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A MULTIREGIONAL ECONOMETRIC MODEL OF THE ITALIAN ECONOMY: THE GROWTH OF SERVICE EMPLOYMENT

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ABSTRACT This paper presents the results of the estimation and simulation of a submodel of a multiregional econometric model which is based on a "bottom-up" and "supply side" approach. The equations of the service sectors follow a specification different from that usually adopted for industrial sectors, as a crucial role is given to selfemployed labour and to labour force growth. The model has been estimated on pooled data for 12 years (1970-1981) for the 20 Italian regions using the ordinary least square technique. The model indicates that the growth of service employment is determined not only by the growth of industrial employment and that macroeconomic policies could be adopted in order to increase employment in service activities.

1. INTRODUCTION

Notwithstanding the fact that service sectors represent more than half of total employment and production in developed countries, national and regional econometric models devote very little emphasis to the specification of the relationships among the most important economic variables within these sectors. In particular, an increasing gap seems to emerge between the structure of existing econometric and noneconometric regional models (Adams and Glickman 1980; Issaev et al. 1982; Nijkamp et al. 1985) and the evolution of the theoretical and empirical studies on regional development and disparities. Most models are based on theories, such as the neoclassical general equilibrium theory and the cumulative growth theory which have been elaborated during the 1950s and 1960s in order to explain a rather different phase in the development process of national and regional economies.

Recent studies, such as those on the functional division of labour among central and peripheral areas, on the local sectorally specialised districts of small firms, on the filtering down of technological innovations in the urban hierarchy and on the product life cycle evolution of regional economies, all attribute a crucial role to the development of tertiary activities. Services represent a crucial external economy for industrial activities because they promote the adoption of more efficient technologies and may also be exported at the interregional and international level.

This paper attempts to embed in a macroeconomic framework the increasing knowledge developed by microeconomic studies on the service sectors and to evaluate the role of service sectors in achieving national and regional macro-economic objectives, such as unemployment rate, inflation rate, balance of trade and public deficit. The paper first describes the structure of a multiregional econometric model of the Italian economy and then presents the results of the estimation and simulation of a model of the service sectors, which represents a submodel of this larger multiregional econometric model.

2. A MULTIREGIONAL ECONOMETRIC MODEL OF THE ITALIAN ECONOMY

The building of a large macroeconometric model for a regional or a national economy often is a slow and continuous process in which it is possible to distinguish different phases and contributions, which are gradually integrated with each other. The model of the service sectors, which is illustrated in this paper, represents an intermediate result of a research which started with the estimation of a regional econometric model for the Lombardy region (Cappellin 1975 and 1976) according to the lines proposed in earlier contributions (Klein 1969; Glickman 1974) and has led to the elaboration of the theoretical specification of a multiregional econometric model (Cappellin 1984) which is innovative in various aspects with respect to the previous literature and can be estimated with the data for the Italian regions.

The model follows a "bottom-up" approach because most national variables are determined through an aggregation or an average of regional variables. However, it also includes important feedback effects which determine an interdependency between regional and national variables. This method presents several advantages with respect to a "top-down" approach. In contrast to single region, "satellite" models, it allows an endogenous estimation of many variables, which would be exogenous in single region models and should be determined by a national model, although they might also be determined as the summation, or average, of regional variables. This characteristic of "bottom-up" models allows an easier elaboration of predictions because only few variables have to be collected from forecasts made with other models or with "ad hoc" methods. Secondly, this approach guarantees the coherence between the regional variables and the corresponding national variables, quite different from a "top-down" approach which leads to an overdetermined system, because several variables may be computed both within the national model and as combination of the variables estimated by the various regional "satellite" models. Thirdly, this approach allows consideration of the interaction among the various regions of a national economy, because each regional model affects the solution of the other regional models through its impact on the national variables. Although compatible with a "bottom-up" approach, a direct specification of multiregional relationships and of the effects of transportation costs and other distance related variables is often impossible, due to the absence of trade flow data.

The major interdependencies among the regional and the national submodels are indicated by Figure 1. The set of regional submodels determine most national variables and, in particular, the components of national aggregate demand. Through a national input-output table, the latter determines the production level of the different sectors at the national level that are then allocated to the various regions according to their respective production capacity, which is determined by regional factors. Regional production affects other variables and in particular aggregate demand in the regional models and the overall national demand determines the output at the national level. Therefore, although the model considers some "top-down" relationships, it mainly follows a "bottom-up" approach, as the national variables are mainly determined by accounting identities.

A second characteristic of the interregional model of the Italian economy and, in particular, of the tertiary sector submodel is that regional development

