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Land, technical progress and the falling rate of profit

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Abstract

The paper sets out a one sector growth model with a neoclassical production function in land and a capital–labour aggregate. If the elasticity of substitution between land and the capital–labour aggregate is less than one and if the rate of capital augmenting technical progress is strictly positive, then the rate of profit will fall to zero. This result holds regardless of the rate of land augmenting technical progress: no amount of technical advance in agriculture can stop the fall in the rate of profit. The paper also discusses the relation of this result to the classical and Marxist literature.

JEL classification: B24; E11; O41

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1. Introduction

This paper is basically about the falling rate of profit. It develops an essentially neoclassical growth model with land, labour and capital as factors of production. Capital accumulates through capitalist savings, the labour supply is infinitely elastic at a subsistence wage and all factors experience factor augmenting technical progress. The result is that if the elasticity of substitution between land and a capital–labour aggregate is less than one and if the rate of technical progress experienced by capital is positive, then the capital–labour ratio rises toward infinity, the share of capital approaches one and the rate of profit falls toward zero. This result holds regardless of the speed of technical progress that land experiences. Surprisingly, technical advance in agriculture cannot halt the fall of the rate of profit.

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This introduction discusses the relation of the result of the paper to the classical and Marxist literature.With respect to the classical literature, the conclusions, but not the logic, of the classical authors are supported against those of modern writers. With respect to the Marxist literature, the falling rate of profit is decoupled from rising wages and a coherent way of linking this concept with Marx's overall view of the future of capitalism is provided. Finally the paradoxical relation between the result of this paper and a particular induced innovation mechanism is underlined.

As a bench mark for the classical case, it is convenient to start with a simplified version of the "corn model" with technical progress in agriculture: the production of corn is constant returns to scale in labour and homogenous land. Capitalists rent land from landlords, paying the marginal product of land after the harvest has been collected and hire labour, paying in advance with their accumulated stock of corn. They save a portion of their profits which becomes zero when the rate of profit reaches its minimum level. The labour force grows only when the wage is above subsistence. At each moment the wage is determined so that the entire stock of corn is used to pay wages. The classical model, when stripped of its frills,[1] corresponds to this corn model. One of the main conclusions of the classical school is that the equilibrium of this model will approach a stationary state with the rate of profit at a minimum, the wage at subsistence and no growth. Now add land augmenting technical progress. With the intuition of the neoclassical growth model, one sees that this model has a steady state in which the rate of profit is above the minimum level, the wage is above subsistence, and output, labour and the stock of corn grow at the rate of technical progress.[2] That is, once land augmenting technical progress is added to the classical model, its equilibrium does not approach the stationary state.

In the light of this, consider the positions of David Ricardo and John Stuart Mill on the falling rate of profit and the approach to the stationary state in the presence of technical progress. Ricardo (1817, p. 120) stated,

> The natural tendency of profits then is to fall; for. . . the additional quantity of food required is obtained by the sacrifice of more and more labour. This tendency. . . is happily checked at repeated intervals by improvements in machinery connected with the production of necessaries, as well as by discoveries in the science of agriculture. . . which enable us to lower the price of the prime necessaries of the labourer. But the rise. . . in the wages is, however, limited; for as soon as wages should be equal. . . to. . . the whole receipts of the farmer, there must be an end to accumulation;. . .

The common interpretation of this has been that technical progress will only slow the fall of the rate of profit. For example Eltis (1988, p. 278), in the New Palgrave, writes of Ricardo that technical progress ". . . reduces the rate at which profits decline, without affecting the proposition that they must fall eventually to the minimum stationary level." Mill (1965, p. 743) also considered the same issues. He concluded

> All improvements, therefore, in production of almost any commodity, tend to widen the interval which has to be passed before arriving at the stationary state.

Again the common interpretation is as with Ricardo. According to Eltis (1988, p. 279)". . . Mill did not envisage that technical progress. . . would be sufficient to overcome the influence of

[1] One of the frills is non-homogenous land and rent. This is important for distribution but not relevant for the falling rate of profit and the approach to the stationary state.

[2] This is confirmed by the work of modern authors cited below.