

IV. SECTORAL AND INPUT-OUTPUT MODELS

Ali Bayar*, Nicolas Delmezis*, Ziegfried Erlich*,
Yvan Guillaume*, Danielle Meulders*

APPLICATION OF THE OPTIMAL CONTROL TECHNIQUE TO EMPLOYMENT PROBLEMS IN BELGIUM

(A PROJECT)

1. Introduction

At the beginning of 1980s, Belgium's economic situation showed a series of substantial disequilibriums (the balance of payments, public finance and employment) as well as a negative rate of growth (in 1981). The last government's economic policy (since the end of 1981 until the end of 1985) was designed chiefly to reduce the external deficit as well as that of public finance, and to restore the competitiveness and profitability of enterprises. The instruments used to these ends included an increase in transfers to the State (especially by wage-earners), a relative or absolute decrease in public expenditure for consumption and investment and in the transfers to individuals, a decrease in real wages by partial abolition of wage indexation and a devaluation of 8.5% (early in 1982).

The government (helped by a change in the external environment) achieved some success as regards the balance of payments and as regards the profitability of enterprises in certain sectors; at the same time, growth is slightly positive and the rate of inflation gives little cause for concern; but on the other hand the public deficit is still well above 10% of the GNP.

* Dr., Free University of Brussels, Belgium.

The most worrying problem of all, however, is unemployment, despite the fact that the latest figures show a very slight improvement. The Belgian rate of unemployment¹ is still one of the highest in the EEC².

In April 1985 it amounted to 11.6% (against an average of 9.9% for the EEC) and was substantially exceeded only by the rate for Ireland. A very large proportion of the unemployment are women (18,3% against 12,2% for the EEC), the male rate of unemployment being slightly below the Community average (7.7% against 8.5%).

In Belgium, evaluation of the economic policy being pursued or of alternative policies has been carried out regularly and is still carried out by simulation of empirical macroeconomic models (e.g. the Breughel and Wallonie models of DULBEA, the Mari-bel model of the Plan Bureau). One partial shortcoming of this simulation technique is that it offers little scope for the classification of policies and it certainly does not propose any. That is why it was decided to make use of the optimal control technique. A recent application of this technique to Belgian problems was the work of Z. E r l i c h et al. (1984) and covered the public debt. Our intention is to carry out a specific study of the problem of unemployment.

This paper presents the project but unfortunately does not give the results of the study. The first part is a brief description of the macrosectoral model which will be used and which is in process of being constructed, the second part gives the sectoral employment equations that lie at the heart of the model, the third describes a set of possible measures and their inclusion in the model, and part four describes the way in which we plan to use the optimal control technique.

2. The Model

The model is an annual model of short-medium term economic policy, with effective demand determining production and regarding imports as the other source of supply.

¹ According to the gauge used by Eurostat and determined by the 13th international conference of labour statisticians (Geneva 1982).

² Excluding Spain and Portugal.

Most of the variables are used at the macroeconomic level, special attention being given to the consideration of measures which are feasible in an employment policy. Thus a clear distinction is made between earned income, interest, dividends, income from individual enterprise, and transfers of various kinds.

Employment, which is the privileged variable in the study, is treated at sectoral level. On the one hand the statistics allow for this, and on the other hand performance undoubtedly differs from one sector to another. We have used eight sectors of manufacturing industry, building, a (broadened) sector of market services and a non-market services sector. The fact that there is a more detailed breakdown of manufacturing industry, though it only accounts for approximately one third of jobs in Belgium, is due to the availability of statistics, which are far more limited for the services sector.

The sectoralization of employment called for corresponding treatment of at least some of the explanatory employment variables; sectoralization was applied to production, the share of capital in new investments, the user rate of output capacity and the duration of work. Owing to the scale of the model (due to logistical constraints caused by the use of optimal control) the wage and price variables have not been sectoralized, and that clearly is one of its limitations.

Sectoral output is determined, on the basis of econometric estimates, according to the aggregates of demand and imports as well as the output of other sectors; the duration of work and the share of new investments in capital are control variables; the latter figure makes it possible to calculate investments, capital and the user rate of sectoral capacity.

3. Employment Equations

As employment is the prime objective of the study, the employment equations constitute the heart of the model and warrant more detailed description than the rest of the model.