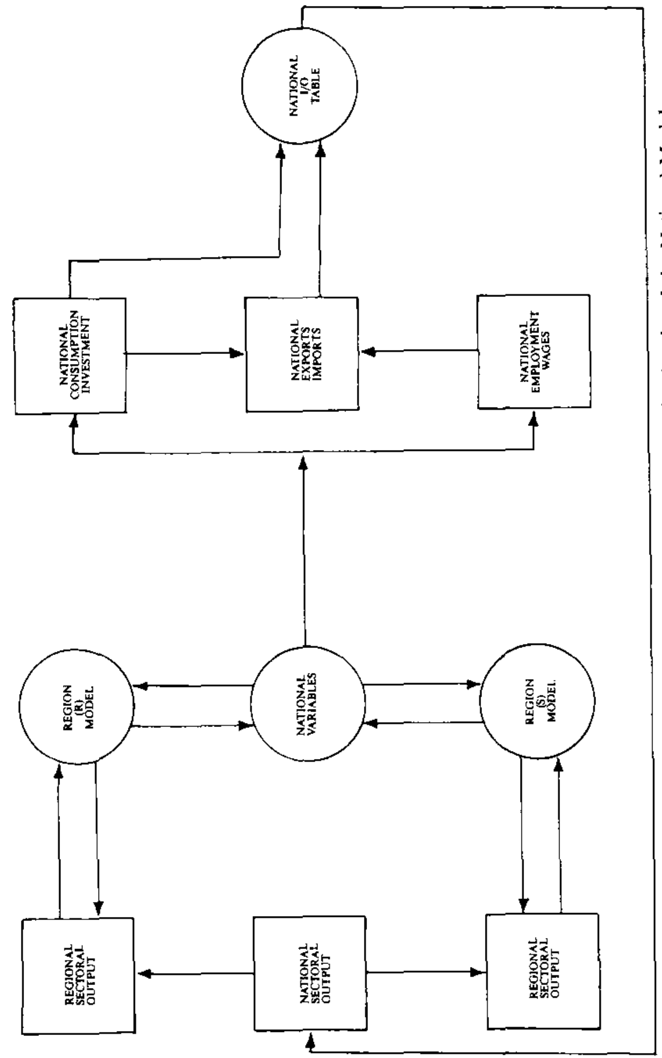


FIGURE 1. Major Interdependent Relationships among the Regional and the National Models

is determined not only by demand factors but also by supply factors. In fact, the specification of the service sectors adopted in this model does not follow the specification of the traditional export base models, which assign a crucial role to aggregate demand and to the output of the industrial or "basic" sector, because technological change and changes of the regional labour force affect employment and output of the service sectors.

A third characteristic of this multiregional model is related to the fact that the model tries to explain the long term growth of an interregional system and, in particular, the evolution of the large and long lasting regional disparities in the Italian economy. Therefore, the various equations in the model are specified according to a coherent theoretical structure and identify distinct demand and supply relationships for the regional and interregional markets of the various outputs, such as services, and production factors like labour. In particular, equilibrium conditions, which may hold in the long term, are defined for each regional and interregional market, and changes in the variables and interregional flows are specified as the result of adjustment processes to these equilibrium conditions. Therefore, the dynamic behaviour of the overall system of equations is determined by the interdependence of the various product markets and production factors, and not just by the growth of exogenous variables.

The model is mainly based on theories, which assign a great relevance to the movement of products and productions factors in the explanation of regional disparities, such as those in the neoclassical growth model, the export base model, the cumulative causation model and in the growth pole model (Richardson 1973). In fact, this characteristic represents a major limitation of our model. Since other more recent theories based on the "endogenous growth approach" emphasise that the growth of a regional economy is not determined by interregional flows of resources but by the capability to employ fully the local resources and to increase their productivity (Cappellin 1983).

Data availability problems and the effort to limit its size represent crucial constraints when embedding in a regional econometric model factors and processes which have been analysed by recent theoretical contributions such as the product life cycle hypothesis, the filtering down process along the urban hierarchy, the deverticalisation of production processes, the incubator function of urban areas with respect to small firms, and innovative productions. Clearly a regional econometric model is unable to explain microeconomic processes, which would require different methods and data. However, the structure of this multiregional model and of the service sector submodel does not contradict these theories. These factors and processes may be taken into account through appropriate exogenous variables and trends. Therefore, the model can represent an operational framework, which establishes quantitative links among the different subsystems of a regional economy and may be helpful in assessing the direct and indirect impact of exogenous variables on the overall growth of a regional economy.

3. MICROECONOMIC AND MACROECONOMIC MODELS OF THE SERVICE SECTORS

Service activities have several distinguishing characteristics with respect to industrial activities: a) they do not allow stocks, b) they have a lower import propensity, c) they require lower inputs of capital and of intermediate products, d) they are sold in competitive markets and not in oligopolistic markets, and e) they have a larger share of selfemployed workers. Therefore, service sectors require a different econometric specification than that usually adopted for the

analysis of industrial sectors. Specifically, the previous characteristics of the service sectors explain a different dynamic behaviour than that of industrial sectors given by: a) production changes that are directly related to sales changes, b) changes of local demand that are more important than those of external demand, c) value added that is almost equal to labour income, d) prices and wages that are rather flexible, and e) employment that is rather fixed.

In contrast to industrial sectors, we may assume that the demand for services is determined not only by the price but also by their quality, which greatly increases through time because product differentiation and innovations are more important in service than in industrial sectors. Thus, technological change has a direct and positive effect on the demand for services and on service employment. Producers and consumers are tightly related in the production of a service whose quality may be considered to be the result of matching the characteristics of producers and the tastes of consumers. The price of services is mainly determined by wages because labour inputs are much more important than inputs of capital and of intermediate products. Lastly, sales are equal to production, since stocks are almost impossible in service activities.

