Beyond the Average Gender Pay Gap: Three New Analyses of Women's Labour Market Outcomes

by

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Abstract

Despite repeated commitments to promote gender equality in the United Nations and elsewhere, women are still not as favoured as men in many dimensions, including the labour market. The aim of this thesis is to investigate the changing female relative labour market outcomes. This thesis is made up of three empirical studies. The first empirical study describes and analyses the impact on the international gender wage differentials, measured at the mean, of globalisation and the development of social openness, and how such impact has been changing over time across different income and development levels and across different cultural backgrounds. The objective of the second empirical study is to understand the variation in the gender differential in employment in Japan, and investigate the relationship between such variation and the development of technology. The third empirical study determines the evolution of the UK gender gap at the top end of the wage distribution in relation to different labour market sectors, occupations, and different cohort groups, both within cohorts over their work lives, and across cohorts.

The results indicate that the effect on gender wage differentials of the development of the economy and technology vary across different regions and skill levels of workers. Having higher human capital accumulation or working in higher level jobs is not always positively associated with good female labour market outcomes. More stringent policy enforcement benefits the majority of women in terms of wages, but such effects are found to be relatively weak for the women at the top decile of the female wage distribution and more recent generations. Societal constraints do not only limit female progress in the labour market but also the positive impact of female politicians.

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Contents

List of Tables

List of Figures

1 Introduction

1.1 Aims and Objectives

Gender differences in earnings, employment, career progression and social status have been much debated issues for several decades. Despite repeated commitments to promote gender equality in the United Nations and elsewhere, women are still not as favoured as men in many dimensions, including the labour market. According to the World Economic Forum's 'The Global Gender Gap Report 2013'[1] (2013), the gender gaps in health outcomes and in educational attainment have been almost closed in the 136 countries considered in 2013, though the gaps in economic participation and in political empowerment have remained significantly large. In terms of the gender pay gap, Weichselbaumer and Winter-Ebmer (2005) suggest that international raw gender wage differentials have declined significantly from about 65% in the 1960s to 30% in the 1990s over the 60 countries they consider. As for more recent evidence, the International Trade Union Confederation (2008, 2012) indicates that the global average gender gap in pay in 2008 was 16.5%[2] across a sample of 62 countries, although it increased to 18.4% in their more recent 2012 report covering 43 countries, while OECD (2012) reports a gender differential of 17.3% in full-time hourly wages in 2011 over OECD countries. Investigating the changes in the gap between male and female pay before and after the 2008 financial crisis, the ILO (2013), in accordance with the OECD's (2012) findings, discovered a

[1] The gender gap index designed in this report is to "measure gender-based gaps in access to resources and opportunities in individual countries rather than the actual levels of the available resources and opportunities in those countries.....In other words, the Index is constructed to rank countries on their gender gaps not on their development level"(World Economic Forum, 2013, p.3).

[2] The result excluded Bahrain, where an inverse pay gap of 40% is shown, which could be explained partly by a relatively high proportion of qualified women in the labour market in view of very low female employment rates. If the figure for Bahrain is included, the world average gap would be 15.6%.

downward trend over the crisis years in most countries. The ILO (2013) additionally suggests that the causes of this phenomenon are not all due to the improvement of female labour market outcomes; rather some are from the deteriorating situation of male outcomes[3].

The sizes of the observed gender wage gaps from the published reports have been found to vary significantly across countries, which are not only due to the differences in the cultural and economical background but also the institutional factors, such as the nationally agreed wage settings, collective bargaining power and unionization (International Trade Union Confederation, 2012). One of the similar conclusions most of these reports have reached is that Asian women seem to face greater difficulty in being rewarded as well as men in the labour market. Japan and South Korea, despite both countries being in developed and high income categories, have often been shown to have the poorest gender parity compared to countries over all the world (International Trade Union Confederation, 2008, 2012; OECD, 2012; World Economic Forum, 2013). Statistics of the pay differentials between men and women have been found to vary depending on the different points in the wage distribution considered and whether part-timers are included in the comparison or only full-time workers are considered. For instance, the average wage gap in Hungary has been found to be one of the lowest in OECD countries, yet the gap at the 80$^{\text{th}}$ percentile of the wage distribution is relatively large compared to other countries (OECD, 2012). In Norway, men and women are paid similarly in part-time employment, but full-time men are paid considerably more than their female counterparts. The overall gender wage gap is found to be higher than that for full-time workers, due

[3] In Estonia, for instance, the narrowing gender pay gap was due largely to the fact that men were more concentrated in sectors that were hardest hit by the crisis together with fewer working hours.

to a greater proportion of female part-time workers who are paid considerably lower than full-time workers (ILO, 2013).

The motivations behind the research presented in this thesis, which investigates the changing female relative labour market outcomes, derive from both economic and sociological fields. First of all, this research is motivated by the variations of female labour market outcomes across countries with different social norms, at different income levels, and at different stages of development over time. Second, motivation is given by the important factors which explain these variations. The changes in female relative outcomes could be driven by the integration of the world economy via the progressive globalisation of trade and the development of technology, which inevitably lead to changes in economic structure of countries and changes in the relative demand for workers with different levels of skill. The changes in female relative outcomes could additionally be affected by the differentials in human capital accumulation; increasing investment in formal education is extensively suggested as having positive impacts on narrowing gender inequality in labour market outcomes, however, the loss of work experience as a result of childbirth and family responsibilities demonstrates the negative implications.

Female allocation to different occupations, sectors, and labour market segments could be strongly associated with their labour market outcomes; previous research has suggested that the persistent gender pay gap can be largely attributed to a greater share of women attached to lower waged, lower status jobs (Bayard *et al.*, 2003; Manning, 2006; Haveman and Beresford, 2012). Moreover, gender differentials in labour market outcomes are likely derived from institutional and societal constraints; generous family friendly policies and sufficient supplies for child care would make more women be able to remain attached to their career and lead to a narrowing gender inequality in employment and wages. Social convention would not only reflect women's social status but also influence their decision on educational investment, on the kind of jobs to apply for, on being work or family oriented, etc (Vella, 1993, 1994; Fernández, 2011; Haveman and Beresford, 2012). The effect of time would be another important element for the shifting female relative labour market outcomes. The development of the economy and technology, the spread of information, the enactment of regulations, and the changes in social norms all require time to see their impact on the real world. In addition, women from different generations are likely to have very different performances in the labour market due to the changing work environment, the differences in human capital investment, and their attitude toward career and family.

The first aim of this thesis is to investigate the impact on female labour market outcomes of globalisation, the spread of technology, the development of economies, and of different social norms and cultural backgrounds. Next, the analysis in this thesis focuses on women at different points in the distributions of occupation and wages.

The first empirical study (Chapter 2) describes and analyses using meta-analysis techniques how international gender wage differentials are associated with globalisation and development of social openness, and how these have been changing over time across a broad range of countries at different income and development levels and with different cultural backgrounds. Due to the unique social norms and labour market structure, gender wage inequality in Japan has been the highest among developed countries (Blau and Kahn, 2003; Miyoshi, 2007). The objective of the second empirical study (Chapter 3) is to understand how the Japanese gender employment differential has been changing over time, to determine what role is played by non-regular employment and to examine how much of the variation can be explained by the development of technology.

Finally, although the closing of the average gender pay gap is an ongoing phenomenon in developed countries, it has been discovered that the gap at the top end of the wage distribution is significantly larger than that at the lower end of the distribution in many European countries. The third empirical study (Chapter 4) thus examines how the UK gender gap at the top end of the wage distribution has evolved with respect to different labour market sectors, occupations, and different cohort groups, both within cohorts over their lifetime, and across cohorts.

1.2 Motivation behind the Research Questions

The majority of research into female relative labour market outcomes has focused on investigating female workers' characteristics relative to those of men. More recently, these have been found to be limited in explaining the gender gap. The motivation behind the research in this thesis is to demonstrate the important factors that impact upon relative female labour market outcomes through both economic and sociological channels. In the economic field, the impact of globalisation via trade together with the spread of technology and the shifting economic structure on the changing demand for different skilled workers will be discussed. In sociological terms, the effect of different social norms and cultural backgrounds in relation to female human capital accumulation and women's performance in the labour market will also be considered.

1.2.1 Globalisation and Technology

The empirical research into the relationship between trade liberalisation and wage inequality has found it difficult to reach a clear cut conclusion. According to the Heckscher−Ohlin (H−O) and the Stolper−Samuelson (SS) theorems, the expansion of trade in developing economies where unskilled workers are abundant would reduce the within-country wage inequality by raising the relative demand and prices for the unskilled workers, while the opposite story would be found for advanced economies as their high skilled workers are relatively abundant (Stolper and Samuelson, 1941; IMF, 2007). However, the implications of both the theorems have been found difficult to verify, especially for the case of middle income countries (Davis, 1996; Feenstra and Hanson, 1996; Xu, 2003; Milanovic, 2005). These countries lose their comparative advantage of unskilled labour abundance compared to low income countries, and their skill-intensive sectors would also be contracted by imports from high income countries, both leading to changes in their labour market structure which possibly result in a rising wage inequality (Wood, 1997).

The development of technology has also led to a change in the relative demand for different skilled workers. Trade liberalisation spread advanced technology from the developed to the developing economies, which facilitates the development of skilled labour in both economies. This increases the relative demand biased towards skilled workers internationally (skill-biased technical change), and decreases the demand and wages for the unskilled, leading to a higher wage inequality (Robbins, 1996, 2003; Berman and Machin, 2000, 2004; Acemoglu, 2003; Thoenig and Verdier, 2003; Goldberg and Pavcnik, 2004, 2007; Conte and Vivarelli, 2007). Therefore, if it is the case that the majority of women are unskilled, international trade may narrow the gender wage gap in countries with higher relative demand for unskilled workers but widen the gap in countries with higher relative demand for the skilled.

However, the hypothesis of skill-biased technical change does not seem to be able to explain the changing demand for different skilled workers in developed countries (Autor *et al.* (ALM hereafter), 2003; Black and Spitz-Oener, 2006, 2010; Spitz-Oener, 2006; Goos and Manning, 2007; Lindley, 2011). A more nuanced concept of tasked-biased technical change is hence developed, where technology polarises employment into high paid and low paid jobs, as the middle paid jobs are usually routine tasks and more easily substituted by computers, resulting in a rising wage inequality (*ibid*). The implications of tasked-biased technical change on gender wage inequality is less clear, as although there is a large proportion of women who have been hired in the middle level clerical jobs, there is also a great number of men working in the middle level production jobs. If it is the case that, compared to men, there is a higher share of women engaged in relatively supporting tasks, then a higher gender wage differential may be the outcome. In addition to these factors, the shift of economic structures towards the service sectors also has a great impact on the requirements from the labour force, which is found to benefit female workers more than male workers (Blau and Kahn, 1992; Murphy and Welch, 1993).

All the arguments above have suggested that, apart from the impact of globalisation and technical change, female labour market outcomes are strongly subject to their human capital accumulation and the jobs in which they work. Further motivations for this research in relation to these points will be discussed in the following subsections.

1.2.2 Human Capital Accumulation and Labour Market Segmentation

Several thoughts have been put forward by Human Capital Theory (e.g. Mincer, 1958; Becker, 1964) on why women do not do as well as men in the labour market: women hold lower necessary educational credentials than men; women have different job preferences than men; and women have lower work experience accumulation than men. Early development of this theory concentrated on the years of schooling or on the accomplishment of a degree, yet as it has been found in many countries that the share of higher-educated women has reached the same or surpassed that of men. Besides, it has also been noted that a more highly educated female workforce does not necessarily lead to a narrower pay gap (Albrecht *et al.*, 2003; Kee, 2006; International Trade Union Confederation, 2008; Barón and Cobb-Clark, 2010; Tachibanaki, 2010). Albrecht *et al.* (2003), Kee (2006), and Barón and Cobb-Clark (2010) discover that educational differences do not have an impact on the gender differential at the top end of the wage distribution. Therefore, more recent research has then argued that the returns to education are more dependent on the subject/fields that the individual has studied, and that women are less likely to enrol in the fields which require mathematical skills which then pushes them away from higher paid, higher status jobs (Carrell *et al.*, 2010; Bertrand *et al.*, 2010).

As for job preferences, some argue that men would be more likely to pursue a job with the characteristics of higher income, job security, and better opportunities of advancement (Rowe and Snizek, 1995; Tolbert and Moen, 1998; Haveman and Beresford, 2012). While for women, as the majority are likely to work in lower positions than men even within the same occupation, they would then care more about a sense of accomplishment and shorter working hours (Kanter, 1977; Rowe and Snizek, 1995; Tolbert and Moen, 1998; Haveman and Beresford, 2012). Furthermore, women are inclined to have less of the work experience required to move up to higher job positions than men as they are more likely to face inevitable interruption in their careers due to family responsibilities such as bearing and raising children (Black *et al.*, 2008; Haveman and Beresford, 2012).

In terms of labour market segmentation, according to Piore's (1973) dual labour market theory, the market can be divided into a primary labour market and a subordinate labour market. The primary labour market provides so-called better jobs, which gives more on-the-job training, more opportunity of promotion, higher wages, and lower turnover rates, with a stable structure. On the other hand, a subordinate labour market provides an unfavourable environment for workers with a lack of promotion opportunities, lower wages and higher turnover rates. Piore (1973) believes the amount of wages depends on which market workers are in, and the markets are based on the different industrial structures.

The implications of this theory suggest a higher gender wage differential if more women are engaged in the subordinate labour market, which is very likely the case, as there is a vast amount of women in part-time employment in order to balance their work and family life. Moreover, a wider gender wage gap would be found if the majority of women are segregated into lower skilled jobs which are thought more suitable (e.g. cleaning, caring, clerical), while a large proportion of men are in the higher level jobs (e.g. professional, engineers, managers). This is referred to as horizontal occupational segregation and usually comes with gender stereotypes (Becker, 1971). On the other hand, occupational segregation can be vertically, which refers to the hierarchy within occupations. That is, women are situated at lower positions than men within the same job, and watch their male counterparts surpass them on the way to the top positions (Charles, 2003). It usually comes with the term 'glass ceiling', which describes the phenomenon whereby women face a barrier to further progression in their career once they have reached a certain level.

1.2.3 Institutional and Cultural Constraints

Many studies have found that the enactment of gender-specific policies will have positive implications on female relative labour market outcomes (Kee, 2006; Manning, 2006; Barón and Cobb-Clark, 2010; World Economic Forum, 2013). The World Economic Forum (2013) suggests that generous gender policies and day care provision is one of the most important reasons for the significantly better female labour market outcomes together with a relatively higher birth rate in the Nordic countries compared to other OECD countries. Yet generous policies may have a negative effect on the outcomes if women are penalised by the longer period out of labour force, and which is more harmful for top ranking women than those in the lower hierarchy Gupta *et al.* (2006).

In addition, the social norms and the cultural background of a country would have strong impacts on female decision making in both the labour market and their life. As mentioned above, the subject/field that individuals study may play an important role in explaining the persistent gender pay differentials. Some research suggests that women tend not to study mathematics and science not because they are unable to do so, but rather because of the influence of stereotypes which make them believe that they will not perform well in such fields (Corell, 2001, 2004; Nguyen and Ryan, 2008). Some evidence also suggests that women's educational attainment is susceptible to religious preferences (Dollar and Gatti, 1999), and traditional conventions in society (Becker, 1985; Tachibanaki, 2010).

Cultural differences also help explain the relatively lower work experience that women accumulate than men. With the typical thought that men are the breadwinners while women take care of the home and children, high-achieving women are more likely to leave higher managerial jobs for lower status jobs with greater flexibility, lower responsibility, and shorter working hours to find a balance between their work and family (Haveman and Beresford, 2012). This leads to their lower accumulation of experience and less opportunity to be promoted to higher level positions once they would like to fully return to the labour market.

1.3 Structure and Content of the Thesis

Chapters 2, 3, and 4 are empirically based research on three separate issues associated with the aims and objectives and motivations discussed above. Chapter 5 will conclude the thesis by giving a summary of the results, and discussing their implications, as well as providing suggestions for further analysis.

1.3.1 Chapter 2

The analysis in Chapter 2 examines the changes in the unexplained portion of the gender wage gap across a broad range of countries, and investigates how much of the variation can be explained by trade globalisation and cultural differences. The motivation behind this analysis is firstly driven by the fact that recent research has found limitations in the widely used variables included in explaining the persistent pay gap between men and women. Thus, the first aim of this chapter is to discuss the explanatory power of a number of factors typically considered in the estimation of gender wage gaps, such as human capital accumulation, type of data used, method of estimation, measures of wage, and other variables in relation to workers' characteristics. This research is further motivated by the fact that it has been found that the changing economic structure as well as trade competition have a positive impact on gender equality in the labour market (Blau and Kahn, 1992; Murphy and Welch, 1993; Garrett, 2001; Oostendorp, 2009; Bussmann, 2009) though it may reach the opposite result if increasing female employment is concentrated in lower status jobs (Blau and Kahn, 2003; Menon and Rodger, 2009). The chapter investigates how trade openness helps to explain the variation in the gender wage residual across countries at different income levels and development status. The effects of trade throughout different sectors are also considered. Additional motivation is provided by the impact of social norms, in particular, whether a higher share of female politicians is associated with lower gender differentials, and how this effect is changing in countries with different social norms.

