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DO SKILLS AND COMPETENCIES EXPLAIN THE GENDER GAP IN THE EUROPEAN LABOUR MARKET?

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Abstract

The paper investigates the link between gender gaps in competencies and the corresponding gaps in job opportunities. In fact, women experience worse labor outcomes in terms of employment and type of contract held within the labor market (part-time and temporary). We discuss a variety of gender gaps, identified by OECD's *Survey of Adult Skills*, regarding proficiency, use of information-processing skills at work and use of job-related generic skills. The differences in competencies are slight in some cases such as reading and writing, but appear wider in other circumstances, such as problem-solving, numeracy proficiency and ICT usage. The research is carried out across the EU-15 member states over a timeframe of 13 years using data from ECHP, EUSILC and PIAAC databases. Different linear probability models are run on each skills' gap identified. Indeed, the results show that gaps in job-related capacities significantly influence women's likelihood of being unemployed or in an atypical labor contract.

Table of Contents

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Introduction

During the past century, women in developed countries have achieved strong employment improvements. Female participation and employment have increased substantially everywhere. According to the Global Gender Gap Index 2015 (World Economic Forum), that has been assessing gender-based disparities for the past ten years, major improvements have been made in the health and education sector. However, no country in the world has yet reached gender equality. The subindexes that are closest to parity are the *Health and Survival* and the *Educational Attainment* index, which respectively stand at 96% and 95%. On the other hand, the *Economic Participation and Opportunity* gap has only relatively decreased, standing at 59%, while *Political Empowerment* has made few slight improvements, with only 23% of the gap being closed.

Cross-country variation must be kept into account when assessing gender gap improvements. Among the European countries, substantial differences can be found. In 2015, only four countries in the EU (Austria, France, Finland and Latvia) had completely closed the gap on both *Health and Survival* and the *Educational Attainment* subindexes. As regarding the economic participation level, the highest spots were occupied by northern European countries (Norway, Sweden and Iceland), while the lowest were occupied mostly by eastern and southern European countries (Hungary, Greece, Romania). The fact that the gender gap remains wide makes it crucial to address the issues of equal opportunities. Women have a lower labor force participation and rate of employment than men; moreover, they face a pervasive occupational and sectorial segregation; clear evidence appears from female's over-representation in atypical jobs. According to Chauvin and Ash (1994) the unexplained differences in the level of employment and pay between males and females are contingent on job performance and thus on the competencies which shape such performance. In fact, it is important to take into account how choices and preferences impact the access to different areas of training, and whether women's proficiency in certain areas is deemed less economically valuable than men's.

Results from the PISA[1] survey display that teenage girls have higher career expectations than boys and are more likely to be enrolled in tertiary education (OECD, 2012). On the other hand, the PIAAC[2] survey results show how proficiency levels in between men and women in literacy and numeracy are similar, but skills' use is not. Gender inequality lasts; with less women being employed in science or technology, and a lower mean salary with respect to men with similar levels of education. The necessity arises to address differences in skills proficiency between men and women and to relate them to gaps in labor force participation and types of occupation. The disappearing of the gender gap in educational attainment has certainly been important in narrowing gender differences in competences. Nonetheless, the path to reach full gender equality is still long. Stereotypes might influence boys and girls in the choice of their subjects of specialization, which in turn will determine the set of skills they will be equipped with and the thus the areas of the labor market in which to be employed. Women not only are less likely to join the labor force, but when they do, they have lower chances than men to be employed full-time or to reach high-level positions (OECD, 2012).

The role of policies is essential for reaching gender equality. Certain policies have been targeted to eliminate sex differences in skills' use, youngsters shall be encouraged to develop their academic curriculum and their career regardless of gender bias. Regarding adults, specific policies should be designed to stimulate women to join the labor force. For instance, a reliable and affordable child-care system, the possibility of flexible working hours and a fair taxation system.

The paper is structured as follows. Section 1 provides a brief literature review: analyzing how women's role in the labor market has evolved in the last decades; discussing the determinants of female unemployment, and type of contracts held by women (part-time and fixed term). A great emphasis is given to the factors that shape gaps in proficiency between gender, and how education choices stereotypical to sex can have a serious impact on future job opportunities. Moreover, we discuss the extent to which discrimination results in negative labor market outcomes for women. Section 2 describes the dataset used, which is taken from EU-SILC, ECHP and PIAAC statistics. Finally, section 3-4 present the results of the regression and conclude on the findings of the empirical research.

[1] OECD (2012) Programme for International Student Assessment - PISA
[2] OECD (2012) Survey of Adult Skills - PIAAC

1. Literature Review

1.1 Historical framework

Historically, women's roles were primarily confined to the household, with females being occupied mainly as caregivers. This resulted in women being excluded from education and many kinds of professions. Women started achieving gains mainly in the post-war period, both in terms of employment and narrowing wage differentials. Several trends can be identified towards the decreasing of the gender gap: the expansion in the number of female hours worked and the increase in the service economy, which brought women to find better jobs that could match their preferences with their household roles. However, the increase in the labor force participation, across developed countries, was uneven both in terms of time and country. The increase of female employment was on average a tenth of a percentage point per year, between 1850 and 2010 and half a percentage point per year considering the period between 1950 and 2005 (Olivetti, 2016). The growth of female employment was not linear, and we can highlight some differences across countries. Between mid 1800 and mid 1900, in Europe, relevant declines were experienced. These declines in female labor force participation were experienced throughout the period - in Netherland, Belgium and Portugal - or after an initial rising phase - in Italy, UK, France, Spain, Austria. By 2008, the employment rate for women reached over the 70% in northern European countries, while it is the lowest in Italy (52%) and Greece (55%). The female share of total labor hours increased substantially in all countries, between 1970 and 2005. Once again, we can find several differences between UK and Scandinavia (40% share of total hours) and on the other extreme southern European countries (15-30%). However, growth rates are the highest in southern Europe, implying a slight convergence towards northern European standards.

The gender convergence experienced in the postwar period was due to a mixture of different elements, such as the rise in the female education level, the increase in the labor supply, the introduction of technological innovations (also in the medical sector, e.g. the introduction of contraceptives) and the change in marriage and fertility decisions. At the same time, new legislation favoring equal pay led to the increase in female wages which prompted women to enter the labor market. Technological developments and the rise of the service sector raised the value of non-manual skills encouraging women to enter the labor market. All these developments favored the creation of jobs which better matched females' skills and preferences,

which in turn led to evolving social norms regarding female employment (see Olivetti and Petrongolo, 2014; Ngai and Petrongolo, 2015). The increase in the participation rate was favored by the outsourcing of traditional female household activities, which allowed women to transit from the home to the labor market, and led to the increase in the number of educated women and women entering higher education. In developed countries, education gaps are in fact now reversing. That is, it is women are the ones who the most enter in higher education and spend more years in academic training.

The 20th century has been characterized by a structural transformation of the labor market segments, seeing an important shift to the service economy. The increase in the tertiary sector of the economy might have caused the increase in the female participation rate by creating safer and more attractive jobs for women (Goldin, 1990) and it might have stimulated the demand for female work, under the hypotheses that women have a comparative advantage in service-sector tasks compared to manual labor (Ngai and Petrongolo, 2015). The rise in the tertiary sector has thus created jobs which are more preferable for women. In fact, differently from the manufacturing and the agricultural sector, the service sector requires more interpersonal skills as opposed to manual skills. This sector gave women a comparative advantage making it cheaper for them to outsource household work and enter the labor market. As evidence, Ngai and Petrongolo (2015) present data for the US in which the whole rise of the share in female labor hours from the 1960s in mainly due to the service sector, since female hours' share in manufacturing remained approximately unchanged.

Recent studies also give credit to the evolution in social norms in influencing positively the labor market participation. Women have gradually become more confident, giving more and more importance to factors such as remuneration, aspiration for independence and fulfilment, and interest in personal development (Fernandez, 2013). Men's attitudes towards married women in the labor market changed and women modified their beliefs on the effect of maternal employment in the upbringing of the children.

Governmental policy has proven to be essential in trying to reach gender equality. A variety of policies have been explicitly designed to encourage the entrance of women into the labor force. Such measures, including voluntary party quotas, paternity leave regimes and non-discrimination policies in hiring, have been showed to be successful in reducing the gender gap in the labor market. Parental benefits allow a more equitable division of child bearing, and thus are closely related to female's economic participation. It has been shown that the longer the period of full paid maternity or parental leave, the higher the increment in the participation of

women in the labor market. However, parental benefits might in some cases offset the increase in workforce participation if the overall duration goes above a certain threshold (i.e. 2 years). Moreover, childcare assistance (public day-care, private day-care and home care) allows women to find a meeting point between family and professional duties, supporting their employment. Taxation systems might to some extent be discriminatory between males and females, and result in different social and economic choices being made at the household level. For example, joint taxation tends to be the least favorable for women, while individual taxation tends to be more favorable for men. In order to ensure equity, taxation should thus be designed to give the same advantages to both males and females. Most recently, as a plan to encourage women to occupy more leadership roles, legislative structures are introducing obligatory and voluntary gender quotas in public and private entities.