The basic work was that of N. D e i m e z i s (1985) which in turn was inspired by the ideas in the Franch Copain model (M. D e b o v e et al. (1981)).

The principles of the employment functions are as follows:

1) the capital and labour production factors are complementary;

2) the ratio between production factors and capacity depend on time, on the age structure of capital; and of the ratio between the cost of labour and the value of productivity;

3) the ratio between the amount of efficient work at full capacity and that of the real use of capacity depends on the extent to which output capacity is used;

4) employment (expressed in terms of men) depends on the amount of work and on its duration;

5) there is no immediate adjustment of the amount of effective work to the amount of efficient work.

Consequently, the employment equations of the manufacturing sectors are shaped as follows:

$$\log \frac{E}{E_{-1}} = \lambda \log c_0 + \lambda c_1 \frac{1}{t} + \lambda c_2 \frac{K_r}{K} + \lambda c_3 RWC +$$

$$+ \lambda \log \frac{K}{E_{-1}} + \lambda d \log U - e \log DH + e(1 - \lambda) \log DH_{-1}$$

where:

E - employment,

K_r - investment in the last five years,

K - capital stock,

RWC - indicator of relative wage cost,

U - user rate of capacity,

DH - duration of work.

The equations have been estimated in this form for the following manufacturing sectors: metals, non-metal products, chemicals, mechanical engineering, food, textiles, paper, miscellaneous.

The equations covering employment in building and commercial services (including energy) are less comprehensive but do still include an RWC type variable. The other sectors are treated exogenously or in the form of control variables (public sector employment).

As will be shown in part three, these equations can be used to study - obviously to varying degrees of quantification - a very wide selection of possible economic policy measures relating specifically to employment.

4. Employment Policies and Flexibility

4.1. Employment Policies

The population of working age can be divided into three groups:

- E - those in jobs,
- U - job-seekers,
- I - those not seeking jobs.

The working population consists of $E + U$.

It is in the light of these categories that we have drawn up a classification of employment policies capable of encompassing all the various policies pursued in EEC member countries. This classification is shown above.

Passive policies covering the first group, designed to faster the passage from E to I and from U to I, have intensified in the EEC countries in recent years; they extend to older workers and unemployed people (pensioners, those in early retirement), young people (compulsory schooling, longer military service), women (benefits for non-working mothers, parental leave, optional taxation units in tax systems), immigrants, and workers in general (sabbatical leave).

Passive policies of the second type are concerned with the social security system which, for budgetary and social reasons, are characterized at present by a transition from the insurance model to the assistance model.

Such passive policies are only mentioned here for completeness sake; they have no impact on E (the number of people in jobs), they could be integrated in the model by introducing a function in which the growth of unemployment would be defined as:

$$(E - U - U - E) + (I - U - U - I).$$

Active policies, which are designed to promote growth in the number of people in jobs (E), are divided into three groups presented above.

Policies designed to increase the supply of jobs; job creation, and creation of businesses are inspired by supply side economics: they operate by compressing the costs of enterprises (wages, social security, company tax) or by granting subsidies. Among these policies, a distinction should be drawn between those creating private sector jobs and the considerably larger proportion which create public-type jobs designed to satisfy other collective needs. Some of these policies create a problem as to the status to be conferred on "new workers"; this raises the whole question of theories pertaining to the dual market (P. B. D o e r i n g e r, M. J. P i o r e (1971));

In our model these policies appear through the medium of employment equations; the relevant variables are RWC, which takes account of all modifications in the wage cost (employers' social security contributions, subsidies to enterprises in order to bring their prices down, the portion of non-indexation which benefits enterprises), eventually also K_r (investment aids), disposable income and the public deficit.

The second group of active policies covers the reduction and redistribution of working time; these are policies designed to increase the number of people in jobs (E); the financing of these policies involves the State, the enterprises and the workers. Their effect on employment will depend on the burden borne by each of these groups (see J. A. D r e z e and F. M o d i g l i a n i (1981), Y. G u i l l a u m e and D. M e u l d e r s (1984)).

The model will be able to take account of these various effects by means of variable DH, of variable RWC, of disposable income and of the public deficit (depending on the shares borne by enterprises, by wage-earners and by the State in the overall cost of reduced working time).

