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LABOR TAXES AND WAGES: EVIDENCE FROM ITALY*

Giorgio Brunello
Maria Laura Parisi
Daniela Sonedda

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CESifo
Center for Economic Studies & Ifo Institute for Economic Research
Poschingerstr. 5, 81679 Munich, Germany
Phone: +49 (89) 9224-1410 - Fax: +49 (89) 9224-1409
e-mail: office@CESifo.de
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Abstract

We study the empirical relationship between labor taxation and pretax wages in Italy. We find that higher tax progressivity increases pretax wages. To explain this result, we introduce in an informal way a relative wage effect and argue that the combination of this effect with the labor supply effect dominates the wage moderation effect. We find also evidence that changes in payroll taxes are not fully absorbed by offsetting changes in the pretax wage and affect labor costs and employment. The evidence on the effect of the average income tax rate on pretax wages is more mixed, but it also points to the presence of some degree of real wage resistance. Finally, we find significant differences in the relationship between labor taxes and pretax wages by age group but not by skill or region of residence.

JEL Classification: H24

Keywords: progressive taxation, wage determination, Italy.

Giorgio Brunello
University of Padova
Department of Economic Science
Via del Santo 33
35100 Padova
Italy
Brunello@decon.unipd.it

Maria Laura Parisi
University of Padova
Department of Economic Science
Via del Santo 33
35100 Padova
Italy

Daniela Sonedda
University College London
Gower Street
London WC1 E6 BT
United Kingdom

1 Introduction

1.1 The Problem

Public finance solutions to high unemployment in Europe have often been advocated during the past years. With unemployment concentrated among the young and unskilled, it has been suggested that the reduction of social security contributions for low wage earnings, financed by a carbon tax, could yield a double dividend, the reduction of unemployment and the abatement of pollution (see Sørensen [1997]).

A decline in average labor taxes reduces unemployment if it generates lower pretax wages. Pretax wages fall if real after tax income from unemployment and leisure is not affected or only partially affected by the change in average taxes. When unemployment benefits are not taxed in a unionized economy, lower average labor taxes reduce the replacement ratio, and unions are willing to accept lower pretax wages because the net income loss from employment increases (see Pissarides [1998], Lockwood and Manning [1993]).

Changes in labor taxation do not necessarily require that average labor taxes vary. In principle, a switch from payroll to income taxes, given average rates, could affect wage pressure and unemployment. The empirical evidence to date, however, does not support this possibility (see Nickell and Layard [1999] for a recent review).

When labor taxation is nonlinear, another opportunity is to vary the degree of labor tax progressivity. Economic theory suggests that higher progressivity could reduce unemployment. The economic intuition is illustrated by Calmfors [1995]. Suppose that wages are bargained over by unions. When a union contemplates the possibility of a wage hike, it has to consider that say for a 1% increase in the after tax wage the pretax wage increases by $\frac{1}{\nu}$, where ν denotes the coefficient of residual income progression[2]. This implies that the expected employment loss

[2]The coefficient of residual income progression suggested by Musgrave and Musgrave [1976] is defined as

$$\nu = \frac{1-\tau}{1-t}$$

associated to the higher after tax wage is $\frac{\varepsilon}{\nu}$, where ε is the elasticity of labor demand. Since $\nu < 1$ with progressive taxation, this loss is higher with progressive than with proportional taxation. It follows that, when labor markets are not perfectly competitive, a certain degree of tax progressivity can be desirable because it makes wage increases less attractive to unions, with positive consequences on the unemployment rate.

1.2 Brief Review of the Literature

In spite of its popularity, the empirical support of the view that unemployment can be reduced by cutting average labor taxes has not been overwhelming. In a well known empirical investigation of the causes of European unemployment carried out in the mid 1980s, Bean et al [1986] did not find much correlation between average labor taxes and unemployment rates. As recently argued by Daveri and Tabellini [2000], this pessimistic result could be explained by the fact that Bean and co-authors used cross - section data and ignored the correlation of the relevant variables over time. More recent studies by Scarpetta [1996], Nickell and Layard [1999], Daveri and Tabellini [2000] and Brunello et al [2001], that use time varying data, have documented a significant positive relationship between unemployment rates and average labor taxes.

As discussed above, changes in tax progressivity, holding average labor taxes constant, can affect wage pressure. Given price setting, changes in wage pressure influence employment and unemployment. The existing empirical evidence on the labor market effects of tax progressivity is mixed. On the one hand, Lockwood and Manning [1993] find that an increase of tax progressivity reduces wage pressure in the UK. In empirical studies of Italy and Sweden, Malcomson and Sartor [1984] and Holmlund and Kolm [1995] also find evidence of a negative relationship between tax progressivity and wage pressure. Sorensen [1997] provides further evidence on the positive employment effects of reduced tax progressivity.

where τ (t) stands for the marginal (average) personal income tax rate.

On the other hand, Newell and Symons [1993] find that the change in unemployment between the 1970s and the 1980s is a significantly *increasing* function of the change in marginal tax rates over the same period[3]. Hansen et al [1999] present empirical evidence based on Danish data and distinguish between blue and white collar workers. They find that a reduction of tax progressivity increases the pretax wages of blue collars but have no significant effects on the pretax wages of white collar employees. Finally, Lockwood et al [2000] also study the Danish case and show that the relationship between tax progressivity and pretax wages is negative for low levels of income (and skill) and positive for high levels of income (and skill)[4].