1.2 Gender differences in skills and competencies

Despite good improvements in the female participation rate, gender gaps (in terms of pay, employment, type of contract) still persist in the labor market. This gap may be explained by differences in the skills and the experience between male and female workers. It is however difficult to determine how the gender employment gap is due to discrimination or to differences in proficiency, use of skills, preferences or choices. In this section we will analyze how gender gaps in skills and competences are shaped, and trends common to these differences.

Gender differences are extensive across all social groups; they comprehend psychological, behavioral and social aspects which are associated to being female or male. Gender differences have been widely researched in the psychological and neuropsychological literature. Skills are broadly defined as the level of training that a job requires, in the past, jobs were termed as skilled or unskilled. However, the exact definition remains subject of debate among social scholars. A significant gap in proficiency between women and men existed for the first half of the 20^{th} century, but has now disappeared or even reversed in some cases (e.g. in literacy skills). Historically, the three major differences in cognitive abilities that have been reported between men and women are: higher verbal abilities, in favor of females; higher spatial abilities; in favor of men; and higher arithmetical abilities; in favor of men.

Women have shown to have a higher performance on a variety of verbal tests (Weiss et al., 2003), furthermore, they usually present greater fluency and accuracy in speech production and have a broader vocabulary. On the other hand, males generally outperform females in special abilities such as navigation strategies and geographical orientation. Concerning

arithmetical capabilities, results have shown that there are no sex disparities in primary numeracy skills (i.e. those found in every culture), but gender differences appear in secondary mathematical domains (i.e. within the school environment), with males surpassing females in such areas as arithmetic and geometry. The male advantage is clearest in high ability samples and for solving complex word problems.

Documentation on gaps in mathematical skills between men and women is wide, and in some cases it appears to be contrasting. Most evidence shows that females tend to underperform males in math standardized assessments, for instance, the mean results of the SAT-M[3] of 2015 present a large gap between American high school boys and girls, with a mean score of 527 for males and 496 for females. The important sex difference in the SAT-M was an uninterrupted trend beginning from the 1970s. On the other hand, PISA[4] results of 2012 show that 15 year-old boys are more probable than girls to be low achievers, and they are more likely than girls not to achieve the baseline level of proficiency in reading, mathematics and science. Girls not only are found to be high-achieving, but they have higher expectations and plans for their future careers (OECD, 2012). In 38 countries, boys outperform girls in mathematics, but only by an average of 11 score points, and the gap is much narrower than in the past. However, girls, even high-achieving ones, are more likely to show feelings of anxiety and uncertainty towards mathematics. They have lower levels of self efficacy and self concept – meaning that they have low beliefs in their ability to solve mathematical tasks and own mathematical abilities.

As regarding psychological skills, some studies identify women as having lower self-confidence, need for achievement and attitude to risk. Females are usually rated lower on leadership abilities; to give an example, we can look at the strong under-representation of women in leadership roles, both in political and managerial contexts. The lower rate that females have in leadership skills occurs because of the different interpretation given to leadership by men and women, in fact, males tend to emphasize on "doing" characteristics while females tend to give importance to "being" characteristics in describing their job aspect (Sparrow and Rigg, 1993). The more "transformational" leadership style of females, which gives a greater importance to motivating others in order to accomplish organizational goals, is not considered of equal value as men's "transactional" leadership style, which on the other hand

[3] Math section of the Scholastic Assessment Test, a stantardized test used for college admissions in the United States. Test takers in 2015 were over 1.69 million high school graduates.
[4] Programme for International Student Assessment by the OECD, with a total of 510'000 students partecipating in 2012.

emphasizes on exercising power by using formal authority. This is to explain how different interpretations and expectations might lead, implicitly or explicitly, to a bias in evaluating competence profiles for males and females.

The driving factors for these gaps may be different, proficiency appears to be correlated with different elements; such as family and economic background, labor market participation, education, social norms but it might also stem from unknown circumstances. In line with the literature, we explain the origin of gender differences in relation to two main categories: their dependence on nature and their dependence on the environment in which the individual grew.

1.2.1 Dependence on nature

Different works analyze the degree to which the gender gap may be due to innate biological differences between males and females. These theories usually root the causes of gender differences in dissimilarities due to biological, genetic, hormonal or cerebral causes (Nollenberger et al., 2014).

In his empathizing-systemizing theory (2003), Baron-Cohen, an American phycologist, argues that essential differences between genders are cerebral, and that, even regarding the environment, women are more likely to be emphatic and attentive to emotions, while men are more likely to be analytical and constructive. Geary (1998) criticizes Royer et al.'s conclusion, according to which gender differences in mathematical skills are exclusively experienced-based and as such have no biological basis. To give an illustration, Geary cites a neuroscience study (Kolb, Forgie, Gibb, Gorny, & Rowntree, 1998) according to which sex hormones shape the way in which males and females respond to environmental inputs. Findings show that men's and women's brains might respond differently to the same experiences, apparently due to the action of sex hormones. Nonetheless, Geary emphasizes the complexity of the relations between among biological factors, experience, and cognitive gender differences; for instance, he agrees that the speed of solving mathematical problems is not entirely biologically based. Geary stresses the fact that also the opposite interests between males and females, for instance in math-intensive careers or other vocational careers, might be indirectly due to biological differences. The gender difference in vocational interest is especially striking when considering mathematically gifted students; according to a research by Lubinski and Benbow (1994), for every mathematically gifted female aspiring to a mathematical, engineering or physical sciences degree there are eight equally talented males. Furthermore, concerning scientific careers, females are biologically more likely to be interested in careers evolving the living

things (e.g. medicine and biology), while males are more likely to specialize in inorganic fields (e.g. mathematics, physics and engineering).

1.2.2 Dependence on the environment

Many criticisms have been raised about theories which emphasize excessively on the nature side of gender differences, since they may disregard the importance of nurture in shaping an individual. Social role models convey that the process by which individuals acquire behaviors, motives and values is largely dependent on the education system, household and culture in which they are nurtured.

Cahoon (1991) analyzes the role of gender differences in the managerial environment. He concludes that there is little evidence that women and men have different competencies and skills, and that when differences appear, it is largely due to sex stereotyping rather than to real differences in individual performance. Stereotype threat is associated to the conscious or unconscious belief of an individual to stereotypically belong to a group known for specific performance deficits. In an influential article, Spencer et al. (1999) explain how stereotype threat is frequently used as an explanation for sex differences in arithmetical abilities. In one of their most famous experiments, 30 women and 24 men were divided into groups and were administrated the same mathematics test, one group of participants was told that the test did not show any gender differences in the past, while the other was told that the test had previously shown gender differences. The results of the test were striking, the group of women who were told that gender differences existed, scored significantly lower than the other groups; while the women in the "no-threat" condition performed equally to men.

Other social role models suggest that traits of behavior different for each gender depend on the group with whom the individual interacts. Children are shown to develop gender-based beliefs according to the environment in which they live, on the basis of gender type roles. These gender traits appear to be more accentuated in traditional cultures as opposed to more egalitarian and progressive cultures. In an experiment conducted in 2009, Booth and Nolen conclude that single-sex environments have an important impact in shaping individual choice. In particular, risk propensity is higher for girls attending single sex schools than it is for girls attending coeducational schools. Moreover, girls in single sex schools show to be as likely as boys, either from single-sex or coed schools, to take risky choices.

Albanesi and Olivetti (2009) analyze how women's lower expectations of labor market returns to mathematical skills push them to invest less in math than boys. Akerlof and Kranton

(2000) consider how beliefs on identity influence economic outcomes. According to their study, an individual's behavior is associated with different social categories and how people belonging to these categories are expected to behave. Identity realization is critical since it may determine the economic behavior, well-being and opportunities of an individual.

1.2.3 A closer look at gender differences in education choices

Until 1960s, boys spent longer in school than girls, and they were more likely to enter university. Now, gender gaps in education have not only been closed in all developed countries and in a growing number of developing ones, but the balance is reversing the other way.

In the past, gender gaps in educational outcomes were due to socio-cultural and economic factors, such as gender roles, social norms and discriminatory institutions. The costs of entering in education are both direct – tuition fees and school materials – and indirect opportunity costs –foregone earnings and unpaid domestic activity. The benefits might be different for males and females, they could involve individual economic gains (better placement and higher earnings) and improved social outcomes (health and social cohesion). Families with limited finances might invest more in boys' education, assuming higher economic returns compared to girls.