Finally, the last group relates to improved adequation between supply and demand for jobs. In most countries, training policies are aimed chiefly at young people and the unskilled unemployed. But the qualitative aspect of these measures makes

them difficult to incorporate in the model. The same applies to geographical adjustments.

4.2. Flexibility

Flexibility is quite clearly the in word in 1985; how does it relate to the employment policies described above?

In fact, three types of flexibility may be distinguished:

1. Numerical flexibility (FN), which is designed to enable employers to dismiss and to recruit without hindrance, to share out the work; it entails more flexible labour legislation;

2. Functional flexibility (FF): adjustment of wages to the performance of the individual and of the enterprise; it implies a return to market performance and therefore modification of the labour legislation;

3. Qualitative flexibility (FQ), which is designed to provide flexible and polyvalent training for workers.

These three types of flexibility are capable of affecting employment:

4. Numerical flexibility may have a positive or negative impact, depending on the trend of the economy; within the framework of employment policies, it may take the form of work-sharing measures. The adjustment coefficient λ may be interpreted in the model as a flexibility indicator (total flexibility if $\lambda = 1$, zero flexibility if $\lambda = 0$). It will serve as a control variable for the model;

5. Functional flexibility will have a positive impact if employment is a function of the wage cost, in the same way as the active policies of type II.a.1; it does not appear explicitly in the model;

Qualitative flexibility is linked to type II.c. employment policies and is not shown in the model.

5. The Optimal Control Algorithm and its Application

The optimal choice of employment measures, designed to maximize employment without adding to the public deficit or creating

a deficit in the balance of payments, can be made by applying the OPTNL programme built by G. C. C h o w (1981) and already used with success at the Universite Libre in Brussels by Z. E r l i c h et al. (1984).

At the first stage, and in order to avoid the problem of weighting in the objective function, the latter will only include employment as the sole argument; for the other economic policy objectives and for the control variables, constraints or limits will be imposed, e.g. by the use of cosine functions.

References

- [1] S h o w G. C. (1981), *Econometric Analysis by Control Methods*, John Wiley and Sons, New York.
- [2] D e h o v e M. et al. (1981), *Le modele COPAIN: Comportements patrimoniaux et integration financiere*, "Economie et Prevision", No 48.
- [3] D e i m e z i s N. (1985), *Analyse sectorielle de l'emploi dans l'industrie manufacturiere belge. Perspectives a long terme*, "Cahiers Economiques de Bruxelles", No 106.
- [4] D o e r i n g e r P. B., P i o r e M. J. (1971), *Internal Labor Markets and Manpower Analysis*, Mass., Heath, Lexington.
- [5] D r e z e J. A., M o d i g l i a n i F. (1981), *The Trade-off between Real Wages and Unemployment in an Open Economy*, "European Economic Review", No 15.
- [6] E r l i c h Z., J a n s s e n J., T h y s - C l e m e n t F., V a n R e g e m o r t e r D. (1984), *Optimal Control of the Public Debt*, Operational Research.
- [7] G u i l l a u m e Y., M e u l d e r s D. (1984), *Impacts d'une reduction de la duree du temps de travail*, [in:] *Emploi - Chomage - Modelisation et Analyses Quantitatives*, eds D. Vitry, B. Marechal, Dijon.

Ali Bayar, Nicolas Deimezis, Ziegfried Erlich,
Yvan Guillaume, Danielle Meulders

ZASTOSOWANIE TECHNIKI OPTIMALNEGO STEROWANIA
DO PROBLEMÓW ZATRUDNIENIA W BELGII

W Belgii, podobnie jak w większości krajów wysoko rozwiniętych, problem bezrobocia jest jednym z głównych przedmiotów zainteresowań władz. Problem ten jest szczególnie trudny do rozwiązania w warunkach istniejących ograniczeń narzuconych przez bilans płatniczy i stan równowagi finansowej tego kraju (charakteryzującego się istnieniem małej gospodarki i wysokim deficytem finansowym).

Przeprowadzone badania zajmują się zastosowaniem techniki optymalnego sterowania do problemów zatrudnienia w Belgii. W pracy wykorzystano narodowy model makroekonomiczny, którego równanie rynku pracy zostało rozwinięte specjalnie dla potrzeb powyższej analizy.