

## 4. The Role of Public Expenditure in a Bisectoral Model

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### 1. Introduction

Economists have traditionally tried to answer the following question: Why are some countries rich and others are poor? Many answers may be provided to this interrogation, crucially depending upon the assumptions and variables employed in order to describe the production function of the economy. It is not strange, then, that the different schools of thought have developed alternative models intending to identify the main factors that, in their view, affect growth.

Pioneering works in the field of development have shown the relevance of agriculture in order to promote growth in countries, especially in the case of less developed countries<sup>1</sup>. As countries develop and reach a higher specialisation level, the interdependence between agriculture and the rest of the economy becomes more significant. The industrial sector traditionally demands agricultural products and absorbs workers no longer needed in agriculture. On the other hand, the agricultural sector demands industrial goods to become more productive. This interaction has favoured the creation of models where both the effects of dual and migratory<sup>2</sup> processes were analysed (Lewis 1954 and 1958).<sup>3</sup>

But, after a period when economic growth analysis was not so relevant in economic research, it has become important again since the eighties when the endogenous growth theory appears. Although, some elements of this theory include both sectors in the growth models, it does not study the existing relationship between the agricultural and the industrial field. This type of research has been carried out from the postkeynesian point of view with the works by Kalecki (1971), Dutt (1986), Kaldor (1975 and 1979) and Thirlwall (1986)<sup>4</sup>. The goal of this chapter is to develop a growth model with two sectors following the guidelines given by the last two authors mentioned above. We also carry out an empirical study of the growth model considered in order to analyse the impact of public expenditure in ten European Union countries, Japan and USA.

### 2. Bi-Sectorial Postkeynesian Growth Model

As it had been anticipated, this is both a Kaldorian-type model<sup>5</sup> and an extension of Thirlwall (1986) as far as the financial sector is concerned (Alfranca and Galindo, 1997). The possibility of an open economy has not been taken into account up to now. In this way, we consider a closed economy in which both agricultural and non-

agricultural activities are included. The agricultural sector will be represented as "a" sub-index in the corresponding variables. On the other hand, we will group industry and services together under sub-index "s". It is supposed that there is interrelation between agriculture and the rest of the economy and that there is a flow of inputs and outputs. Thus, for instance, industry sells manufactured products (for instance, machinery) in exchange for goods produced by agriculture (for instance, food) that industry adopts as inputs in its productive function. As far as agriculture is concerned, this intersectorial flow has been intensified in the last years and has consolidated the appearance of the agro-food chain<sup>6</sup>.

In principle, we consider that the production function  $Q$  involves a production function for agriculture ( $Q_a$ ) and another production function for rest of the sectors in economy ( $Q_i$ ). Let us develop each one of these functions. Starting by the agricultural sector, we have the following equations:

$$Q_a = A_a K_a^{a_1} B_a^{a_2} E^{a_3} \quad (1)$$

where  $A_a$  are the different factors that affect agricultural activity, (i.e. technological progress, weather variable...),  $K_a$  is the capital used in this sector,  $B_a$  is the private benefit and  $E$  is the public expenditure in the economy.

Equation (1) becomes

$$\frac{\Delta Q_a}{Q_a} = \frac{\Delta A_a}{A_a} + a_1 \frac{\Delta K_a}{K_a} + a_2 \frac{\Delta B_a}{B_a} + a_3 \frac{\Delta E}{E} \quad (2)$$

On the other hand, the capital used would be expressed in the following way:

$$\frac{\Delta K_a}{K_a} = -b_1 r + b_2 b_a + b_3 g_a \quad (3)$$

where  $r$  is the interest rate, (which we assume it is the same for all sectors),  $b_a$  is the agricultural profit rate and  $g_a$  represents the rate of change in agricultural subsidies.

By replacing this expression in (2):

$$\frac{\Delta Q_a}{Q_a} = \frac{\Delta A_a}{A_a} + a_1 (-b_1 r + b_2 b_a + b_3 g_a) + a_2 \frac{\Delta B_a}{B_a} + a_3 \frac{\Delta E}{E} \quad (4)$$

On the other hand, considering the level of savings, we have:

$$S_a = s_a Q_a \quad (5)$$

Where  $S_a$  is saving in this sector and  $s_a$  is a constant proportion of saving.

As can be observed, technical progress, subsidies, profits and public expenditure have a positive effect on agricultural production. The interest rate, on the other hand, has a negative effect.