Most studies of the effects of tax progressivity on wages (and employment) consider unionized labor markets and decompose the impact of tax progressivity on pretax wages into a *wage moderation effect* and a *labor supply effect.* As discussed above, the wage moderation effect occurs because, when the marginal tax rate increases, the price of a higher take home pay in terms of foregone employment goes up. This allows the union to buy more employment through wage moderation, because a given fall in the pretax wage leads to a smaller change in the after tax wage (see Sørensen [1997], p.228). The labor supply effect can generate higher wage pressure when an increase in tax progressivity reduces the supply of working hours, because the income effect is dominated by the substitution effect. If the wage moderation effect prevails over the labor supply effect, higher labor tax progressivity reduces pretax wages and increases employment.

Sonedda [2001] develops an overlapping generations model of a unionized economy where hours of work are allowed to vary endogenously. The model is calibrated for Italy, a country where unskilled workers are highly unionized and can use overtime to vary their supply of hours. Her quantitative results show that an increase in income tax progressivity raises union wages, and that the labor supply effect prevails over the wage moderation effect.

[3]See Nickell and Layard [1999], p.3061.

[4]See also Hansen et al [1999].

1.3 Our paper

Overall, our reading of the empirical literature is that there is no broad consensus on the key empirical issues. While most contributions find some effects of average and marginal tax rates on wages (and employment), there is no agreement either on the size or on the direction of these effects.

This empirical paper adds to the existing literature additional evidence based on Italian data. We use both panel and grouped data to study the effects of average and marginal (payroll and income) tax rates on wage pressure, and investigate whether these effects vary by skill, age group and region of residence.

1.4 Key findings

Our empirical findings are summarized as follows:

a) changes in average payroll taxes are not fully absorbed by offsetting changes in the after tax wage and affect both pretax wages and employment;

b) the estimated effects of changes in average income taxes on pretax wages are mixed but on balance the evidence suggests that after tax wages do not fully offset these changes;

c) higher tax progressivity *increases* pretax wages;

d) there are significant differences in the relationship between labor taxes and pretax wages by age group but not by region of residence or skill.

We also find that the estimated elasticity of pretax wages to changes in marginal tax rates, given average rates, is large and ranges between 0.919 and 1.131, depending on the specification being used. It is difficult to explain this large positive elasticity exclusively with the argument that the labor supply effect prevails over the wage moderation effect. Therefore, we add an additional mechanism, the relative wage effect, and describe how it can contribute to producing the above results.

Briefly put, when individuals and unions care about relative wages and an increase in tax progressivity reduces the own wage via the wage

moderation effect, this reduction translates into lower relative wages, which can only be avoided by increasing wage pressure[5]. This idea that unions and employees are concerned not only with the absolute but also with the relative wage goes back at least to Keynes (see Gylfason and Lindbeck [1984]). A relative wage concern can also be justified either by "fairness" (Fehr and Schmidt [1999], Agell and Lundborg [1995], Akerlof and Yellen [1990] and Oswald [1990]) or by "envy" considerations (Clark and Oswald [1996]).

1.5 Outline

The paper is organized as follows. Section 2 introduces the empirical specification and Section 3 presents the data. The empirical results are presented in Section 4 and discussed in Section 5. Conclusions follow.

2 The Empirical Specification

We follow Lockwood and Manning [1993], Holmlund and Kolm [1995] and Lockwood et al [2000] and use the following wage equation in the empirical analysis

$$\ln w_i - \ln q_i = f_i + \alpha_1 \ln(1+t_e) + \alpha_2 \ln(1-t) + \alpha_3 \ln v + \alpha_4 \ln u + \epsilon_i \quad (1)$$

where w is the pretax hourly wage, gross of income taxes but net of payroll taxes, q is the output price, t_e is the payroll tax wedge, defined as the ratio of payroll taxes to pretax wages, t is the average income tax, defined as the ratio of income taxes to pretax wages, $(1-t)$ is the average income tax retention rate, ν is the coefficient of residual income progression, our selected measure of tax progressivity, u is the unemployment rate, i is for the individual, f_i is an individual fixed effect and ϵ_i is the random error term.

This loglinear relationship can be derived from a standard wage bargaining model, where unions and employers bargain over the wage and

[5]See Brunello and Sonedda [2002] for a theoretical model of the relative wage effect.

the employer operates a Cobb Douglas technology and chooses employment to maximize profits. It has the advantage of having been used in previous empirical work, which facilitates the comparison of empirical results.

In this setup, w_i is the pretax wage net of payroll taxes. This wage is related to the total labor cost c_i by the following identity: $\ln c_i = \ln w_i + \ln(1 + t_e)$. Changes in labor taxes, both average and marginal, do not affect per capita labor costs and employment when the following restrictions hold:

$$\alpha_1 = -\frac{t_e}{1 + t_e}; \quad \alpha_2 - \alpha_3 = 0; \; \alpha_3 = 0 \tag{2}$$

When the former two restrictions hold, we say that there is no real wage resistance to change in average labor taxes.

3 The Data

We investigate the relationship between labor taxes and pretax wages in Italy by using two data sets: a panel drawn from the 1993 and 1995 waves of the survey on income and wealth of Italian households, carried out by the Bank of Italy ($SHIW$), and grouped data covering a longer period, from 1977 to 1995, obtained by collapsing data from $SHIW$ and by merging the results with other sources of information. Genuine longitudinal information is available from $SHIW$ only from 1989, and we choose the 1993 - 1995 window to minimize attrition in the data. The main advantage of the grouped data from 1977 to 1995 is that they allow us to exploit the time variation in average and marginal tax rates to study how these variables affect the pretax wage.