The analysis in this chapter uses meta-regression analysis (MRA) with a set of constructed meta-data in order to reveal the variations in estimated gender wage differentials across different empirical papers, countries, and over time. The chapter helps to inform whether international trade and cultural differences have any significant explanatory power on the wage residual.

1.3.2 Chapter 3

Chapter 3 explores the changes in Japanese regular/non-regular employment between male and female workers and the effect of technical development on the changes in the distribution of employment over time. The first motivation behind this analysis is driven by the fact that women seem to face more difficulties in the Japanese labour market than in other developed countries owing to the unique labour market structure and social conventions. Over the course of the long term recession in Japan, together with the advocacy of lifetime employment, a dual labour force, with the shrinking of regular employment (primary), and the expansion of non-regular employment (subordinate), has been found to be more pronounced in Japan since the 1990s. Without appropriate government policy and the protection of trades unions, the rights of non-regular employees have been largely ignored, and their wages are considerably lower than the wages of regular employees. This labour market dualism increases the income and social security gap between male and female workers, as women dominate non-regular employment.

The existence of job polarisation alongside rising wage inequality as a consequence of the development of technology found in Western economies has additionally motivated this research. A hypothesis of task biased technical change (TBTC) proposed by Autor *et al.* (ALM) (2003) argues that technology has replaced the routine tasks which are situated in the middle of the wage and skill distributions, and has been associated with an increase in relative demand for well-paid skilled jobs and also for low-paid least skilled jobs. If this hypothesis also holds true in the case of Japan, it may push women into a worse situation in the labour market, as the majority of women are employed in routine clerical jobs, given the strong stereotypes in the society. The aim of this chapter is to understand how regular and non-regular employment has been changing differently for male and female workers over time, and to discover the within industry relationship between workers' characteristics changes and technical change.

The analysis uses the Japanese Employment Status Survey and EU KLEMS data in order to investigate the changes in Japanese regular/non-regular employment between male and female workers associated with the technical development over time. Following the ALM model, decomposition and regression methods are employed to analyse the within and between industry relationship between technical change and

Japanese workers' characteristics changes on the one hand, and the changes in the gender regular/non-regular employment gap on the other.

1.3.3 Chapter 4

Chapter 4 investigates how female relative pay at the top end of the pay distribution in Britain has evolved with respect to different labour market sectors, occupations, and different cohort groups, both within cohorts over their lifetime, and across cohorts. The analysis in this chapter is firstly motivated by the fact that the existence of a glass ceiling has been well discussed in empirical research, yet the information on where the glass ceiling locates and how it has been changing over time has remained unclear. Further motivation is provided by the large amount of evidence that the gender differential at mean wages for younger birth cohorts is lower than for older cohorts, but there is a lack of information on the link between the cohort effect and the gender gap at other points of the wage distribution. The analysis is also motivated by the fact that women may not face only one glass ceiling over the entire wage distribution or in managerial positions, but multiple glass ceilings at different job levels as well as different and shifting patterns across the public and the private sectors. Therefore, the main idea of this chapter is to estimate how female relative pay in the top decile of the UK wage distribution has varied over time in relation to different labour market sectors, occupations, and cohort groups. It will also investigate how female workers' characteristics are associated with the changes in the location of the glass ceilings.

This analysis draws upon two data sources: the New Earnings Survey (NES)/Annual Survey of Hours and Earnings (ASHE) is used to implement cohort analysis to explore the shifting patterns of the glass ceiling in different sectors and occupations for different cohort groups by individual level; the Labour Force Surveys serve as a supplement with the demographic data for the multivariate analysis at occupational levels. A cohort analysis is conducted to study the behaviour of lifecycle earnings/glass ceilings profiles, to find out whether the changing pattern of female relative pay at the 90^{th} percentile of wage distribution is similar to the pattern at the average. Regression at both individual and occupational levels helps discover the effect of female worker's characteristics, the place she works, the occupation she is in, and the qualification she holds on the top female relative pay.

1.4 Conclusion

The underlying theme of the thesis is that women's position in the labour market is not being fully captured by the analyses that focus solely on changes in average wages. Therefore, this thesis explores the variation of remaining unexplained differences in average wages (Chapter 2), of employment and job quality (regular/non-regular) (Chapter 3), and at other points in the wage distribution. In this way, it is expected to obtain a fuller description of women's position in the labour market and how this has changed over time. The final chapter of thesis will then conclude by summing up the findings and discussing the implications.

2 The Impact of Trade and Culture on the International Gender Wage Gap

Summary

- Using meta regression analysis (MRA) with a set of constructed meta-data, this chapter is interested in the variations of the gender wage differential in terms of the unexplained portion (gender 'discrimination') across different empirical studies, a broad range of countries, and over the period of 1963 to 2007.

- The effects of trade globalisation and cultural differences on gender 'discrimination' are also examined across different income levels and development regions.

- The findings of this chapter indicate that the overall effects of both trade and female politician are associated with lower gender 'discrimination', however, different patterns are observed across different economies and regions.

- Trade openness together with the diffusion of technology reduces the gender wage gap for countries in the higher and the bottom income categories, but increases the gap in lower-middle groups, with some weak evidence that the trade effect is stronger in low income, and developing countries.

- Female politicians seem to find more difficulty to help women to improve their work environment in countries with strong social conventions towards gender roles.

2.1 Introduction

Female relative labour market outcomes have been extensively investigated over the past decades. Of these, the Blinder−Oaxaca decomposition (Blinder 1973; Oaxaca 1973) is one of the methods applied the most, which divides the gender wage differential into an "explained" and an "unexplained" portion. The former accounts for the part of the gender differential due to productivity characteristics (the endowments effect), the latter captures the potential effects of any differences in unobserved factors between men and women. In addition, the unexplained part of the differential may not be due to differences in characteristics between men and women at all, but be due to gender wage discrimination (as is often referred to as the discrimination component. The cumulative evidence of the empirical literature suggests that the magnitude of the unexplained portion of the gender gap (the 'discrimination') is strongly subject to the setting of the wage estimating models, such as the inclusion of workers' productivity characteristics, the type of data used, or the econometric approaches (Stanley and Jarrell, 1998; Weichselbaumer and Winter-Ebmer, 2003, 2005). However, the explanatory power of these factors has been found to be limited for the recent studies (Weichselbaumer and Winter-Ebmer, 2003, 2005).

Therefore, this chapter aims to determine and quantify the important factors which cause the constant residual gap, and can explain the variation of gender 'discrimination' across a broad range of countries in both economic and sociological fields. The analysis in this chapter will focus on demonstrating the effects of trade globalisation, the changing economic structure, cultural difference, and the democratic system on the changes in the unexplained gender wage gap, rather than the female personal development of their working skills.

In terms of trade liberalisation, the standard trade theory, the Heckscher−Ohlin (H−O) model together with the Stolper-Samuelson (SS) theorem, proposes that an increase in trade openness in a developing country where unskilled labour is abundant will increase the relative demand and wage for unskilled workers and result in a lower within-country income inequality (Stolper and Samuelson, 1941; IMF, 2007). However, the empirical research has found conflicting evidence against these theorems in particular for the middle income countries (Davis, 1996; Feenstra and Hanson, 1996; Xu, 2003; Milanovic, 2005), as these countries may be seen as unskilled intensive in the view of developed countries, but would be relatively skill intensive compared to lower income countries. Moreover, the use of technology would be widespread from developed to developing economies via the expansion of trade, which improves the skills in the developing economies to a more advanced level and hence lead to the relative demand for workers biased toward the skilled internationally, resulting in a decrease in demand and prices for unskilled workers and a rising wage inequality. Thus, trade liberalisation together with the diffusion of technology may widen the gender pay gap in countries where the majority of women are relatively lower skilled, which is very likely the case in the developing economies.

As for theories of gender discrimination coupled with trade globalisation, conflicting theories have been proposed. Becker's (1971) theory argues that increased industrial competitiveness from international trade will reduce wage discrimination in the long run. Firms in a competitive market will be under pressure to cut costs, including costs associated with discrimination. On the contrary, the other school of thought is that an increase in trade competition may reduce discrimination in certain groups of industries but raise it in others. It may weaken women's bargaining power if they are segregated into lower waged or lower status jobs (Darity and Williams, 1985; Williams, 1987).

Women could benefit from an increase in international trade at both macro and micro levels. At the macro level, international trade is not only an important source of income for governments but also compels them to invest in public goods such as infrastructure, education, and health services to increase their competitiveness in the global market. This would reduce the gender differential of human capital investment, and then narrow the gender wage gap (Garrett, 2001; Oostendorp, 2009; Bussmann, 2009). As for the micro level, women could benefit from the boost of export industries with more job opportunities. An increase in female labour force participation could lead to a narrowed gender wage gap (Bussmann, 2009). However, it may lead to the opposite outcome if the increased employment for women is mainly in low paid and low skilled jobs (Blau and Kahn, 2003; Menon and Rodger, 2009).

Drawing upon a broader socio-economic analysis, the changing effects of social norms and cultural differences will also be considered. These are regarded as important factors because they would show the perceptions of appropriate gender roles in societies, which are closely related to the gender division of labour. Societal convention may affect female decisions in human capital investment, their attitude towards career and family commitments, with some women maybe self-selecting into lower status jobs for child-bearing or household responsibilities in order to meet social expectations (Dollar and Gatti, 1999; Fernández, 2007, 2008, 2011; Haveman and Beresford, 2012).

Most empirical research has focused on how much the degree of gender discrimination has changed in the labour market, rather than attempt to explain why it has changed. In order to investigate how the magnitude of the gender wage gap is subject to the measure of wages utilised, the use of different estimation techniques, and the inclusion or exclusion of specific explanatory variables, this chapter adopts the meta-analysis approach to explain the variations in the reported gap from one study to the next across countries. This approach can also help explore how much of the variation in the gender differential can be explained by trade globalisation and cultural differences. Unlike recent studies into the effect of trade on gender gaps that have only focussed on the manufacturing sector, such effects across different sectors will be taken into account, with a concern that many economies have shifted away from agriculture and toward manufacturing and service sectors. Moreover, the interactive effects between international trade/culture and different economies will also be investigated.

The next section of the chapter presents the existing empirical findings relating to the impact of trade globalisation and cultural differences on the gender wage gap. Section 2.3 explains the conceptual framework of the meta-analysis and the construction of the meta-data, Section 2.4 describes the methodology used to estimate the effects of trade and culture on the gender gap. Sections 2.5 and 2.6 present the results by using meta-analysis regression techniques to examine how trade globalisation and cultural differences can impact on the gender wage gap, and whether such effects act differently across countries with different social norms, at different income levels, and at different stages of development. The final section concludes.

2.2 Literature Review

2.2.1 The Effect of Trade Globalisation on Gender Wage Inequality

According to the IMF (2007), world trade in real terms has risen five fold from 1980 to 2005, and its share of world GDP has increased by almost 20 percent to 55 percent. Figure 2.1 provides more information on the changes in trade globalisation between 1965 and 2008 for 190 countries by stage of development, measured as the trade share of GDP in constant 2000 US dollars[4]. It can be seen that the trade openness for Newly Industrialized Asian Economics (NIEs) has far exceeded other groups. This group includes some typical export oriented countries: Hong Kong, Singapore, South Korea, and Taiwan, with trade accounting for more than 200% of their national GDP in the 2000s. Despite that, the trends of opening trade for some other economies are also significant. As former Eastern bloc economies joined the international trading market and as developing Asia progressively tore down barriers to trade, their trade openness has increased considerably since the 1990s. It is worth noting that trade openness in developing economies has been catching up with or exceeding that in advanced economies, reflecting the fact that the trade regimes of emerging markets and developing countries have moved on to more open trading systems than in advanced economies (IMF, 2007).

The integration of the world economy and its benefit for economic growth has often been addressed in the literature. Due to trade openness, countries are able to focus on making products (and services) for export with relatively lower costs, and on importing products from another country with much cheaper costs. National output and real income will then be increased as industries can reach higher productivity by allocating resources efficiently (Bussmann, 2009; Menon and Rodger, 2009).

The standard trade theory, the Heckscher−Ohlin (H−O) model coupled with the Stolper−Samuelson (SS) theorem, predicts that international trade would benefit economies for their abundant factors of production. An increase in trade openness

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[4] The plots for the changes in the ratios of import penetration and exports to GDP can be seen in Appendix Figure 2.5 and 2.6.

in a developing country in which unskilled labour is relatively abundant would raise the relative demand and compensation for unskilled workers and lead to a decrease in within-country income inequality (Stolper and Samuelson, 1941; IMF, 2007). Yet it may lead to the opposite conclusion in a developed economy where high-skilled factors are relatively abundant, higher inequality would be observed. Both the H−O and the SS theoretical frameworks have been criticised extensively for their restrictive and unrealistic assumptions. For instance, the model is based upon perfect competition, with constant returns to scale, within countries but not international labour and capital mobility, identical production functions with fixed-shared technology across countries, etc (Elson *et al.*, 2007; IMF, 2007; Bussmann, 2009).

Moreover, the implications of both the theorems have generally not been verified in the empirical research, especially for the effects of international trade on wage inequality in developing countries (Davis, 1996; Feenstra and Hanson, 1996; Xu, 2003; Milanovic, 2005). Thus, to explain the rise in skill premium between skilled and unskilled workers in some developing countries has been a particular challenge. A developing country which has been seen as unskilled abundant from a global point of view might be considered relatively skill abundant compared to other developing countries (Davis, 1996). This is very likely to be the case for middle income countries. Middle income countries face strong competition in low skill intensity sectors from lower-waged, unskilled abundant low income countries, and in high skill intensity sectors from developed countries, leading to the contraction of both sectors and hence a declining relative demand and prices for unskilled workers as well as a higher wage inequality (Feenstra and Hanson, 1996; Xu, 2003).

In addition to trade openness, the development of technology also plays an important role in explaining the changes in demand for labour and in wage inequality for both the advanced and the developing economies. International trade facilitates the spread of technology from advanced to developing countries, leading to an increase in higher skilled workers in developing countries. Advanced economies upgrade their skills to reduce the threat of imitation from other countries. This leads to a rising relative demand biased toward skilled workers internationally (skill-biased technical change, SBTC) together with a falling demand and wage for the unskilled, and hence an increase in wage inequality (Robbins, 1996, 2003; Berman and Machin, 2000, 2004; Acemoglu, 2003; Thoenig and Verdier, 2003; Goldberg and Pavcnik, 2004, 2007; Conte and Vivarelli, 2007). The implications of these theories on the gender pay gap would be that if the majority of women engage in lower status, unskilled jobs, greater openness might decrease the gender differential in countries with larger demand for unskilled workers (e.g. perhaps low income groups) but increase the differential in countries with a rising demand for skilled workers.

As for the theories of labour market discrimination combined with trade globalisation, the neoclassical approach (Becker, 1971) argues that trade expansion will lead to increasing competitive pressure in the product market, thus discrimination against women or minorities becomes more costly to employers and could not persist in the long run. This implies that employers with market power who have a taste for discrimination would be better able to practice the taste than those operating in a competitive market. In this case the changes in market power would lead to changes in wages and employment for those who were initially discriminated against, and increased competition from international trade is thus supposed to reduce wage differentials between women and men over time. In contrast, non-neoclassical theory (Darity and Williams, 1985; Williams, 1987) contends that discrimination would persist in a competitive economy, as an increase in trade competition may reduce discrimination in certain groups of industries but raise it in others. Gender wage inequality may widen in countries where women have weaker bargaining power and are assigned to lower paid or lower status jobs.

Considering there may be some simultaneous events, which are unrelated to participation in international markets, that would contribute to an increase in trade competition, many studies estimate the effects of trade openness on gender pay discrimination by comparing the residual wage gap in more concentrated industries to less concentrated (competitive) industries to avoid results being distorted (Berik *et al.*, 2004; Black and Brainerd, 2004). It is argued that firms operating in relatively concentrated industries will be facing less domestic competition, hence any observed decrease in discrimination against women in such industries should be ascribed to the international competitiveness rather than to domestic pressure.

Using data for US manufacturing industries, Black and Brainerd (2004) find evidence to support this hypothesis that the residual wage gap was narrowed more rapidly in concentrated industries than in competitive industries by import penetration between 1976 and 1993. In the case of Mexico, Artecona and Cunningham (2002) demonstrate that trade liberalisation widens the gender wage gap in the manufacturing sector, which is ascribed to general movements in the economy over trade reform and raised premiums to skills. Yet a narrower gap is observed after eliminating these two effects from the sample, particularly in those industries that were compelled to be more competitive. Similarly, focusing on urban Mexico, Hazarika and Otero (2004) discover a positive relationship between competition from foreign trade in the product market and lower gender discrimination.

