

Does Unionism Prevent Polarization? Evidence from the Italian Labor Market*

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Abstract

This paper analyzes the labor market polarization issue with a model in which the effects of the computers diffusion are analyzed in an economy with union. The union can follow different behavioral policies. We get that computerization induces a clear polarization pattern for wages and not for employment when union takes care only of its members. On the contrary, we have uncertain effect on wage structure and polarization of employment when union considers all the labor supply.

The empirical analysis of Italian wage and employment structures for the period 1985-2004 shows wage polarization and no polarization trend relatively to employment. This evidence can be easily interpreted in the light of the model.

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1 Introduction

In last decades labor markets of developed countries, including US and UK, have been undergoing a deep restructuring in response to a powerful force of change, the computerization process.

As a result, from the late 1980s, the related wage structures have been experiencing some crucial radical changes: 1) the proportion of middle-income jobs, which represented the core of employment during post-war years, has been declining, 2) wages have been growing faster in the top and bottom of the earning distribution than in the middle. We generally call these two phenomena employment and wage *polarization*.

The effect of technological change on the US earning distribution has already been studied in a deep way. On the contrary, fewer works have appeared covering continental Europe.

This analysis aims at filling this gap in the literature, verifying the presence of polarization trends in the Italian labor market and studying the interactions between unionism and technical innovations of last decades.

Noteworthy, during the 1980s, continental Europe used to have less inequality growth. Its labor market institutions were able to mitigate the effects of market forces through the collective bargaining process.

Looking at the Italian labor market behavior in recent years, and comparing it with the American one, could extent this comparison, in order to verify whether national peculiarities can still lead to different inequality trends in a global economy.

The WHIP dataset, from the Italian social security institute (INPS) reveals a huge polarization in wages, while the proportion of middle-income workers had not significantly changed. We develop a model that analyzes the impact of computerization on wages and employment in different parts of the wage distribution. We imagine an economy with three types of human labor inputs in production: high-skilled workers performing non-routine cognitive tasks, moderately skilled workers performing routine tasks, and low skilled workers enrolled in non-routine manual tasks.

Our point of reference is the framework of Autor et al. (2006), which proposes a nuanced version of the skill-biased technological change for the US case. In their framework computerization is embodied by an exogenous shock, i.e. the decline in the real price of computers.

The main difference between our model and their one is the labor market environment: while they analyze the effects of computerization in a competitive framework, we introduce some rigidities related to the union activity. In our model, the union bargains with the firm the highest wage that assures a certain employment objective. The size of this employment goal depends on the union employment target.

Our model predicts that technological change induces (i) a reduction of wages and employment in routine labor tasks, typically replaced with computer capital; (ii) an increase in wages and employment in abstract labor tasks, complements with computers; (iii) some heterogeneous results in the manual labor market,

depending on the union employment target. We observe a positive effect on manual wages and no change in manual employment when the union cares only about employed manual workers; we have an uncertain effect on manual wages and a positive one on manual employment when union takes into accounts also of the manual labor supply.

We conclude that union can influence the way computerization acts on the labor market. The more restrictive is the target of the union policy, the greater is this influence.

The comparison between the empirical evidence and the theoretical results suggests that the Italian wages and employment structures in the period 1985-2004 are compatible with a setting of technological change and national bargaining, when union takes care only of its members. In a way, we provide a kind of *empirical test* of the Italian union behaviour. Furthermore, because of the important changes occurred in the Italian labor market during the last twenty years, we have analyzed wages and employment in two sub-periods of the sample. The application of our *'theoretical test'* to this new evidence suggests an evolution of the union policies, able to take into account the higher degree of market competition.

The paper is organized as follows: after a brief survey of the related literature, we summarize the Italian institutional setting in section 3; in section 4 we show our empirical evidence; then we describe our theoretical model in section 5 and, finally, section 6 presents a brief comparison between the theoretical results and the Italian empirical evidence.

2 The Changing Nature of Wage Inequality

Debate on the evolutions of the wage distributions started deepening in US during the 1980s, when after more than 50 years of a narrowing or fairly stable wage structure, a number of researchers noticed a definite increasing trend in wage inequality¹. There was wide consensus among the fact that the primary responsible factor was the relative demand for skill, which had been growing since 1970s, but for some years it was outstripped by the steep growth in educational attainment of the baby-boom generation. In particular, Katz and Murphy (1992) noticed that the technological change driven by the computer revolution was not factor-neutral: it favored skilled over unskilled labor by increasing relative productivity of skill workers and, therefore, their relative demand. Among the others, the so called *skill-biased technological change* (SBTC) is the most convincing demand-side factor, even though a number of facts is even today difficult to reconcile with that framework. The hypothesis of SBTC comes under attack whenever we try to compare the US evidence with other advanced countries, such as Italy, France, Japan or Germany. These had witnessed much smaller increases in inequality during the 1980s or not increases at all, yet firms in those economies had access to the same technologies as firms in the US or Britain.

