

Job Polarization, Immigration and Worker's
Intrinsic Motivation:
Three Essays on Labor Economics

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Overview

This doctoral thesis contributes to some key issues analyzed in labor economics. The research follows three different lines focusing, respectively, on the labor market polarization, the relationship between immigration and female labor market participation and, finally, the impact of intrinsic motivation on task allocation. Depending on the specific subject, the analysis is carried out from a theoretical and/or empirical point of view.

The first part of the research belongs to the wide literature on wage inequality and job market polarization.

During the 1980s some researchers started noticing a clear trend in increasing inequality in US income distribution. Then, in the mid-to late 1980s, new data showed a sharp and continuing growth in inequality. Since the beginning of 1990s many authors studied this phenomenon and important papers by Bound and Johnson (1992), Katz and Murphy (1992), Levy and Murname (1992) and Juhn, Murphy and Pierce (1993) reach the same important conclusions. First of all, inequality had been growing sharply in the 1980s; secondly, the primary factor behind the growth was the increase in the relative demand for skill. While these authors were not very interested in explaining the source of this phenomenon, later in 1990s, it became widely accepted that the skill-biased technical change (SBTC), driven by computers revolution, was the main source of growth in the relative demand for skill, as claimed by Krueger(1993) and Bound, Berman and Griliches (1994). Among researchers there was consensus also relatively to the fact that all dimensions of inequality were growing in the 1980s, as return to education and experience, residual and within group inequality (Juhn, Murphy and Pierce, 1993). According to them the SBTC drove increase in all dimension of skill (education, experience, unobservable ability,etc). Also

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Acemoglu (2002) claims that technological change was the leading explanation for inequality growth in the US throughout the 1970s, 1980s and 1990s. The main problem with the SBTC explanation was the evidence that many advanced economies like France, Japan and Germany (hit by the same technological shock) failed to experience any significant growth in inequality during 1980s. Freeman and Katz (1995) suggest that the supply and demand changes, related to SBTC, were part of the story and that the remaining part is related to wage-setting institutions. They claim that the common demand shock across countries are mitigated by supply and institutional factors (i.e. union bargaining in France and Germany). Moreover, authors like Card(1992), Freeman (1993), Di Nardo, Fortin and Lemieux (1996) and Lee (1999) show that even in the United States wage setting institutions - as the reduction of unionization and the decline in the real value of the minimum wage - appear to play a role in inequality growth. All these factors moved in the same direction, giving the impression that a single factor as SBTC was the only driving force behind the increase in wage inequality. But this is not true; indeed the SBTC is not able to account for the diverging patterns of inequality growth across advanced countries and it failed to provide explanation for the fact that institutional factors were also important, especially in the lower end of the wage distribution.

Debate went on during the following years and some researchers like Mincer (1997) and Deschenes (2002) showed that the wage gap between post-graduates and college graduated increased more than that between college graduate and high school graduates that, in turn, increased more than wage gap between high school graduates and high school dropouts. Piketty and Saez (2003) find that wage gains are concentrated in the very top of the earnings distribution. Moreover, Lemieux (2006) shows that within-group inequality grew substantially among college-educated workers but changed a little for most other groups. Autor, Katz and Kearny (2005) provide evidence that top end wage inequality (difference between the 90th and the 50th percentiles of the distribution of residuals) increased, while residual inequality at the low end (the 50 – 10 gap) actually decreased. With respect to this point Lemieux, MacLeod and Parent (2007) shows that all of the growth in inequality prior to 1988-90 is concentrated in the 1980s. Moreover he shows that while both low end (50-10 gap) and top end (90-50 gap) inequality were growing before 1988-90, the situation was very different in

the 1990s and 2000s. The 50-10 gap declined while the 90-50 gap continued to grow as in the previous period. So, after 1990 we observe a U-shape in the change of real wages, as workers both in the lower and upper tails of the distribution were characterized by larger gains than workers in the middle of the distribution.

Many institutional factors have been taken into account to explain the previous evidence relative to the difference between US and UK and the continental Europe and the U-shape pattern of wage inequality. DiNardo, Fortin and Lemieux (1996) and Lee (1999) suggest that most of the growth in the 50-10 gap in the 1980s was due to the decline in the minimum wage but they underline that it cannot account for the growth in the top end inequality. Fortin and Lemieux (1997) highlights a second institutional factor that can be useful to explain the changes in top end inequality after 1990, that is deregulation. Instead, Card (1992) and Freeman (1993) show that de-unionization accounts for a sizeable share of the increase in the variance of wages in the 1980s. Finally, Picketty and Saez (2003, 2006) provide evidence that wages are less equally distributed on performance-pay than non performance-pay jobs, because returns to education are higher in performance-pay jobs. So, they suggest that the growth of performance pay in the 1980s and 1990s could have contributed to the increase in wages variance; indeed, they show that its contribution is about 25% of the overall increase.

As evident, there exists a wide body of literature that has shown the importance of wage setting institutions in explaining the US changes in inequality. De-unionization explains increasing inequality at the top end and decreasing inequality at the low end. Minimum wage can account for the fact that inequality expanded in the low end of the distribution in the 1980s, when the real value of the minimum wage fell sharply. Finally, higher use of performance pay jobs justifies a large share of the growth in inequality above the 80th percentile of the wage distribution.

An additional element in favour of the institutional approach is suggested by Freeman and Katz (1995). They claim that institutional factors are important to explain cross-country differences in inequality changes. We see, for example, that countries where top-end inequality increased the most (US, UK and Canada) experienced a large decline in the importance of union. Manacorda (2004) shows that the Italian inequality pattern is linked to the rise and fall of the Scala Mobile, a country wide indexation system that com-

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pressed wages by awarding larger cost-of-living adjustments to low wage than high wage workers. Relatively to German the paper of Dustman, Ludsteck and Schonberg (2007) indicates that inequality increased while unionization rate declined substantially over the last twenty years. They provide evidence that de-unionization accounts for a large part of the German growth in inequality.

Even though institutions have been shown to be important determinants of wage and income inequality, they typically do not quantitatively account for most of the observed changes in wage dispersion. Moreover, as claimed by Acemoglu, Aghion and Violante (2001) it could emerge a problem of endogeneity. If unions keep strong wage compression policies to face the decreased demand of low skilled workers due to the SBTC, this will result in de-unionization since the outside option of skilled workers will grow and, consequently, the coalition between skilled and unskilled workers in support of unions will be weakened. Given these limits, some authors started to investigate other factors beyond institutions that may be a source of these changes.

The SBTC rests on the idea that workers vary according to their skill level and that the price of skill increased in response to a growing demand for skill due to technological changes. Autor, Katz and Kearny (2006) propose a nuanced version of the SBTC to explain the U-shape of wage growth appeared in the US after 1990. They claim - as well as Autor, Levy and Murnane (2003) - that the simple definition of skilled and unskilled workers is not enough to capture the effect of technological change. They introduce an additional distinction between routine tasks, that can be also executed by computers, and non-routine tasks that require human labor. In their theoretical model they show that the large diffusion of computers, due to the decline of their price, displaces routine workers, who shift to manual tasks jobs, decreasing the routine employment as well as routine wages. Consequently, manual employment increases and, according to the relative variation of manual demand and supply, the manual wage may increase or decrease. Finally, non-routine abstract wage and employment rises, because of the higher demand induced by the complementarity of abstract jobs with the computer diffusion.

Using data from the Dictionary of Occupational Titles they show that the share of the workforce in routine occupations has declined over time, pro-

viding evidence that the technological change is biased against these types of jobs. Moreover, they show that changes in occupational shares are U-shaped, that is occupation in the middle of the skill distribution declined relative to occupations both at the bottom and top end. Therefore, the Autor, Katz and Kearney theoretical explanation is consistent with the US evidence (that is the same for UK, Goos and Manning, 2007).

Another possible explanations of the polarization phenomenon is that the rise in the share of income going to the rich in the US and the UK may have led to an increase in demand for low-skilled workers whose employment increasingly consists of providing home services to the rich (Manning, 2004; Mazzolari and Ragusa, 2007). Given that the technological change increased the opportunity cost of time of high skill workers, they outsourced many services that are substitutes of household production. Because these kind of services are generally provided by low skill workers, an increase in high skilled workers wage and employment is associated with an increase in low skilled workers wage and employment. Also offshoring could have affected the employment structure of developed countries in the same way (Blinder, 2007). In fact, Levy and Murname (2006) suggest that routine jobs that can be replaced by computers are also the easiest ones to offshore. On the contrary, services performed by doctors, lawyers and professors cannot offshored so easily.

The research presented in the first chapter (carried out with Elisabetta Olivieri) follows this literature. Its main goal is to explain cross-country differences in job polarization trends, focusing on a Continental European country, i.e., Italy, where there has been significant polarization in wages from 1985 to 2004 but where the proportion of low-income workers has not significantly changed. In doing so, we study the interactions between the institutional environment and technical innovations in order to verify whether national peculiarities can still lead to different inequality trends in a global economy. Indeed, the result of the nuanced version of the SBTC is based on the hypothesis of competitive labor market, that does not fit well with Italy (and other European countries), characterized by strong labor market institutions. To cope with this problem we develop a model that follows the one proposed by Autor et al. (2006) and where we introduce labor market institution. In their nuanced version of the skill-biased technological change

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- where the computerization is embodied by an exogenous shock, i.e., the decline in the real price of computers - we introduce some rigidities related to the bargaining process. In our model, the union bargains with the firm for the highest possible 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. Therefore we enrich the nuanced version of the SBTC with the presence of a labor market institution in order to explain the differences between Italy (and other European countries) and US in wage and employment growth patterns.

The second line of this research focuses on the the impact that immigration has on the female participation in the labor market.

A significant body of literature regards the immigrant' effects on the labour market of destination countries. Different results have been provided and economists continue to debate the wage effects of immigrants inflow. The main goal of the analysis is the understanding of the effects induced on the groups of natives competing directly with immigrants (Altonji and Card, 1991, Borjas et al. 1996, Card and Di Nardo 2000, Card 2001,), especially when we consider low skilled migrants. Some authors (Borjas, 1992, and Borjas, Frreman and Katz, 1996) argue that large inflow of immigrants reduced the wage paid to natives with similar characteristics. When workers' skills are differentiated only by their level of educational attainment, then a large flow of immigrants with low level of education reduced wages paid to less educated natives through direct substituitability in carrying out the same typologies of jobs. Ottaviano and Peri (2008) develop their analysis following a different assumption, that immigrants and natives with similar observable characteristics are imperfect substitutes in production and, therefore, they don't compete with most native-born workers. This is due by the fact that natives and foreign-born workers of comparable educational attainment and age might posses unique skills that lead them to specialize in different occupation. The immediate consequence is a lower wage loose that hits natives workers. In particular, Peri and Sparber (2009) show empirically that natives and foreign born workers within the same groups of workers specialize in differentiated production tasks. Less educated foreign-born workers are found mostly in agricultural and personal services while natives in manufacturing and mining.

The latter evidence is interestingly correlated with the work of Cortes and Tessada (2007), resting on the fact that low skilled immigrants work disproportionately in service sectors that are closely substitutes of household production. Starting from that they claim that low-skilled immigration could affect the time-use decisions of natives, in particular those taken by high skilled women. Indeed, the prices reduction of time intensive services, induced by low skilled immigrants who increase labor supply, has risen hours worked by women with a graduate degree, especially those with a professional degree or PhD and those with children. In addition, they find a decrease in the time high skilled women spend in household work and increases reported expenditures on housekeeping services.

The work of Cortes and Tessada (2007) is interesting especially because moves away from the traditional focus and tries to explore a new dimension in which low skilled immigrants affect the average level of natives welfare and its distribution.

Other papers deal with the effects of immigration on prices for services. Cortes (2008) estimates the impact of low-skilled immigration on prices, wages and purchasing power of US natives and finds that, at city level, low-skilled immigration benefits the native population by decreasing the nontraded goods component of the cost of living (such as housekeeping and gardening). In particular, the group of natives that benefits the most is that of high-skilled natives, because they devote a larger share of their budget to immigrant-intensive services. She suggests that wages are a likely channel through which this effect takes place. Indeed, Cortes (2008) finds that a 10-percent increase in the share of low-skilled immigrants in the labor force decreases the price of immigrant-intensive services by 2 percent. Interestingly, she finds that the local concentration of low-skilled immigrants has little impact on the prices of traded goods.

The research presented in the second chapter (carried out with Elisabetta Olivieri), investigating the effects of immigration on wages (here considered as a good proxy of prices) in the non-tradable services sector and trying to explore the consequences of immigration for female participation to the labor market, is part of this literature. Looking at the channel through which immigrant inflows can affect female natives situation, it provides additional evidence, using Italian data, of the positive outcome that natives can get

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from the presence of immigrants.

Italy is one of the developed countries with the lowest female participation in the labor market and where women spend more time on home production. Hence, the research considers the Italian labor market for services directly substitute for household production in order to verify whether it could be responsible in some way for the labor supply decisions of Italian women. This kind of analysis calls into question also the immigration issue, since immigrants are highly specialized in time-intensive low-skilled services. A higher supply of labor in these market sectors could in principle have a positive effect on the native labor supply - through the reduction of wages paid to home services workers. The goal of the empirical analysis, developed using an instrumental variable approach, is twofold. First, it studies the wage and employment patterns of the market for non-tradable home services. Secondly, it deals with the possible impact that migrants inflows have on female labor decisions.

The third chapter investigates what the introduction of intrinsic motivation implies for the definition of the optimal incentive scheme when the worker carries out more than one task. Therefore, such analysis, is a *trait d'union* between the multitasking principal agent theory and the literature on intrinsic motivation.

Contributions of the last decades in principal-agent theory have recognized the need of a broad perspective, focusing on the definition of the optimal incentive scheme when agents carry out more than one task. The effort allocation among different tasks is determined by the relative benefits the agents derive from the various tasks and from their complementarity or substitutability in terms of cost of effort. In this framework, the incentives provided by the principal don't serve only to allocate the risks, motivate and reward hard work, but also to direct the allocation of agent's attention among various tasks. Therefore, the interaction between tasks becomes really crucial.

The most important contribution is the paper of Holmstrom and Milgrom (1991) that offers the most general treatment of the multitasking issue in a moral hazard context, where the crowding out or crowding in effects emerge, depending on the fact that tasks are substitute or complement in the agent's cost function. In this framework, given the interaction between tasks, incen-

tives for any given activity can be provided either by rewarding that activity or by decreasing its opportunity cost, through the reduction of the incentive for the other activity.

There are many application of this mechanism. The definition of the incentive pay for teachers (Holmstrom and Milgrom, 1991); the quality-quantity trade-off (Laffont and Tirole, 1991; Hart et al., 1997); the balance between short and long term profit incentives (Laffont and Tirole, 1988; Holmstrom and Milgrom, 1991).

The interaction between different activities could also imply the task separation, such that each tasks is assigned to a different agent. This occurs in the paper of Dewatripont and Tirole (1999), where they consider the effort spent looking for pros and cons of a given decision (in the judicial area). Other examples concern the ex ante and ex post control of fraud or misbehaviour (Boot et al, 1993; Dewatripont and Tirole, 1994a) or the demand-side management in energy regulation (Joskow, 1990).

Splitting tasks between several agents is not always useful; sometimes the multitasking framework predicts task clustering. This happens when tasks have similar degrees of measurability, when there is the risk of conflicts of interest or when the objective is the functional specialization, i.e. the unification of tasks requiring similar talents. The basic mechanism acting in the multitasking framework is the crowding out, that is the result of the tasks interaction.

Also Frey (1997), analyzing the relationship between intrinsic motivation and extrinsic rewards, introduces a crowding out effect that he calls moral crowding out effect. He points out that, since intrinsic motivation refers to doing something because it is inherently interesting or enjoyable, and so rewarding, an external intervention - be it rewards or commands - may affect intrinsic motivation. The external intervention crowds-out intrinsic motivation when it is felt to be controlling but crowds-in intrinsic motivation when it is perceived to be supporting self-determination and self-esteem.

When moral crowding out occurs, work performance decreases if the negative effect on intrinsic motivation induced by an extrinsic reward dominates the normally considered positive effect of external interventions. Frey (1997, 1999, 2001) empirically shows the relevance of this effect, underlying how it allows to explain some evidences contradicting principal-agent theory, such as why pay-for-performance is so little used, why managers of for-profit

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institutions receive part of their salary in terms of bonuses while managers in non-for profit institutions receive a fixed payment or why people are more willing to accept a locally unwanted project, but useful for the community, if they are not paid to accept that.

The vast work of Frey, as well as theoretical and empirical evidence from psychology and sociology, clearly highlights the importance of the agent's intrinsic motivation in terms of agent's behaviour and incentives provision. Indeed, the view of human motivation based only on extrinsic interventions (i.e. rewards, punishment, control) appears to be narrow and may severely limit the understanding of the determinants and effects of incentives. For this reason many authors have tried to better understand the levels and the changes in agents' behaviour introducing intrinsic motivation in the principal-agent framework and studying its implication with respect to different situations.