At the international level, Weichselbaumer and Winter-Ebmer (2007) adopt the Economic Freedom Index to examine the impact of competition on the residual gender wage gap across 62 countries. The findings are in line with Becker's model, illustrating an increase in competition leading to a decrease in the gender wage differential, whereas it is also noted that the residual gap can be constrained as well as boosted by market orientation. Oostendorp (2009) studies cross-country differences in the effects of globalisation on occupational gender pay differentials by using FDI net flows and the trade to GDP ratio as competition indicators, and finds that an increase in trade is associated with a narrowed residual gap within low-skill occupations, while this effect within high-skill occupations can only be proved in richer countries.

On the contrary, Berik *et al.* (2004) discover the opposite result for Taiwan and Korea in the 1980s to 1990s, that increasing competition from international trade in concentrated industries is significantly associated with increased discrimination against female workers. Similar evidence from India (Menon and Rodgers, 2009) suggests that increased trade openness in concentrated manufacturing industries results in a larger residual gender pay differential from 1983 to 2004. In another study, about the effects of market forces and sex discrimination in the United States, Hellerstein *et al.* (2002) find there is a positive relationship between profitability and the proportion of female employees at firm level. It indicates that those plants with higher market power tend to hire more women leading to higher profitability. This result is consistent with Becker's model that the employers with higher market power are more able to practice discrimination. However, there is no evidence found whether market power reduces discrimination by the penalty of lower growth for being discriminatory.

Economic integration could also influence the requirements from the labour force. Several academic researchers indicate that the shift of economic structures towards the service sectors benefits female workers more than male workers. Owing to innate ability, women are unable to reach the same productivity as men in labour-intensive industries, resulting in a rising gender wage inequality. However, the expansion of service sectors may increase female competitiveness to male workers, as less physical strength is required and women would have a comparative advantage even in unskilled nursing or servicing jobs (Fan and Lui, 2003). Blau and Kahn (1992) show that a decrease in the demand for employees in manufacturing is one of the critical factors reducing the gender gap by examining different countries along with different economic structures. Murphy and Welch (1993) also find evidence to support this theory; the economy moving away from manufacturing to the service sectors in the United States having a positive influence on relative women's earnings during $1964 - 1988$.

2.2.2 The Effect of Culture on Gender Wage Inequality

Due possibly to the difficulty of finding an efficient method to identify the separate influences of the economic and institutional environment from those of culture, the effect of culture on economic outcomes was largely ignored for a long period in economic literature. More recently, several new approaches have been put forward to investigate what role social attitudes and beliefs (the culture) have played in explaining the changes in economic outcomes across different countries, social groups, and over time (Fernández, 2011)[5]. For instance, some provide experimental results of examining the differences in the behaviour of playing different strategies in games when individuals are from different social groups (Henrich *et al.*, 2001). In addition, a great portion of evidence is provided following the epidemiological approach, which

[5] Fernández (2011) provides a series of literature reviews on culture and economics.

is used to distinguish the effects of culture from those of environment on economic outcomes for individuals in the same economic and institutional setting, but whose cultural backgrounds are potentially different (Fernández, 2007, 2008).

The differences in the distribution of social preferences and beliefs have a non-negligible impact on female labour market outcomes. Limited by family or social expectations, women encounter more difficulties in their career progression; they often face career interruption as a result of child-bearing or household responsibilities and are generally under-represented in supervisory roles and in managerial occupations which thereby affects their earnings. The findings of Fernández and Fogli (2009) indicate that countries which possess a more traditional view of female roles are more likely associated with lower female workforce participation and higher fertility[6]. Alesina *et al.* (2010) discover a negative relationship between the strength of family ties and labour market outcomes, where individuals from a more family-focused background are less willing to move away from family to take advantage of job opportunities.

Social conventions could also have a great impact on female educational investment. Becker (1985) points out that the traditional thinking of the female as having household responsibilities reduces their willingness to invest in education. This then decreases their productivity and wages. According to IMF (2007), although female educational participation has shown a positive trend all over the world, it is with great variation across countries. Some indicate that a part of the differential in the investment in education between men and women may be explained by religious preferences rather than the choice of economic efficiency (Dollar and Gatti, 1999).

[6] However, this may make more and more women unwilling to start a family and have children. (Haworth, 2013).

Alesina and Giuliano (2007) find a lower ratio of girls to boys in tertiary education in response to stronger family ties. In addition, it has also been noted that a more highly educated female workforce does not necessarily lead to a narrower pay gap (Albrecht *et al.*, 2003; Kee, 2006; International Trade Union Confederation, 2008; Barón and Cobb-Clark, 2010; Tachibanaki, 2010). Albrecht *et al.* (2003), Kee (2006), and Barón and Cobb-Clark (2010) discover that educational differences do not have an impact on the gender differential at the top end of the wage distribution. Tachibanaki (2010) states that, following the traditional convention, some Japanese women graduating from elite universities may give up a much better job offer at a smaller firm but self-select into a low-level clerical job in a prestigious company, as it gives them a better chance to find a better qualified husband.

Against this background, this chapter is interested in discovering how the changes in the development of social openness will lead the changes in the gender wage residual. To demonstrate this point, the analysis uses the share of women in the national parliament as a proxy. Given the fact that the cultural or the social differences are difficult to measure, this proxy allows the research to have a quantitative measure on such issues, and to see the differences in empowerment of women across countries. Elections are one very important channel for people to express their preferences. Societal preferences would not be accurately voiced while participation of female politicians is limited or non-existent, leading to the under-provision of public goods (e.g. female education opportunities, health care) or sufficient gender- specific policies in the labour market (Brown, 2004). Countries where more women hold positions in the national parliament could therefore be seen as more democratic and as a proxy for societal constraints on women, since those women are not only better able to promote policies for female rights but also serve as role models for other women.

However, although the share of women in the national parliament can provide good information about the social openness across countries, some issues still need to be borne in mind by adopting this estimator. One of the concerns is that this estimator is not actually a continuous variable over time due to the cycle of elections. Besides, the power of individual female politicians may vary significantly due to the position each of them hold, for instance, those who are in the cabinet or senior positions may be more able to address gender issues. For a discussion of the representativeness of politicians in the UK, see Durose *et al.* (2011).

Figure 2.2 and Figure 2.3 shows how the proportion of females in national parliaments has evolved over time across different economic and cultural regions/groups of countries. Overall, the recruitment of female politicians has accelerated since the 1990s in most countries apart from CEE (post-communist countries in Central and Eastern Europe). A dramatic decrease in the share of female politicians in CEE countries could be partly attributed to the introduction of market reforms and partly to the disintegration of communism since 1989. It is not very surprising that there was a quite high proportion of seats in their parliaments held by women in communist countries, as these countries have a commitment to secure gender equality in the labour market (Brainerd, 2000), and their governments offered higher minimum wages, generous maternity benefits and day care centres which inspired women to work.

However, those counties in the Confucianism group have considerably lower proportions of females in national parliament, even though they are all developed and high income countries: Japan, South Korea, Singapore, and Taiwan. East Asian societies are strongly influenced by Confucianism, whereby people deem that the male plays a higher role than the female in any given situation. This occurs in politics, public policy, labour market, son preference, and even in sex-selective abortions (Almond *et al.*, 2009; Chun and Gupta, 2009). Women have always been seen as followers in the Confucian society; following their father in childhood, their husband in marriage and their son in widowhood. One of the more important responsibilities they have is to produce a son for the family. Since a female is not able to continue the lineage, nor to perform ancestral rites, she is an outsider of the family as soon as she leaves home at marriage. Due to this traditional convention, women have often been considered a subordinate class in society (Chun and Gupta, 2009).

Recent empirical literature on the relationship between trade globalisation and gender inequality has mainly focussed on the manufacturing industries, either on the manufacturing trade effect on the total gender gap or on the effect of trade openness on the manufacturing gender gap. Most of them have only taken into account the overall trade effect while ignoring such effects at sectoral levels. Since the economic structures of many countries have moved away from agriculture toward manufacturing and service sectors following the development of the economy, it is of both practical and academic interest to discover how the pay differential is influenced by the trade from different sectors. Therefore, the analysis in this chapter will discuss the link between the impact of overall and sectoral trade openness on gender earnings inequality, and also investigate the differences in such effects on countries at different income levels and developing status.

With respect to cultural differences, the particular changing pattern in cultural backgrounds and political regimes observed from Figure 2.3 raises a question: what role do the social attitudes and beliefs play in explaining the variation in gender wage differentials across countries, developing regions, and over time? Does Communism contribute to a decrease in the gender pay gap but Confucianism to an increase in the gap?

Two stages of analysis will be implemented in this chapter. The first stage of estimation focuses on discussing what factors have played important roles in explaining the variation in the gender wage gap from the published empirical literature by using meta-analysis. The following section will investigate the changes in the gap when the effects of trade globalisation and cultural differences have been introduced.

2.3 Research Framework for Meta-Analysis

Meta-analysis is a means to amass and assess previously obtained research results in a specific field. It offers a helpful structure providing a systematic review to quantitatively summarise and evaluate the literature on a given topic. It not only combines the results of a set of studies, but examines whether the variation of estimates is more than expected due to different sampling, and accentuates the practical effect rather than the statistical significance of single studies. The meta-analysis approach started as a tool of combining and summarising the results of several experiments which has been widely practiced in medicine and biological sciences. In the field of economics, meta-regression analysis (MRA) has been designed to assess a series of nonexperimental publications (Stanley and Jarrell, 1998). It is a meta-analytic technique to explain the variations of reported estimates from one study to the next using a regression model.

The research framework for this chapter is based upon the studies from Weichselbaumer and Winter-Ebmer (2003, 2005), which examine the international gender wage gap and were an extension of the Stanley and Jarrell (1998) study that only focuses on the US data.

Stanley and Jarrell (1998) set up some rules for the inclusion of studies into their sample, such as the studies must present estimation of the US gender wage gap by using a broad range of national data, and the estimated results must be from a regression analysis. The MRA is adopted without a specific weighting scheme involved, and only 12 factors[7] are included. The MRA results are statistically significant for almost all the coefficients with more than 80 percent of the variation explained by the model.

On the other hand, Weichselbaumer and Winter-Ebmer (2003, 2005) look at the changes in the international gender wage gap across 62 countries, with many more identified factors[8] included and a specific weighting scheme[9] was used to correct for possible bias derived from the problem of biased sampling used with a concern to the quality of the studies. In addition to these concerns, the effects of unobserved characteristics, such as institutional factors, across countries may also be one of the factors for the different results in Weichselbaumer and Winter-Ebmer (2003, 2005) who find the effects of many estimators to be insignificant or inconsistent across different model specifications.

With an awareness that the lack of significance of the estimators will also be a concern for the analysis in this chapter, as the analysis will be based upon the data from Weichselbaumer and Winter-Ebmer (2003, 2005), suitably updated, a careful choice of model specifications with different econometric considerations will be discussed in the following sections.

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[7] The measure of wage, whether dummy variable for sex is used, whether studies control for selection bias, the omission of workers characteristics, and the sex of the researcher

[8] Table 2.2 explains the estimates in detail.

[9] See Section 2.3.3 and 2.3.4 in more detail.

2.3.1 Estimating Gender Wage Differentials

The decomposition approach is commonly used to measure discrimination, in particular the one developed by Blinder (1973) and Oaxaca (1973). It divides the gender inequality into a measurable (explained) part and an immeasurable (unexplained) part. The measurable part can be identified and quantified by average group differences in observed variables/characteristics, such as age, education, and marital status. On the other hand, the unexplained portion, which is also called the residual portion, is often attributed to discrimination. If the inequality in the residual component is large, it may imply that labour market discrimination is relatively large.

Given two groups m (Male) and f (Female), a wage variable W, and a set of control variables, to measure the mean wage differences as follows:

$$Gap = E\left(W_m\right) - E\left(W_f\right) \tag{2.1}$$

where $E\left(W\right)$ is the expected value of the wage variable, calculated by group differences in the control variables. Based on the wage regression equation:

$$W_{gi} = \beta_g X_{gi} + \varepsilon_{gi} \tag{2.2}$$

where $g = (m,\ f)$ denotes male and female workers respectively. W_{gi} is the natural logarithm of earnings and X_{gi} are observable characteristics of an individual i in group g. β_g is a vector of coefficients. ε_{gi} is a disturbance term.

Some suggest that a set of non-discriminatory coefficients should also be taken into account for estimating the contribution of male and female differences in control variables to the overall wage differences (Oaxaca, 1973; Reimers, 1983; Cotton, 1988;

Neumark, 1988). Let β^* be such a vector of non-discriminatory coefficients, Equation 2.1 can then be rewritten as (Jann, 2008):

$$Gap = \left[E\left(X_m\right) - E\left(X_f\right)\right]' \beta^* + \left[E\left(X_m\right)' \left(\beta_m - \beta^*\right) + E\left(X_f\right)' \left(\beta^* - \beta_f\right)\right] \tag{2.3}$$

The first term on the right hand side represents, the explained portion, the contribution that the differences in endowments make to the gender pay gap. The second term is the unexplained/residual portion that captures the potential effects of differences in unobserved factors and is usually referred to as the magnitude of gender wage discrimination.

Furthermore, there may be a case to assume that discrimination is directed solely against one of the groups, thus $\beta^* = \beta_m$ or $\beta^* = \beta_f$ (Oaxaca 1973). If, for instance, there is no wage discrimination of men but discrimination is only directed towards women, then adopting $\hat{\beta_m}$ as an estimate for β^*, the group means $\overline{X}_m$ and $\overline{X}_f$ for $E\left(X_m\right)$ and $E\left(X_f\right)$, and $\overline{W}_m$ and $\overline{W}_f$ for $E\left(W_m\right)$ and $E\left(W_f\right)$, Equation 2.3 can be arranged as (Oaxaca, 1973; Weichselbaumer and Winter-Ebmer, 2003, 2005; Jann, 2008):

$$G\hat{A}P = \overline{W}_m - \overline{W}_f = \left(\overline{X}_m - \overline{X}_f\right)' \hat{\beta}_m + \overline{X}_f' \left(\hat{\beta}_m - \hat{\beta}_f\right) \equiv Q + U \tag{2.4}$$

where Q is the explained portion and U is the unexplained portion.

And if wage discrimination is solely directed towards men but not on women, then the decomposition is

$$G\hat{A}P = \overline{W}_m - \overline{W}_f = \left(\overline{X}_m - \overline{X}_f\right)' \hat{\beta}_f + \overline{X}_m' \left(\hat{\beta}_m - \hat{\beta}_f\right) \equiv Q + U \tag{2.5}$$

However, it is not often there is a specific reason to assume that there is no discrimination for one or the other group. Some derivatives of the Blinder−Oaxaca decomposition are proposed.

Reimers (1983) adopts the average coefficients over male and female groups as an estimate for β^*, then

$$\hat{\beta}^* = 0.5\hat{\beta}_m - 0.5\hat{\beta}_f \tag{2.6}$$

Cotton (1988) proposes the use of group sizes n_m and n_f to weight β^*

$$\hat{\beta}^* = \frac{n_m}{n_m + n_f}\hat{\beta}_m - \frac{n_f}{n_m + n_f}\hat{\beta}_f \tag{2.7}$$

Neumark (1988) suggests the coefficients from a pooled regression to be an estimate for the non-discriminatory coefficients β^*. Furthermore, Brown *et al.* (1980) advocate the inclusion of the probability from a multinomial logit model of being in a certain occupation for the estimation of wage differentials.

Moving away from decompositions, another common approach to examine the gender differential is simply to introduce a sex dummy into an earnings regression equation:

$$W_i = \beta X_i + \gamma Sex_i + \varepsilon_i \tag{2.8}$$

where W_i is the natural logarithm of earnings. X_i is a vector of individual characteristics. β is a vector of coefficients, γ is the gender differential coefficient. ε_i is a disturbance term.

The meta-regression analysis (MRA) in this study includes all the published estimates of the gender wage differential examined by dummies (from Equation

2.8), residual gender gap (U from Equation 2.4 to 2.7) or the derivatives[10] of the Blinder−Oaxaca decomposition discussed above. These reported estimates are employed as the dependent variable in this MRA study, which are expected to be explained by the data set used in the respective papers, methods of estimation used, measures of wage used, gender of the authors, etc. Yet the reported gender wage differentials as well as the meta-wage residuals in the estimations are very likely suffering from some biases, as the perfect wage equation and data set remain unknown, some potentially important factors might have been omitted in the empirical studies.

2.3.2 Meta-Data

Part of the meta-data in this analysis were constructed by Weichselbaumer and Winter-Ebmer (2005) for those papers published in the period from the 1960s to the 1990s and a few in 2000[11]. Following Stanley and Jarrell (1998) and Weichselbaumer and Winter-Ebmer (2003, 2005), in October 2010, the author searched the Economic Literature Index (EconLit) for any reference to: "(wage* or salar* or earning*) and (discrimination or differen*) and (sex or gender)", and restricted the published year to be between 2000 and 2010. The empirical papers that only focus on theoretical discussions, or simply report the ratios of median or average wages without taking the effect of workers' characteristics into account were eliminated. Following this standard, 142 articles were finally qualified to be included in the meta-data analysis. Some papers might estimate the gender wage differential for various countries, regions, different sample of populations, period of time, etc.

