MODELLING HOUSEHOLD CHOICES OF DWELLING AND LOCAL PUBLIC SERVICES: A Behavioural Simulation of the Effects of Fiscal Decentralization.

Ugo Colombino
Department of economics
University of Turin
Corresponding author*
e-mail: ugo.colombino@unito.it

Marilena Locatelli Biey
Department of economics
University of Turin
e-mail: marilena.locatelli@unito.it

JEL Classification D1, R2

(*) Dipartimento di Economia – Università di Torino - Via Po 53, 10124 Torino, ITALY - Phone: +39-0116702704 - Fax: +39-0116702762

1. Introduction

During the last few years, fiscal decentralisation reforms have been proposed and partially implemented in Italy. Ultimately, this process would affect the configuration of local public services and expenditures, introducing a more direct link between taxes paied (either locally or nationally) by the households and the benefits provided by local expenditures. In this paper we develop a micro-econometric model of household residential choice, which allows estimating household utility as a function of dwelling attributes, environmental characteristics, local public expenditures and net available income (i.e. gross income minus local and national taxes). The model can thus be used to evaluate the effects on household behaviour and welfare of the fiscal decentralisation process. We provide an example with a simple version of fiscal reform.

2. The model

The model we develop and estimate follows the approach proposed by McFadden (1978) and applied among others by Quigley (1985), Train et al. (1987) and Colombino (1998).

We assume that the consumer faces a residential location decision among the alternatives belonging to the opportunity set Ω. For consumer *h*, the alternative $j \in \Omega_h$ produces a utility flow

$$U_{hj} = \beta' z_{hj} + \lambda \ln(y_h - R_{hj} - T_{hj}) + \varepsilon_{hj} \qquad (2.1)$$

where β and λ are parameters to be estimated, z_{hj} is a vector of household, dwelling and environmental characteristics, y_h is the annual household consumption, R_{hj} is the price of housing, T_{hj} represents local taxes and ε_{hj} is a random component accounting for unobserved variables[1]. The price of housing R_{hj}

[1] Thus the model adopts a Tibout view: the residential choice depends on the configuration of taxes and local expenditures, besides the specific characteristics of the dwelling. To be sure, we do not test the hypothesis, we simply assume it holds. See Dowland and Biggs (1994) for a survey of empirical tests of the Tiebout hypothesis.

is the actual annual rent paid if the household rents the dwelling, otherwise is the annualised present dwelling value[2] if the household owns the dwelling. The consumer *h* chooses the alternative *j* if

$$U_{hj} > U_{hi} \ , \quad \forall i \neq j \tag{2.2}$$

Under the assumption that the ε_{hj} are i.i.d. type I Extreme Value, it is well-known that the probability that household *h* chooses alternative $j \in \Omega_h$ turns out to have the multinomial logit form[3]:

$$P_{h,j} = \frac{\exp(\beta' z_{hj} + \lambda \ln(y_h - R_{hj} - T_{hj}))}{\sum_{i \in \Omega_h} \exp(\beta' z_{hi} + \lambda \ln(y_h - R_{hi} - T_{hi}))} \tag{2.3}$$

The parameters β and λ will be estimated by Maximum Likelihood i.e.:

$$(\beta^{ML}, \lambda^{ML}) = \arg\max_{\beta,\lambda} \sum_h \ln(P_{h,j(h)}) \tag{2.4}$$

where $j(h)$ represents the observed alternative chosen by the household h.

The computation of (2.3) would require a complete enumeration of the opportunity set Ω that could be very large or even infinite or not completely known. In fact we only observe the characteristics (z, R, T) of the choice actually made by each household. In principle, the choice set coincides with the whole space of those characteristics. However, using this set would be computationally troublesome and also very inefficient, since in practice only a relatively small subset will actually be relevant for each household. To solve this problem we use a procedure developed by McFadden (1978). The procedure essentially consists in sampling, from a previously estimated distribution, a given number of vectors of characteristics, with which we define alternatives that added to the chosen one will form a simulated choice set. Expression (2.3) – appropriately corrected as explained

2 I.e. the dwelling's value multiplied by an interest rate equal to 1.75%.
3 See for example McFadden (1974) or Ben-Akiva and Lerman (1985).

in the section 3 – is then computed using the simulated choice set instead of the true one. McFadden shows that this method produces consistent estimates. More details are provided in the next section – which can be otherwise skipped. A related problem is that we need a price equation to input a price to each alternative in the choice set (since we only observe the price of the chosen alternative).

