

PROFIT, RENT AND THE TERMS OF TRADE

A Reply

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Andrews (1985) investigates the theoretical coherence and policy relevance of our (1982) model and concludes, contrary to our own findings, that a positive rate of profit is not necessary to obtain a two-signed derivative of the profit rate with respect to agriculture's terms of trade. She characterizes the model as 'Neo-Ricardian' on the grounds that the technology is the 'culprit' and also questions the empirical relevance of our 'fixed profit equilibrium' or 'land-price treadmill'. We show here that if a viability condition stated in our original paper holds, parameter values of the model must yield a positive rate of profit if the profit rate is to fall following an improvement in the terms of trade. We then contrast our model with a more neoclassical one in which the sign of the derivative does strictly depend on the 'technology', that is, upon factor intensities. Finally, we present empirical evidence from a detailed study of the U.S. economy based on our original model. These data support the existence of a land-price treadmill in agriculture, especially for countries in which workers are successful in defending a given real wage.

1. Introduction

In our (1982) paper, we show that terms-of-trade policy designed to stimulate agricultural production may instead depress that sector's profit rate. Even in the simplest general equilibrium models, the function relating agriculture's profit rate to its terms of trade is not necessarily increasing. If land is scarce and earns rent, an exogenous improvement in the terms of trade may therefore cause the profit rate to rise or fall. If investment in agriculture is positively related to profit, supply response to higher prices may accordingly be weak. This finding may help explain the wide variability of agricultural supply response noted in the empirical literature.¹

Andrews (1985) attempts to circumscribe the relevance of this perverse profit response to a terms-of-trade intervention, developing in detail conditions leading to an inverse relationship between the terms of trade and the

¹See the survey of the literature by Behrman (1968).

profit rate.² She criticizes us for maintaining that a positive rate of profit is necessary to obtain the result and provides an algebraic argument showing that the sign of the profit response does not depend upon a positive profit rate. She concludes that it is the peculiar nature of the technology which is ultimately responsible for the 'perverse profit syndrome'. Andrews also questions our 'land-price treadmill', arguing that ever increasing rents and stagnating profits would only be observed in 'exceptional circumstances' [Andrews (1985, p. 124)].

In this paper, we shall show that a positive rate of profit is indeed a necessary condition to obtain a two-signed derivative. In our model, the rate of profit is determined simultaneously with land rent by taking wages, and hence the technique, as given by the social conditions under which labor is employed. If for a given set of techniques, the wage rate does not allow positive profits, a negative derivative cannot obtain. To illustrate the fundamental role played by the rate of profit, we contrast our model with the standard neoclassical setup in which the effect of terms-of-trade policy *does* depend only on the nature of the technology, that is, upon factor intensities. Finally, we offer some results of an empirical study based on our model. Data for the U.S. economy in 1970's lend support to the notion of a 'land-price treadmill'.

We stress that our disagreements with Andrews are largely conceptual rather than algebraic. In fact her footnote 2 establishes the equivalence of the necessary and sufficient conditions for an inverse relation between the profit rate and the terms of trade,

$$a_{22}/t_2 > a_{21}/t_1$$

and eq. (5) of our original text. For our model, in which wages were given in nominal rather than real terms, the corresponding condition can easily be seen to be:

$$\frac{a_{22} + w l_2}{t_2} > \frac{a_{21} + w l_1}{t_1}.$$

We obviously have no objection to this reformulation of our finding.

