Do Labor Market Institutions Prevent Polarization? Evidence from Italy*

Viki Nellas† Elisabetta Olivieri‡

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Abstract

According to the recent literature, the computerization process *has been polarizing* the labor market of advanced economies: employment has been shifting toward very high and very low-wage jobs and wages have been growing faster at the extremes of the earning distribution. By the way, from 1985 to 2004 we observe in Italy a convexification trend in wages and no polarization in employment shares. This paper proposes a theoretical model to study the effects of computerization in a unionized economy. According to our framework, the definition of the union policy is crucial in order to catch the effects of a demand-side shock on the all wage and employment structures. Furthermore, the difference in labor market institutions can explain the stylized cross-country heterogeneity.

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

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†GREMAQ, Toulouse School of Economics and Department of Economic Science, University of Bologna.

‡Bank of Italy and Department of Economic Sciences, University of Bologna. The views expressed here do not necessarily reflect those of the Bank of Italy.

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 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[1]. Noteworthy, during the 1980s, continental Europe used to have less inequality growth because its labor market institutions were able to mitigate the effects of market forces through the collective bargaining process (Blau and Kahn, 1996). Looking at behavior of European countries in recent years could extent this comparison, in order to verify whether national peculiarities can still lead to different inequality trends in a global economy. This analysis aims at filling the gap in the literature, verifying the presence of polarization trends in the Italian labor market and studying the interactions between institutional environment and technical innovations.

The WHIP dataset, from the Italian social security institute (INPS) reveals a huge polarization in wages from 1985 to 2004 in Italy, while the proportion of low-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 bargaining process. In our model, the union bargains with the firm the highest possible

[1]Dustmann et al. (2007) deal with the German case. More in general, Piketty and Saez (2006) analyze the cross-country evolution of top incomes. Brandolini et al. (2005) look at the share of low-paid workers from 1977 to 2002 in Italy using data from the Bank of Italy; Brandolini et al. (2000) explore also the Italian wage structure in the period spanning from 1977 to 1998.

wage compatible with a certain employment objective. The size of this employment target is crucial to determine the effects of computerization on the labor market.

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 expect a positive effect on manual wages and no change in manual employment when the union cares only about the employment status of its current members (*insiders*); we have an uncertain effect on manual wages and a positive one on manual employment when union takes into accounts the entire manual labor supply.

According to this model, Italian labor market institutions have avoided employment growth in low-paid jobs by keeping a high level of manual wage. Splitting our period of analysis in two sub-periods, we observe that only in late 1990s employment has been polarizing a bit, probably because of the higher degree of competition in the Italian labor market.

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

2 The Changing Nature of Wage Inequality

Debate on the effects of the computerization process on wage inequality 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 inequality[2]. There was wide consensus among the fact 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 (Katz and Murphy, 1992). Even if the so called *skill-biased technological change* (SBTC) is the most convincing explanation, 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

[2]For a review see Levy and Murnane (1992), Katz and Autor (1999).

other advanced countries, such as Italy, France, Japan or Germany. These had witnessed much smaller increases in inequality during the 1980s or no 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 heterogeneity in labor market institutions[3]. 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 shock by their collective bargaining process.

This debate did not conclude in the 1980s, but it is still evolving with recent stilized facts. Above all, the decline in the proportion of middle-income jobs in US is the main evidence to be still explained. Moreover, US 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 come[4].

In order to explain the polarization phenomena, Autor et al. (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

[3]For instance, Blau and Kahn (1996)

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

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 ways[5]. In our framework we assume that union and firm bargain over the level of wages. The union's goal is to reach the highest possible wage compatible with a certain employment level (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 union policy is crucial in order to catch the effects of a technological shock on the wage and employment structure.

3 The Italian 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 PCs in Italy has grown by 588% (499% in Germany, 561% in France, 381% in the United Kingdom). The percentage of firms that organize orders through internet has grown by 20 percentage points from 2003 to 2007 (ISTAT).

Bugamelli and Pagano (2004) 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, technological change has

[5]Some 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 the union and the 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 occurs in subsequent stages. See Oswald (1985) for a complete review on unions and labor markets.

been affecting also the Italian economy. Thus, we may attend that nowadays the computerization pressure on the Italian wage and employment structure is 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. Thre major confederations 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 a new forward-looking policy tool, the target inflation rate[6], avoiding that social conflict were ultimately resolved by inflation.

Many of the outcomes of collective agreements are differentiated across workers according to a skill ranking system. The law first divides non-self-employed workers into four categories: blue-collars, white-collars, *quadri*[7], 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

[6]With an ex-post compensation for the difference between this rate and the actual inflation rate in the two preceding years.