We will estimate (and simulate) the model under two different specification of the price function, denoted by *A* and *B* in the following. Common to both specifications is the assumption that the marginal cost depends on structural and environmental characteristics of the dwelling.

The two specifications however differ as to the assumptions on returns to scale. If we assume constant returns, then the price is equal to the constant marginal cost: therefore it will be written as a function of the same structural and environmental characteristics.

$$R_{hj} = R^{A}_{hj}\ (\tilde{z}_{hj}) \tag{2.5}$$

where $(\tilde{z}_{hj})$ is a sub vector of the characteristics vector (z_{hj}).

If, on the other hand, we assume that the marginal cost rises with the number of dwellings with given characteristics (decreasing returns), then the equilibrium price that households face will also depends on the equilibrium number of dwellings and therefore also on dwelling location characteristics affecting demand such as local taxes and local public expenditures.

This alternative price specification will then include local taxes and local public expenditures besides dwelling and environmental characteristics:

$$R_{hj} = R^{B}_{hj}\ (z_{hj}, T_{hj}) \tag{2.6}$$

It will be interpreted as an approximation to an equilibrium correspondence between the configuration of characteristics of a certain dwelling-location and the dwelling price.

3. **Imputation of the choice set**

Let (z,T) a vector of residential location characteristics, and let $f_h(z,T)$ a joint density function. This could be any density, but in practice it turns out that a sensible and efficient choice is to use a density estimated on the empirical observations. The suffix h indicates that the density might depend on some household characteristics[4].

Equations (2.5) or (2.6) are estimated using the price and the characteristics of the observed choices. Let M be the number of alternatives that we decide to put into the simulated choice set[5]. Then we proceed to sample M-1 vectors of characteristics for each household from the density $f_h(z,T)$: $(z_{h,1},T_{h,1}),(z_{h,2},T_{h,2}),...,(z_{h,M-1},T_{h,M-1})$. Using the previously estimated price function (2.5) or (2.6) we compute the corresponding M-1 rents, e.g. $R_{hj}=R^B_{hj}(z_{hj},T_{hj}),\ j=1,...,M-1$ in the case of specification (2.6). We now have M-1 triples (z,R,T) that define M-1 alternative location choices. Together with the actually chosen alternative $(z_{h,j(h)},R_{h,j(h)},T_{h,j(h)})$ they form the simulated choice set C_h that will be imputed to household h. The probability (2.3) is then replaced by the conditional probability given that the choice set is C_h (instead of Ω_h). It turns out (see Train et al. 1987 for details) that the conditional probability can be written as follows (with specification 2.6):

$$P_{h,j}(C_h)=\frac{\exp(\beta' z_{hj}+\lambda\ln(y_h-R_{hj}(z_{hj},T_{hj})-T_{hj})-\ln f_h(z_{hj},T_{hj}))}{\sum_{i\in C_h}\exp(\beta' z_{hi}+\lambda\ln(y_h-R_{hi}(z_{hi},T_{hi})-T_{hi})-\ln f_h(z_{hi},T_{hi}))} \qquad (3.1)$$

Accordingly, the Maximum Likelihood estimates are computed as:

$$(\beta^{ML},\lambda^{ML})=\arg\max_{\beta,\lambda}\sum_h \ln(P_{h,j(h)}(C_h)) \qquad (3.2)$$

[4] The estimates of $f_h(z,T)$ are not reported here, but are available from the authors upon request.

[5] We tried alternatively M = 10, M = 30 and M = 50 with similar results.

4. The data

In order to carry out this study, we use the 1993 Survey of Household Income and Wealth (SHIW93) collected by the Bank of Italy. It furnishes usual information about individual characteristics and exceptionally, information about dwelling characteristics as well as subjective appraisal of satisfaction on the public services supplied at local level for about 8100 anonymous Italian households.

We merge this data set with the ANCI' s data set (National Association of Italian Municipalities) that contains information about local taxes and expenditures for the different local public services and some important objective characteristics of the urban territory. In principle, the aim in this merging is to reflect the level of both taxes paid and services received by each household. Unfortunately ANCI' s data are aggregated by municipality and as a consequence it is not possible to have local data for different neighbourhoods. Moreover the enforced Italian privacy rules on the privacy do not allow us to know the codes of the cities with a number of inhabitants smaller than 100,000. For this reason we cannot merge the whole SHIW93 with the ANCI data set, and hence details of only a sub sample of about 1300 dwellings (including only owners and renters) located in chief towns of district are considered.