But what we do object to is Andrews' reluctance to investigate the consistency of her necessary and sufficient conditions with the basic assumptions of the model. First, the derivatives at issue must be evaluated at

²While we referred in our original paper to a 'perversity' in the distributional effects of terms-of-trade policy, this was only with respect to our initial model in which more favorable terms of trade always improved the sectoral profit rate. Of course what is perverse in one model may well be a regularity in another and we did not imply anything more by the use of the term. In the standard neoclassical model discussed below for example, an improvement in the terms of trade leads uniformly to a fall in the profit rate but it is in no way deemed a 'perversity'.

economically viable equilibria. Combinations of parameter values which produce negative profits or rents, for example, are clearly inadmissible but in our paper, we go further and question whether a zero rate of profit is economically feasible under the given assumptions. We find that it is not and introduce a viability condition on p. 40 of the original text. This condition imposes the requirement that when land is scarce, any alternative, high-cost process must increase the *net* supply of agricultural product. If it does not, there is no reason for the high-cost alternative method to have been adopted.³ Although Andrews does not explicitly object to this viability condition (indeed, she refers to it later in her paper [Andrews (1985, p. 122)]) its absence explains entirely our disagreement over the role of the profit rate.

Put more formally, Andrews uses only the first two of a three equation model:

$$\pi = \frac{p(t_2 - t_1)}{C_1 t_2 - C_2 t_1}, \quad \rho = \frac{p(C_1 - C_2)}{C_1 t_2 - C_2 t_1}, \quad (1), (2)$$

$$(1 - a_{11})/t_1 > (1 - a_{12})/t_2. \quad (3)$$

Based on the full model, we offer the following theorem:

Theorem. The following three propositions cannot hold simultaneously:

- (a) $\pi = 1$ (zero profit),
- (b) $(1 - a_{11})/t_1 > (1 - a_{12})/t_2$ (viability),
- (c) $a_{22}/t_2 > a_{21}/t_1$ [$d\pi/dp < 0$; eq. (7a) of Andrews]

or

$$(a_{22} + w_1 t_2)/t_2 > (a_{21} + w_1 t_1)/t_1.$$

Proof. (c) $a_{22}/t_2 > a_{21}/t_1 \rightarrow (1 - \pi a_{11})/t_1 < (1 - \pi a_{12})/t_2$ by Andrews' footnote 2. But if statement (a) holds, then statement (b) is contradicted. Q.E.D.

Remark. Note that parameter values for the technical coefficients and the wage rate which correspond to negative profit and rental rates can be ruled

³Sraffa (1960, p. 75) writes: 'While any two methods would in these circumstances be formally consistent, they must satisfy the economic condition of not giving rise to a negative rent: which implies that the method that produces more corn per acre should show a higher cost per unit of product, the cost being calculated at the ruling levels of the rate of profits, wages and prices.' As we shall see in the theorem below, the non-negativity criterion set forth in this passage is not equivalent to the additional 'viability' requirement that the alternative process supply more *net* output.

out a priori. Nothing, however, precludes a combination of parameter values for which $\pi=1$. The theorem shows that the social and technical conditions required for a negatively sloped relationship between the terms of trade and the profit rate cannot obtain if the rate of profit is zero. It makes no sense to evaluate Andrews' derivative of eq. (7a) for $r=0$, since at that profit rate, capitalists would not adopt the technique to which the derivative applies.

The theorem shows that a positive profit rate is necessary to our result in a more profound sense. Observe that condition (c) implies that process 2 uses *more* of all other inputs and labor (per unit of land and hence per unit of net output) than process 1. Andrews notes that this technology is somewhat 'odd' [Andrews (1985, p. 126)]. It *is* odd in the specific sense that the positive rate of profit conceals an 'inefficiency' which is ultimately responsible for the perverse derivative. If method 1 were used exclusively, more net output would be available now and in perpetuity. But with a positive rate of profit, the total cost of each method is the same so that rational capitalists are indifferent between them. Both the 'efficient' land-saving process and the 'inefficient' process 2 cooperate. If wages rose to the point that the equilibrium profit rate fell to zero, the inefficiency would reveal itself and the land-using process would be truncated.⁴

As we suggested in our paper, this profit-induced inefficiency is not unknown in the trade literature.⁵ Samuelson (1975) writes:

'There is nothing controversial or surprising about this. Economists have always known that taxes which are not lump-sum will have distorting substitution effects and will create deadweight loss. If taxes can distort, why can't profit rates? This seems to be a legitimate question for critics of the present order to ask, whether they be Marxian or non-Marxian.'