In the attempt to solve this puzzle, many authors considered cross-country

¹For a review see Levy and Murnane (1992), Katz and Autor (1999).

heterogeneity in labor market institutions². According to this view, English-speaking countries had reflected every change occurred in the demand and supply for skill, while European wage structures had been sterilized from every demand-side shock by their collective bargaining process.

The US and UK wage structure debate did not conclude in the 1980s, but it is still evolving. Above all, the decline in the proportion of middle-income jobs is the main stylized fact to be still explained. Moreover, US and UK employment polarization has been accompanied by a wage polarization: wages have been growing faster in the top and bottom quartiles than in the middle two quartiles, with a continued spreading out of the distribution in the top quartile. In other words, the lower part of the wage distribution has no more lost out relative to the middle.

For someone, middle-class decline has been an unremarkable feature of economic adjustments which does not represent a policy problem at all. A widening employment polarization, however, means a growing number of *working poor*. Thus, it may accelerate the erosion of the middle-class consensus that stabilizes political life, and plant the seeds of new political tensions in years to come³.

Literature provides alternative promising explanations of the polarization phenomenon. Among them, Autor, Katz and Kearney (2006) propose a more nuanced version of SBTC, where technology can affect in a different way different parts of the wage distribution. They imagine an economy with three types of human labor inputs in production: high skilled workers performing non-routine cognitive tasks, moderately skilled workers performing routine tasks, and low skilled workers enrolled in non-routine manual tasks. If computers directly substitute for the routine tasks and most strongly complement cognitive tasks, then an exogenous reduction in the real price of computing power will lead to some polarizing trends in wage and employment growth, consistently with the US observed evidences.

This model fails to fit the Italian case because of its very restrictive assumptions. Above all, the hypothesis of a perfect competitive labor market mismatches with Italian collective bargaining process. Our goal is to give a theoretical contribution by picking the peculiarities of a continental European country, that is characterized by strong labor market institutions.

The bargaining process can be modeled in many different ways⁴. In our framework we assume that union and firm bargain over the level of wages. The union's goal is to rich the highest possible wage compatible with the full em-

²For instance, Blau and Kahn (1996)

³For details on policy responses to employment polarization see Banting, Beach and Betcherman (1995).

⁴Some of the most popular theoretical frameworks are the *monopoly model* (Dunlop, 1944 and Oswald, 1982), where union chooses unilaterally the wage level and the representative firm determines employment, and the *right to manage model* (Nickell, 1982), where the wage is determined in a bargaining process between union and employer. In both models the equilibrium wage is higher than in a competitive framework, with a lower employment. The so called *efficient bargaining model* notes that both union and firm can improve on the monopoly outcome by jointly bargaining over employment and wages. Its outcome, again inefficient, is at least Pareto-efficient from the standpoint of the two parts. Finally, in *sequential bargaining models* (Manning, 1987) bargaining over wage and employment occur in subsequent stages. See Oswald (1985) for a complete review on unions and labor markets.

ployment of its members (Blanchard and Summers, 1986). This employment target is a function of the number of currently employed workers and of the total supply of work in manual tasks. The more the union cares about total labor supply, the lower is the bargained wage.

Thus, the definition of the subjects represented by the union is crucial in order to catch the effects of unionism on the all wage and employment structures.

3 The Italian Institutional Setting

The US economy has experienced in the nineties a period of massive investment in information and communication technology (ICT), fueled by strong computer price declines. Analogous information on the European countries is quite limited since the lack of reliable measures of ICT capital stock. According to the World Bank, from 1991 to 2004 the number of PC in Italy has grown by 18% (17% in Germany, 22% in France, 36% in the United Kingdom). The number of firms that organizes orders through internet has grown of 20 percentage points during the same period (ISTAT).

Bugamelli and Pagano (2001) using microdata on Italian manufacturing firms, suggest a measure of capital stock which includes hardware, software and communication equipment. They show a delay in ICT accumulation with respect to US manufacturing of about 8 years and they find a positive correlation at firm level between ICT investment and reorganization.

Despite the delay and the different magnitude of the computerization process in Italy and in English-speaking countries, the technological change has been affecting also continental Europe. Thus, we may attend that nowadays the computerization pressure on the Italian wage and employment structures are the same occurred in the US since the 80s.