A large share of employment in services consists of proprietors or selfemployed workers. Thus, employment is not determined by sectoral labour demand but by sectoral labour supply, and the latter is affected by changes both in the total labour force and in the employment levels of other sectors. Wages or labour income rates are quite flexible in the short run, similar to profits in industrial sectors, due to the relevance of selfemployed workers in the service sector. In contrast the high mobility of these workers towards other occupations is hampered by the fact that selfemployed workers should disinvest the capital invested in their firms if they withdraw from service production. Moreover, they have specialised skills, which have been developed through human capital investments, that cannot be easily employed in other sectors.

Clearly, these two structural specifications overemphasise the dichotomy between the industrial and the service sectors since both sectors may in fact present intermediate characteristics. However, the first model is certainly more appropriate for industrial sectors than for service sectors and the opposite is true for the second model.

4. THE SPECIFICATION OF THE EQUATIONS

The most important causal relationships considered by the model are indicated by the flow chart of Figure 2 (the meaning of the variables is indicated in the appendix). The specification of the employment and wages equations follows a coherent demand supply framework, which is different for the selfemployed and the employee labour described by Figures 3(a) and 3(b). The labour supply schedule in each figure has two different shapes, which correspond to a normal case (S′) and to a more extreme case (S″). The per capita revenue of selfemployed workers may be determined according to a demand specification, while the level of selfemployed labour may be determined according to a supply specification. On the other hand, the labour of employees in service sectors may be specified according to a demand schedule and the wage rate may be specified according to a supply schedule. Total employment is, then, determined by the sum of selfemployed and employees.

The symmetrical specification of the employment level and wage rate equations in the case of the selfemployed and of the employee labour is due to the different rigidity of the labour demand and supply schedules in the two different types of employment (selfemployed and employee labour). Service

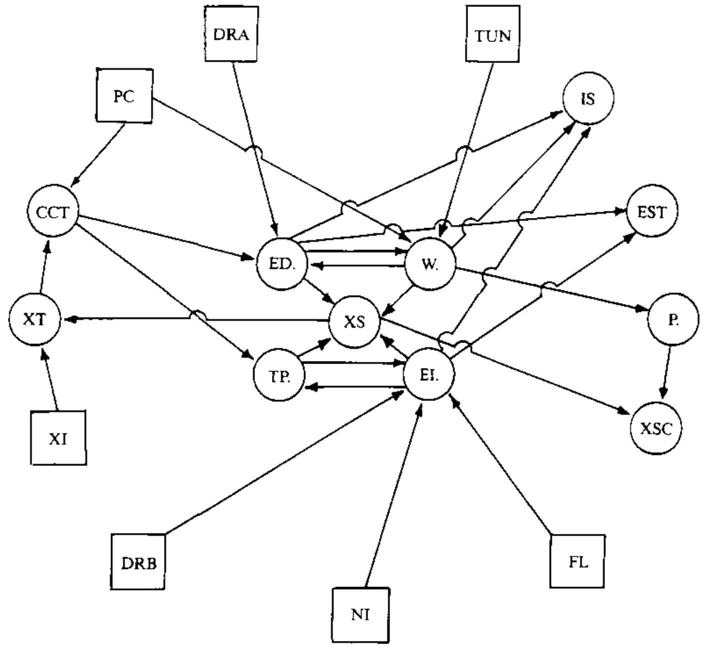
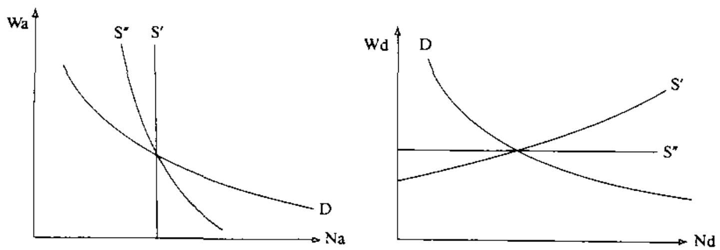


FIGURE 2. Major Interdependent Relationships in the Regional Model (see Appendix for the definition of terms)



(a) Selfemployed (b) Employee

FIGURE 3. Demand and Supply of Labour

labour supply is rather rigid in the case of selfemployed labour because it is mainly determined by the labour force. In contrast, service labour supply is rather elastic in the case of employee labour because the wage rate is rather

fixed, being determined by the opportunity cost of labour and by the wage rate prevailing in other sectors of the economy.

The demand for labour represents the reduced form of the following structural model:

$$DS = f(CR) \tag{1}$$

$$XS = g(XI, DS) \tag{2}$$

$$ES = h(XS, WS) \tag{3}$$

where the final demand for services (DS) may be determined by regional consumption (CR) according to a matrix which disaggregates the various aggregate demand components in the outputs of the different sectors. The value added of services (XS) may be determined by regional final demand and regional intermediate demand, which is determined by the industrial sector (XI) according to an input-output specification (Cappellin 1975). Employment in services (ES) is specified according to an investment equation as a function of expected output and labour costs (WS). However, a direct estimation of this detailed structural model does not seem appropriate due to the severe limitations of the official data for the final demand of services (DS) and the value added for services (XS). Therefore, labour demand may be estimated according to the following reduced form specification:

	Selfemployed workers	Employee workers	
Demand	$WS = \ell(CR, XI, ES)$	$ES = \ell(CR, XI, WS)$	(4)
Supply	$ES = \ell(LF, EI, WS/WI)$	$WS = \ell(LF, EI, WI, ES)$	(5)

The labour demand Equation (4) can be solved for the employment level, as in the case of employee labour, or for the wage rate, as in the case of selfemployed labour. On the contrary, labour supply is a function of labour force (LF), the wage rate in the service sector (WS) and in the industrial section (WI), and the employment opportunities in the industrial sector (EI). Also the labour supply Equation (5) may be solved either for the wage rate, as in the case of the employee labour, or for the employment level, as in the case of selfemployed labour. Total product at current prices of the service sectors is then determined as the product of employment, both selfemployed and employee labour, by the respective average revenue and wage. Product at constant prices is obtained by deflating product at current prices through the service sector deflators, which are a function of service wage rates.