[10] Brown *et al.*, 1980; Reimers, 1983; Cotton, 1988; and Neumark, 1988

[11] I would like to record my special thanks to Rudolf Winter-Ebmer and Doris Weichselbaumer for supplying their data

In this case, the empirical paper would then be split into different "studies" while the estimates were associated with different populations and periods of time. This process yielded 457 different studies from the 142 qualified articles. Moreover, if a paper reports several evaluations based upon the same sample of population and time period, all the evaluations were included and coded in this meta-data. Each specific estimate was treated as one observation. A total of 952 estimates were then created in this process, which accounts for 38 percent of the total data sample.

Adopting multiple estimates from a single study is a cause of concern: a problem of nonspherical errors is very likely to occur as multiple estimates based upon the same sample are not independent of each other. Besides, a study with more estimates would gain more weight if multiple estimates from one study are treated as different observations. These concerns will be further discussed in the following subsection. It has to be noted that the meta-data analysis suffers from sample selection biases, as those papers published in non English languages as well as unpublished papers for policy-making or from research institutes were not included. Table 2.1 summarises the distribution of the meta-dataset, which covers a time span from 1963 to 2007 (depending on the time of the original dataset collection rather than the date of publication of the paper). The sample in total contains 405 articles, which yield 2487 estimates, for the gender wage gap with identical characteristics in 84 countries. In the 1960s and the 1970s, the estimates are mainly conducted in America, but Europe has caught up with and surpassed America since the 1980s. With respect to income levels, the estimates for high income countries dominate over time especially for the 1960s.

A list of meta explanatory variables adopted in the analysis is given in Table 2.2. It depicts the original dataset was most frequently from surveys where the wage was usually not measured by hour, and that the majority of researchers employed the Blinder−Oaxaca decomposition or its derivatives, but with instrumental variables very unlikely to be employed. As for workers' characteristics, over 90% of researchers controlled for workers' job experience real or potential. However, there is very large proportion of estimates that failed to account for whether or not workers had children or on-the-job training, their union status, the share of women in their jobs, and the number of weeks they worked. This might be due possibly to the lack of availability of data for those individual characteristics.

Figure 2.4 presents the development of the reported total gender wage gap ($\overline{W}_m - \overline{W}_f$ in Equation 2.4 to 2.7) and reported residual gap (the unexplained portion U in Equation 2.4 to 2.7 of the decomposition approach or the estimated coefficienton the sex dummies in Equation 2.8) averaged at each time point over the period 1963-2007 together with 95% confidence intervals, based on the studies used in the meta analysis. It is clearly shown that the estimated total wage gap declines dramatically from over 65% in the 1960s in some studies to less than 30% after 1990, although the reported residual gap remains almost the same over time. This considerable decrease in the total gap can largely be explained by the self development of females through increased education and work experience. In addition, the confidence intervals indicate that the total wage gap is significantly higher than the residual gap in the 1960s, yet there is almost no significant difference between them after 1995. It also implies that the standard control variables, e.g. human capital, occupational segregation, and industrial segregation, provide limited explanations of the gender wage gap in recent times.

2.3.3 Meta-Regression Analysis

The employed meta-regression model in this analysis takes the following form (Weichselbaumer and Winter-Ebmer, 2005):

$$Gap_j = \beta_0 + \beta_1 Z_{kj} + \beta_2 t_{\tau j} + \beta_3 C_{ij} + \varepsilon_j \tag{2.9}$$

where

Gap_j is the natural logarithm of the gender wage residual of the j^{th} estimate, which comes from the unexplained portion U (Equation 2.4 to 2.7) in the decomposition approach or the estimated coefficient on the sex dummies (Equation 2.8).

Z_{kj} is a $n \times k$ matrix of meta explanatory variables.

$t_{\tau j}$ is a set of time dummies to show that the individual estimate j draws upon data in time τ.

C_{ij} is set of country dummies that the individual estimate j belongs to.

ε_j is the error term.

The set of meta explanatory variables are segregated into the selection of data set, the methodology of estimation, measure of wages, and control variables for omitted individual or workplace characteristics. To explain the results, the base category for the selection of data set is a random sample of the total population (as opposed to an estimate based on a restricted sample such as public sector only), and the base category for the control variables is the inclusion of the respective variables in the original regression (so the estimated results show the effect of omitting the respective variable relative to this base category of including it). Several issues have to be taken into account when using meta-analysis. Due to the approach relying heavily on published papers, one of the major weaknesses of meta-analysis is the 'file drawer problem'. It is not known how many unpublished papers and results have been conducted as most academic journals tend to only publish the significant results, which would then lead to a biased and skewed distribution of the outcomes as well as an overestimation of the significance of the published papers (Stanley, 2005). Yet, this concern is less problematic for this analysis, as gender wage differentials are usually examined by Blinder−Oaxaca decomposition, which does not rely on a significance test. Besides, as it has been largely accepted that a gender wage gap exists, a study observing no bias or a reverse effect is actually more likely to be published (Stanley and Jarrell, 1998).

Another severe weakness of meta techniques is that some studies are conducted under certain expectations to achieve political, economic, or social goals. This "Pygmalion effect would then abuse and bias the true effect size. In the field of gender inequality, one might suspect that female authors are inclined to be generous with the result of higher estimated gaps as they might have experienced discrimination on a personal basis (Stanley and Jarrell, 1998). The gender of author thus is adopted to examine and control for this possible bias in this study (Stanley and Jarrell, 1998; Weichselbaumer and Winter-Ebmer, 2003, 2005). In addition, an issue remaining is that different researchers might have used different methods to examine the data which is the same or very much alike, producing a lack of independence of the data points, although there is no clear scheme to correct this bias. These drawbacks will hence be considered when interpreting the results of this analysis.

2.3.4 Econometric Considerations for MRA

Study quality is the primary cause for concern in meta-analysis. With a concern that some data points are conducted by the same study therefore producing non-spherical standard errors, a clustering approach, defined on the ID of studies, is applied to all specifications to correct for the possible biases in the precision of the estimates. A weighting scheme is also developed to cope with the issue of the lack of independence of the estimates. One of the weighting approaches is the inverse of the number of estimates conducted by a single study, which thereby takes into consideration that an individual study with more estimates would otherwise be given more weight than the one with fewer estimates. Another method, the inverse of the coefficient of variation among the estimates within one study, gives more weight to those studies that provide less variation in results across specifications, as a study is seen as more reliable if the same result is reached by different specifications. Yet the difference between estimating approaches might not be properly identified, as the different estimates within the same study are treated alike under this weighting method. A preferred approach would be the typical weighting that takes the precision of the estimate (the standard error) as a quality indicator. Although the t-statistics are not available as the majority of reported gender gaps are estimated by Blinder−Oaxaca decomposition, the square root of the degrees of freedom is instead employed as a proxy. Note that many meta analyses may use the ranking of journals to control for the quality of the publication. Yet this weighting approach is not adopted in this analysis as it may drop a high proportion of observations due to the inclusion of a large number of books and working papers. With concern about this issue, the Fixed Effects model will hence also be employed in the further analysis, to control for the specific effect of individual published papers.

2.4 Estimating the Effects of Trade Globalisation and Culture on the Gender Pay Gap

2.4.1 Data

The data for trade globalisation are from various sources, with the majority from the World Bank's World Development Indicators database (September 2010). Trade openness is the sum of exports and imports of goods and services measured as a share of gross domestic product. Imports, exports, and sectoral trade data on agriculture, manufacturing and services are also expressed as a ratio to GDP. All the trade related variables are treated as natural logarithms as the distributions are typically skewed. The women in parliaments variable is the percentage of parliamentary seats in a single or lower chamber held by women. The data are from the World Bank's World Development Indicators database (September 2010) and Women's Indicators and Statistics database (www.ipu.org).

The classification by income level is from the World Bank's World Development Indicators database (September 2010). The countries are divided into income groups: low, lower-middle, upper-middle, and high income according to gross national income (GNI) per capita in the period $1987-2007$, calculated using the World Bank Altas method. Note that the data for the current level of income classifications are only available from 1987 onwards, so those before 1987 are arranged to the 1987 categories. Hence, a robustness check on a restricted sample for the period $1987 - 2007$ will be implemented for the models including income level indicators. The category of developing status is from the World Economic Outlook (October 2010) and continent is from the United Nations Statistics Division (September 2010). The classification by beliefs is from Gradstein *et al.* (2001) to investigate how the gender wage gap varies with belief system, as well as to hold beliefs constant to focus on other country level effects. It has to be noted that only the classifications by beliefs and income levels are time varying, all other definitions of country classifications are at constant levels in 2010. The detailed classification of countries is presented in Appendix 2A Table 2.10.

2.4.2 Basic Regression Model

In order to explore how much the magnitude of the reported gender wage residual can be explained by the effect of trade liberalisation and culture differences, these two variables introduced to Equation 2.9 can be written as follows:

$$Gap_j = \beta_0 + \beta_1 Z_{kj} + \beta_2 t_{\tau j} + \beta_3 Trade\ Globalisation + \beta_4 Culture + \varepsilon_j \qquad (2.10)$$

where

Gap_j is the natural logarithm of gender wage residual of the j^{th} estimate.

Z_{kj} is a $n \times k$ matrix of meta explanatory variables.

$t_{\tau j}$ is a set of time dummies for individual estimate j drawing upon data in time τ.

ε_j is the error term.

Trade Globalisation is measured by trade openness, the share of imports, the share of exports, and both the share of imports and exports in agriculture, manufacturing and service sectors. All these trade related variables are in natural logarithms.

Culture is measured by the proportion of women in national parliaments (*Fparl*) and a set of social norms dummies. The variable of *Fparl* has additionally been split into dummies by dividing the distribution of the share of female politicians into three components(as tertiles), low, middle, and high, in order to identify whether there are threshold effects on the residual gender wage gap.

2.4.3 Regression Model with Interaction Terms

The interaction terms are introduced to test how trade competition is associated with the gender pay gap across countries at different income and development levels:

$$\begin{aligned} Gap_j = \beta_0 + \beta_1 Z_{kj} + \beta_2 t_{\tau j} + \beta_3 Trade\ Globalisation \\ +\beta_4 Income\ Levels\ (or\ Advanced\ Economies) \\ +\beta_5 Trade\ Globalisation \times Income\ Levels\ (or\ Advanced\ Economies) + \varepsilon_j \end{aligned} \tag{2.11}$$

As for measuring the interactive effect of culture,

$$\begin{aligned} Gap_j = \beta_0 + \beta_1 Z_{kj} + \beta_2 t_{\tau j} + \beta_3 Fparl + \beta_4 Beliefs\ (or\ Income\ Levels) \\ +\beta_5 Fparl \times Beliefs (or\ Income\ Levels) + \varepsilon_j \end{aligned} \tag{2.12}$$

where the base category for income levels is the low income countries, the omitted variable for religion is Confucianism, and the base category for development status is the developing economies.

Results from this subsection will reveal whether trade globalisation and the development of social openness have similar impacts on female relative wages across different income, development levels, and cultural backgrounds. It will identify whether the higher share of trade in developing countries compared to advanced countries as shown in Figure 2.1 leads to a greater reduction in the gender gap in the developing countries. It can also be seen whether more women recruited into parliament in the more conservative countries helps women to be paid more equally.

As mentioned above, the classification of countries by income status is only available for the period from 1987 to 2007. All the models including the income level variable will thus also be restricted to the period 1987 to 2007 to examine how robust the original models are. The weighting scheme introduced above will also be applied to all the models. Besides, a year lagged trade share and two year lag of the share of female politicians are adopted to measure whether it takes time for these variables to have an effect on the gender wage residual. One-year lagged data is often used in the economic analysis to discount the influence of the current shock. On the other hand, the choice of the two-year lagged female politician share is with a concern that the influence they have, such as the promotion of policies, education etc., would take a longer time to be effective.

2.5 Results of Meta-Regression Analysis

2.5.1 OLS Model

Table 2.3 presents the results of the benchmark meta-regression model in this analysis showing how the magnitude of the residual gender wage gaps is related to the control variables in reported empirical research. The effects of data and methods on the residual wage gap in this meta-analysis are similar to the findings of Weichselbaumer and Winter-Ebmer (2003, 2005)[12]. It is suggested that the type of data set used plays a very important role in the magnitude of the residual gender wage gap, where the results are consistent across all the specifications and are in line with the common findings of the empirical literature. Compared to a random sample of the whole population, the gender wage residual is lower by about 7 percentage points if studies only focus on new entrants in the labour market. Moreover, the estimated

[12] The replication of Weichselbaumer and Winter-Ebmer's (2003) MRA results can be found in Appendix 2A Table 2.11, where it can be seen clearly that the authors results are similar to theirs. For instance, the results from Table 2.3, Table 2.11 and Weichselbaumer and Winter-Ebmer's (2003) all reach the same conclusion that the sample of data used has the strongest effects on the magnitude of gender gap, and that the impact of the omission of workers' characteristics on the gap is very similar in terms of both the size and the sign.

gap is found to be narrower in the public sector, in samples based on particular occupations, in high-prestige occupations, and for non-married individuals, but it is significantly wider in samples of married workers and in the private sector. These results are consistent with popular concerns that, for instance, women fare better in the public sector as a result of more strict regulation enforcement; their relative wages are higher in top occupations due possibly to their higher human capital accumulation; and married women are more disadvantaged in the labour market owing to family commitment while the reverse holds true for men.

With respect to econometric methods, strong evidence suggests that the gender wage residual tends to be higher if a Blinder−Oaxaca decomposition with female coefficients is used, but it does not seem to matter if other decomposition approaches or dummy variable techniques are used. A little evidence, in *column 4* only, suggests that the estimated gap would be lower if a panel dataset is used compared to if other kinds of data are used, as panel data allows the researcher to control unobserved individual heterogeneity. In contrast to Stanley and Jarrell (1998), the results suggest that not using the Heckman correction for selection bias results in a larger residual wage gap. Considering that women may usually work few hours, one would expect that using an hourly wage measure would produce a narrower estimated gap than other measures, and weak but consistent evidence has been found supporting the idea. In comparison with using a measure of actual experience, using a variable of potential experience, calculated as *age minus years of education minus 6*, is strongly associated with a larger estimate of the gender residual. This suggests that the estimated residual gap would be overstated when the measure of individual workers' characteristics are less accurate.

In terms of the exclusion of particular control variables, the estimated gap is lower when individual's work experience (no matter whether it is actual or potential) is omitted. The result confirms Makepeace *et al.* (2004) that rates of reward to experience for men and women are not equal, hence when any form of experience measure is included, the unexplained portion increases. The omission of marital status reduces the wage gap, corresponding to what Becker (1985) proposed that the household responsibilities of women would lead to lower productivity and wages. On the contrary, men usually benefit from their marriage due to their wife's contribution at home. Similar to the findings from Weichselbaumer and Winter-Ebmer (2005), the omission of tenure, union status, and the share of females in occupations widens the residual gap. Omitting industry variables is also associated with a higher gender differential. Moreover, the effect of the gender of the authors is not clear, that is there is no evidence found that female authors tend to be more likely to report a higher estimated gap.

2.5.2 Fixed Effects

One would suspect that some traits of the empirical papers, such as detail of the questionnaire and the data set, or minor adjustment of research techniques, are not able to be captured by the meta-coding, which may affect the accuracy of the meta-data set. The Fixed Effects approach is therefore adopted to control for the specific effect of individual papers. Following Weichselbaumer and Winter-Ebmer (2005), this study uses (i) Fixed Effect within papers to control for the specific characteristics of each paper; and (ii) Fixed Effect within studies (one country at a time point within a paper) to control for the specific features of each study. Note that the sample for these Fixed Effect models is restricted to those papers that include more than one estimate, which impacts on the precision of some of coefficients due to the low variation within a specific group (paper or study). Hence, given this concern coupled with the elimination of a great number of observations, the Fixed Effect model is not the preferred approach compared to the OLS methods, although it would provide a good control for the quality of the publication.

It is suggested again that the type of data set is playing a very important role (Table 2.4). The gender wage gap is narrowed if studies only focus on a sample of new entrants, the singles (never-marrieds), and the full-time workers, but it is found to be significantly larger in the private sector. The results confirms that the gender pay residual is larger if the model does not consider part-time and full-time workers separately, as a large proportion of female part-timers is engaged in lower paid jobs which enlarges the wage gap between them.

Compared to the OLS results, there is no clear evidence found that the use of decomposition techniques or dummy variable techniques affects the estimated gap. Moreover, the effects of the measure of wages emerge more explicitly. The panel models demonstrate that the use of non hourly wages results in a significantly higher gender differential. Due to more job interruptions and fewer working hours for women, it could be expected that the use of hourly wages results in a smaller estimated gap than other measures of wages. As expected, if the studies exclude whether or not a worker has a child, it will result in a lower gender wage differential. Similar to the previous findings, the omission of union status and the share of females in occupations will increase the estimated gap.