In order to analyze the consequences of these pressures on the Italian labor market, we have to focus on the Italian institutional setting. The wages of Italian workers are determined through a national agreement. Three major confederation of sectoral unions (CGIL, CISL and UIL), initially characterized by different political inspirations, represent Italian workers. On the other side, all private industrial employers are represented by a single association (Confindustria) that has traditionally played the leading role in bargaining. Other similar associations represent employers in the other main sectors.

This agreement sets minimum contractual wages for employees at different skill levels in each industry, covering both unionized and non-unionized workers. Higher wages can be negotiated at the firm level for a single worker or a group of workers. Typically, sectoral contracts last approximately three years.

Until the early 1990s, all wage levels were also automatically adjusted by the *Scala Mobile* indexation mechanism, which granted the same absolute wage increase to all employees as prices rose, thereby potentially compressing wage differentials. Formally, the abolition of this mechanism took place in 1993, even if its equalizing effects had been falling since the late 1980s. After that, national wage increases were anchored to the expected inflation rate, avoiding that social conflict were ultimately resolved by inflation.

Many of the outcomes of collective agreements are differentiated across work-

ers according to a skill ranking system. The law first divides non-self-employed workers into four categories: blue-collar, white-collar, quadri⁵, and managers. The nature of the occupation, whether manual or intellectual, traces the borderline between blue-collar workers and the other categories, while the amount of directive responsibilities traces the distinctions among the highest categories. Within the ranks of non-managerial workers, collective contracts at the sectoral level further differentiate workers into several quasi-skill categories called *inquadramento* levels. For example, in the metal-manufacturing sector there are eight *inquadramento* levels and fifteen different skill ranks. The *inquadramento* level of the workers explains approximately 80-90 percent of the total variance of average monthly wages across firms (Erickson and Ichino, 1995).

From the 80s to nowadays, the unions progressively began to lose members and public support, because of their inability to protect less skilled workers from layoffs and the opposition of the high-skilled workers to egalitarianism.

Since the 1990s, further deep changes have crucially contributed to make the Italian labor market more competitive than before. A key factor has been the increasing competition by emerging economies in manufacturing sector. Competition has obliged firms to rapidly reorganize their structures, sometimes externalizing inefficient or expensive phases of the production process.

Another source of change has been the huge diffusion of temporary jobs. In 1997 the so called *Treu Law* (Law 196/1997): (i) legalized temporary contracts⁶; (ii) reformed some non-standard labor relationships (apprenticeship)⁷; (iii) legalized and regulated the supply of temporary workers by authorized agencies⁸. This reform represents one of the steps towards the liberalization of atypical contracts, which are less expensive for firms in terms of taxes and social security payments.

4 The Italian Trends of Polarization

Our main source of data is WHIP⁹. It is a database of individual work histories, based on Italian social security institute (INPS) archives. The reference population is made up by all the people Italian and foreign who have worked in Italy even only for a part of their working career. A large representative sample has been extracted from this population: the sampling coefficient is about 1:180 for a dynamic population of 370,000 people. These data are collected through 20 surveys carried out yearly over the period 1985-2004.

The dataset provides information on Italian and foreign employees and *para-*

⁵High-level white-collar workers with directive responsibilities.

⁶Temporary contracts were still forbidden in the following cases: 1) replacement of workers on strike; 2) by firms that made collective dismissals in the previous 12 months; 3) in jobs which require medical vigilance; 4) by firms that are experiencing a time-of-work reduction; 5) they cannot exceed the 8-15% of the total employees, depending on the sector; 6) they are admitted only for a closed number of motivations such as a peak activity.

⁷It modifies the law 25/55 and introduces a lower bound of 16 years and an upper bound of 24 years of age for apprentices.

⁸The so called *Temporary Help Employment*, a contract in which an agency hires a worker with the aim of placing him in a using firm for a short-term assignment.

⁹The *Work Histories Italian Panel*, created by the centre for employment studies *Laboratorio R. Revelli*. See <http://www.laboratoriorevelli.it/whip>.

*subordinati*¹⁰ with working experience in Italian private sector. On average, we have 53,000 labor relationships per year for employees and 7,700 for *parasubordinati*. Around 67% of employee labor relationships concerns blue-collar, 32% white-collar, 1% managers.

Unfortunately, employees and *parasubordinati* surveys have a different structure, so information on those two types of workers are not assimilable. In particular, data on *parasubordinati* are very rough: we do not know either the hours, the weeks and even the months worked during the year and the dataset does not provide any information on the business sector of workers. For this reason, we mainly focus on *employees*.

