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Credit constraints, growth and inequality dynamics☆

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ABSTRACT

This paper examines how credit constraints affect the dynamics of wealth and thereby the dynamics of capital and output growth. We develop standard *Ak* growth models that display transitional dynamics, contrary to general belief, once the complete credit markets assumption is relaxed. The mechanism is that credit constraints make individual productivity differences persist, which in turn leads to the persistence of income inequality. The dynamics of inequality is jointly determined with the dynamics of aggregate capital. The economy thus passes through a transitional period of inequality, individual and aggregate capital dynamics before it converges to a long-run balanced growth path. The application of the model to the analysis of intergenerational mobility and inequality dynamics suggests substantial economic and policy significance. In particular, introducing credit constraints to the Barro *Ak* model, public investment could have an indirect impact on growth via its effect on inequality and mobility.

1. Introduction

Perhaps the most important assumption in neoclassical growth models is that firms invest to the point that their marginal rate of return to investment equates the economy's interest rate. Implicit in this assumption is the existence of complete capital markets. There are at least two problems with such an assumption. The first is that it may not fit reality well. In fact, credit constraints pervade the economic activities of most of the developing world. Even in advanced economies, credit market frictions could exist due to the substantially high cost of administrating credit. This is particularly evident from many empirical works that find that firms' investment falls below the level of investment required to equate the marginal rate of return to capital with that of the market interest rate. According to Mel et al. (2008), for instance, in Sri Lanka the average real return to capital is about 60% per year, for a set of micro-enterprises, much higher than the market interest rate. The return to capital for a set of Indian firms is estimated at greater than 90% , which is twice as high as the market interest rate (Banerjee and Duflo, 2004). McKenzie and Woodruff (2006), using Mexican micro-enterprises, argue that not only is the marginal product of capital significantly different from that of the market interest rate but also that the returns to capital among different-sized firms are not equal.[1]

Second, it undermines a considerable amount of individual dynamics. The complete capital market assumption, implicit in standard growth models, implies that individual dynamics often coincide with aggregate dynamics. As a result, the models easily admit a representative-agent framework that increases their tractability substantially, although it could also restrict their applicability to inequality and mobility studies.[2] The present paper aims to contribute towards this line of thought. The paper in particular introduces credit constraints to endogenous growth models, which lead the models to show an uncharacteristically rich transitional dynamics emanating from individual differences. It also shows that, when applied to the analysis of growth and the distributional impact of public investment policy, this could have a substantial economic and policy implication.

We thus examine how credit constraints affect the dynamics of wealth and thereby the dynamics of capital and output growth. We develop a standard *Ak* growth model that displays transitional

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[1] They estimate 15% per month return to capital for firms with investment capital of less than $200; 7 to 10% per month for firms with investment capital between $200 and $500; 5% per month for firms with investment capital between $500 and $1000. They estimate the market interest rate at 3% per month.

[2] One of the few exceptions is the work by Caselli and Ventura (2000), which allows a distributional analysis within a representative-agent framework where aggregate equilibrium becomes the determinant force of the evolution of wealth and income inequality. See Garcia-Penalosa and Turnovsky (2007) and Chatterjee and Turnovsky (2012) for applications of this model.

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dynamics, contrary to the general belief, once the complete credit markets assumption is relaxed. The main mechanism is that credit constraints make individual productivity differences persist, which in turn leads to a persistent inequality. The dynamics of inequality is jointly determined with the dynamics of aggregate capital. The economy thus passes through a transitional period of inequality, individual and aggregate capital dynamics before it converges to a long-run balanced growth path.

The *Ak* growth model is arguably the basis of every endogenous growth model. It has been the workhorse model of economic growth during the last two decades.[3] Particularly, it provides a convenient framework for understanding policy issues in relation to long-run growth (see, for instance, Barro, 1990 and Turnovsky, 1996, 1997b, among many others). In spite of such popularity, the model in its simplest form has been criticized for a lack of transitional dynamics that appears to be an empirical regularity (e.g., Mankiw et al., 1992).

Under the assumption of perfect capital markets, the standard *Ak* growth model in the spirit of Romer (1986) and Barro (1990), with diminishing returns at the individual household level but constant returns at the aggregate level, has no transitional dynamics. All aggregate variables – aggregate consumption, capital and output – grow at a constant rate at all times. A perfect capital market implies an instantaneous equalization of intra- and inter-temporal individual household productivity in the economy, as individuals trade capital, in a Pareto-efficient way, until the point where their productivity differences vanish. It fixes the rate of return to capital to a constant market interest rate. The economy thus jumps to its long-run balanced growth path at the first period.

Credit constraints, on the other hand, make initial individual productivity differences prevail. The intuition is that, with imperfect credit market, individuals with low endowment and hence with a high marginal rate of return could not borrow, from individuals with the opposite trait, and invest more efficiently. A higher initial wealth inequality thus relates to a greater inefficiency (lower growth), as it leads the economy to forgo more productive investment opportunities. Differences in marginal productivity tend to generate differences in growth rates among individual households. This leads to inequality dynamics, which becomes the driving force of aggregate capital dynamics. Along the transition to a steady state, the economy features a declining inequality since individuals with relatively lower initial endowment rapidly accumulate wealth due to their relatively high marginal productivity.

