MODELING A REGIONAL ECONOMIC SYSTEM: THE CASE OF LOMBARDY

By

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Abstract: During recent years the demand for quantitative economic investigation to be used for policy analysis has grown rapidly. In addition, the European economic and monetary integration process has increased the economic impact of regional economies, thus calling for analytical instruments aimed at supporting the decision-making process. We set up a regional econometric model of Lombardy's labour market, in which both labour demand and supply are endogenously determined and thus unemployment is determined by their interaction. Therefore, we model labour demand in the industrial sector and in private services, while labour supply is split into two components which define respectively the participation rate and self employment. The model simulations (both deterministic and stochastic) evaluate the response of the regional labour market, in comparison with the national one, to exogenous shocks depending on shocks in either demand or supply.
The industrial and service sectors show employment multipliers which are higher in Lombardy than those prevailing at the national level. The intersectoral difference highlights the fact that industry, although declining in terms of employment, still maintains a crucial role in generating employment multiplier effects, which in turn may reduce unemployment. This evidence has important policy implications, as it suggests that industrial policy may play a crucial role in stimulating labour demand and supply, and through this route the whole regional growth process.

JEL Classification: E17, R23
Key words: Regional econometric models, Simulation

1. Introduction

The use of macroeconometric models for policy analysis has been implemented during recent decades with wavering fortune. In the sixties and early seventies macreoeconometric models were an important tool used to represent alternative scenarios and then draw conclusions leading to policy suggestions. However, since Lucas's critique they have partially lost their appeal as a policy tool, though the development of econometric analysis has permitted the incorporation of rational expectations within such models. Macroeconometrics is still an important tool used by central banks (Bank of Italy (1986)), government research units (Fiorito 2000) and international organisations (IMF (1998), European Commission, Roeger (1997)). However, little attention has until now been

[§] I would like to thank Laura Barbieri for her invaluable assistance in preparing the data set and the estimation procedures. I would like also to thank Riccardo Fiorito, who firstly introduced me to macroeconometric modelling, thus giving me the opportunity to grasp some of his great competence on econometric modelling. This research is part of a more general project on "Regional Competitiveness Indicators" coordinated by Prof. Enrico Ciciotti (MIUR , National Research Funds 2002).

paid to regional macroeconometric models able to explain how different territories respond to exogenous shocks.

This is particularly relevant as European economic and monetary integration have increased the economic impact of regional economies, thus calling for analytical tools which may help the decision-making process. We propose a labour market model of Lombardy, which is one of the most economically advanced regions within Italy and the European Union. We extend such a model to the national economy and compare the results of policy simulation, which then enables us to define the characteristics of the regional economy more precisely. This approach follows a previous study (Baussola and Fiorito, 1994) in which the three macro areas (North, Centre and South) characterising the Italian economy are modelled within a macroeconometric framework based on a seminal work by Fiorito (1984). In this paper we extend such an analysis and focus on labour demand and supply, which are both endogenously determined. This characteristic of the model highlights the difference from other approaches to labour market modelling, in which the labour force is taken as exogenous (Modigliani, Padoa Schioppa and Rossi 1986), thus distorting the effect of demand and supply shocks on unemployment.

In the following section we briefly characterise the growth pattern of Lombardy and Italy over the last 30 years, by focusing on the main macroeconomic indicators. In Section Three we describe the structure of the model, and present the estimates of labour demand and supply at the regional and national levels. In Section Four we simulate the model and discuss the response of the endogenous variables to different exogenous shocks. Implications and conclusions are then disused in Section Five.

2 Regional Growth and the Labour Market

In order to better analyse the labour market model used in the following sections, it is worth recalling the main macroeconomic facts which have characterised the regional and national economy over last 30 years.

Table 1 Regional and national economic indicators*

	1970-1980		1980-1990		1990-2000	
	Lombardy	**Italy**	**Lombardy**	**Italy**	**Lombardy**	**Italy**
GDP/POP	2.70	3.33	2.24	2.66	1.13	1.25
GDP/EMP	2.54	2.82	1.74	2.11	1.39	1.43
VAIND/EMP	4.40	3.86	3.95	3.36	2.53	2.12
VASER/EMP	1.53	3.26	0.69	3.35	0.73	2.78
FIXED INV.	1.90	1.68	1.57	1.55	1.80	1.39
TFP *INDUSTRY*	3.23	3.14	2.64	2.30	1.43	1.30
TFP *SERVICES*	0.70	1.04	0.70	0.30	0.37	0.60
LC *INDUSTRY*	16.62	17.92	9.34	9.88	2.50	2.96
LC *INDUSTRY*	18.19	18.65	13.13	12.53	4.99	5.20
DEF *INDUSTRY*	12.87	13.14	7.73	7.96	2.44	2.44
DEF *SERVICES*	14.84	14.50	10.21	10.30	4.24	3.93
DEF GDP	14.29	14.11	9.67	9.26	3.46	3.55
EEIND	-0.24	1.16	-2.15	-1.48	-1.67	-0.80
EESER	2.19	2.50	2.83	2.85	1.07	1.62

***(Average annual growth rate)**
Legend: POP=Population, EMP=Employees (labour units), VAIND=Value added in industry, VASER= Value added in services, FIXED INV =Fixed Investment, TFP= Total Factor Productivity, LC = Labour cost, DEF = Deflator, EEIND =Employees in industry, EESER =Employees in services

Table 2 Regional and national economic indicators *

	1970-1975		1976-1980		1981-1985	
	Lombardy	**Italy**	**Lombardy**	**Italy**	**Lombardy**	**Italy**
GDP/POP	1.64	2.16	3.00	4.22	1.49	1.89
GDP/EMP	2.01	2.10	2.22	3.28	1.83	1.57
VAIND/EMP	2.60	2.25	4.85	3.91	4.72	4.14
VASER/EMP	0.63	3.17	2.10	2.84	-0.03	3.87
FIXED INV.	0.68	0.55	4.00	3.77	-1.95	-0.56
TFP *INDUSTRY*	1.03	1.11	4.25	3.72	2.73	2.73
TFP *SERVICES*	-0.41	0.19	1.39	1.55	0.22	-0.36
LC *INDUSTRY*	16.81	17.89	15.34	16.88	9.93	10.83
LC *INDUSTRY*	17.41	17.71	18.65	19.38	16.00	15.35
DEF *INDUSTRY*	12.13	12.19	13.15	13.68	10.71	11.14
DEF *SERVICES*	13.74	13.14	16.25	16.09	12.88	12.86
DEF GDP	12.75	12.85	15.88	15.29	11.92	11.64
EEIND	0.16	1.43	-0.76	0.84	-4.75	-3.18
EESER	2.35	2.61	1.74	2.18	3.80	4.00

*(Average annual growth rate) – **Source: Calculation by ISTAT, National Accounts 1980-2000, and SVIMEZ, Regional Accounts for the period 1970-1980**

Table 3 Regional and national economic indicators *

	1986-1990		1991-1995		1996-2000	
	Lombardy	**Italy**	**Lombardy**	**Italy**	**Lombardy**	**Italy**
GDP/POP	3.18	3.73	1.15	0.96	1.51	1.49
GDP/EMP	2.10	2.78	2.25	2.37	1.15	0.71
VAIND/EMP	4.07	3.27	4.02	3.57	1.75	1.47
VASER/EMP	1.39	3.01	1.72	3.41	0.85	2.41
FIXED INV.	5.68	4.71	-0.51	-2.05	3.92	4.43
TFP *INDUSTRY*	3.42	2.69	2.88	2.62	0.90	0.93
TFP *SERVICES*	1.00	1.47	0.69	1.23	0.94	0.65
LC *INDUSTRY*	8.46	8.68	2.01	2.12	1.92	2.36
LC *INDUSTRY*	9.26	9.16	3.61	4.05	4.68	4.62
DEF *INDUSTRY*	3.58	3.67	3.01	2.90	1.32	1.20
DEF *SERVICES*	5.98	5.88	4.59	4.49	2.49	1.94
DEF GDP	5.86	5.46	3.77	3.85	1.87	2.18
EEIND	0.51	0.69	-2.56	-1.74	-0.29	0.51
EESER	1.67	1.68	-0.62	-0.05	2.25	2.80

***(Average annual growth rate) – Source: Calculation by ISTAT, National Accounts 1980-2000, and SVIMEZ, Regional Accounts for the period 1970-1980**

Looking at per-capita income, we see that convergence between the regional and the national economy has been week, as the ratio of Lombardy's per capita income to the corresponding Italian value shifts from 1.42 in 1970 to 1.32 in 2000. This means that after 30 years the gap between the regional and national income still remains high, as Lombardy shows an income level which is 32% higher than in Italy as a whole. This gap is small (16% in 2000) if we look at value added per employee; in this case the gap remained steady over the 30 years considered in this analysis. However, if we look at the sectoral breakdown of value added per employee, the gap is still high and persistent in private services. In this sector, value added per employee is more than 3.6 times higher in Lombardy than in Italy as a whole in 1970, and it declines to 2.04 in 2000. The gap in agriculture remains steady over the whole period, implying that value added per employee in agriculture is more than 40% higher in Lombardy than in Italy as a whole.

Table 4 Ratio of Lombardy to Italy

	GDP/POP	GDP/EIEND	VAIND/EEIND	VASER/EESER	VAAGR/EMP
1970	1.41	1.16	1.01	3.67	1.42
1975	1.36	1.15	1.02	3.33	1.47
1980	1.34	1.15	1.03	3.20	1.45
1985	1.34	1.17	1.05	2.61	1.36
1990	1.34	1.15	1.07	2.43	1.38
1995	1.33	1.13	1.10	2.21	1.38
2000	1.32	1.14	1.12	2.04	1.41

Source: Calculation on ISTAT, National Accounts 1980-2000, and SVIMEZ, Regional Accounts for the period 1970-1980

In terms of growth rate, the regional and national economies show a more convergent pattern; during the first decade per capita value added grows at an average annual rate which is more than 3.3% in Italy as a whole and 2.7% in Lombardy. In the second decade, this growth rate is about 2.3% in Lombardy and 2.7% in Italy as a whole, while in the third decade it declined sharply in both contexts, as the annual growth rate drops to an average annual value of 1.3% in Lombardy and 1.25% in Italy as a whole.

If we split each of the three decades into two sub-periods, we have a picture which shows that the more successful periods of growth were between 1976 and 1980 and between 1986 and 1990, while there was a gloomy period between 1991 and 1995, which in turn coincided with the financial crisis of 1992 and the set-up of the Maastricht agenda.

The growth rate of value added per employee is relatively steady and it varies between a maximum of 2.54 % in the first decade and 1.39% in the last decade in Lombardy. In Italy the maximum and minimum are reached in the same periods with corresponding values of respectively 2.82%. and 1.43%. The sub-period 1996-2000 confirms a gloomy trend, as value added per employee grew only 1.15% in Lombardy and 0.71% in Italy as a whole.

In addition, during these years investment decreased, although this decrease was greater in Italy as a whole, given that fixed investment decreased at an average annual rate of 0.51% in Lombardy and 2.05% in Italy. On the whole, the growth rate of fixed investment in the decade between 1990 and 2000 remains below the threshold of 2% per year in both the regional and national context. Not

surprisingly, Total Factor Productivity follows the same pattern as income growth, in that it shows a growth rate which is higher in the first decade and then starts declining, particularly during the last sample period. The pattern is moderately differentiated between sectors, revealing that industry has a higher TFP growth rate compared with services. TFP growth rate declines sharply between 1996 and 2000, this being coherent with international comparisons of productivity growth rates, suggesting that the use of information technology has sped up productivity in the US more than it has done in Europe, and therefore in Italy.

The growth rate in nominal labour cost in industry and services follows a similar pattern in both the regional and national labour markets. The growth rate of product prices, i.e., the deflator in industry and services, is less than that of labour cost, particularly during the early seventies, as in this period union power increased considerably, thus giving an important push to nominal wages. It is worth noting, however, that the growth rate of inflation as measured by the growth rate of the GDP deflator is close to that of nominal labour cost in industry in both frameworks. This is not the case in the service sector, where the growth rate of money wages is always higher than that of inflation; in this framework a crucial role may be played by the wage setting rules in sectors like finance and banking, where wages have always been higher than in industry.

Labour market indicators highlight the differences between Lombardy and the rest of the country even more, as the participation rate and the employment rate are significantly higher in the former labour market, and therefore the unemployment rate indicates a better performance in this context.

Table 5 Labour market indicators

	Participation rate		**Unemployment rate**		**Employment rate**	
	Lombardy	**Italy**	**Lombardy**	**Italy**	**Lombardy**	**Italy**
1970	41.73	38.08	2.97	5.44	45.14	37.18
1975	41.10	37.63	2.76	5.88	44.30	37.28
1980	43.12	39.30	4.52	7.60	45.87	39.10
1985	43.63	40.46	7.71	10.30	45.35	39.54
1990	44.46	42.61	4.05	11.39	48.22	41.34
1995	43.78	39.67	6.17	11.99	46.14	39.32
2000	44.42	40.76	4.37	10.58	47.00	40.62

The participation rate and the employment rate are calculated over the total population
Source: ISTAT- Labour Force Surveys, various years

In general it can be seen that the macroeconomic performance of Lombardy is constantly better than that of Italy with respect to income, employment, and unemployment. However, over the last decade and particularly during the period 1996-2000, there has been a significant decrease in some of the economic indexes used to analyse aggregate performance. In particular, a reduction in the TFP growth rate and income growth rate, pose questions as to the ability of even a well-developed region like Lombardy to remain on a stable and higher growth path in the long-run.