The above dataset allowed us to obtain information about: (i) demographic aspects: gender, birthplace, year of birth; (ii) professional status of employees: place of work, type of contract, business sector, employment qualification and number of worked weeks per year; (iii) annual earnings.

In this analysis we use real weekly wages expressed in Euros: their values are obtained by dividing the annual earnings by the number of weeks worked. These nominal values are then transformed into real terms using a GDP deflator.

Once collected, we use this pool of data to observe the changing nature of inequality in different parts of the wage distribution over the period of analysis. Figure 1 plots average weekly real earning growth by wage percentile¹¹ from 1985 to 2004.

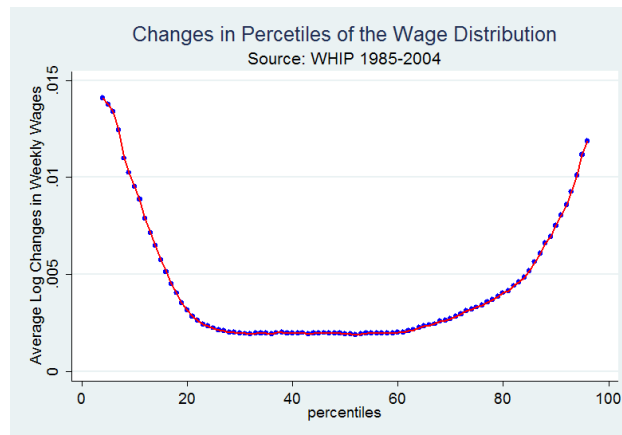


Figure 1: Changes in log weekly wages by percentile. Source: WHIP, 1985-2004.

On the whole, in last decades very low wages and very high wages have been the ones growing the most. This evidence is very similar to Autor et al. (2006) and it was verified in the US case. In particular, they computed a difference between cumulative wage growth to extremes and in the middle of the US wage distribution of 12 log points from 1988 to 2004, while our gap in cumulative

¹⁰Atypical labor contracts whose fundamental characteristics are: 1) continuity of the labor relationship; 2) absence of a subordinate position of the worker; 3) not entrepreneurial nature of the activity.

¹¹From the 4th to 96th percentile.

wage growth during the same years is about 17 log points.

This wage growth curve can be differently evaluated depending on the related employment trends by percentile of the wage distribution. Figure 2 shows how the share of worked weeks in each occupation varies on average over time, after sorting occupations by the average weekly wage paid in 1985¹².

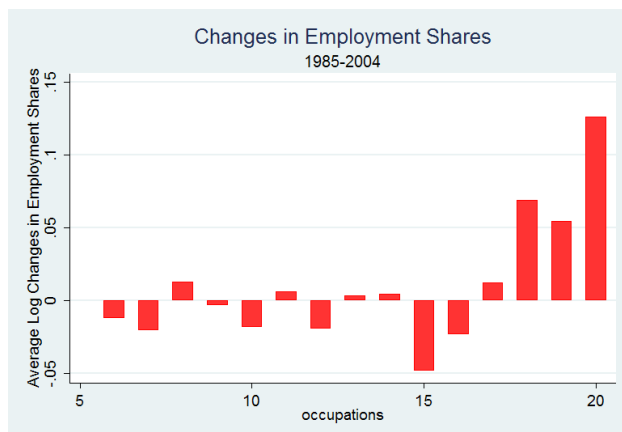


Figure 2: Changes in employment shares by occupation. Occupations are sorted by the average weekly wage paid in 1985. Source: WHIP, 1985-2004.

This figure reveals that Italian employment tendencies are different from the American ones. Employment shares especially remain rather constant along the whole 1985 wage distribution, except the most paid occupations (right side of the graph). On the whole, we do not observe any polarizing trend (u-shape curve) in employment shares: the proportion of middle-income jobs has been declining a bit, but employment shares of low paid jobs have not been increasing.

5 The Theoretical model

We propose a theoretical model that analyzes the impact of computerization on wages and employment, in a labor market characterized by the presence of a union.

Following the simple framework of Autor et al. (2006), computerization is embodied by an exogenous decline in the real price of computers. Indeed, the decrease of computing power price has been the main responsible factor of computer diffusion in productive processes.

We study an economy with three different groups of workplace tasks: abstract (A), routine (R) and manual (M)¹³. These groups roughly correspond to high, intermediate and low skilled occupations.

The technological shock hit in a different way the workers enrolled in these

¹²Our *occupations* come from the interaction between worker qualification (blue-collar, clerks, executives) and industry (agriculture, manufacturing, energy, constructions, commerce, hotels and restaurants, transports, broking, other services).