According to Stanley and Jarrell (1998), the more wage-related and productivity-related factors are included, the smaller the residual gap will be. The results do support this idea as the omission of occupation is associated with a wider estimated gap. However, the inclusion of occupational variables is often controversial. As Stanley and Jarrell (1998, p.965) state,"Many researchers would argue that there has been so much segregation and gender stereotyping that the measured effect of occupation on wages is itself gender discrimination rather than reflection of unobserved skill differences". Thus, occupational variables should not necessarily be taken into account. On the contrary, controlling for occupations may somewhat obscure the effect of other variables. As the choice of occupation usually depends on education, experience, wages, and many other similar variables maybe accounted for in the estimation model, then the problem of multicollinearity with occupations is also a cause for concern (*ibid*).

Overall, the estimated results from both the OLS and the Fixed Effects models are found to be very similar to the findings from Weichselbaumer and Winter-Ebmer (2003, 2005). It is suggested that the specification of the estimated wage equation has a significant impact on the magnitude of the unexplained portion of the gender wage gap. In particular, the type of the data used has a greatest effect on the size of the gender wage residuals, and the method of estimation seems less important compared to the other factors in the wage equations. In addition, the lack of significance of, and the inconsistence of, some coefficients across model specifications is also found to be similar in this study, in contrast to the very strong results observed by Stanley and Jarrell (1998). One of the main reasons for these significant differences is due to the fact that Stanley and Jarrell (1998) strictly controlled their sample to only include those studies that estimate the US gender wage gap, using national databases and only estimates from a regression analysis. However, this study and the Weichselbaumer and Winter-Ebmer (2003, 2005) include over 60 countries with no possible method to control for the datasets used in individual studies and which adopt all measures of gender wage residual calculation (from a regression analysis and the derivatives of the Blinder-Oaxaca decomposition). The analyses for both the studies suffer from non-spherical error due to some estimates being based on the same data (country and time span) are hence not independent from each other. Moreover, the unobserved characteristics across countries (i.e. the institutional factors) may play some role.

2.6 The Effect of Trade Globalisation and Culture on the Gender Pay Gap

2.6.1 Basic Regression Model

This subsection intends to explore how international trade and the development of social openness are associated with the magnitude of the residual gender wage gap (Equation 2.10). The estimated results with different specifications are presented in Table 2.5, where the first five columns display the results when looking at the overall effects of a social openness proxy, the share of women in national parliament ($Fparl$), on the gender pay residual, and the next five columns demonstrate the threshold effects of social openness ($Fparllow$, $Fparlmid$, and $Fparlhigh$). In each case, the first column shows the results from an OLS specification; the next two columns from a continent Fixed Effect specification, which allows the analysis to control for unobserved differences across continents and investigates the within-continent variation; and the final two columns from an income Fixed Effect specification which allows the analysis to concentrate on the within-income group variation. The specifications with continent (income groups) Fixed Effect intend to explore how the changes in trade or female politicians within each continent (income group) are associated with the changes in the gender wage differential. The overall results will give some insight into how the impacts, on the variation of the gender wage gap, of the within-continent trade and cultural effect changes are different to the within-income level changes.

In line with Becker's model, the results indicate that an increase in trade competition in general leads to a decrease in the residual gender wage gap, and it does not seem to matter whether the measure of trade liberalisation is by trade openness, the share of exports to GDP, or the import penetration ratio[13]. It is suggested that a one percent increase in trade within continents will decrease the gender wage gap by about 1 to 2.5 percentage points.

As for social openness, its impact on the gender pay residual is found to be statistically stronger than trade openness across all specifications. Of these, the size of the overall effect is quite low, where a one percentage point increase in the share of women in national parliaments will decrease the gender pay gap by about 0.1 to 0.2 percentage points. In contrast, the size of the threshold effects (*columns 6 to 10*) is much greater and both $Fparlmid$ and $Fparlhigh$ have been found to have a significantly negative effect on the dependent variable as compared to $Fparllow$[14]. In particular $Fparlmid$ shows a stronger impact on reducing the unexplained gender wage gap, where a one percentage point increase in the share of women in national parliaments is associated with about a 2 to 2.6 percentage points change. It indicates that the countries with a share of women in the national parliament in the middle to higher end of the distribution have a smaller gender pay gap compared to those at the lower end of the distribution. The results also imply that the negative effect of the share of female politicians does not continue increasing once it has reached a

[13] The results for the measure of export or import share can be seen in Appendix 2A Table 2.12 and 2.13

[14] The estimated coefficients for testing the threshold effects are strong and robust across all specifications and to small changes in the choice of cutoff points for the thresholds (Also see Appendix Table 2.12, 2.13)

certain point.

Alongside the integration of world economy, many countries have experienced a changing economic structure. The following analysis hence considers the impact of trade at the sectoral level on the changing international gender wage gap. Table 2.6 displays the estimated results with different specifications, in which the first five columns present the results with sectoral effects of exports on the gender residual, and the next five columns focus on imports at sectoral level, and the final column includes imports and exports simultaneously. Similarly, in each case, the first column shows the results from an OLS specification with the measure of overall effects of $Fparl$; the next two columns with continent or income level Fixed Effect specifications; and the final two columns present the results with the threshold effects of $Fparllow$, $Fparlmid$, and $Fparlhigh$, with a continent or an income level Fixed Effect used. The results are expected to provide information on whether female workers benefited from their economies moving away from agriculture or male-dominated manufacturing towards the service sectors.

The results indicate that there is a positive relationship between a higher share of exports in agriculture and manufacturing sectors and the unexplained gender wage gap. One would expect that female workforces would benefit from the boost of export industries with more job opportunities, yet it might also hurt their wages as they usually hold the lower skilled and lower paid jobs. The results confirm the latter, which corresponds to several studies suggesting that more women working in manufacturing widens the residual wage gap (Fan and Lui, 2003; Bussmann, 2009, Menon and Rodgers, 2009). In contrast, a significant narrowing of the wage gap is found where the share of exports from the service sector is increasing, with a one percentage point increase in this share of exports leading to at least a 1.6 percentage point decrease in the gender pay differential, which may imply that women might benefit on gender parity following a rising demand for workers in the service sectors.

As for import penetration, the results indicate that more imports in the agricultural and manufacturing sectors are associated with lower gender differentials, though the estimates for the latter are not statistically significant. In addition, higher gender inequality would be observed where the share of imports in the service sector is increasing. The results reflect the fact that while states have moved from agriculture and manufacturing towards the services, more women engaging in the service sector where they have comparative advantage even in low-skilled nursing or servicing jobs, and fewer women working in the male-dominated manufacturing and physical-strength-required agriculture, would be associated with lower gender gaps (Blau and Kahn, 1992; Fan and Lui, 2003; Murphy and Welch, 1993). Noted that the results in *column (11)* suggest that putting imports and exports together into the same equation does not make much difference to the results.

2.6.2 Testing for Trade Effects on the Gender Pay Residual in Different Development Economies

Table 2.7 displays the results explaining how trade competition will affect gender wage inequality in countries at different income and development levels (Equation 2.11). Results with different specifications are included, *columns 5 to 8* showing the results with the one year lagged trade variable for the purpose of testing the time effect of trade openness on the gap and also being a robustness check; columns 9 and 10 are the results for the restricted sample with a concern that data for the indicators of income levels of countries were available only from 1987 onwards. The outcomes for different trade effects across different income levels are found to be statistically weak but very consistent across all specifications.

It is revealed that the residual gender pay gap is significantly smaller in all higher income countries as compared to low income countries at zero levels of trade openness, though the estimates are only statistically significant for the low middle income countries. As for the interactive effect, it suggests that trade openness reduces the gender gap for countries in higher and the bottom income categories, but increases the gap in lower-middle groups, with some weak evidence that the trade effect is stronger in lower income, and developing countries. The further F-test on the coefficients of the interaction terms $TradeLM$ and $Trade$[15] has indicated that the interaction effect is statistically significant and opposite in sign to the base trade effect, which suggests that a one percent increase in the share of international trade will widen the residual gender pay gap by 5 to over 7 percentage points (*columns 2, 6, 9, and 10*). The results for trade effects associated with different development economies are not found to be significantly different from zero[16]. The weak results observed from the higher income countries may imply that the changes in gender pay differentials in these countries are more likely to be affected by the pressure within the countries and by female workers' characteristics. Moreover, the findings of the widening gender gap associated with the expansion of trade in the lower-middle income countries are in line with the empirical evidence (Davis, 1996; Feenstra and Hanson, 1996; Berman and Machin, 2000, 2004; Acemoglu, 2003; Xu, 2003; Goldberg and Pavcnik, 2004, 2007; Conte and Vivarelli, 2007) that trade liberalisation together with the diffusion of technology depresses the relative demand and prices for unskilled worker, where women account for the majority, resulting in a higher

[15] Test on $Trade{+}TradeLM{=}0$ successfully rejects the hypothesis

[16] The lack of significance for the division of the developing region may be due partly to the fact that the classifications are not time varying

wage inequality.

2.6.3 Testing for Societal Effects on the Gender Pay Residual in Different Cultural Backgrounds and Development Economies

This subsection is interested in exploring how female relative wages will change along with the development of social openness against different cultural backgrounds and income levels (Equation 2.12). Table 2.8 display the outcomes for the interactive effect of social openness and culture/beliefs on the residual gender pay gap. Similar to the preceding analysis, different specifications are included. The first three columns are from the basic models, and the final three columns are the results with the two years lagged cultural indicator ($Fparl$) for the purpose of testing the time effect of social openness on the gap and also being a robustness check.

The results are found to be quite weak and inconsistent across all specifications, with some evidence suggesting that the countries with Communist and Mixed beliefs are associated with lower gender inequality as compared to Confucianism countries where the share of female politician is zero. In terms of interactive effects, an increase in the share of female politicians in Protestant countries significantly lowers the gender differential, but opposite story is found in the Communism, Confucianism, Muslim, and Mixed countries. This implies that the effect of female politicians on gender pay equality in countries with stronger social constraints might be quite weak. It might also be because female politicians are rather in the minority in these countries and so might not have such authority that men would have for policy conducting or implementing.

Table 2.9 presents the results examining the interactive impact of social openness and income levels on gender wage inequality. The first two columns show the results from basic models; the next two columns are with the two years lagged cultural indicator ($Fparl$); and the last two columns are the results for the restricted sample in the period $1987 - 2007$. The results indicate that the gender gap is found to be narrower for richer countries as compared to low income countries at zero levels of '$Fparl$'. Yet a higher share of female politicians does not seem to have much impact on the narrowing gender wage gap in higher income categories, while such effects are found to be much stronger in the low income countries. The positive interaction coefficients for '$Fparl$' with higher income countries offsets the negative base '$Fparl$' effect, implying that the effect of a higher share of women in national parliaments on gender parity is stronger in the low income countries. Although the further F-test on the coefficients of interaction terms $FparlH$ and $Fparl$ is significantly different from zero, the size of effects is minor, with a one percentage point increase in the share of women in national parliament decreasing the gender wage differential by 0.1 percentage points (*columns 2 and 4*).

2.7 Conclusion

The results indicate that the magnitude of the gender wage residual is significantly affected by the specification of estimated models, in particular by the type of data set (the sample) used and the control variables included. Of these, studies focusing on a sample of new entrants in the labour market, non-married individuals, full-time workers, the public sector, and top-level occupations are associated with a smaller unexplained portion of gender wage gap, whereas an opposite story is found in those studies looking at married women and the private sector. It implies that when the models have a lower possibility of being driven by unobserved characteristics the estimated gap would be lower. For instance, women may be under relatively strong protection from gender-specific policies in the public sectors, and their wages are more influenced by the market economy in the private sector. Discrimination against married women is more likely in practice, as they may be considered a group that see their family commitment as a priority rather than their career. Furthermore, the omission of real experience, marital status, and the presence of children are all found to decrease the residual gender gap, which suggests that a lower estimated gap would be observed if the model ignores the factor in relation to female workers' disadvantages. As for the use of potential experience, the result is found to increase the unexplained portion of gender pay gap, suggesting that this portion is likely to be overstated when estimating models including less precise measures of labour force characteristics.

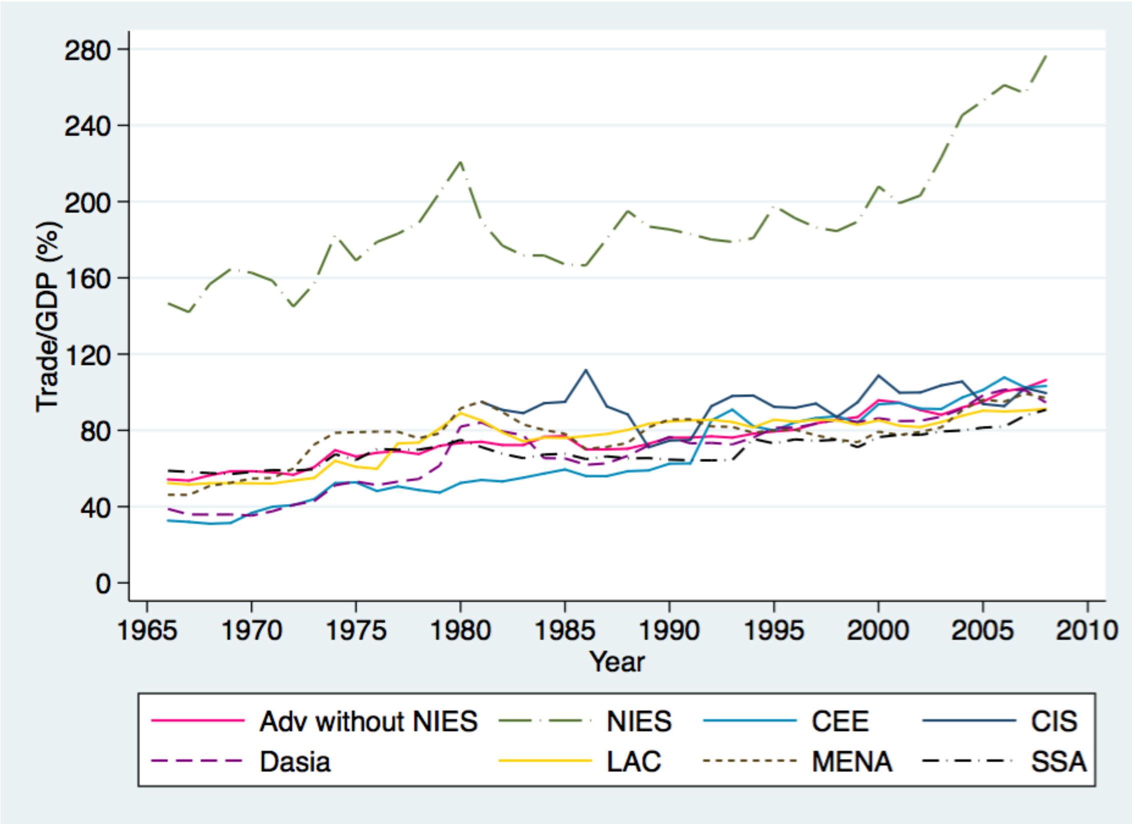
With respect to trade globalisation, the results indicate that the expansion of trade on average decreases the international gender wage gap, although different patterns are observed across countries at different income levels and development categories. Trade openness reduces the gender gap in higher and the bottom income countries, but such an effect is found to be stronger in low income, and developing countries. It implies that the variations of the gender gap in the high income and advanced countries may be more likely to be driven by domestic pressure and female workforce characteristics.

On the contrary, the introduction of trade is found to widen the gender wage gap strongly in the middle income countries. It implies that while trade liberalisation together with the development of technology change the relative demand for workers biased towards skilled workers, it pushes the majority of women in those countries into a more difficult situation, as they are more likely engaged in unskilled jobs. When the female labour supply cannot keep up with the relative demand for skilled workers, the overall gender wage gap will be increased. Moreover, the findings for trade competition in different industrial sectors indicate that the economic structure moving towards the service sectors benefited women in terms of their wages, as women are more likely to have a comparative advantage for the jobs in the latter sector than in the labour-intensive agriculture and male-dominated manufacturing sectors.

In terms of the cultural effect, it is suggested that a higher share of female politicians is associated with lower international gender pay inequality. The interactive effects of social openness across different cultural backgrounds and income levels are relatively weak. It is in general suggested that female politicians seem not quite able to improve female working situation in countries with stronger social conventions on women's traditional roles. It might imply that it is difficult for female workers in those countries to break out of the gender stereotype trap. Besides, a higher share of women in parliament is found to have a stronger effect on narrowing the gender gap in the low income than the high income countries.

Overall, the results in this chapter indicate that although the international total gender wage gap has been falling significantly over the period of $1963 - 2007$, the unexplained portion of the gap remained persistent. Although improvement in the estimated wage equations would result in a smaller unexplained portion of the gender wage gap, it has to be kept in mind that it does not necessarily mean that the discrimination against women in the labour market is lower. Rather, it is likely due to models with a lower possibility of being driven by unobserved characteristics. Nevertheless, it is suggested that globalisation together with the spread of technology and the shifting economic structure have strong influences on female relative pay throughout the changing relative demand for different skilled workers, although it is not all positive. A very strong societal constraint on women is likely to limit their career pursuing. Furthermore, it is found that the reasons for the persistent gender wage residual in the high income countries are more complex, hence other factors and dimensions will need to be taken into account for further analysis.