Samuelson's answer in the present context would undoubtedly be that the path from a steady state in which both processes coexist to one in which method 1 is used exclusively unavoidably involves the sacrifice of capital accumulation. Although less of both good 2 and labor is required for method 1, more seed is. Thus if the model is interpreted neoclassically, there is no 'inefficiency' inasmuch as the profit rate is simply part of the supply price of capital. However, if one does not consider capital as a 'factor of production' on par with labor and land, then the coexistence of both methods creates deadweight loss due to the positivity of the profit rate. Since the perversity will only occur in this model when the inefficiency is present, we conclude that a positive profit rate is a *sine qua non* of our result.

⁴See McLeod (1982) for further discussion of these profit-rate efficiency issues.

⁵See Steedman (1979) and references cited therein.

2. Terms-of-trade policy in a neoclassical model

As was clear from the title of our original paper, it is important to theoretically distinguish produced and nonproduced means of production. Associated with this conceptual division is a division of the physical surplus produced by labor into the categories of profit and rent. While profit on reproducible capital goods depends principally upon the rate at which labor is exploited, rent is due to the scarcity of means of production which are not freely reproducible [Gibson (1984)]. The definition of scarcity, put forward by Sraffa (1960) and discussed in our original paper, requires objective evidence in the form of alternative methods of production employed to produce the same commodity. Sraffa's argument is that if some of the means of production were not scarce, only one method would be employed, the cheapest.

This approach stands in clear contrast to the neoclassical view of capital as an endowed, time-dependent magnitude.⁶ To see how terms of trade affect the relative remunerations of land and capital in a standard neoclassical model, consider an orthodox setup in which two commodities, agriculture and industry, are produced by means of labor, capital and land with no intermediate goods. The economy is endowed with homogeneous supplies of all factors, but only land and capital are fully employed. For purposes of comparison with our original model, we assume that there are excess supplies of labor at an institutionally determined wage rate.

Under these assumptions, we may write the price equations:

$$p_1 = wl_1 + rk_1 + \rho t_1 \quad (\text{agriculture}),$$

$$p_2 = wl_2 + rk_2 + \rho t_2 \quad (\text{industry})$$

which can be expressed vectorally as:

$$P - wL = [r\rho] \begin{bmatrix} K \\ T \end{bmatrix},$$

where $K = \{k_i\}$, $i = \text{industry, agriculture}$, is the vector of capital coefficients. All of what was capital in our model is now lumped into the endowed K . Even if K consists of the same goods, industry and agriculture, 'time' enters to distinguish capital from other commodities. Note that everything to the left of the equals sign in this last equation is taken as given. The solution to this system is shown in fig. 1 and is drawn such that the agricultural sector is land intensive while the industrial sector is capital intensive. It can be easily

⁶See Marglin (1984) and Hahn (1983) for full details of the comparison between neoclassical and Marxian/Neo-Ricardian approaches.

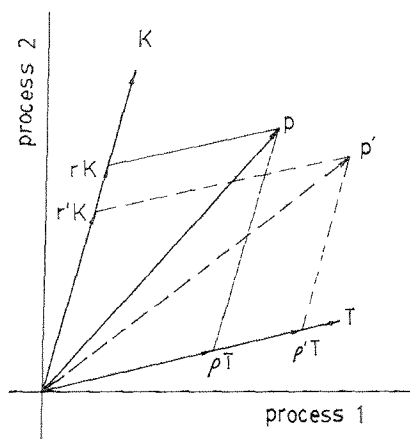


Fig. 1

seen that when the terms of trade turn in favor of agriculture (process 1), the rental rate rises and the profit rate *falls*. This is hardly surprising; indeed, we have only illustrated the well-known Stolper-Samuelson theorem. Were factor intensities reversed, an improvement in the agricultural terms of trade would cause profit to rise and rent to fall.