2. The regional labour market model

The structure of the regional model is defined as follows:

(1) EEAGR(i) = g_1{VAGR(i), WAGR(i)/DEFAGR(i), TFPAGR}

(2) EEIND) = g_2{VAIND(i), WIND(i), DEFIND(i), TFPIND(i)}

(3) EESER = g_3{VASER(i), WSER(i)/DEFSER(i), TFPSER(i)}

(4) SEIT = g_4{PROFSE(i), UR(i), SE(i), YU(i)}

(5) PR = g_5{, SE/POP(i), EE/POP(i), IMMIG(i)}

(6) TE = EEIND+EESER+EEAGR+OEE+SE

(7) TEE= α*TE

(8) LF=PR*POP

(9) UR=(LF-TEE)/LF*100

(10) PROF=((VAIND*DEFIND+VASER*DEFSER+VAGR*DEFAGR)-
(WIND*EEIND+WSER*EESER+WAGR*EEAGR)-INTAX)

(11) PROFSE=PROF/SE

(12) EE=EEIND+EESER+EEAGR+OEE

Legend:

DEFAGR	**value added deflator in agriculture (1995=100)**
DEFIND	**value added deflator in industry (1995=100)**
DEFSER	**value added deflator in tradable services (1995=100)**
EE	**total employees**
EEAGR	**employees in agriculture**
EEIND	**employees in industry**
EESER	**employees in tradable services**
FORINTO	**immigration flows from abroad**
INTAX	**net indirect taxes**
LF	**labour force**
OEE	**other employees**
PR	**participation rate**
PROF	**nominal total profits**
POP	**population**
SE	**self employment**
TE	**total employment (labour units)**
TEE	**total employment adjusted for discrepancy (α) with total labour units**
TFPAGR	**total factor productivity in agriculture**
TFPIND	**total factor productivity in industry**
TFPSER	**total factor productivity in tradable services**
UR	**unemployment rate**
VAAGR	**value added in agriculture at 1995 prices**
VAIND	**value added in industry at 1995 prices**
VASER	**value added in tradable services at 1995 prices**
WAGR	**per capita nominal labor cost in agriculture**
WIND	**per capita nominal labor cost in industry**
WSER	**per capita nominal labor cost in tradable services**
YU	**ratio of persons searching a job for the first time to total unemployed**

The model has five stochastic equations, and seven identities. Equations 1) to 3) identify labour demand in agriculture, industry and private services. Labour demand depends on value added, factor cost, and a proxy of technological factors. The adjustment process is captured by lagged endogenous variables and in the specification for industry by value added growth rate. This specification implicitly derives from the usual Cobb-Douglas production function, in which output is proxied by value added. Labour demand is therefore obtained by the usual profit maximisation condition, which implies that labour productivity be equal to real wages. If one uses a log transformation of the condition for profit maximisation, one can decompose the labour cost variable (product wage) into nominal wage and product prices.[1]

Labour supply is split into two components (equations 4) and 5)) .The first is a modified version of the discouraged worker hypothesis (Tella 1964). Following this hypothesis, fluctuations in

[1] In the agriculture sector we did not use such a decomposition of the labour cost variable because of the problem of significance of factor costs and product prices; thus we decided to use the real wage specification, i.e., labour cost deflated by the corresponding product price.

labour supply, as described by fluctuations in the labour force participation rate, are crucially influenced by variations in employment, and thus reflect changes in the demand for labour. Thus a shrinking labour market may discourage labour force participation, while an expanding job market will have the opposite effect. This specification takes into account how different levels of economic activity may influence labour demand and supply, and therefore unemployment. In addition, we modify this original version of the discouraged worker by separating employment into two components: self-employment and employees (Baussola and Fiorito 1994). In our specification the participation rate depends on the ratio of employees to population and the ratio of self-employment to population. In addition we include a migration index to take the effect of migration flows from foreign countries into account, and a lagged pendent variable to capture the adjustment process.

The second component of labour supply is self-employment, and this represents the typical neo-classical version of the supply of labour. Thus we include profits (10) and structural variables (the unemployment rate and the ratio of young unemployed to total unemployed) as explanatory variables to capture the marginal component of workers who eventually decide to set up an independent activity in response to adverse job market opportunities.

Unemployment is endogenously determined (9) by the interaction of the labour force (8) and total employment (6). The former is obtained by applying the participation rate as determined in equation (5), and the latter is the sum of employees in industry, private services, employees in agriculture, other employees and self-employment.

3.1 Estimates

We present Three Stage Least Squares estimates of the model presented in the previous section. As we take the product market and prices and wages as given in this model, only equation 5) presents

an endogenity problem. The estimation by three stage least squares also allows us to take the correlation between innovations in each equation into account.

- **Labour demand**

Labour demand is described by using three sectoral specifications of employees, i.e., employees in agriculture, industry and services. Employment in each sector depends on the variable described in section 3.1. The equation of the demand for labour in agriculture shows coefficients which suggest, as expected, a negative relationship between the demand for labour and its real unit cost. The impact is more significant in Lombardy than in Italy, as the short run elasticity is -0.463 in the former area, and -0.238 in the latter. In this case, however, the coefficient on the product wage is significant only at the .10 significance level.

Value added enters this equation significantly only in the regional specification. This result is coherent with the fact that agriculture is still relevant within the Lombardy economy, accounting for a large amount of the national value added in agriculture. Total factor productivity enters the equation with the correct (negative) sign, though in the regional specification its coefficient is significant only at the 16.6 significance level. The lagged dependent variable captures the adjustment process, and it suggests that the speed of adjustment is higher in Lombardy than at the national level.

Labour demand in industry shows decreasing labour returns in both the regional and national specifications. However, in the former specification the result holds both in the short and in the long run, while in the latter the short run elasticity of value added is close to unity, implying, therefore, almost constant labour returns. This result may depend on labour hoarding, which in turn may be more relevant at the national level (which includes southern regions), implying a less flexible response by labour to business cycle fluctuations.[2]

[2] See bussola and Fiorito (1994), and Bodo and Sestito (1989)

The effect of labour cost is significant and enters the equation with the expected sign; its impact is homogenous between the regional and national specifications, implying a short run elasticity of about 0.22. Product price enters the equation separately from the labour cost variable, as described in section 3.1; the impact is again similar in the national and regional specifications, with a short run elasticity higher than 0.16. Total factor productivity, as derived from the growth accounting methodology, implies that technical change significantly and strongly affects labour demand both in the short and in the long run. The short run effect is higher in Lombardy than at the national level, while the adjustment process proxied by the lagged dependent variable is significant only in the national specification, while in the regional specification the adjustment process is mainly captured by the percentage variation of value added, though it is significant at the 0.21 significance level.

Table 6 Labour Demand - Employees in Industry - 3SLS Estimates

Dependent Variable: log(EEIND)

Regressors	Lombardy	Italy
log(VAIND)	1.351	1.067
	(0.075)	(0.069)
log(WIND)	-0.227	-0.208
	(0.033)	(0.027)
log(DEFIND)	0.163	0.164
	(0.034)	(0.026)
log(TFPIND)	-1.359	-1.068
	(0.106)	(0.102)
$log(EEIND)_{t-1}$	0.052	0.261
	(0.055)	(0.050)
dlog(VAIND)	0.039	0.091
	(0.032)	(0.028)
CONST.	-4.329	-3.854
	(0.374)	(0.364)
Elasticity		
α (1)	1.425	1.444
β (1)	-0.240	-0.280
γ (1)	0.172	0.222
δ (1)	-1.435	-1.445
ε (1)	0.042	0.123
SE/VM (2)	0.001	0.001

Standard errors in parenthesis
(1) Short run elasticity with respect to: VAIND, WIND, DEFIND, TFPIND, d(VAIND).
(2) Ratio of standard error of regression to mean value of dependent variable.

Labour demand in tradable services shows increasing labour returns in the national specification, while at the regional level we have almost constant returns in the short run. As for the industrial sector equation, this pattern may be the result of a different response by labour to exogenous shocks in demand, suggesting that labour responds more quickly in the regional labour market than in the national one. This is also confirmed by the speed of adjustment, which is the complement to unity of the value of the coefficient on the lagged dependent variable; in Lombardy this value is 0.74, while in the national specification it is 0.58.

Product wage is not significant in the regional equation and this is contrary to the significant effect that is shown at the national level. This result may depend on the characteristics of private services in Lombardy compared to those prevailing at the national level, influenced by the characteristics prevailing in services in the Central and Southern regions. Indeed, the size of such activities is particularly small in such areas, and thus labour cost becomes a constraint on expansion. This fact is less relevant in Lombardy, where business size is on average bigger, thus contributing to absorbing labour cost variations.

In addition, total factor productivity shows a significant effect in both the regional and national equations, with a short run effect which is however higher in the former equation.

Table 7 - Labour Demand - Employees in Tradable Services - 3SLS Estimates

Dependent Variable: log(EESER)

Regressors	Lombardy	Italy
log(VASER)	1.013	0.708
	(0.130)	(0.074)
log(WSER)	-0.056	-0.108
	(0.092)	(0.046)
log(DEFSER)	-0.039	0.075
	(0.103)	(0.052)
log(TFPSER)	-1.022	-0.909
	(0.176)	(0.098)
$log(EESER)_{t-1}$	0.262	0.420
	(0.089)	(0.060)
CONST.	-4.512	-1.372
	(1.129)	(0.610)

Elasticity		
α (1)	**1.373**	**1.220**
β (1)	**-0.076**	**-0.186**
γ (1)	**-0.053**	**0.130**
δ (1)	**-1.385**	**-1.566**
SE/VM (2)	**0.002**	**0.001**

Standard errors in parenthesis
(1) Short run elasticity with respect to : VASER, WSER, DEFSER, TFPSER.
(2) Ratio of standard error of regression to mean value of dependent variable.

Table 8 Labour Demand - Employees in Agriculture - 3SLS Estimates

Dependent Variable: log(EEAGR)

Regressors	**Lombardy**	**Italy**
log(VAAGR)	**1.037**	**0.026**
	(0.423)	**(0.137)**
log(WAGR/DEFAG)	**-0.251**	**-0.077**
	(0.111)	**(0.035)**
log(TFPAGR)	**-0.677**	**-0.181**
	(0.251)	**(0.068)**
log(EEAGR)$_{t-1}$	**0.458**	**0.677**
	(0.161)	**(0.099)**
CONST.	**-5.220**	**2.532**
	(3.316)	**(1.654)**
Elasticity		
α (1)	**1.913**	**0.082**
β (1)	**-0.463**	**-0.238**
γ (1)	**-1.250**	**0.5601**
SE/VM (2)	**0.021**	**0.004**

Standard errors in parenthesis
(1) Short run elasticity with respect to: VAAGR, WAGR/DEFAGR, TFPAGR.
(2) Ratio of standard error of regression to mean value of dependent variable.

- ## Labour supply

Labour supply is described by means of the participation rate and self-employment. The estimation of the participation rate shows coefficients which are all significant and with the expected signs, but the coefficient on the migration variable in Lombardy. In this area the discouragement effect, as measured by the link between employment and the labour force participation, is milder than in the national equation, where the short-run and long-run elasticity of self-employment and employees is much higher than in the regional equation with respect to the participation rate. This result is

coherent with the fact that the discouragement effect prevails in the national labour market, and therefore, the response of the labour force participation rate to changes in economic conditions, proxied by changes in employment, is higher in this context, and determines a quick adjustment in the participation rate. In addition, we include a migration variable to take the impact of inflows of immigrants on the participation rate into account. This impact is mild and significant at the national level only. This result is not unexpected, as immigration inflows from foreign countries has increased over the last ten years, therefore affecting only the last part of the sample period. However, it is worth including this variable as it will become ever more important in the future, as immigration, even though restricted at the national and regional level, is an important key to resolving differences between labour demand and supply in some industrial sectors of the Italian and regional economy.

Table 9 Labour Supply - Participation Rate - 3SLS Estimates

Dependent Variable: (LF/POP)

Regressors	Lombardy	Italy
$(SE/POP)_t$	0.578	1.401
	(0.112)	(0.107)
$(EE/POP)_t$	0.212	0.678
	(0.099)	(0.103)
$(IMMIG)_t$	0.565	2.920
	(0.754)	(0.747)
$(LF/POP)_{t-1}$	0.481	0.100
	(0.101)	(0.057)
DUM93	-0.005	-0.007
	(0.754)	(0.001)
COST.	0.085	0.003
	(0.049)	(0.018)
Elasticity		
α (1)	0.327	0.473
α (2)	0.170	0.426
β (1)	0.311	0.511
β (2)	0.162	0.460
γ (1)	0.006	0.010
γ (2)	0.003	0.009
SE/VM (3)	0.007	0.006

Standard errors in parenthesis
DUM93 = Dummy variable for year 1993 to take into account the change in methodology of the Labour Force Sample Survey.
(1) Short run elasticity with respect to : SE/POP, EE/POP, IMMIG.
(2) Long run elasticity with respect to : SE/POP, EE/POP, IMMIG.
(3) Ratio of standard error of regression to mean value of dependent variable.

The classical component of labour supply is modelled using self-employment as a dependent variable. Therefore, we include per capita nominal earnings as a regressor to take the effect of a change in earned income on individual labour supply into account, as in the typical neoclassical story. In addition, we include the unemployment rate and the ratio of young unemployed to total unemployed, to take the marginal component of self employment into account, i.e., those individuals who react to failure in finding a job as employees. The earning variable is significant in both the regional and national specifications, though with different elasticity: in Lombardy the short-run elasticity of self-employment to earnings is about 0.066, while at the national level its value is fairly low, 0.014. In the long run this gap between the two specifications is even higher, as in Lombardy the elasticity is about 0.145, compared with a corresponding value of 0.034 in Italy as a whole.

The unemployment rate does not enter the regional equation significantly, while in the national equation this variable is significant at the 0.16 significance level. However, the effect of youth unemployment is significant in both specifications, with a higher elasticity in both the short-run and the long-run in the national equation.

Table 10 Labour Supply - Self Employment – 3SLS Estimates

Dependent Variable: log(SE)

Regressors	Lombardy	Italy
$\log(PROFSE)_{t-1}$	**0.065**	**0.014**
	(0.012)	**(0.007)**
$\log(UR)_{t-1}$	**0.016**	**0.046**
	(0.015)	**(0.033)**
$\log(SE)_{t-1}$	**0.550**	**0.579**
	(0.076)	**(0.079)**
log(YU)	**0.059**	**0.144**
	(0.014)	**(0.024)**
CONST.	**2.924**	**3.678**
	(0.487)	**(0.668)**

Elasticity		
α (1)	**0.145**	**0.034**
β (1)	**0.035**	**0.109**
γ (1)	**0.132**	**0.342**
SE/VM (2)	**0.002**	**0.001**

Standard errors in parenthesis
(1) Short run elasticity with respect to : $(PROFSE)_{t-1}$, $(UR)_{t-1}$, YU .
(2) Ratio of standard error of regression to mean value of dependent variable.

4. Simulation

The model has been simulated from 1985 to 2000 by means of dynamic deterministic and stochastic simulations. In Appendix 3 we report the figures with actual and simulated series together with the usual statistics (RMSE, Theil's inequality coefficient, Mincer-Zarnowitz test). In addition, we report the upper and lower boundary of the simulated solution, as it is derived from the stochastic simulation. The overall performance of the simulated model is good, according to the previously-mentioned statistics, and thus the baseline solution is a good benchmark for evaluating the response of the models to exogenous shocks.

We consider both demand and supply shocks, which are approximated by value added shocks (the former) and labour cost shocks (the latter). In addition, we consider other possible sources of exogenous shock with regard to demographic factors (population and immigration flows) and an increase in state employment. Finally we consider the effect of technological shocks which are proxied by a change in total factor productivity.

For all shocks, each variable has been changed one at a time by a 1% variation, which has been held constant (in absolute terms) over the whole simulation sample.

- **Value added shocks**

A unit value added increase in industry (VAIN) increases sectoral employment (EIND) and the total number of employees (EE). This response is higher in the regional labour market than in the national one, although in the long-run these responses tend to converge, showing a certain degree of

persistency. It has to be underlined that these multipliers reflect a crucial assumption, i.e. the ceteris paribus condition. In other words, one analyses the impact of each shock assuming that all else remains equal. This is a necessary assumption in order to highlight and discuss the role of each variable in the determination of the endogenous variables under observation. It is clear, however, that in reality more than one variable changes over time, and the impact on the endogenous variables does depend on the combination of different effects. In this case the overall impact would be obtained by taking into account the impact of labour cost, prices and total factor productivity on employees in industry. In the following sections all these arguments will be analysed.

The impact on labour supply is mild in both markets (regional and national) and this reinforces the positive effect on the unemployment rate, which decreases by more than a ¼ percentage point in Lombardy and less than 0.07 percentage points in Italy in the short-run. In the longer run the impact decreases in both labour markets, although the initial impact gap is maintained, implying that the regional multiplier is almost three times the multiplier prevailing in Italy.

The impact on labour supply is driven by the discouragement effect, which has been described when analysing the participation rate equation. However the impact is mild, and is also affected by the negative (though tiny) impact on self-employment, which is mainly determined by the decrease in the unemployment rate. This impact more than offsets the positive impact of earnings on self-employment.