Today, poor school performance and drop-out rates are highest among boys. According to the OECD, an average of 63% of boys complete their secondary education on time, compared to 73% of girls. However, males still have an important advantage in the labor market. In some ways, this can be explained by the diverse preferences in subjects of study during higher education. As already mentioned, males and females show gender-stereotypical attitudes against mathematics. As soon as primary school, girls start rating their arithmetic ability lower than the one of boys, even if their real performance is no different from theirs. The lack of girls' confidence in mathematical abilities has a serious impact on the labor market. In fact, even if mathematical abilities are rated the same between a young woman and a young man, the girl is unlikely to enter the same occupations as her counterpart - only a very few number of girls foresee their entrance in certain fields such as engineering and computing (Sikora and Pokropek, 2011). In higher education and beyond, females appear to be under-represented (proportion of about 28%)[5] in the sectors of mathematics, technology and engineering while they dominate the fields of humanities, social sciences and natural sciences, such as biology

[5] OECD 2012.

and medicine (Osborne et al., 2013). Not only women hold an extremely low-share of STEM[6] degrees, but women graduated in STEM subjects are less likely than men to work in an occupation related to those fields. The career paths of female and male graduates diverge significantly: women are twice as likely as men to be employed in education or healthcare occupations. This is significant not only because of the severe under-representation of women, but also because graduates from STEM sectors are highly demanded in the labor market and have amongst the highest wages (OECD, 2012). Apart from gender stereotyping, there are other possible explanations for this gender discrepancy, such as the lack of female role models and a less family-friendly flexibility in those fields.

The teaching of STEM subjects can be made more interesting to young women in different ways, for instance, by using learning materials more appealing to girls, by eliminating gender stereotypes from textbooks and by promoting female role models in such fields. An interesting example is being given by Korea, which since 2000 has introduced a female-friendly mathematics and science curriculum. Korea has carried out this initiative by promoting female engineers or scientists as role models for girls and using more gender neutral language and examples in textbooks.

1.3 Employment, unemployment and participation rates

As already mentioned, women's participation in the labor market has steadily increased over the recent decades. However, there are still considerable differences in workforce participation across countries and parity is yet to be reached. In addition, women tend to be over-represented among the unemployed. The proportion of women within the labor force in 2014 was 62.8%, compared to 79.7% of men; while the employment rate was 58%, compared to 73.7% of men (OECD, 2015).

As we discussed in the previous paragraphs, the key determinants of women's choice not to enter the labor market are: cultural and social norms, access to education, fertility, income level, institutions (labor unions, legal framework etc.), sectoral base of the economy (industrial, agricultural, service-based). Men and women have different patterns of workforce participation. Women are more likely to fall out of the labor force after having children, and re-enter after a certain period of time, usually when children begin school. Data shows that labor force participation for young women had decreased in the recent decades, this can be seen as a

[6] Science, technology, engineering and math education.

positive trend as long as it is used for education and training. On the other hand, the decline is youth female participation rate can also be seen as negative if it reflects the growing incidence increase in young "NEET"[7]. In 2010, in European countries, the gender gap in the NEET rate for young people was around 1 percentage point, compared to 2 percentage points in 2000 (Global Employment Trends for Youth for 2012). Women have a lower workforce participation compared to men at every education level, nevertheless, the gap shrinks as educational attainment increases. A highly educated woman has a stronger tendency to remain economically active with respect to her lower educated peers. In fact, after lengthy and costly investments in education, the opportunity cost of being inactive increases. In addition, a higher education might increase the possibility of finding a better education, both in terms of opportunities and salary. However, many highly educated women are unable to properly utilize their skills and enter the labor market. Women having a tertiary or secondary education tend to have a greater possibility to face unemployment than a man with a similar level of education. Female labor force participation and employment appear to be correlated to the level of economic growth in a country. The relationship follows a U-shaped pattern, at initial phases of economic growth, women workforce participation decreases, while after having reached a specified level of output per capita, a positive relation appears (Lechman, Kaur 2015).

The general increase in women's workforce participation has gone hand in hand with the increase of women employed in part-time work, temporary and casual work, underemployment and unemployment. Thus, the value of an increased supply of female labor appears weakened when considering other indicators, such as the increase in unemployment and non standard, precarious jobs. Women are more likely than men to be unemployed. Gender differences in the unemployment rate tend to be higher among the educated workers, while they are lower among the less educated in the majority of the countries. The main reasons for a high female unemployment rate may be the preference of employers for male workers, or the fact that educated women choose not be employed in certain available jobs. On the other hand, in certain jobs, typically low-skilled or low-pay ones, employers might have a preference in employing women, increasing occupational segregation.

Considering the case of long-term unemployment, this tends to be lower for females than for males. probably because women stop searching jobs earlier than men, and thus end up classified as non active even though they may be available to work.

[7] Not engaged in employment, education or training

1.4 Temporary and part-time jobs

Despite the increase in female participation in the labor market, sectorial and occupational segregation have not improved, gender pay gaps remain persistent and women still appear to be under-represented in leadership positions, both in company boards and in political contexts. Segregation involves the presence of obstacles to choosing a job that are related to gender. Identifying the impediments which characterize the choice of an occupation may improve the transition from school to work, and encourage young women to pursue careers which fully reflect their potential, with the result of improving female labor market participation. A greater occupation equality can help to eliminate sex stereotypes that have a negative impact on the condition of women (Anker, 1997). In this section we will analyze the role of occupational segregation and "atypical" jobs in Europe and the extent to which they are shaped by preferences.

Part-time work has spread out principally during the 1980s and early the 1990s, and this phenomenon has seen women as the main protagonists. The recent literature focuses more broadly on the growth of the so-called "non-standard" or "atypical" jobs, which refer to part-time, temporary or casual employment. The fact that women are more likely than men to work part-time and be employed in temporary jobs, enhances the possibility of under-utilization of women skills and discrimination.

In Europe, part-time employment is not a stepping stone to full-time employment as it is in America, but tends to be persistent and long-lasting. The availability of part-time employment is advantageous in the sense that it allows workers to gain a higher control over their working time and less stress with respect to their full-time counterparts. However, part-time workers tend to be penalized in different settings, and are often subject to an unequal treatment comparing to the full-time employed. Among the drawbacks, we find: lower hourly earnings, fewer opportunities for training and using skills, less job security, less benefits (e.g. pensions, employment insurance). Evidence shows that eight out of ten individuals voluntarily choose to work-part time (OECD, 2010). Women are more likely than men to choose to work part-time, in order to have better work arrangements. In the case of married women with children, especially if having a young age, the likelihood of part-time employment increases, because of the higher need to reconcile family duties with job employment.

Petrongolo (2004) considers the reasons that bring individuals to choose to be employed part-time, and finds part-time employment is more likely to be perceived voluntary in northern and central Europe as opposed to southern countries, especially by women. In particular, this

can be explained by the fact that in northern and central European countries, women voluntarily engage in part-time work for family reasons. On the other hand, in southern Europe female part-time employment is more likely to be involuntary as a consequence of market constraints on the working hours. In southern countries, women are more likely to achieve the reconcile home production by not working, rather than being employed part-time. As Petrongolo reports, only 15% of female employees engage in part-time work in southern Europe, as opposed to 25% in the northern countries. However, women living in the south are more frequently engaged in other form of "flexible" labor, such as self-employment and unpaid work for family business.

Petrongolo (2004) also analyzes the incidence of temporary work, intended as work covered by a fixed term contract or no contract, in European countries. More often than men, women are found in non-permanent employment. In particular, single women are more likely to be employed in temporary work in southern European countries and Austria, Belgium, Finland and Sweden; furthermore, being married reinforces this tendency. Differently from part-time employment, temporary work is not a voluntary choice for the majority of women. The literature has underlined a variety of negative aspects on temporary work conditions: a wage penalty with respect to permanent jobs, a lower access to on-the-job training and a higher perception of workplace insecurity.

An interesting message appears when analyzing satisfaction for atypical jobs. A lower job satisfaction is associated with part-time jobs and temporary jobs, but this dissatisfaction is more frequent for southern Europe than it is for the north. Women, once again, appear more negatively affected than men and differences are more marked in southern European countries. Furthermore, part-time workers are found 12% more likely than full-time employed to hold a fixed contract, and this reinforces the insecurity of the job. The lower satisfaction for atypical jobs is thus mainly due the results of lower earnings, increased job insecurity and lower career prospects. The fact that preferences and productivities are not the main factors in shaping job segregation, gives credit to some extent to the hypothesis of discrimination, especially in southern Europe.

The larger employment of women in the part-time sector may explain the differences in skills use and competencies acquired by men and women (OECD, 2013). To give an illustration, if numeracy and literacy skills are used more frequently in full-time jobs than in part-time jobs, this could explain the difference in skills use between genders. Men, commonly employed in full-time jobs, have the possibility to use skills more intensively compared to women. The same

reasoning could be applied when considering the fact that women are more likely to be employed in low-level jobs that require a lower use of information-processing skills. Taking into account these factors, differences in competencies between men and women may appear largely smaller.