¹³See the theory appendix of Autor et al. (2006) for a clear definition of these tasks.

three activities. In particular, we assume that: (i) computer capital is a close substitute for human labor in routine cognitive and manual activities; (ii) routine tasks are complement to abstract tasks (i.e. coordination activities and problem solving) and probably, to some extent, also to manual activities¹⁴.

Aggregate output is produced using the Codd-Douglas production function:

$$Y = L_A^\alpha (L_R + K)^\beta L_M^\gamma \quad (1)$$

where $R \equiv L_R + K$, $\alpha, \beta, \gamma \in (0, 1)$ and $\alpha + \beta + \gamma = 1$. Only workers can perform abstract and manual tasks (L_A, L_M), while routine tasks can be done either by workers (L_R), or by computer capital (K). K is measured in efficiency units and it is elastically supplied to routine tasks at price ρ per efficiency unit.

The main difference between our model and Autor et al. (2006) is the labor market environment. While they deal with a competitive market, we introduce some rigidities related to the union activity.

Since the main differences with respect to the US case are in the lower tail of the earning distribution, we focus on the effects of the union activity on low-paid workers. In order to simplify, we assume that routine and abstract labor markets are perfect competitive, while in manual labor market employment and wages depends on the national bargaining. Actually, institutions typically safeguard also middle earners status. By the way, our assumption is supported by three features: (i) unions mainly protect low paid workers; (ii) the direct substitutability between routine workers and computer capital makes it reasonable to assume perfect competition in the routine market; (iii) the collective bargaining sets labor conditions separately for every industrial sector and worker qualification, thus it is reasonable to focus on a single segment of the labor market.

In our framework we assume that the union's goal is to reach the highest possible wage compatible with a certain employment target. This target (L_m^*) is a function of the number of union members, L_M^I , (employed workers at the moment of the bargaining process) and of the total supply of work in manual tasks, S_M .

$$L_M^* = \phi L_M^I + (1 - \phi) S_M \quad (2)$$

where $\phi \in (0, 1)$ represents the weight assigned to L_M^I . If ϕ is equal to one, then $L_M^* = L_M^I$. If $\phi < 1$, the employment target depends also on S_M . The union bargains over the wage level that equalizes L_M^* to its expectation of the manual demand of the firm $E(L_M)$.

In this economy there are many income-maximizer workers. Each of them is endowed with a vector of three skills, one for each production task ($E_i = (a_i, r_i, m_i)$). θ is the fraction of college graduated workers on the labor force. These workers are endowed with one efficiency unit of abstract skill ($E_i =$

¹⁴All these hypothesis are well-supported for the US by case-studies and representative evidences (Levy and Murname, 2004). It makes sense to assume that these relationships between computer and labor inputs are valid also in Italy, given that the computerization process has had the same characteristics in both countries.

$(1, 0, 0)$) that are inelastically supplied to abstract tasks. Every other worker has one efficiency unit to supply to manual tasks and cannot perform abstract tasks. Moreover, non-graduated workers are characterized by η efficiency units of routine skill, with η continuous variable distributed on the unit interval ($\eta \in (0, 1)$) with positive probability mass at all points. Therefore, non-graduated workers have the endowment vector $E_i = (0, \eta, 1)$ and they can choose to supply their efficiency units either to manual or routine tasks.

Supply choices of the non-graduated workers are determined by a self-selection rule. According to it, workers self-select themselves into one specific task given their ability, the levels of wages and the probability to be enrolled in each tasks. Let w_R and w_M the wage paid to routine and manual workers, then each worker compares w_M and ηw_R . The higher is the value of η , the more likely is that the worker chooses a routine job.

Furthermore, supply choices depend on the probability to have a job in the two sectors. Since the routine market is competitive, at the equilibrium no worker will be an involuntary unemployed. In the manual market, the probability to be employed depends on ϕ . Only when $\phi = 0$ for sure there is no unemployment. A more restrictive employment target ($\phi > 0$), implies a lower probability to find a job in the manual sector and a lower manual labor supply. To summarize, the manual labor supply function can be defined as $S_M(\frac{w_M}{w_R}; \phi)$, with $\frac{\partial S_M}{\partial \frac{w_M}{w_R}} > 0$, $\frac{\partial S_M}{\partial \phi} < 0$ and $\frac{\partial^2 S_M}{\partial \frac{w_M}{w_R} \partial \phi} < 0$.

Routine labor supply is $S_R(\frac{w_M}{w_R}; \phi)$, with $\frac{\partial S_R}{\partial \frac{w_M}{w_R}} < 0$, $\frac{\partial S_R}{\partial \phi} > 0$ and $\frac{\partial^2 S_R}{\partial \frac{w_M}{w_R} \partial \phi} > 0$.