Each observation of the merged data set contains therefore structural characteristics of the dwelling, socio-economic characteristics of the family, subjective appraisal of satisfaction on the public services and both average per capita taxes paid and services supplied in the town where the dwelling is located.

Table 1 presents a description of the variables used in the analysis while Table 2 reports the descriptive statistics.

5. Empirical results

As explained in section 3, we use some ancillary estimates, such as the densities $f_h(z,T)$ and the price function $R_{hj}(z_{hj},T_{hj})$. The last has some interest in itself, and we give here the essential details on specification and estimates. The specification is as follows:

$$R_{hj} = S^{\alpha} \exp\left\{\gamma' x_j + u_{hj}\right\} \tag{5.1}$$

where S is the dwelling's surface in square metres, x_j is a vector of local characteristics (dwelling, area, and also expenditures and taxes (in the case of equation (2.6)), u_{hj} is a standard normal random variable and (α, γ) are parameters to be estimated and to be used to compute the price for the unchosen alternatives. Taking logs of (5.1), the parameters can be estimated by OLS. The results are reported in Table 3 if the price function is estimated using equation (2.5) and in Table 9 if the price function is estimated using equation (2.6). The estimates do not differ substantially as regard as the variables of sub-vector $(\tilde{z}_{hj})$. Table 3 shows that an increase of 1 per cent in the dwelling's surface leads to an increase of 1.11 per cent in the dwelling's value. If dwellings are in property (expressed by a dummy variable), the dwelling's values are 29 per cent higher than those rented. When dwellings are located downtown, their values are about 5 per cent lower than those located in the suburbs.

Table 9 shows that an increase of 1 per cent in the dwelling's surface leads to an increase of 1.17 per cent in the dwelling's value. If dwellings are in property (expressed by a dummy variable), the dwelling's values are 28 per cent higher than those rented. When dwellings are located downtown, their values are about 7 per cent lower than those located in the suburbs.

For what concerns local public expenditures, which are continuous variables, the estimated coefficients give the proportional variation of dwelling value due to a unit increase in the correspondent expenditure variable. For example, a hundred Euro increase (per family) in the expenditure for the transport system, implies a variation in dwelling's value equal $\gamma_{\text{transport\_exp}} * 0.1 = 2.8$ per cent.

A hundred Euro increase (per family) in the expenditure for the education system, implies a variation in dwelling's value equal $\gamma_{\text{educ\_exp}} * 0.1 = 32$ per cent.

Table 4 and Table 10 present estimates of the parameters of multinomial logit (3.1) respectively in the specification of expressions (2.5) and (2.6). The model includes variables that measure dwelling quality: dwelling surface in logs (lnsurface), presence of heating (heating) and the age (building age); variables that measure dwelling location: downtown (downtown), in a town with more than 500000 inhabitants (l_town); variables that measure local (municipal) expenditure for public services (educ_exp, maternal_exp, house_exp, sport_exp, road_exp, transport_exp) and a variable showing the amount of money left over for consumption of "other goods", i.e. annual consumption minus housing price and local taxes (ici_tax*property and garbage_tax).

The βs measure the marginal utility of characteristics. In both specifications (2.5) and (2.6), the coefficients of variables (such as lnsurface or heating) measuring dwelling's structural characteristics are well determined.

Also the coefficients associated to municipal expenditures for elementary education, for maternal school, for sport facilities and transportation, are highly significant and have the right sign.

The coefficient on the "expenditure in other goods" variable, which measures the marginal utility of log. income, can be used to compute the marginal utility of income and then to estimate the marginal willingness to pay for the various characteristics that enter the utility function.

6. A Behavioural Simulation of Fiscal Decentralization.

In this section we present an exercise in simulation effects upon consumers welfare of a hypothetical fiscal decentralisation reform.

In the simulation, the total expenditure for local services (elementary education facilities, child care and maternal school, expenditure for the house in aid to people in economic difficulties, sport facilities, expenditure for road network and other pipes, transportations etc), is kept constant, but it is re-distributed among the different locations, i.e. towns, in such a way that the local expenditures of each town represent the same proportion of the (national) income taxes paid by the households living in that town.

The two specifications (2.5) and (2.6) used for the price function becomes particularly relevant with respect to the simulation.

When expression (2.5) is used, the new values of the local public expenditures affect the desirability of the alternatives only through the characteristics vector $(\tilde{z}_{hj})$ appearing as a direct argument of utility as in expression (2.1). When instead expression (2.6) is used, the new local expenditures also affect (R_{hj}), which in turn affects (U_{hj}). This second, indirect effect, is interpreted as an equilibrium effect according to the discussion at the end of section 2.