Heyes (2005) and Delfgaauw and Dur (2007) focus on the screening of workers' motivation in order to attract highly motivated workers. The higher productivity of those workers is assumed by Heyes while Delfgaauw and Dur prove it extending a standard incentive wage model. Then both paper examine how the principal can attract and select highly motivated workers to fill a vacancy. Even if in a different framework they get that posting a higher wage decreases the expected average quality of job applicants because less (or not) motivated workers are induced to apply. This result derives from the fact that motivated workers obtain utility directly from working.

The previous result is got also by Nyborg, Kverndokk and Brekke (2003), who focus mainly on the motivation related to the way in which job impacts on the workers' self-image. They study the self-selection into different occupations, considering that agents differ in their preference for *being important to others*. What emerges is that those with intermediate preferences will end up in private market employment, while the public sector (where effort and productivity cannot be verified) will attract both workers with highest and lowest work motivation. The first ones for the opportunity to be important, the second ones for the opportunity to shirk. Given this result they suggest that a solution to attract motivated workers to the public sector, without attracting shirkers, is not a wage increase but the improvement of the workers' opportunities to do a good job, by investing capital that rises their productivity. Also in this case it is evident that the presence of intrin-

insic motivation is able to modify the way in which workers behave and the incentive scheme that has to be defined.

The work of Nyborg, Kverndokk and Brekke (2003) is a link between theoretical analyses that underline the less importance of monetary rewards when motivated workers are considered and those analyses looking in particular at the implication of workers' motivation for the job design. Francois (2000) and Besley and Ghatak (2005) study incentives in this context, focusing on the role of matching the mission preferences of the principal and agents in increasing organizational efficiency. When workers' motivation is related to some particular mission, as the public service motivation presented by Francois (2000), an organization having as main goal the attainment of that mission rather than the profit (as government bureaucracy) obtains more effort from agents. On the other hand, a mission-oriented organization that hires workers sharing the same mission can economize on the need for high-powered incentives, because the agents' effort is also remunerated by the simple fact of working in that particular context. So, it clearly emerges, that the presence of workers' intrinsic motivation makes some aspects of the organization design (i.e. mission choice, relational dynamics, etc) important because they directly act on the intrinsic incentives leading the agents' working behaviour.

My research is part of this literature that looks carefully at the presence of intrinsic motivation in the principal-agent relationship and enriches it by studying the implication of the agent's motivation in a multitasking framework.

I develop a theoretical model, based on the multitasking framework proposed by Holmstrom and Milgrom (1991), where an agent carries out two tasks: one that is directly related to the intrinsic motivation for the job and another one that is not. Moreover, they may differ according to their degrees of observability. This heterogeneity derives from the evidence according to which the effort for tasks that embody intrinsic motivation (caring for nurses, teaching of high-thinking skills for teachers, etc.) is generally less measurable than the effort related to non motivational tasks (i.e. bureaucratic activities, teaching basic skills, etc.). The main mechanism acting in this framework, the *indirect moral crowding out effect*, captures the link between the multitasking principal agent theory and the literature on intrinsic

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motivation. It implies that, when the agent is highly intrinsically motivated, the principal has to set a fixed wage and, therefore, is no more able to use monetary rewards as an incentive device. Given this result, the empirical analysis carried out in the second part of the chapter, using the National Sample Survey of US registered nurses, aims at verifying the validity of a different source of incentives emerging from the theoretical analysis - the tasks allocation.

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Chapter 1

Job Polarization and Labor Market Institutions

1.1 Introduction

In the last decades, labor markets of developed countries such as the US and the UK have undergone a deep restructuring in response to a powerful force of change, the computerization process. As a result, since the late 1980s, the related wage structures have been experiencing some crucial radical changes: (i) the proportion of middle-income jobs, which represented the core of employment during post-war years, has declined, (ii) wages have grown faster in the top and bottom of the earning distribution than in the middle. We generally call these phenomena employment and wage *polarization*.¹

Goos et al. (2009) show that job polarization is a pervasive phenomenon not confined to the US economy. They also find in Europe a huge fall in the fraction of middle-income jobs (on average -7.77% from 1992 to 2006). This is a surprising result, given that during the last decades, labor market institutions in continental Europe were able to mitigate the effects of market forces through the collective bargaining process (Krugman, 1994; OECD, 1994; Blau and Kahn, 1996). Despite their findings, there is a certain cross-country heterogeneity among the polarization patterns. In particular, unlike in the US, in Continental Europe, the fall in the employment share of middle-

¹See Autor et al. (2003), Goos and Manning (2007), Autor et al. (2006), Lemieux (2007).

paid jobs does not come with a growth in the fraction of low-paid jobs.

This analysis aims at explaining cross-country differences in job polarization trends, focusing on a Continental European country, i.e., Italy, where there has been significant polarization in wages from 1985 to 2004 but where the proportion of low-income workers has not significantly changed. In doing so, we study the interactions between the institutional environment and technical innovations in order to verify whether national peculiarities can still lead to different inequality trends in a global economy.

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 hired in non-routine manual tasks. Our point of reference is the framework of Autor et al. (2006), who propose 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. If computers directly substitute for routine tasks and most strongly complement cognitive and manual tasks, then an exogenous reduction in the real price of computing power will lead to some polarizing trends in wage and employment growth, consistent with the findings observed in the US.

The main difference between our model and theirs 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 for the highest possible 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 by computer capital; (ii) an increase in wages and employment in abstract labor tasks that are complements to 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 protects only its current members (*insiders*); we

have an uncertain effect on manual wages and a positive one on manual employment when unions care about the entire manual labor supply.

According to this model, Italian labor market institutions have avoided employment growth in low-paid jobs by maintaining a high level of manual wage. Since other unionized labor markets have behaved in a similar way (France, Germany, Spain), this model can be useful in order to explain cross-country differences in job polarization trends.

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 we then describe our theoretical model in section 5. Finally, we discuss our results in section 6.

1.2 The Changing Nature of Wage Inequality

Debate on the effects of the computerization process on wage inequality started intensifying in the 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. There was wide consensus over the fact that the technological change driven by the computer revolution was not factor-neutral: it favored skilled over unskilled labor by increasing the relative productivity of skilled workers and, therefore, their relative demand.² Even if the so-called *skill-biased technological change* (SBTC) is the most convincing explanation, a number of facts are even today difficult to reconcile with this framework. The hypothesis of SBTC comes under attack whenever we try to compare the US evidence with observations from 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 did firms in the US or Britain.

In the attempt to solve this puzzle, many authors have considered cross-country heterogeneity in labor market institutions.³ According to this view, English-speaking countries had reflected every change occurred in the

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

³For instance, Blau and Kahn (1996). For details on the impact of institutions on the US labor market see Fortin and Lemieux (1997).

demand and supply for skill, while European wage structures had been *protected* from every shock by their collective bargaining processes.

This debate did not conclude in the 1990s: it is still evolving with recent stylized facts. Above all, the decline in the proportion of middle-income jobs in the US is the main piece of evidence to be explained. Moreover, US employment polarization has been accompanied by 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 some, middle-class decline has been an unremarkable feature of economic adjustments and does not at all represent a policy problem. A widening employment polarization, however, means a growing number of *working poor*. Thus, it may accelerate the erosion of the middle-class majority that stabilizes political life and plant the seeds of new political tensions in years to come.⁴

There are different possible explanations of the polarization phenomenon. The rise in the share of income going to the rich in the US and the UK may have led to an increase in demand for low-skilled workers whose employment increasingly consists of providing home services to the rich (Manning, 2004; Mazzolari and Ragusa, 2007). Also, outsourcing could have affected the employment structure of developed countries (Blinder, 2007). Finally, the third possible factor is the computerization process. With this concern in mind, Autor et al. (2006) propose a more nuanced version of SBTC where technology can affect in different ways different parts of the wage distribution. They suggest that the effect of technological progress is to replace routine labor, which tends to be in the middle of the wage distribution.

The last explanation is probably the most convincing⁵. However, their model may fail to fit Continental Europe because of its very restrictive assumptions. Above all, the hypothesis of a perfect competitive labor market does not account for the collective bargaining process. Our goal is to give a theoretical contribution by examining the peculiarities of Continental Europe, which is characterized by strong labor market institutions.

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

⁵See Goos et al. (2009).

The bargaining process can be modeled in many different ways. In our framework, we assume that a union and a 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). The size of this employment target is crucial in order to catch the effects of a technological shock on the wage and employment structures.

1.3 The Italian Setting

The US economy experienced in the 1990s 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, due to the lack of reliable measures of ICT capital stock. According to the World Bank, from 1991 to 2004, the number of PCs in Italy grew by 588% (499% in Germany, 561% in France, 381% in the United Kingdom). The percentage of firms that fulfill Internet orders grew by more than 40 percentage points from 2003 to 2007 (ISTAT). Bugamelli and Pagano (2004), using microdata on Italian manufacturing firms, suggest a measure of capital stock that includes hardware, software and communication equipment. They show a delay in ICT accumulation with respect to US manufacturing of about 8 years and find a positive correlation at the 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 also been affecting the Italian economy. Thus, we could say that currently, the computerization pressure on the Italian wage and employment structure is the same that has occurred in the US since the 1980s.

In order to analyze the consequences of these pressures on the Italian labor market, we have to focus on the Italian institutional setting.⁶ The wages of Italian workers are determined through a national agreement. Three major confederations of sectoral unions (CGIL, CISL and UIL), characterized by different political inspirations, represent Italian workers. On

⁶For details on the Italian labor market see Brandolini et al. (2001), Erickson and Ichino (1995), Brandolini et al. (2006).

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. The formal 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, avoiding that social conflict were ultimately resolved by inflation.

Collective agreements set wages by differentiating according to a skill ranking system. The law divides employers into four categories: blue-collar, white-collar, *quadri*,⁷ and managers. The nature of the occupation, whether manual or intellectual, traces the border between blue-collar workers and the other categories, while the amount of directive responsibility traces the distinctions among the highest categories.

In the 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 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; (ii) reformed some non-standard labor relationships (apprenticeship); (iii) and legalized and regulated the supply of temporary workers by authorized agencies.⁸ This reform represents one of the steps

⁷White-collar workers with directive responsibilities.

⁸The so called *Temporary Help Employment*, a contract in which an agency hires a

towards the liberalization of atypical contracts, which are less expensive for firms in terms of taxes and social security payments.

1.4 The Italian Trends of Polarization

Our main source of data is the WHIP.⁹ 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 for only 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 65,000 labor relationships per year. Around 67% of employee labor relationships concern blue-collars, 32% white-collars, and 1% managers.

The above dataset allowed us to obtain information about: (i) the professional status of employees: place of work, type of contract, business sector, employment qualification and number of worked weeks per year; (ii) the employees' 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, these data are used 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 percentile¹⁰ from 1985 to 2004. On the whole, in the last decades very low wages and very high wages have been the ones that have grown the most. This evidence is very striking. In particular, Autor et al. (2006) have calculated a difference in cumulative wage growth between the lower extreme and the middle of the US wage distribution of 5 log points from

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>.

¹⁰From the 4th to the 96th percentile.

1988 to 2004, while our gap in cumulative wage growth over the same years is about 15 log points.

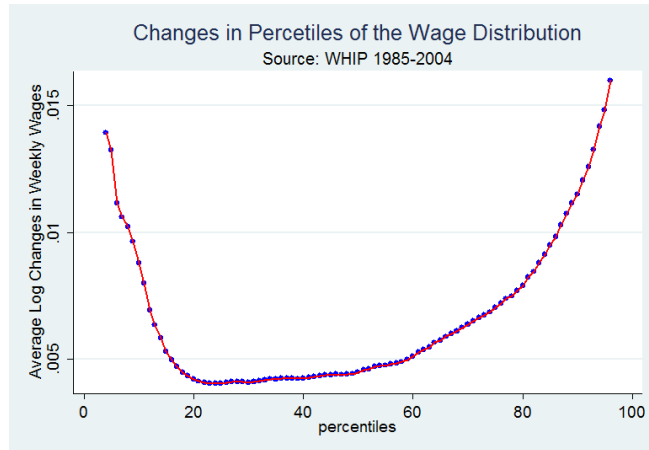


Figure 1.1: Changes in log weekly wages by percentile. Source: WHIP, 1985-2004.

This wage growth curve can be differently evaluated depending on the related employment trends. 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 1985.¹¹ This figure reveals that Italian employment trends are different from American ones. Employment shares especially remain rather constant along the whole 1985 wage distribution, except for the most paid occupations. 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 the share of low-paid jobs has not been increasing.

1.5 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 bargaining process. Following the simple framework of Autor

¹¹Our *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).

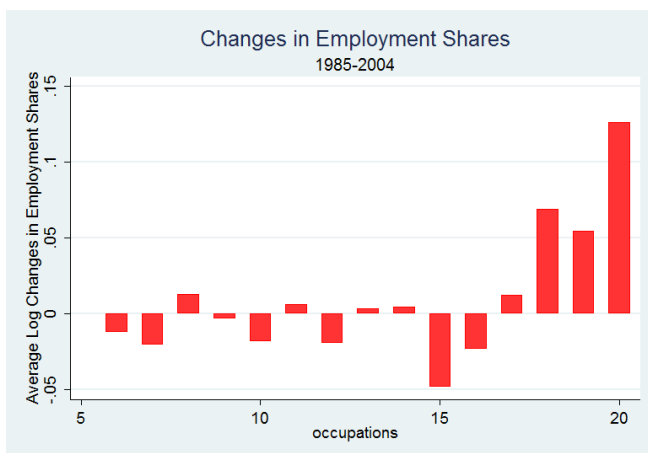


Figure 1.2: Changes in employment shares by occupation. Occupations are sorted by the average weekly wage paid in 1985. Source: WHIP, 1985-2004.

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). These groups roughly correspond to high-, intermediate- and low-skilled jobs. The technological shock hits in a different way the workers hired in these three activities (Levy and Murname, 2004). 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 complements of abstract tasks (e.g., coordination activities and problem solving) and probably, to some extent, also of manual activities.

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

$$Y = L_A^\alpha (L_R + K)^\beta L_M^\gamma \quad (1.1)$$

where $\alpha, \beta, \gamma \in (0, 1)$ 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 is elastically supplied to routine tasks at price ρ per efficiency unit.

The main difference between our model and that used by Autor et al. (2006) is the labor market environment. While they deal with a competitive market, we introduce some rigidities related to the bargaining process between unions and firms. We assume that the abstract labor market is perfectly competitive, while in manual and routine labor markets, employment and wages depend on the bargaining process. The union's goal is to reach in every labor market the highest possible wage compatible with a certain employment target.¹² This target (L_j^* with $j = M, R$) is a function of the number of union members, L_j^I , (employed workers at the moment of the bargaining process) and of the total labor supply for those tasks, S_j . 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 final outcome in the routine labor market is equal to the competitive equilibrium.

The employment target in the manual labor market is:

$$L_M^* = \phi L_M^I + (1 - \phi) S_M, \quad (1.2)$$

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 on the demand of the firm $E(L_M)$.

In this economy, there are many income-maximizing 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 is 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 being a 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 can choose to supply their efficiency units to either manual or routine tasks.

¹²It is reasonable to treat separately the three labor markets since the bargaining process sets labor conditions for every industrial sector and worker qualification.

Supply choices of the non-graduate workers are determined by a self-selection rule. According to it, workers select themselves into one specific task given their ability, the wage levels and the probability of being hired for each task. Let w_R and w_M be the wage paid to routine and manual tasks per efficiency unit; then, each worker will compare w_M and ηw_R . The higher the value of η is, the more likely it is that the worker chooses a routine job. Furthermore, supply choices depend on the probability of having a job in the two sectors. Since the routine market equilibrium is equal to the competitive outcome, at the equilibrium, no worker will be an involuntarily unemployed. In the manual market, the probability of being employed depends on ϕ . Only when $\phi = 0$ there is certainly no unemployment. A more restrictive employment target ($\phi > 0$) implies a lower probability of finding a job in the manual sector and therefore a lower manual labor supply.

To summarize, manual labor supply (S_M) is a function of $\frac{w_M}{w_R}$ and ϕ , 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 $S_R(\frac{w_M}{w_R}; \phi)$, and an increase in relative wages induces a deeper reduction in S_R when ϕ is low.