The two second cross partial derivatives imply that workers' supply decisions are more sensitive to changes in the relative wages when ϕ is low.

Wage definition for abstract, routine and manual workers is different, depending on the functioning of the corresponding markets. While abstract and routine workers are paid at their marginal productivity, the manual wage depends on the interaction between union and representative firm. Once the bargaining process has led to the optimal wage, the level of the manual employment L_M is chosen by the firm according to its labor demand function.

$$L_M = \left(\frac{\gamma L_M^\alpha (L_R + K)^\beta}{w_M} \right)^{\frac{1}{1-\gamma}}. \quad (3)$$

When no shock hit the economy, $L_M^* = E(L_M) = L_M$ and we obtain w_M from equations (2) and (3). Our result differs according to the chosen value of ϕ . In particular, if union cares only about its current members ($\phi = 1$), we have:

$$w_M = \gamma (L_M^I)^{\gamma-1} L_A^\alpha (L_R + K)^\beta. \quad (4)$$

While, when $\phi < 1$:

$$w_M = \gamma [\phi L_M^I + (1 - \phi) S_M]^{\gamma-1} L_A^\alpha (L_R + K)^\beta. \quad (5)$$

Now we consider the effects of a positive shock on the manual labor market. In particular, the exogenous force that hits this economy is the reduction of the computer price, ρ .

Since computer capital is a perfect substitute for routine labor input, $w_R = \rho$ and, consequently, a decline in ρ reduces w_R one to one. With downward sloping factor demand curves ($R'(\rho) < 0$), the decline in ρ raises the demand for routine task. This increase in the demand for routine tasks leads to an increase in the abstract and manual labor demands, because of the existing complementarities.

Both computer capital and routine labor inputs are potentially able to satisfy this additional routine demand, but the self-selection rule implies that the additional demand will be satisfied by computer capital (Autor et al. 2006). In fact, when ρ declines, the ratio between manual and routine wages raises¹⁵.

Thus, after the reduction in computer price, some workers decide to switch from routine to manual tasks. These workers are those having the lowest values of η . As a result, the additional demand for routine tasks will be satisfied by computer capital.

In terms of labor supplies, we have a decline in S_R and an increase of S_M . Since the worker supply decision is related to the ease of finding a job in each sector, the magnitude of the labor supply change will depend on the value of the parameter ϕ . Noteworthy, less restrictive is employment target (lower is ϕ), higher is the reduction of S_R .

The effect of the reduction in ρ on the manual employment depends on the union policy and on the predictability of the shock. If the union does not expect the increase in the manual demand, then $L_M^* = E(L_M) < L_M$. In this case, whatever is the value of ϕ , the manual employment increases and the manual wage stays constant.

Actually, it is reasonable to assume that union can anticipate technological shocks¹⁶. Then, the bargained wage embodies the shock and the employment level coincides with the union expectation. In this case, the effects on the manual labor market crucially depend on ϕ . When $\phi = 1$, an increase in the manual supply does not affect the union employment target; when $\phi < 1$, an increase in S_M leads to a positive effect on manual employment¹⁷.

In order to analyze the effects of a decline in computer price on wages, we differentiate the three wage equations with respect to $-\rho$. As far as concern the routine wage, our result is obvious and strictly related to the substitutability between computers and routine workers:

$$\frac{\partial w_R}{\partial(-\rho)} = -1. \quad (6)$$

The impact of computerization on w_M has to be studied separately when

¹⁵To understand why this occurs, let consider $\frac{w_M}{w_R} = \frac{[L_M^I + (1-\phi)S_M(\eta^*(-\rho))]^{\gamma-1}\gamma R(-\rho)}{\beta L_M^\gamma}$. Differentiating it with respect to $-\rho$ (that represents a decline in the price of K), we get that $\frac{\partial \frac{w_M}{w_R}}{\partial(-\rho)} > 0$.

¹⁶This assumption is reasonable for all those economies a bit far from the technological frontier (as Italy). Indeed, these economies generally face a given shock some years later than US, so they expect the technological innovations and them consequences.

¹⁷ $\frac{\partial L_M^*}{\partial(-\rho)} = (1-\phi)\frac{\partial(S_M)}{\partial(-\rho)} > 0$.

$\phi = 1$ and $\phi < 1$. By differentiating equation (6), we get:

$$\frac{\partial w_M}{\partial(-\rho)} = \gamma L_A^\alpha R^{\beta-1} L_M^{\gamma-1} \frac{\partial R}{\partial(-\rho)} \quad (7)$$

This derivative is positive, therefore the union is able to obtain a higher wage level after the technological shock. Since manual employment does not change, a higher demand for manual tasks (due to factor complementarities) leads only to a higher wage level.