For each household we compute the expected maximum utility before and after the reform as follows:

$$V_h^0 = \ln \sum_{i \in c_h} \exp\left\{\beta' z_{hi}^0 + \lambda \ln(y_h - R_{hi}(z_{hi}^0, T_{hi}^0) - T_{hi}^0) - \ln f_h(z_{hi}^0, T_{hi}^0)\right\} \tag{6.1}$$

$$V_h^1 = \ln \sum_{i \in c_h} \exp\left\{\beta' z_{hi}^1 + \lambda \ln(y_h - R_{hi}(z_{hi}^1, T_{hi}^0) - T_{hi}^0) - \ln f_h(z_{hi}^0, T_{hi}^0)\right\} \tag{6.2}$$

where z_h^0 and z_h^1 denote the local expenditures before and after the reform.

We can than compute the equivalent variation EV_h, a measure of the amount of money necessary to maintain the same level of households' utility facing under two different fiscal decentralization regimes, which is implicitly defined as:

$$\begin{aligned} &\ln \sum_{i \in c_h} \exp\left\{\beta' z_{hi}^0 + \lambda \ln(y_h + EV_h - R_{hi}(z_{hi}^0 - T_{hi}^0) - \ln f_h(z_{hi}^0, T_{hi}^0)\right\} = \\ &\ln \sum_{i \in c} \exp\left\{\beta' z_{hi}^1 + \lambda \ln(y_h - R_{hi}(z_{hi}^1 - T_{hi}^0) - \ln f_h(z_{hi}^0, T_{hi}^0)\right\} \end{aligned} \tag{6.3}$$

Table 5 and Table 11 present the mean values of EV_h by town (values in 10^3 Euro) of the two specifications. The overall mean is positive in both cases, and therefore the reform is efficient. However it is disequalizing, as suggested in Table 5 and Table 11 where it is possible to see that some towns have a positive EV and other have a negative one. In general, the richest towns have the higher EV.

The distributional effects are further investigated in Table 7 and Table 13, where we show the results of a regression of EV upon various household's characteristics. Richer households and households living in more expensive houses are clearly made better- off by the reform. Are also made better- off by the reform households living in the North or in the Centre of Italy instead households living in the South or in the Isles. It is also interesting to notice that households living in towns with over than 500,000 inhabitants, are less- off by the reform than that living in smaller towns.

The disequalizing effect is confirmed by the more formal exercise illustrated in Table 8 and Table 14.

We compute the iso-elastic social welfare function

$$W_\omega = \frac{1}{1-\omega}\sum_h (V_h)^{1-\omega}, \qquad \omega = 2,1,0.5,0.25. \tag{6.4}$$

for the values of the inequality aversion parameter: $\omega = 2$, $\omega = 1$ (i.e. $W = \sum \ln(V_h)$), $\omega = 0.5$, $\omega = 0.25$ and $\omega = 0.125$.

From Table 8 we can see that social welfare decreases as a consequence of the reform only for the highest value of the inequality aversion parameter $(\omega = 2)$. On the contrary Table 14 shows that social welfare always decreases as a consequence of the reform. In this case, despite the reform being significantly efficient, the disequalizing effect is large enough to produce a negative social welfare evaluation essentially for any non-zero degree of inequality aversion.

7. Conclusions

We have estimated a model of household choice of dwelling and local public services based on Italian data related to chief towns of district, adopting the discrete choice approach proposed by McFadden (1978). The model is estimated under two different specification of price function. The two specifications differ as to the assumption on returns to scale: constant return or decreasing return. Common to both specifications is the assumption that the marginal cost depends on structural and environmental characteristics of dwelling.

In sum, our results provide support for several of the underlying assumptions of the model. In fact, the results presented in the previous section, support the hypothesis that dwelling quality, location and local public services affect residential choice decisions, giving a quantitative measure of their relevance.

Since residential choice decisions of individual households are affected by the actions of local government, in a decentralised system, the local government, through its expenditure and tax decisions, can influence the socio-economic composition of its population and consequently the size of its tax base.

A simulation of the effects upon consumer's welfare of a hypothetical fiscal decentralisation is investigated. In the simulation, the expenditure for town services represents the same proportion of the (national) income taxes paid by households living in that town. In both specifications *A* and *B,* the reform is efficient, since the overall mean value of EV is positive but it produces different disequalizing effects depending on the chosen specification. In fact, specification *A* is disequalizing only for the highest value of the inequality aversion parameter, whereas specification *B* is always strongly disequalizing.