1.5 Discrimination

Changes in experiences and education have played an important role in narrowing the gender gap. Nevertheless, women are still more likely to be employed for fewer years than men and to have a part-time employment. The persistent job segregation can appear for a variety of motives other than discrimination. Altonji and Blank (1999) try to explain gender differences in labor market outcomes with other factors that might be correlated with the outcomes. The "preferences/human capital" hypothesis, regards differences in preferences and skills as the reason for differences in occupation levels, earnings and types of occupation. In such case, discrimination is identified as the residual difference in the labor market outcomes which is not able to be explained by these factors.

Since differences in skills and proficiency have already been analyzed in the previous section, we hereby find a brief overview of of how preferences and investments in human capital might influence the participation rate, and the likelihood of being employed part-time or full-time.

1.5.1 Preferences

Potential differences in preferences might provide additional insights in the gender participation gap within the job market. Preferences may concern market versus non market work, part-time versus full-time work, work in the private or public sector and other types of job held (Altonji and Blank, 1999). A wide literature has analyzed how gender differences appear in the type of occupations that males and females pursue. Occupational exclusion may arise because of different reasons, not necessarily employer discrimination among different jobs. Pre-labor investments in human capital may lead to different comparative advantages in engaging in different types of careers. Women's expectations of future labor market discrimination might discourage their investment in human capital, intended as the quantity and quality of schooling (Thomas, 1990). Furthermore, women might be encouraged to engage in part-time jobs because of social norms or because of their duties as caregivers. In the recent years, different studies

have shifted the emphasis on other dimensions of gender preferences, such as preferences towards competition, risk, and negotiation, which might drive choice - contributing to the gender labor market gap. For instance, careers which are more associated to risk (e.g. earning volatility or job-loss risk) usually have higher mean salaries, and tend to be male-dominated (Azmat and Petrongolo, 2014).

1.5.2 Comparative advantage and human capital investment

Differences in productivity and human capital that men and women can bring to the labor market can potentially lead to different comparative advantages. The gender role of women in reproduction causes them to have a comparative advantage in home production rather than in market work. Historically, since women expected to spend more time as caregivers, they were less likely to invest in valuable market-place skills and attend higher education. As birth rates and marriage rates are declining, biologically based comparative advantage should also have decreased, encouraging women to engage in education choices and career paths similar to men (Altonji and Blank, 1999). In addition, the increase in the service sector economy as opposed to the manufacturing and agricultural sector has further decreased sex differences in comparative advantage.

As already mentioned, investment in education and training increases together with the expected future market participation. Investments in human capital by women may be discouraged by the expectation of future or pre-labor market discrimination. The return to investments in human capital is higher for people who expect to work full-time. Pre-labor market discrimination may affect not only the access and duration of schooling, but also the type of studies pursued. Family background is often important in shaping the choice for investment in human capital; until recently, parental discrimination was in favor of boys as to the entrance in education and fatherly in the labor market. Because of the role of women in marriage and family, investing in a daughter's education was not considered as economically valuable as investing in a son's.

1.5.3 Theoretical framework on discrimination

Discrimination is defined as a situation in which equally productive providers of labor are treated unequally according to an observable characteristic, in our case, gender. The study of gender discrimination appears difficult because of the presence of numerous unmeasured

factors and the complexity of extracting information on productivity and preferences. Another difficulty in assessing discrimination is the ability to distinguish the effects of past discrimination on current discrimination. Lundberg and Starz (1998) emphasizes that previous labor market discrimination has effects also on the human capital of future generations of workers and may lead to persistent differences in group skills. Traditionally, gender discrimination has been tested using regression-based methods on observational data (e.g. labor force data). Differentials in employment and level of wages between males and females are decomposed into an "explained" gap, associated to gender differences in individuals; and an "unexplained" gap, driven by the effect of discrimination. The two main drawbacks of regression based analysis are the possibility to overstate or understate the impact of discrimination. In fact, if discrimination is affecting the preferences, the education investment or the job choice of the worker, the "unexplained" gap will more likely understate discrimination, since some of the control variables are themselves affecting the impact of discrimination (Baldwin and Johnson, 1992). On the other hand, if some variables are omitted - for instance because of the difficulty of extracting clear measures of proficiencies and skills – and these variable are correlated with the outcome (e.g. wages, likelihood of employment) then the "unexplained gap" will overstate the impact of discrimination. In this case, the outcome will not be due to the real impact of discriminatory behaviors, but it will also reflect the unmeasured characteristics. The increased awareness on the regression approach limitations, has encouraged researchers to shift the emphasis on field experiments, which are able to compare outcomes for individuals who are identical apart from gender.

Following Altonji and Blank (1999), we discuss two main types of discrimination operating in a competitive framework. Firstly, discrimination seen as arising from prejudice of employers, employees or customers ("taste-based discrimination"); secondly, as the result of a signal extraction problem regarding the imperfect knowledge of workers' competences ("statistical discrimination"). Moreover, we will analyze how perfect competition has an impact on these models.

1.5.3a Taste-based discrimination

Taste discrimination arises when individuals – intended as employers, employees or customers – prefer certain individuals, or a certain group to another. For the purpose of our analysis, we will focus only on the case of taste discrimination of employers.

Following Becker's (1971) seminal paper, the theory assumes that all individuals are equally productive. Individuals are divided into two groups: a preferred group and a non-preferred group. The employer models discrimination as a personal prejudice against associating with the non-preferred group, in our case, women. The strength of the employer's discriminatory taste is denoted by a coefficient *d,* which involves an extra-cost associated with the discriminatory decision. Thus, the cost of employing the preferred group is identified as w_P, while the cost of employing the non-preferred group is $w_{NP} + d_e$. The discriminating employer will only hire the non-preferred group at a lower wage:

$$w_{NP} = w_P - d_e < w_P$$

$$w_{NP} < w_P$$

Under the assumption of equal productivity, the discriminated group is paid less than their marginal productivity. The wage differential increases the larger the discriminatory coefficient d_e and the greater the number of discriminatory firms. Furthermore, as d_e increases, the number of workers (belonging to the non-preferred group) seeking employment increases.

The theory presents various criticisms, for instance when considering competitive markets. In the case of perfect competition, each worker must earn its marginal product. Since discrimination is costly, non-discriminatory firms will have a competitive advantage in hiring cheaper labor, driving out discriminatory employers. Even without driving discriminatory employees out of the market, no wage differential will exist if the number of non-discriminatory firms is large. This model can be easily extended to a theory of occupational segregation, considering the circumstance in which the disutility of the employer depends on the type of job filled by the non-preferred workers.

1.5.3b Statistical discrimination

Statistical discrimination has been analyzed by the milestone papers of Phelps (1972) and Arrow (1973). The premise of this theory is that employers have limited information on the competencies and the turnover propensity of candidates. Given this scenario, employers have an incentive to "statistically discriminate" applicants based on observable characteristics (e.g. gender or race) correlated with expected productivity. Contrary to taste based discrimination, statistical discrimination is not eliminated in perfectly competitive markets. This type of discrimination is efficient and profit-maximizing, since it is the optimal solution to a signal

extraction problem. However, it is nowadays illegal to discriminate on the basis of the expected productivity of a certain group.

Coate and Loury (1993) analyze how stereotypes on the performance of a group can influence hiring and pay decisions. Most importantly, they discuss how even if different groups have the same innate ability, they might develop different levels of competences. Their model develops as follows: a large population of workers is to be matched with a number of employees. Workers can be assigned to job 0 or job 1. Job 0 can be performed satisfactorily by any worker, while job 1 can only be performed by a skilled worker. Thus, workers will earn a wage of ω if employed in job 1, and a wage of 0 if employed in job 0. On the other hands, employers will earn:

$x_q > 0$ *for a qualified worker on task 1*

$-x_u < 0$ *for an unqualified worker on task 1*

0 *for a worker on task 0*

Employers can only clearly observe the worker's gender $G \in [m; f]$, and they have a noisy signal on the worker's performance $\theta \in [0; 1]$. The distribution of the signal for qualified workers stochastically dominates the one for unqualified workers. In addition, workers are qualified to perform job 1 only if they have ex ante invested in the required skills for the task. Equilibrium will then be a set in which employer beliefs and workers' investment are self-confirming. It will be a discriminatory equilibrium since employers form a belief that workers from one group are less likely to be qualified. Because of the negative stereotypes employers have about a certain group, workers belonging to such group will set a lower standards and invest less in training and skills.

2. The Data

2.1 The PIAAC framework

The *Programme for the International Assessment of Adult Competencies* is a study by the OECD in 24 countries regarding the use of cognitive and workplace skills. The survey was conducted between 2008 and 2016[8], interviewing adults aged 16 to 65. For the purpose of this research, we will focus only on the EU-15.

In the PIAAC framework, skills assessed are "key-information processing competencies" deemed relevant to adults for the participation in the job market and their integration in social contexts. The competencies directly assessed regard the literacy, numeracy, reading components and problem solving skills. The survey also aims at assessing the use of skills in the workplace, intended as information-processing skills or generic skills.