[7]High-level white-collar workers with directive responsibilities.

across firms (Erickson and Ichino, 1995).

In last decades, some deep changes have crucially contributed to make the Italian labor market more competitive than before. Unions progressively began to lose members and public support. Another 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.

A further source of change has been the huge diffusion of temporary jobs. In 1997 the so called *Treu Law* (Law 196/1997): (i) legalized temporary contracts[8]; (ii) reformed some non-standard labor relationships (apprenticeship)[9]; (iii) legalized and regulated the supply of temporary workers by authorized agencies[10]. 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 WHIP[11]. 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 employees with working experience in Italian private sector. On average, we have 53,000 labor relationships per

[8]Temporary 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.

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

[10]The 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.

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

year. Around 67% of employee labor relationships concerns blue-collars, 32% white-collars, 1% managers.

The above dataset allowed us to obtain information about: (i) professional status of employees: place of work, type of contract, business sector, employment qualification and number of worked weeks per year; (ii) 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 price 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 the annual average growth of weekly real earnings by wage percentile[12] from 1985 to 2004.

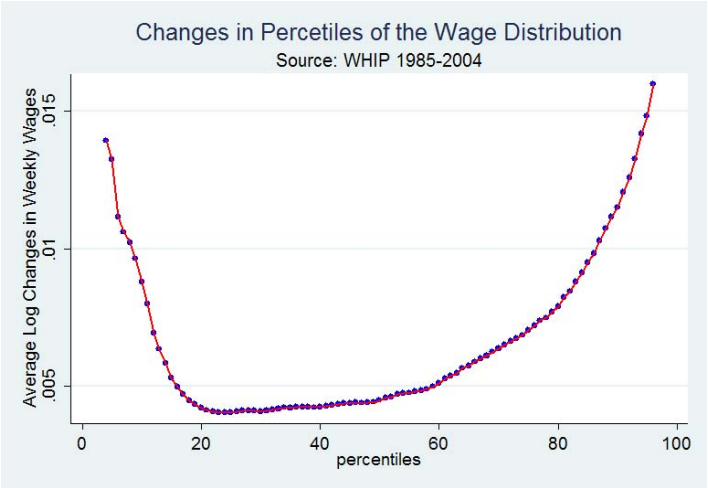

Figure 1: Changes in log weekly wages by percentile. Source: WHIP, 1985-2004.

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 the US one. In particular, Autor et al. 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 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. Figure 2 shows how the share of worked weeks

[12]From the 4th to 96th percentile.

in each occupation varies on average over time, after sorting occupations by the average weekly wage paid in 1985[13].

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 trends are different from the American ones. Employment shares especially remain rather constant along the whole 1985 wage distribution, except for 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

[13]Our *occupations* come from the interaction between worker qualification (blue-collars, clerks, executives) and industry (agriculture, manufacturing, electricity and gas, construction, trade, hotels and restaurants, transport and communication, financial intermediation, other services).

of computer diffusion in productive processes.

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

The technological shock hits in a different way the workers enrolled in these 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 activities[14].

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

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

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 abstract labor market is perfectly competitive, while in manual and routine labor markets employment and wages depends on the national bargaining.

In our framework we assume that the union's goal is to reach in every segment of the market the highest possible wage compatible with a certain employment target[15]. This target (L_i^*) is a function of the number of union members, L_i^I, (employed workers at the moment of the bargaining process)

[14] All 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.

[15] Focusing on a single segment of the labor market is reasonable since the collective bargaining sets labor conditions separately for every industrial sector and worker qualification.

and of the total supply of work in that tasks, S_i. Actually, the direct substitutability between routine workers and computer capital leads the union to bargain a wage equal to the price of one efficiency unit of computer capital; otherwise, no routine worker would be employed. Thus, despite the bargaining process, the routine labor market is perfect competitive.

The employment target in the manual labor market is:

$$L_M^* = \phi L_M^I + (1 - \phi) S_M \tag{2}$$

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_i. The union bargains over the wage level that equalizes L_M^* to its expectation on the 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 ($E_i = (a_i, r_i, m_i)$). College-graduate workers are endowed with one efficiency unit of abstract skill ($E_i = (1, 0, 0)$) that are inelastically supplied to abstract tasks. Every non-graduate worker has one efficiency unit to supply to manual tasks and cannot perform abstract tasks. Moreover, non-graduate 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-graduate 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-graduate 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 task. Let w_R and w_M be the wage paid to routine and manual tasks per efficiency unit, 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 $\frac{\partial^2 S_M}{\partial \frac{w_M}{w_R} \partial \phi} < 0$. The last derivative implies that

workers are more sensitive to changes in the relative wages when ϕ is low.