Hence Andrews' (1985, p. 121) claim that the 'culprit responsible for distributional perversities' is the 'technology' appears to be a criticism more appropriate to the neoclassical model.⁷ In contrast to a Stolper-Samuelson world in which the relation between the terms of trade and factor returns is well-behaved and depends only on factor intensities, the derivatives of our model can be of either sign. Which sign the derivatives happen to take depends as much upon the level of wages as upon the technology. Indeed, we have seen that without social relations of production which lead to a positive profit rate, a negative relationship between the terms of trade and the profit rate won't emerge.

3. Some empirical evidence

Andrews also comments on the empirical and policy implications of terms of trade policy in the presence of nonproduced means of production. She argues policy makers need not be concerned with a 'fixed-profit equilibrium' in which higher prices bring forth rent increases but leave the profit rate

⁷ Andrews refers to our model as 'Neo-Ricardian', a term often employed by critics of the Sraffian framework who see undue emphasis placed on so-called 'technological' rather than social relations of production. See, for example, Shaikh (1982) and references cited therein. We object to this characterization on the grounds that it is the neoclassical rather than the Sraffian or classical approach which most often substitutes technological for social analysis.

virtually unchanged. Since this phenomenon 'only emerges when prices are near infinity', the effect is not relevant in practice. But note that while it is formally correct to point out that the profit-response derivative approaches zero as the relative price of agricultural products goes to infinity, this property implies nothing about how high the profit limit is or how rapidly it is approached as prices increase.

To obtain some indication of the empirical relevance of this profit ceiling, a multisectoral model based on Gibson and McLeod (1982) was estimated for United States grain production over the period 1972–1977 [McLeod (1982)]. Several of the simulations performed for that study explored the shape and limit of the profit-response curve under various assumptions about wage reactions and pricing behavior outside agriculture. This study shows that the more responsive industrial prices and wages are to increases in food prices, the lower is the maximum obtainable profit rate in agriculture and the faster it is approached with increases in the relative price of agricultural products.⁸

Fig. 2 summarizes the results of these simulations for two wheat production processes (a higher yielding irrigated method operating with a lower cost but more land-intensive dryland method). For all three of the response curves, prices for nonagricultural sectors were set as an exogenous mark-up over costs. In the baseline run, both nominal wages and the value of imported petroleum are held fixed as the price of grain varies. In this case the profit ceiling, $r_{\max}$, is high ($r_{\max}=2.8$) and is approached slowly over the entire range of grain prices simulated. However, if nominal wages are allowed to adjust fully to the change in food prices (i.e., if real wages are held constant) price feedback effects dramatically reduce the attainable rate of profit in agriculture ($r_{\max}$ falls to 0.95). Finally, if the price of imported

⁸To see this, consider the following model:

$$p = \pi C_1 + \rho t_1, \quad p = \pi C_2 + \rho t_2, \quad dw/dp = \lambda d$$

where d is the amount of commodity one consumed per unit of labor, and λ is the rate at which wages are indexed to the cost of commodity one [$0 \leq \lambda \leq 1$]. Computing the derivative of π with respect to p :

$$d\pi/dp = \frac{t_2(1 - \pi a_{11}) - t_1(1 - \pi a_{12}) - \pi(t_2 l_1 - t_1 l_2) \lambda d}{t_2 C_1 - t_1 C_2}$$

which, for $\lambda=0$, is equivalent to condition (c) above. As long as the land-saving method uses more labor per unit of land, the profit response to terms of trade policy falls as the degree of indexation rises. For the empirical model, this condition holds. In order to compute $r_{\max}$, take the limit as $p \rightarrow \infty$ for both $\lambda=0$ and $\lambda=1$:

$$1 + r_{\max} = \lim_{p \rightarrow \infty} \pi = (t_2 - t_1)/(t_2 a_{11} - t_1 a_{12}), \quad \lambda = 0,$$

$$= (t_2 - t_1)/(t_2(a_{11} + d l_1) - t_1(a_{12} + d l_2)), \quad \lambda = 1,$$

from which it is seen that $r_{\max}$ is lower when wages are fully indexed. See McLeod (1982, ch. 3) for further discussion of the conditions under which this profit ceiling exists.