2.1.1. Proficiency levels

The proficiency levels tested in the *Survey of Adults Skills* are the literacy and numeracy level. The results are reported on a 500-point scale. At each point on the scale, a respondent with a proficiency score of that value has a 67% chance of completing successfully test items located at that point. Literacy skills are meant as the ability to of an individual to access, manage and evaluate information from written texts and use these skills to participate in the community and develop one's knowledge. Studies have shown literacy ability to be positively associated to good performance at work and in social situations. Numeracy skills regard the ability to use, implement and translate mathematical information and ideas and respond to numerical content in a range of situations in adult life.

The PIAAC survey shows little variation in proficiency between males and females. As regarding the overall results, we find a mean higher proficiency of men with respect to women on the numeracy, and literacy scales. The gap in favor of men appears reduced in the case of literacy, and in more than half of the countries there is no statistically significant difference between males and females. As we see in Table 1, the largest differences in proficiency, at both the numeracy and literacy level, are found in Germany, the Netherlands and Belgium while the smallest gaps (almost inexistent in the case of literacy) are found in Italy, Finland and France. However, in Italy and Spain only 1 in 20 individuals is likely to achieve the highest level of

[8] Depending on the country surveyed

literacy proficiency. These gaps may be explained taking into account characteristics such as educational attainment and socio-economic status.

An interesting finding is that gender differences appear minor when considering the youngest age group surveyed (16-24 year olds). In this case, in more than half of the countries men and women appear to be equally proficient both in numeracy and literacy, with young women being slightly more proficient in literacy in certain countries.

Table 1. Difference between men and women scores in numeracy and literacy proficiency[9]

Country[10]	**Numeracy**	**Literacy**
DK	10,31	3,57
NL	16,74	3,99
BE	16,03	6,59
FR	10,8	1,99
IE	11,92	5,29
IT	10,74	0,44
ES	12,5	6,78
AT	13,18	2,54
FI	10,18	2,31
SE	13,56	5,44
DE	17,29	5,22
UK	14,26	2,57
Mean	13,13	3,89
Min	10,18	0,44
Max	17,29	6,78

The innovation of the PIAAC survey is in using a "job-requirements" approach, that is surveying adults on the frequency and the extent in which they use a number of information processing and generic skills in the work context. The analysis of skills' use at work is divided in two categories: use of information processing skills and use of generic skills.

[9] Survey of Adult Skills (PIAAC) (2012)
Greece, Luxembourg, and Portugal did not participate to the proficiency assessment.

[10] Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Ireland (IE), Italy (IT), Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE) and United Kingdom (UK).

2.1.2. Use of information-processing skills at work

Information processing skills comprehend the use of reading, writing, numeracy, ICT and problem solving skills at work. This range of skills is measured by direct assessment on the frequency with which individual perform specific tasks in the workplace. A summary of the tasks measured by each indicator can be found in Table 2. For instance, reading components are closely linked to the literacy skills, and they are meant as the set of decoding skills that enable to read fluently and extract meaning and knowledge from a text.

Table 2. Indicators of skills use at work - Information processing skills[11]

Indicator	Group of tasks
Reading	Reading documents (books, e-mails, directions, diagrams, maps, invoices)
Writing	Writing documents (reports, e-mails, forms, letters, articles)
Numeracy	Calculating costs and budgets; use of fractions or percentages; use of algebra or formulas; preparation of graphs and tables, use of advanced mathematics
ICT skills	Using e-mail, Internet and online resources; word processors and spreadsheets, programming languages
Problem solving	Facing complex problems (at least 30 minutes to find a solution)

Table 3. Difference between men and women in the use of information-processing skills at work[11]

Country	Reading	Writing	Numeracy	ICT	Problem solving
DK	2,45	1,13	21	11,5	12,3
NL	6,71	1,44	34,2	12,6	22,4
BE	6,74	4,41	18,3	5,94	18,7
IE	5,7	-3,2	9,34	2,59	14,8
IT	-2,6	-1,7	2,92	4,51	18,2
ES	3,61	6,99	8,11	9,2	26,7
AT	7,22	9,08	16,6	7,36	29,5
FI	0,82	2,32	16,4	4,31	6,66
SE	2,08	-0,3	17,8	6,74	9,81
DE	4,63	6,17	14	7,39	27,6
UK	2,91	0,79	14,3	10	8,65
Mean	3,66	2,47	15,72	7,47	17,76
Min	-2,6	-3,2	2,92	2,59	6,66
Max	7,22	9,08	34,2	12,6	29,5

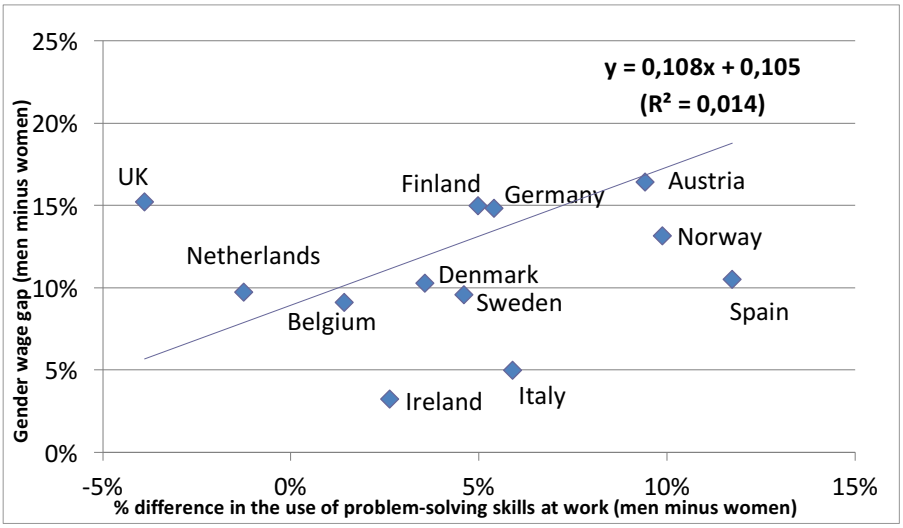
[11] Survey of Adult Skills (PIAAC) (2012)
Greece, Luxembourg, France and Portugal did not participate to the use of skills at work assessment.

Numeracy is an increasingly crucial skill because of the expansion of quantitative and mathematical information in an individual's daily life and in the workplace. ICT skills are also extremely important, as communication takes place through the use of the internet and digital applications. At the country level, studies show a clear relationship between average proficiency in information processing skills and organized adult learning activities. A higher proficiency in these skills is deeply linked to the labor market, as it allows individuals to access to better-paying and more rewarding jobs, and to participate in further education and training. Using those skills at work increases labor productivity, results show that workers employed in small establishments or in part-time jobs are more likely to show an under-use of qualifications. This is especially common for workers at the margin, such as the women, youngsters and foreign born. Qualifications mismatch is shown to have a bigger impact on labor market outcomes compared to skills proficiency (OECD 2012).

The greatest gap identified in all countries is certainly in problem solving skills, the gap reaches its peak in Austria and Germany. Interestingly, if we plot the gender wage gap against the difference in use of problem solving skills at work, a correlation appears (table 3).

Moreover, if we consider not only the EU-15 member states tested (table 3), but all the countries assessed in the PIAAC[12], keeping all other factors constant, half of the gender gap in salary can be explained by the use of problem solving skills at work.

Table 3. Correlation between gender gap in wages and in the use of problem-solving skills at work[13]



[12] Adding Canada, USA, Japan, Korea, Estonia, Poland, Slovak Republic, Cyprus and Czech Republic.
[13] Data used taken from the Survey of Adult Skills (PIAAC) (2012)

Equal skills between genders do not always imply the same opportunities. As seen in table 3, on average, women use less literacy and numeracy skills at work than men. Exceptions can be found for a small group of countries, including Italy and the Ireland, which show a greater use of writing workplace skills for women than men.

The gaps in the use of skills at work can be explained by gender stereotyping, but it may also result from differences in literacy and numeracy skills, or differences in the type of job. For instance, the fact that literacy and numeracy skills are used more frequently in full-time jobs than in part-time jobs, and women are more likely than men to employed in a part-time job, might explain part of the gap. Moreover, the difference in the skills use in ICT at work may be justified by the greater computer use among men in everyday lives. This difference contributes to a significant gap in ICT proficiency. Results from the survey highlight how men are more likely to use ICT in 15 of the 23 countries surveyed by the PIAAC.

2.1.3 Use of generic skills at work

Generic work skills are classified in three broad categories: interaction and social skills, physical skills, and learning skills (description in table 4). Interaction and social skills include time management, communication and negotiation skills and collaboration with other co-workers. Physical skills cover the use of fine and gross motor skills. Learning skills comprehend teaching others, learning formally and informally; developing and enhancing already existing skills; having the flexibility to adapt to new jobs and tasks. This range of skills is measured by self-reported use at work.