The wage definitions for abstract, routine and manual workers are different, depending on the functioning of the corresponding market. 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.

$$L_M = \left(\frac{\gamma L_A^\alpha (L_R + K)^\beta}{w_M} \right)^{\frac{1}{1-\gamma}}. \quad (1.3)$$

When no shock hits 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 value of ϕ . In particular, if union cares only about its current members ($\phi = 1$), we have:

$$w_M = \gamma L_A^\alpha (L_R + K)^\beta L_M^{\gamma-1}. \quad (1.4)$$

When $\phi < 1$:

$$w_M = \gamma L_A^\alpha (L_R + K)^\beta [\phi L_M^I + (1 - \phi) S_M]^{\gamma-1}. \quad (1.5)$$

Now we consider the effects of a positive shock on the manual labor market. In particular, the exogenous force that hits the 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 on a one-to-one basis. With downward-sloping factor demand curves ($R'(\rho) < 0$), the decline in ρ raises the demand for routine tasks. 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 it will be satisfied by computer capital (Autor et al., 2006). In fact, when ρ declines, the ratio between manual and routine wages increases and some workers will 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 employment in routine tasks declines. A worker's decision to supply labor 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 is that the less restrictive the employment target is (the lower ϕ is), the greater the reduction in S_R will be.

The effect of the reduction in ρ on 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 $L_M^* = E(L_M) < L_M$, and whatever the value of ϕ , the manual employment increases. Actually, it is reasonable to assume that the union can anticipate technological shocks.¹³ 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

¹³This 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 the US, so they expect the technological innovations and their consequences on the labor market.

supply does not affect the union employment target; when $\phi < 1$, an increase in S_M leads to a positive effect on manual employment.¹⁴ Therefore, the higher ϕ is, the lower the effect of the computer price decline on manual employment. In particular, when $\phi = 1$, the increasing labor supply does not play any role.

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:

$$-\frac{\partial w_R}{\partial \rho} = -1. \quad (1.6)$$

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

$$-\frac{\partial w_M}{\partial \rho} = -\beta\gamma L_A^\alpha R^{\beta-1} \frac{\partial R}{\partial \rho} L_M^{\gamma-1}. \quad (1.7)$$

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 (5), getting:

$$\begin{aligned} -\frac{\partial w_M}{\partial \rho} &= \gamma(1-\gamma)(1-\phi)L_A^\alpha R^\beta [\phi L_M^I + (1-\phi)S_M]^{\gamma-2} \frac{\partial S_M}{\partial \rho} + \\ &\quad -\beta\gamma L_A^\alpha R^{\beta-1} \frac{\partial R}{\partial \rho} [\phi L_M^I + (1-\phi)S_M]^{\gamma-1}. \end{aligned} \quad (1.8)$$

The effect of computerization on w_M is no 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. Both the effects depend on ϕ . A restrictive employment target implies that changes in labor demand are almost completely transferred to wages; then the higher ϕ , the

¹⁴ $-\frac{\partial L_M^*}{\partial \rho} = -(1-\phi) \frac{\partial S_M}{\partial \rho} > 0$.

stronger the impact of factor complementarities. On the other side, the impact of ϕ on the supply-side effect is ambiguous: (i) when ϕ is high, fewer workers shift to manual tasks, (ii) the higher ϕ is, the weaker the increase in manual employment and (iii) the higher ϕ is, the more demand-side shocks are transferred to wages. While according to (i) and (ii) a restrictive employment target implies a lower supply-side effect, (iii) makes the supply-side effect stronger when ϕ is high.

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

Finally, the abstract wage unambiguously increases:

$$-\frac{\partial w_A}{\partial \rho} = -\alpha L_A^{\alpha-1} [\beta R^{\beta-1} \frac{\partial R}{\partial \rho} L_M^\gamma + \gamma R^\beta L_M^{\gamma-1} \frac{\partial L_M}{\partial \rho}] > 0. \quad (1.9)$$

This is due to the increase in the demand for abstract tasks, which is not followed by a countervailing labor supply. Therefore, the computerization process implies a higher w_A and a higher abstract employment, exactly as in Autor et al. (2006)'s model.

To summarize, the model predicts that a reduction in $\rho (= w_R)$ 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 worker mobility, the dimension of this reduction depends on ϕ . Moreover, it has positive effect both on abstract wage and abstract employment. The changes in w_M and manual employment depend on the union policy. When the union cares only about employed workers, computerization leads to an increase in w_M , and the wage structure tends to polarize to the detriment of manual employment growth.¹⁵ 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 can we observe an employment polarization as in Autor et al.'s (2006) perfect competitive framework.

¹⁵Note that the observed wage, in the case of routine tasks, may differ from the wage paid per efficiency unit of routine task input. Observed routine wages are affected by composition. As workers self-select out of routine tasks, the remaining routine workers have above-average routine skills, meaning that the observed routine wage can either rise or fall as ρ declines.

In this setting, low-skilled unemployment seems to be the only alternative to employment polarization. Thus, the union, by bargaining for a high level of low-skilled wage, decreases inequality in the lower tail of the earning distribution, at the cost of an increasing number of unemployed workers.

1.6 A Discussion of the Italian Trends

Autor et al. (2006) explain polarization trends in US wages and employment with the sharp decrease of computing power price and the related diffusion of computers. Since computerization is a global phenomenon that has also been affecting Continental Europe, we may expect that the labor markets in Continental Europe and the US have reacted in a similar way to the decline of the price of computers. Moreover, wages and employment in many European countries are determined through bargaining between the confederations of trade unions and the association of entrepreneurs and thus they may not directly reflect changes in labor demand and supply.

Figures 1 and 2 plot the changes in wages and employment by wage level in Italy, 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 in section 5. Indeed, according to our framework, the more the union - or other labor market institutions - protects its members, the more wages for low-skilled jobs tend to be high, to the detriment of low-skill employment. Conversely, when the union's goal is not far from the competitive equilibrium of the labor market, employment shares will polarize.

Our evidence could be used as an *empirical test* in order to understand the role played by labor market institutions. Therefore, the correspondence between our theoretical predictions when $\phi = 1$ and the Italian trends may suggest that labor market institutions in Italy have mainly protected employed workers, leading to a huge increase in manual wages to the detriment of manual employment. In other words, the increase in the demand of manual work induced by computerization - which in a competitive world would have had a positive effect on both wage and employment - has raised only manual wages.

Labor market institutions avoid employment growth in manual jobs through two channels: (i) they can keep their employment target constant; (ii) they can oppose the shifts of routine workers to manual tasks by resisting the fall in routine employment.¹⁶

If only the first channel is acted, we would conclude that institutions prevent job polarization at the cost of growing low-skilled unemployment. This is consistent with the growing difference in unemployment rates of unskilled and other workers.¹⁷ This political implication is mitigated by the second channel, where in a unionized market, fewer workers leave routine occupations.

In a competitive market, the drawbacks of computerization impact (i) routine workers who decide to stay in R even with a lower wage per efficiency unit and (ii) manual workers when the increase in manual labor supply is greater than the increase in the labor demand. Conversely, in a non-competitive market, routine workers have to pay all the drawbacks of the technological shock: in terms of wage if they stay in R and in terms of employment if they move. Furthermore, the bargaining process and its effects on the labor decisions of routine workers lead to smaller substitution between computers and labor input, which implies a lower degree of computer capital adoption.

The Italian labor market experienced many deep changes during these 20 years. Therefore, the general tendencies presented in figures 1 and 2 may not be representative of the entire period of analysis. Splitting our data into two sub-periods, we observe that, from 1985 to 1996, the log ratio between the 50th and the 5th percentile had declined by 0.11 percentage points, while from 1996 to 2004, it declined only by 0.05. This means that in the mid-1990s, wage polarization became weaker. As far as employment shares are concerned, figure 3 shows that the employment growth in low-paid occupations from 1996 to 2004 is a bit higher than before. The share of worked weeks in middle-paid occupations remains rather constant in the first period and tends definitely to decrease over the second one. Furthermore, worker flows from middle-paid jobs to low-paid jobs increase significantly

¹⁶The bigger the value of ϕ , the lower the probability of finding a manual job and, therefore, the lower the shift of workers from R to M when ρ declines.

¹⁷This difference grew from 0.1 percentage points in 1993 to 2.3 in 2005.

after the mid-1990s: from 1995 to 2004, the number of workers who shifted from receiving middle wages (30-60 percentiles) to receiving low wages (1-30 percentiles) increased by 33% (14% in the previous ten years). Thus, in the second sub-period, we observe a light employment polarization and a weak wage convexification. These results could be related to a decline in the value of ϕ and are consistent with the increasing degree of competition of the Italian labor market.

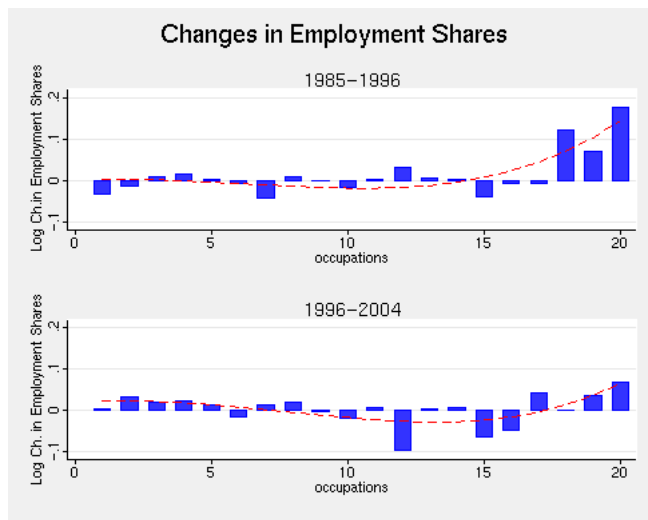


Figure 1.3: Changes in employment shares by occupation. Occupations are sorted by the average weekly wage paid in 1985 and 1996. Source: WHIP, 1985-2004.

In order to assess the important role of labor market institutions and the interactions between them and the computerization process, we should also extend the predictions of our model to other countries. Noteworthy is that 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) show that in Germany, as in Italy, wage inequality increased in the 1980s but only at the top of the wage distribution. In the lower tail, inequality tends to increase, and about one-third of this increase can be related to de-unionization. This suggests once more that the lower tail of the wage distribution is crucially influenced by the labor market institutions.

According to Goos et al. (2009), in France, Austria and Denmark, there

is also not an increase in the employment share of low-paid occupations from 1993 to 2006. In Belgium, Greece and Spain, there is only a very weak increase.

1.7 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 this, the comparison between wage and employment patterns of the US and some European countries (e.g., Italy, France and Spain) shows a clear discrepancy. During the period 1988-2004, the US labor market was characterized by a clear job polarization trend. Conversely, in Continental Europe, the employment share of low-paid jobs did not increase at all (or only slightly increased). In Italy particular, the lack of job polarization has come with: (i) an increasing difference in the unemployment rates of low-skilled workers and overall workers and (ii) a huge polarization in wages.

In order to explain these patterns, we propose a theoretical framework that captures national peculiarities in the institutional environment. In particular, we give voice to the role played by unions in the process of wage setting. In our model, the union can choose to adopt different policies depending on its employment target. As a result, labor market institutions regulate the trade-off between low-skilled wage growth and low-skilled employment growth.

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Chapter 2

Too Much or Too Little Immigration? Evidence from Non-Tradable Services

2.1 Introduction

This study focuses on time-intensive services that directly substitute for household production. This sector has special relevance because its functioning is correlated with key issues in the economic and political debate, in particular the female labor supply. These time-intensive services are a natural *trait d'union* between highly skilled laborers whose time represents a high opportunity cost, and low-skilled workers who sell services on the market. The externalization of home production allows skilled workers to engage in more productive occupations and increases job opportunities for less skilled workers. In the aggregate, this externalization increases the national GDP (Alesina and Ichino, 2009).

We focus on the Italian case, which is particularly interesting because of the low female labor supply with respect to that of other advanced economies. The opportunity for women to participate in the labor market strictly depends on the availability of time-intensive services that are close substitutes for household production. Hence, we want to consider the Italian labor market for these services to verify whether it could be responsible in some way for female decisions to not supply labor.

From a policy point of view, the policy-maker could use many potential methods to increase the female labor supply. In this paper, we focus on the least expensive solution, which is relaxing restrictive immigration policies to increase the private service supply.

The argument against immigration tends to be that immigrants displace Italian workers, reducing wages and job opportunities in the labor market. This idea plays a crucial role in the implementation of restrictive immigration policies. Conversely, however, Cortes and Tessada (2007) show that immigration has had a positive effect on the female labor supply in the US because immigrants increase the supply and lower the price of housekeeping services. A higher supply of labor in these market sectors could in principle have a positive effect on the native labor supply. Given that immigrants in Italy are highly concentrated in services that substitute for home production, all of these restrictive immigration policies could actually be discouraging female labor participation.

We use Italian administrative data on wages and employment at a provincial level from the Italian social security institute (INPS). We select all household services and observe changes over time in weeks worked and weekly real wages. We find that both wages and weeks worked have increased over time and that they are positively correlated across provinces and time. This evidence reveals that the demand for time-intensive services has grown more rapidly over time than the supply despite the massive migration inflows.

Next, we verify that our pattern is compatible with a demand-side shock using an IV strategy. We instrument relative employment in time-intensive services to determine the effects of a demand-side shock on relative wages. Our instrument deals with the age structure of the population. We find that an increase of 1% in relative employment due to a demand-side shock would increase relative wages by 0.2%. Thus, the demand for household services, which is growing more than the supply, has led Italian families to pay more for service externalization, providing incentives for women to stay home.

Finally, we exploit the effects of immigration on female labor participation. In fact, a weaker restrictive immigration policy could in principle increase the service supply and lower prices. We look at the causal effect

of immigration on natives' decisions to participate in the labor market. We use an IV strategy, instrumenting the share of immigrants with the interaction between previous settlements of immigrants in Italian provinces and an arguably exogenous supply-push factor. More specifically, we use an OECD index that captures the credit and political risk of each country of origin of Italian immigrants. We find that immigration tends to lower the probability of a female's not supplying labor; conversely, it has no effect on male decisions to supply labor.

The paper is organized as follows. After a brief survey of the related literature, we present the main characteristics of the supply and demand for services related to household production in Sections 3 and 4. In Sections 5 and 6, we propose our empirical analysis. Section 7 provides a conclusion.

2.2 Literature

Many papers focus on low-skill services to determine the effects of immigration on the labor markets of destination countries.¹ Some authors argue that immigrants reduce the wage paid to natives with similar characteristics. Others show that immigrants and natives with similar observable characteristics are imperfect substitutes in production, and therefore, the former do not compete with the latter in the job market (Ottaviano and Peri, 2008). Indeed, immigrants and natives have different specializations across economic sectors: foreign-born workers are concentrated in the agricultural sector and personal services while natives tend to work in manufacturing and mining (Peri and Sparber, 2009).

Other papers deal with the effects of immigration on prices for services. Cortes (2008) focuses on the influence of low-skilled immigrants on the prices of non-tradable goods and services in the US. She finds that a 10-percent increase in the share of low-skilled immigrants in the labor force decreases the price of immigrant-intensive services by 2 percent. Frattini (2008) deals with the UK case and finds that immigration reduces price growth in services with a high concentration of low-skilled immigrants.

¹There is a significant body of literature on the effect of migration inflows on the labor market. See Okkerse (2008) for a review.

Finally, Cortes and Tessada (2007) and Barone and Mocetti (2009) observe that low-skilled immigrants work disproportionately in service sectors that are close substitutes for household production. Starting from that observation, they claim that low-skilled immigration could affect the time-use decisions of natives, thus increasing the labor supply. In particular, Cortes and Tessada (2007) show that a reduction in the cost of services as induced by low-skilled immigration would increase hours worked by women with graduate degrees in the US. In addition, they find that immigration lowers the amount of time that highly skilled women spend at home and increases reported expenditures on housekeeping services.

2.3 Immigration and Service Supply

According to the Italian National Institute of Statistics (Istat), immigrants in Italy are highly specialized in domestic activities. Figure 2.1 shows the immigrant specialization index across market sectors. This index is the ratio between the share of immigrants in a certain sector over the total number of immigrants over the share of Italian workers in the same sector. When the ratio takes a value of 1, native-born and foreign-born workers are present in the sector in the same proportion. Despite the high concentration of immigrants in every low-skill sector (i.e., agriculture and construction), immigrants' degree of specialization in household services is truly significant²; the share of foreign-born individuals in this sector is more than 11 times the share of Italians. Furthermore, this is the only labor market that hires more immigrants than natives.³

Immigrants' specializing in household services probably reflects their lower reservation wages, which is consistent with their need for a job to stay in Italy. In fact, this is the worst paid sector of the economy, with an average wage in 2004 that is 19 percent lower than the average wages across other low-skilled jobs. The labor market for services that substitute for home production activities is very low-skill. Figure 2.2 shows that 97%

²In *Household services* Istat includes all services to families (baby-sitting, assistance, cleaning services).

³See Cortes and Tessada (2007) and Peri (2006) for similar evidence on the US.