A major characteristic of the specification adopted in this model of the service sectors is that product at constant prices is obtained from product at current prices and not vice versa which is the usual specification for macro-econometric models. This approach eliminates the well known problem of measuring prices and constant price productivity in service sectors. In fact, available data on these variables seem biased by the rough statistical procedure adopted by the official statistical offices which compute service price changes on the basis of wage changes, thus assuming a zero increase of productivity in service sectors. Therefore, the model does not estimate prices according to behavioural equations, but through "ad hoc" equations which indicate the statistical procedures followed in the construction of the price deflator.

This specification of the labour market of service activities clearly represents a simplified model of the long term growth of service employment. In fact, in a microeconomic framework, the demand and supply relationships, which are represented by the schedules of Figures 3(a) and 3(b), should be a function of many different variables (Daniels and Holly 1983; Coffey and Polese 1984; Cappellin 1986; Illeris 1986).

Clearly, a macroeconometric regional model estimated on annual data does not consider all the factors which are considered by the growing literature on service location and employment. The sectoral disaggregation allowed by the value added statistics are too limited, the size of the regions considered are too large and the annual time span is too small to allow for the required statistical variability of many variables. Therefore, the choice of the explanatory variables to be used in the econometric estimation of a regional annual model is limited and constrained to those variables which indicate a large variability both in time and in space among observations which are considered. In particular, an annual econometric model should specify exactly the relationship between the product, or employment, in the sectors considered and other variables which are endogenously determined within the model itself. In contrast, the number of exogenous variables should be severely restricted and they can eventually be substituted by appropriate dummy variables. In fact, an explicit consideration of numerous exogenous variables would not contribute to the explanation of the complex interdependent relationships among the endogenous variables, and would make the use of the model in forecasting exercises rather complex.

5. ESTIMATION METHODOLOGY

The model has been estimated on pooled data for 12 years (1970 through to 1981), for the 20 Italian regions, collected and published by the Italian Central Statistical Institute (ISTAT). For detailed information on the sources that have been used and for the list of the variables see the appendix. We have data for employment, divided into selfemployed workers and employees, and on output for the five service sectors: 1), *CAPE* — retail, trade and hotels; 2), *TC* — transport and communications; 3), *CA* — banking, finance and insurance; 4), *AS* — other services; and 5), *SNV* — non-market services. In addition, we have data on regional income, population, labour force, wages and prices in the service and industrial sectors. Also, data on investments in the service sector and output of the industrial sector are available.

Given this panel of data, we used a very simple estimation technique, that is we assumed our equations to be "fixed effect" models, where only the intercepts are allowed to vary across regions.

$$y_{it} = b_{i0} + \sum_{k=1}^{K} b_k x_{kit} + e_{it}$$

where:
y_{it} = the dependent variable for individual i at time t,
b_{ki} = the coefficient relative to the k^{th} explanatory variable for individual i,
x_{kit} = the k^{th} explanatory variable for individual i at time t,
e_{it} = the error term,
$i = 1, \ldots, N$ $(N = 20)$ = individuals, in our case regions, and
$t = 1, \ldots, T$ $(T = 12)$ = time periods, (1970/1981).

This type of model can be estimated with ordinary least squares (OLS) techniques on pooled data, either by introducing regional dummy variables, or by transforming all the variables in each equation into rates of change, a transformation that automatically eliminates all region specific time invariant effects.

We can test for the appropriateness of this approach by computing the following F statistic on the estimated equations:

$$F_{(K(N-1),\, T(N-K))} = [(RRSS - URSS)/K(N-1)]/[URSS/T(N-K)]$$

where:
$RRSS$ = sum of the squared residuals of the model with constant coefficients across individuals,
$URSS$ = sum of the squared residuals of the N unrestricted models, which have been estimated separately,
K = number of parameters to be estimated for each model, and
$K(N-1)$; $T(N-K)$ = degrees of freedom.

Preliminary tests that were performed on some of the model equations indicated that the hypothesis of constant parameters had to be rejected because the computed F statistics were larger than the critical value at the 10 percent level of significance. We assume, however, that the different "distribution" of the residuals across regions, indicated by the F test, is more likely to be due to a set of omitted variables which are relevant at the regional level of disaggregation rather than to significant differences in the structure of, for example, employment mechanisms or consumer tastes across regions. We decided not to introduce additional variables, however, because: first, not all of this region specific information is published or otherwise available; second, the limited number of observations in the sample does not allow us to specify equations with too many variables; and lastly, our final target is to build a macroeconometric model of the Italian economy, and we think that it is more interesting to keep in our specifications only those variables that do not lose economic relevance at the more aggregated national level, rather than try to get the best possible fit for each region. It is well known that variables that determine the behaviour of individuals lose significance at the aggregated level (Klein 1975, p. 375).