Table 5 presents the gaps (men minus women) in use of generic skills at work. Depending on the country, gaps between males and females can largely vary for the same skill, particularly for gross physical skills. However, the main trend appears to favor men, especially in the case of task discretion. The heterogeneous picture that appears in table 5 is mostly due to the different roles played by other factors, such as contract types (part-time work and permanent versus temporary) and proficiency across types of skills. Generic skills, as opposite to information-processing skills, are less likely to be acquired while working or outside school.

Table 5. Indicators of skills use at work - generic skills[14]

Indicator	Group of tasks
Task discretion	Changing the sequence of job tasks, working hours, speed of work; flexibility in choosing how to do the job
Learning at work	Learning by doing; learning new things from co-workers or supervisors; keeping up-to-date with new products/services
Influencing skills	Instructing and training people; delivering speeches; negotiation skills; persuading others; advising people; selling products and services;
Co-operative skills	Collaborating with co-workers
Self-organizing skills	Organizing one's time
Dexterity	Using accuracy with one's hands or fingers
Physical skills	Working physically for a long period

Among generic skills, influencing, task discretion and self-organizing skills are more commonly used by workers on stable contracts than by ones on temporary contracts; probably because these skills are intensively used in managerial jobs that are usually held by experienced workers.

Table 6. Difference between men and women in the use of generic skills at work[14]

Country	Task discretion	Learning skills	Influencing skills	Co-operative skills	Self-organizing skills
DK	6,11	1,15	1,32	-2,42	0,97
NL	6,78	5,89	7,21	6,09	3,51
BE	5,44	4,13	9,22	12,5	-3,73
IE	11,98	-2,95	-1,75	-0,32	7,42
IT	2,84	2,55	-2,09	8,37	-3,82
ES	2,05	4,63	4,89	14,47	0,12
AT	2,85	5,03	7,33	5,01	5,22
FI	6,87	-3,32	-8,27	-1,46	-2,38
SE	9,46	0,36	-1,08	-4,58	-0,65
DE	2,73	-0,01	2,55	10,66	4,46
UK	7,54	-1,79	-3,89	-1,94	0,68
Mean	5,88	1,42	1,4	4,22	1,07
Min	2,05	-3,32	-8,27	-4,58	-3,82
Max	11,98	5,89	9,22	14,47	7,42

[14] Survey of Adult Skills (PIAAC) (2012)
Greece, Luxembourg, France and Portugal did not participate to the use of skills at work assessment

Table 6. Difference between men and women in the use of generic skills at work[14] (continue)

Country	Dexterity	Physical skills
DK	-2,86	7,27
NL	-1,16	-1,72
BE	-0,77	4,34
IE	-2,59	22,7
IT	9,6	26,58
ES	14,68	15,48
AT	-3,53	6,72
FI	-9,27	7,62
SE	-2,01	0,74
DE	-4,9	7,6
UK	-1,92	16,7
Mean	-0,43	10,37
Min	-9,27	-1,72
Max	14,68	26,58

Temporary workers are more likely to be learning at work more intensively and more frequently than fixed-term employees. Partly, this is due to the fact that young workers are more likely to hold a temporary contract, and being less experienced, they learn more on the job.

If we adjust for the distribution of female and male workers across occupation, differences in the use of generic skills increase for most countries, however, even when controlling within occupations, notable differences in skills' use remain at the individual level. Research shows that differences in the use of skills strongly correlate with the average wage penalty between temporary and permanent contracts (OECD 2012). The relationship is statistically significant even when accounting for proficiency, occupation and education. This suggests that workers employed under different contractual agreements carry out substantially different tasks.

2.2 The dataset

The dataset is the one used in Cipollone *et al.* (2012), it is obtained by combining micro data from two sources: the ECHP (European Community Household Panel) and the EU-SILC (European Union Statistics on Income and Living Conditions) statistics. The integration between the two provides a unique dataset of comparable household and individual level characteristics across the 15 EU countries, over a 13-year period time.

The ECHP is a panel survey by Eurostat interviewing a sample of households and individuals throughout eight years, from 1994 to 2001. The aim of the survey is to assess a wide range of topics covering living conditions: financial situation, working life, social relations, housing situation, biographical and health information. The member states involved were Austria, Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

The EU-SILC replaces the ECHP beginning from 2003-2004, it was initially launched in the EU-15 member states and then expanded to the EU-25 countries. Similar to the ECHP, it provides cross-sectional data on income, social exclusion, and other living conditions. For consistency of reasons, the data used for this analysis are those relative to the EU-15 countries.

For the purpose of the analysis, the differences between men and women identified in the PIAAC survey are integrated with the micro data for the 15 countries examined (with the exception of Greece, Luxembourg and Portugal which did not participate to the PIAAC assessment).

2.2.1 Descriptive statistics

The dataset used was reduced to the working age population (16-64). The sample includes a total of 2.477.399 observations, composed by 51% women and 29% men.

In order to analyze the role of women within the European labor market, we take into consideration three dimensions: unemployment, fixed-term contracts and part-time contracts. The unemployment rate is at 8% for the male sample, and increases to 11% for the female sample. Temporary and part time employment account for 19% and 33% respectively for women, decreasing at 14% and 8% respectively for male respondents.

The variables described in tables 6 and 7 are the ones which will be used as control variables in our specifications: marital status of the individual (*incouple, separated, divorced, widowed, single*); level of education of the individual, that is upper secondary education or tertiary education, respectively *ISCED_3_5* and *ISCED_5_7*; age of the individual (*age_25_34, age_35_44, age_45_54, age_55_64*); presence of children within the household (*children*); presence and age of dependent children within the household (*child_d, child_0_3d, child_3_6d, child_6_14d*); if in couple, level of education of the partner (*pISCED_0_3, pISCED_5_7, pISCED_5_7*).

Individual characteristics are intended as marital status, age and education level of the respondents. Women and men present a similar distribution in the education level. The

percentage of highly educated individuals (*ISCED 5-7*) is around 22% for the male and the female sample, however, men are slightly more likely to have achieved middle levels of education (*ISCED 3-5*), standing at 35% and 32% respectively for men and women. 61% of the men and 57% of the women live with a partner (*incouple*), divorce rates stand at approximately 4 % for the male sample and similarly 5% for the female sample.

Household characteristics comprehend: presence, age, and number of (dependent and independent) children. Moreover, the level of the partner's education is taken into account. 53% of the female respondents reported having a child, against only 32% of male ones; of these, 8% reported the presence of a child in pre-school years (*child_3_6d*). Over 14% of those living in couple have a highly educated partner (*pISCED_5_7*), and approximately 25% live with a partner who is low educated.

Table 7. Summary statistics: Male sample

	Variable	Obs.	Mean	Std. Dev.	Min	Max
Individual characteristics	unemployment	784742	0,080	0,272	0	1
	temporary	580997	0,139	0,346	0	1
	parttime	725593	0,076	0,265	0	1
	incouple	1184505	0,605	0,489	0	1
	separated	1184505	0,010	0,100	0	1
	divorced	1184505	0,037	0,188	0	1
	widowed	1184505	0,029	0,168	0	1
	single	1184505	0,319	0,466	0	1
	ISCED_3_5	1151860	0,345	0,475	0	1
	ISCED_5_7	1151860	0,227	0,419	0	1
	age_25_34	1193042	0,162	0,368	0	1
	age_35_44	969821	0,227	0,419	0	1
	age_45_54	969821	0,217	0,412	0	1
	age_55_64	969821	0,188	0,391	0	1
Household characteristics	children	1193042	0,315	0,801	0	14
	child_d	1193042	0,168	0,374	0	1
	child_0_3d	1193042	0,073	0,260	0	1
	child_3_6d	1193042	0,081	0,273	0	1
	child_6_14d	1193042	0,196	0,397	0	1
	pISCED_0_3	1193042	0,285	0,451	0	1
	pISCED_3_5	1193042	0,209	0,407	0	1
	pISCED_5_7	1193042	0,149	0,356	0	1

Table 8. Summary statistics: Female Sample

	Variable	Obs.	Mean	Std. Dev.	Min	Max
Individual characteristics	unemployment	630231	0,106	0,308	0	1
	temporary	536417	0,187	0,390	0	1
	parttime	567634	0,330	0,330	0	1
	male	1284343	0	0	0	0
	incouple	1276340	0,565	0,496	0	1
	separated	1276340	0,013	0,115	0	1
	divorced	1276340	0,054	0,226	0	1
	widowed	1276340	0,112	0,316	0	1
	single	1276340	0,255	0,436	0	1
	ISCED_3_5	1234368	0,320	0,466	0	1
	ISCED_5_7	1234368	0,215	0,411	0	1
	age_25_34	1284343	0,156	0,363	0	1
	age_35_44	1009683	0,233	0,423	0	1
	age_45_54	1009683	0,222	0,415	0	1
	age_55_64	1009683	0,190	0,392	0	1
Household characteristics	children	1284343	0,529	0,897	0	15
	child_d	1284343	0,328	0,469	0	1
	child_0_3d	1284343	0,073	0,261	0	1
	child_3_6d	1284343	0,082	0,275	0	1
	child_6_14d	1284343	0,199	0,399	0	1
	pISCED_0_3	1284343	0,248	0,432	0	1
	pISCED_3_5	1284343	0,200	0,400	0	1
	pISCED_5_7	1284343	0,150	0,357	0	1

3. Regression Analysis

The descriptive analysis presented how women in Europe generally present a slight lower proficiency in numeracy and literacy, and use less skills at work than men. In this section, we provide an econometric analysis of EU-15 women's employment opportunities, filtering the data across the numerous gender gaps identified in the previous section. Our aim is to investigate the impact of competencies' differences between males and females on labor market outcomes; specifically, unemployment, part-time and temporary employment.