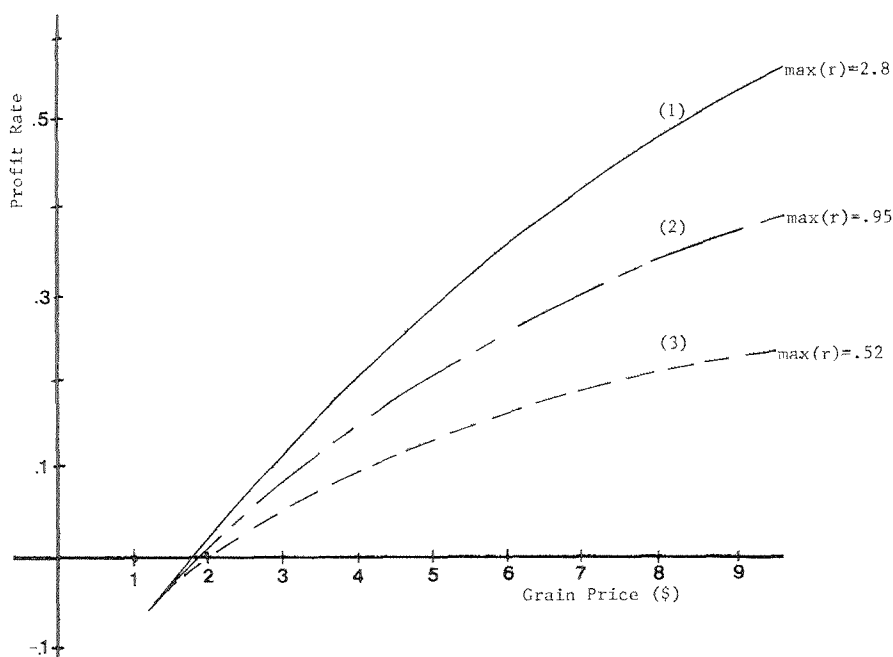


Fig. 2. Profit responsiveness under different macroeconomic regimes: (1) baseline, (2) indexed wages, (3) indexed wages and petroleum import prices.

petroleum is allowed to increase in step with grain export prices, the profit ceiling falls to 52%.

This last observation can be explained by noting that in the United States (and elsewhere) land-saving processes depend heavily on energy-based inputs (e.g., irrigation pumps, fertilizer, etc.). Rising energy prices, therefore, drive up rents very rapidly, sometimes leading to a profit squeeze even if grain prices rise faster than the overall rate of inflation. During the five-year period studied by McLeod (1982), for example, wheat prices and the overall price level increased at about the same rate (56% and 57% respectively), but between 1972 and 1977, rents on midwestern grain farms increased by over 75% and land prices by 125%. It appears that the rate of profit (and the share of profits in net income) actually fell during this period [see McLeod (1982, p. 129)]. Thus a terms-of-trade dynamic similar to that discussed here may help explain the profit squeeze experienced by U.S. grain producers during this period.

Finally, observe that the lowest profit-response curve levels out quickly at the relatively low profit rate of 17%. By the time the price of wheat reaches \$6.50 a bushel, the derivative $d\pi/d\rho$ has fallen to about 0.07. While this is in

the high range for wheat prices and the indexing assumptions are strong, these simulations indicate that even in a relatively advanced economy such as the U.S., limitations on profit responsiveness may be encountered at plausible price and profit levels. For less developed economies in which food is a more important wage good and where exchange rates are relatively flexible, these limitations on effectiveness of price policy may be even more restrictive.

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