The impact of a shock in tradable services value added follows the same pattern described for the industrial sector shock, though with a milder impact on the unemployment rate, particularly in the national labour market. In this context, the impact on labour supply is higher than in Lombardy, thus reducing the short-run and long-run effect on unemployment.

The same kind of argument may be applied to the agriculture value added shock; in this case it is not surprising that the higher impact on labour demand and supply is found in the regional economy, as Lombardy is the region where agriculture is most developed within the Italian economy, featuring strong integration with the industrial sector.

- **Labour cost and product price shocks**

A unit rise in money wage, which for a given product price implies a rise in real product wage, reduces employment in all sectors. Industry and tradable services employment are more affected than agriculture employment both in the short-run and in the long-run. Although the dynamic multipliers for Lombardy and Italy are narrow with respect to industry employment, the impact on unemployment shows a more differentiated pattern between the two areas. Unemployment increases more in Lombardy, as the participation rate is less responsive to employment changes.

The impact of the wage shock in services on unemployment is milder than that derived from the industrial sector, and is still stronger in Lombardy. However, in the long run the multipliers in the two contexts (regional and national) do converge towards a common value.

- **Total factor productivity and value added shocks**

In order to analyse the impact of a change in technology, proxied by a unit change in Total Factor Productivity, we should also hypothesise a change in value added, as production is clearly affected by a change in productivity. Therefore, we consider a unit change in Total Factor Productivity associated with the change in value added which is derived from the estimates of the elasticity of value added to TFP. This latter may be obtained from the usual production function regression in which for a given capital stock, value added depends, on labour input, TFP, and an adjustment factor.

In our case a unit change in TFP in industry implies a change in value added of 1.01 percentage points in Italy as a whole, and 0.98 percentage points in Lombardy. Therefore the impact on employment is offset by the symmetric effect of TFP and value added multipliers; this also implies

that unemployment remains steady, showing only a mild increase in the short run in both the national and regional labour markets. However, it is worth while underlining the fact that as long as technology shocks bring about a significant increase in production, the negative effect on employment may be offset.

In private services the compensation effect determined by the increase in TFP on value added is weaker than in the industrial sector. Therefore, a unit increase in TFP in services brings about a 0.93 increase in value added in Italy and a 0.83 increase in Lombardy. Thus if we hypothesise such contemporaneous shocks we end up with an increase in unemployment determined by the reduction of employment in services and by the (small) increase in labour supply caused by the increase in self-employment (through the increase in profits). In the long-run the unemployment rate is increased more in Lombardy than in Italy, as in the former, value added in services shows a lower elasticity to TFP changes, and the discouragement effect is weaker than in the national labour market. Such shocks are taken into account for the agriculture sector only for the regional economy, as TFP and value added changes are not significant in the national estimates. The elasticity of value added to TFP is about 0.61 in Lombardy, and given the impact of TFP on employee's employment in this sector as shown in equation 9), we can derive the simulation exercise. It shows that the reduction in employment is confined to the short run, and the impact on the unemployment rate is on the whole negligible.

- **Demographic shocks**

Demographic shock is modelled through an exogenous unit increase in population, which in turn affects labour supply, changing both the participation rate and self employment. The short-run effect is higher in Italy than in Lombardy and it reflects the stronger discouragement effect prevailing in the national labour market. However, in the long-run the negative effect on

unemployment is higher in Lombardy, given a higher impact on labour force as the participation rate is reduced less than in the national labour market.

- **Public sector employees shocks**

Direct creation of employment is simulated by shocking the OOE variable, which includes employees in the public sector together with employees in construction. However, this latter represents a small percentage of the whole aggregate of Other employees, and in addition is crucially related to government investment in infrastructures. The impact on unemployment of this shock is stronger in Lombardy than in the national labour market, and this is brought about by a weaker impact on the participation rate and thus on labour supply. This result is coherent with the weaker discouragement effect estimated in Lombardy, which implies that the elasticity of labour force participation rate to employment is less that the corresponding value prevailing in Italy. The impact on total employment is stronger in the latter than in Lombardy, and this reflects the structure of Lombardy's economy, in which public sector employees, though relevant, represent about 24% of total employment, compared with almost 33% in Italy.

5. Conclusion

We have investigated the characteristics of labour demand and supply by using a regional econometric model of Lombardy. We have compared the performance of such a model in the regional and national context by adopting a specification which allows for the endogeneity of both demand and supply of labour. The labour force participation rate and self-employment are the two components of labour supply, whereas labour demand is determined by the equations that define employees in industry and in private services, as we take as given employees in construction and in the public sector.

This specification allows us to estimate and then solve the model, in order to highlight the specific characteristics of the regional labour market, and therefore, the different responses to various exogenous shocks. It should be underlined that one of the main difference with respect to previous studies carried out within the same analytical framework, is that the short-run and long-run multipliers of employment are significantly higher in the simulation exercise we have presented in this paper. This fact depends on two main elements: the first is that labour hoarding in industry has sharply declined over the last 15 years, and the second deals with the use of a more appropriate measure of employees, i.e., full-time equivalent labour units. The response of employment (particularly employment in industry) to demand shocks, proxied by a unit value added shock, is therefore higher in comparison to earlier models in which labour demand was specified in terms of hours worked and employees were derived through the estimate of hours per worker. The regional labour market, in comparison with the national one, shows a higher elasticity of employment, to value added shocks in both industry and services. This fact, together with the low discouragement effect estimated for Lombardy in the participation rate equation, brings about a higher impact (reduction) of unemployment in the regional labour market than in Italy. On the supply side, labour cost and price shocks affect the demand and supply for labour and therefore unemployment; this latter increases more in Lombardy than in Italy through the same kind of transmission mechanisms previously highlighted, i.e., the milder discouragement effect prevailing on Lombardy's labour supply. The same conclusion could be derived by analysing the effect of demographic change and an exogenous increase in government employment, which has a higher impact on the regional unemployment rate than in the national labour market. Technological shocks, which are compensated by an increase in value added, may have mild effects on unemployment, both at the regional and the national level.

It has to be underlined that, although Lombardy has experienced a significant decline in employment in industry and a corresponding increase in employment in services, employment multipliers, which in turn affect unemployment, are higher in the former sector than in the latter.

This evidence suggests that policy aiming at maintaining and increasing employment in industry may have important implications, as this sector still remains crucial for stimulating the labour market and the whole economy.

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APPENDIX 1

RESPONSE TO EXOGENOUS SHOCKS

(Attacched on a separate file)

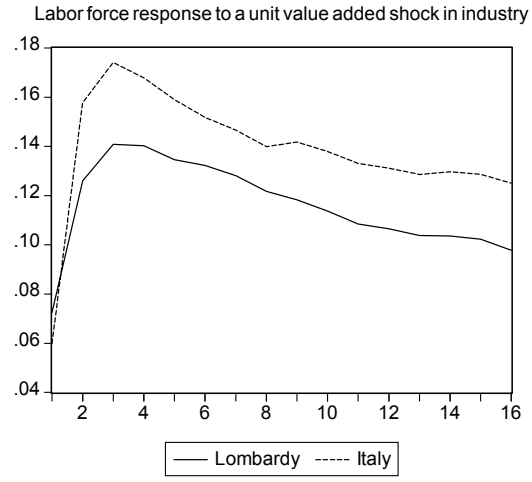
APPENDIX 2 – DATA SOURCES

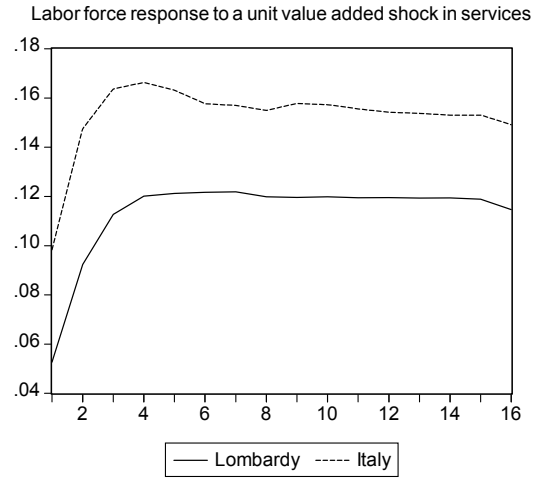
DEFAGR	value added deflator in agriculture (1995=100)	
DEFIND	value added deflator in industry (1995=100)	
DEFSER	value added deflator in tradable services (1995=100)	
EE	total employees	(NA)
EEAGR	employees in agriculture	(NA)
EEIND	employees in industry	(NA)
EESER	employees in tradable services	(NA)
FORINTO	immigration flows from abroad	(ID)
INTAX	net indirect taxes	(NA)
LF	labor force	(ILF)
OEE	other employees	
PR	participation rate	
PROF	nominal total profits	(NA)
POP	population	(NA)
SE	self employment	(ILF)
TE	total employment	(ILF)
TEE	total employment adjusted for discrepancy with total labour units	(ILF)
TFPAGR	total factor productivity in agriculture	
TFPIND	total factor productivity in industry	
TFPSER	total factor productivity in tradable services	
UR	unemployment rate	(ILF)
VAAGR	value added in agriculture at 1995 prices	(NA)
VAIND	value added in industry at 1995 prices	(NA)
VASER	value added in tradable services at 1995 prices	(NA)
WAGR	per capita nominal labor cost in agriculture	(NA)
WIND	per capita nominal labor cost in industry	(NA)
WSER	per capita nominal labor cost in tradable services	(NA)
YU	ratio of persons searching a job for the first time to total unemployed	(ILF)

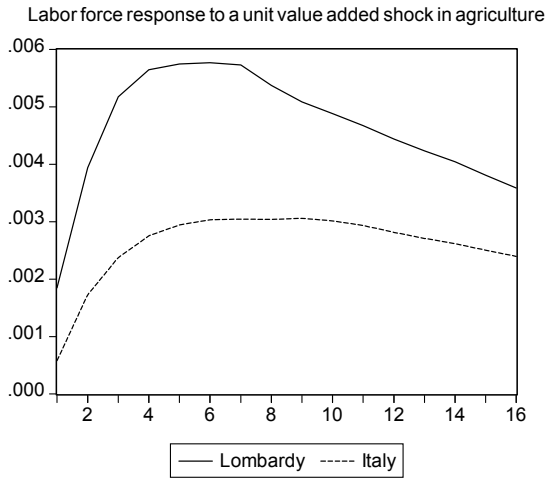
ID = ISTAT, National Demographic Statistics
ILF = ISTAT (Labor Force Survey)
NA = National Accounts (1970-1980; SVIMEZ (1998); 1980-2000 ISTAT(2000))

APPENDIX 1

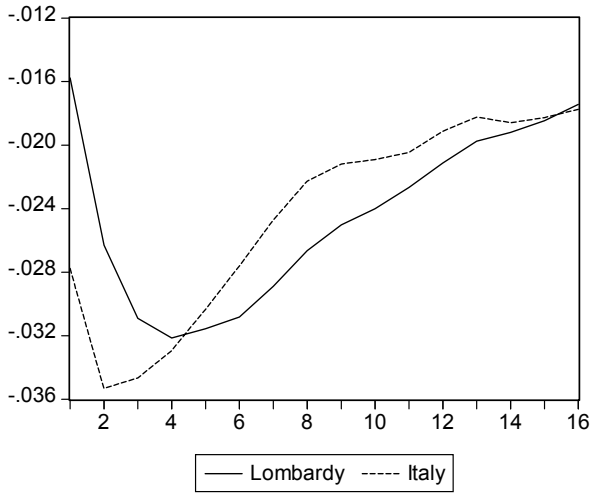
RESPONSE TO EXOGENOUS SHOCKS



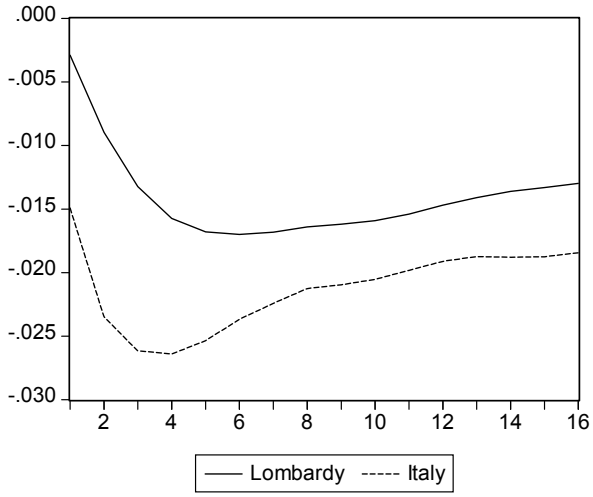




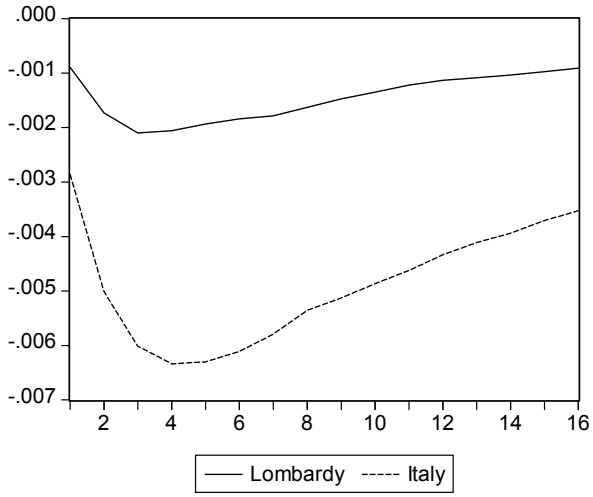
Labor force response to a unit wage shock in industry



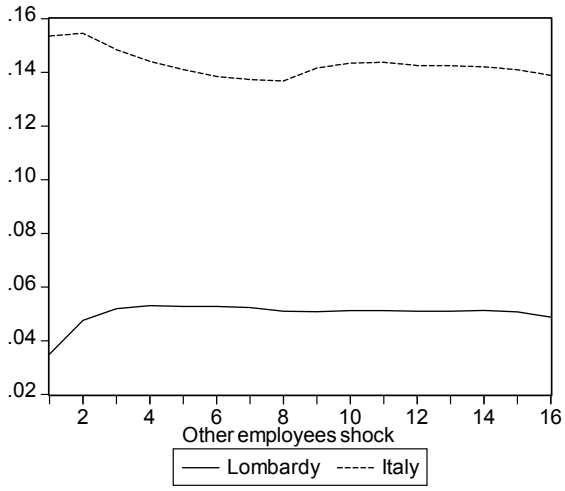
Labor force response to a unit wage shock in services



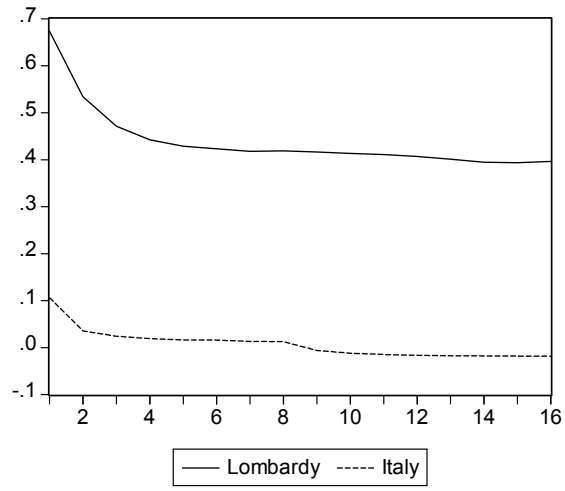
Labor force response to a unit wage shock in agriculture