When $\phi < 1$, we differentiate (7) getting:

$$\begin{aligned} \frac{\partial w_M}{\partial(-\rho)} &= \gamma(\gamma-1)(1-\phi)L_A^\alpha R^\beta [\phi L_M^I + (1-\phi)S_M]^{\gamma-2} \frac{\partial S_M}{\partial \eta^*} \frac{\partial \eta^*}{\partial(-\rho)} + \\ &+ \beta \gamma L_A^\alpha R^{\beta-1} [\phi L_M^I + (1-\phi)S_M]^{\gamma-1} \frac{\partial R}{\partial(-\rho)}. \end{aligned} \quad (8)$$

The effect of computerization on w_M is no more clear: two opposite effects act simultaneously. On one side, complementarities would induce a manual wage increase. On the other side, the workers shift induces an increase in S_M due to the self-selection rule. Therefore, it tends to decrease manual wage. The final effect depends on the prevailing force.

An interesting consideration arises from that result: the reduction of ρ has a different impact on the manual segment according to the weight assigned to union members and to manual labor supply. Therefore, the presence of union can affect the way computerization acts.

Finally, the abstract wage unambiguously raises:

$$\frac{\partial w_A}{\partial(-\rho)} = \alpha L_A^{\alpha-1} [\beta R^{\beta-1} \frac{\partial R}{\partial(-\rho)} L_M^\gamma + \gamma R^\beta L_M^{\gamma-1} \frac{\partial L_M}{\partial(-\rho)}] > 0. \quad (9)$$

This is due to the increase in the demand for abstract tasks, that is not followed by a countervailing labor supply. Therefore, computerization process implies a higher w_A and a higher abstract employment, exactly as in Autor et al.'s model.

To summarize, the model predicts that a reduction in the computer price induces an increase in the demand for routine input - supplied by K - and a reduction in the labor supply to routine activities. Since less competition in the labor market leads to less workers mobility, the dimension of this reduction depends on ϕ .

Moreover, it emerges a negative effect on w_R and a positive effect on w_A . The predicted effects on w_M and manual employment depend on the union policy. When the union cares only about its members, computerization leads to an increase in w_M and the wage structure tends to polarize to the detriment of manual employment. When the union's behavior is more *market oriented*, an increase in the manual labor supply has a positive effect on manual employment. Only in this case we observe an employment polarization as in Autor et al. perfect competitive framework.

In this setting, an alternative option to employment polarization exists and this is manual unemployment. Thus union, by keeping a high level of low-skill workers' wage, decreases inequality in the lower tail of the earning distribution, but increases the number of unemployed workers¹⁸.

6 A Discussion on the Italian Trends

Autor et al. (2006) explained polarization trends in US wages and employment with the sharp decrease of computing power price and the related diffusion of computers. Despite the Italian technological delay, the computerization process has been affecting also continental Europe. Thus, we may attend that Italian labor supply and demand have reacted in a similar way.

By the way, wages and employment in Italy are determined through bargaining between the confederations of trade unions and the association of entrepreneurs, thus they may not directly reflect changes in labor demand and supply.

Figure 1 and 2 plot the changes in wages and employment by wage level, showing a clear polarization pattern for wages - even bigger than in the US - and no convexification in employment. This evidence can be easily explained by the model presented in section 5, that is applicable to the Italian labor market, given its institutional characteristics.

Indeed, according to the model, the more the union protects its members, the more low-skill wages tend to be high to the detriment of low-skill employment. Conversely, when union's goal is not far from the competitive equilibrium of the labor market, employment shares - and seemingly wages - polarize.

Our evidence could be used as an *empirical test* for the Italian union behavior. Indeed, the correspondence between the theoretical predictions when $\phi = 1$ and the Italian trends, may suggest that the Italian union has cared only about the interests of employed workers. In this way it has prevented the simultaneous occurrence of polarization pattern in wages and employment, allowing the manual wage increase, to the detriment of employment, that has not grown in the bottom part of the earning distribution.

Furthermore, the higher dimension of the gap between middle and low wages in Italy than in US, supports the idea according to which the manual wage increase induced by computerization has been overdrawn by the union activity.

Despite that, the Italian labor market experienced many deep changes through these 20 years. Among them, the abolition of the *Scala Mobile*, the *Treu Law*, the globalization process have increased the degree of competition. Therefore, the general tendencies presented in figures 1 and 2 are not representative of the entire period of analysis because, in recent years, the effects of technological change have been less far from the US ones.