The $SHIW$ survey covers most years from 1977 to 1989 and the years 1991, 1993, 1995 and 1998. Individual earnings in this dataset are net of taxes and social security contributions. For each year and for each individual in the sample, we compute pretax wages (gross of income taxes but net of payroll taxes) by using the information on income tax rates, tax brackets and tax allowances from the relevant tax legislation and information on the composition of the household (whether the individual has a dependent spouse and/or children, is a single parent and whether

she is employed or self - employed) from $SHIW$. Given pretax and net wages, we compute for each individual the relevant average and marginal income tax rate. These rates are based on labor income only, and do not take into account additional income from capital and self - employment. Since there is no individual information on social security contributions paid by the employer and by the employee, we use regional data from the Regional Accounts, that cover the period 1977-1995.

Grouped data are obtained by combining information from different sources: wages and income tax rates from $SHIW$, unemployment rates from the Labor Force Survey and payroll taxes from the Regional Accounts. Each cell in the data contains the average value of these variables by gender, educational attainment, age group, macro area of residence and year. We classify educational attainment into two categories, at least upper secondary education (the skilled) and less than upper secondary education (the unskilled). We also group individuals into two age groups, the young (20-29) and the adults (30-59) and in three macro areas of residence (North, Center and South).

While information on unemployment rates and payroll taxes is available for the entire period 1977 - 1995, wages and tax rates are missing in the years when $SHIW$ was not carried out. We take care of these missing values in two ways: first, average and marginal tax rates are linearly interpolated using the available data points; second, pretax wages in the missing years are estimated by using the rate of growth of regional pretax wages, which are available for the full period. Appendix A at the end of the paper provides additional technical details on this issue.

Figure 1 gives a summary description of the data. The first panel of the figure shows that the unemployment rate has increased during the sample period, especially among the unskilled. As a consequence, the relative unskilled unemployment rate has risen from less than 0.5 in 1977 to about 1 in 1995. Nominal gross wages by skill have also increased (see panel 2), and the absolute gap between skilled and unskilled wages was higher in 1995 than in 1977. Panel 3 shows that average income taxes have increased sharply from 1977 to the early eighties and only mildly thereafter. Clearly, the skilled have higher average income tax rates, and

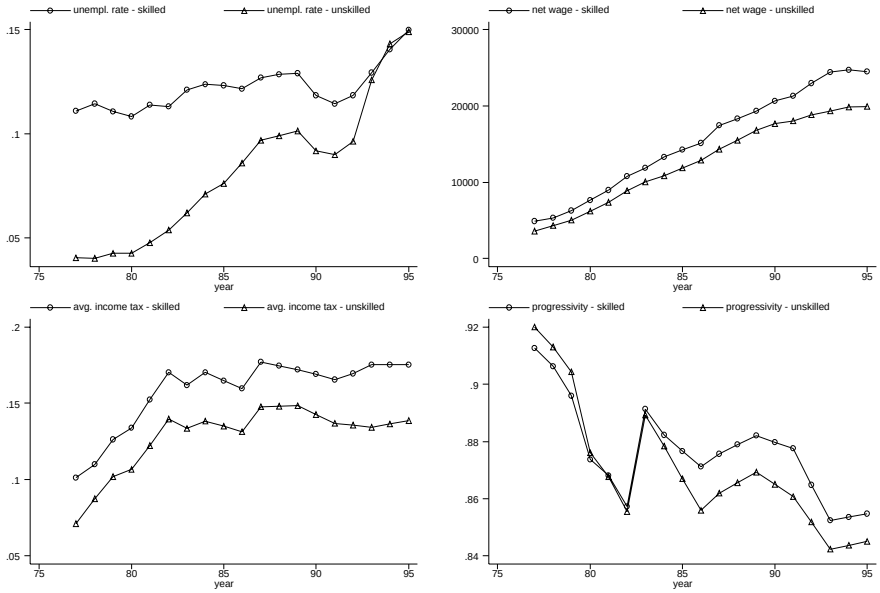

Figure 1: By skill

the absolute gap with the unskilled has slightly increased in the 1990s. Finally, the evolution of tax progressivity is illustrated in the last panel of the figure.

Income tax rates in Italy were almost proportional before the sweeping fiscal reform of 1974, which introduced steeply rising marginal tax rates. This reform was followed by a significant cut in the payroll tax wedge in 1976[6]. In the early 1980s, two-digits inflation increased significantly the average tax rate and tax progressivity. As remarked by Giavazzi and Spaventa [1988]

"..the inflation induced increase in the average tax rate was such that the wedge between the cost of labor for enterprises and take-home pay actually increased in the period, in spite of the substantial cut in contributions...." (p.147)

Since fiscal drag was responsible of a sharp increase in the tax burden of employees, unions started to negotiate with the government both the

[6]See Brunello et al [2001] for a detailed discussion.