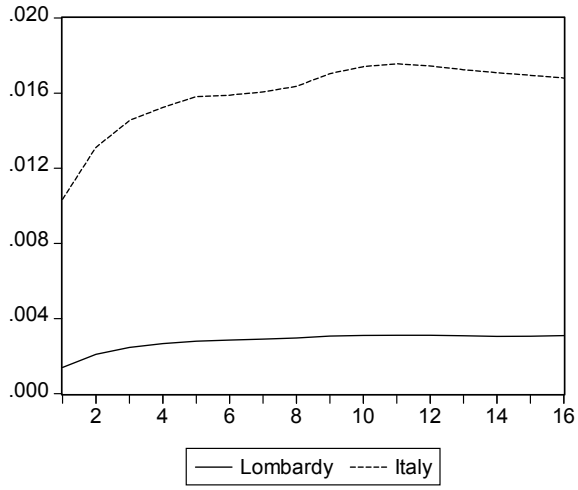
Labor force response to direct creation of employment

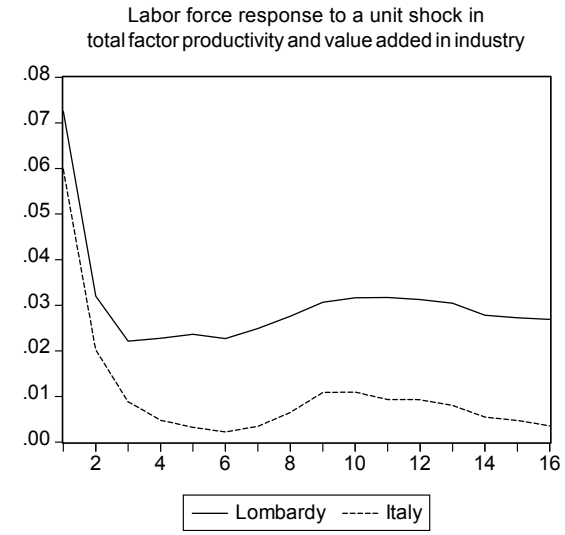


Labor force response to a unit shock in population



Labor force response to a unit shock in immigration




Labor force response to a unit shock in
total factor productivity and value added in industry
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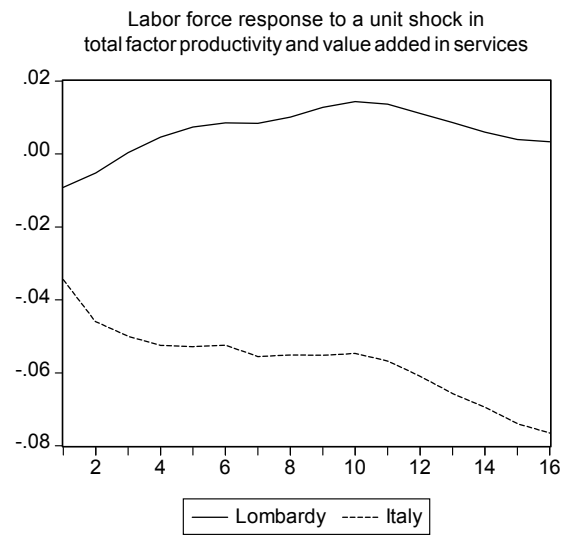
Lombardy
Italy


Labor force response to a unit shock in
total factor productivity and value added in services
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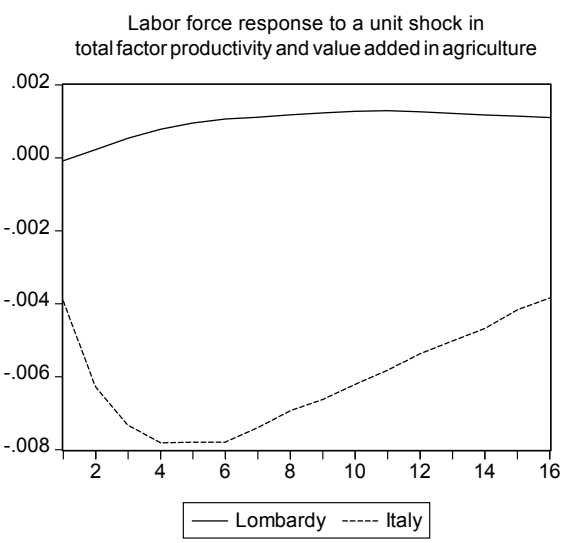
Italy


Labor force response to a unit shock in
total factor productivity and value added in agriculture
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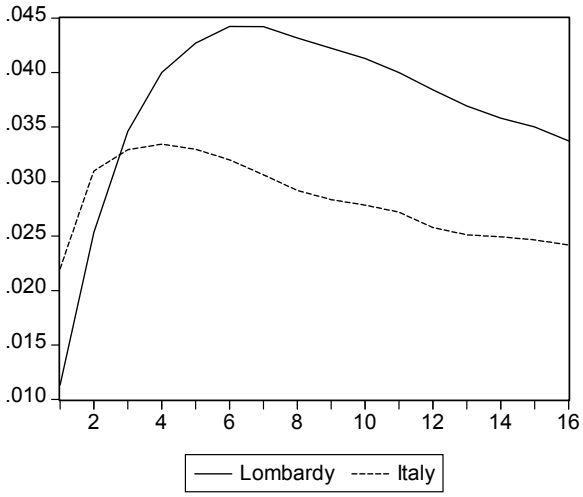
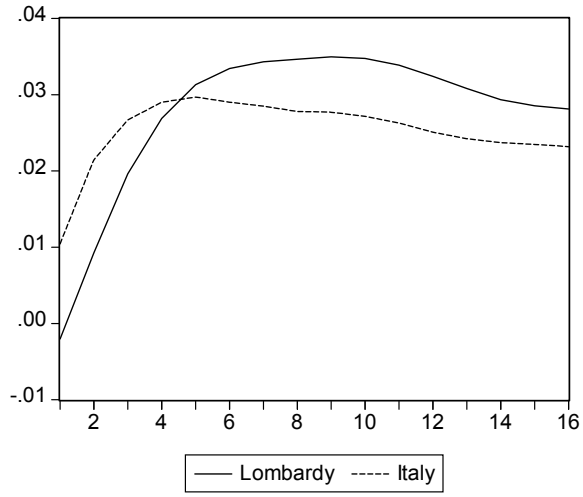
Lombardy
Italy

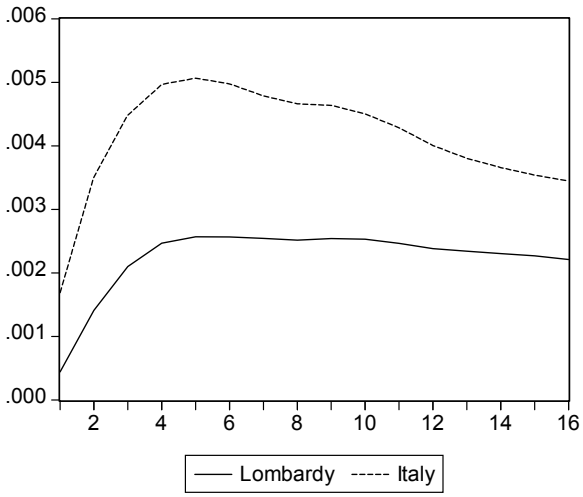
Labor force response to a unit product prices shock in industry



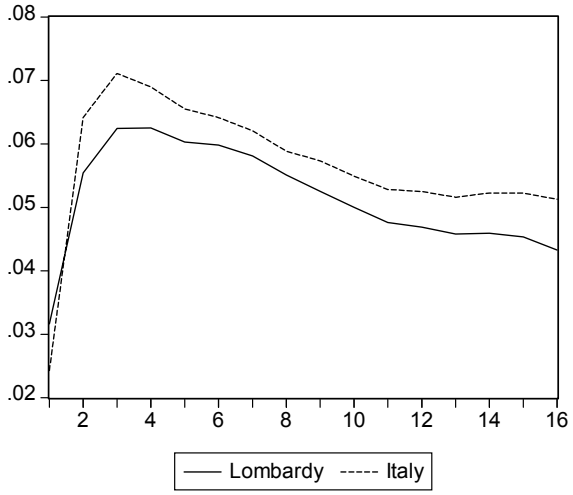
Labor force response to a unit product prices shock in services



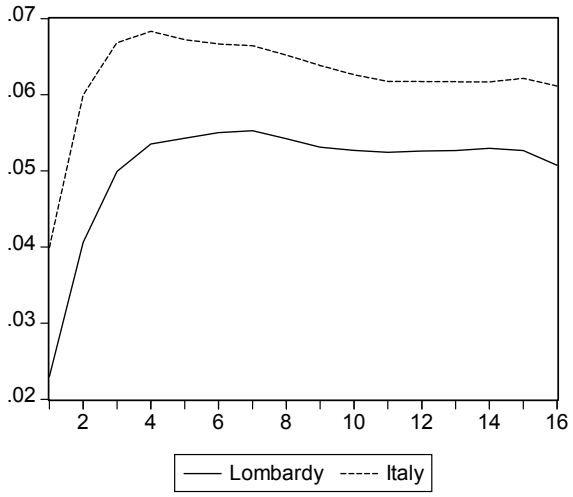
Labor force response to a unit product prices shock in agriculture



Participation rate response to a unit value added shock in industry



Participation rate response to a unit value added shock in services



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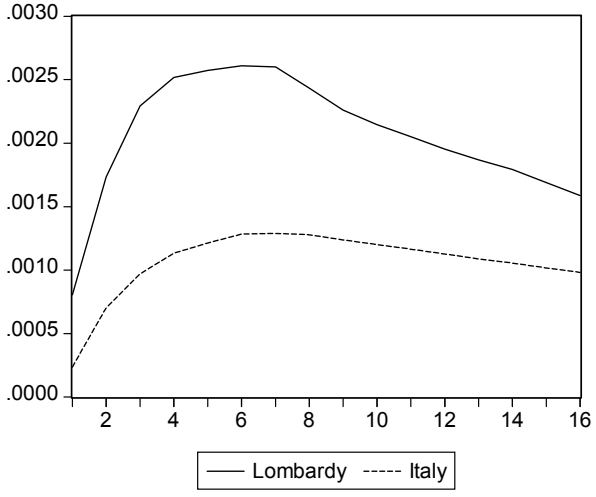
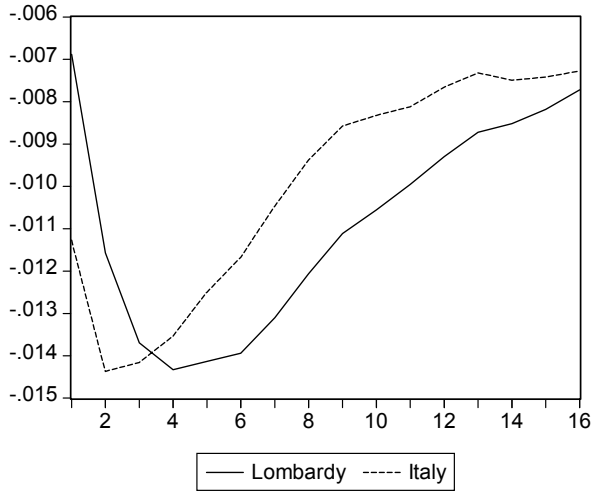
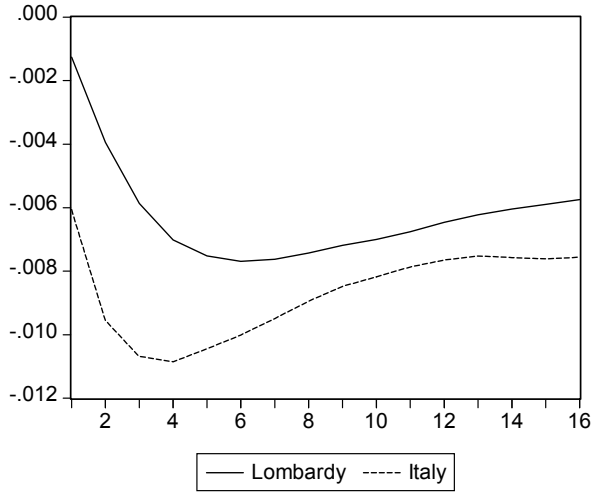


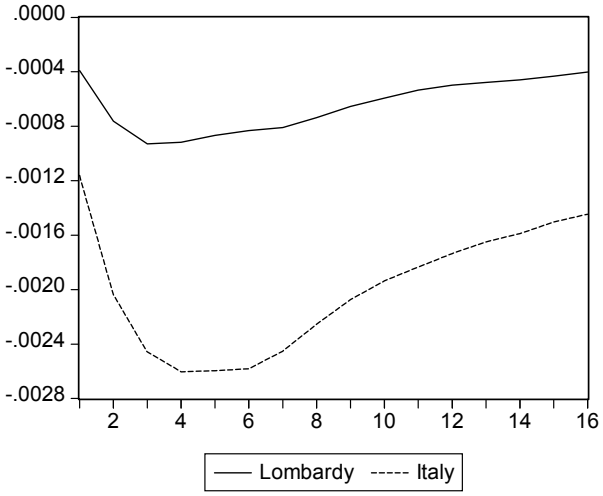
Participation rate response to a unit wage shock in industry



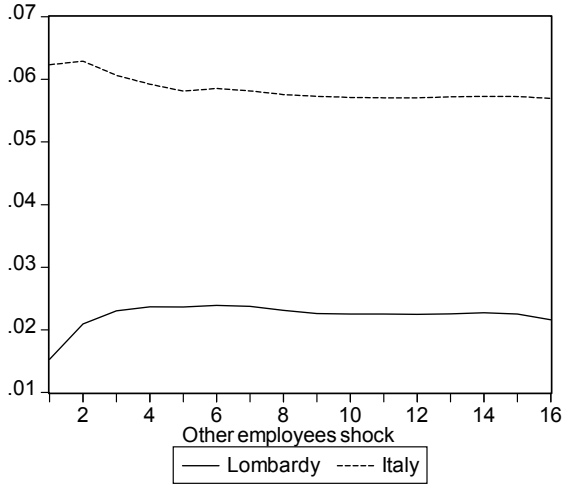
Participation rate response to a unit wage shock in services



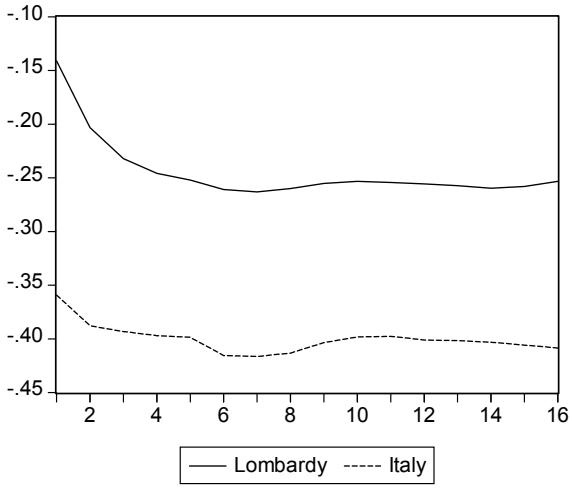
Participation rate response to a unit wage shock in agriculture