As far as the industrial equations are concerned, we will follow the same steps as in the case of the agricultural sector.

$$Q_s = T_s K_s^{a_4} B_s^{a_5} E_s^{a_6} \quad (6)$$

The letters have the same meaning as in the previous sector but sub-index "s" shows that they refer to the industrial and services sectors. Equation (6) becomes,

$$\frac{\Delta Q_s}{Q_s} = \frac{\Delta A_s}{A_s} + a_4 \frac{\Delta K_s}{K_s} + a_5 \frac{\Delta B_s}{B_s} + a_6 \frac{\Delta G}{G} \quad (7)$$

The capital equation is

$$\frac{\Delta K_s}{K_s} = -b_i i + b_s b_s + b_g g_s \quad (8)$$

where  $i$  is the interest rate,  $b_s$  is the industrial profit rate and  $g_s$  is the industrial subsidies. Expression (7) then becomes

$$\frac{\Delta Q_s}{Q_s} = \frac{\Delta A_s}{A_s} + a_4 (b_i r + b_s b_s + b_g g_s) + a_6 \frac{\Delta E}{E} \quad (9)$$

Saving in this case would be represented by the following expression:

$$S_s = s_s Q_s \quad (10)$$

Therefore, it can be observed in a similar way that in the agricultural sector, that capital accumulation, technical progress, subsidies and public expenditure favour industrial production growth. In the following section we are going to estimate this model in the case of some OECD countries.

### 3. Empirical Results

As it has been said, in this section we are going to estimate the bisectorial growth model above to analyse the relationship between public expenditure and growth for a

panel of countries. We think this could be interesting for economic policy analysis, which usually does not take into account the sensitivity of different sectors to public policies. If inference is made on aggregated models, following these results could result in inefficient and costly policies to improve growth in sectors which are scarcely responding to public expenditure.

Regarding the specification of the models, it would be advisable not to use cointegration contrasts, because no evidence should be achieved with such short series. Therefore, we prefer to present a linear model and a first differences model. Linear models should be valid when cointegration exists. First differences models should be valid in the case that the variables are integrated of order 1 (I(1)) and they are not cointegrated.

In our analysis we are going to consider twelve countries<sup>7</sup> and time period between 1977-1991. The estimated model is a linear specification of equations 4 and 9 which have been exposed in the theoretical model of section 2. The equations are specified logarithms, so that the estimated coefficients represent output elasticities. The definition and theoretical foundation of the variables can be summarised as follows<sup>8</sup>: The dependent variable  $Q_{it}$  represents the gross domestic product for each country.

The public expenditure  $E_{it}$  is represented by the government expenditure, (excluding subsidies), for each country. The expected sign is positive. The interest rate ( $r_{it}$ ) is represented by the real interest rate. The expected sign is negative. The private benefits ( $B_{it}$ ) are represented by the profit of the firms. The expected sign is positive. The subsidies ( $G_{it}$ ) are represented by the subsidies received by producers. It is expected that the relationship between subsidies and production is positive. The weather index ( $IM_{it}$ ) is represented by the deviations of cereal yields around their means. No sign can be expected. This variable had been included in A in equation 4 above and we separate this variable in order to reflect external shocks on agriculture.

No indirect paid taxes have been included as independent variable because its relevance in agriculture is very small in all selected countries. Following most of statistical offices, we consider that indirect taxes in agriculture are marginal in relative terms, (if we compare them with subsidies), and we do not include them in the agricultural production function. Taxes are considered in industrial and tertiary activities and in the aggregated model only. The industrial and services equation includes public expenditure, real interest rate, non agricultural profit, ( $B_s$ ) agricultural subsidies ( $G_s$ ) and indirect taxes (T). Taxes (T) are represented by taxes linked to production. The expected sign is negative.

Available series are fifteen years long only. So, no cointegration tests should be used to contrast the existence of long term relationships between the variables. We prefer to present linear and first differences models rather than using cointegration tests for specification, because no solid evidence could be obtained from these tests.

Albeit cointegration techniques could be used to estimate a long run relationship

such as a growth function, ordinary least squares (OLS) and generalised least squares (GLS) have been used<sup>9</sup> in this work, because of the short length of the series which is available for most of the countries. Asymptotic cointegration tests may not be very useful for a fifteen year series, and following from these, first differences models are preferred to avoid spurious relationships that could appear with OLS (given that we are working with time series).