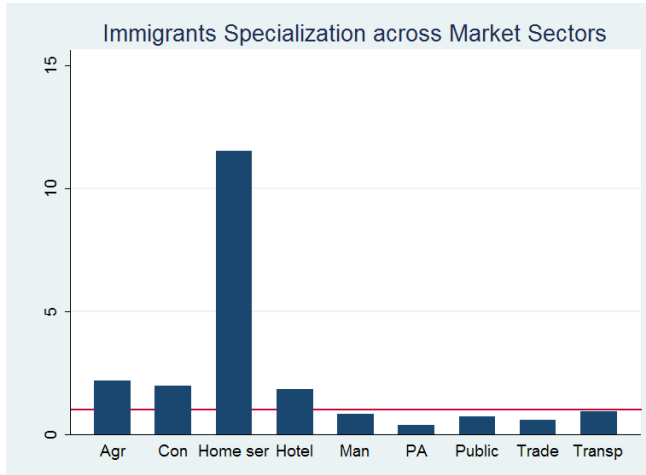


Figure 2.1: Immigrant specialization across market sectors (Istat, 2008).

of the workers in this sector do not have high-school diplomas.

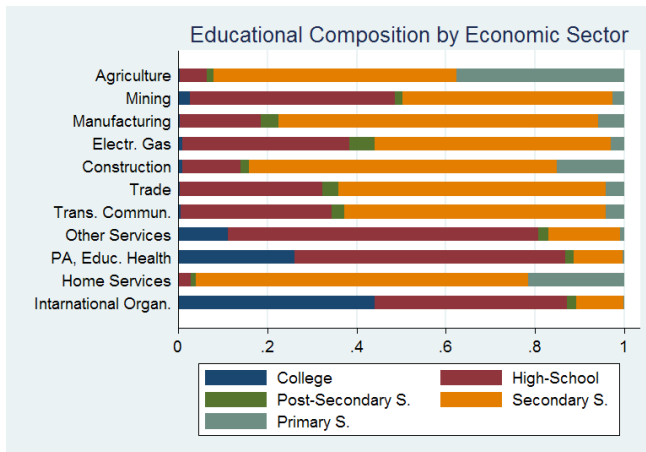


Figure 2.2: Educational composition of employment across market sectors (Istat, 2001).

In recent years, immigration in Italy has increased even more than in other advanced economies. According to the Istat Census data, the amount of foreigners in 2001 was four times the amount of foreigners in 1991. Furthermore, their presence is still growing: from 2008 to 2009 alone, the number of regular immigrants increased by 13.4 percent. Currently, regular immigrants represent almost 6 percent of the population. According to the OECD (2007), immigrants in Italy are, on average, younger and less qualified than those from abroad.

This substantial increase has certainly generated a supply-side shock in the labor market for services that substitute for home production. It is reasonable to expect that this shock has had a negative effect on the wages paid in this sector and a positive impact on weeks worked.

2.4 Home Production and Service Demand

The demand side of services that substitute for home production is strictly correlated with female participation in the labor market. Indeed, it is common knowledge that women spend more time than do men on household production. Therefore, the possibility of outsourcing home production, buying services on the market, may provide a way for women to devote a higher fraction of the day to paid work. After Malta, Italy is the country with the highest percentage of women who are not looking for a job (27.1% of women 25-34 years old, 30.5% of women 35-44 years old and 19.1% of women 45-54 years old). Burda et al. (2006) develop a cross-country analysis (US, Germany, Italy and Netherlands), from which three interesting aspects emerge: (i) male-female differences in the allocation of time between market work and household production are smaller in the US than in the EU countries (among them, Italy is the country with the highest index of gender inequality); (ii) women spend more time on household production than do men in all countries; and (iii) Italy is the only country in which women work (market work and household production combined) more than do men, despite the fact that Italian women spend much less time than men on market activities. This evidence sheds light on the potential role of the externalization of home production in female participation in the labor market.

We expect that female participation is strictly correlated with (i) the individual opportunity cost of time (gain from externalization) and (ii) the market price of services that substitute for home production (cost of externalization). Figure 3 shows the family consumption shares in different types of services by women's educational level. As expected, the higher the level of education, the higher the consumption share for services that substitute for home production. This is perfectly consistent with the fact that highly

skilled women experience a higher opportunity cost and thus find the externalization of home production more convenient. Figure 2.3 for instance shows that families with high-skilled women have higher consumption shares in assistance and food preparing services.

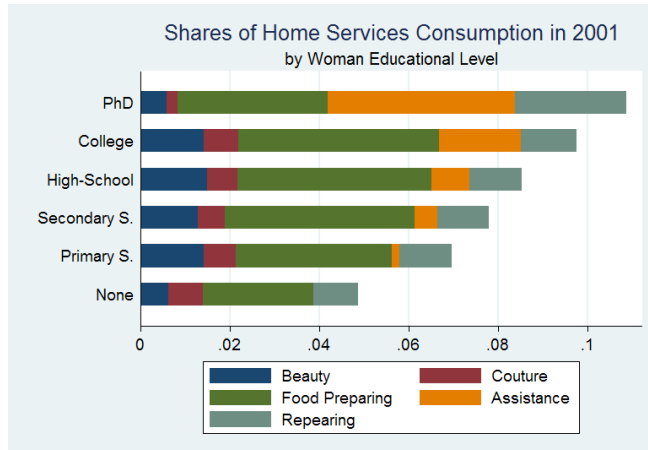


Figure 2.3: Consumption shares in non-tradable services by woman educational level (Istat, 2001).

Furthermore, Figure 2.4 shows the correlation at the provincial level between the activity rate for highly skilled women and relative wages in such services that substitute home production. The estimated coefficient from an OLS regression of the two variables reveals that this correlation is significant (at 1%). As expected, highly skilled female participation is negatively correlated with service wages.

In last decades, many changes could have increased the demand of household services. In Italy there has been an influential growth in families with only one individual in age of working. This change in family composition has probably induced many inactive women to participate in the labor market (during the 1995-2005 period, there was an increase of 6 percentage points in the female participation rate).

Furthermore, the aging population has led to a massive increase in the demand of assistance.

We expect that both these phenomena represent a demand side shock in household services, with consequences in terms of both wages and employ-

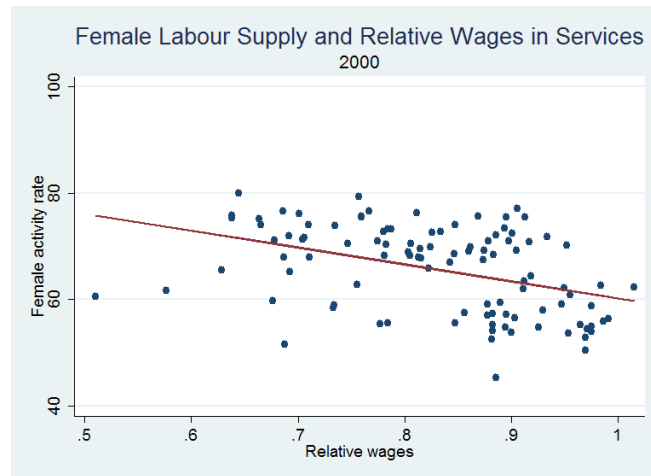


Figure 2.4: The correlation between the provincial participation rates for highly skilled women and relative wages for services related to home production over other low-skilled wages (Istat and INPS, 2000) .

ment in this labor market.

2.5 Empirical Evidence

2.5.1 Data and Methodology

We aim to analyze the labor market for household services with particular reference to the pattern of wages and employment over time. We want to verify whether there is an increasing demand for these services due to the growing externalization of home production by Italian families.

We use administrative data from the Italian social security institute from 1998 to 2004. This archive provides information on all labor contracts for employees hired in the private sector and born on four particular days of the year. We collected data on (i) the sum of monthly wages paid every year (including extra wages); (ii) the number of weeks paid; (iii) the province where the work took place; and (iv) worker sector and qualifications. In particular, we achieved significant detail (5-digit variables) regarding the definition of the workers' sectors of activity. Given this detail, we can easily identify services that substitute for home production. We include everything that people can produce directly or buy on the market. This causes us to include non-tradable, time-intensive sectors spanning from repair services, cleaning

services, and surveillance to food preparation and personal services.⁴

We run the following regressions to verify the trend of weekly wages and weeks worked:

$$\log \frac{\bar{W}_{pt}^s}{\bar{W}_{pt}} = \alpha + \beta Trend_t + \mu_p + \epsilon_{pt} \quad (2.1)$$

$$\log \frac{Weeks_{pt}^s}{Weeks_{pt}} = \gamma + \phi Trend_t + \mu_p + \epsilon_{pt} \quad (2.2)$$

where \bar{W}^s is the average wage for household services and \bar{W} is the average wage in all sectors; we include province (p) fixed effects. The estimated coefficients for the two linear trends reveal the expected annual changes in relative weeks worked and relative weekly wages in time-intensive services over the entire economy. If both of the coefficients are positive, we must conclude that weeks worked and wages have increased more for these services than in other sectors because of a growing demand on the part of Italian families. Conversely, if β is negative and ϕ positive, it is probable that the labor supply has increased more than the demand.

Furthermore, we look at the correlation between wages and weeks worked using the following specification, which includes year and region fixed effects, and the interaction of the two:

$$\log \frac{\bar{W}_{pt}^s}{\bar{W}_{pt}} = \delta + \omega \log \frac{Weeks_{pt}^s}{Weeks_{pt}} + \mu_r + \nu_t + \eta_{rt} + \epsilon_{pt}. \quad (2.3)$$

A positive correlation will reveal a crucial role for the relative demand for household services; conversely, a negative correlation would be observed after a supply-push shock.

From a methodological point of view, a simple supply and demand framework is used to analyze changes in the Italian household service sector. We study the patterns of wages and employment to determine the behavior of the demand and supply of household services as did Katz and Murphy (1992) to verify the effects of a skill-biased technological change on the US wage structure. We find that β , γ and ω are positive. To check whether these

⁴Our definition is consistent with that of Mazzolari and Ragusa (2004).

results derive from a demand-side shock, we must verify that the shape of the service supply curve is consistent with this simple demand-supply framework. In other words, we want to verify whether a demand-side shock increases both wages and weeks worked. We do this by estimating the elasticity of the relative supply.

Thus, we again estimate 2.3 using an instrument for a shock on the demand side: the share of elderly people in a province in a certain year over the entire population.⁵ Indeed, the Istat consumption survey reveals that families with at least one elderly person exhibit a greater service consumption share on average (figure 2.5).

In an ordinary framework with an upward sloping labor supply, we should also see a positive ω in the IV strategy.

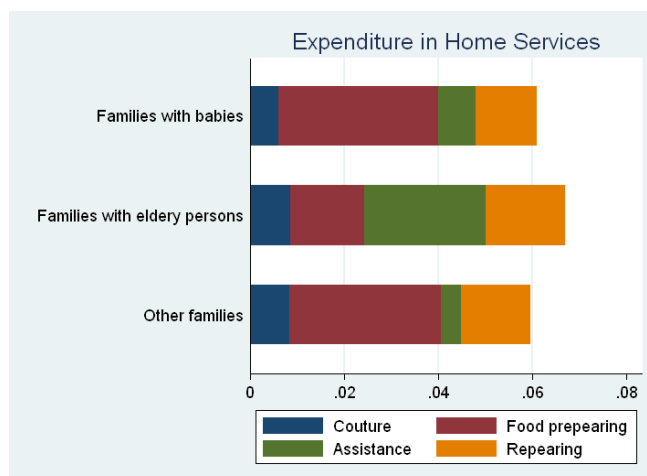


Figure 2.5: Service consumption shares for families with at least one child, families with at least one elderly person and other families (Istat 2001).

2.5.2 Results: A Demand-Side Shock

According to INPS data, the number of weeks worked in household services has dramatically increased over time (on average, by 6.5 percent per year from 1998 to 2004.) Nominal weekly wages in the same sector have increased by 4.5 percent per year on average. These results also remain valid in relative terms: the share of weeks worked in household services over the total number of weeks worked has increased every year by 1.4 percentage

⁵We consider an elderly person someone over 80 years old.

points on average, while relative wages have increased by 0.7. Table 2.1 shows the estimated results of the regressions for relative wages and relative employment on an annual linear trend, controlling for province-related fixed effects. The two estimated coefficients are both significant at 1 percent. Every year, there is an expected increase of 0.5 percent in relative wages and of 3.5 in relative employment.

Italy has implemented several regularizations in recent years that have offered irregular immigrants the opportunity to obtain a residence permit. The most important of these regularizations was probably introduced in 2002; it involved 700 thousand individuals. For our purposes, such regularizations are important because they lead to an increase in the amount of regular employment, which does not reflect an increase in actual employment. Table 1 splits our period of analysis in two sub-periods to verify whether the regularization is the only factor explaining our results. We find that prior to and since 2002, our estimated coefficient for the annual linear trend has been significant at 1%. Columns (2) and (6) display the results using construction as a reference sector. Because this is another Italian market where labor demand has increased over time and it has a high share of irregular labor, this choice should reduce the probability that the regularizations are affecting our results. Even with respect to construction, relative wages and relative employment in services that substitute for home production have increased over time.

	Rel W			Rel Empl		
	(1)	(2)	(3)	(4)	(5)	(6)
Trend/100	0.48*** (0.14)	0.62*** (0.000)	3.50*** (0.16)	4.07*** (0.45)	4.11*** (0.64)	1.62*** (0.34)
Prov FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.1: (1) is the regression of relative wages on an annual linear trend with province fixed effects; (3) does the same for relative employment; (4) uses data on relative employment only before 2002; (5) only uses data since 2002. (2) and (6) use as their dependent variables relative average wage and relative weeks worked in time-intensive services over construction. All dependent variables are in log form. The results (except in col. 2) remain significant at the 1% level, even clustering standard errors by year.

Furthermore, we observe a positive correlation between relative wages and relative employment (table 2). This correlation is significant controlling for regional, annual fixed effects and the interaction between the two.

	Wages		Relative Wages			
	(1)	(2)	(3)	(4)	(5)	(6)
(Rel) Empl	0.11*** (0.01)	0.15*** (0.01)	0.15*** (0.01)	0.14*** (0.01)	.14*** (0.01)	0.10*** (0.01)
Region FE	Yes	No	No	Yes	Yes	Yes
Year FE	Yes	No	Yes	No	Yes	Yes
Region X Year FE	No	No	No	No	Yes	No
lPop	X	X	X	X	X	X
Irregulars				X		

Table 2.2: (1) is the regression of average wages in time-intensive services over weeks worked; (2) is relative wages over relative employment without any control variable; (3) controls for year fixed effects. (4) includes regional fixed effects and the relative share of irregular input in these services over the entire economy (estimated by Istat); (5) has regional, year fixed effects and the interaction between the two; in (6) the reference sector is construction. All variables are in logs.

Because both employment and wages tend to increase over time, and they are positively correlated, we argue for an important role of demand for household services. This implies that the supply of time-intensive services is sloping upward. Thus, one positive demand-side shock should lead to positive co-variation in employment and wages. To verify that an increase in the demand for household services is consistent with our observed pattern of wages and employment, we estimate the elasticity of the supply of household services. We present instrumental variable estimates of the relationship between relative wages and relative employment obtained by instrumenting employment with an arguably exogenous measure of home service demand. The instrument is the share of elderly people in the province in a certain year.⁶

A problem of endogeneity could arise if the share of elderly people is greater in places away from which young skilled people tend to move. In these provinces, there will be a simultaneously high incidence of elderly persons and low-skilled workers. Because household services are the least skilled sector, this correlation could affect our estimates in some way. Indeed, we control for the log of the population in the province in that year. Our results are presented in table 3.

We estimate the elasticity of the relative supply of household services to

⁶We define an elderly person as someone who is at least 80 years old.

	Relative Wages (IV)			Wages (IV)	
	(1)	(2)	(3)	(4)	(5)
(Rel) Employment	0.22** (0.09)	0.23** (0.09)	0.21** (0.08)	0.16* (0.10)	0.35*** (0.10)
Region FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	No	Yes	No
Region X Year FE	No	Yes	No	No	No
lPop	X	X	X	X	X
Irregulars			X		X
Stat F first stage	11	10	13	10	13

Table 2.3: In (1), (2) and (3), we regress log relative wages on log relative weeks worked in time-intensive services over the entire economy; in (4) and (5), we regress log wages in time-intensive services over log weeks worked. The instrument is the share of elderly persons.

be equal to 0.2. This means that an increase of 1% in relative employment due to an increase in the demand for services that substitute for home production should increase relative wages by 0.2%.

2.6 Service Supply and Female Labour Participation

2.6.1 Data and Methodology

A further step in the analysis is to verify whether there is a correlation between relative wages in household services versus those of other low-wage jobs and the participation rates of highly skilled women.