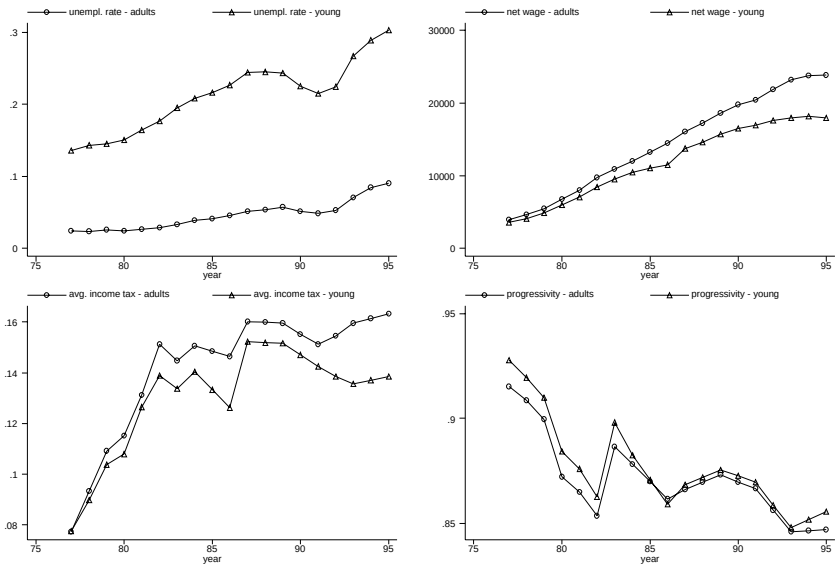

Figure 2: by age

restitution of the drag and measures that could reduce the progressivity of income taxation. These measures were eventually implemented and progressivity was generally lower in the late 1980s than in the 1982 peak. The next decade saw a return of progressivity to a new peak in 1993 and a slight decline thereafter.

Figure 2 presents similar evidence by age group. We notice that youth unemployment is much higher than adult unemployment over the entire sample period. A high gap in the unemployment rate has been accompanied by an increasing gap in the wage differential between the adults and the young. While income tax progressivity does not vary significantly across the two groups, average income taxes paid by the young have declined since the late 1980s and their gap with the tax rates paid by the adults have increased.

Finally, Figure 3 shows the evolution of the average payroll tax wedge from 1977, just after the 10% cut of 1976, to 1995. With the exclusion of the few years at the start of the sample, the wedge increased by close to 10 points from about 0.45 to about 0.55.

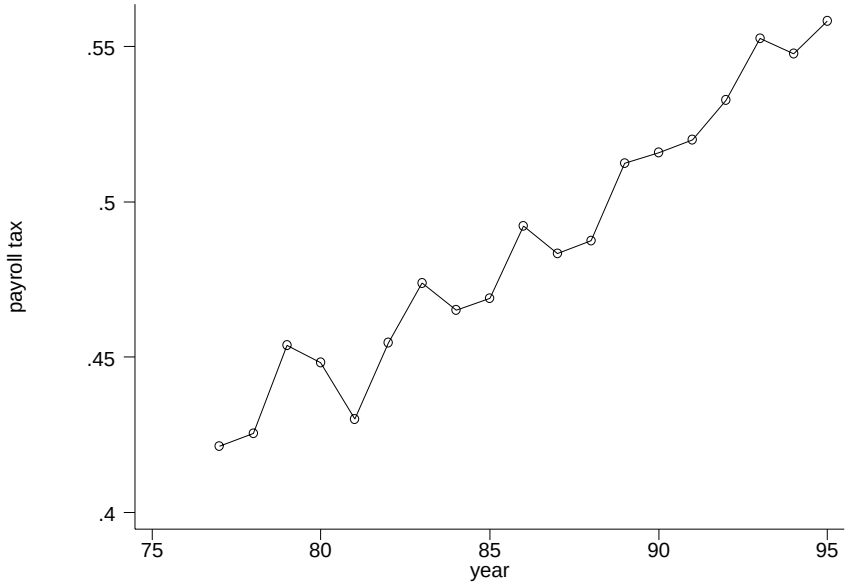

Figure 3: the average payroll tax rate

4 Results

We start our empirical analysis by estimating (1) on the 1993-95 panel. First, we eliminate the individual fixed effect f_i by taking first differences; second, we add to the explanatory variables additional controls, including gender, marital status, age and education. We also include occupation, sector of activity, firm size and region of residence dummies[7]. These dummies fully capture the differences in local labor market conditions, including those in the unemployment rate. Since payroll taxes in our data are only available as regional averages, their effects on individual wages cannot be separately identified once we include regional dummies in the regression.

The dependent variable is the change in the pretax (log) hourly wage, obtained by dividing the annual wage by total hours worked (defined as weekly hours by number of weeks by number of months of employment). By construction, shocks to individual pretax hourly wages affect both tax progressivity and the average income tax retention rate $(1-t)$. The

[7]We use region of residence in 1993.

endogeneity of the current changes in tax progressivity and in the retention rate requires that we use instrumental variables[8]. Our selected instruments include the 1991 to 1993 changes in both variables, computed from grouped data. We also add the change in a dummy indicating the presence of a dependent spouse in the household, the change in a dummy indicating whether the household has purchased a life insurance, a private health insurance or a private pension scheme, and a dummy indicating whether the individual has had medical or college expenses in 1993. All these variables affect tax deductions and income tax rates without any obvious effect on the hourly wage.

Instrument validity is tested with the Sargan criterion, a misspecification test of whether additional instruments can be omitted from the vector of explanatory variables. The quality of instruments is tested with the Bound test, an F test of the additional instruments in the regression of each endogenous variable on the full list of instruments.

Since our data have a regional dimension, spatial effects are likely to be important. We test model misspecification due to spatial dependence in the form of spatial autocorrelation with Moran's I test. The technical details on the construction of this test are in Appendix B at the end of the paper.

Our main results are reported in Table 1, which shows both the estimated coefficients and the implied wage elasticity of each tax variable[9]. The Sargan criterion clearly rejects the hypothesis of misspecification. Not reported in the table, the Bound tests suggest that the selected instruments are significantly correlated with each endogenous variable. Finally, Moran's I cannot reject the null hypothesis of no spatial residual dependence, which suggests that potential regional correlation has been sufficiently captured by our explanatory variables.