We will estimate models for the agricultural sector, non agricultural sector, and an aggregated model. The models estimated for each of these variables will be:

1. A multivariate regression model,

$$y_{it} = \mathbf{a} + X_{it} \mathbf{b} + u_{it}$$

where  $i$  is for the country and  $t$  refers to a year. In this model, the intercept and the coefficients are the same for all countries.

2. A fixed effects model,

$$y_{it} = \mathbf{a}_i + X_{it} \mathbf{b} + u_{it}$$

In this model we accept that the coefficient is common for all the countries, but the constant term may differ. Constant term should include omitted variables with a different impact on each of the countries. We assume that these effects are constant.

3. A random effects model,

$$y_{it} = \mathbf{a}_i + X_{it} \mathbf{b} + e_i + u_{it}$$

In this model omitted variables in each country present a random effect. So, specific random variables  $e_i$  will be included.  $e_i$  mean is 0, and variance is  $s_e^2$ . Each of these models are estimated in linear and first difference form. Given that no cointegration contrasts should be valid because of the short length of the series, we rather analyse the results in the first difference models.

Taking into consideration the above questions, the empirical results can be summarised as follows. First the economic effects of public expenditure on growth, in the linear models most of the coefficients for public expenditure present unexpected signs and very low significance. On the contrary, first differences models are all positive and significance can be easily accepted in all models. In this sense we have

observed differences in both sectors. The rank of the public expenditure elasticities in the first differences models goes from 0.184 (the common model for agriculture), (table II) and 0.283 (fixed effects model for industrial and services production) (table III). This implies that agricultural production response to public expenditure is always smaller than industrial and services production. Aggregated production model estimation seems to confirm these results and public expenditure response is bigger than agriculture response. However, the estimated elasticity is smaller than for the industrial and services production, probably because of the reduced economic weight of agricultural production in the considered countries.

Although some differences exist among economic sectors regarding production response to public expenditure, results seem to be quite robust when analysed specifically for the different economic sectors. A Wald test to contrast the existence of scale economies for private inputs<sup>10</sup>, has been calculated. Although most of linear models show that constant scale economies could be accepted, all first differences models show high values of Wald test that clearly reject this hypothesis. So, positive scale economies hypothesis cannot be rejected for any of the estimated models. This implies a correct specification is being used, because this assumption has been included already in the model. Second, interest rate appears to be a small determinant of growth in these models. Significance of this variable can be accepted, (with the expected sign), for the industrial and service sectors (table III). This variable presents a very low response to agricultural output. Besides, in the agricultural model, interest rates are far from being significant. In the aggregated model, interest rates show a negative influence on production, and weak significance can be accepted<sup>11</sup>, as it is shown in table I. Third, private benefit is the strongest determinant of growth for all sectors, specially in agriculture (table II). This variable is highly significant and presents the expected positive sign in all cases.

The differences between the sensitivity of output between sectors are rather small. The rank of values for the coefficient goes from 0.326, (in the fixed effects model for industrial and service sectors), to 0.511 (in the random model for the agricultural sector). The narrow similarity between the aggregated and non agricultural coefficients may be due to the small weight of agriculture in most of OECD economies.

These estimations results are quite surprising when we take into account the extremely low sensitivity of agricultural production to interest rate, and the common general assumption, that considers agriculture and economic activity less sensitive to private benefit and more closely related to public funds, such as subsidies. Four, subsidies are only significant in agriculture, and present the positive expected sign. The elasticity of agricultural production to changes in subsidies is bigger than 2.14% in any case. For the rest of the economy the coefficients are even smaller, with positive signs but low significance values. If agricultural profits are assumed to be a proxy for agricultural income, these results might indicate that agricultural subsidies

are used rather as a direct income transfer, than as a tool to improve agricultural productivity.

Finally, we have to consider the results of taxes, weather and the constant. Sensitivity of output to taxes appears to be higher than sensitivity to subsidies, even though the elasticity it is still fairly small. Coefficients are significant in the aggregated and in the industrial and services models, and present the expected negative signs, as it is shown in tables I and III.

Weather appears to be a positive determinant of agricultural production, although significance can be rejected in all cases (see table II).

The constant term can be understood to represent the specific sectorial characteristics on growth. So, this intercept may include unobserved variables related to human capital, (such as managerial efficiency or workers ability), or technological progress which are very likely to be correlated with some explanatory variables, specially with the private benefit. The constant term is significant in the aggregated model and in the industrial and service model.