As an alternative to introducing a large set of regional variables, we could have used more sophisticated estimation techniques, such as generalised least squares (GLS) so that the variance covariance structure of the residuals could have been taken into account, and more efficient estimates would have been obtained. This technique would be especially adequate if autocorrelation in the residuals existed within each region. We performed a test suggested by Barghava et al. (1982), on the equations in the *CAPE* sector (not given but available upon request) with mixed results: there is evidence of some autocorrelation in both employment equations, but not in the wage equation. However, given the computational burden of the GLS technique which requires the estimation of a ((12*20)*(12*20)) symmetric variance covariance matrix, we decided to leave the use of the more efficient estimation technique for the future, together with the solution to the last, and maybe most disturbing problem: the estimation of models with pooled data which include the lagged dependent variable among the explanatory variables, given that most of the equations in the model are dynamic. As is well known, the estimation of dynamic models on pooled data creates problems that the literature has not yet fully solved, and that we have at present had to disregard.

Despite these problems, we performed estimations on pooled data using OLS techniques, after we had transformed the variables either into logarithms or into percentage rates of increase and with the addition, if needed, of four dummy variables ($DR1$ = 1 for all Northwestern regions, $DR2$ = 1 for all Northeastern regions, $DR3$ = 1 for all Central regions, and $DR4$ = 1 for all

Southern regions and Islands) to take care of the most obvious discrepancies across regions.

6. RESULTS OF THE ESTIMATION

All dependent variables in the model are determined in dynamic equations, where the lagged dependent variable is either included among the explanatory variables, or all the variables in the equations have been transformed into percentage rates of increase. In particular, the functional form of all the employment equations, of the per capita consumption, of the investment, and of the remuneration of selfemployed labour equations is of the double logarithmic form. In the wages and prices equations, all variables have been transformed into percentage rates of increase.

The model is closed by a series of identities, which define total employment and output, both at constant and at current prices, for each single sector and for the aggregated service sector. The large R^2 statistics of almost all equations and the significance of the estimated coefficients speak for themselves about the goodness of fit of the components of the model.

Given that the structure and the theory underlying the model have already been explained, we need only to point out some of the more relevant results that have been obtained. The disaggregated labour markets by sector and by type of employment are the most interesting features to analyse. In the market for employees, we had to distinguish between the *CAPE*, *TC* and *AS* sectors, and the *CA* and *SNV* sectors. For the first group we have labour demand well defined by the labour equations (*LEDCAPE, LEDTC, LEDAS*), where employment is negatively related to the average wage in the aggregated service sector (*WS*). This variable, in turn, is positively related to total services employment (*EST*) in an inverted labour supply equation (see Appendix 5.1). In contrast, for the second group of sectors the estimations indicate that, while demand is downward sloping according to the underlying neoclassical approach, wages seem to be infinitely rigid with respect to employment. In both the *CA* and *SNV* sectors the estimated coefficients of the employment variable in the sector specific wage equations (*WCA* and *WSN*) were not statistically significant. In other words, labour is willing to supply an infinite amount of its services at the prevailing wage rate.

This same behaviour characterises selfemployed workers in the *CAPE* and *TC* sectors (see *LEICAPE* and *LEITC* in Appendix 5.2), but not the selfemployed labour in the *AS* sector. The latter reacts positively, that is it supplied more labour as its remuneration rate increases, though with a temporal lag of one period (see *LEIAS*). All the equations for the remuneration of selfemployment are specified as inverted demand for labour equations and they all behave as the underlying neoclassical theory predicts.

The rate of inflation in each sector, measured by the rate of increase of the implicit sector specific output deflators, is specified as a mark up process over wage inflation. The estimated equations are good in terms of R^2 and standard errors of the coefficients. Neither the per capita consumption nor the investment equations pose great problems or show any particular features.

7. SIMULATION RESULTS

The goodness of fit and predictive power of the estimated model have been checked with static simulations. Static simulations also allow us to explicate more clearly the interdependencies among the variables in the system. If we order the equations in the model to check for simultaneous versus recursive

determination among the variables, we may show that most of the employment and remuneration (wage) variables are simultaneously determined in the first block of equations, while total output and prices are determined recursively in a second block of equations, which are themselves recursive with respect to those in the first block. This means that the labour market pulls the whole service sector with selfemployed labour as the leading element.

The static simulation was performed on all regions for the period 1975/1981, and the simulated regional variables were aggregated to compute "simulated" national variables. The results are quite astonishing, both at the regional and the national levels. For almost all regions, the simulated variables come very close to the actual variables according to the computed Theil's *U* statistics. It does not seem worthwhile to present all the goodness of fit and predictive power statistics for all variables, for all regions. However, it must be noted that the model presents some weak points when it is simulated for some small regions (Valle d'Aosta, Trentino Alto Adige, Molise) and the results are slightly worse than average for the *WCA* variable in all regions. Table 1 shows the mean percentage errors (MPE) of the "simulated" national variables. None of the MPE of the simulated national employment variables exceeds the 2 percent level, while most stay well below the 1 percent level.