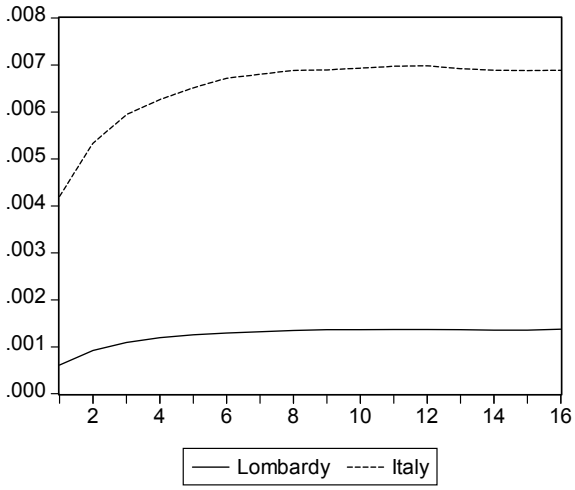
Participation rate response to direct creation of employment



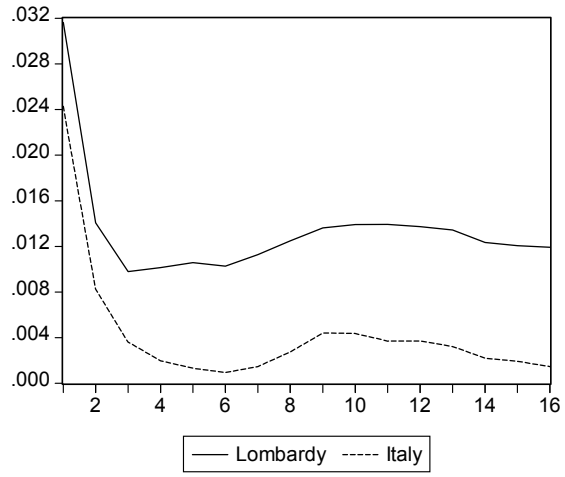
Participation rate response to a unit shock in population



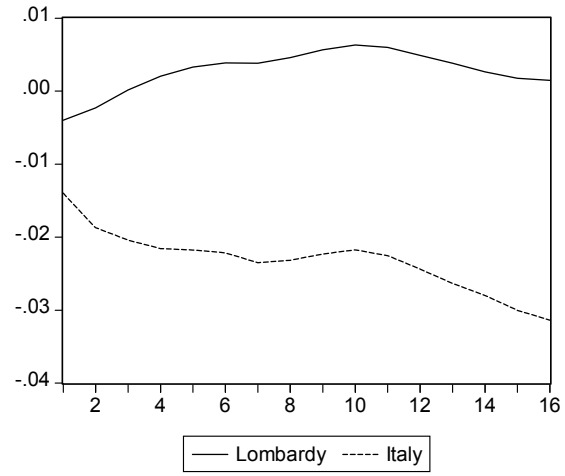
Participation rate response to a unit shock in immigration



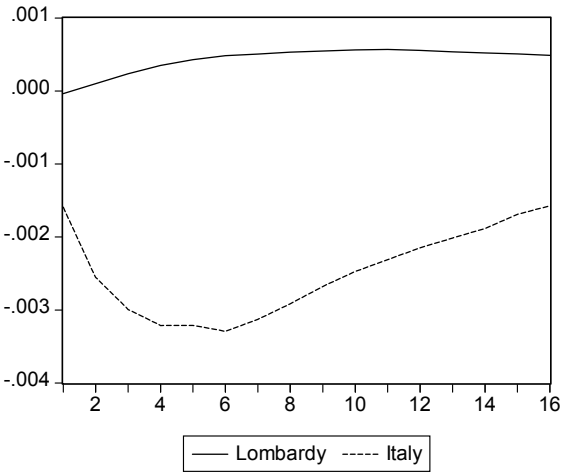
Participation rate response to a unit shock in total factor productivity and value added in industry



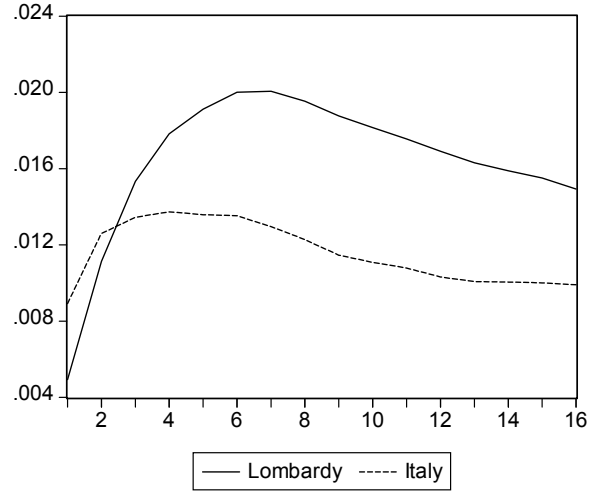
Participation rate response to a unit shock in total factor productivity and value added in services



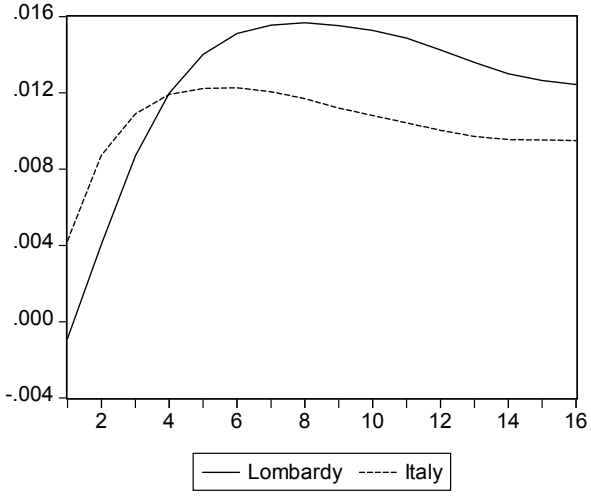
Participation rate response to a unit shock in total factor productivity and value added in agriculture



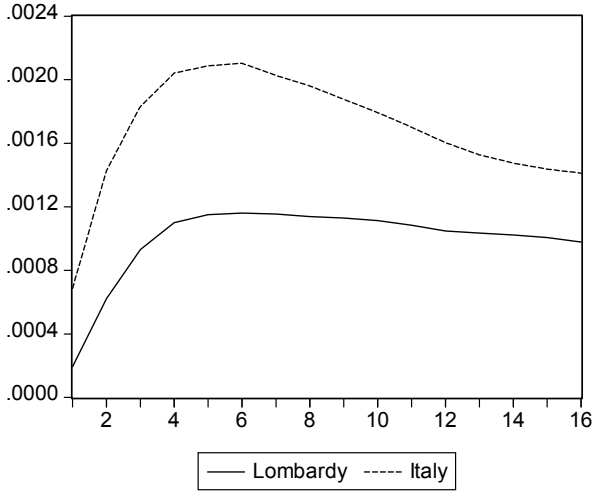
Participation rate response to a unit product prices shock in industry



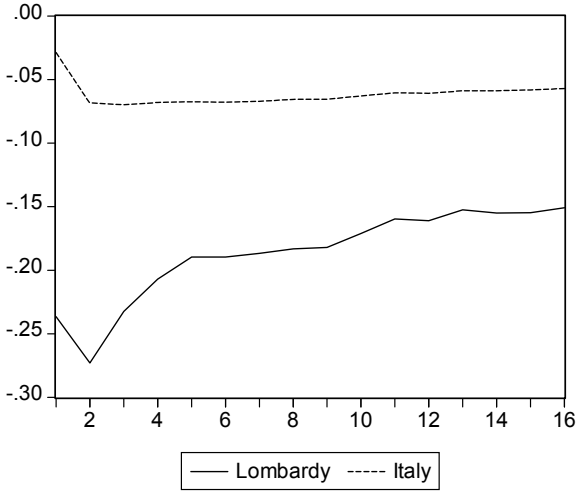
Participation rate response to a unit product prices shock in services



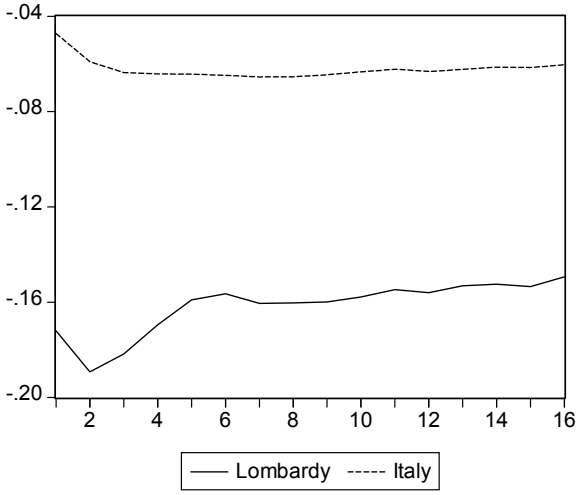
Participation rate response to a unit product prices shock in agriculture



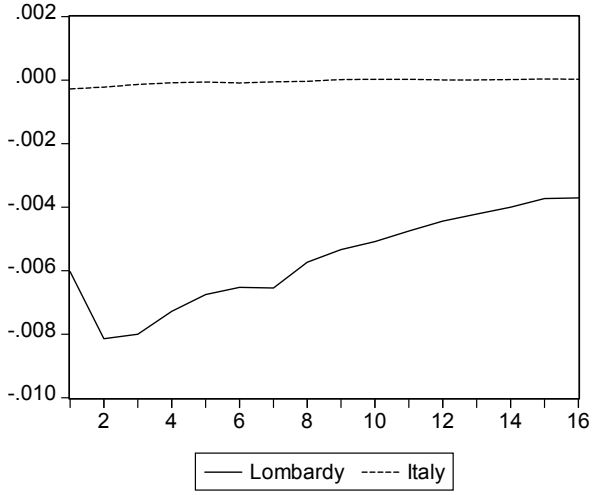
Unemployment response to a unit value added shock in industry



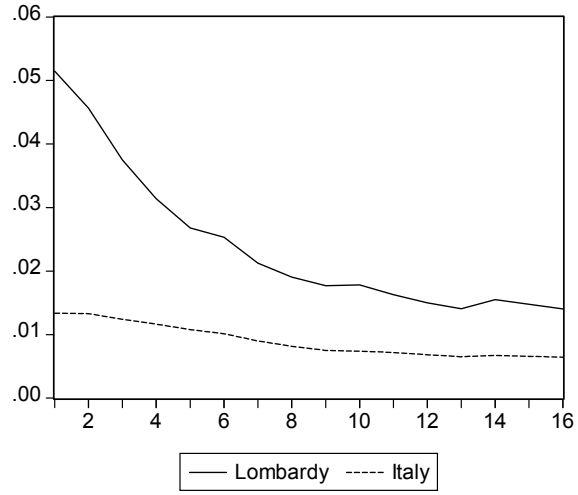
Unemployment response to a unit value added shock in services



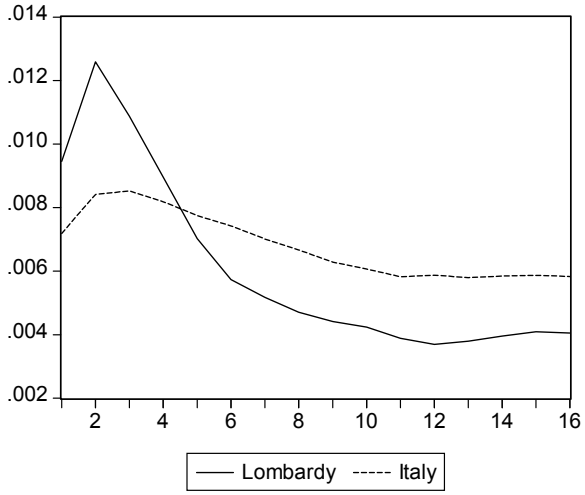
Unemployment response to a unit value added shock in agriculture



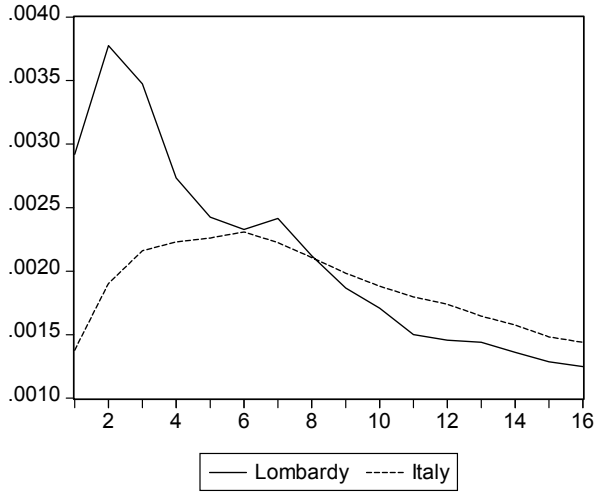
Unemployment response to a unit wage shock in industry



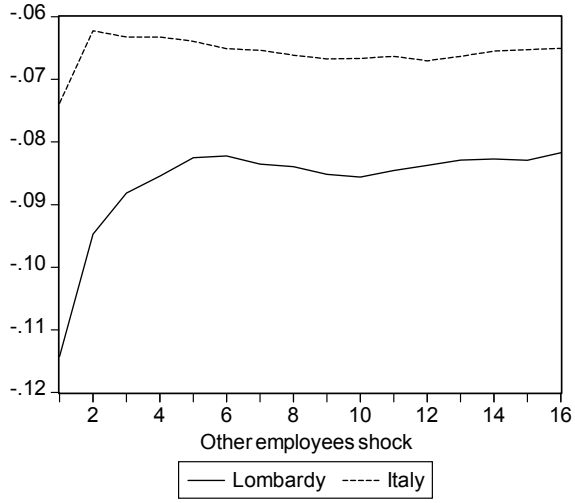
Unemployment response to a unit wage shock in services



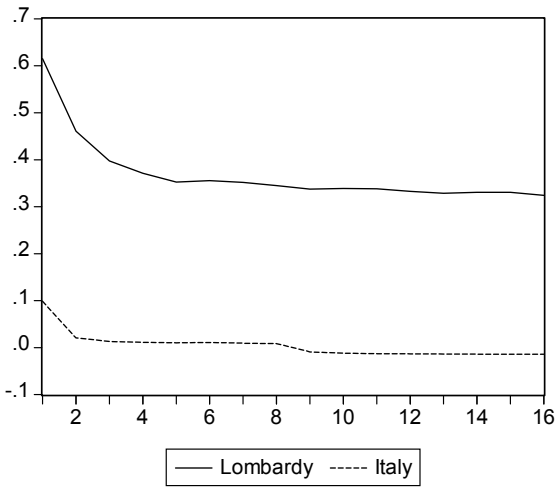
Unemployment response to a unit wage shock in agriculture



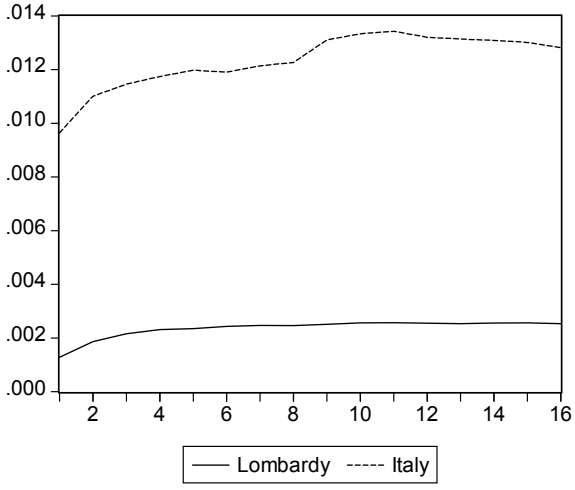
Unemployment response to a direct creation of employment