We find that higher marginal taxes, given the retention rate, significantly *increase* the pretax wage. A similar result holds also for average taxes, given tax progressivity. The estimated coefficients associated to the change in the average tax retention rate and to the change in tax

[8]See Gruber [1997] for a discussion.

[9]These elasticities are computed using the sample averages of τ and t in 1995.

Table 1: IV estimates of (1) based on panel data (1993-95). Dependent variable: two - year change in log hourly pre-tax wage

	Coefficient
$\Delta_2 \ln(1 - T_a)$	-2.693
	(.818)
$\Delta_2 \ln V$	-2.612
	(.877)
η_1	.017
η_2	1.131
$Nobs$	2233
R^2	.285
SC	.336
I	.568

Note: Each regression includes a constant, individual age and marital status, plus gender, part time, education, region, occupation, firm size, sector dummies. Additional instruments are the changes in the average retention rate between 1991 and 1993, in tax progressivity between 1991 and 1993 and between 1989 and 1991, computed from grouped data, the changes in the number of dependent children, in a dummy indicating whether the spouse is dependent, in dummies indicating whether the household has purchased a life insurance, a private health insurance or a private pension scheme, and a dummy showing medical and college expenses in 1993. Robust standard errors within parentheses. η_1 : average income tax elasticity of the gross wage; η_2 : marginal income tax elasticity of the gross wage. I : value of Moran's I statistic, which has a $\chi(1)$ distribution. The critical value of the test at 5% is 3.84. SC : P- value of the Sargan test for the validity of instruments.

progressivity are not significantly different from each other (P-value of the test: 0.68). Therefore, and conditional on marginal taxes, changes in average labor tax rates do not significantly affect changes in pretax hourly wages (the implied elasticity is equal to 0.017). On the other hand, changes in the marginal tax rate, given average taxes, have a large and significant positive effect on hourly wage changes (the implied elasticity is equal to 1.131).

The evidence in Table 1 is based on the cross - sectional variation of changes in taxation and changes in hourly wages. These changes cover

a short period of time (two years), when tax rates exhibited relatively little variation. The longitudinal dataset could be extended backward to 1989 and forward to 1998 at the price of significant attrition[10]. A more appealing alternative is to use grouped annual data from 1977 to 1995. In these data, each cell contains average values classified by year, gender, age group, macro area of residence and educational attainment. We have information on pretax and net annual wages[11], the unemployment rate, the average and the marginal personal income tax rate. One important implication of using annual rather than hourly wages is that changes in annual wages incorporate also changes in annual worked hours.

We estimate the empirical model (1), with the caveat that the subscript i is now for the cell rather than for the individual. Rather than taking first differences, we capture the cell specific fixed effect with gender, education, age and area dummies and estimate two alternative empirical specifications. In the former specification we regress cell - specific annual wages on cell - specific retention rates, tax progressivity and unemployment rates and model aggregate, region, age and skill specific effects with time dummies and interactions of these dummies with region of residence, educational attainment and age. Since payroll taxes are available only at the regional level, these dummies capture also the impact of payroll taxes on pretax wages.

In the latter specification, we add lagged payroll tax rates[12] to the list of regressors and model the remaining aggregate, region, age and skill specific effects with a linear and a quadratic trend and with the interactions of these trends with region, educational and age dummies. The second specification allows us to identify the effect of payroll taxes at the price of imposing restrictions on the shape of aggregate, region, age and skill specific effects.

By construction, income tax rates and cell - specific unemployment rates u are endogenous. A disadvantage of the longer span of time is that most of the variables used as instruments in Table 1 are not available.

[10]The inclusion of 1991 would reduce the sample size from 2233 to 1650 individuals.

[11]Since hours of work are not available in the first part of the sample, we use annual wages, the product of hourly wages by annual worked hours.

[12]We use lagged rather than current values to avoid endogeneity issues.

An advantage is that we have a richer lag structure. We exploit this advantage by selecting as additional instruments the first and second lags of the average income tax retention rate, the first lag of log tax progressivity and the first and second lag of log regional unemployment.

Table 2 shows our estimates for the full sample, with the former specification in the first column and the latter specification in the second column. Since the payroll tax is defined at a higher level of aggregation than the annual wage, Column (2) reports IV estimates with standard errors corrected for the lack of independence of errors within regions of residence. The Sargan criterion always rejects the hypothesis of misspecification. Moreover, the Moran's I test cannot reject the null of no spatial residual dependence.

Both columns in the table show that a higher average income tax retention rate and a lower rate of tax progressivity significantly reduce pretax annual wages. These findings broadly confirm the results in Table 1. Compared to that table and conditional on marginal tax rates, we find that changes in average income taxes have a positive and significant effect on the pretax wage, thereby suggesting the presence of real wage resistance. We also find that the impact of marginal taxes on wage pressure, given average taxes, is positive and quantitatively similar to that found in Table 1. Moreover, a one percentage point increase in payroll taxation is estimated to increase labor costs per head by 0.427[13]. Overall, this evidence suggests that increases in average income and payroll taxes are only partially absorbed by reductions in take home pay and affect pretax wages, labor costs per head and (un)employment.