3.1 The linear probability model

The econometric model used is the linear probability model (LPM). It is a multiple regression model for which the dependent variable Y is binary. The estimated regression function corresponds to the probability that Y=1 (for e.g. the probability that the individual is unemployed) given the set of independent variables X. The interpretation given to the coefficient of X is the following: it is the change in probability that Y=1 given a one unit change in the regressor X.

In the case of the linear probability model, since the dependent variable is binary, R^2 is not a useful statistic, as it is not possible to imagine a situation in which R^2 equals 1. Thus, we will not take into consideration the R^2 as a measure of fit in our regressions. Since the errors of the LPM are always heteroskedastic, we will use heteroskedasticity-robust standard errors for the inferences.

The LPM has the possibility for bias and inconsistency because of its linearity. However, I decided to model the relationships with a linear probability model, as the limitations of this model are not particularly relevant in our setting. The LPM is increasingly seen as a valid alternative to the probit or logit. Some researches show that predicted probabilities from the LPM are very similar to the ones from a probit model. Wooldrige (2002) defends the LPM stating that: "*…the main purpose is to estimate the partial effect of [the independent variable] on the response probability, averaged across the distribution of [the independent variable], then the fact that some predicted values are outside the unit interval may not be very important"*[15].

[15] Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*. MIT Press. Page 455.

3.2 Specification

The econometric analysis of the labor market performance of females is carried out using the following specification:

$$Y_{ijt} = \beta \boldsymbol{male}_{ijt} + \delta \boldsymbol{X}_{ijt} + \theta\left(\boldsymbol{male}_{ijt} * \overline{GAP_j}\right) + yr_t + cty_j + \varepsilon_{ijt} \quad (1)$$

where Y_{ijt} is the dummy relative to unemployment (*unemployed*) or the dummies relative to the contractual status of the worker: part-time contract (*part-time*) and fixed-term (*temporary*) for individual *i* in country *j* at time *t*. $\boldsymbol{male}$ is the variable of interest: it is a dummy variable which takes value 1 when the individual is male. The coefficient β captures a gap between males and females in the probability of participating to the labor market (*unemployed, temporary, part-time*) imposed as dependent variable. $\boldsymbol{X}_{ijt}$ is the set of control variables, it contains individual and household characteristics. The controls used account for the age, the level of education and the marital status of the individual; the presence, the age and the number of children within the household; and if in couple, the level of the partner's education, as reported in section 2.2.1 These controls are introduced to capture the true (as much as possible) relationship between the employment status and the independent variable tested. yr_t is a year dummy and cty_j is a country dummy, while ε_{ijt} is the error term for individual *i* in country *j* at time *t*.

In order to investigate the effect of gender differences in competences on labor market status, an interaction term is introduced. The coefficient of interaction $\left(\boldsymbol{male}_{ijt} * \overline{GAP_j}\right)$ captures that the effect of gender on labor market outcomes is different depending on the existence of a gap between men and women in proficiency or use of skills at work. If there were no interaction term, β would be interpreted as the unique effect of being a male on labor market status. From the sign and the significance of coefficient θ we can evaluate how the identified gender gap in competences has an impact on labor market outcomes.

3.3 Results

The following tables present the results of specification 1, showing the effects of country gaps in competences discussed in section 2 on the probability of being unemployed (column 1), holding a fixed term contract (column 2) and working part-time (column 3).

Since gender differences in proficiency and use of skills at work are likely to be correlated to one another, we will run a different regression for each gap identified. The analysis is divided into three sections, which test the impact of gender gaps in proficiency level, use of information-

processing skills at work, and use of generic skills at work on job opportunities. All the models include control variables (individual and household characteristics) which, as discussed in the literature, have a significant impact on women's status within the labor market.

3.3.1 Assessing the impact of gaps in proficiency

The results observed (table 8) for the impact of gaps in proficiency on job opportunities largely correspond to the ones we were expecting for the literacy case, while numeracy presents slight discrepancies in the unemployment and temporary work columns (1 – 2).

As displayed in the second row, both gender and literacy gap negatively affect men's likelihood of being unemployed, engaged in a temporary contract or working part-time. This means that men are more likely than women to have better job outcomes once active.

The most interesting case is probably the one of part-time employment, for which the interaction term on the proficiency gap has the greatest magnitude and is a statistically significant (at 1%) determinant of labor market status for men. The interpretation is the following (same interpretation is given to *unemployment* and *temporary*):

$$\frac{\partial parttime}{\partial male} = \beta + \theta * \overline{GAP}$$

The effect on the probability of working part-time, is influenced by the coefficient β on $\boldsymbol{male}$ and by the coefficient θ on the interaction term $(\boldsymbol{male} * \overline{GAP})$. The greater the average gap between men and women, the greater the positive effect on job opportunities for men, *ceteris paribus*. For instance, we shall take the average numeracy gap in EU-15 member states, that is of 13,13 points. The estimated effect of gender (male) on part time work will be:

$$\frac{\partial parttime}{\partial male} = 0{,}2086 + (-0{,}0370 * 13{,}13) = -0{,}28$$

Interestingly, for Germany, which has the largest numeracy gap (17,29 points)[16], the estimated effect is $-0{,}43$. As opposite, the effect decreases to $-0{,}17$ when we consider Finland, which has the lowest numeracy gap among all countries considered (10,18 points)[16].

To sum up, considering the case of individuals already within the labor market, a lower proficiency in numeracy and literacy decreases job opportunities, and women, appear to bear the most negative consequences for their lack of proficiency in these skills. The finding appears significant in all cases considered.

[16] Detailed in section 2.1.1

This evidence is consistent with our hypotheses: women are more likely than men be unemployed or to hold a part-time or temporary contract with the existence of a gender gap in proficiency levels.

Table 9. Proficiency gender gaps[17]

	Unemployed		**Temporary**		**Part-time**	
	Coef.	*Std. Err.*	*Coef.*	*Std. Err.*	*Coef.*	*Std. Err.*
male	-0,0445 ***	(0,0028)	-0,0676 ***	(0,0040)	0,2086 ***	(0,0039)
*(male*gap)*						
m_numeracy	0,0011 ***	(0,0002)	0,0023 ***	(0,0003)	-0,0370 ***	(0,0003)
male	-0,0278 ***	(0,0012)	-0,0316 ***	(0,0016)	-0,2342 ***	(0,0015)
*(male*gap)*						
m_literacy	-0,0007 ***	(0,0003)	-0,0015 ***	(0,0004)	-0,0107 ***	(0,0004)
Observations	1155146		705181		1048128	

Research shows that qualification mismatch (skills' use at work) has a higher impact on wages than mismatches in skill proficiency (numeracy and literacy). This suggests that labor market mismatch is more likely related to generic or job-related skills, or that employers adapt job content accordingly to employees' real or perceived skills. We will test job-related skills in the following regressions (tables 9 and 10).

3.3.2 Assessing the impact of gaps in information-processing skills at work

The regressions (table 9) of the binary variable *unemployed/temporary/part-time* against the difference in information-processing skills shows heterogeneous results. Gaps in the skills used appear to decrease male's unemployment (column 1) and part-time employment (column 3).