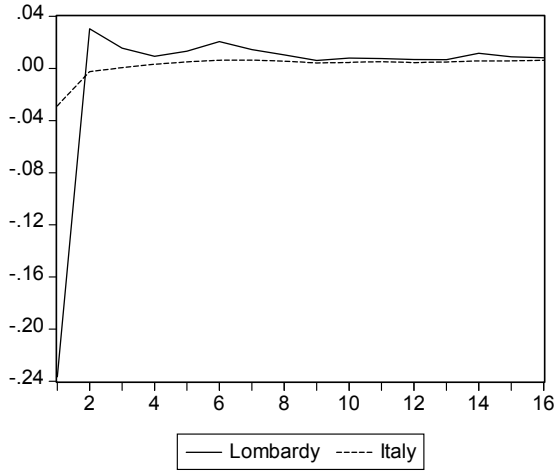
Unemployment response to a unit shock in population



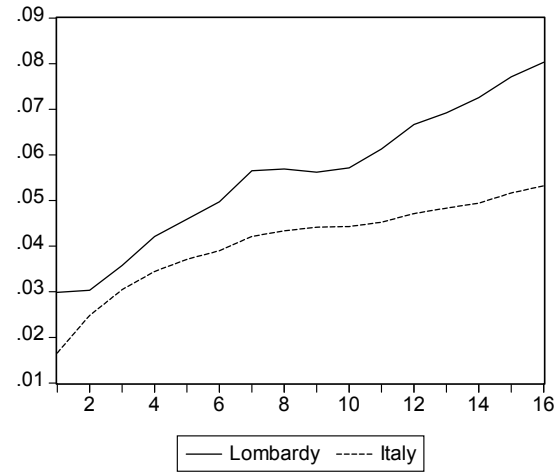
Unemployment response to a unit shock in immigration



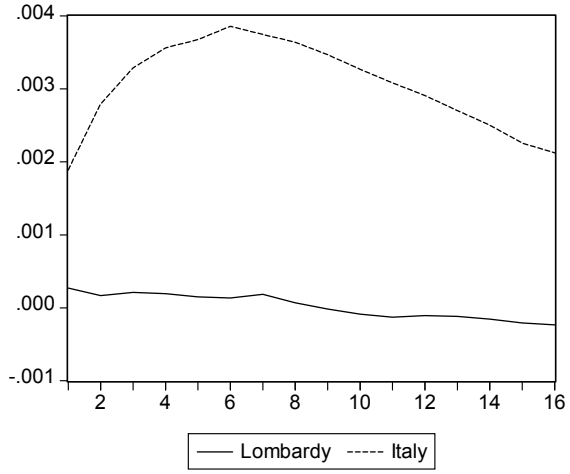
Unemployment response to a unit shock in total factor productivity and value added in industry



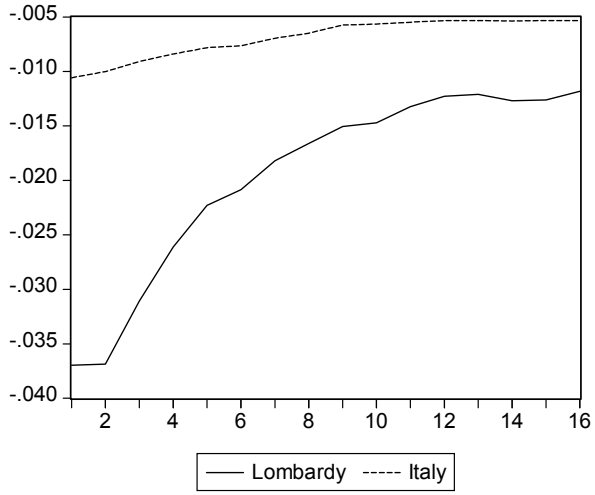
Unemployment response to a unit shock in total factor productivity and value added in services



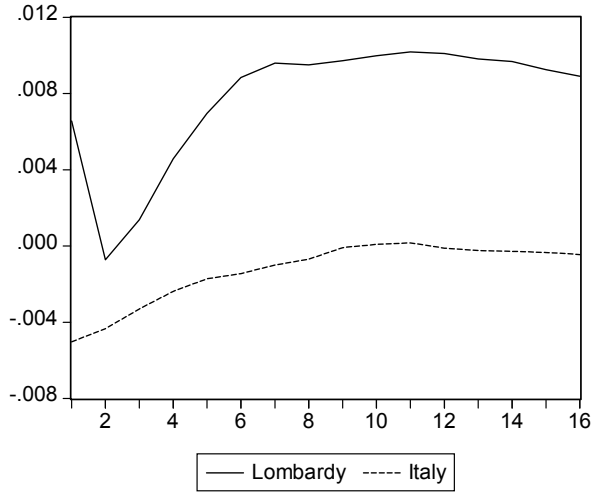
Unemployment response to a unit shock in total factor productivity and value added in agriculture



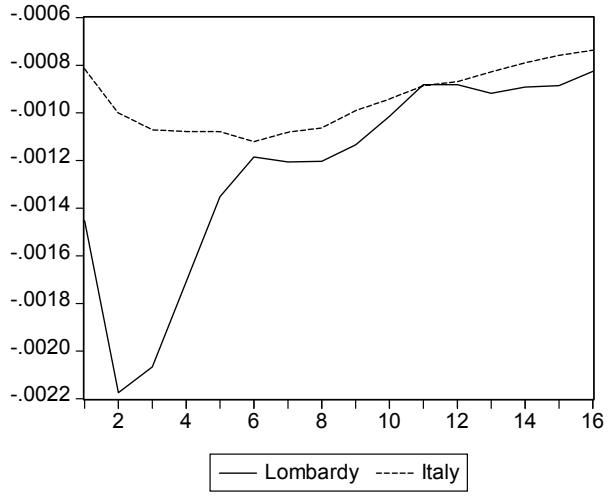
Unemployment response to a unit product prices shock in industry



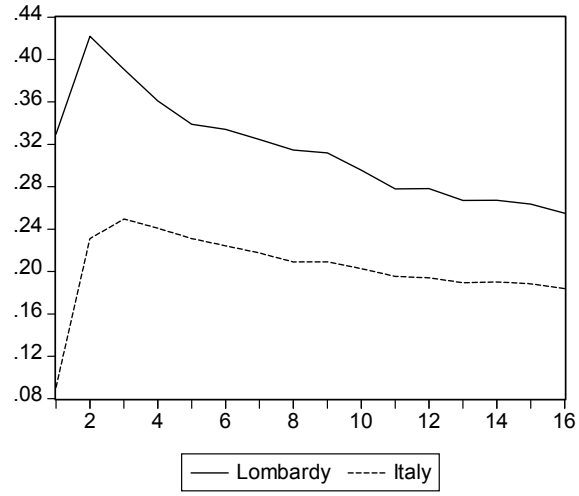
Unemployment response to a unit product prices shock in services



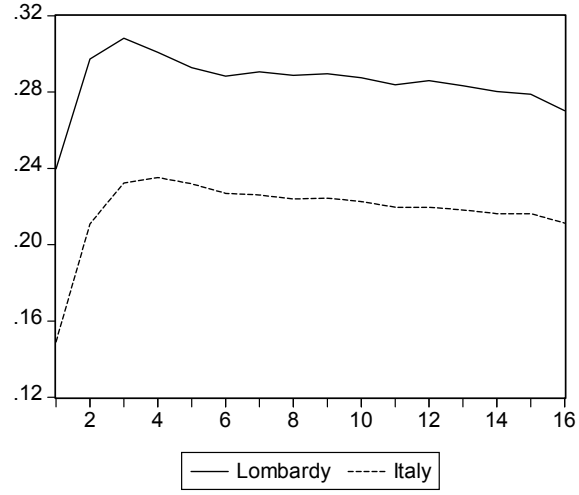
Unemployment response to a unit product prices shock in agriculture



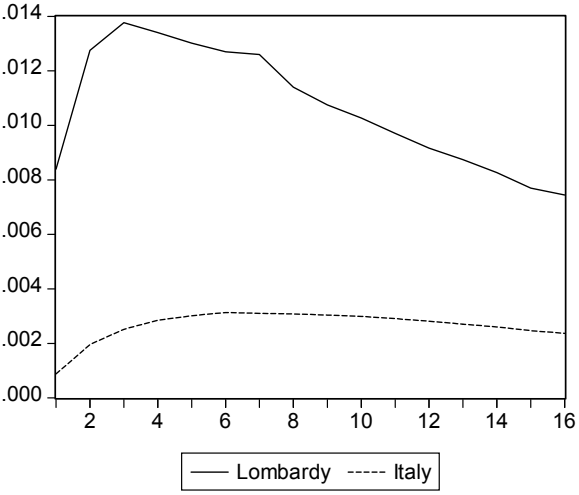
Total employment response to a unit value added shock in industry



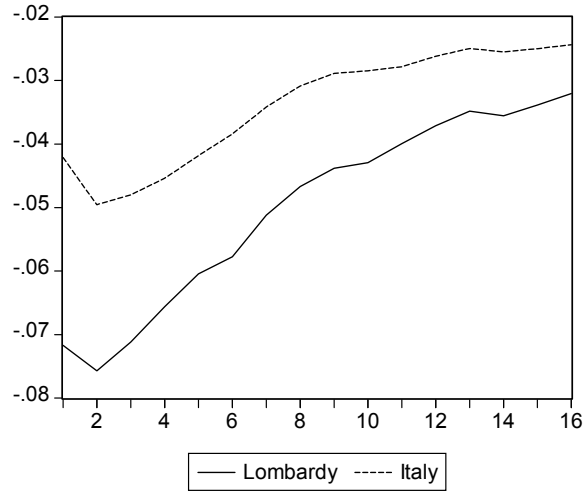
Total employment response to a unit value added shock in services



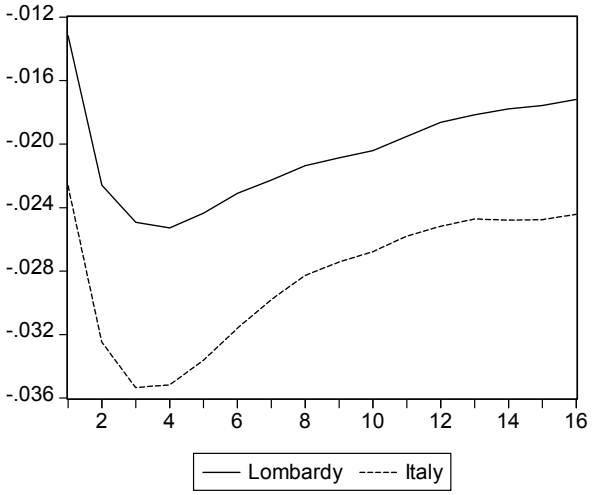
Total employment response to a unit value added shock in agriculture



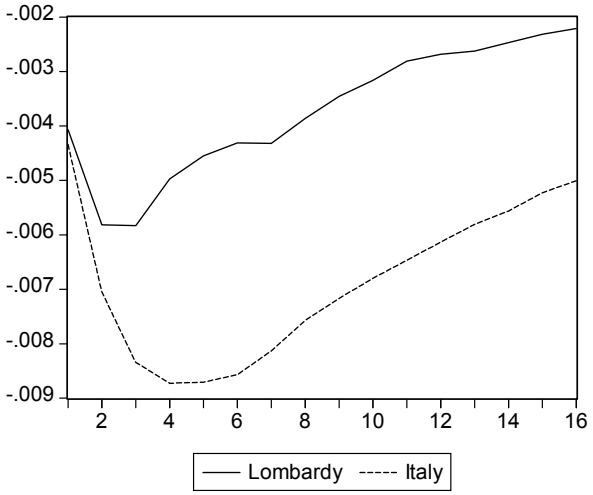
Total employment response to a unit wage shock in industry



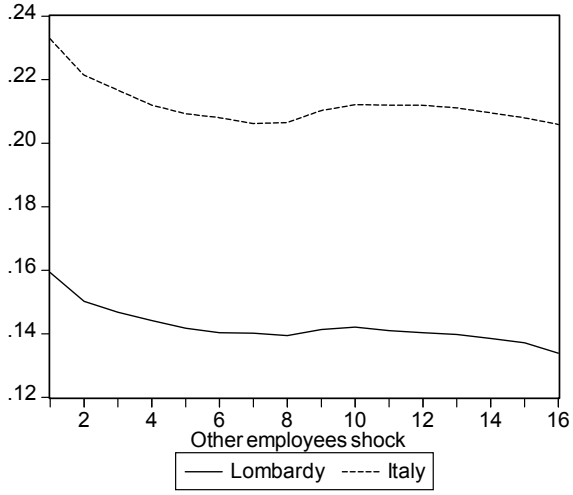
Total employment response to a unit wage shock in services



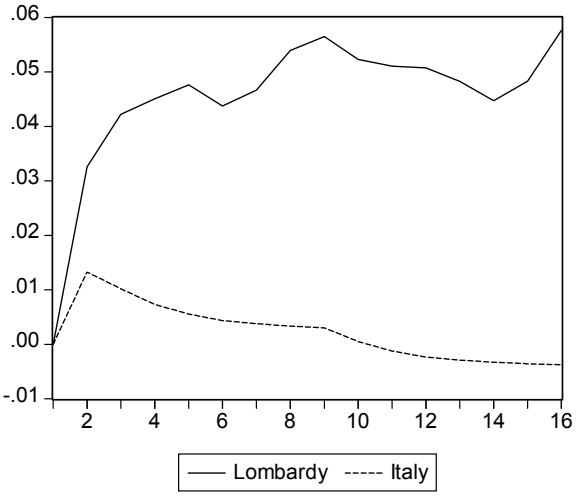
Total employment response to a unit wage shock in agriculture



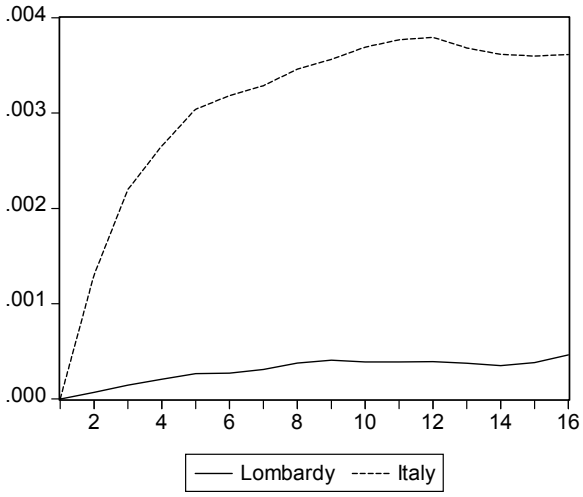
Total employment response to direct creation of employment



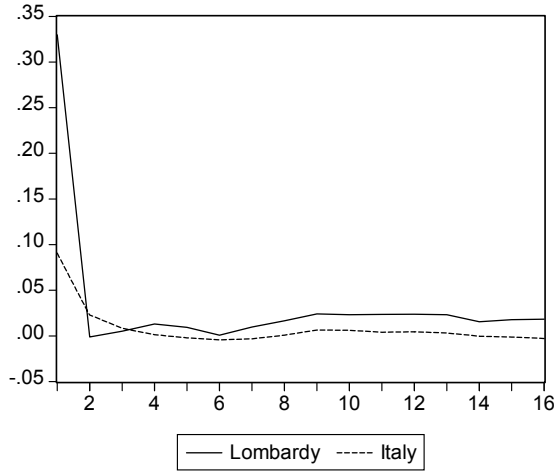
Total employment response to a unit shock in population



