strong, the impact from scale on growth is ambiguous. The intuition for this result is most readily explained in the special case of a Diamond model with Cobb–Douglas preferences. In the Diamond setting, bequest is absent by construction and savings' only role is to fund retirement (only the life-cycle motive is operative). As a result, the all-important driving force behind capital accumulation becomes wage income; the return to capital does not matter due to the absence of a bequest motive and because preferences are Cobb–Douglas.[2]

Increasing the labor force implies that more individuals are saving resources for old age which stimulates capital accumulation. At the same time, however, increasing the labor force entails diminishing marginal returns to labor input, which works so as to reduce the wage rate, savings, and capital accumulation. The impact on growth from an increasing population therefore depends on which of these two effects dominate. Formally, a larger labor force leaves growth *unaffected* if the elasticity of labor demand is equal to 1, or equivalently, if the elasticity of substitution between capital and labor equals capitals' share of income.

More generally, we provide numerical experiments which serves to quantify the significance of scale effects, when both motives for savings are operative. We find that under reasonable assumptions the scale effect is quantitatively small and diminishes as the size of the labor force increases. When bequest as well as life-cycle considerations influence aggregate savings, the impact from scale may change due to a changing factor distribution of income. If the elasticity of substitution is below one, a rising labor force will increase capital's share of national income and thus the (numerical value of the) elasticity of labor demand. When the elasticity of labor demand becomes sufficiently large, the scale effect changes sign. Hence, the scale effect may be positive when the labor force is "small" and turn negative when the labor force becomes sufficiently large.

It is important to stress that, in general, the correct measure of "scale" is not the labor force *per se*, but rather, the labor force in efficiency units. This is demonstrated in an extension to the baseline model, where growth is fueled by capital accumulation and (government financed) R&D effort. Importantly, the general points above turn out to be unaffected by such extensions.

This paper is related to the by now considerable literature on scale effects (see, e.g., Jones, 1995; Young, 1998; Dinopoulos and Thompson, 1998; Peretto, 1998; Howitt, 1999; Dalgaard and Kreiner, 2001; Peretto and Smulders, 2002; Strulik, 2005). A common feature of all of these contributions is that they are cast within an RCK framework, where the life-cycle motive for savings is absent. The importance of this modeling choice appears to be under-appreciated in the literature. In fact, it would appear that the scale issue has not been explored systematically within a framework where the life-cycle motive is operative. The present paper corrects this error of omission, and proceeds to show how the motive for savings have bearing on the issue at hand.

The paper is also related to another strand of literature, cited above, which highlights the importance of the savings motive for macroeconomic outcomes (Bertola, 1993, 1996; Caballe, 1998; Galor, 1996; Jones and Manuelli, 1992; Uhlig and Yanagawa, 1996). Whereas previous results have revealed its importance for growth and taxes, convergence, as well as the sustainability of growth through capital accumulation, the present paper demonstrates that it is also central to the scale effect property.

2. The model

Consider a closed economy where activity extends infinitely into the future, but where each individual lives for only two periods. Time is discrete, and denoted by $t = 1, 2, \ldots$. The economy produces a homogenous good that is either consumed or

[1] More generally, however, our argument pertains to a larger class of endogenous growth models that have the AK-structure as their ultimate form. For example, it is straightforward to show that a Romer (1987) model, featuring growth due to increasing specialization, can be reduced to an AK-model. See also the R&D driven endogenous growth model developed in Barro and Sala-i-Martin (1995, Chapter 6).

[2] With a unitary elasticity of intertemporal substitution (Cobb–Douglas preferences) the savings rate is independent of the real rate of interest.