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 $\frac{\partial^2 S_R}{\partial \frac{w_M}{w_R} \partial \phi} > 0$. In this case, an increase in relative wages induces a deeper reduction in S_R 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[16], 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.

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

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:

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

While, when $\phi < 1$:

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

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

[16]Note that the observed wage, in the case of routine tasks, may differ from the wage paid per efficiency unit of routine task input.

al. 2006). In fact, when ρ declines, the ratio between manual and routine wages raises. 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. Since the shock reduces S_R, the additional demand for routine tasks will be satisfied by computer capital.

Workers' supply decision is related to the ease of finding a job in each sector, thus the magnitude of the labor supply change will depend on the value of the parameter ϕ. Noteworthy, the less restrictive is the employment target (the lower is ϕ), the 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.

Actually, it is reasonable to assume that union can anticipate technological shocks[17]. 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 employment[18].

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 the routine wage is concerned, our result is obvious and strictly related to the substitutability between computers and routine workers:

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

The impact of computerization on w_M has to be studied separately when $\phi = 1$ and $\phi < 1$. By differentiating equation (4), we get:

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

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

[17] This 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 then US, so they expect the technological innovations and their consequences.

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

- leads only to a higher wage level.

When $\phi < 1$, we differentiate (5) getting:

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

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-skilled wage, decreases inequality in the lower tail of the earning distribution, but increases the number of unemployed workers[19].

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, 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.

Indeed, according to the model the more the union protects its member, 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 labor market institutions in Italy have mainly protected employed workers.

Despite that, the Italian labor market experienced many deep changes through these 20 years. Among them, the abolition of the *Scala Mobile*, the *Treu's Law* and the globalization process have increased the degree of competition. Therefore, the general tendencies presented in figures 1 and 2

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

are not representative of the entire period of analysis. From 1985 to 1996, the difference between the average annual wage growth at the 10^{th} and 50^{th} percentiles is 0.91 percentage points, while from 1996 to 2004 it is equal to -0.23. This means that in the middle of the 1990s the wage structure stopped polarizing.

According to the model, 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 -.

As far as employment shares are concerned, 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 one[20].

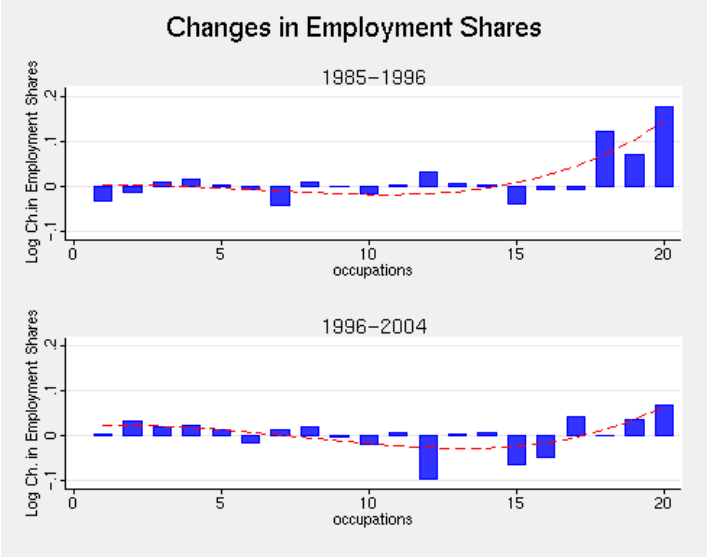

Figure 3: Changes in employment shares by occupation. Occupations are sorted by the average weekly wage paid in 1985. Source: WHIP, 1985-2004.

Furthermore, workers flows from middle paid jobs to low paid jobs increase al lot after the middle of the 1990s: from 1995 to 2004 the number of workers who shift from middle wages (30-60 percentiles) to low wages (1-30 percentiles) increases by 33% (14% in the previous ten years).

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

In order to assess the important role of labor market institutions and the interactions between them and computerization process, we should extend the predictions of our model also to other countries. Noteworthy, labor market institutions play a weaker role in the US than in Europe. It is interesting to note that the US case is consistent with our model when $\phi < 1$.

As far as continental Europe is concerned, Dustmann et al. (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 raise, 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. 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 low-paid and middle-paid jobs, while they increase in high-paid jobs.

One possible explanation is the difference in the institutional environment. In particular, the role played by unions 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.

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 adapt its strategies to a more competitive market.

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