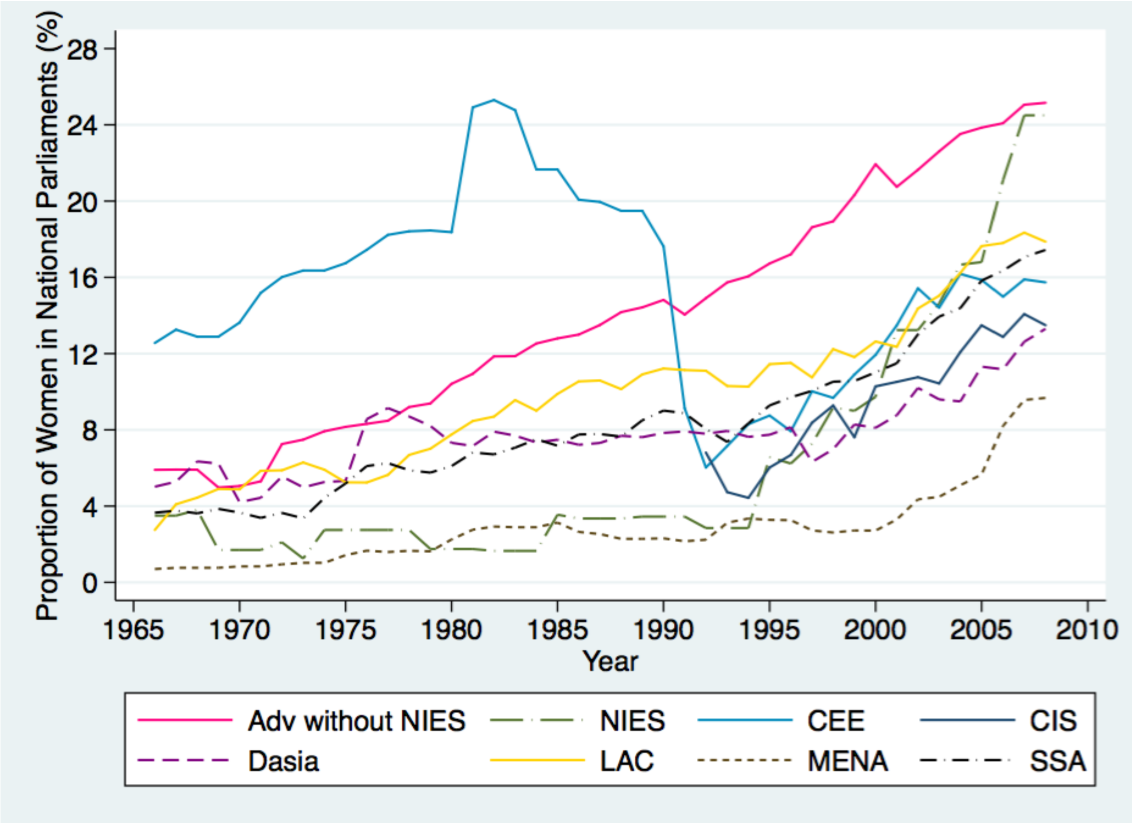
Figure 2.1: The Evolution of Trade Globalisation by Development Region



Source: World Development Indicators (2010)

Note: Advanced Economics (Adv); Newly Industrialized Asian Economics (NIEs); Central and Eastern Europe (CEE); Commonwealth of Independent States (CIS); Developing Asia (Dasia); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA); and Sub-Saharan Africa (SSA)

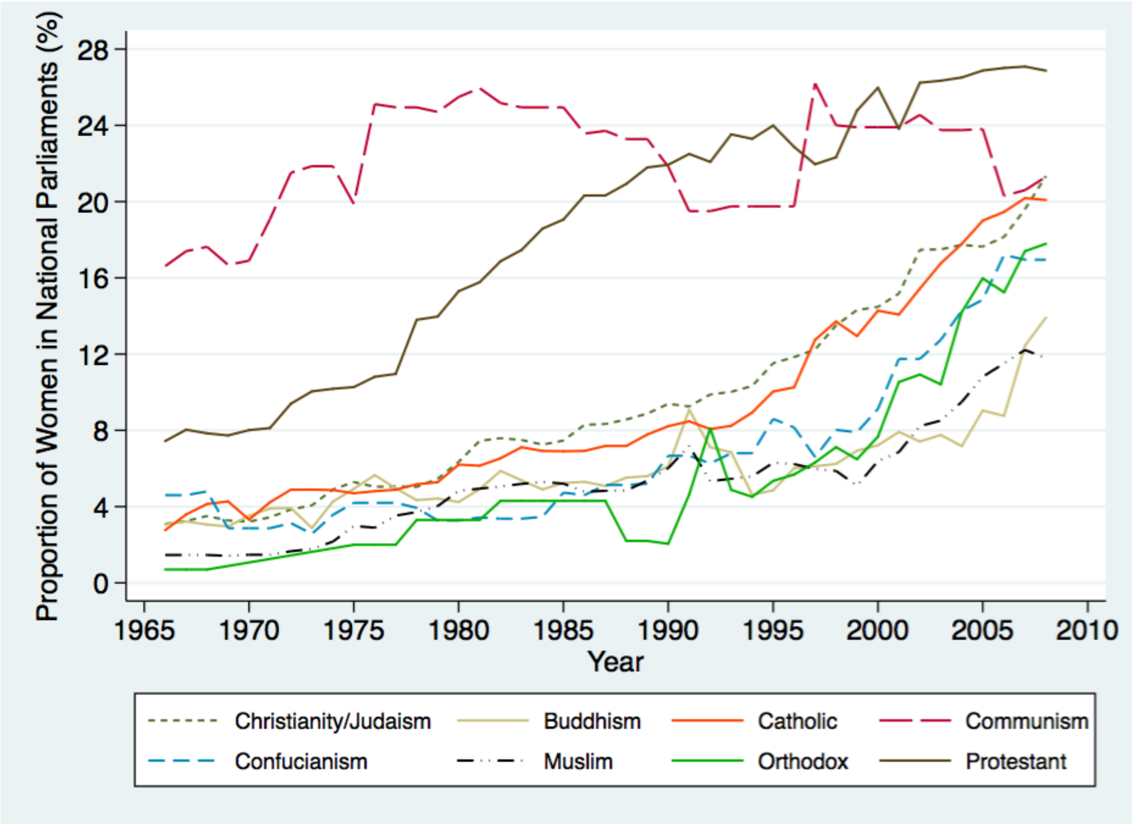
Figure 2.2: Proportion of Women in National Parliament by Development Region



Source: Women's Indicators and Statistics (2010); World Development Indicators (2010)

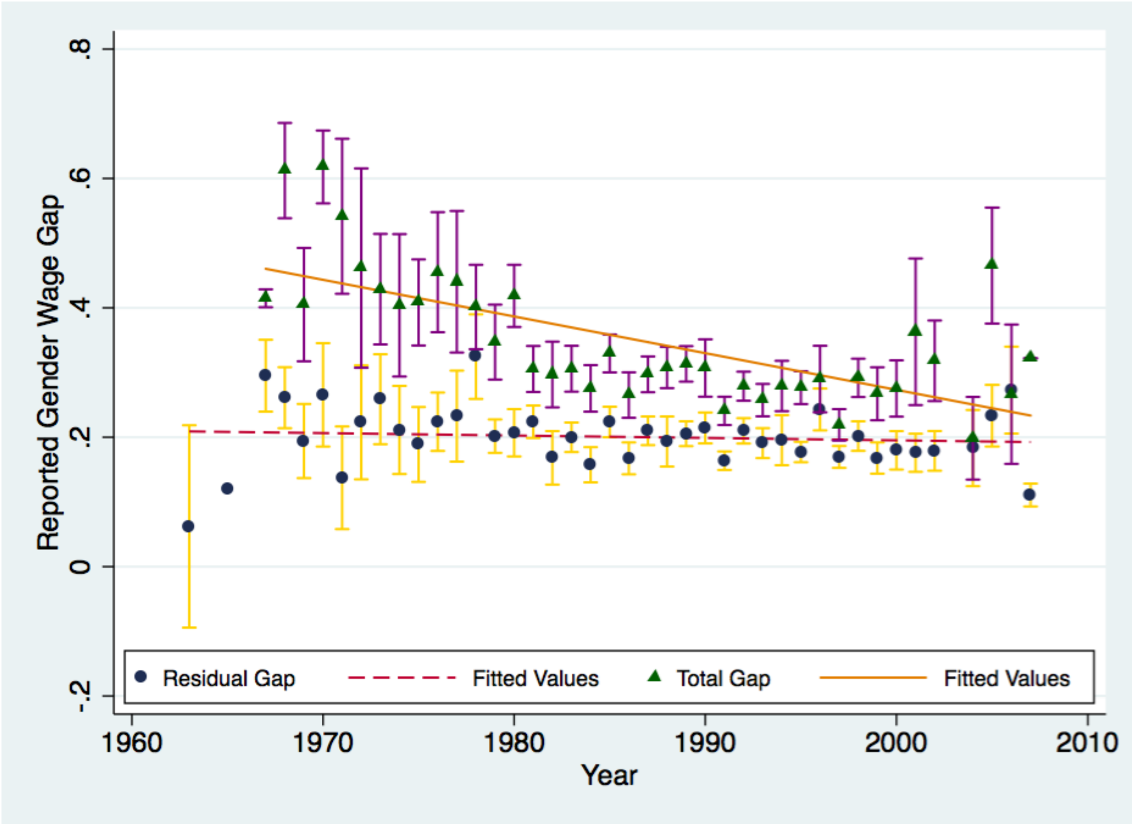
Note: Advanced Economics (Adv); Newly Industrialized Asian Economics (NIEs); Central and Eastern Europe (CEE); Commonwealth of Independent States (CIS); Developing Asia (Dasia); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA); and Sub-Saharan Africa (SSA)

Figure 2.3: Proportion of Women in National Parliament by Social Norms



Source: La Porta *et al.* (1998); Women's Indicators and Statistics (2010); World Development Indicators (2010)

Figure 2.4: Reported Log Gender Wage Gap



Source: Weichselbaumer and Winter-Ebmer (2005), extended and updated by the author (2013)

Table 2.1: Female/Male Wage Ratio

	1960s	1970s	1980s	1990s	2000s	All
Number of Papers	12	68	203	178	49	405
Number of Studies	17	145	492	495	96	1245
Number of Estimates	50	304	983	945	205	2487
Fraction of Estimates						
Continent						
Africa	0.00	0.02	0.03	0.04	0.16	0.04
America	0.66	0.69	0.51	0.34	0.19	0.44
Asia	0.08	0.17	0.18	0.15	0.16	0.16
Europe	0.18	0.08	0.26	0.43	0.44	0.32
Oceania	0.08	0.04	0.03	0.03	0.05	0.04
Income level						
High Income	1.00	0.83	0.74	0.59	0.55	0.68
Upper-Middle Income	0.00	0.04	0.09	0.11	0.04	0.09
Lower-Middle Income	0.00	0.08	0.10	0.18	0.22	0.14
Low Income	0.00	0.05	0.07	0.12	0.19	0.10
Mean Total Wage Gap	0.470	0.429	0.310	0.268	0.344	0.314
Mean Residual Wage Gap	0.225	0.223	0.196	0.190	0.201	0.198

Source: Weichselbaumer and Winter-Ebmer (2005), extended and updated by the author (2013)

Table 2.2: Descriptive Statistics. Unit of Observation: the 2487 Estimates from within Papers

		Mean	Standard Deviation
A. Paper			
Author Female	percentage of female authors	0.35	0.38
B. Data Set			
New Entries	1 = study investigated the wages of new entrants only	0.02	0.13
Public	1 = study investigated the wages of workers in the public sector only	0.08	0.28
Private	1 = study investigated the wages of workers in the private sector only	0.11	0.31
Narrow Occ	1 = study investigated the wages of workers in a narrowly defined occupation only	0.12	0.32
Low Occ	1 = study investigated low prestige occupations only	0.03	0.17
Medium Occ	1 = study investigated medium prestige occupations only	0.08	0.27
High Occ	1 = study investigated high prestige occupations only	0.13	0.33
Single	1 = study investigated non-married workers only	0.03	0.16
Married	1 = study investigated married workers only	0.02	0.14
Minority	1 = study investigated minority workers or immigrants only	0.08	0.27
Majority	1 = study investigated majority workers only	0.14	0.35
Full-Time	1 = study investigated full-time workers only	0.26	0.44
C. Method of Estimation			
BOf*	1 = Blinder−Oaxaca decomposition with female coefficients was used	0.43	0.49
BOm*	1 = Blinder−Oaxaca decomposition with male coefficients was used	0.18	0.39
Neumark*	1 = Neumark decomposition was used	0.09	0.29

Table 2.2: *Continued*

		Mean	Standard Deviation
Reimers*	1 = Reimers decomposition was used	0.01	0.08
Cotton*	1 = Cotton decomposition was used	0.02	0.15
Brown*	1 = Brown *et al.* decomposition was used	0.01	0.09
Dummy	1 = if a study used a dummy to investigate the gender wage gap	0.26	0.44
IV	1 = instrumental variables was used	0.01	0.09
Panel	1 = panel method was used	0.02	0.15
Heckman	1 = Heckman (selectivity correction) was used	0.18	0.39
D. Alternative Measures of Wages			
Not Hourly	1 = not hourly wages	0.49	0.50
Hourly Conducted	1 = hourly wages were computed from daily, weekly, monthly, or annual wages	0.16	0.37
Gross	1 = gross wage was used	0.35	0.48
E. Variables for Workers' Characteristics			
Potential Exp	1 = potential experience was used	0.47	0.50
Experience	1 = worker's experience was omitted	0.11	0.31
Race/Immigrant	1 = race or immigrant status was omitted	0.70	0.46
Marital Status	1 = marital status was omitted	0.44	0.50
Kid	1 = the presence of children was omitted	0.73	0.44
Marital/Kid	1 = study omitted interaction children×marital status	0.97	0.18
Training	1 = study omitted on-the-job training, further education, etc	0.91	0.29
Tenure	1 = study omitted tenure at employer	0.70	0.46

Table 2.2: *Continued*

		Mean	**Standard Deviation**
Occupation	1 = study omitted worker's occupation of employment	0.56	0.50
Industry	1 = study omitted worker's industry of employment	0.63	0.48
Government	1 = study omitted government/private employment distinction	0.63	0.48
Union	1 = study omitted worker's union/nonunion status	0.79	0.41
Share of Female	1 = study omitted the percentage of women in the worker's occupation	0.86	0.34
FT-PT	1 = study omitted worker's full-time/part-time status	0.59	0.49
Urban	1 = study omitted SMSA, city size	0.73	0.45
Region	1 = study omitted worker's geographical area of employment	0.42	0.49
Working time	1 = study omitted the number of weeks worked during the year	0.94	0.24

Source: Weichselbaumer and Winter-Ebmer (2005), extended and updated by the author (2013)
*Decomposition method see Section 2.3.1 for details.