The results are, on average, equally good when the national output variables are simulated, with the exception of the Retail, Trade and Hotels value added at current prices whose MPE is 3.4 percent, and of the *CA* value added (*XCA*), that shows a MPE of −8.2 percent. This last result is due to the above mentioned quite poor fit of the *WCA* equation at the regional level, given that output is computed by the identity $XCA = WCA * ECAT$ (see Appendix 5.6). Notwithstanding the failure of the model to catch the dynamic behaviour of this specific sector, the MPE of the simulated value added of the aggregate service sector, *XS*, goes down to 0.64 percent.

As for the wage variables, we must point out that the national value has been computed as a weighted mean of the regional values, wherein the weights are the ratio of the regional over the national simulated employment in the specific sector (total service employment, *EST*, for *WS*, and total employment in the non-market services sector, *EDSNV*, for *WSN*). This implies that the simulated national wage variables contain a double source of error, which explains the larger than average MPEs that have been obtained for these variables.

Lastly, even the MPE of the simulated consumption and investment national variables stay within the 10 percent boundary, which is a rather good result, given that: first, the consumption equation is just a preliminary and tentative specification of regional consumption behaviour that has been added to the model for completeness' sake; and second, investments are, by their very nature, quite unpredictable, and highly variable in time and space.

It is worth restating the potential of such a disaggregated approach in modelling an economy for forecasting purposes. As an example of this potential

TABLE 1. Mean Percentage Errors of the Computed National Variables

VARIABLES	MPE %	VARIABLES	MPE%	VARIABLES	MPE %
EDCAPE	1.43	*EIAS*	.79	*XAS*	.55
EICAPE	.31	*EAST*	.99	*XSNV*	1.85
EDTC	.78	*EDSNV*	−.22	*XS*	.64
EITC	1.01	*EST*	.35	*WS*	7.72
ETCT	.089	*XCAPE*	3.40	*WSN*	6.87
ECTA	.046	*XTC*	.47	*CCTR*	2.34
EDAS	.98	*XCA*	−8.19	*IS*	−6.41

use of the model, we performed a within sample simulation of an economic policy measure. The expansionist policy assumed is such that industrial output at constant prices (*XCI*) increases by 2.5 percent, while industrial employment (*NI*), the industry price deflator (*PI*) and the consumption price index (*PC*) increase by 1.25 percent, and industrial wages by 2 percent.

The policy change simulation has been performed over the last three years in the sample: 1979, 1980 and 1981. It is a static simulation that examines how the endogenous employment variables have been affected period by period by the policy measure, rather than analysing the whole dynamic path followed by these variables over the three years. We have computed the percentage changes of the simulated variables with respect to their "control" values, that is those values that had been obtained with the static simulation described in the previous paragraph. The results were that: first, the total national employment increased on average by 0.40 percent with respect to the control values; and second, employment in the service sector increased by the 0.025 percent with respect to its control values. A tentative conclusion is that the policy measures that have been assumed would have had some positive effect on total employment but this effect would have been quite limited given the amplitude of the initial changes in the policy instruments. This result is also due to the structure of the model, where a major share of employment in the service sectors is determined by supply rather than demand for labour. Supply is itself negatively determined by industrial employment so that an increase in industrial activity leads to a decrease in labour supply and hence in the general activity level of the service sector, which is contrary to what the export base theory suggests. The overall effect on national employment will then have to be smaller than the initial percentage in the industrial sector.

8. CONCLUSIONS

The model of the service sector which is presented in this paper represents a submodel of a larger multiregional model of the Italian economy, which in various aspects innovates with respect to the previous literature. The model follows a "bottom-up" approach in the determination of national output. It indicates the effect of various "supply-side" factors on regional economies and it is based on the analysis of the equilibrium conditions between the demand and supply in the regional and interregional markets of products and factors.

The economy of the service sectors is specified according to a different model than that usually followed in the analysis of industrial sectors. Employment is disaggregated into employees and selfemployed labour. Product at current prices of the individual service sectors is determined as the sum of factor incomes. The model has been estimated on pooled data for 12 years for the 20 Italian regions using OLS.

The results of the within the sample simulation indicate that a multiregional model may be used for forecasting purposes and to simulate economic policy changes at the national level because the national variables computed by aggregating simulated regional variables are extremely close to their actual values. The model indicates that the growth of service employment is not automatically determined by the growth of industrial employment and public authorities could adopt macroeconomic policies aimed to increase employment in service activities by increasing: (i), public output; (ii), consumer services demand through fiscal incentives; and (iii), corporate investment in business services through fiscal and credit incentives.

