Journal of Development Economics 28 (1988) 111-119. North-Holland

SUPPLY CONSTRAINTS, GOVERNMENT SUBSIDIES AND INDUSTRIAL EMPLOYMENT

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Received March 1986, final version received August 1986

This paper considers a model of economic development where both agricultural output and industrial wage fund impose constraints on industrial employment. In this set-up, the effect of an increase in government expenditure on industrial employment is determined.

1. Introduction

The purpose of this paper is to construct a macroeconomic model for developing economies and to identify, in terms of that model, the constraints on economic development. While doing so, a very important role has been assigned to the agricultural sector. This differentiates the present model from well known macromodels of developed economies where agriculture does not play any crucial role. On the other hand, our main focus of analysis has been industrial output and employment, especially industrial employment. The purpose is not to deny the growth potential of the agricultural sector but to concentrate on the process of development when the supply of agricultural goods acts as a constraint to industrial growth.

In the Latin American tradition of the structuralist school, food supply rigidities have played a crucial role in the process of development. In Taylor (1979, 1982) and Bose (1985) rigidities of supply in the agricultural sector have been integrated with a Keynesian industrial sector facing demand constraints and experiencing excess capacity. The main difference between these approaches and ours is that in this paper the modelling of the industrial sector is more classical in spirit. Rather than having effective demand as the main factor constraining industrial output and employment, in our model the constraint is imposed by the supply of wage fund which, in turn, is assumed to depend upon the rate of profit. Consequently, it is shown that an increase in government expenditure financed by an increase in profit tax has a contractionary effect on industrial employment provided such an expenditure has no direct impact upon production.

*The author wishes to thank, without implicating, two anonymous referees, especially the one whose comments on an earlier draft greatly improved the presentation of the paper.

In what follows, the basic model is spelt out in section 2. In section 3 we carry out a few comparative statics exercises, first to identify the constraints on industrial employment and output and second, to determine the effect of an increase in transfer payments by the government on industrial employment. Section 4 contains some concluding remarks.

2. The model

We consider an economy which is in a stationary state and which consists of one agricultural and one industrial sector. In the agricultural sector one single good is produced. The output of the agricultural good is assumed to be fixed and production in the agricultural sector is assumed to be carried on through small family based farms. In the industrial sector two goods are produced, one of which is a wage good consumed by industrial workers and farmers (in the agricultural sector), and the other is a luxury good consumed by capitalists (in the industrial sector). The agricultural good is consumed by the industrial workers and partly by farmers. The capitalists, by assumption, do not consume any wage good or agricultural good.

Industrial production is carried on along capitalist lines. At the beginning of each period, the capitalists start with a wage fund F which is advanced to the workers. We have

$$F = w\{a_w X_w + a_L X_L\}, \tag{1}$$

where w is the wage rate, a_w, a_L are the fixed labour–output ratios, and X_w, X_L are the output levels in the wage good and the luxury good sectors, respectively. Production of each industrial good requires only labour and is characterized by a uniform one period production lag. Let p_w, p_L be the prices of the wage good and the luxury good respectively; let r be the rate of profit. Then competition implies that

$$p_w = a_w w(1+r), \tag{2}$$

$$p_L = a_L w(1+r). \tag{3}$$

It is assumed that the wage rate is indexed to the wage good and the agricultural good so that

$$w = b_w p_w + b_a p_a, \tag{4}$$

where p_a is the price of the agricultural good and b_w, b_a are positive constants.

Apart from the agricultural and the industrial sectors, there is also a government sector in the economy. The government makes a total transfer payment G to the industrial workers and farmers. The transfer payment is financed by a lump-sum profit tax.

We assume that both farmers and the industrial workers spend a fraction β of their income on the industrial wage good and the rest on the agricultural good. Thus, demands for the wage good and the agricultural good are given by

$$p_w X_w = \beta[F + G + p_a X_a] \tag{5}$$

and

$$p_a X_a = (1-\beta)[F + G + p_a X_a]. \tag{6}$$

Finally, we assume that the supply of wage fund is an increasing function of the rate of profit, i.e.,

$$F = F(r), \qquad F' > 0. \tag{7}$$

We now proceed to determine the equilibrium of our model economy. We choose the luxury good as the numeraire setting $p_L = 1$. Also, by Walras' Law we can omit the demand equation for the luxury good

$$X_L = rF - G,$$

which states that all profit incomes are spent on the luxury good and where the transfer payment G is equal to lump-sum tax imposed on profits. We are thus left with seven equations and seven variables. The variables are p_w, p_a, w, r, X_w, X_L and F.