Table 1. Variable description.

Variable name	Description
Personal and family characteristics:	
EDUCATION	Education in years of school: 5 years for primary schooling + 3 years for middle schooling + 5 years for secondary schooling + 4 years for university degree + 3 for postgraduate qualification.
N_MEMBERS	Number of persons belonging to the family.
N_EARNERS	Number of persons, in the family, that receive a salary.
Y	Annual household consumption.
Location, house characteristics and local taxes:	
LNSURFACE	Logarithm of dwelling surface in m^2
HEATING	Dummy variable: 1 presence of an heating system, 0 otherwise.
DOWNTOWN	Dummy variable: 1 dwelling located downtown, 0 otherwise.
L_TOWN	Dummy variable: 1 city with over than 500000 inhabitants, 0 otherwise.
BUILDING AGE	Age of the house: (1993 – year of construction of the house)/100.
PROPERTY	Dummy variable: 1 house in property, 0 otherwise.
RENT	Dummy variable: 1 house in rent, 0 otherwise.
LNVALUE	Logarithm of dwelling's value
R	Price of housing: actual annual rent paid if the household rents the dwelling or annualised present dwelling value if the household owns the dwelling.
T	Local taxes: - ICI_TAX: per capita local tax on real estate multiplied by number of components of the family. - GARBAGE_TAX: per capita local tax for waste materials multiplied by number of components of the family.
Public services:	
EDUC_EXP	Per family local government expenditure for elementary education.
MATERNAL_EXP	Per family local government expenditure for maternal school.
HOUSE_EXP	Per family local government expenditure for the house in aid to the people in economic difficulty.
SPORT_EXP	Per family local government expenditure for sport facility, leisure and culture.
ROAD_EXP	Per family local government expenditure for road network and other pipes.
TRANSPORT_EXP	Per family local government expenditure for transportation.
ROOM DENSITY	Local house market indicator: total number of rooms in the town divided by total number of occupants.

Note to Table 1. The personal and family characteristics education, n_members, n_earners and consumption are used in the estimation of the density of location characteristics, see section 2.

Table 2. Descriptive Statistics

Number of observation 1274

Variable	Mean	Std. Dev.	Minimum	Maximum
EDUCATION	9.2246	4.3654	2.00	20.00
N_MEMBERS	2.9555	1.3611	1.00	9.00
N_EARNERS	1.7709	0.7951	1.00	7.00
CONSUMPTION (Y)	17.5142	215.5518	41.00	3049.00
LNSURFACE	4.4468	0.4151	2.64	5.99
HEATING	0.8251	0.3801	0.00	1.00
DOWNTOWN	0.1898	0.3923	0.00	1.00
L_TOWN	0.5389	0.4987	0.00	1.00
BUILDING AGE	0.4753	0.6412	0.03	7.94
PROPERTY	0.5730	0.4948	0.00	1.00
LNVALUE	4.4884	0.7512	3.91	9.62
PRICE OF HOUSING (R)	1.9932	1.4177	0.05	13.56
ICI_TAX	0.5658	9.6218	0.53	61.44
GARBAGE_TAX	0.2150	2.3021	0.47	13.45
EDUC_EXP	0.2177	0.9779	2.18	6.77
MATERNAL_EXP	0.1462	1.1854	0.44	4.97
HOUSE_EXP	0.0411	0.5228	0.04	3.43
SPORT_EXP	0.1367	1.0334	0.26	4.93
ROAD_EXP	0.4074	5.0219	1.15	20.33
TRANSPORT_EXP	0.5344	6.0423	0.01	20.27
ROOM DENSITY	1.5164	0.1808	1.20	1.80

Measure unit:
- dwelling surface in m^2
- monetary values in 10^3 Euro

Table 3. Estimates of the price function (equation (2.5))

Variable	Estimate	Std. error	t-value
α:	1.1120	0.0359	30.9567
γ:			
CONSTANT	-1.2199	0.1612	-7.5692
HEATING	0.4590	0.0372	12.3392
DOWNTOWN	-0.0523	0.0282	1.8569
L_TOWN	0.3357	0.0276	12.1569
PROPERTY	0.2559	0.0296	8.6492
BUILDING AGE	0.0800	0.0219	3.6465

Valid cases:	1274
Dependent variable:	LNVALUE
Std error of est:	0.494
Rbar-squared:	0.568
F(6,1267):	296.378

Table 4. **Estimates of preference parameters - equation (3.1) specification A - (values in 10^3 Euro)**