Next we ask whether the impact of marginal and average taxes on pretax wages vary by skill, age and region of residence, where skill is measured by educational attainment. This is done by selecting the empirical specification in the second column of Table 2 and by interacting the main regressors either with the dummy $UNSK$, equal to one for cells

[13]This elasticity is computed as follows

$$\frac{\partial \ln c}{\partial \ln t_e} = (1 + \frac{\partial \ln w}{\partial \ln t_e}) \frac{t_e}{1 + t_e}$$

Table 2: IV estimates of (1) based on grouped data. Dependent variable: log annual pretax wage

	(1)	(2)
$\ln(1-T_a)$	-4.656	-5.895
	(.431)	(.411)
$\ln V$	-2.857	-2.735
	(.495)	(.493)
u	-.060	-.029
	(.011)	(.009)
$\ln(1+T_e)_{-1}$	-	1.002
		(.194)
η_1	.298°	.524°
η_2	.960	.919
η_3	-	.324†
η_4	-	.427
$Nobs$	408	408
R^2	.986	.965
SC	.315	.374
I	1.085	3.376
$Regressors$	time dummies	trends

Note: Additional instruments include first and second lags of the average retention rate, first lag of log tax progressivity, first and second lag of log regional unemployment. Robust standard errors in Column (1) and cluster adjusted robust standard errors in Column (2) within parentheses. η_1 : average income tax elasticity of the gross wage; η_2 : marginal income tax elasticity of the gross wage; η_3: payroll tax elasticity of the gross wage; η_4: payroll tax elasticity of the labor cost; SC : P- value of the Sargan test for the validity of instruments. ° and † if the estimated elasticity is significantly different from zero and one at the 10 percent level of confidence. I : value of Moran's I statistic, which has a $\chi(1)$ distribution. The critical value of the test at 5% is 3.84.

of individuals with less than upper secondary education and to zero otherwise, or with the dummy $YOUNG$, equal to one if the cell consists of individuals younger than 30 and to zero otherwise, or finally with the dummy $SOUTH$, equal to one for cells of individuals that live and work in the South of Italy and to zero otherwise.

We use the Wald test to verify whether the interactions of these dummies with the tax variables are jointly different from zero. Table 3 illustrates the results. The P-values of the Wald tests in the table show that only the interactions with $YOUNG$ are (jointly) significantly different from zero. Therefore, there is evidence in our data that the relationship between taxation and pretax wages varies significantly by age group but not by skill or region. This result is in line with the findings by Lockwood and al. [2000], who show that in the Danish data there are significant differences by income level in the effects of tax progressivity on wages, and in contrast with Brunello et al [2001], who find that average labor taxes (inclusive of payroll and income taxes) have a significantly lower impact on Southern pretax wages than in the rest of the country. We speculate that this contrast is due to the fact that we exclude in our sample the period from the mid 1960s to the late 1970s, when the regional difference in the dynamics of average tax rates was much sharper[14].

We find that the elasticity of the pretax wage to changes in tax progressivity is lower in the younger (0.354) than in the older age group (0.791). On the other hand, the elasticity of the pretax wage to changes in the income tax retention rate and in the payroll tax is higher among the young (0.678 and 0.406 respectively) than among the adults (0.617 and 0.123 respectively). Only for payroll taxes, however, is the observed difference in the elasticities significantly different from zero.

The higher real wage resistance to changes in payroll taxes among the young could be explained with the fact that the wages of this group have been relatively close to sectorial wage floors set by collective bargaining in an economic environment characterized by increasing payroll taxes. As a consequence, the take home pay of this group could not adjust

[14]See Brunello et al [2001] for more details.

Table 3. IV estimates of (1) based on grouped data. Dependent variable: log annual pretax wage. With age, skill and region of residence interactions.

	(1)	(2)	(3)
$\ln(1-T_a)$	-5.708	-5.655	-5.981
	(.770)	(.426)	(.582)
$\ln V$	-1.988	-2.222	-1.936
	(.515)	(.541)	(.496)
u	-.035	-.047	-.029
	(.010)	(.011)	(.011)
$\ln(1+T_e)_{-1}$	1.020	.381	.806
	(.169)	(.375)	(.277)
Interactions with $\ln(1-T_a)$	-.361	.067	.328
	(.409)	(.366)	(.128)
Interactions with $\ln V$	-.736	1.099	-.669
	(.371)	(.424)	(.608)
Interactions with u	.006	.064	-.013
	(.002)	(.008)	(.003)
Interactions with $\ln(1+T_e)_{-1}$	-.129	.876	.382
	(.059)	(.348)	(.497)
Nobs	408	408	408
Wald Test	.176	.025	.246
SC	.321	.564	.341
R^2	968	.975	.970
Regressors	trends	trends	trends

Note: interactions with $UNSK$ in column (1); interactions with $YOUNG$ in column (2); interactions with $SOUTH$ in column (3). Additional instruments include first and second lags of the average retention rate, first lag of log tax progressivity, first and second lag of log regional unemployment plus all interactions with the dummies $UNSK$, $YOUNG$ and $SOUTH$. Cluster adjusted robust standard errors within parentheses. SC : P- value of the Sargan test for the validity of instruments.

downward as much as in the case of adult workers to compensate for the higher payroll taxes. An alternative explanation is that unionized young workers involved in collective bargains have valued the employment costs associated to after tax wage gains relatively less than unionized adults.

We can further illustrate our results by means of the following policy experiment. Marginal income taxes in our sample have increased from 1977 to 1995 by close to 39%, and the relative employment of the young has fallen during the same period by close to 25%. Suppose that the government decides to keep average income taxes unchanged, to reduce the marginal income tax rate borne by the young by 10% and to increase it by the same amount for the adults. Since the young earn on average lower annual wages, this can be accomplished by reducing progressivity for the low wage income group and by increasing it for the high wage income group. Assuming that the estimated wage pressure equation is invariant to this policy experiment, our estimates in the second column of Table 3 suggest that the relative pretax wage of the young would fall by 11.45%, a substantial reduction.