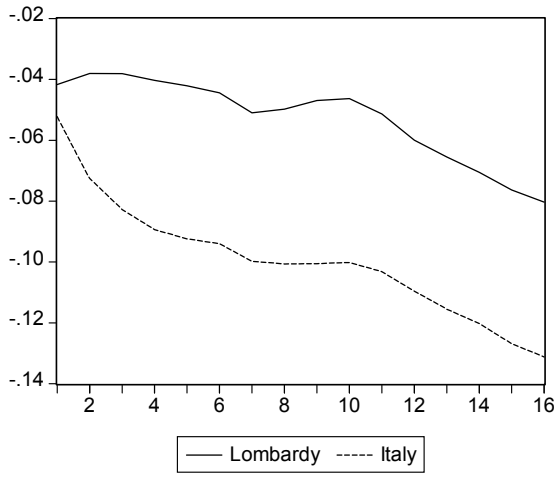
Total employment response to a unit shock in immigration



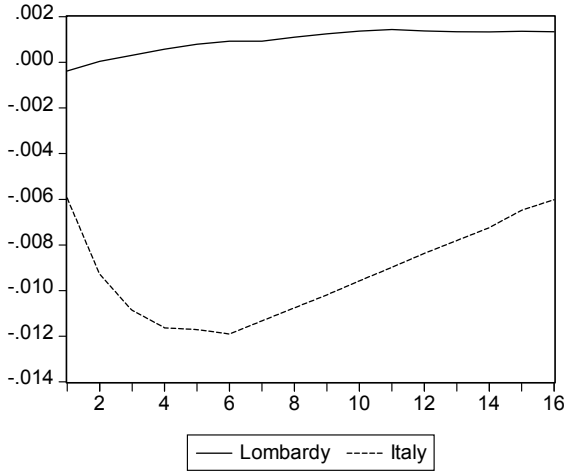
Total employment response to a unit shock in total factor productivity and value added in industry



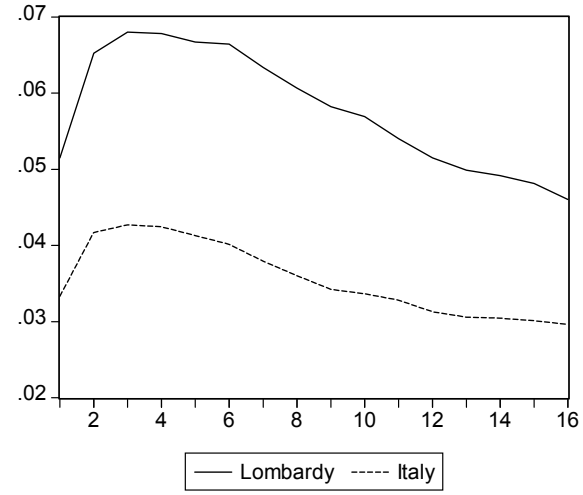
Total employment response to a unit shock in total factor productivity and value added in services



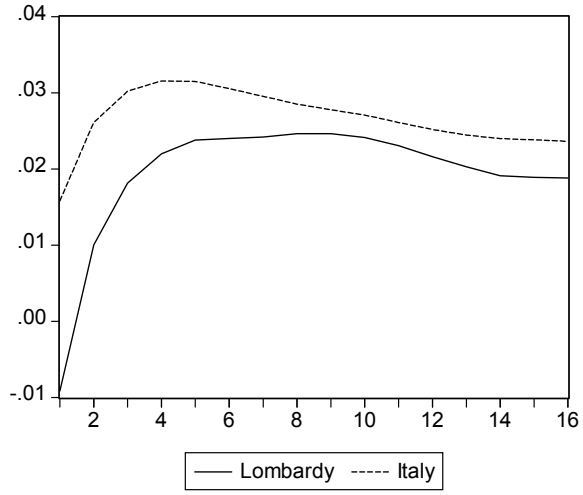
Total employment response to a unit shock in total factor productivity and value added in agriculture



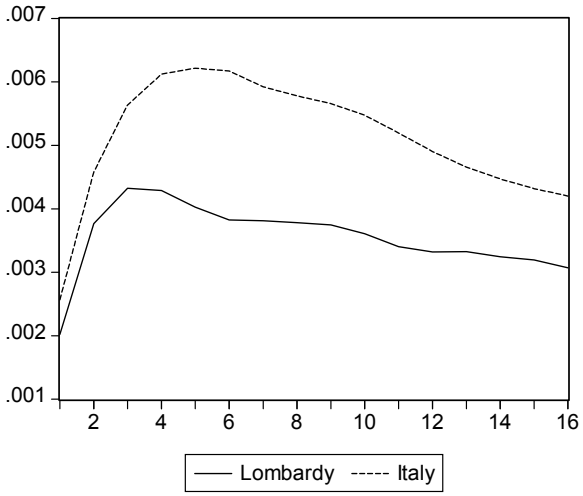
Total employment response to a unit product prices shock in industry



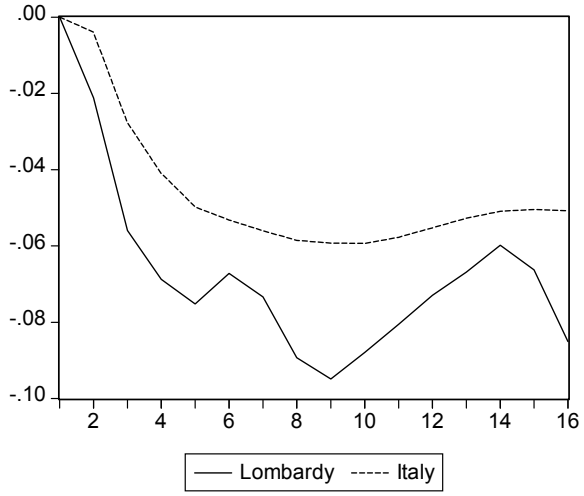
Total employment response to a unit product prices shock in services



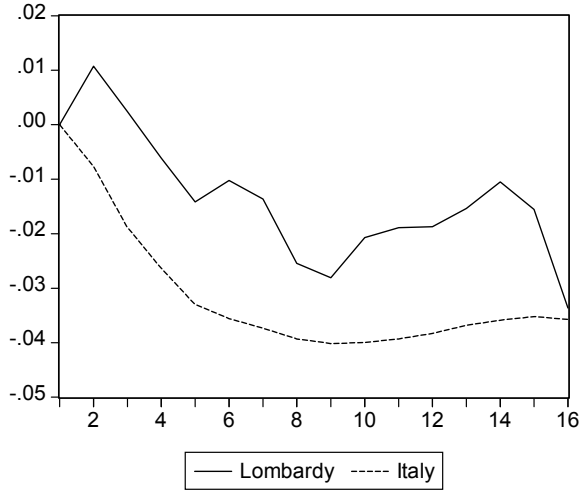
Total employment response to a unit product prices shock in agriculture



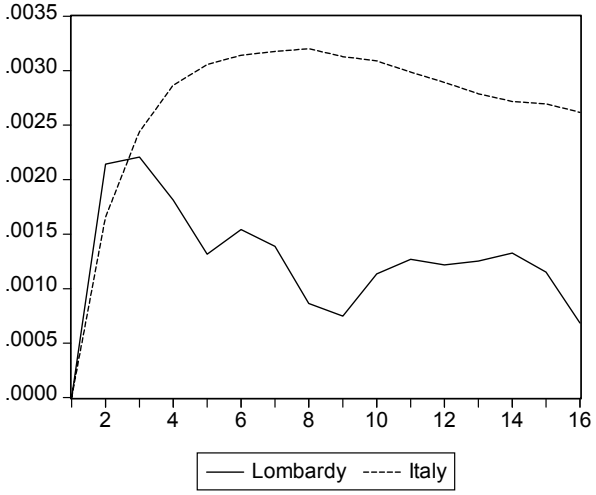
Self employment response to a unit value added shock in industry



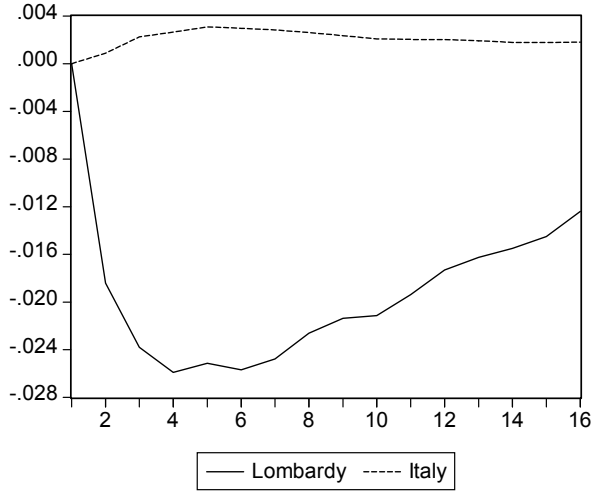
Self employment response to a unit value added shock in services



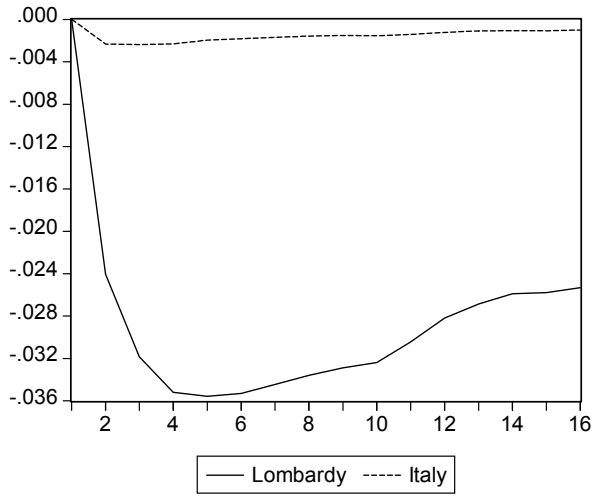
Self employment response to a unit value added shock in agriculture



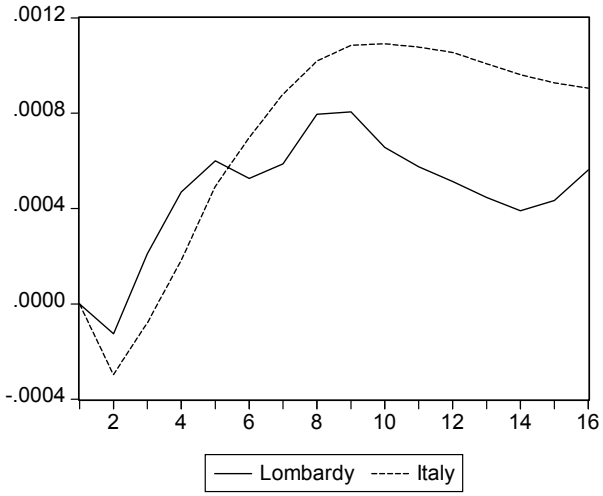
Self employment response to a unit wage shock in industry



Self employment response to a unit wage shock in services

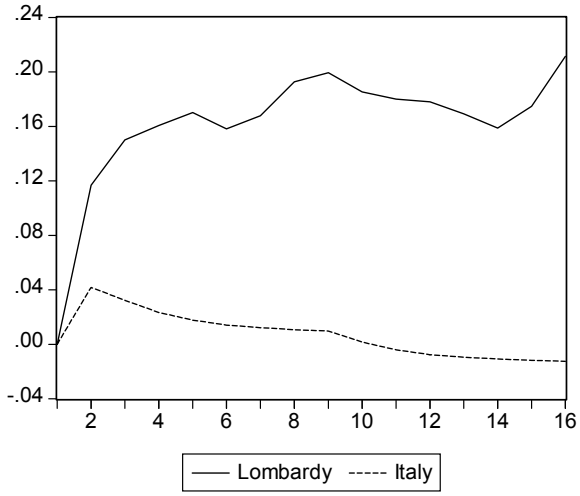


Self employment response to a unit wage shock in agriculture

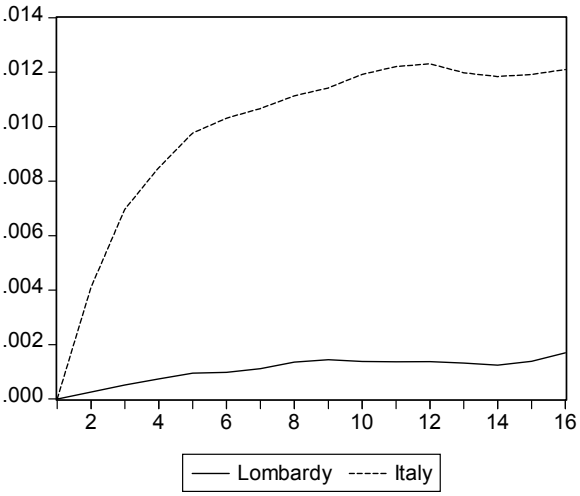


Self employment response to direct creation of employment

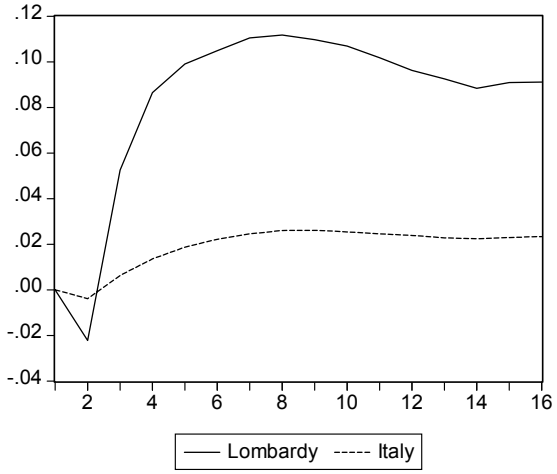
Self employment response to a unit shock in population



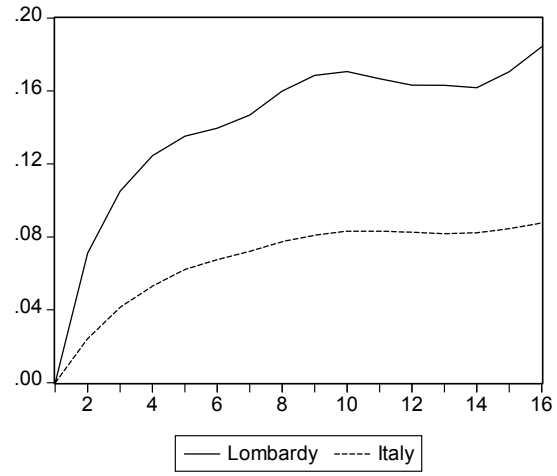
Self employment response to a unit shock in immigration