We use data from the Italian labor force survey (Istat) from 1998 to 2003 at the individual level. This dataset provides information on marital status, hours worked, professional status, age and education level. We use information on females from 15 to 64 years old. Furthermore, we select only skilled females to ensure that the correlation is not related to a possible specialization of women in low-skilled, time-intensive service sectors. We estimate the following:

$$I_{it} = \alpha + \beta Ed_{it} + \gamma Exp_{it} + \delta Exp_{it}^2 + \phi Married_{it} + \sigma \frac{\bar{W}_{pt}^s}{\bar{W}_{pt}} + \mu_r + \nu_t + \rho_{rt} + \epsilon_{it} \quad (2.4)$$

where the dependent variable is a dummy variable that is equal to one when the individual does not supply labor because of family reasons (child-care, elderly persons care), p is the province, and r is the region. We control for years of schooling, experience, experience² and marital status. We exclude females who do not supply labor for other reasons. We include regional, annual fixed effects and the interaction between the two.

Next, we want to verify whether a particular supply-side shock in the labor market of services would increase female activity rates. We focus on the effects of immigration on the female labor supply, claiming that immigrants, by increasing the labor supply in this sector, have led native women to change their time-use decisions.

Barone and Mocetti (2009) also deal with this issue using Italian data. They study the effects of immigration on the number of weeks worked by highly skilled women. We exploit the extensive issue and among inactive women (or men) we select those who are not supplying labor because of their families. This focus makes our data more appropriate for the analysis. More specifically, we estimate the effect of immigration on the probability that an individual does not supply labor because of child/elderly care. We run separate regression for males and females.

In the first regression, again the dependent variable is a dummy variable that is equal to one when the individual does not supply labor for family reasons (childcare or caring for the elderly). Again, we include in our sample all men and women of working age except the ones who do not supply labor for other reasons. We use the following specification:

$$I_{it} = \alpha + \beta Ed_{it} + \gamma Exp_{it} + Exp_{it}^2 + \lambda Married_{it} + \delta \phi ImmSh_{it} + \mu_p + \nu_t + \epsilon_{it} \quad (2.5)$$

where p is the province, t the year (2004-2007), l is the local labor district and i is the individual. We also control for years of schooling, years of experience, the square of experience and marital status. OLS estimates are probably biased by the fact that immigrants will choose their destination city depending on wages. Hence, we also run an IV regression.

We propose a new instrument for migration inflows: we instrument the share of immigrants in the labor force with a variable that directly reflects the supply-push component of immigration. In particular, we interact the share of immigrants coming from a certain country (n) in a certain province in the first quarter of 1995 with an index ($I_{n,t}$) that measures the instability of institutions in countries of origin in every year of the analysis. This index, from the OECD Consensus Country Classifications, is the most frequently used in risk ratings for most public credit and political risk insurers. The OECD classifies countries into eight risk categories (0 - 7). This classification is produced for the purpose of setting minimum premium rates for transactions covered by the Export Credit Arrangement. Furthermore, the OECD takes into account the political risk associated with a country to consider the likelihood that the country will not service its external debt.

$$S_{lt} = \sum_n \left(\frac{Imm_{n,l,1995}}{Imm_{l,1995}} \sum_{\tau=1999}^t I_{n,\tau} \right). \quad (2.6)$$

Thus, the identification strategy relies on the fact that the instability of institutions is positively correlated with migration inflows from developing countries. Furthermore, the political stability of countries of origin is exogenous to demand-pull factors in Italian provinces. We test the correlation between inflows from every country and I through an OLS regression of I on changes in immigration to Italy by country of origin from 2002 to 2006, controlling for country fixed effects. We achieve a positive estimated coefficient that is significant at the 1% level.⁷

⁷Even including only the 30 countries that we use in our instrument or estimating an ordered probit.

2.6.2 Results

The first evidence that we attain deals with relative wages for household services and female activity rates. Table 2.4 shows estimation results from regression 2.4.

	Females	Males
RelWages/100	6.21*** (0.47)	0.26 (0.25)
Exp	1.91*** (0.01)	-0.22*** (0.01)
Exp ²	-0.01*** (0.00)	0.01*** (0.00)
Ed/100	0.14*** (0.02)	-0.51*** (0.01)
Married	0.30*** (0.00)	-0.03*** (0.00)
Region FE	Yes	Yes
Year FE	Yes	Yes
Region X Year FE	Yes	Yes

Table 2.4: We exclude individuals who do not supply labor for other reasons. The results remain significant even when standard errors are clustered at the provincial level. The F statistic in the first stage is higher than 10.

The higher the relative wages are for services that substitute for home production, the higher the probability is that a woman does not supply labor. The effect is not significant for males.

Next, we look at the effects of immigration on labor supply of high-skilled women. We focus on the effects of immigration on the probability a graduated female does not supply labor because of family-related constraints.

By instrumenting immigration with $S_{i,t}$, we estimate that an increase of 1 percentage point in the immigrant share (i.e. from 6 to 7 percent) would reduce by 0.1 percent points the probability that a women does not supply labor because of her family. This means that doubling immigration would reduce this probability by 0.6 percentage points. The same coefficient is not statistically significant for males.

Note that the effects of immigration on the female labor supply are much higher than those of relative wages. This is probably true for two reasons:

(i) immigration lowers the price of services not only by reducing wages (and thus production costs) but even by increasing competition in these markets; and (ii) immigrants increase female participation to the labor market, not only lowering prices but also increasing the supply of services that substitute for home production.

	OLS	IV
Imm. Sh.	-0.21* (0.13)	-10.23*** (2.13)
Ed	-0.02*** (0.00)	-0.07*** (0.00)
Exp	0.33 (0.38)	0.38 (0.36)
Exp ²	0.00 (0.00)	0.00 (0.00)
Marital Status	0.13*** (0.00)	0.13*** (0.00)
Province FE	Yes	Yes
Year FE	Yes	Yes

Table 2.5: We exclude females who do not supply labor for other reasons. The results remain significant even when standard errors are clustered at the LLD level. The F-stat in the first stage is greater than 10.

2.7 Conclusion

This analysis reveals that in Italy, the demand for services that substitute for household production has increased more than the supply. In fact, both wages and employment in household services have increased significantly over time and the changes are positively correlated across provinces and time. We check this finding by estimating the elasticity of the relative supply curve. We find that an increase of 1% in relative employment due to an increase in the demand for services that substitute home production increases relative wages by 0.2%.

Because service demand has increased more than supply, Italian families have paid increasing costs for home production externalization. In order to increase the low rate of female labor market participation, an increase in service supply would be a desired policy outcome. The policy maker has many alternative ways to do that: it could directly provide services (i.e.,

nurseries, kindergarten, elderly care), or it could help families to find them in the market. In particular, we focus on a possible solution (certainly the most economical): a less restrictive immigration policy.

We show that a greater presence of immigrants at the province level would increase the female labor supply by decreasing the probability that a woman does not work because of her family.

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Chapter 3

Intrinsic motivation and the allocation of tasks: theory and evidence

3.1 Introduction

The principal-agent literature has been enriched noticeably by the multitasking framework developed by Holmstrom and Milgrom (1991). Analyzing the optimal incentive scheme when the agent carries out more than one tasks, they point out two crucial elements. First, there could be interactions between tasks such that an increase in the agent's compensation for one task causes some reallocation of attention away from other tasks (crowding out effect). Secondly, they raise the issue of performance measurability. It is possible that the different activities the agent performs are not observable in the same way.

The standard principal-agent theory concerns with extrinsic work motivation. Recently, the empirical evidence and the interaction with other disciplines (psychology and sociology) have made clear that some workers are willing to provide effort not only for pecuniary reasons. Some agents take their effort decisions considering also their intrinsic motivation (e.g., Predergast 2007, Besley and Ghatak 2005)¹. Intrinsic motivation relates to ac-

¹Agents may be intrinsically motivated to work for different reasons. One might simply like to undertake some activities and the evaluation of intrinsic qualities of different jobs may vary across people. Intrinsic motivation may be related also to "self-esteem". In this

tivities an agent likes doing or to a situation in which an agent derives some satisfaction from doing her duty. When the worker cares about what she does in addition to what she is paid, her effort choice is strongly influenced by the presence of intrinsic motivation, because “the task in itself or the task for the attainment of a given goal become intrinsically rewarding” (Galbraith, 1977).

In this paper, I enrich the Holmstrom and Milgrom’s framework (1991) by formally introducing intrinsic motivation. The interest for this kind of analysis arises from two different evidences. First, there are jobs for which intrinsic motivations is particularly relevant (Besley and Ghatak 2005); this means that the degree of the agent’s motivation for the job can affect the effort she provides. Among the different tasks the agent carries out, some are related to intrinsic motivation, while others are not, e.g. taking care of patients is an intrinsically motivated task for nurses, while bureaucratic tasks are not. In the rest of the paper I consider task 1 the motivational one, that for which the agent feels motivated, and task 2 the non motivational one. This heterogeneity affects the cost of effort the agent bears to performs the activities. Even if the agent carries out both motivational and non motivational task, she gets intrinsic benefits only from the performance of task 1. Secondly, the different degree of tasks measurability is different for motivational and non-motivational tasks. Generally, tasks more related to the agent’s intrinsic motivation are those more difficult to measure. Two examples are useful to further clarify this point. Teachers, usually, carry out other tasks in addition to teaching the basic skills that are tested on standardized exams: promoting curiosity and creative thinking, refining students’ oral and written communication skills, etc. It is reasonable to think that the effort a teacher exerts in these tasks is more related to her intrinsic motivation than to extrinsic incentives (such as career concerns). Evidently, all the activities in the second category are hardly measurable, unlike the former.

The second example are nurses. Nurses carry out different duties to take care of patients. While it is quite easy to measure how many injections they do or how many medications they provide to patients, it is difficult to mea-

case an agent is intrinsically motivated to work because it makes him think better about himself. Again, people may have intrinsic motivation to work in a given organization for the goal that is pursued in such organization.

sure the overall attention to the patient's well being, i.e. the way in which they take care of the patients, how they provide treatments (e.g. injection can be given in a more or less lovely way). The manner in which treatments are provided is related to nurses' intrinsic motivation. The nurse's case suggests that the measurability problem not always relates directly the task but to the way in which it is carried out, the devotion and the quality.

The previous examples highlight a link between the intrinsic motivation embodied in a given task and the problem of its measurability. As a consequence, intrinsic motivation influences the optimal incentives in a multi-tasking environment. The first goal of this paper is to study this aspect in a formal way.

In the model the principal has to define the optimal wage scheme for an agent who carries out task 1 and task 2. The intrinsic motivation enters the cost function and it acts in two ways: i) it makes the effort for the motivational task less costly than the effort exerted for the other task; ii) it generates an interdependency between the two activities.

In analyzing the incentive scheme, there emerges *indirect moral crowding out effect*, such that providing monetary incentives for the task not related with intrinsic motivation leads the agent to exert less effort in the motivational activity. This effect is the *trait d'union* between the multitasking framework and the literature on motivation. Indeed, on one hand, Holmstrom and Milgrom (1991) introduce a simple crowding out effect and, on the other hand, the work of Frey(1999) presents the moral crowding out effect, according to which the intrinsic motivation is weakened by the provision of extrinsic reward aimed to provide incentives for the activity directly related to motivation. Taking into account, in the same theoretical framework, the distinctive elements of both literature, gives rise to the *indirect moral crowding out effect*.

The mechanism acting in the model is the following. In a job for which motivation matters, workers are, on average, motivated, even if there is heterogeneity with respect to their degree of intrinsic motivation. Therefore, the specific nature of the tasks they have to fulfill becomes crucial to define the incentive mechanism. A standard agent interested only in the extrinsic reward is indifferent in carrying out task 1 or task 2 : what matters is that she has to exert a given level of effort to get an extrinsic remuneration. On the contrary, for a motivated agent, carrying out motivational task is in itself

a source of satisfaction, given the intrinsic benefit she gets from it. Despite the different relation with motivation, both tasks have to be done and the agent has a timing constraint. This implies that the extrinsic incentives provided by the principal to induce the agent to allocate her time among the two tasks is a critical point, because taking time away from the motivational task could reduce effort through its negative effect on (intrinsic) incentives. Indeed, providing incentive to task 2 lessens the opportunity cost of task 1 to increase and the agent substitutes effort away from motivational activity to which intrinsic benefit - that reduces the cost of effort - is associated. Consequently, the effort provided for the motivational task - that is generally the main activity for a job for which motivation matters - is reduced. In this context it can emerge a moral crowding out effect whose source is the task allocation. If we have to assign more than one task to a motivated worker it is necessary to consider the impact that each of them could have on her intrinsic motivation (are they coherent with it or not? Could they induce a moral crowding out effect?)².

To solve the model I assume that the effort exerted for the motivational task is not observable and therefore, in the wage scheme, it is not possible to define an extrinsic incentive for it. On the other hand, the optimal value of extrinsic incentive for the other activity is decreasing in the agent's degree of intrinsic motivation: more motivated workers should be given less incentives to carry out this kind of task. As a consequence, the best the principal can do is to set a fixed wage, if the agent has a high degree of intrinsic motivation. This results from the simultaneous presence of intrinsic motivation and tasks measurability problem in the theoretical framework. The result gives rise to the following question: how can we provide incentives to intrinsically motivated workers without using extrinsic rewards directly related to each task? The primary mechanism acting in the model suggests that job organization and tasks allocation may provide a valid answer. It is possible to have two different ways of incentive provision: the usual monetary payment and the task allocation, i.e. the definition of the workday fraction devoted to different activities. The model implies that the best policy is to exploit the tasks characteristics in terms of intrinsic motivation

²Moreover, if the principal handles with many agents, heterogeneous with respect to intrinsic motivation, it is also important to understand what is the best task allocation among them, in order to obtain the highest level of effort.

to, thus, increase the benefit the agent gets from her job and, consequently, raise the level of effort by the reduction of its cost.

The possibility to implement such strategy is related to the observability of the agent's degree of intrinsic motivation. I assume that it is observable, as other authors do (Besley and Ghatak, 2004; Francois, 2000).

In the last part of the paper I want to verify the validity of this kind of incentive mechanism developing an empirical analysis.

I use data relative to nurses coming from the National Sample Survey of US registered nurses for the year 2004. This dataset provides many demographic and working information. Among them, the most interesting for my analysis are those related to the percentage of workweek spent in different typologies of tasks, the self-declared job satisfaction and the amount of overtime hours for each nurse.

The choice of this particular class of workers is motivated by the fact that nursing is a job where intrinsic motivation is relevant and workers can be motivated (and, on average, they are)³.

The aim of the empirical analysis is twofold. First, I want to verify if a relation between the tasks allocation and the job satisfaction exists. What emerges is that the time spent directly with patients and doing activities closely related to care (task 1) impact in a positive way on the self-declared job satisfaction. The opposite occurs when I consider the time spent in other tasks not directly related with patients care (tasks 2: administration, consultation, supervision, research, teaching). Then, I investigate if task allocation is correlated to nurses' effort decision and in which way. In order to analyze this point I run a regression whose dependent variable is a proxy of nurses' effort - the amount of voluntary overtime - and the covariate is the task allocation. What I get is a positive impact of direct patients care on effort, while the impact of the other tasks is negative.

The empirical evidence corroborates the policy implication of the model: tasks allocation mechanisms that take into account intrinsic motivation can be good incentive instruments, since they have direct and indirect (through

³This statement is supported by evidence in nursing literature showing, for example, that the loss of direct contact with patients - due to a job reorganization within hospital - creates discontent among nurses and reduces their satisfaction (Clark et al., 2001). Moreover, it has been shown that the main source of nurses' satisfaction is related to relational aspects (first, relation with patients, then relation with colleagues) and one of the main reasons for nurses' dissatisfaction making them dissatisfied is the amount of administrative duties they have to carry out (Shields and Ward, 2001)

job satisfaction) impacts on the agent's effort decision.

3.2 Literature review on intrinsic motivation

Empirical evidence, in social and psychological sciences, shows that some workers take their effort decisions considering the extrinsic and intrinsic benefits associated to their job. For this reason both these sources of incentive have been introduced in the principal-agent theory.