The result is remarkably robust to alternative environments. In particular, in an economy where households have a finite life span and preferences are non-homothetic (as in the Stone–Geary utility function), credit constraints play an important role in inequality and growth dynamics in *Ak* models but through a *different* mechanism. Such an economy features two different consumers, a non-Ricardian household whose consumption decisions entail consuming the full amount of its labor income as it falls below subsistence consumption, and a Ricardian household whose optimal decisions are based on its budget constraints. As the economy grows and its capital stock expands, the productivity of the poor increases via trickle down growth, eventually leading inequality to converge and the economy to function at its full potential in equilibrium.

Introducing credit constraints to the Barro (1990) *Ak* model, public investment policy could have an indirect impact on growth via its effect on inequality and mobility. This is in addition to the standard productivity and complementarity effects often mentioned in the literature. Higher inequality corresponds to lower growth when the credit and insurance markets are missing, as these prevent the efficient amount of investment to be undertaken in the economy. In this case, egalitarian public investment policy has a positive impact on growth through its effect on mitigating inequality. However, such an effect is compromised due to its negative impact on individual productivity.

A quantitative analysis of the model suggests that public investment has nontrivial effects on intergenerational mobility and inequality. A strong negative distributional effect from public capital could double steady-state inequality and intergenerational elasticity. The model's prediction of mobility and inequality is quite consistent with that of many estimates in intergenerational mobility and inequality, particularly when the public investment is pro-rich. In such cases, much slower and more plausible transitional dynamics are obtained vis-à-vis an exceedingly fast speed of dynamics implied by a private pre-existing condition.

The paper contributes to the understanding of whether and, ultimately, how capital market imperfections affect the dynamics of *Ak* growth models, and their implication for policy analysis. With few exceptions, previous works often abstract from capital market imperfections.[4] For instance, Turnovsky (1997a) considers a small open economy that faces an upward-sloping supply curve for debt in a Barro-type *Ak* model. In the model, the borrowing interest rate increases with the debt–capital ratio of the borrowing nation. There would be a transitory dynamics in the economy through an adjustment in the debt–capital ratio that drives the interest rate to a level at which the growth rate is equalized. Therefore the mechanism is different from the current paper, where persistence of individual productivity differences, due to credit constraints and diminishing returns to investment at the individual firm level, is the driving force behind aggregate dynamics.

The paper relates to the literature of imperfect credit markets, inequality and growth, particularly with respect to linking inequality dynamics to the dynamics of aggregate capital and output, although this literature does not focus on transitional dynamics in *Ak* models.[5] The paper is also related to the recent literature on inequality, growth and public investment (e.g., Garcia-Penalosa and Turnovsky, 2007; Chatterjee and Turnovsky, 2012; Getachew,2010, and Getachew and Turnovsky, 2015).[6] Getachew and Turnovsky (2015) study the distributional and growth effects of public investment in a growth model with missing capital markets and a CES production function, where both growth and inequality are endogenously determined. In the paper, the effects of public investment policy on inequality and growth depend on the elasticity of substitution between between public and private capital. This is in contrast to the current paper, which emphasizes policy targeting.

The rest of the paper proceeds as follows. Section 2 sets up a growth model, with missing credit markets, which is *Ak* at the aggregate level as the production function at the firm level is augmented by an economy-wide externality. Section 3 mainly examines transitional dynamics in the general *Ak* model. Section 4 relaxes the

[3] As is well known, the model introduced into the modern literature through the seminal works of Romer (1986), Rebelo (1991) and Barro (1990). According to Aghion and Howitt (1998, p. 26), the model was first introduced by Frankel (1962), although Barro and Sala-i Martin (2004, p. 63) think that the production function was first used by Neumann (1937).

[4] See Tamura (1991), Carroll et al. (1997, 2000), Boucekkine et al. (2005), Gomez (2008) and Guerrini (2010), which were all written independently of our study. Jones and Manuelli (1990), for instance, used a production function that asymptotically displays an *Ak* model.

[5] See, for example, Loury (1981), Galor and Zeira (1993), Banerjee and Newman (1993), Aghion et al. (1999), Matsuyama (2000), Benabou (2002), Giannini (2003), Getachew (2010), Bandyopadhyay and Tang (2011) and Shin (2012).

[6] Garcia-Penalosa and Turnovsky (2007), and Chatterjee and Turnovsky (2012) study the impact of growth-enhancing fiscal policies on inequality, but within a complete market framework that follows the line of Caselli and Ventura (2000). Getachew (2010), on the other hand, considers incomplete capital markets although his analysis is restricted to short-run effects, as the model does not feature idiosyncratic uninsurable risks.