Clearly, from eqs. (2) and (3) we have

$$w = \frac{1}{a_L(1+r)} \tag{8}$$

and

$$p_w = \frac{a_w}{a_L}. \tag{9}$$

Then from eqs. (5) and (6) we have

$$\frac{X_a}{X_w} = \frac{1-\beta}{\beta}\frac{a_w}{a_L}\frac{1}{p_a},$$

so that

$$p_a = \frac{X_w}{X_a}\frac{1-\beta}{\beta}\frac{a_w}{a_L}. \tag{10a}$$

Using the value of p_a from eq. (10a) and that of w from eq. (8) in eq. (4), we get

$$\frac{1}{1+r} = a_w\left[\frac{b_a X_w}{X_a}\frac{(1-\beta)}{\beta} + b_w\right], \tag{10b}$$

which implies that

$$X_w = \Phi(r), \qquad \Phi' < 0. \tag{11}$$

On the other hand, from (5) and (6) we get

$$\frac{a_w}{a_L}X_w = F + G. \tag{12}$$

Combining (11) and (12) we finally have

$$F = f(r), \qquad f' < 0. \tag{13}$$

Eq. (13) is represented in fig. 1. It represents the rate of profit that can be realized at any given level of F. Bringing in the supply of wage funds as given by eq. (7) we determine the equilibrium values of F and r at the intersection point of the two curves in fig. 1. Once r is determined, we can determine all other variables and in particular X_L from eq. (1).

3. Comparative statics

In this section we carry out a few comparative exercises. Through the first two exercises we identify the constraints on industrial output and employment while through the third exercise we establish the main result of this paper.

Consider first an increase in agricultural output. Clearly, this shifts the $f(r)$ curve to the right and as a consequence both r and $F(r)$ increase. This leads to an increase in X_w through eq. (12). Also, since total profit increases and the lump-sum profit tax remains constant, X_L also increases. The increase in the levels of industrial output leads to an increase in industrial employment. Thus industrial output and employment are partly constrained by agricultural output.

Secondly, consider an upward shift of the $F(r)$ function. This leads to an

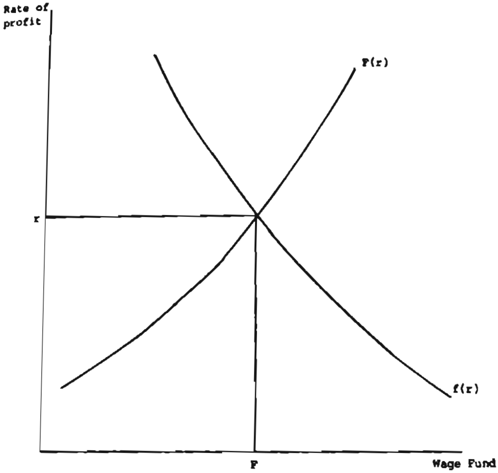

Fig. 1

increase in F but a fall in r. Thus, change in total profit is ambiguous and so is the change in X_L. However, the increase in F leads to an increase in X_w. As for total industrial employment L, we have

$$L=F/w,$$

so that, denoting proportionate change by a '^' on a variable, we get

$$\hat{L}=\hat{F}-\hat{w}. \tag{14}$$

But we have from wage-indexation and unchanged p_w,

$$\hat{w}=\gamma_a\hat{p}_a,$$

and from eqs. (10) and (12),

$$\hat{p}_a = \lambda_w \hat{F},$$

where $\gamma_a = b_a p_a / w$ and $\lambda_w = F/F+G$.

Thus (14) can be written as

$$\hat{L} = \hat{F}(1 - \gamma_a \lambda_w). \tag{15}$$

Since γ_a and λ_w are both positive fractions, from (15) we can conclude that industrial employment increases with an upward shift of the $F(r)$ function. Thus, industrial employment and the output of the wage good are constrained also by the supply of the wage fund.

Given these constraints on industrial output and employment, we now consider an exogenous increase in G. From eq. (12) an increase in G shifts the $f(r)$ curve to the left and reduces r and F. Since total profit falls and the lump-sum tax on profit increases (because the increase in G is financed by an increase in profit tax), X_L clearly goes down. As for X_w, we have

$$\hat{X}_w = \lambda_w \hat{F} + \lambda_G \hat{G},$$

where $\lambda_G = G/F+G$.

Denoting the elasticity of F with respect to $(1+r)$ as obtained from eq. (7) by σ_S and noting that $(1\hat{+}r) = -\hat{w} = -\gamma_a \hat{p}_a = -\gamma_a \hat{X}_w$, we get

$$\hat{X}_w (1 + \lambda_w \sigma_S \gamma_a) = \lambda_G \hat{G}. \tag{16}$$

From (16) it becomes clear that X_w increases with an increase in G. This implies an increase in p_a and the wage rate w. The fall in F along with an increase in w implies, from eq. (14), that employment falls. Thus an increase in transfer payments by the government leads to a contraction of industrial employment.