In the estimated model, we have only changed the constant for each country, (or the variance of the constant term). The problem is that changes may appear in coefficients. If coefficients are very different, this could affect the liability of the results. In our work, the United States and Japan, with a different external behaviour from most of European countries, (which follow EU rules), may distort the results, if the model imposes restrictions on equality of coefficients. Nevertheless, protection for agriculture do exist both in Japan and in the United States, (although using different tools from those used in Europe), and industrial policies are rather liberal in all countries included. So, although some distortions may appear from this assumption, the consequences should not have to be very important.

The estimation shows the relevance of public expenditure and private benefits in both sectors, but it is more significant in the non-agricultural sector. In this sense, it must be taken into account that the economic weight of agriculture is very low in the countries of the panel. Hence, the policy implications of this analysis are clear: policymakers should pursue public expenditure mainly in non agricultural sectors if aggregated growth wants to be improved.

On the other hand, the estimations show that it is necessary to increase public expenditure and improve private benefit in non-agricultural sector. But we also have to take into account the distributional effects derived from these kinds of policies. In the case of advanced countries the policy maker have to design a democratic strategy for stronger macro performance. This implies to assure employment opportunities for everyone and promoting higher rate of productivity growth in all the sectors, achieving grater equity (Gordon, 1995).

#### **4. Conclusions**

This work tries to do some empirical research about the connection between public expenditure and growth in a bi-sectorial model, using a sample of ten European Union

countries and Japan and USA. The analysis follows a Postkeynesian approach and includes public expenditure, private benefit, subsidies, taxes and specific sectorial variables as regressors as well. The main conclusion of this chapter is that some evidence exist about the positive influence of public expenditure on growth in all sectors. The existence of different sectorial responses to public expenditure in the different sectors is accepted. Industrial and services production is specially sensitive to changes in public expenditure. This indicates that the traditional single equation model to analyse the impact of public expenditure may not be adequate, at least for this sample of countries, and these data.

Private benefit is clearly the main determinant of growth for all sectors in the model, specially in agriculture. Agricultural production response to subsidies seems to be smaller than the response of industry and services. Given that public expenditure and agricultural production shoe low elasticity values, we could think that subsidies might be considered rather a tool to increase agricultural income than a measure to improve production. So even though efficiency of subsidies in agricultural production is low, (this is one of the main discussion points in recent CAP reforms, policy makers should not have to refuse its use, otherwise, redistributive problems may appear. The main problem is to maintain the trade off between private benefit and social benefit.

Table 1. *Postkeynesian model. Aggregated production. Levels and first differences panel data.*

Levels	Common	Fixed	Random
LnGP	-0.0163	-0.0134	-0.183
T	-0.761	-0.216	-2.441
LnIR	-0.00968	0.0228	0.0437
T	-0.631	2.61	3.277
LnB	0.969	0.383	0.729
T	99.476	13.286	25.0156
LnT	0.0282	0.11	0.0747
T	5.275	7.209	3.971
LnS	-0.0656	-0.0442	-0.0581
T	-4.848	-2.731	-2.8405
Constant	2.136		7.109
T	10.407		10.387
Adjusted R-squared	0.994	0.999	0.999
DW	0.1923	0.401	0.561
Wald test (scale economies)	20.384	89.695	28.471
First differences	Common	Fixed	Random
LnGP	0.201	0.256	0.281
T	3.871	4.658	4.3102
LnIR	-0.0516	-0.0535	-0.0541
T	-1.487	-1.747	-1.818
LnB	0.355	0.328	0.369
T	4.779	5.261	4.853
LnT	-0.13	-0.151	-0.175
t	-3.269	-3.988	-3.971
lnS	0.00373	0.00342	0.00386
t	0.379	0.435	0.284
Constant	5.981		10.284
t	4.202		8.663
Adjusted R-squared	0.795	0.841	0.881
DW	1.332	1.788	1.692
Wald test (scale economies)	240.27	227.466	235.901

Table II. Postkeynesian model. Agricultural production. Levels and first differences panel data.