Many authors (Heyes 2005, Delfgaauw and Dur 2007, Murdock 2002, Benabou and Tirole 2003, Besley and Ghatak 2004) have studied the implications of the introduction of intrinsic motivation in the agent's decision process. They focus, in particular, on how the presence of motivated/devoted workers affects the optimal incentive contract. The following results are particularly important. First, the presence of intrinsic motivation generally decreases the importance of monetary incentives used to induce effort and the optimal level of effort provided by the agent increases as well as the profit of the principal. The second result concerns job design (the tasks included in the job description, the activities excluded and the specification of the working rules), that is an important incentive instrument to motivate workers (Holmstrom and Milgrom 1994), especially if they are intrinsically motivated. Indeed, in this case, also additional aspects of the organization design (i.e. mission choice, the relational aspects, etc.) become important to provide incentives, because they act on the agent's intrinsic motivation which leads him to exert effort, even if extrinsic rewards are absent (Francois 2000, Besley and Ghatak 2004). Third, it emerges an interaction between extrinsic and intrinsic work motivation and, consequently, extrinsic and intrinsic reward. This interaction can affect positively or negatively the total amount of effort provided by the agent. An external intervention (as monitoring or monetary reward) on work performance imposed by the principal can have two opposite effects: the first concerns the extrinsic motivation and implies that higher level of monitoring (through the imposition of a higher marginal cost on shirking) has a discipline effect, or higher pecuniary remuneration can induce more effort through the "extrinsic channel". The second effect acts on the intrinsic preferences. Monitoring may appear as a signal of distrust to the agent, reducing his self-determination and shifting

the “locus of control” away from him. Moreover, higher pecuniary remuneration may decrease the intrinsic value of a given action, thereby reducing in this way the effort provided by the person⁴. From a psychological point of view this happens because the agent perceives an external intervention as a control device and so his intrinsic motivation to perform the task diminishes. If this second effect prevails (it depends on the weight of the intrinsic motivation and on the magnitude of the extrinsic reward) we observe the “motivation crowding out effect”. This phenomenon has been defined by Bruno Frey (1997), according to whom “the motivation crowding effect suggests that external intervention via monetary incentives or punishments may undermine, and under different identifiable conditions strengthen, intrinsic motivation”. Frey has shown the empirical relevance of this effect: he presents a large number of studies based on circumstantial evidence, laboratory studies by both psychologists and economists as well as field research by econometric studies that show the existence of the moral crowding out effect in different countries and periods of time⁵. Frey argues that moral crowding out is a relevant phenomenon that can, in specific cases, even dominate the effect induced by extrinsic incentives.

The intrinsic motivation theory and the work of Frey have shown that when an agent is intrinsically motivated it is necessary to be careful with respect to the way in which extrinsic incentives are provided, to avoid that the intrinsic motivation is crowded out and, consequently, the agent provides less effort.

Frey considers that the benefit the agent gets from her job is $B(P_i, E_i)$, where P_i is the performance of activity i that provides itself utility, because of the presence of intrinsic motivation, and E_i is the remuneration offered by the principal for task i . The moral crowding out occurs when $B_{P_i E_i} < 0$.

In this paper I introduce intrinsic motivation in a multitasking framework, underlying the fact that the different degrees of tasks observability can be related to the relation between tasks and intrinsic motivation. Enriching multitasking and agency with intrinsic motivation, gives rise to the

⁴A clear example of this phenomenon is provided by Frey and Oberholzer-Gee, 1997, who analyze the “not in my backyard” problem. The willingness of a community to accept a positive but “inconvenient” project (as an airport or a nuclear waste repository) falls if it’s compensated with monetary reward.

⁵See Frey and Jegen, 2001

indirect moral crowding out effect, according to which the agent's benefit deriving from the performance of the motivational task can be decreased by the monetary incentives provided for the other tasks not related with motivation. Using the same terms of Frey, the *indirect moral crowding out effect* occurs when $B_{P_i E_j} < 0$, where E_j is the payment for the task not related to intrinsic motivation that the agent has to carry out.

3.3 The model

This section explores the implications of the worker's intrinsic motivation for the design of the optimal incentive scheme for a job consisting of two different tasks.

I refer to the multi-tasking framework developed by Holmstrom and Milgrom (1991) and introduce the agent's intrinsic motivation, the latter interpreted as "task involvement", that is the degree to which a person derives utility from the performance of a task.

I consider an agent who carries out two tasks, tasks 1 and 2. She can have different degrees of intrinsic motivation. If she is not a motivated worker the typology of the tasks is not a relevant point. However, the latter matters a lot if she has both extrinsic and intrinsic motivation for the job, as I will clarify in the section 3.2.

I define the effort for the first and second task respectively as a_1 and a_2 and assume that there is a one to one relationship between one unit of effort and one unit of task.

The principal observes a signal of the agent's effort

$$x_1 = a_1 + \varepsilon_1$$

$$x_2 = a_2 + \varepsilon_2$$

where the error term ε is normally distributed with mean zero and covariance matrix Σ . From now on we assume that the two signals are independent. The observability of the task, and the related issue of performance measure, is a crucial element for the definition of the optimal incentive scheme, as it will be clarified later.

I consider an agent with constant absolute risk aversion and, therefore, the risk neutral principal offers her a linear contract.⁶

⁶See Holmstrom and Milgrom 1987

$$\omega(x_1, x_2) = \alpha_1 x_1 + \alpha_2 x_2 + \beta$$

The parameter α_1 represents the monetary reward provided to incentivize effort for task 1; α_2 is the incentive parameter related to task 2 and the fixed part β satisfies the individual rationality constraint.

The certain equivalent of the agent's wage is

$$CE = \alpha_1 x_1 + \alpha_2 x_2 + \beta - C(a_1, a_2) - \frac{r}{2} \alpha' \Sigma \alpha$$

It consists of the expected wage minus $C(a_1, a_2)$, the private cost of effort for two tasks, and the risk premium. The term $\alpha' \Sigma \alpha$ is the variance of the agent's income under the linear compensation scheme while r measures the agent's risk aversion.

The profit of the principal directly depends on the efforts exerted in the two activities since they determine both the output produced and the wage paid. Since a_1 and a_2 are observed imperfectly by the principal, the profit is function of x_1 and x_2 and I assume that it is equal to $B(x_1, x_2) = x_1 + x_2 - \omega(x_1, x_2)$ so that $B(x_1, x_2)$ is increasing in both inputs.

Given that the principal's expected profit is $E\Pi = (1 - \alpha_1)a_1 + (1 - \alpha_2)a_2 - \beta$, the joint surplus is $a_1 + a_2 - C(a_1, a_2) - \frac{r}{2} \alpha' \Sigma \alpha$. The latter is independent on the intercept term β : in fact it simply represents a transfer from the principal to the agent, necessary to satisfy the participation constraint and incentive neutral. As a consequence, the incentive-efficient linear contract only includes the levels of effort and the incentive parameters α_i .

The principal defines the optimal contract maximizing the expected total surplus under the incentive compatibility constraint of the agent. Thus (a_i^*, α_i^*) must be the solution of the following problem

$$\max_{\alpha_1, \alpha_2} a_1 + a_2 - C(a_1, a_2) - \frac{r}{2} \alpha' \Sigma \alpha \quad (3.1)$$

$$s.t. \text{ argmax}_{a_1, a_2} \alpha_1 a_1 + \alpha_2 a_2 + \beta - C(a_1, a_2)$$

In the following I will define the optimal value of the incentive parameters considering at first the benchmark case in which the agent is not intrinsically motivated, and then the interesting case of the motivated worker.

3.3.1 The “standard” agent and the independence of tasks under full information

I consider a standard agent who draws motivation for her job only from extrinsic rewards. Therefore, spending time performing task 1 rather than task 2 is the same, since they don't differ in terms of their relation with intrinsic motivation. This implies that the two tasks are independent in the agent's cost function and consequently the Hessian matrix is diagonal. Finally, I consider that in this case both tasks are observable and measurable (in my framework observability is related to intrinsic motivation).

To define the optimal incentive scheme I consider that a_1 and a_2 are strictly positive and from the incentive compatibility constraint I get $\alpha_i = C'_i(a_1, a_2)$, where subscripts on C denote partial derivatives.

Inserting the latter in the first-order necessary condition for an optimum in problem (1) I obtain the optimal value of the incentive parameters

$$\alpha_i^* = \frac{1}{1 + r\sigma_i^2 C''_{ii}} \quad (3.2)$$

α_i^* is the same that the principal would offer if he had considered the tasks separately. This happens because the cost of inducing the agent to perform any given task is independent on the other task. Noteworthy, I find here the standard moral hazard framework, in which incentives are weaker the higher the risk aversion (r) and the risk (σ_i^2) and they are stronger more responsive to incentives the agent is.

3.3.2 The motivated agent and the dependence of tasks

Now I consider an agent having a vocation for her job. As an exemplary case, I refer to a nurse, who has to carry out nursing (task 1) and bureaucratic (task 2) activities. In this case 1 is the main task, the activity having a positive relation with the agent's intrinsic motivation. It is the task that reflects the worker's motivation for the job and from whose performance she gets benefit. For this reason the agent is induced to exert effort in 1 not only by pecuniary incentives, but also by the intrinsic ones. In the nurse's case task 1 is the caring activity, but there are many other examples, as the medical activity for a physician, the teaching of higher-thinking skills for a teacher, the research activity for academic people. On the other hand task 2, the

secondary task, is an activity that does not reflect the agent's intrinsic motivation and it is not correlated with the motivational characteristics of the job for which motivation matters. Consider, for example, the bureaucratic tasks that nurses (as well as physicians or researchers) have to carry out in addition to their main activity or the teaching of basic measurable skills for a teacher.

The heterogeneous relation that the two tasks have with the agent's motivation makes an interaction between them possible. This is the main difference with respect to the Holmstrom and Milgrom's result. In their model the effort for the two tasks can interact in the agent's cost function in different ways: the activities can be complement or substitute in term of cost of effort. The introduction of intrinsic motivation in the multitasking framework implies that only the substituitability case remains relevant. In fact, given the agent's timing constraint, the task 2 subtracts time to task 1, from which intrinsic benefit derives. So, the reduction in the benefit that the worker can get from the job (through the performance of tasks 1) increases the marginal cost of effort for the main activity. In order to capture and analyze in a formal way this feature, that is the interdependence of tasks, we assume that the effort relative to the two activities, a_1 and a_2 , interact in the cost function of the agent. Consequently the Hessian matrix is no more diagonal.

The second consequences derived from the introduction of intrinsic motivation is the different degree of tasks observability. Since 1 is the task related to intrinsic motivation a_1 is not observable while a_2 is .

Given the relation between tasks and intrinsic motivation previously described, I define the agent's cost function in the following way

$$C(a_1, a_2, \gamma) = \frac{1}{1 + \gamma} a_1^2 + a_2^2 + \gamma a_1 a_2 \quad (3.3)$$

The agent's cost of effort depends non linearly on the quantity of effort exerted in the two tasks and on the parameter $\gamma \in [0, 1]$, capturing the degree of intrinsic motivation for the job. If $\gamma = 1$ the agent has the highest degree of motivation; if $\gamma = 0$ we come back to the standard case of non motivated-agent. This variable is taken as exogenous because the intrinsic motivation for a given job is an ex-ante characteristic of the worker. γ can also be considered as a measures of the magnitude of the interaction between the

two tasks. Indeed, the reason for which a_1 and a_2 interact is the presence of intrinsic motivation. Moreover, γ represents the value of second cross partial derivative of the cost function, C''_{ij} . In particular, given the interval to which γ belongs, we have $C''_{ij} > 0$, whenever the agent is intrinsically motivated (i.e. $\gamma \neq 0$). This implies that the two tasks are substitute in the cost function⁷. Indeed, as previously explained, now the intrinsic motivation becomes a well defined source of substitutability.

It is straightforward to note that a_1 and a_2 have different weights: one unit of effort for the motivational task costs less than one unit of bureaucratic effort. Higher the values of γ bigger this difference. This occurs since, if the agent is strongly intrinsically motivated, the cost for a_1 is lower with respect to the case in which she is weakly motivated, while the cost of a_2 does not change in the two situations. Moreover, the interaction between tasks becomes more important when the value of γ increases, and so the possible negative effects due to that interaction becomes more important and might be really crucial.

The next step is the definition of the optimal incentive scheme. The principal's problem is

$$\max_{\alpha_2} \alpha_1 + a_2 - \left(\frac{1}{1+\gamma} a_1^2 + a_2^2 + \gamma a_1 a_2 \right) - \frac{r}{2} \alpha' \Sigma \alpha \quad (3.4)$$

$$s.t. \operatorname{argmax}_{a_1, a_2} \alpha_1 a_1 + \alpha_2 a_2 + \beta - \left(\frac{1}{1+\gamma} a_1^2 + a_2^2 + \gamma a_1 a_2 \right)$$

First of all it is interesting to focus on some elements emerging from the incentive compatibility constraint. As already seen, it becomes $\alpha_i = C'_i(a_1, a_2)$. By differentiating and inverting the latter relation I get the elasticity of task a_i with respect to α_i . The direct effect, i.e. $\frac{\partial \delta a_i}{\partial \delta \alpha_i}$, is positive, meaning that the incentive specifically drawn for a given task has a positive effect on the amount of effort exerted for such activity. Instead, an interesting aspect emerges looking at the indirect effect $\frac{\partial \delta a_i}{\partial \delta \alpha_j}$. If we consider the specific case

$$\frac{\partial a_1}{\partial \alpha_2} = -\frac{\gamma(1+\gamma)}{4-\gamma^2(1+\gamma)} < 0$$

we can immediately note that a negative relation between the main task

⁷The parameter γ could be also interpreted as the degree of cost substitutability

and the incentive related to the secondary activity emerges. The higher the incentive for task 2, lower the amount of effort provided for task 1. This effect is called *crowding out effect* (Holmstrom and Milgrom, 1991) and derives from the cost function, when the substitutability of the two inputs emerges. Indeed, the negative sign of the derivative of a_1 with respect to α_2 is due to the sign of the numerator (positive), representing the second cross partial derivative of the cost function. Since in this case the source of the substitutability is the presence of intrinsic motivation, I speak of *moral crowding out effect*. Notice that bigger is γ , greater is the effect in absolute value. This implies that the stronger the agent's intrinsic motivation, the more important *the moral crowding out effect*, because a big value of α_2 induces a greater reduction in the effort exerted for the first task.

In this context the *moral crowding out effect* introduced by Frey emerges from a simple multitasking framework, in which the agent's cost function is modified with respect to the standard framework to take into account the role of intrinsic motivation. Moreover, an important aspect is that here the crowding out of intrinsic motivation is not a direct effect (as proposed by Frey), where the extrinsic reward for a given task impacts on effort exerted for such task. Here it acts indirectly: indeed, it is the monetary incentive for the secondary activity that crowds out the effort for the main task. So, in this particular framework, an *indirect moral crowding out effect* emerges, that acts through the tasks allocation induced using monetary incentives.

Now I proceed by computing the solution of the principal's problem. As already pointed out, it is generally difficult to measure the effort exerted for the task related to intrinsic motivation; therefore, I solve the problem assuming that the first task is not observable while the second one is. Moreover the error terms are independent. Then the optimal solution must satisfy

$$\alpha_1^* = 0 \tag{3.5}$$

$$\alpha_2^* = \frac{1 - \frac{\mu(1+\gamma)}{2}}{1 + r\sigma_2^2(2 - \frac{\gamma^2(1+\gamma)}{2})} \tag{3.6}$$

Looking carefully at equation (6) is important because, given that a_1 is not observable at all, the only way to provide incentives for a_1 passes

through the value of α_2 .

Even in this case the crucial term is C''_{ij} , whose positive sign determines the way in which the optimal value of α_2 has to be set. The term $\frac{\gamma(1+\gamma)}{2}$ is the explicit value of $\frac{C''_{12}}{C''_{11}}$, thus it is obvious that the complementarity or substitutability between the two tasks is crucial for the final result (as shown by Holmstrom and Milgrom, 1991). When, as in this context, the tasks can only be substitutes in the cost function, the desirability of providing incentive for the bureaucratic task is reduced because it decreases the amount of effort for nursing. The reason is that increasing α_2 raises the opportunity cost of a_1 . Noteworthy, the solution of the principal's problem reflects the *indirect moral crowding out effect*. In fact, the optimal value of α_2 is strictly correlated to the degree of intrinsic motivation: bigger the value of γ , lower the optimal value of α_2 . This implies that, when the motivational incentives are very strong, the principal should induce the agent to spend few time doing bureaucratic activity. In the limit case in which $\gamma = 1$, the optimal value of α_2 should be zero. This result can be interpreted in the following way. If the link between the agent's intrinsic motivation and her motivational task is very strong, the use of explicit incentive to induce effort in one task that is not correlated with motivation and that, moreover, takes time away from the main task, can imply a big loss in term of agent's effort. In this case the *indirect moral crowding out* would be very strong and, consequently, an important incentive (the intrinsic benefit) would be weakened. So, if she was induced to spend even few time on bureaucratic activity, she would lose a big part of her intrinsic benefit and would put to work herself less in the job.

The opposite situation is the one in which the agent is not intrinsically motivated at all, so $\gamma = 0$. In this case we come back to the case of a standard agent, for which the optimal incentive contract depends only on the risk aversion and the task observability. So we will set $\alpha_2 = \frac{1}{2r\sigma_2^2}$.