A couple of comments are now in order. First, if production is supply constrained, it is evident that government policy, aimed at increasing aggregate demand, will not increase employment. What this paper shows is that under certain reasonable assumptions it will reduce employment. The intuition is simple. An increase in transfer payments by the government, increases demand for agricultural goods and given fixed supply, drives up the agricultural price. Since the industrial wage rate is partly indexed to the agricultural price, this leads to an increase in the wage rate and a fall in the rate of profit. The fall in the rate of profit, in turn, reduces the supply of the wage fund and finally the increase in the wage rate along with a fall in the wage fund reduces employment. All this holds provided the increase in government expenditure has no direct effect on production. Such unproductive expenditure is shown to be counter-productive so far as industrial employment is concerned.

Secondly, the increase in G can take various forms. One of the possible ways in which a transfer payment can be made to the agricultural sector is through an agricultural support price. Suppose the farmers sell their produce to the government at a support price p'_a and then buy their own consumption requirement from the government at the market price p_a where $p'_a > p_a$. Then total agricultural subsidy given through the support price is $(p'_a - p_a)/X_a$. It can be easily verified that an increase in the agricultural support price p'_a will lead to an increase in this subsidy and hence an increase in G. Thus, from the above analysis it becomes clear that an increase in the agricultural support price will have a contractionary effect on industrial employment.

Before we end this section, we would like to point out that the demand equations represented by (5) and (6) could be made somewhat more general. For instance, (5) and (6) can be replaced by any homothetic demand function of the form

$$\frac{X_w}{X_a} = D\left(\frac{p_w}{p_a}\right), \qquad D' < 0.$$

In this case, of course, one has to bring in the omitted demand equation for the luxury good to determine the model. It can, however, be easily verified that this alternative demand specification does not change the qualitative nature of the results.

One could also bring in Engel's Law to characterize demand for the agricultural good. Suppose demand is represented by (5) and (6) with the additional specification that β, the share of income spent on the industrial good, increases with the level of non-capitalists' income Y_N, where

$$Y_N = F + G + p_a X_a = \frac{F+G}{\beta} \tag{17}$$

Let σ_D be the elasticity of β with respect to Y_N, i.e.,

$$\hat{\beta} = \sigma_D \hat{Y}_N, \qquad \sigma_D > 0. \tag{18}$$

Since from (17) we have

$$\hat{Y}_N = (F + \hat{G}) - \hat{\beta},$$

eq. (18) can be written as

$$\hat{\beta}=\frac{\sigma_D}{1+\sigma_D}(F\hat{+}G). \tag{19}$$

Now, from (5) and (6) we have $p_w X_w = F+G$ from which we get

$$\hat{X}_w=(F\hat{+}G),$$

because p_w is given by a_w/a_L and is fixed. From eq. (10b) we get

$$-(1\hat{+}r)=\theta[\hat{X}_w+(1\hat{-}\beta)-\hat{\beta}], \tag{20}$$

where

$$\theta=\frac{b_a X_w}{X_a}\frac{(1-\beta)}{\beta}\bigg/\left\{\frac{b_a X_w}{X_a}\frac{(1-\beta)}{\beta}+b_w\right\}$$

Using (19), eq. (20) can be written as

$$-(1\hat{+}r)=\theta\hat{X}_w\left(1-\frac{1}{1-\beta}\frac{\sigma_D}{1+\sigma_D}\right) \tag{21}$$

From eq. (21) it becomes clear that for the function $X_w=\Phi(r)$, $\Phi'<0$ provided $(1-\beta)>\sigma_D/(1+\sigma_D)$. In this case, all the results obtained from the above analysis hold. Since $\sigma_D/(1+\sigma_D)$ is increasing in σ_D we can conclude that the quantitative nature of the model remains unchanged if σ_D is small i.e., if Engel's Law is not very strong.

4. Concluding remarks

In this paper, we have considered a model of economic development where agricultural output and industrial wage fund impose constraints on industrial employment. We have shown that in this set-up an unproductive expenditure by the government aimed at increasing the purchasing power of the non-capitalist class will reduce industrial employment. The result holds not only with homothetic preferences but also with demand exhibiting relatively weak Engel's Law. The analysis has been confined to stationary states and comparisons of stationary states. Thus, capital accumulation and in particular, capitalists' choice between consumption and investment have been abstracted from. We hope, however, that this simple model has been able to provide some useful insights.

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