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APPENDIX

1. ENDOGENOUS VARIABLES

CCT = regional consumption, constant price
EDAS = employees "other services"
EDCAPE = employees "retail, trade, hotels"
EDCA = employees "bank, finance, insurance"
EDTC = employees "transport, communication"
EDSNV = employees "non-market services"
EIAS = selfemployment "other services"
EICAPE = selfemployment "retail, trade, hotels"
EITC = selfemployment "transport, communication"
EAST = regional employment "other services"
ECAPET = regional employment "retail, trade, hotels"
ETCT = regional employment "transport, communication"
ECAT = regional employment "bank, finance, insurance"
EST = regional service employment
IS = service investment, current price
PALS = implicit price "other services"
PCAPE = implicit price "retail, trade, hotels"
PCRA = implicit price "bank, finance, insurance"
PSNV = implicit price "non-market service"
PTRC = implicit price "transport, communication"
TPAS = remuneration selfemployment "other services"
TPCAPE = remuneration selfemployment "retail, trade, hotels"
TPTC = remuneration selfemployment "transport, communication"
WCA = wage of "bank, finance, insurance"
WNS = non-market service wages
WS = market service wages
XAS = reg. value added, current price "other services"
XCA = reg. value added, current price "bank, finance, insurance"
XCAPE = reg. value added, current price "retail, trade, hotel"
XTC = reg. value added, current price "transport, communication"
XSNV = reg. value added, current price "non-market services"
XS = regional service value added, current price
XSC = regional service value added, constant price
XT = total value added, current price

2. EXOGENOUS VARIABLES

DR1 = dummy (Northwest regions of Italy = 1; other = 0)
DR2 = dummy (Northeast regions of Italy = 1; other = 0)
DR3 = dummy (Central regions of Italy = 1; other = 0)
DR4 = dummy (South regions of Italy = 1; other = 0)
DT1 = temporal dummy: 1974, 1977 = 1; other = 0)
EICA = selfemployment "bank, finance, insurance"
FL = labour force
NAG = agricultural employment

NI = industrial employment
PC = consumption price
POR = regional population
PX = deflator regional value added
T = temporal trend (value: 1, 2, 3, . . .)
TDR3 = T × *DR3*
TDR4 = T × *DR4*
TUN = regional unemployment rate
WAG = agricultural wage
WI = industrial wage
XA = agricultural value added, current price
XI = industrial value added, current price

3. DATA SOURCES

1. ISTAT, Collana di Informazioni, occupati presenti in Italia, vari anni.
2. ISTAT, Indagine sulla forza lavobo, vari anni.
3. ISTAT, Annuario di Contabilita' Názionale, vari anni.
4. ISTAT, Censimento sulla Popolazione, 1971 e 1981.

4. NOTE

1. All variables beginning with (*L*) are logarithms;
2. All variables ending with (*P*) are percentage rates of increase;
3. First row: value of variables;
   Second row: value of coefficient;
   Third row: standard error.

5. EQUATIONS

5.1 *Employees Equations*

RWSNV = real wage for non-market services: *WDSNV/PC*
RWI = opportunity wage: *WS/WI*
RWS = real wage for market services: *WS/PC*
RWCA = real wage for credit and insurance services: *WCA/PC*

LEDCAPE =	− *C*	+ *LEDCAPE*(−1)	+ *LCCT*	− *LRWI*	R^2 = .99
	(.054)	(.974)	(.023)	(.035)	
	(.043)	(.009)	(.011)	(.015)	

LEDTC =	*C*	+ *LEDTC*(−1)	− *EITCP*	+ *LCCT*	− *LRWS*	R^2 = .99
	(.324)	(.987)	(.163)	(.015)	(.046)	
	(.113)	(.005)	(.045)	(.005)	(.014)	

LEDCA =	*C*	+ *LEDCA*(−1)	+ *LCCT*	− *LRWCA*	R^2 = .99
	(.138)	(.981)	(.022)	(.022)	
	(.153)	(.011)	(.013)	(.014)	

LEDAS =	*C*	+ *LEDAS*(−1)	− *LRWI*	R^2 = .99
	(.052)	(.997)	(.028)	
	(.007)	(.002)	(.014)	

LEDSNV =	*C*	+ *LEDASNV*(−1)	− *LRWSNV*	+ *DR1*	+ *DR3*	+ *DR4*	R^2 = .99
	(.270)	(.995)	(.029)	(.013)	(.010)	(.014)	
	(.131)	(.002)	(.016)	(.006)	(.005)	(.005)	

5.2 *Selfemployment Equations*

LTPASC = real remuneration for selfemployment "other services": *TPAS/PC*

LEICAPE =	− *C*	+ *LEICAPE*(−1)	+ *LFL*	− *LNI*	− *DR3*	− *DR4*	R^2 = .99
	(.154)	(.937)	(.091)	(.028)	(.014)	(.014)	
	(.037)	(.016)	(.021)	(.011)	(.005)	(.006)	

LEITC =	*C*	+ *LEITC*(−1)	− *LNI*	+ *LNI*(−1)	R^2 = .99
	(.003)	(.999)	(.146)	(.148)	
	(.020)	(.007)	(.071)	(.071)	

LEIAS =	− *C*	+ *LEIAS*(−1)	+ *LFL*	− *INI*	+ *LTPASC*(−1)	R^2 = .99
	(.358)	(.980)	(.042)	(.022)	(.029)	
	(.162)	(.016)	(.022)	(.012)	(.013)	

5.3 *Employment Identities*

ECAPET = *EDCAPE* + *EICAPE*
ETCT = *EDTC* + *EITC*
ECAT = *EDCA* + *EICA*
EAST = *EDAS* + *EIAS*
EST = *ECAPET* + *ETCT* + *ECAT* + *EAST* + *EDSNV*

5.4 *Employees Wage Equations*

QWS = share of service wage: (*WS*EST/XS*)

WSP =	*C*	− *WSP*(−1)	+ *PCP*	+ *ESTP*	− *T*	R^2 = .72
	(.077)	(.222)	(.952)	(.557)	(.001)	
	(.008)	(.041)	(.052)	(.162)	(.007)	