The evaluation of the employment consequences of such reduction requires an estimate of the elasticity of relative employment to changes in relative labor costs. Following Katz and Autor [1999], we estimate a relative labor demand equation, where the dependent variable is the log of youth employment relative to adult employment and the explanatory variables are regional, gender and skill dummies, linear and quadratic trends interacted with regional dummies, lagged relative log employment and the current and lagged predicted log relative gross wage, computed after fitting the annual wage of the young and of the adults on the full set of instruments used in Table 3.

It turns out that the estimated long run elasticity of relative employment to relative labor costs is -0.942. Using these estimates, the 11.45% reduction in the relative wage of the young generated by the policy experiment would increase the relative employment of the young by an hefty 10.78%, from 0.279 to 0.309, close to the value taken in 1992. This simple experiment suggests that in Italy changes in tax policy can have significant effects on relative employment.

5 Discussion

We have found that higher tax progressivity increases pretax wages. There is also evidence that changes in payroll taxes are not fully absorbed by offsetting changes in the pretax wage and affect labor costs and employment. The evidence on the effect of the average income tax rate on pretax wages is more mixed and varies with the data set being used, but on balance it also points to the presence of some degree of real wage resistance. Finally, we have found significant differences in the relationship between labor taxes and pretax wages by age group but not by skill or region of residence.

Our finding that there is real wage resistance in the relationship between labor taxes and pretax wages is not surprising in the Italian institutional environment. Income from unemployment in this country includes both ordinary unemployment benefits and more generous unemployment subsidies paid to dismissed employees from large firms. Provided that income is above a given threshold, both are subject to income taxes, but the latter are exempt from taxation after the first year of unemployment[15]. Neither is subject to payroll taxes, that constitute the largest share of the overall tax wedge. When income from unemployment is only partially taxed, changes in average taxes (both payroll and income) affect wage pressure by influencing the replacement rate.

Our results are also consistent with previous research. Daveri and Tabellini [2000] find that taxes affect unemployment relatively more in countries like Italy with an intermediate degree of centralization of the wage bargain. Brunello et al [2001] show that the long term relationship between the regional average labor tax wedge and regional unemployment is significant and large.

The positive effect of higher marginal income tax rates on pretax wages, given average rates, is not in line with most of the empirical literature, which typically finds a negative effect (see the review in subsection 1.2). Perhaps even more striking is the large size of the estimated

[15]Dismissed workers from large firms are enrolled in "mobility lists" and can draw subsidies for longer than one year if they live in the South or are older than 40. See Brunello and Miniaci [1997] for details.

elasticity of pretax wages to changes in marginal tax rates, that ranges from 0.919 to 1.131, depending on the data being used. We believe it is unlikely that such a large effect can be explained in terms of the sole labor supply effect.

An additional effect that works in the right direction is the relative wage effect. In Brunello and Sonedda [2002] we model a two sector economy with the following features: labor markets are unionized and product markets are competitive, workers and unions care about their absolute and relative wages, and unions in each sector set wages by taking into account the effects of their own decisions on the other sector wage. In this context, we show that the presence of a relative wage concern reinforces the labor supply effect and could help in generating a strong positive relationship between tax progressivity and wage pressure.

The economic mechanism at work can be illustrated as follows[16]. On the one hand, the union in one sector realizes that a decline in its sectorial wage induced by higher tax progressivity (the wage moderation effect) is going to reduce its relative wage, and reacts to this by increasing wage pressure. On the other hand, the union in the other sector notices that the former union can avoid the expected reduction in the relative wage by bargaining for a higher wage. In order to prevent the deterioration in its own relative wage, the latter union also increases wage pressure. These effects are amplified by the strategic complementarity between the two wages and generate an increase in average wage pressure.

This insight can also be used to speculate on our empirical finding that the relationship between labor income taxes and pretax wages does not vary significantly by skill. Hansen et al [1999] and Lockwood et al [2000] argue that, if the unskilled are heavily unionized and have a flat labor supply function, the wage moderation effect should prevail on the labor supply effect. Therefore, the negative impact of tax progressivity on pretax wages should be stronger for the unskilled than for the skilled. When the relative wage effect is taken into account, the sign of this effect does not vary by skill group, because wages are strategic complements. At the same time, if the relative wage effect is important,

[16]See Brunello and Sonedda [2002] for further details.

it could dampen the differences in the elasticity of pretax wages with respect to changes in labor taxes.

6 Conclusions

We have started this paper by saying that public finance solutions to high unemployment have received much attention both in the policy and in the academic debate. Proposals to reduce taxes in order to fight high unemployment have often been met with scepticism, because of the lack of fully persuasive empirical evidence in support of a positive relationship between labor taxation and unemployment.

Our paper uses Italian data to show that changes in labor taxation, both average and marginal, significantly affect wage pressure. In a standard unionized labor market model where unemployment is determined by the interaction of wage pressure with the price setting decisions of firms, significant changes in wage pressure affect equilibrium unemployment.

Labor taxation also affects relative (un)employment. As illustrated at the end of the Section 4, a switch of tax progressivity from the young to the adults could help reduce the relative unemployment of the young. A message of this paper is not only that this tax instrument can be effective, but also that is should be used in the same direction as the other tax instruments (average income and payroll taxes).