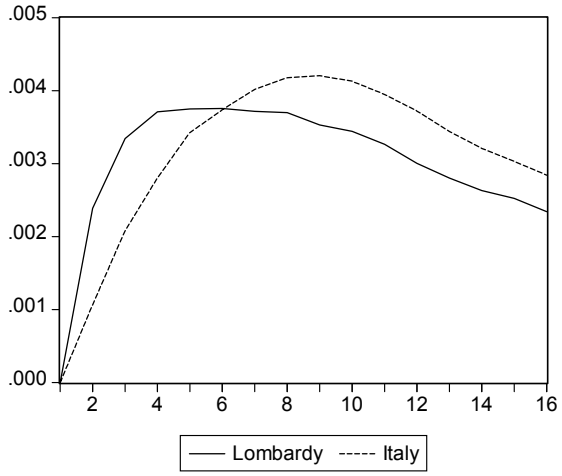
Self employment response to a unit shock in total factor productivity and value added in industry



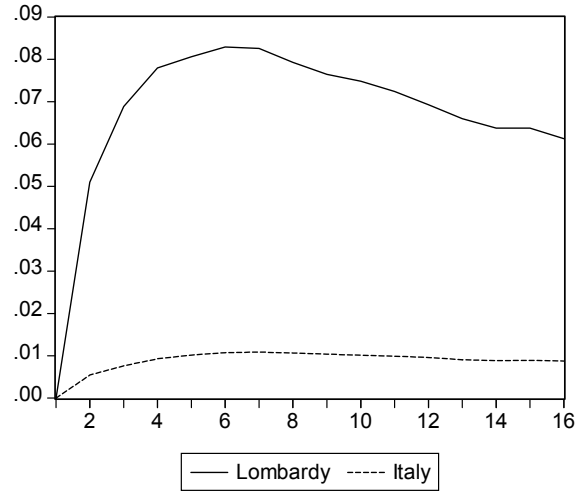
Self employment response to a unit shock in total factor productivity and value added in services



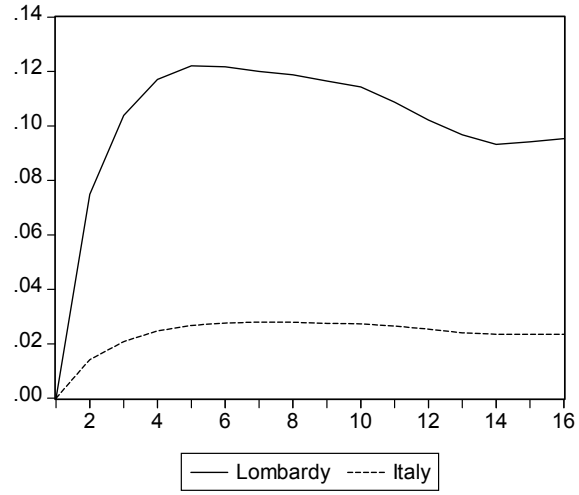
Self employment response to a unit shock in total factor productivity and value added in agriculture



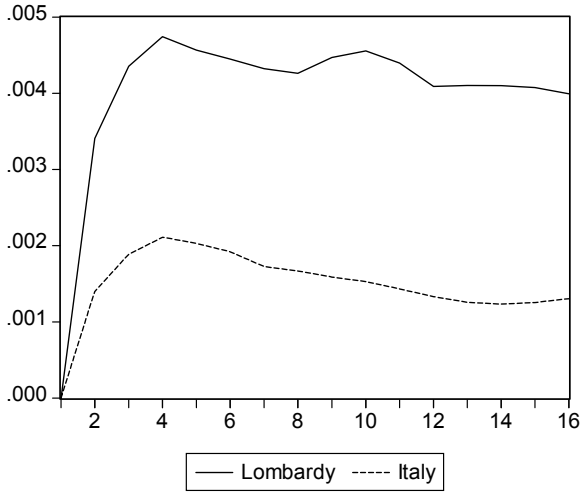
Self employment response to a unit product prices shock in industry



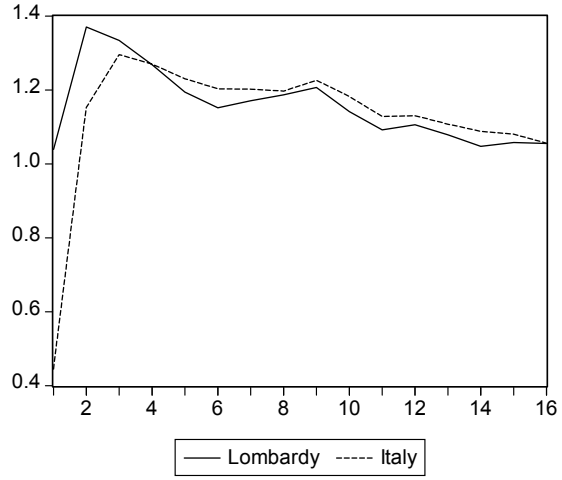
Self employment response to a unit product prices shock in services



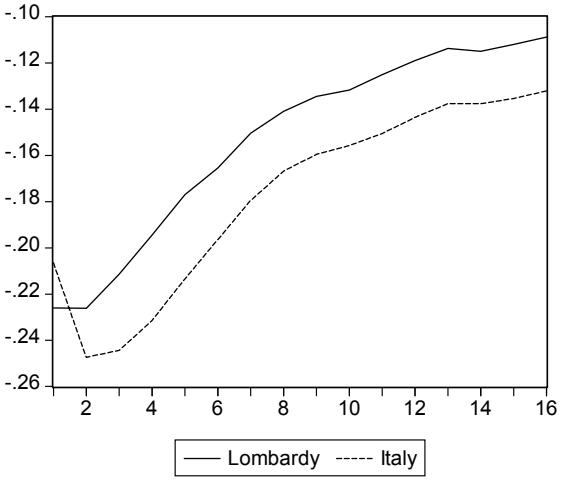
Self employment response to a unit product prices shock in agriculture



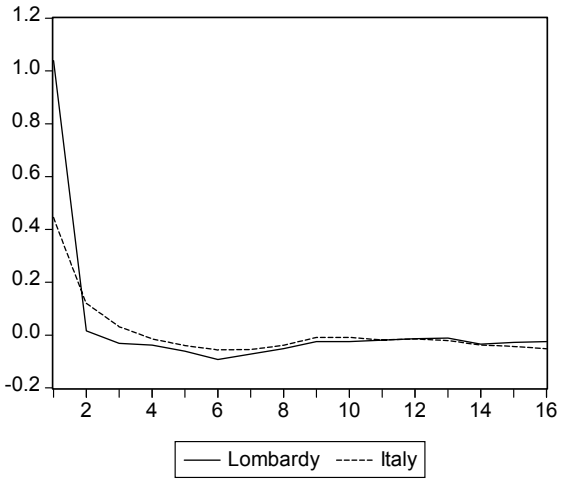
Response of employees in industry to a unit value added shock



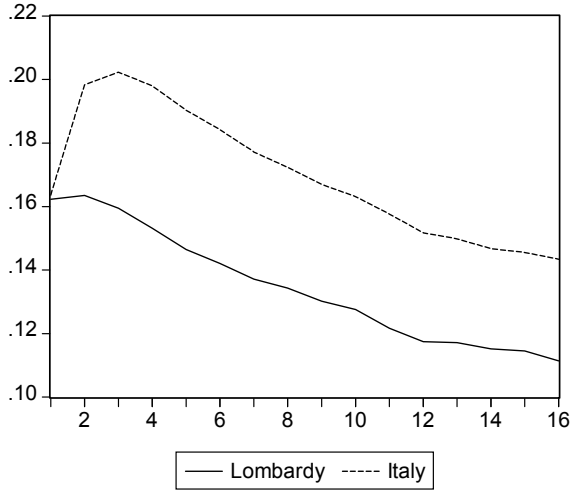
Response of employees in industry to a unit wage shock



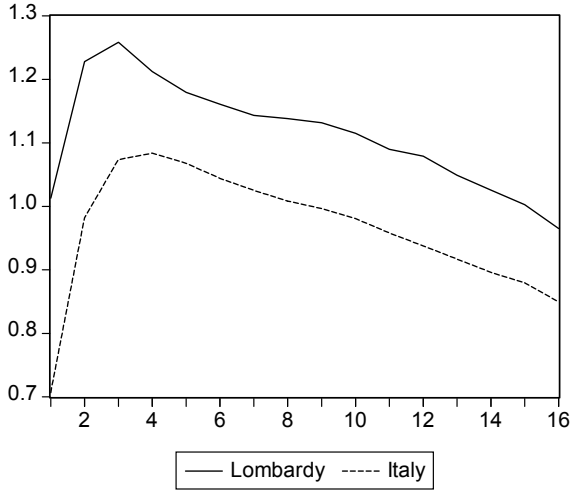
Response of employees in industry to a unit shock
in total factor productivity and value added



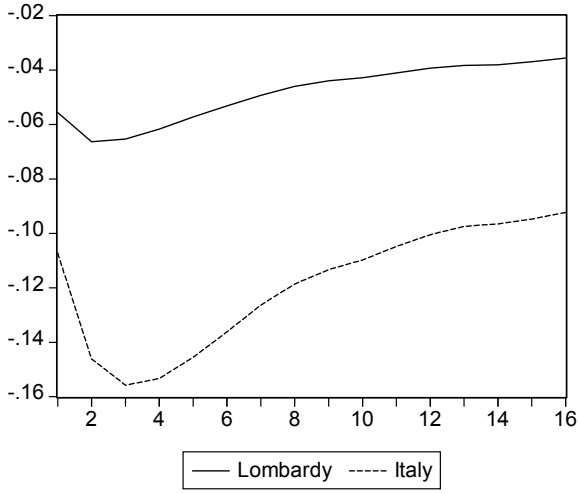
Response of employees in industry to a unit product prices shock in industry



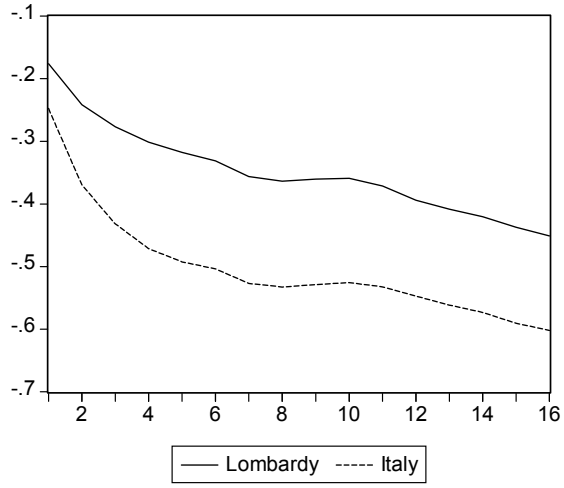
Response of employees in services to a unit value added shock



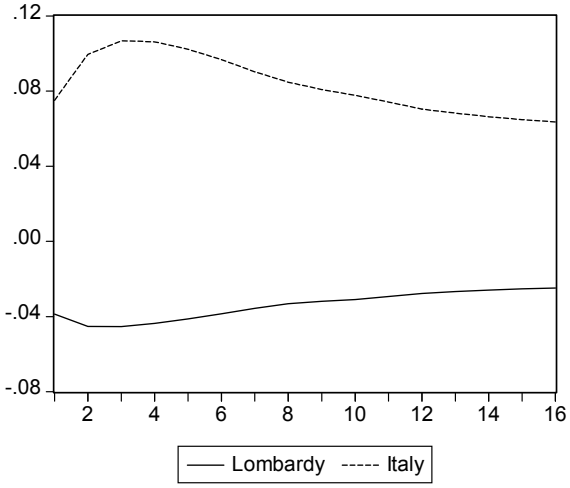
Response of employees in services to a unit wage shock



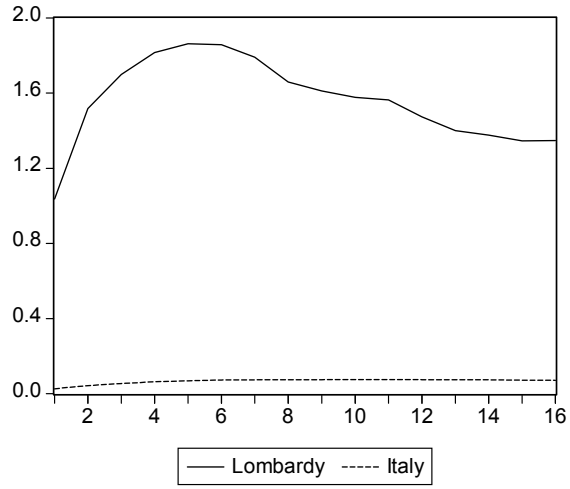
Response of employees in services to a unit shock
in total factor productivity and value added



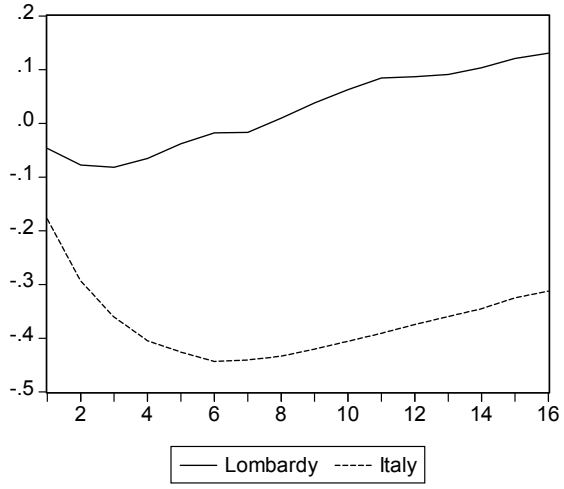
Response of employees in services to a unit product prices shock



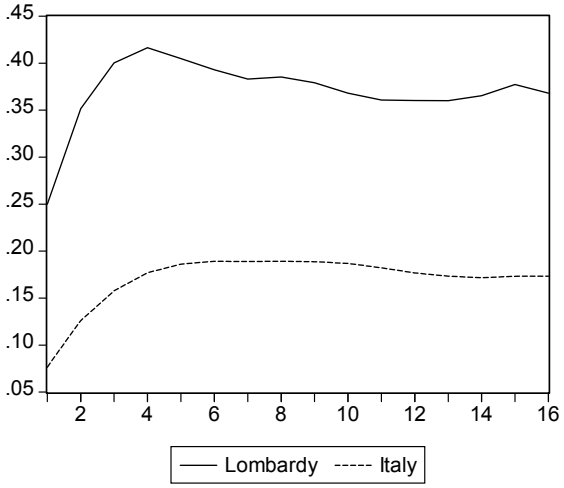
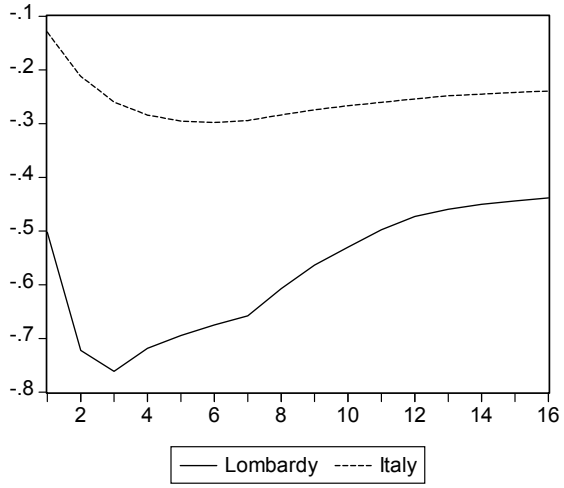
Response of agricultural employees to a unit value added shock in agriculture



Response of employees in agriculture to a unit shock
in total factor productivity and value added



Response of employees in agriculture to a unit product prices shock



Response of employees in agriculture to a unit wage shock