Mean log-likelihood -6.88009
Number of cases 1274

	Estimates	Std. error	Est./s.e.
β:			
LNSURFACE	0.7552	0.0939	8.04
HEATING	1.7511	0.1108	15.81
DOWNTOWN	0.4727	0.0808	5.85
L_TOWN	0.3852	0.0797	4.83
BUILDING AGE	-0.7114	0.0764	-9.31
EDUC_EXP	3.2943	0.6867	4.80
MATERNAL_EXP	5.6703	0.5883	9.64
HOUSE_EXP	-0.6522	1.2106	-0.54
SPORT_EXP	3.7579	0.6171	6.09
ROAD_EXP	-0.0770	0.1491	-0.52
TRANSPORT_EXP	1.0391	0.1100	9.44
ROOM DENSITY	0.1928	0.1707	1.13
λ:			
	4.4520	0.3112	14.31

Table 5. **Efficiency effect of fiscal decentralisation simulation: mean equivalent variation (EV) per family by town – specification A - (values in 10^3 Euro)**

Towns	**n. obs**	**Mean EV.**	**Std.Dev.**	**Min.**	**Max**
ALL TOWNS	1274	0.59	2.77	-13.36	47.83
BARI	26	0.54	0.28	0.19	1.14
BERGAMO	17	10.41	10.50	2.12	47.83
BRESCIA	25	0.88	0.59	0.30	3.02
CAGLIARI	29	0.13	0.10	0.02	0.52
CATANIA	4	-4.13	5.46	-12.29	-1.09
FERRARA	26	0.67	0.56	0.14	2.86
FIRENZE	85	1.57	1.02	0.26	7.47
FOGGIA	22	-0.25	0.10	-0.49	-0.11
FORLI	20	0.99	0.55	0.32	2.54
GENOVA	83	0.32	0.20	0.06	1.00
LATINA	18	2.64	1.81	0.55	8.00
MESSINA	13	-0.92	0.57	-2.46	-0.24
MILANO	131	2.01	1.30	0.38	8.13
MODENA	22	2.24	1.03	0.63	4.51
NAPOLI	109	-2.38	1.68	-13.36	-0.47
NOVARA	26	4.09	2.59	0.65	11.55
PADOVA	25	3.47	1.48	1.45	8.25
PALERMO	107	-2.14	1.29	-5.57	-0.23
PARMA	20	4.65	2.69	1.49	10.61
PERUGIA	31	0.23	0.12	0.05	0.57
PESCARA	27	3.32	4.25	0.62	22.89
RAVENNA	22	1.50	0.68	0.44	2.90
REGGIO CALABRIA	13	-0.87	0.29	-1.37	-0.40
REGGIO EMILIA	17	3.08	2.49	0.92	11.43
ROMA	102	0.12	0.07	0.01	0.38
SASSARI	16	-0.31	0.25	-1.13	-0.11
SIRACUSA	4	-0.15	0.06	-0.23	-0.10
TARANTO	20	-0.47	0.27	-1.18	-0.10
TERNI	9	0.49	0.25	0.26	1.09
TORINO	141	-0.25	0.18	-1.29	-0.05
TRIESTE	22	-0.15	0.07	-0.31	-0.04
VENEZIA	18	-1.49	0.60	-2.82	-0.77
VERONA	24	4.52	2.94	1.13	11.06

Table 6. Efficiency effect of fiscal decentralisation simulation: mean equivalent variation (EV) by income deciles – specification A - (values in 10^3 Euro)

Decile	n. obs.	Mean EV	Std. Dev.	Min.	Max
All obs.	1274	0.5900	2.7700	-13.3600	47.8300
1	127	-0.0530	1.1204	-5.0723	3.5278
2	127	-0.1157	1.2050	-3.3350	2.8649
3	128	-0.0989	1.3575	-3.3625	4.0918
4	128	0.0946	1.8234	-8.5088	9.1145
5	128	0.3605	1.5666	-3.7237	5.2518
6	127	0.8045	1.9884	-5.4339	8.8532
7	128	1.3284	2.6847	-3.6093	11.5526
8	127	0.3853	2.1240	-7.8902	8.8140
9	127	1.0321	2.8917	-5.5677	13.0702
10	127	2.1226	6.1482	-13.3612	47.8350

Table 7. **Estimate of equivalent variation (EV) function – specification A - (values in 10^3 Euro)**