[17] Heteroskedasticity-robust standard errors used
*,**,*** Statistically significant observations at 10%, 5%, 1% respectively
In the specifications we also control for individual characteristics, household characteristics, year and country dummies. (Data described in section 2)

Table 10. Gender gaps in information-processing skills at work[18]

	Unemployed		**Temporary**		**Part-time**	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
male	-0,0239 ***	(0,0007)	-0,0405 ***	(0,0010)	-0,2772 ***	(0,0010)
*(male*gap)*						
m_writing	-0,0023 ***	(0,0002)	0,0009 ***	(0,0002)	-0,0001 *	(0,0002)
male	-0,0366 ***	(0,0008)	-0,0436 ***	(0,0012)	-0,2086 ***	(0,0011)
*(male*gap)*						
m_reading	0,0024 ***	(0,0002)	0,0018 ***	(0,0003)	-0,0232 ***	(0,0003)
male	-0,0382 ***	(0,0012)	-0,0480 ***	(0,0018)	-0,1516 ***	(0,0016)
*(male*gap)*						
m_numeracyatwork	0,0006 ***	(0,0001)	0,0007 ***	(0,0001)	-0,0087 ***	(0,0001)
male	-0,0164 ***	(0,0015)	-0,0618 ***	(0,0023)	-0,1269 ***	(0,0022)
*(male*gap)*						
m_ict	-0,0018 ***	(0,0002)	0,0032 ***	(0,0003)	-0,0202 ***	(0,0003)
male	0,0077 ***	(0,0014)	-0,0437 ***	(0,0021)	-0,1644 ***	(0,0020)
*(male*gap)*						
m_problemsolving	-0,0020 ***	(0,0001)	0,0003 ***	(0,0001)	-0,0061 ***	(0,0001)
Observations	1060483		636226		962754	

[18] Heteroskedasticity-robust standard errors used
*,**,*** Statistically significant observations at 10%, 5%, 1% respectively
In the specifications we also control for individual characteristics, household characteristics, year and country dummies. (Data described in section 2)

As to temporary jobs, results are contrasting, as the signs of the coefficients on the interaction terms are positive. In the case of columns 1-3, the coefficients estimated on the interaction term $(\boldsymbol{male} * \overline{GAP})$ have a negative sign; indicating that *ceteris paribus,* men are statistically less likely than women to hold a part-time contract or to be unemployed. The interpretation given to the effect follows the same logic as the one explained in paragraph 3.3.1.

The models suggest that women's lower use of information-processing skills at work with respect to men (e.g. in writing, ICT, problem solving) results in a higher risk for females of experiencing less job opportunities. Recapping the literature, skills are less frequently used in part-time jobs than in full-time jobs, suggesting why women's lack in this area might influence the type of job contract held. Indeed, when skills and other controls are taken into account, differences in gender labor outcomes for part-time employment appear smaller. Similarly, a 1ower ability to use skills at work, even if slight, puts women at a disadvantage in terms of employment opportunities. As discussed in the literature, the reasons for discrepancies in skills' used may be many, ranging from education choices to stereotypical behaviors of individuals.

The fact that the signs of the coefficients on gaps in column 2 (*temporary*) are positive for almost all cases analyzed may seem contradictory. In fact, we would expect fixed-term contract jobs to have a lower skill content than permanent jobs; thus we would predict a lower probability for men than women to be in a fixed term contract, *ceteris paribus*, given their higher use of skills at work. This weakness may be explained because of other factors we didn't take into account, such as the gap in proficiency adjusted for the education level or the type of job and industry in which the worker is employed.

3.3.3 Assessing the impact of gaps in generic skills at work

In line with the literature, results show that women, once in the labor market, are more likely than men to be unemployed; and in the case they are employed, they are more likely to hold a part time or a temporary contract. Overall, gaps in generic skills' use at work significantly appear to increase this effect (table 11).

However, we have some slight discrepancies in the signs of the coefficients, indicating that for certain skills further investigation is required. Once again, the interpretation of the coefficient on $(\boldsymbol{male} * \overline{GAP})$ is parallel to the one explained in paragraph 3.3.1. The effect of being a male on the probability of employment depends not only on gender, but also on the magnitude of the gap.

Table 11. Gender gaps in generic skills at work[19]

	Unemployed		**Temporary**		**Part-time**	
	Coef.	*Std. Err.*	*Coef.*	*Std. Err.*	*Coef.*	*Std. Err.*
male	-0,0165 ***	(0,0006)	-0,0372 ***	(0,0009)	-0,2517 ***	(0,0009)
*(male*gap)*						
m_learning	-0,0081 ***	(0,0002)	-0,0005 *	(0,0003)	-0,0163 ***	(0,0003)
male	-0,0721 ***	(0,0013)	-0,0380 ***	(0,0018)	-0,2417 ***	(0,0017)
*(male*gap)*						
m_taskdiscretion	0,0083 ***	(0,0002)	-3,54E-05 ***	(0,0003)	-0,0069 ***	(0,0003)
male	-0,0267 ***	(0,0006)	-0,0390 ***	(0,0009)	-0,2635 ***	(0,0008)
*(male*gap)*						
m_influencing	-0,0028 ***	(0,0001)	0,0006 ***	(0,0002)	-0,0141 ***	(0,0002)
male	-0,0322 ***	(0,0006)	-0,0400 ***	(0,0009)	-0,2657 ***	(0,0008)
*(male*gap)*						
m_selforganising	0,0050 ***	(0,0002)	0,0027 ***	(0,0002)	-0,0194 ***	(0,0002)
male	-0,0088 ***	(0,0007)	-0,0325 ***	(0,0010)	-0,2628 ***	(0,0010)
*(male*gap)*						
m_cooperative	-0,0038 ***	(0,0000)	-0,0009 ***	(0,0001)	-0,0028 ***	(0,0001)
male	-0,0259 ***	(0,0006)	-0,0364 ***	(0,0008)	-0,2801 ***	(0,0008)
*(male*gap)*						
m_dexterity	-0,0029 ***	(0,0001)	-0,0011 ***	(0,0001)	0,0027 ***	(0,0008)

[19] Heteroskedasticity-robust standard errors used
*,**,*** Statistically significant observations at 10%, 5%, 1% respectively
In the specifications we also control for individual characteristics, household characteristics, year and country dummies. (Data described in section 2)

male	-0,0261 ***	(0,0009)	-0,0322 ***	(0,0013)	-0,3389 ***	(0,0013)
*(male*gap)*						
m_physical	-0,0003 ***	(0,0001)	-0,0005 ***	(0,0001)	0,0052 ***	(0,0001)
Observations		1060483		636226		962754

The columns show qualitatively similar results to the ones obtained from the previous regressions on proficiency and information-processing skills. Among all, gaps in learning and cooperative skills are the ones which appear to affect most negatively women, in the three scenarios considered (unemployed, temporary, part-time).

The part-time column (3) appears interesting, as it presents the coefficients with the greatest magnitudes, indicating a larger effect of women's probability of being in a part-time job. Previous literature shows that part-time jobs have lower qualification requirements than full time jobs. Following, full-time workers tend to use generic skills more intensively than their colleagues in part-time employment. With the exception of physical and dexterity skills, which are two types of manual skills more frequently associated to part-time jobs.

4. Conclusion

Women's presence in the labor market has increased dramatically over the last two decades. However, women's work patterns remain diverse to those of men. Women do not work steadily; they face great barriers to continuous full-time work and they are more likely than men to be unemployed or to work on a fixed-term contract. While it is true that many women voluntarily choose not to work full-time, we research the extent to which "negative" labor market outcomes associated with being a women are constrained by factors other than discrimination.

In particular, we investigate the effect of gender gaps in proficiency and in skills' use at work on job opportunities for women. According to the *Survey of Adult Skills* (OECD 2012) in Europe, gender gaps in proficiency are not very large, but increase for numeracy with respect to literacy. On the other hand, skills used at work show wider discrepancies, especially concerning problem solving areas.

The empirical analysis conducted in this paper uses data that covers a period of 13 years on EU-15 member states. Through linear probability models, we tested the effects and the significance of gender and differences in competencies as determinants of unemployment, part-time employment and fixed-term employment. Gender gaps in competencies are measured as the difference between scores (men minus women) in the PIAAC assessment. The controls used in the regressions range from individual characteristics to household features.

The estimated results confirm that in most cases an increase in the skills gap between males and females leads to a statistically significant decrease in job opportunities for women. However, some discrepancies emerged in the sign of the interaction coefficients on gender and gaps. The heterogeneity found in the results can be explained by different facts.

Firstly, part-time and temporary employment may not be due to differences in skills but may be due to a voluntary decision of the woman, for instance, a skilled woman who decides to care for family members instead of working full-time. For this reason, a woman may be employed in a job that does not fully match her qualifications. Secondly, qualified women might exit the workforce for a period of time (i.e. for childcare) and when re-entering face a phenomenon of job-skills mismatch. Thirdly, we might have involuntarily omitted factors which might have in the relationship between labor market outcomes and gender gap in competencies; such as education and age of an individual, or the different type of industry in which she is employed.

Our research shows to some extent that the gaps women face in proficiency and skills' use affects job opportunities. A shortage of skilled women workers is an issue that has the potential for serious impacts on the labor market. The greater use of atypical contracts is likely to have adverse effects on female workers. In fact, data shows that workers on temporary contracts have fewer opportunities to gain job-specific skills and receive less training from their employers, potentially reducing their chances for future career development.

In conclusion, understanding the differences in the skills used by workers on part-time and temporary contracts is a crucial element for designing appropriate policies to address the problem. However, further research is needed in order to fully understand the link between gender gaps in competencies and the corresponding gaps in the job market.

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