From 1985 to 1996, the difference between the average annual wage growth at the 50th and 10th percentiles is 0,91 percentage points, while from 1996 to

¹⁸Also if in a unionized economy ($\phi = 1$) there is less worker mobility, thus less substitution between routine workers and computers.

2004 it is equal to -0.23 . This means that in the middle of the 1990s the wage structure has started polarizing.

As far as concern employment shares, figure 3 shows that the employment growth in low-paid occupation from 1996 to 2004 is a bit higher than before. Furthermore, the share of worked weeks in middle-paid occupations remains rather constant in the first period and tends definitely to decrease during the second one¹⁹.

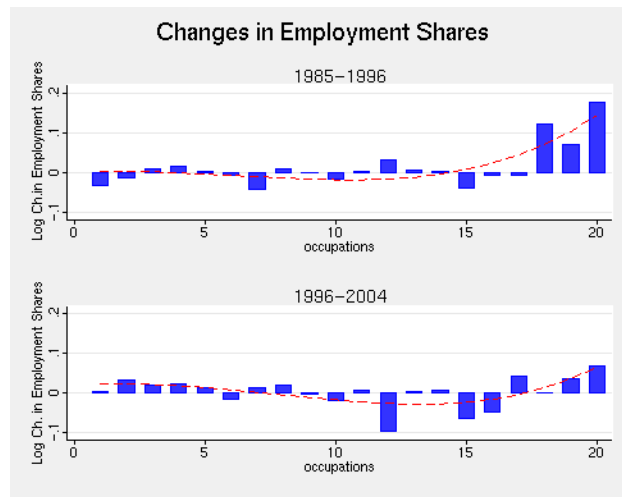


Figure 3: Changes in employment shares by occupation. Occupations are sorted by the average weekly wage paid in 1985. Source: WHIP, 1985-2004.

According to the model in section 5, these evidences effectively correspond to a decline in the value of ϕ . While the first sub-period presents almost the same wage pattern of the whole sample (corresponding to the case of $\phi = 1$), from 1996 to 2004 manual wage doesn't grow anymore (it decreases a bit) and the employment pattern is more polarized.

This suggests that, during the 1990s, the union has reacted to the higher competition: indeed, the mechanism acting when the union policy is reflected by a lower ϕ is very similar to that working in a competitive framework.

Furthermore, our data confirm that in late 1980s the workers flow from middle wage jobs to low paid jobs was weaker: from 1986 to 1993 the number of workers who shift from middle wages (30-60 percentiles) to low wages (1-30 percentiles) increases of 14%, while from 1993 to 2004 it increases of 33%. Thus, we observe less shifts from middle-paid to low-paid occupations in the first period, when the institutional environment makes less attractive the shift from routine toward manual occupations.

In order to assess the important role of unions and the interactions between union and computerization process, we should extend the predictions of our model to other countries of continental Europe.

¹⁹This result is well supported by Bank of Italy SHIW data from 1996 to 2004.

For instance, Dustmann (2007) shows that in Germany, as in Italy, wage inequality has increased in the 1980s but only at the top of the distribution. In the lower tail of the distribution, inequality tends to increase, and about one third of this increase can be related to de-unionization.

This suggests, once more, that the main difference between technological impact on a unionized and a non-unionized economy concerns mainly low-paid workers.

7 Conclusions

Autor et al. (2006) have explained in a cogent way the US polarization evidence through demand shifts, induced by computerization. Given that the technological change has been a global transformation, it would be reasonable to think that it has generated the same effects in all advanced countries.

In spite of that, the comparison between wage and employment patterns of US and Italian labor markets shows a clear discrepancy among these countries.

During the period 1988-2004, the US labor market is characterized by a clear job polarization trend. Conversely in Italy, during the same years, polarization has occurred only in wages and not relatively to employment. In fact, the employment shares remain rather constant in the bottom and middle part of the earning distribution, while they increase in the top half.

One possible explanation is the difference in the institutional environments in Italy and in the US. In particular, the role played by union in the process of wage setting is clearly greater in Italy than in the US.

Our analysis tries to capture this institutional heterogeneity in a theoretical model in which the union can choose to adopt different policies, according to its employment target.

We find that computerization alone is not sufficient to describe the Italian context, even if it plays an important role on wages and employment of workers located in the middle and in the top of the earning distribution. Moreover, we suggest that the pattern of Italian low paid workers directly depends on the union activity. Finally, we find a mild evidence of a change in the union behavior over time: probably the union has been rethinking the role of labor supply, in order to make its strategies adapt to a more competitive market.

To conclude, the institutional setting seems to affect the way the labor market absorbs computerization. Furthermore, the behavioral policy adopted by the union can influence the wage structure in a deep way.

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