Variable	Estimate	Std. error	t-value
CONSTANT	-0.2650	0.5733	-0.4621
INCOME	0.0345	0.0048	7.2277
LNVALUE	-0.1069	0.1353	-0.7899
N_MEMBERS	-0.0085	0.0554	-0.1531
N_EARNERS	-0.0130	0.0953	-0.1368
EDUCATION	-0.0163	0.0171	-0.9550
TYPE of WORK	0.0534	0.0244	2.1908
NORTH	2.5376	0.1527	16.6164
CENTRE	1.5601	0.1888	8.2640
L_TOWN	-1.8677	0.1291	-14.4657

Valid cases:	1274
Dependent variable:	EV
Std error of est:	2.237
Rbar-squared:	0.346
F(9,1264):	75.659

Table 8. **Welfare effect of a fiscal decentralisation reform – specification A -**

	$\omega = 2$	$\omega = 1$	$\omega = \frac{1}{2}$	$\omega = \frac{1}{4}$	$\omega = \frac{1}{8}$
Pre-reform	90.17	109.79	122.35	129.21	132.83
Post-reform	90.08	109.94	122.64	129.58	133.24
% variation	-0.10	0.14	0.24	0.28	0.30

Table 9. Estimates of the price function (equation (2.6))

Variable	Estimate	Std. error	t-value
α:	1.1667	0.0352	33.1197
γ:			
CONSTANT	-2.7322	0.2528	-10.8094
HEATING	0.4089	0.0391	10.4479
DOWNTOWN	-0.0675	0.0262	2.5752
L_TOWN	0.2748	0.0594	4.6237
PROPERTY	0.2481	0.0273	9.0766
BUILDING AGE	0.0523	0.0206	2.5422
EDUC_EXP	3.2028	0.2959	10.8250
MATERNAL_EXP	-0.6217	0.2942	-2.1131
HOUSE_EXP	0.4501	0.7935	0.5673
SPORT_EXP	0.4486	0.4486	0.9998
ROAD_EXP	0.1285	0.0724	1.7755
TRANSPORT_EXP	0.2761	0.0972	2.8402
ICI_TAX	-0.0135	0.0506	-0.2679
GARBAGE_TAX	-0.1250	0.1697	-0.7367
ROOM DENSITY	0.3321	0.1250	2.6554

Valid cases:	1274
Dependent variable:	LNVALUE
Std error of est:	0.454
Rbar-squared:	0.634
F(15,1258):	156.745

Table 10. **Estimates of preference parameters - equation (3.1) specification B - (values in 10^3 Euro)**

Mean log-likelihood	-6.86571
Number of cases	1274

Parameters	**Estimates**	**Std. err.**	**Est./s.e.**
β :			
LNSURFACE	0.8833	0.0967	9.13
HEATING	1.7360	0.1102	15.75
DOWNTOWN	0.4211	0.0808	5.21
L_TOWN	0.3697	0.0795	4.65
BUILDING AGE	-0.7371	0.0746	-9.88
EDUC_EXP	5.9215	0.7025	8.43
MATERNAL_EXP	5.4356	0.5893	9.22
HOUSE_EXP	-1.3148	1.2047	-1.09
SPORT_EXP	4.2063	0.6210	6.77
ROAD_EXP	-0.0203	0.1193	-0.17
TRANSPORT_EXP	1.2608	0.1109	11.37
ROOM DENSITY	0.5337	0.1707	3.13
λ :	4.8202	0.3281	14.69

Table 11. Efficiency effect of fiscal decentralisation simulation: mean equivalent variation (EV) per family by town - specification B - (values 10^3 Euro)

Town	n. obs.	Mean EV	Std.Dev	Min	Max
ALL TOWNS	1274	0.53	2.83	-11.76	56.89
BARI	24	0.47	0.38	-0.64	1.21
BERGAMO	16	10.55	13.10	0.21	56.89
BRESCIA	25	0.81	0.70	0.035	3.30
CAGLIARI	29	0.12	0.10	0.015	0.53
CATANIA	4	-3.89	4.95	-11.27	-0.98
FERRARA	26	0.63	0.54	0.09	2.66
FIRENZE	87	1.43	1.12	0.02	8.11
FOGGIA	22	-0.25	0.10	-0.51	-0.11
FORLÍ	20	0.96	0.61	0.01	2.68
GENOVA	84	0.29	0.21	-0.04	1.03
LATINA	17	2.29	1.69	0.19	7.18
MESSINA	13	-1.10	0.77	-3.18	-0.31
MILANO	133	1.86	1.34	-0.042	8.38
MODENA	22	2.19	1.05	0.56	4.44
NAPOLI	109	-2.25	1.69	-11.76	0.39
NOVARA	25	3.73	2.99	-1.05	12.08
PADOVA	25	2.98	1.74	-0.19	8.91
PALERMO	105	-2.13	1.39	-5.95	-0.17
PARMA	20	4.51	2.63	1.52	10.98
PERUGIA	31	0.23	0.15	0.04	0.67
PESCARA	28	3.04	4.34	0.07	23.66
RAVENNA	23	1.45	0.73	0.21	2.68
REGGIO CALABRIA	13	-0.96	0.41	-1.82	-0.29
REGGIO EMILIA	17	3.08	2.65	0.59	11.81
ROMA	100	0.12	0.08	0.01	0.38
SASSARI	17	-0.27	0.23	-0.99	0.01
SIRACUSA	4	-0.18	0.08	-0.29	-0.12
TARANTO	20	-0.52	0.33	-1.37	-0.05
TERNI	9	0.48	0.23	0.27	1.04
TORINO	144	-0.24	0.18	-1.45	-0.04
TRIESTE	22	-0.14	0.08	-0.31	-0.03
VENEZIA	18	-1.30	0.56	-2.60	-0.53
VERONA	22	4.19	3.07	1.18	11.96