Table 2.3: Meta Regression

Weighting Scheme	No Weights (1)	No. of Estimates in Study (2)	(2)+ Precision of Estimates (3)	(2)+ Square Root of DF (4)
A. Paper				
Author Female	0.0029	0.0096	−0.0103	0.0190
	(0.0101)	(0.0115)	(0.0116)	(0.0138)
B. Data Set				
New Entries	−0.0753***	−0.0635**	−0.0730***	−0.0605
	(0.0190)	(0.0223)	(0.0163)	(0.0322)
Public	−0.0310*	−0.0288	−0.0142	−0.0503***
	(0.0149)	(0.0148)	(0.0228)	(0.0150)
Private	0.0315	0.0316	0.0776***	0.0282
	(0.0179)	(0.0175)	(0.0198)	(0.0159)
Narrow Occ	−0.0486**	−0.0539**	−0.0266	−0.0637**
	(0.0162)	(0.0175)	(0.0259)	(0.0225)
Low Occ	0.0147	0.0225	0.0189	0.0491
	(0.0194)	(0.0184)	(0.0407)	(0.0261)
Medium Occ	−0.0240	−0.0309**	−0.0289	−0.0348
	(0.0143)	(0.0119)	(0.0286)	(0.0224)
High Occ	−0.0913***	−0.0879***	−0.0765**	−0.1060***
	(0.0158)	(0.0153)	(0.0238)	(0.0185)
Single	−0.1086***	−0.1032***	−0.1430***	−0.1272**
	(0.0217)	(0.0183)	(0.0355)	(0.0395)
Married	0.0939***	0.0851***	0.0096	0.0786
	(0.0270)	(0.0221)	(0.0398)	(0.0560)
Minority	−0.0004	−0.0089	0.0118	−0.0228
	(0.0128)	(0.0155)	(0.0168)	(0.0182)
Majority	0.0138	0.0103	0.0200	−0.0128
	(0.0120)	(0.0124)	(0.0182)	(0.0145)
Full-Time	0.0153	0.0134	0.0080	0.0009
	(0.0099)	(0.0108)	(0.0125)	(0.0117)
C. Method of Estimation				
Bof	0.0189**	0.0246***	0.0014	0.0250**
	(0.0064)	(0.0073)	(0.0026)	(0.0087)
Neumark	0.0168	0.0097	0.0114	0.0074
	(0.0094)	(0.0111)	(0.0067)	(0.0109)
Reimers	0.0018	0.0118	−0.0029	0.0397*
	(0.0300)	(0.0275)	(0.0146)	(0.0169)
Cotton	0.0137	0.0132	−0.0052	0.0165
	(0.0132)	(0.0149)	(0.0069)	(0.0085)
Brown	0.0161	0.0177	0.0184	0.0279
	(0.0170)	(0.0185)	(0.0144)	(0.0143)
Dummy	0.0148	0.0158	0.0087	0.0299*
	(0.0109)	(0.0125)	(0.0109)	(0.0125)
IV	0.0073	−0.0128	0.0215	−0.0209
	(0.0265)	(0.0311)	(0.0402)	(0.0351)
Panel	−0.0158	0.0011	−0.0069	−0.0708*
	(0.0201)	(0.0236)	(0.0330)	(0.0313)

Table 2.3: *Continued*

Weighting Scheme	No Weights (1)	No. of Estimates in Study (2)	(2)+ Precision of Estimates (3)	(2)+ Square Root of DF (4)
Heckman	−0.0207	−0.0354	0.0097	−0.0330**
	(0.0112)	(0.0184)	(0.0076)	(0.0120)
D. Alternative Measures of Wages				
Not Hourly	0.0250	0.0229	0.0129	0.0323*
	(0.0131)	(0.0164)	(0.0183)	(0.0139)
Hourly Conducted	0.0059	0.0075	0.0147	−0.0095
	(0.0107)	(0.0122)	(0.0138)	(0.0110)
Gross	−0.0055	0.0031	−0.0241*	0.0005
	(0.0120)	(0.0118)	(0.0114)	(0.0128)
Potential Exp	0.0270**	0.0338***	−0.0036	0.0302*
	(0.0092)	(0.0100)	(0.0117)	(0.0122)
E. Variables for Workers' Characteristics				
Experience	0.0019	−0.0012	−0.0266*	−0.0029
	(0.0126)	(0.0130)	(0.0134)	(0.0170)
Race/Immigrant	0.0023	0.0132	0.0117	−0.0001
	(0.0098)	(0.0114)	(0.0118)	(0.0121)
Marital Status	−0.0278**	−0.0421***	0.0040	−0.0342**
	(0.0098)	(0.0115)	(0.0113)	(0.0123)
Kid	0.0078	0.0112	−0.0151	0.0315**
	(0.0096)	(0.0111)	(0.0106)	(0.0122)
Marital/Kid	−0.0101	0.0117	−0.0385	−0.0015
	(0.0212)	(0.0235)	(0.0198)	(0.0250)
Training	0.0166	0.0116	0.0034	0.0017
	(0.0154)	(0.0158)	(0.0153)	(0.0165)
Tenure	0.0227*	0.0145	0.0282**	0.0219
	(0.0089)	(0.0120)	(0.0106)	(0.0118)
Occupation	0.0091	0.0097	0.0158	0.0171
	(0.0079)	(0.0086)	(0.0093)	(0.0090)
Industry	0.0217*	0.0275**	0.0071	0.0394***
	(0.0095)	(0.0098)	(0.0105)	(0.0091)
Government	0.0265**	0.0188	0.0207	0.0112
	(0.0097)	(0.0106)	(0.0111)	(0.0107)
Union	−0.0112	−0.0101	0.0153	0.0197
	(0.0120)	(0.0155)	(0.0173)	(0.0134)
Share of Female	0.0467***	0.0513***	0.0260*	0.0301**
	(0.0096)	(0.0102)	(0.0116)	(0.0109)
FT-PT	−0.0031	0.0021	−0.0061	−0.0022
	(0.0094)	(0.0105)	(0.0109)	(0.0100)
Urban	0.0086	0.0105	0.0075	0.0031
	(0.0104)	(0.0115)	(0.0148)	(0.0121)
Region	−0.0095	−0.0061	−0.0026	−0.0132
	(0.0094)	(0.0106)	(0.0111)	(0.0097)
Constant	0.0483	0.0252	0.1025	−0.0199
	(0.0494)	(0.0503)	(0.0564)	(0.0608)
N	2370	2370	1702	1927
R^2	0.4390	0.4386	0.7184	0.5140

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: Country and Year dummies are included in all specifications

Table 2.4: Fixed Effects Model

	FE(Paper) (1)	FE(Paper) (2)	FE(Study) (3)
Data Set			
New Entries	−0.0669***	−0.0666***	−0.0578**
	(0.0144)	(0.0149)	(0.0197)
Public	0.0098	0.0223	.
	(0.0413)	(0.0481)	.
Private	0.0778**	0.0847**	0.0108***
	(0.0242)	(0.0285)	(0.0030)
Narrow Occ	0.0274	0.0283	.
	(0.0156)	(0.0157)	.
Low Occ	−0.0131	−0.0269	−0.1780***
	(0.0610)	(0.0714)	(0.0081)
Medium Occ	0.0303	0.0236	.
	(0.0195)	(0.0206)	.
High Occ	0.0833	0.0868	.
	(0.0716)	(0.0681)	.
Single	−0.2596***	−0.2409***	−0.3031***
	(0.0263)	(0.0239)	(0.0000)
Married	0.0884	0.1064*	.
	(0.0464)	(0.0460)	.
Minority	−0.0780	−0.0770	−0.0859**
	(0.0497)	(0.0512)	(0.0283)
Majority	−0.0769	−0.0761	.
	(0.0614)	(0.0636)	.
Full-Time	−0.0612***	−0.0661***	−0.0495***
	(0.0120)	(0.0123)	(0.0059)
Method of Estimation			
Bof	0.0082	0.0082	0.0083
	(0.0099)	(0.0101)	(0.0064)
Neumark	0.0161	0.0161	0.0158
	(0.0296)	(0.0302)	(0.0098)
Reimers	−0.0028	−0.0028	−0.0029
	(0.0316)	(0.0321)	(0.0300)
Cotton	0.0196	0.0195	0.0195*
	(0.0162)	(0.0164)	(0.0082)
Brown	0.0185	0.0180	0.0043
	(0.0154)	(0.0135)	(0.0105)
Dummy	0.0122	0.0120	0.0074
	(0.0155)	(0.0158)	(0.0116)
IV	0.0060	0.0060	0.0069
	(0.0250)	(0.0255)	(0.0283)
Panel	−0.0411	−0.0156	−0.0388
	(0.0462)	(0.0367)	(0.0417)
Heckman	−0.0117	−0.0107	−0.0166*
	(0.0094)	(0.0096)	(0.0083)

Table 2.4: *Continued*

	FE(Paper) (1)	FE(Paper) (2)	FE(Study) (3)
Alternative Measures of Wages			
Not Hourly	0.0923***	0.1240***	0.1023***
	(0.0069)	(0.0173)	(0.0114)
Hourly Conducted	−0.0229	0.0088	−0.0130
	(0.0561)	(0.0593)	(0.0567)
Gross	−0.0852***	.	.
	(0.0000)	.	.
Potential Exp	0.0256*	0.0290*	0.0393***
	(0.0127)	(0.0116)	(0.0086)
Variables for Workers' Characteristics			
Experience	0.0125	0.0256	0.0505
	(0.0231)	(0.0258)	(0.0265)
Race/Immigrant	0.2740**	−0.0007	−0.0032
	(0.0989)	(0.0544)	(0.0486)
Marital Status	0.0339	0.0587***	0.0677***
	(0.0203)	(0.0148)	(0.0148)
Kid	−0.0584***	−0.0761***	−0.1032***
	(0.0170)	(0.0164)	(0.0160)
Training	−0.0254	−0.0305	−0.0113
	(0.0189)	(0.0209)	(0.0086)
Tenure	0.0332	0.0418*	0.0336
	(0.0200)	(0.0202)	(0.0182)
Occupation	0.0473**	0.0482**	0.0540***
	(0.0156)	(0.0157)	(0.0101)
Industry	0.0193	0.0193	0.0119
	(0.0124)	(0.0125)	(0.0095)
Government	−0.0131	−0.0085	0.0045
	(0.0184)	(0.0162)	(0.0153)
Union	0.0485**	0.0208	0.0340**
	(0.0184)	(0.0160)	(0.0107)
Share of Female	0.0401**	0.0406**	0.0389***
	(0.0140)	(0.0143)	(0.0078)
FT-PT	0.0096	−0.0043	0.0189
	(0.0152)	(0.0151)	(0.0107)
Urban	−0.0938	−0.0119	−0.0602
	(0.0579)	(0.0366)	(0.0355)
Region	−0.0141	−0.0131	−0.0011
	(0.0131)	(0.0138)	(0.0094)
Constant	−0.0026	0.2264***	0.1178**
	(0.0675)	(0.0458)	(0.0378)
Year Dummies	No	Yes	No
Country Dummies	No	Yes	No
N	1731	1731	1731
R^2	0.2698	0.3472	0.1393

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2.5: The Effect of Trade Openness and Women in National Parliaments on the Residual Gender Wage Gap

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Trade	−0.0002	−0.0132	−0.0229**	0.0019	−0.0134	−0.0023	−0.0158*	−0.0250**	−0.0006	−0.0131
	(0.0095)	(0.0068)	(0.0081)	(0.0062)	(0.0072)	(0.0090)	(0.0070)	(0.0081)	(0.0063)	(0.0070)
Fparl	−0.0016**	−0.0012**	−0.0003	−0.0017***	−0.0007					
	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0004)					
FparlM						−0.0263*	−0.0218**	−0.0190*	−0.0228**	−0.0228**
						(0.0118)	(0.0084)	(0.0087)	(0.0083)	(0.0085)
FparlH						−0.0235*	−0.0128	−0.0026	−0.0258**	−0.0164
						(0.0111)	(0.0088)	(0.0096)	(0.0087)	(0.0091)
Constant	0.0298	0.1251	0.1837	0.0610	0.1324	0.0498	0.1428	0.1976	−0.0019	0.1167
	(0.0404)	(0.1178)	(0.1195)	(0.1171)	(0.0781)	(0.0402)	(0.1180)	(0.1194)	(0.0743)	(0.0784)
FE(Continent)	No	Yes	Yes	No	No	No	Yes	Yes	No	No
FE(Income)	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Beliefs Dummy	No	No	Yes	No	Yes	No	No	Yes	No	Yes
N	2181	2181	2176	2181	2176	2181	2181	2176	2181	2176
R^2	0.2999	0.2841	0.3052	0.2846	0.3054	0.2982	0.2835	0.3072	0.2825	0.3068

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: The regression includes all the explanatory variables presented in Table 2.3. A set of year dummies is included. To allow for the variations of trade openness and cultural indicators across countries, country dummies are not included.

Table 2.6: The Effect of Trade Openness and Women in National Parliaments on Residual Gender Wage Gap by Sectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Agri Ex	0.0043	0.0095**	0.0005	0.0086*	−0.0006						−0.0004
	(0.0055)	(0.0035)	(0.0034)	(0.0036)	(0.0035)						(0.0043)
Manu Ex	0.0111	0.0008	0.0142**	0.0009	0.0149**						0.0385***
	(0.0066)	(0.0054)	(0.0045)	(0.0055)	(0.0045)						(0.0061)
Serv Ex	−0.0190*	−0.0212**	−0.0157**	−0.0226***	−0.0181**						−0.0151
	(0.0095)	(0.0067)	(0.0060)	(0.0067)	(0.0059)						(0.0103)
Agri Im						−0.0026	−0.0352***	−0.0155*	−0.0328***	−0.0142*	−0.0434***
						(0.0125)	(0.0089)	(0.0070)	(0.0090)	(0.0072)	(0.0091)
Manu Im						−0.0274	0.0018	−0.0194	−0.0004	−0.0179	−0.0277*
						(0.0210)	(0.0131)	(0.0115)	(0.0133)	(0.0117)	(0.0135)
Serv Im						0.0284*	0.0133	0.0321**	0.0090	0.0234*	0.0463***
						(0.0139)	(0.0117)	(0.0099)	(0.0116)	(0.0096)	(0.0121)
Fparl	−0.0017**	−0.0015***	−0.0015***			−0.0018***	−0.0015***	−0.0018***			−0.0018***
	(0.0005)	(0.0004)	(0.0004)			(0.0005)	(0.0004)	(0.0004)			(0.0004)
FparlM				−0.0198*	−0.0186*				−0.0128	−0.0137	
				(0.0088)	(0.0086)				(0.0088)	(0.0087)	
FparlH				−0.0191*	−0.0213*				−0.0097	−0.0182*	
				(0.0091)	(0.0091)				(0.0091)	(0.0091)	
Constant	0.1231	0.1789*	0.0578	0.1679*	0.0264	0.1196	0.0087	0.0085	−0.0140	−0.0215	−0.0580
	(0.0770)	(0.0725)	(0.0711)	(0.0726)	(0.0710)	(0.0982)	(0.0788)	(0.0785)	(0.0788)	(0.0784)	(0.0819)
Fixed-Effect											
Continent	No	Yes	No	Yes	No	No	Yes	No	Yes	No	No
Income	No	No	Yes	No	Yes	No	No	Yes	No	Yes	Yes
N	2009	2009	2009	2009	2009	2011	2011	2011	2011	2011	2009
R^2	0.3119	0.2976	0.2992	0.2952	0.2971	0.3110	0.3018	0.3013	0.2981	0.2968	0.3177

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$.
Note: The regression includes all the explanatory variables presented in Table 2.3. A set of year dummies is included. To allow for the variations of trade openness and cultural indicators across countries, country dummies are not included.

Table 2.7: The Interactive Effect of Trade and Different Development Levels on the Residual Gender Wage Gap

	Basic				One Year Lagged Trade				1987 - 2007	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Trade	−0.0138	−0.0272	−0.0208	−0.0223*	−0.0085	−0.0224	−0.0198	−0.0208*	−0.0454	−0.0497*
	(0.0229)	(0.0160)	(0.0164)	(0.0095)	(0.0222)	(0.0165)	(0.0168)	(0.0097)	(0.0264)	(0.0197)
High	−0.0821	−0.0339			−0.0675	−0.0293			−0.2174	−0.1162
	(0.0895)	(0.0713)			(0.0878)	(0.0736)			(0.1146)	(0.0947)
UpM	0.1042	−0.0292			0.0839	−0.0322			−0.1965	−0.2112
	(0.1271)	(0.0872)			(0.1201)	(0.0859)			(0.1630)	(0.1101)
LowM	−0.3285*	−0.4542***			−0.2414	−0.3484***			−0.4331**	−0.3856***
	(0.1374)	(0.0960)			(0.1354)	(0.0949)			(0.1633)	(0.1099)
TradeH	0.0036	−0.0012			−0.0011	−0.0037			0.0416	0.0291
	(0.0242)	(0.0185)			(0.0236)	(0.0190)			(0.0291)	(0.0238)
TradeUM	−0.0351	0.0001			−0.0313	−0.0000			0.0384	0.0534
	(0.0315)	(0.0222)			(0.0299)	(0.0220)			(0.0389)	(0.0273)
TradeLM	0.0689	0.1011***			0.0474	0.0758**			0.0992*	0.0988***
	(0.0353)	(0.0239)			(0.0355)	(0.0240)			(0.0402)	(0.0271)
Adv			−0.0999	−0.0347			−0.0964	−0.0282		
			(0.0671)	(0.0553)			(0.0667)	(0.0556)		
TradeAdv			0.0160	0.0042			0.0153	0.0031		
			(0.0171)	(0.0131)			(0.0173)	(0.0133)		
Constant	0.1831	0.1798*	0.1885*	0.1511*	0.1729	0.1761*	0.1848*	0.1442	0.3352**	0.2963***
	(0.0938)	(0.0864)	(0.0771)	(0.0758)	(0.0927)	(0.0883)	(0.0762)	(0.0756)	(0.1102)	(0.0827)
FE(Continent)	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
N	2326	2326	2331	2331	2312	2312	2317	2317	1403	1403
R^2	0.3042	0.2816	0.2940	0.2735	0.3037	0.2793	0.2956	0.2745	0.2906	0.2287

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
Note: The regression includes all the explanatory variables presented in Table 2.3. A set of year dummies is included. To allow for the variations of trade openness and cultural indicators across countries, country dummies are not included.