Levels	Common	Fixed	Random
lnGP	-0.0297	0.057008	-0.0653
t	-1.0859	0.807	-0.864
lnIR	0.101	-0.00964	-0.004903
t	5.388	-0.965	-0.367
lnBA	1.0693	0.395	0.741
t	56.643	9.813	20.485
lnS	-0.127	-0.02103	-0.0169
t	-7.188	-2.492	-1.508
lnIM	0.0389	0.0523	0.03009
t	5.00463	4.748	2.406
Constant	0.298		3.256
t	1.116		4.485
Adjusted R-squared	0.988	0.999	0.998
DW	0.284	0.479	0.506
Wald test (scale economies)	1.976	48.699	14.724
First differences	Common	Fixed	Random
lnGP	0.184	0.196	0.201
t	2.796	3.929	3.471
lnIR	-0.0097	-0.008906	-0.008168
t	-0.791	-0.858	-1.0014
lnBA	0.434	0.4901	0.511
t	3.709	3.531	3.778
lnS	0.02006	0.0165	0.0214
t	3.211	3.478	3.719
lnIM	0.0526	0.16003	0.159
t	0.455	0.7701	1.0298
Constant	-0.239		1.756
t	-0.1405		1.347
Adjusted R-squared	0.885	0.929	0.916
DW	2.706	2.398	2.451
Wald test (scale economies)	207.915	214.633	238.545

*Table III. Postkeynesian model. Industrial and Services production. Levels and first differences panel data.*

Variable	Common	Fixed	Random
lnGP	-0.0165	-0.0351	-0.205
t	-0.772	-0.5701	-2.768
lnIR	-0.0121	0.0238	0.0459
t	-0.789	2.695	3.397
lnBNA	0.962	0.377	0.727
t	109.628	12.972	24.938
lnT	0.0276	0.0995	0.064
t	5.221	6.827	3.524
lnSNA	-0.0573	-0.0253	-0.0378
t	-4.96	-2.0205	-2.309
Constant	2.202		7.231
t	10.846		10.658
Adjusted R-squared	0.994	0.999	0.999
DW	0.193	0.366	0.531
Wald test (scale economies)	11.416	16.764	30.571
First differences	Common	Fixed	Random
lnGP	0.202	0.257	0.283
t	3.883	4.797	4.41
lnIR	-0.0594	-0.0585	-0.0581
t	-5.921	-5.772	-5.817
lnBNA	0.354	0.326	0.368
t	4.298	4.646	4.818
lnT	-0.0493	-0.0506	-0.0454
t	-3.916	-3.885	-4.148
lnSNA	0.00387	0.00341	0.00374
t	1.546	1.309	1.647
Constant	6.748		10.347
t	5.354		8.132
Adjusted R-squared	0.866	0.83	0.8705
DW	1.535	1.795	1.448
Wald test (scale economies)	227.94	254.36	228.351



### **Appendix 1: Definitions of the variables and data sources.**

Definitions of the variables.

- E. Government expenditure, excluding subsidies.
- r. Official discount rate, deflated with the deflator for GDP .
- B. Profit.
- G. Subsidies.
- T. Taxes linked to production.
- IM. Deviations of cereal yields around the mean.

All the variables are expressed in US\$ (PPP) 85 price.

Data sources :

- Eurostat. (EU).
- Faostat. (FAO).
- Government Financial Statistics. (IMF).
- National Accounts (OECD).
- Ricardo (1993)
- Summers, R. and Heston, A. Penn-World tables mark 5.6.

### **Notes**

- 1 For the explanation of these ideas, see Ghatak (1995, pp. 271-273).
- 2 See for example, Todaro (1969) and Harris and Todaro (1970).
- 3
- 4 For the case of structuralist models where fixed and flexible prices are involved, see Cardoso (1981) and Taylor (1983).
- 5 See Kaldor (1975,1979) where a model is developed for the case of a world economy where countries are divided among those that produce primary goods and those that make industrial goods.
- 6 As Sumpsi (1994) states, it is not possible to understand some aspects of agricultural evolution regardless what happens in the agro-food sector. Sumpsi (1994) also presents some comments on the recent evolution and perspectives of the agro-food industry after the CAP reform and the Uruguay Round of GATT.
- 7 These countries are: Belgium, Denmark, France, Germany, Italy, Ireland, Japan, Netherlands, Spain, Sweden, United Kingdom and United States.
- 8 A definition is given for the aggregated variables. The same definition may be applied for the sectorial variables, and for this reason, it will not be repeated. A

definition of these variables appears in appendix 1.

- 9 Although the fixed effects model can be estimated by OLS, random effects required GLS.
- 10 This means that the sum of private input coefficients is equal to one.
- 11 5% significance can be accepted for the fixed and random models, and 10% for the common model.

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