Table 12. Efficiency effect of fiscal decentralisation simulation: mean equivalent variation (EV) by income deciles – specification B - (values in 10^3 Euro)

Decile	n. obs.	Mean EV	Std. Dev.	Min.	Max
All Obs.	1274	0.5300	2.8300	-11.7600	56.8900
1	127	-0.0916	1.0456	-5.4828	3.7773
2	127	-0.0814	1.1218	-3.3167	3.7497
3	128	-0.1798	1.2597	-3.1493	4.1833
4	127	0.0764	1.5916	-3.5153	9.1115
5	128	0.2221	1.6673	-9.1539	3.2213
6	128	0.6372	1.8326	-4.9636	8.5903
7	127	1.3088	2.6717	-3.1402	12.1076
8	128	0.3924	2.1179	-8.3110	8.7188
9	127	0.8634	2.6193	-5.9515	10.1891
10	127	2.1447	6.6883	-11.7584	56.8942

Table 13. Estimate of equivalent variation (EV) function - specification B - (values in 10^3 Euro)

Variable	Estimate	Std. error	t-value
CONSTANT	-2.5403	0.5373	-4.7278
INCOME	0.0281	0.0050	5.5966
LNVALUE	0.5266	0.1307	4.0292
N_MEMBERS	-0.0408	0.0579	-0.7054
N_EARNERS	-0.0365	0.1011	-0.3608
EDUCATION	-0.0320	0.0179	-1.7835
TYPE of WORK	0.0435	0.0256	1.7005
NORTH	2.2179	0.1677	13.2250
CENTRE	1.1372	0.2144	5.3034
L_TOWN	-1.7621	0.1342	-13.1356

Valid cases:	1274
Dependent variable:	EV
Std error of est:	2.348
Rbar-squared:	0.312
F(9,1264):	65.015

Table 14. Welfare effect of a fiscal decentralisation reform - specification B -

	$\omega = 2$	$\omega = 1$	$\omega = \frac{1}{2}$	$\omega = \frac{1}{4}$	$\omega = \frac{1}{8}$
Pre-reform	87.74	108.39	120.50	127.22	130.79
Post-reform	87.19	108.09	120.20	126.92	130.49
% variation	-0.62	-0.28	-0.25	-0.24	-0.23

References

Ben-Akiva, M., and Lerman, S.R., 1985, "Discrete choice analysis", (MIT Press, Cambridge).

Colombino, U., 1998, "Evaluating the effects of new telephone tariffs on residential users' demand and welfare. A model for Italy", Information Economics and Policy, No.10, 1998, p. 283-303.

Dowding, K., John P. and Biggs, S., 1994, "Tiebout: A Survey of the Empirical Literature", Urban Studies, Vol. 31, Nos. 4/5, 767-797.

McFadden, D.L., 1974, "Conditional logit analysis of qualitative choice behavior, in Paul Zarembka, ed., Frontiers in econometrics (Academic Press, New York) 105-140.

McFadden, D.L., 1978, "Modelling the choice of residential location" in Karqist (Ed.), Spatial Interaction theory and planning models, North Holland.

Quigley, J.M., 1985, "Consumer choice of dwelling, neighborhood and public services", Regional Science and Urban Economics, No.15, p. 41-63.

Train, K.E., McFadden, D.L. and Ben-Akiva, M., 1987, "The demand for local telephone service", Rand Journal of Economics, No.18, p. 109-123.