3.4 Discussion and empirical analysis

According to the prediction of the theoretical model, the best a principal can do when he defines a wage scheme for an agent whose degree of intrinsic motivation is quite high (as it generally happens in the case of nurses, physicians, teachers) is to set a fixed wage, $\omega = \beta$. This results from the si-

multaneous presence of the *indirect moral crowding out* effect - which makes it suboptimal to provide incentive for the task not correlated with intrinsic motivation, therefore $\alpha_2 = 0$ - and to the measurability problem - which makes it impossible to define incentives based on the non observable task, i.e. $\alpha_1 = 0$ -. Another important point that emerges from the theoretical analysis is the relevance of the tasks allocation related to the occurrence of the moral crowding out effect.

The issue that comes into question is in which way the principal can still provide incentives for the agent, even if he has to pay a fixed wage. The idea that emerges as a corollary of the theoretical results is that the tasks allocation might be a useful incentive mechanism⁸. Carrying out tasks positively correlated with the intrinsic motivation for the job generates higher satisfaction and, consequently, higher level of effort. On the contrary, if the motivated agent is assigned to tasks not correlated with it, satisfaction may decrease as well as provided effort. Therefore, allocating tasks in order to assign the right weight to the agent's extrinsic and intrinsic motivations becomes strategic in the light of incentive provision. With respect to this point the observability of the agent's intrinsic motivation is a crucial element. In order to assign tasks in the optimal way, the principal should know the value of γ and I assume that this occurs. Moreover, two considerations make this assumption reasonable: i) in jobs for which motivation matters the workers, even if heterogeneous, are on average motivated. Therefore the initial allocation of tasks could be thought avoiding to assign to them a lot of non motivational tasks⁹. ii) The principal is able to infer, even if in an imper-

⁸Also Holmstrom and Milgrom (1991) use the multitasking framework to analyze job design, looking at the impact of the crowding out effect in some principal-agent relationships. In particular they look at: i) how tasks should be divided among different agents; ii) how to allocate tasks if, respectively, the principal or the agent own the assets; iii) the necessity of limiting the outside activities of the agents when the main task is hardly measurable. My analysis is coherent with their one and is a way to introduce intrinsic motivation in job design

⁹The two tasks are both necessary to produce outcome. If it is useful, in order to provide incentive, to assign a small or null amount of task 2 to workers that are, on average, motivated but whose exact motivation is not known by the principal, it is important to understand to whom this task has to be assigned. Holmstrom and Milgrom suggest that, in some cases, one should better assign tasks to different agents. The situation with motivated agents, implying substituitability of the tasks in the cost function, is probably one of these cases. The issue that immediately emerges is the budget constraint that the principal has to bear. Indeed, more than one agent, generates higher costs. But the higher costs should be compared with the improvement in terms of effort provided by the agent and it is not obvious which is the result with respect to principal's profit.

fect way, the workers' motivation through the observation of the agents' behaviour over time. Once the value γ of the intrinsic motivation is known, the principal can modify the task allocation so that he assigns more task 1 and less task 2 to the agents with higher γ and less task 1 and more task 2 to the worker with low γ .

In the following I want to verify the validity of the previous statement looking at some empirical evidences relative to nurses' activities. Before presenting my own analysis I relate the results of some studies developed in nursing literature that support the usefulness of tasks allocation as incentive device.

Some empirical studies (Sochalsky et al. 1997, Clark et al. 2001, Burke 2003) conducted in the USA, Canada and Western Europe analyze the impact that the healthcare reforms implemented in the 90's have had on the way in which healthcare professional deliver services, looking in particular at the nurses' case. A common evidence is the hospital restructuring induced by different reforms. In the new organization the hospital systems are characterized, at international level, by a very similar restructuring interventions, aimed at the reduction of labour expenses through work redesign. From data it emerges that nurses have been a prime target for work redesign and this has generated a change in their numbers and skill mix and a fundamental reorganization of clinical care at the inpatient unit level.

Clark et al. (2001) report the results of a survey related to the workplace experience of hospital based nurses. They analyze the impact of hospital reforms that have lead to a job restructure through reduction in staff levels, increasing in workload, change in the typology of tasks they have to carry out and expansion of responsibilities. Consequently, nurses' job was changed directly and indirectly in different ways. Their number was reduced and so the workload for the remaining nurses increased. The downsizing of the nurse work force was accompanied by an expanded use of unlicensed assisting personnel: so the nurses were asked to solve supervision activity, very far from their primary task. It is obvious that this kind of changes modify a lot their work, from direct patient care at the bedside to indirect supervision of care. It is shown that the loss of direct contact with patients reduces the quality of care and the satisfaction they receive from their work. Moreover, the substantial increase in the amount of paper-work they were required to complete after the job reorganization created a lot of discontent among

nurses. The time spent doing this work further reduced the direct nurse contact with patients. In addition to the higher level of stress and the lower job satisfaction felt by nurses, the empirical analysis shows that also the total amount of effort exerted by nurses (measured in term of absenteeism) decreased after the job reorganization.

Burke (2002) analyzes more explicitly the impact of hospital reorganization in Ontario on nursing staff satisfaction and well-being. He finds that, as a consequences of the job reorganization (with the same characteristics pointed by Clark et al.) nursing staff reports less job satisfaction, more absenteeism and less psychological well-being than nurses employed in other workplace.

What emerges from the previous case studies is the negative relation between a job organization that induces nurses to spend less time doing activities related to their intrinsic motivation (direct patients care), and the level of satisfaction and effort exerted by nursing staff. The indirect moral crowding out effect could be a reasonable way to explain this evidence. The fact that nurses have to spend a lot of time doing supervision and bureaucratic activities, that clearly are not tasks for which intrinsic motivation matters, reduces the intrinsic benefit and, consequently, the exerted effort.

3.4.1 Data and methodology

An empirical analysis of the role of task allocation in the definition of workers' incentive scheme is carried out using data coming from the national sample survey of US registered nurses. This survey is conducted, since 1980, every four years; I use the sample relative to 2004. The purpose of the survey is to provide an integrated, in-depth picture of the total registered nurses population through the gathering of data about: nurses' demographic and economic situation, education, advanced training and graduate degrees by speciality, principal employment status, secondary employment in nursing, employment outside of paid nursing and plans for employment in nursing. The target population is all registered nurses with active licences in 50 states and the sample is composed of 35724 nurses representing a probability sample of registered nurses selected from the target population. Among them I eliminated all those people for which information about tasks allocation is not available. The sample I use is composed of 29452 observations.

The nurses I consider are mainly women (94% of the sample), whose edu-

cational level is mostly characterized by the attainment of an associate or a bachelor's degree and no other degrees after the initial registered nurses education (28% gets an additional academic degree and only 10% complete the formal education for advanced practice nurse preparation). Hospital and ambulatory are the principal health care settings for the 68% of the sample and for the 60% *clinical nurse specialist* is the position title that is most-closely related to their nursing position.

Table 1 shows the descriptive statistics for the overall sample in 2004 and for the subsample on which I perform my econometric analysis. As it can be seen, there are no marked differences between the two, as far as the observable characteristics are concerned.

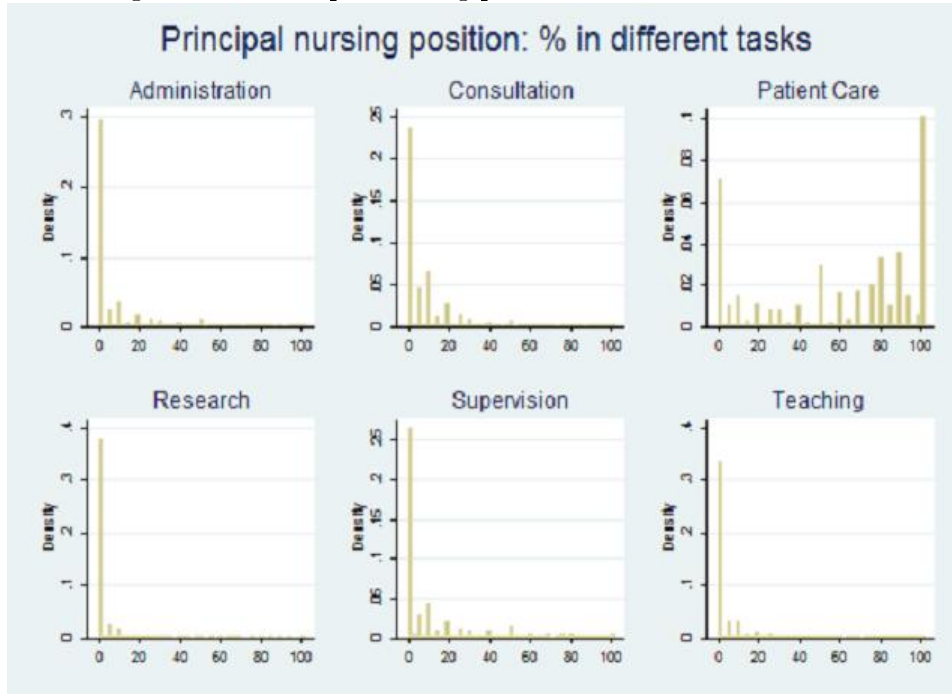
Before introducing the regressions I run I present some descriptive statistics relative to the main variables used in the empirical analysis.

All the nurses that are employed or self-employed in nursing are asked to estimate the percentage of their time spent in different activities during a usual workweek. The activities are: administration, consultation with agencies and professionals, direct patient care, research, supervision and management, teaching nursing or other health profession students and, finally, a general other activities. As the picture 1 shows the largest part of nurses carries out mainly the direct patient care task (mean: 60%; median: 75%) and the other tasks represent lower than 20% of their total time.

The dataset provides a constructed variable (*domfunct*) that uses the answers to the previous question to identify the function which occupies more than 50% of the time in the principal nursing position during a usual workweek. To develop the analysis I aggregate the functions that are homogeneous and built dummy variables taking value one if the nurse's main activities are the considered ones. I define dominant function administrative (*domfnct administrative*) the sum of administrative and consultant activities (5, 58% of the sample); dominant function direct patient care (*domfnct caring*, 60, 46% of the sample); dominant function teaching (*domfnct teaching*) as the sum of teaching, researching and supervision (8, 52% of the sample). The previous ones are the independent variables of the regressions.

Another question of the survey that is very important for my analysis asks 'How would you best describe your feelings about your principal nursing position?'. The largest part of the nurses in the sample (78, 36%) declares to

Figure 3.1: Principal nursing position: % in different tasks



be satisfied with their job, a small group is neither satisfied nor dissatisfied (7, 83%) and the remaining part (13, 75%) is dissatisfied. I define satisfaction the dummy variables that takes value one if nurse declares to be satisfied. From a simple analysis of the covariances matrix between the job satisfaction and all the typologies of dominant function it emerges a positive correlation only between satisfaction and domfnct caring, while the correlation is negative when the nurse's dominant function is not strictly related to caring. As usual in literature, the proxy for effort that I use is the amount of overtime (numbers of hours that are voluntarily chosen and that are paid as overtime) provided by nurses in their principal nursing position. On average, the overtime hours are 1,6 per week. The most part of nurses who declare to have provided overtime hours in their last workweek (23% of the sample) relate between 1 and 12 hours. I build a dummy variable called overtime equal to one if the amount of overtime is greater than zero. Moreover, I also use the dummy variable high overtime, that is equal to one when the nurse works more than 5 hours of overtime (6, 13% of the sample). Again, a first look at the covariances between overtime and the other main variables of the analysis is interesting. The correlation between a positive

amount of overtime and the nurse's dominant functions is positive if the nurse spends the most part of her worktime in caring activity and negative for all the other dominant functions. The same relationships stay valid also considering the correlation with high overtime. Noteworthy, also the correlation between overtime and satisfaction is positive.

I aim at verifying if the tasks allocation can be an alternative (with respect to monetary rewards) and valide incentive mechanism when the job is one for which motivation matters (nursing, in this case) and, therefore, the payment method is a fixed wage. In order to understand if the way in which activities are allocated¹⁰ is relevant I develop two different analyses. First, I verify if a correlation between the time spent in different tasks and job satisfaction exists and, if yes, in which direction it acts. The goal is to understand if the allocation of working time among activities that are differently correlated with motivation is associated with the the satisfaction workers get from their job.

Then, the same analysis is carried out considering tasks allocation and the amount of overtime work hours, used as a measure of effort. I want to investigate if the way in which the principal assigns different tasks to an intrinsically motivated agent impacts on the effort decision. If effort were positively correlated with motivational task (direct patient care) and negatively correlated with non motivational tasks (administration, supervision, consultancy, teaching) I could claim that an allocation of tasks coherent with the agent's intrinsic motivation for the job is a useful incentive mechanism.

I run the following regressions in order to look at the correlation between the tasks the agent has to carry out and her satisfaction and effort:

$$\begin{aligned} satisfaction_i = & \alpha + \beta domfnctcaring_i + \gamma domfnctadministrative_i + \\ & + \delta domfnctteaching_i + \nu \mathbf{x}_i + \epsilon_i \end{aligned} \tag{3.7}$$

¹⁰Given the working contract of nurses I consider that, in the sample, the task allocation is mainly defined by the principal.

$$\begin{aligned} overtime_i = & \theta + \phi domfncctcaring_i + \varphi domfncctadministrative_i + \\ & + \lambda domfncctteaching_i + \nu \mathbf{y}_i + \epsilon_i \end{aligned} \quad (3.8)$$

where \mathbf{x}_i and \mathbf{y}_i are the vector of controls and i the individuals. I estimate the two equations using the probit model and the linear regression model. The estimated coefficients reveal the expected impact that the main activities the agent carries out have on job satisfaction and hours of overtime. According to the theoretical prediction I expect a positive coefficient for the domfncct caring and negative for all the other explanatory variables associated with tasks allocation.

3.4.2 Results

Table 2 shows the results of the probit and OLS estimation of equation (6), without controls. In column (1) and (3) the coefficients of domfncct caring and domfncct administrative are statistically significant with the expected signs, while the opposite is true for the other covariate. This suggests that taking care of patients as main activity has a positive impact on the probability that the nurse declares satisfaction with her job. The opposite is true if the main task is administrative and being mainly engaged in teaching is not correlated with satisfaction.

Columns (2) and (4) present the results of the estimation of equation (6) with the introduction when of some controls. I add control variables (gender, age, annual income, level of education, hours worked) that could be correlated with the nurses' satisfaction in order to verify if the activities they do are really relevant. First, only the variable domfncct caring remains statistically different from zero and with the expected positive sign. Being young (< 40 years) and being female each has a positive impact on the probability of job satisfaction. Noteworthy, among the other controls that are significantly correlated with the probability of being satisfied, obtaining additional degrees after graduating from nursing and having the status of advanced practice nurses have negative signs.

The previous empirical evidence strongly suggests that the activities related to caring are positively correlated with job satisfaction. On the other hand, spending most of the working time on tasks for which motivation does not

matter (i.e. domfnct administrative and teaching) is negatively correlated with the probability of job satisfaction. Moreover, it is interesting to note that only the task-related variables (except the demographic ones) have an impact on job satisfaction.

Table 3 shows the probit and OLS estimations of equation (7), with overtime as dependent variable. Columns (1) and (3) clearly show that: i) all the typologies of dominant function are significant determinant of overtime work; ii) domfnct caring is the only one positively correlated with the probability of providing hours of overtime; the coefficient of the other dominant functions have negative signs. The same results still hold when controls are added to the regression (columns (2) and (4)). In particular, the coefficients keep the same sign after controlling for hours worked in the last workweek, net of the voluntary overtime (hours worked), the worked weeks in a year and the place of job (that is for the fact that the nurse works in hospital or ambulatory). All the previous controls are correlated with the probability to provide overtime in the predictable way. Among the other controls that are statistically different from zero, having children younger than 6 and being married each has the predictable negative signs, while having adult dependents at home has the predicted positive sign.

Running the same equation using the dummy *high overtime* as dependent variable yields the same results discussed above (or exactly the opposite signs with *low overtime*).

What clearly emerges from this empirical analysis is again the relevance of the tasks the nurse carries out. The main activity of a nurse is correlated with the effort she provides. In particular, doing caring activities is positively correlated with the probability of providing overtime work. On the contrary, all the other dominant functions are negatively correlated with effort.

3.4.3 Robustness checks

In order to verify the existence of the correlation between the tasks carried out by nurses, job satisfaction and overtime as a measure of effort, I look at the prevalent function of each nurse. As an additional proof I run the equation (6) and (7) using different independent variables related to tasks allocation. Using directly the declared percentage of time spent in different tasks during the usual workweek I build different measure of tasks alloca-

tion.

First, I keep the previous level of aggregation but use the mean instead of the median (that is used to build the dominant function variables) as threshold value. Therefore, I use the followings as independent variables : i) motivational task that is a dummy taking the value of one if the nurse spends more than 60% (sample mean value of the variable *time in direct patient care*) of her time on direct caring activity and zero otherwise; ii) nonmot administrative, a dummy that takes the value of one if the nurse spends more than 27% (mean value) of her time carrying out administration and consultancy and zero otherwise; iii) nonmot teaching, a dummy that takes the value of one if the nurse spends more than 12% (mean value) of her time carrying out researching, teaching and supervising and zero otherwise.