WCAP =	*C*	+ *WSP*(−1)	+ *PCP*	− *TUN*	+ *TUN*(−1)	− *DR1*	+ *DT1*	R^2 = .39
	(.115)	(.306)	(.862)	(1.89)	(1.71)	(.063)	(.048)	
	(.030)	(.141)	(.175)	(.438)	(.474)	(.015)	(.014)	

WMSP =	*C*	− *WNSP*(−1)	+ *PCP*	− *PCP*(−1)	+ *TUN*	− *TUN*(−1)	+ *T*	R^2 = .72
	(.020)	(.119)	(.343)	(.258)	(.814)	(.764)	(.021)	
	(.013)	(.069)	(.096)	(.082)	(.199)	(.218)	(.002)	

5.5 *Selfemployed Income Equations*

LTPCAPE =	*C*	+ *LTPCAPE*(−1)	+ *LCCT*	+ *LPX*	− *LEICAPE*	R^2 = .97
	(.48)	(.91)	(.09)	(.13)	(.09)	
	(.23)	(.03)	(.05)	(.03)	(.05)	

LTPTC =	*C*	+ *LTPTC*(−1)	+ *LCCT*	+ *LPX*	− *LEITC*	R^2 = .98
	(.52)	(.90)	(.08)	(.25)	(.07)	
	(.21)	(.02)	(.04)	(.03)	(.04)	

LTPAS =	*C*	+ *LTPAS*(−1)	+ *LCCT*	+ *LPX*	− *LEIAS*	R^2 = .97
	(1.23)	(.72)	(.36)	(.22)	(.38)	
	(.24)	(.04)	(.05)	(.03)	(.05)	

5.6 *Value Added Identities*

XCAPE = *ECAPED* * *WS* + *EICAPE* * *TPCAPE*
XTC = *EDTC* * *WS* + *EITC* * *TPCAPE*
XCA = *ECAT* * *WCA*
XAS = *EDAS* * *WS* + *EIAS* * *TPAS*

$$
\begin{aligned}
XSNV &= EDSNV * WNS\\
XS &= XCAPE + XTC + XCA + XAS + XSNV\\
XT &= XA + XI + XS\\
XCAPEC &= XCAPE/PCAPE\\
XTCC &= XTC/PTRC\\
XCAC &= XCA/PCRA\\
XASC &= XAS/PALS\\
XSNVC &= XSNV/PSNV\\
XSC &= XCAPEC + XTCC + XCAC + XASC + XSNVC
\end{aligned}
$$

5.7 Final Demand Equations

Consumption equation

$LCCTPO$ = per capita consumption: $\log(CCT/POR)$

$LYLPO$ = per capita real wage incomes: $\log[((WAG*NAG+WS*EST+WI*NI)/PC)/POR]$

$LYNLPO$ = per capita real nonwage income: $\log[((XT-WAG*NAG-WS*EST-WI*NI)/PC)/POR]$

$$
\begin{array}{llllllll}
LCCTPO = & -C & +\,LYLPO & +\,LYNLPO & -\,TDR3 & -\,TDR4 & & R^2 = .86\\
 & (5.70) & (.685) & (.155) & (.008) & (.005) & & \\
 & (.183) & (.030) & (.020) & (.002) & (.002) & &
\end{array}
$$

Investment equation

$$
\begin{array}{lllllll}
LIS = & C & +\,LEST - LEST(-1) & +\,QWSP & +\,LIS(-1) & & R^2 = .98\\
 & (.09) & (2.07)\quad (2.11) & (1.46) & (1.05) & & \\
 & (.07) & (.95)\quad (.94) & (.32) & (.02) & &
\end{array}
$$

5.8 Service Implicit Price Equations

$$
\begin{array}{llllllll}
PCAPEP = & -C & +\,WSP & +\,WSP(-1) & & & +\,T & R^2 = .65\\
 & (.071) & (.597) & (.431) & & & (.004) & \\
 & (.012) & (.052) & (.051) & & & (.001) & \\
PTRCP = & -C & +\,WSP & +\,WSP(-1) & & & +\,T & R^2 = .65\\
 & (.106) & (.526) & (.570) & & & (.009) & \\
 & (.016) & (.066) & (.065) & & & (.001) & \\
PCRAP = & C & +\,WCAP & +\,WCAP(-1) & +\,DR1 & +\,DT1 & -\,T & R^2 = .61\\
 & (.057) & (.152) & (.647) & (.024) & (.049) & (.004) & \\
 & (.015) & (.044) & (.044) & (.011) & (.011) & (.001) & \\
PALSP = & C & +\,WSP & +\,WSP(-1) & +\,DRI & +\,DTI & +\,T & R^2 = .81\\
 & (.018) & (.232) & (.211) & (.006) & (.011) & (.006) & \\
 & (.006) & (.023) & (.023) & (.002) & (.003) & (.000) & \\
PSNVP = & C & +\,WSNVP & +\,WSNVP(-1) & -\,DTI & +\,T & & R^2 = .94\\
 & (.006) & (.718) & (.093) & (.013) & (.005) & & \\
 & (.004) & (.031) & (.027) & (.003) & (.001) & &
\end{array}
$$

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