7 Appendix

A. Data and variables

The Bank of Italy [2000] supplies information on net income for each individual in the interviewed household. Income can be from employment, self - employment and welfare (pensions and other benefits). For each household, there is also information both on the number of individuals earning income and on the number of dependents (spouse or children). This information is available by gender, educational attainment, occupation, sector of activity, region of residence and age. The survey covers the years from 1977 to 1989 (with the exclusion of 1985), 1991,

1993, 1995 and 1998. In the longitudinal panel, we use the 1993 and the 1995 wave. In the grouped data, we focus on the period 1979-1995.

For each year, pretax wages w are calculated from the available information on net wages nw and tax legislation as follows

$$w = \frac{(nw - basdet)}{(1 - T_{mi})} + \frac{[max_1 * (T_{m1} - T_{m2}) + ... + max_{i-1} * (T_{mi-1} - T_{mi})]}{(1 - T_{mi})} \tag{A1}$$

where w is the pretax wage, nw the net wage, $basdet$ are tax deductions, which vary with the type and level of income, with the number of dependent children and with whether the individual is single or have a dependent spouse, and max_i is the upper bound of each income bracket relevant to each individual. In (A1) T_{mi} is the marginal tax rate and T_{mk}, $k = 1..i$ are the marginal tax rates associated to each tax bracket. Finally, individual tax rates are defined as $T_a = \frac{(w-nw)}{w}$.

Grouped data for the period 1977-95 are obtained by collapsing individual data by gender, age group, area of residence and educational attainment. Since a few years are missing, we linearly interpolate marginal and average tax rates and gross wages. Missing gross wages are computed by applying to the available data the rate of change of regional pretax wages in the missing years[17].

Data on employment, unemployment and active population by age group, gender, region of residence and educational attainment come from the Labor Force Survey (Istat [2000]). This survey underwent a number of minor changes over the sample period and a major change in 1992. Starting from October 1992, the Statistical Office has used new weights to expand the sample data to the universe and implemented a restricted definition of unemployment. In order to reduce the risk of structural jumps in the data, we restrict our attention to two age categories (20-29 = young and 30-59 = adult), two educational levels (elementary plus middle school = unskilled, and high school plus university degree = skilled), three macro areas (north, centre and south). For each group, we work with the pre-1992 definition of unemployment and ex-

[17] Holmlund and Kolm [1995] use a similar method.

tend it forward to 1995, using the data provided on-line by Fondazione Brodolini[18].

Finally, grouped data from $SHIW$ and the Labor Force Survey are merged with regional account data, that include information on the payroll tax rate. Table A1 presents the summary statistics for 1995 of the main variables used in the paper.

Table A1. Summary statistics.

	Mean	St.D.
Annual wage	31764.48	17588.2
Hourly wage	18.86	10.4
Payroll tax rate	0.48	0.07
Average tax retention rate	0.83	0.06
Tax progressivity	0.85	0.04
Gender	0.38	0.48
Age	40.62	9.52
Part time	0.04	0.20
Marital status	0.73	0.44
Educational attainment	0.56	0.49
Unemployment rate	0.15	0.14

B. Testing spatial dependence

We apply Moran's I test for model misspecification due to spatial dependence both to the panel (Table 1) and to the group-level data (Tables 2 and 3), after controlling for individual and spatial heterogeneity (see for instance Anselin and Moreno [2001]). If the model is specified as in Anselin et al [1996]

$$y = X\beta + Y_2\gamma + u$$
$$u = \rho W u + \varepsilon$$

where y is the dependent variable, X are exogenous and Y_2 endogenous regressors, ε is $N(0, \sigma^2 I)$ and u is an $Nx1$ spatial autoregressive

[18]These data are available at the following elctronic address: www.aiel.it.

disturbance, W is the weighting matrix NxN, Moran's I tests the null hypothesis $H_0 : \rho = 0$. More in detail, Moran's I test can be written as follows (Anselin et al [1996]):

$$I = \frac{\left(\widehat{u}'W\widehat{u}/\widehat{\sigma}^2\right)^2}{tr(W'W + WW)}$$

where $\widehat{u}$ are $Nx1$ IV-residuals. The asymptotic distribution of this statistic is $\chi(1)$ (see Anselin and Kelejian [1997]). The selected matrix of weights follows the so-called "queen criterion" and satisfies the statistical assumptions made by Anselin and Kelejian [1997]. Each individual in one region in the cross-section is assigned a $1xR$ row-vector of zeroes and ones to her "adjacent" regions, where R = number of regions over which observations are spread. In our case, observations are available for 19 Italian regions.

In the 1993-95 panel, each region contains a different number $N(r)$ of individuals. Therefore, we calculate the test by drawing randomly the same number of individuals for each region (15) and by getting a balanced set of $N = 285$ individuals over which we calculate W and the test. We run 799 iterations of this test and get an empirical distribution. We use the mean of this distribution and compare it with the $\chi(1)$. It turns out that our empirical distribution has mean equal to 0.568 and variance equal to 2.35.

We also compute the statistic using a row-standardized weighting matrix, such that weights for each individual sum to one. Pinkse [2000] argues that "*it is best to select a weight matrix which is simple in structure but is nonetheless consistent against the spatial correlation structure of interest. [...] In a test statistics, 'misspecifying' W by choosing a simpler structure may in fact increase the power of the test.*"

In the grouped data, we have 24 groups observed over 19 time periods. Each observation is assigned a row-vector of W such as contiguity is considered between North-Centre on one hand, and Centre-South on the other. Observational units in the Centre have two contiguity values (ones) while in the other two macro areas units have only one contiguity value. W is block-diagonal and equal for each time period ($TRxTR$). In

our case $N = TR = 408$ because 2 years are discarded in IV estimation. As before, we also calculate the test with a row-standardized weight matrix.

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