Columns (1) and (2) of table 4 show that the time of the caring task is significantly different from zero and positively correlated with job satisfaction as before. In this case neither the administrative tasks nor the teaching tasks are statistically correlated with satisfaction. Among the controls, the variables that are statistically different from zero are the same of the analysis with that of the dominant functions.

Columns (1) and (2) of table 5 present the estimated coefficients of the overtime equation. Again, the motivational task is positive and statistically different from zero and the two variables representing non motivational tasks are not different from zero.

Finally I run again the two regressions again using the percentage of time devoted to each task directly as regressors. Columns (3) and (4) of table 4 and 5 show that, for both satisfaction and overtime the positive correlation with the task for which motivation matters still exists, even after introducing more controls. Administrative task, consultation and research remain negatively correlated with overtime, while supervision activity is now positively correlated with both satisfaction and overtime. Time spent in teaching is no more relevant for both the dependent variable.

Changing the aggregation level also yields the same result: a positive relationship between direct patient care, job satisfaction and effort still emerges. Also some evidence of the negative relationship with the other tasks is found

11.

¹¹The different results with respect to the case in which the non caring tasks represent the agent's dominant function may be due to the fact that, on average, the percentage of time spent in these activities is quite low. So if they are not the prevailing activities,

Finally, I can conclude that the results of the empirical analysis support the corollary of the model. Indeed, the analysis developed using data relative to a job - nursing - for which intrinsic motivation matters shows that the time the agent spends carrying out tasks directly related to her motivation is positively correlated with job satisfaction and, more important for incentives, with effort. On the contrary, the relationships between the two previous variables and all the time spent on activities not directly related to motivation are negative. So, the evidence of this relationships between tasks, satisfaction and effort supports the idea that a possible way to provide incentives to intrinsically motivated workers is the task allocation. Noteworthy, in this particular situation the job organization is even more relevant since the effort exerted in tasks related to motivation is difficult to observe and, so, extrinsic rewards based on effort cease to be an useful instrument.

3.5 Conclusion

The issue of providing incentives to agents is, generally, not trivial. The design of an appropriate incentive scheme becomes even more complicated when agents are intrinsically motivated for their job and, moreover, have to carry out several tasks which differ in the degree they motivate them and in their degrees of observability and measurability.

In the paper, I enrich the multitasking framework proposed by Holmstrom and Milgrom (1991) with the agent's intrinsic motivation, underlying the fact that the difficulty to measure the effort exerted for a given task is often correlated with the fact that the task reflects the agent's intrinsic motivation for the job. The theoretical analysis shows the occurrence of the *indirect moral crowding out effect*, according to which the provision of extrinsic incentives for the non motivational task reduces the amount of effort for the task linked to intrinsic motivation. It is the task allocation that crowds out the benefit induced by the intrinsic motivation and not the monetary reward for the motivational task, contrary to the model of Frey (1999) . Given this effect, the optimal incentive scheme is such that, with high level of intrinsic motivation, the best thing the principal can do is to set a fixed wage.

their effects are reasonably lower. But it is noteworthy that the correlation, when exists, remain mainly negative.

The empirical analysis aims at validating the implication of the model, according to which an allocation of tasks that reflects the link between activities and agent's intrinsic motivation can be a valide incentive instrument if the wage cannot be used as an incentive. This idea is supported by the positive correlation between motivational tasks, job satisfaction and overtime, and the negative one between non motivational tasks, job satisfaction and overtime in the case of nursing.

The theoretical and empirical analyses carried out in this paper point out the existence of a variety of incentive instruments that is wider than the simple pay for performance scheme, especially when job motivations different to the extrinsic incentives are taken into account.

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3.7 Appendix

Table 3.1: Descriptive statistics

	All Sample	Subsample
female	.94 (.001)	.94 (.001)
age	46 (.060)	45 (.061)
additional degree	.27 (.002)	.27 (.002)
apn status	.10 (.001)	.11 (.001)
professional degree	.34 (.002)	.35 (.002)
hospital and ambulator	.68 (.002)	.68 (.002)
total hours worked	39 (.089)	39 (.088)
annual income	52189 (149.285)	52235 (149.736)
overtime	.35 (.002)	.23 (.002)
satisfaction	.42 (.002)	.49 (.002)
No. of Obs.	35724	29586

Notes: Standard error in parentheses. *Source:* Author's elaborations on National Sample Survey of Registered Nurses, 2004.

Table 3.2: Effect of task allocation on satisfaction - dep.var. dummy = 1 if the nurse is satisfied

	Probit		OLS	
	(1)	(2)	(3)	(4)
domfct caring	0.075 (0.017)***	0.056 (0.018)***	0.030 (0.007)***	0.022 (0.007)***
domfct administrative	-0.075 (0.034)**	-0.053 (0.034)	-0.030 (0.014)**	-0.021 (0.014)
domfct teaching	0.032 (0.029)	0.046 (0.029)	0.013 (0.012)	0.018 (0.012)
young		0.141 (0.017)***		0.056 (0.007)***
female		0.061 (0.030)**		0.024 (0.012)**
annual income		-0.000 (0.000)		-0.000 (0.000)
additional degree		-0.035 (0.018)*		-0.014 (0.007)*
apn status		-0.124 (0.027)***		-0.049 (0.010)***
professional degree		-0.001 (0.015)		-0.001 (0.006)
total hours		0.000 (0.001)		0.000 (0.000)
constant	-0.040 (0.014)***	-0.105 (0.041)**	0.484 (0.006)***	0.458 (0.016)***
No. of Obs.	29586.000	29518.000	29586.000	29518.000
Log likelihood	-20489.766	-20374.427	-21455.577	-21337.980
F test			11.754	17.311

Notes: Robust standard error in parentheses. *Source:* Author's elaborations on National Sample Survey of Registered Nurses, 2004.

Table 3.3: Effect of task allocation on overtime - dep.var. dummy = 1 if the nurse provide voluntary overtime

	Probit		OLS	
	(1)	(2)	(3)	(4)
domfnct caring	0.275 (0.020)***	0.252 (0.021)***	0.083 (0.006)***	0.073 (0.006)***
domfnct administrative	-0.606 (0.050)***	-0.690 (0.055)***	-0.119 (0.008)***	-0.135 (0.008)***
domfnct teaching	-0.106 (0.034)***	-0.106 (0.036)***	-0.027 (0.009)***	-0.027 (0.009)***
hours worked		-0.010 (0.001)***		-0.003 (0.000)***
annual weeks worked		0.013 (0.001)***		0.003 (0.000)***
hosp _a mb		0.296 (0.021)***		0.075 (0.005)***
female		-0.287 (0.033)***		-0.097 (0.011)***
young		0.214 (0.021)***		0.064 (0.007)***
children under 6		-0.162 (0.027)***		-0.051 (0.008)***
annual income		0.000 (0.000)***		0.000 (0.000)***
adult dependents		0.160 (0.023)***		0.047 (0.007)***
high household income		0.021 (0.026)		0.007 (0.007)
married		-0.098 (0.020)***		-0.030 (0.006)***
constant	-0.891 (0.017)***	-1.291 (0.073)***	0.187 (0.004)***	0.140 (0.017)***
No. of Obs.	29586.000	28394.000	29586.000	28394.000
Log likelihoods	-15551.884	-14332.907	-15979.362	-14721.729
Adjusted R ²			0.019	0.057
R ²	0.020	0.056		
F test			309.723	155.985

Notes: Robust standard error in parentheses. *Source:* Author's elaborations on National Sample Survey of Registered Nurses, 2004.

Table 3.4: Effect of task allocation on satisfaction - dep.var. dummy = 1 if the nurse is satisfied

	Probit (1)	OLS (2)	Probit (3)	OLS (4)
motivational task	0.047 (0.026)*	0.019 (0.010)*		
nonmot administrative	0.000 (0.024)	0.000 (0.009)		
nonmot teaching	-0.025 (0.021)	-0.010 (0.008)		
young	0.141 (0.017)***	0.056 (0.007)***	0.141 (0.017)***	0.056 (0.007)***
female	0.061 (0.030)**	0.024 (0.012)**	0.061 (0.030)**	0.024 (0.012)**
annual income	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
additional degree	-0.034 (0.018)*	-0.013 (0.007)*	-0.028 (0.019)	-0.011 (0.007)
apn status	-0.122 (0.027)***	-0.049 (0.011)***	-0.116 (0.027)***	-0.046 (0.011)***
professional degree	-0.001 (0.015)	-0.000 (0.006)	-0.001 (0.015)	-0.000 (0.006)
total hours	0.000 (0.001)	0.000 (0.000)	0.000 (0.001)	0.000 (0.000)
administration			-0.000 (0.001)	-0.000 (0.000)
consultation			-0.000 (0.001)	-0.000 (0.000)
patient care			0.001 (0.000)***	0.001 (0.000)***
research			0.001 (0.001)	0.000 (0.000)
supervision			0.002 (0.001)***	0.001 (0.000)***
teaching			0.000 (0.001)	0.000 (0.000)
constant	-0.090 (0.047)*	0.464 (0.018)***	-0.163 (0.054)***	0.435 (0.022)***
No. of Obs.	29518.000	29518.000	29518.000	29518.000
Log likelihood	-20375.695	-21339.254	-20365.934	-21329.471
F test		17.067		14.650

Notes: Robust standard error in parentheses. *Source:* Author's elaborations on National Sample Survey of Registered Nurses, 2004.

Table 3.5: Effect of task allocation on overtime - dep.var. dummy = 1 if the nurse provide voluntary overtime

	Probit (1)	OLS (2)	Probit (3)	OLS (4)
motivational task	0.322 (0.031)***	0.090 (0.008)***		
nonmot administrative	0.007 (0.028)	0.000 (0.008)		
nonmot teaching	-0.033 (0.025)	-0.006 (0.007)		
hours worked	-0.011 (0.001)***	-0.003 (0.000)***	-0.010 (0.001)***	-0.003 (0.000)***
annual weeks worked	0.013 (0.001)***	0.003 (0.000)***	0.013 (0.001)***	0.003 (0.000)***
hosp _a mb	0.310 (0.021)***	0.079 (0.005)***	0.233 (0.022)***	0.059 (0.005)***
female	-0.289 (0.033)***	-0.098 (0.011)***	-0.283 (0.033)***	-0.094 (0.011)***
young	0.223 (0.021)***	0.067 (0.007)***	0.204 (0.021)***	0.061 (0.007)***
children under 6	-0.162 (0.027)***	-0.050 (0.008)***	-0.172 (0.027)***	-0.053 (0.008)***
annual income	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***
adult dependents	0.166 (0.023)***	0.049 (0.007)***	0.161 (0.023)***	0.046 (0.007)***
high household income	0.022 (0.026)	0.006 (0.007)	0.027 (0.026)	0.009 (0.007)
married	-0.101 (0.020)***	-0.030 (0.006)***	-0.093 (0.021)***	-0.028 (0.006)***
administration			-0.008 (0.001)***	-0.002 (0.000)***
consultation			-0.002 (0.001)**	-0.001 (0.000)***
patient care			0.005 (0.001)***	0.001 (0.000)***
research			-0.003 (0.001)***	-0.001 (0.000)***
supervision			0.005 (0.001)***	0.001 (0.000)***
teaching			-0.001 (0.001)	-0.000 (0.000)
constant	-1.328 (0.076)***	0.129 (0.018)***	-1.470 (0.086)***	0.097 (0.019)***
N	28394.000	28394.000	28394.000	28394.000
log likelihood	-14444.005	-14805.166	-14152.525	-14559.444
Adjusted R ²		0.051		0.067
R ²	0.049		0.068	
F test		124.555		146.253

Notes: Robust standard error in parentheses. Source: Author's elaborations on National Sample Survey of Registered Nurses, 2004.

Chapter 4

Conclusion

The research developed with this doctoral thesis concerns heterogeneous labor issues. The aim of each analysis was the understanding of the mechanisms acting in a given situation and the identification of the possible policy implications.

The recent literature on wage inequality and income distribution show that the computerization process has *polarized* the labor markets of advanced economies: employment has shifted toward very high-wage and low-wage jobs, and wages have grown faster at the extremes of the earning distribution. While this evidence is clearly present in the US labor market, in many European countries (among them Italy, France and Spain), there has not been any significant change in the share of low-paid employment. Starting from the fact that one of the main difference between the US and the European labor market is the institutional environment, we proposes a theoretical model to study the effects of computerization in a unionized economy in order to explain cross-country differences in job polarization trends. In the model, the union can choose to adopt different policies depending on its employment target. It predicts that technological change induces (i) a reduction of wages and employment in routine labor tasks, typically replaced by computer capital; (ii) an increase in wages and employment in abstract labor tasks that are complements to 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 protects only its current members (*insiders*); we have

an uncertain effect on manual wages and a positive one on manual employment when unions care about the entire manual labor supply. Therefore, as a result, labor market institutions regulate the trade-off between low-skilled wage growth and low-skilled employment growth.

The comparison between the theoretical predictions and the Italian labor market pattern provides empirical support to the analysis. Indeed, a country as Italy - where the technological shock occurred and the union is an influential presence - has a labor market characterized by the same wages and employment patterns predicted by the model.

This analysis is a step further in the comprehension of the role performed by institutions and of the labor market effects that can emerge from the interaction between technological shocks and a specific institutional environment.

The investigation of the link between the female participation in the labor market and the immigration issue is the goal of the second part of my research, that uses Italian labor market as an interesting case study. A significant body of literature highlights that the labor supply decisions of women are strictly related to the market for time-intensive services, which directly substitute for household production. For this reason we look at these specific sectors to reach our goal. Examining the pattern of wages and employment in these sectors we find that both of them have increased substantially over time, probably because of an increase in service demand greater than supply. As a result, Italian families have had to pay for the growing cost of externalizing home production, which has probably reduced the incentive to participate to the labor market. Therefore, the reduction of this cost may induce a higher participation rate, especially among women; to get this result an increase of services supply would be desirable. The policymakers could theoretically use many measures to reach this result. Among the others, we consider the immigration issue (surely the most inexpensive solution in terms of public spending). Because immigrants are highly specialized in time-intensive low-skilled services, we verify whether migration inflows have any impact on female decisions to supply labor. We find that the higher the share of immigrants in the province, the lower the probability that a woman does not supply labor because of her family.

The interesting policy implication deriving from this analysis is the necessity to be very careful in the implementation of restrictive immigration policies,

usually sustained by the idea according to which immigrants displace Italian workers, reducing wages and job opportunities in the labor market. Many authors run down this idea, showing that this is not always the case, because of the imperfect substitutability between natives and immigrants. Also our research provides evidence against the naive use of restrictive policies. Indeed, we find that: i) the lack of immigrants makes the supply of some crucial services grow less than the demand, inducing higher cost for natives; ii) higher presence of immigrants impact positively on the female participation in the labor market, because they provides services that reduce the time spent for household production.

Finally, the last issue examined in the thesis is relative to the effect of introducing intrinsic motivation in a multitasking framework. Some tasks are positively related to the intrinsic motivation while others not and the different activities the agent carries out are heterogeneous in terms of their degree of observability. The simultaneous presence of these two elements in the theoretical framework leads to the occurrence of the *indirect moral crowding out effect*, according to which the benefit generated by the intrinsic motivation associated with the motivational task is crowded out by the extrinsic incentives for the non motivational task. Given that the *indirect moral crowding out effect* is the main mechanism acting in the model, the prediction I get is that with highly motivated agents the principal sets a fixed wage and, so, he cannot use monetary rewards to provide incentives. This result suggest that the principal should find other ways to incentivate motivated workers. The idea that emerges from the formal analysis is the usefulness of the task allocation to reach such objective. If the principal takes correctly into account the correlation between tasks and intrinsic motivation can raise the effort exerted by the agent, through the intrinsic benefit that she derives from the simple fact of working. An agent more satisfied of her job will provide more effort. The empirical analysis, that studies the correlation between the tasks allocation, job satisfaction and effort (measured using the hours of voluntary overtime) of the US registered nurses, support this hypothesis. Indeed, I find a positive correlation between nurses' motivational tasks and job satisfaction, and between motivational tasks and voluntary overtime work, while a negative correlation between non motivational tasks and job satisfaction, and non motivational tasks and

overtime work.

What the analysis entails is the necessity to define the incentive scheme looking carefully at the agent's characteristics. The extrinsic remuneration is not the only possible and useful method, mainly when agents are led to exert effort also by non pecuniary reason. The way in which different tasks are allocated to the agent (or to different agents) can, in some situations, reach better results in terms of effort and, also, cost reduction.

This work has contributed to the labor economics literature, through the discussion of some issues that are central and debatable in the economic analysis. Moreover, some of them are relevant also from a political point of view and, therefore, the results obtained can enrich the political debate relative to important economic issues.