Table 2.8: The Interactive Effect of Women in National Parliaments and Countries with Different Social Norms on the Residual Gender Wage Gap

	Basic			Two Years Lagged Fparl		
	(1)	(2)	(3)	(4)	(5)	(6)
Fparl	0.0043	0.0059*	0.0045	−0.0036	−0.0026	−0.0030
	(0.0063)	(0.0028)	(0.0026)	(0.0070)	(0.0032)	(0.0031)
Christ	0.0030	0.0262	0.0088	−0.0260	−0.0162	0.0053
	(0.0460)	(0.0315)	(0.0337)	(0.0450)	(0.0310)	(0.0355)
Buddh	−0.0257	−0.0044	−0.0214	−0.1212*	−0.1016	−0.1128
	(0.0538)	(0.0597)	(0.0586)	(0.0609)	(0.0654)	(0.0640)
Catho	0.0098	0.0165	−0.0017	−0.0357	−0.0316	−0.0097
	(0.0474)	(0.0280)	(0.0355)	(0.0445)	(0.0283)	(0.0369)
Commu	−0.0697	−0.1167	−0.0767	−0.2100*	−0.3105***	−0.2563**
	(0.1198)	(0.0958)	(0.0950)	(0.0967)	(0.0916)	(0.0886)
Mixed	−0.3102***	−0.3148***	−0.2922***	−0.4485***	−0.4535***	−0.4161***
	(0.0792)	(0.0485)	(0.0532)	(0.1069)	(0.0621)	(0.0669)
Muslim	0.0139	−0.0030	0.0147	−0.0265	−0.0531	−0.0194
	(0.0587)	(0.0374)	(0.0350)	(0.0674)	(0.0403)	(0.0388)
Ortho	0.0358	0.0388	0.0488	−0.0394	−0.0542	−0.0022
	(0.0469)	(0.0337)	(0.0370)	(0.0480)	(0.0344)	(0.0394)
Protest	−0.0160	0.0074	−0.0073	−0.0635	−0.0483	−0.0235
	(0.0401)	(0.0284)	(0.0334)	(0.0407)	(0.0285)	(0.0358)
Fparlbu	0.0027	−0.0039	0.0024	0.0165	0.0083	0.0157*
	(0.0078)	(0.0066)	(0.0063)	(0.0091)	(0.0081)	(0.0078)
Fparlcath	−0.0052	−0.0062*	−0.0043	0.0026	0.0019	0.0027
	(0.0069)	(0.0027)	(0.0027)	(0.0072)	(0.0032)	(0.0031)
Fparlchr	−0.0053	−0.0076**	−0.0054*	0.0016	0.0002	0.0013
	(0.0066)	(0.0028)	(0.0027)	(0.0071)	(0.0032)	(0.0032)
Fparlcom	−0.0008	−0.0012	−0.0005	0.0117	0.0137**	0.0137**
	(0.0082)	(0.0049)	(0.0049)	(0.0079)	(0.0051)	(0.0050)
Fparlmix	0.0090	0.0078*	0.0073	0.0286**	0.0280***	0.0275***
	(0.0073)	(0.0039)	(0.0039)	(0.0099)	(0.0058)	(0.0059)
Fparlmus	0.0056	0.0053	0.0057	0.0120	0.0118**	0.0113**
	(0.0083)	(0.0039)	(0.0038)	(0.0090)	(0.0044)	(0.0044)
Fparlorth	−0.0053	−0.0069*	−0.0057*	0.0053	0.0047	0.0049
	(0.0064)	(0.0030)	(0.0029)	(0.0072)	(0.0036)	(0.0035)
Fparlprot	−0.0060	−0.0077**	−0.0058*	0.0020	0.0010	0.0019
	(0.0063)	(0.0028)	(0.0026)	(0.0070)	(0.0032)	(0.0031)
Constant	0.0828	0.0705	0.0858	0.1924*	0.1933*	0.0927
	(0.0577)	(0.0430)	(0.0455)	(0.0976)	(0.0800)	(0.0796)
FE(Continent)	No	No	Yes	No	No	Yes
FE(Income)	No	Yes	No	No	Yes	No
N	2197	2193	2197	2180	2175	2180
R^2	0.3474	0.3291	0.3182	0.3404	0.3193	0.3141

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$.
Note: The regression includes all the explanatory variables presented in Table 2.3. A set of year dummies is included. To allow for the variations of trade openness and cultural indicators across countries, country dummies are not included.

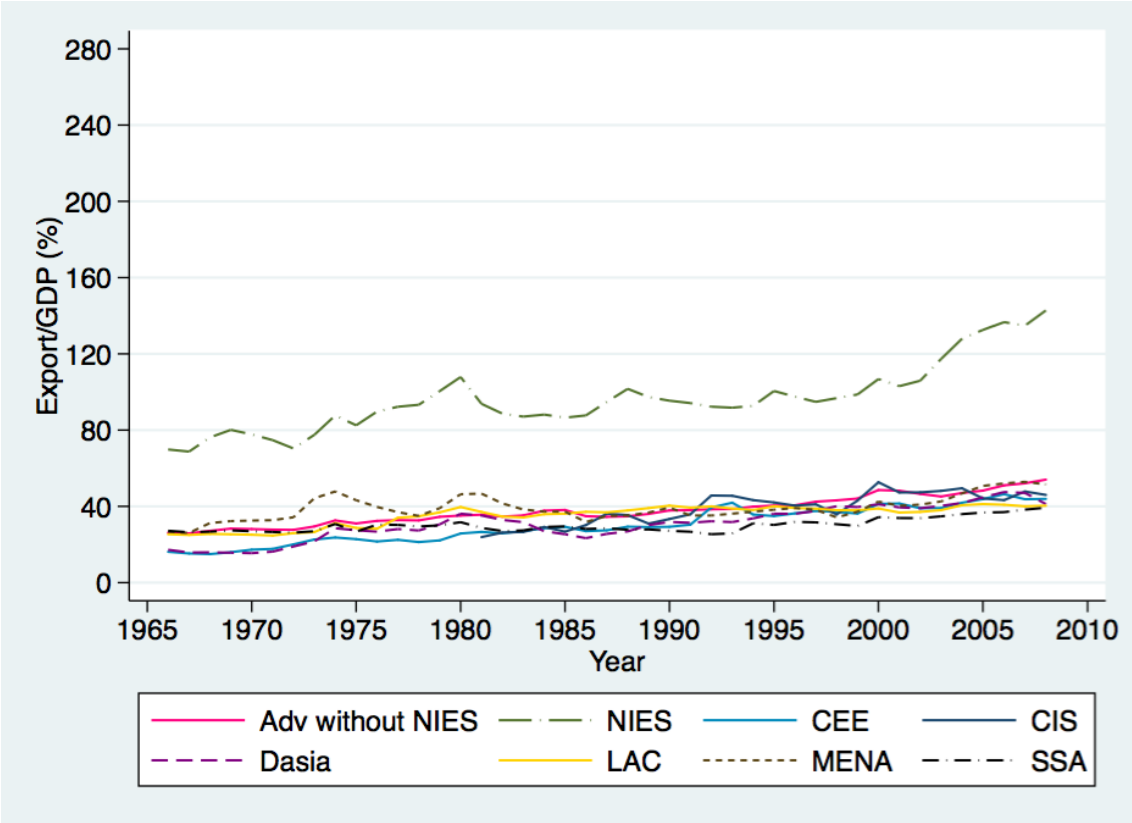
Table 2.9: The Interactive Effect of Women in National Parliaments and Different Development Levels on the Residual Gender Wage Gap

	Basic		**Two Years Lagged Fparl**		**1987 - 2007**	
	(1)	(2)	(3)	(4)	(5)	(6)
Fparl	−0.0023	−0.0042***	−0.0038	−0.0071***	−0.0045*	−0.0047***
	(0.0018)	(0.0012)	(0.0021)	(0.0014)	(0.0023)	(0.0014)
High	−0.0676*	−0.1046***	−0.1012**	−0.1552***	−0.1151*	−0.1047***
	(0.0340)	(0.0229)	(0.0349)	(0.0247)	(0.0461)	(0.0297)
UpM	−0.0260	−0.0730**	−0.0543	−0.1109***	−0.1213*	−0.1000**
	(0.0434)	(0.0250)	(0.0439)	(0.0264)	(0.0534)	(0.0326)
LowM	−0.0695	−0.1014***	−0.1154**	−0.1659***	−0.0994*	−0.0698*
	(0.0409)	(0.0235)	(0.0416)	(0.0248)	(0.0503)	(0.0310)
FparlH	0.0006	0.0028*	0.0022	0.0059***	0.0031	0.0040**
	(0.0019)	(0.0012)	(0.0021)	(0.0015)	(0.0024)	(0.0015)
FparlUM	−0.0001	0.0030	0.0010	0.0047*	0.0052	0.0061**
	(0.0024)	(0.0017)	(0.0027)	(0.0019)	(0.0028)	(0.0019)
FparlLM	0.0030	0.0043**	0.0063*	0.0092***	0.0049	0.0047**
	(0.0024)	(0.0015)	(0.0026)	(0.0017)	(0.0027)	(0.0017)
Constant	0.1082*	0.1864	0.1077*	0.2188**	0.1545**	0.1486***
	(0.0531)	(0.1182)	(0.0479)	(0.0762)	(0.0586)	(0.0443)
FE(Continent)	No	Yes	No	Yes	No	Yes
N	2198	2198	2180	2180	1307	1307
R^2	0.3081	0.2918	0.3135	0.2967	0.3029	0.2461

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$.
Note: The regression includes all the explanatory variables presented in Table 2.3. A set of year dummies is included. To allow for the variations of trade openness and cultural indicators across countries, country dummies are not included.

Appendix 2A

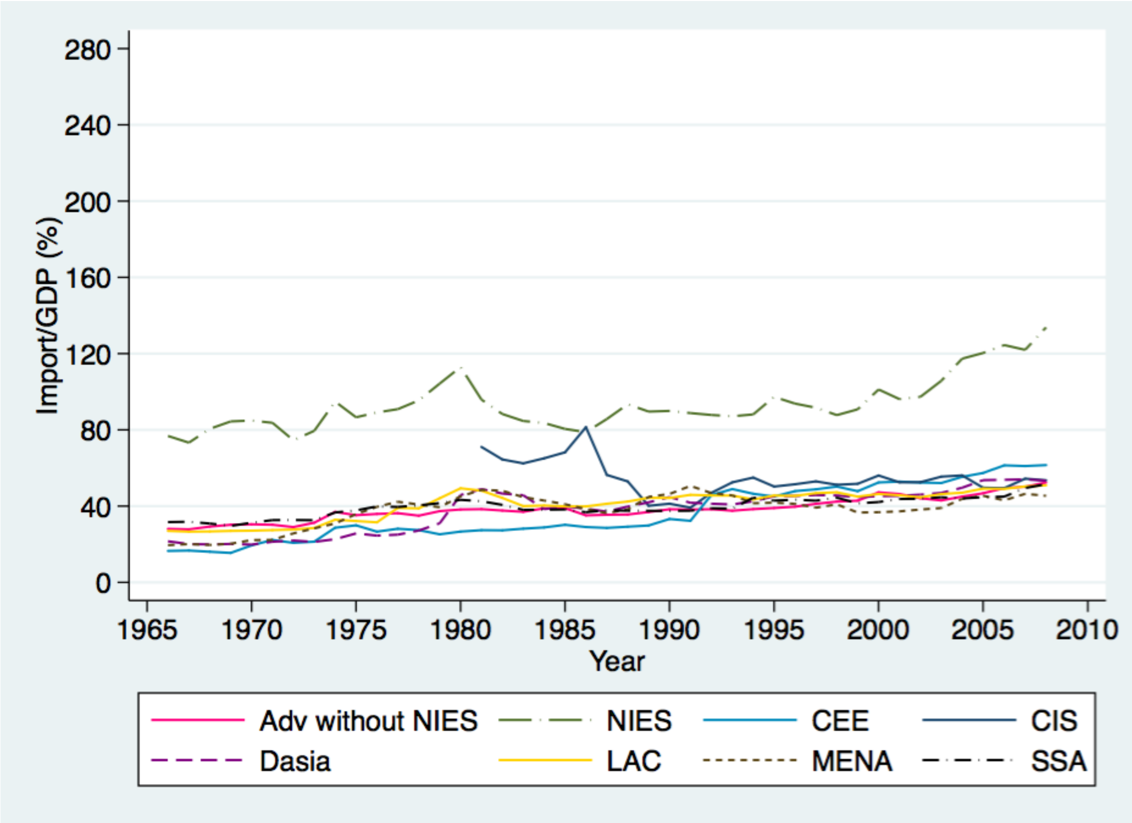
Figure 2.5: The Evolution of Trade Globalisation by Developing Region (Export/GDP)



Source: World Development Indicators (2010)

Note: Advanced Economics (Adv); Newly Industrialized Asian Economics (NIEs); Central and Eastern Europe (CEE); Commonwealth of Independent States (CIS); Developing Asia (Dasia); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA); and Sub-Saharan Africa (SSA)

Figure 2.6: The Evolution of Trade Globalisation by Developing Region (Import/GDP)



Source: World Development Indicators (2010)

Note: Advanced Economics (Adv); Newly Industrialized Asian Economics (NIEs); Central and Eastern Europe (CEE); Commonwealth of Independent States (CIS); Developing Asia (Dasia); Latin America and the Caribbean (LAC); Middle East and North Africa (MENA); and Sub-Saharan Africa (SSA)

Table 2.10: Definition of Variables

Trade	Trade (% of GDP)
Export	Exports (% of GDP)
Agri Ex	Agriculture Exports (% of GDP)
Manu Ex	Manufacturing Exports (% of GDP)
Serv Ex	Service Exports (% of GDP)
Import	Imports (% of GDP)
Agri Im	Agriculture Imports (% of GDP)
Manu Im	Manufacturing Imports (% of GDP)
Serv Im	Service Imports (% of GDP)
Fparl	Proportion of Seats Held by Women in National Parliaments (%)
	Dummy Variable For
Fparllow	Fparl at the Lower End of the Distribution (*Reference Group*)
Fparlmid	Fparl at the Middle of the Distribution
Fparlhigh	Fparl at the Higher End of the Distribution
Confu	Confucianism (*Reference Group*)
Christ	Christianity/Judaism
Buddh	Buddhism/Hinduism
Catho	Catholic
Commu	Communism
Mixed	Mixed
Muslim	Muslim
Ortho	Orthodox
Protest	Protestant
Dev	Developing Economies (*Reference Group*)
Adv	Advanced Economies
Low	Low Income Countries (*Reference Group*)
LowM	Lower-Middle Income Countries
UpM	Upper-Middle Income Countries
High	High Income Countries
	Interaction Terms
TradeDev	Trade × Developing Economies (*Reference Group*)
TradeAdv	Trade × Advanced Economies
TradeL	Trade × Low Income (*Reference Group*)
TradeLM	Trade × Lower-Middle Income
TradeUM	Trade × Upper-Middle Income
TradeH	Trade × High Income
Fparlconfu	Fparl × Confucianism (*Reference Group*)
Fparlbu	Fparl × Buddhism/Hinduism
Fparlcath	Fparl × Catholic

Table 2.10: *Continued*

Fparlchr	Fparl × Christianity/Judaism
Fparlcom	Fparl × Communism
Fparlmix	Fparl × Mixed
Fparlmus	Fparl × Muslim
Fparlorth	Fparl × Orthodox
Fparlprot	Fparl × Protestant
FparlL	Fparl × Low Income (*Reference Group*)
FparlLM	Fparl × Lower-Middle Income
FparlUM	Fparl × Upper-Middle Income
FparlH	Fparl × High Income
	Countries by Development Region
Adv	Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, France, Germany, Greece, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, UK, USA
NIEs	Hong Kong, Singapore, South Korea, Taiwan
CEE	Bulgaria, Hungary, Latvia, Poland, Turkey, Yugoslavia
CIS	Belarus, Georgia, Kazakhstan, Russia, Tajikistan, Ukraine, Uzbekistan
Dasia	Brunei, China, India, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam
LAC	Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad & Tobago, Uruguay, Venezuela
MENA	Morocco, Sudan
SSA	Botswana, Cote d'Ivoire, Ethiopia, Guinea, Kenya, Madagascar, South Africa, Tanzania, Uganda
	Countries by Cultural Background/Beliefs[a,b]
Confucianism	Hong Kong, Japan, Singapore, South Korea, Taiwan
Christ&Jud	Botswana, Canada, East Germany, Germany, Israel, Jamaica, Kenya, Madagascar, Netherlands, South Africa, Switzerland, Uganda
Buddhism	India, Sri Lanka, Thailand
Catholic	Argentina, Austria, Belgium, Bolivia, Brazil, Chile, Colombia, Costa Rica, Czech Republic, Ecuador, El Salvador, France, Guatemala, Honduras, Hungary, Ireland, Italy, Mexico, Nicaragua, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Slovakia, Slovenia, Spain, Uruguay, Venezuela
Communism	China, Czech Republic, Hungary, Russia, Slovakia, Vietnam
Mixed	Cote d'Ivoire, Guinea, Tanzania, Trinidad & Tobago
Muslim	Brunei, Indonesia, Kazakhstan, Malaysia, Morocco, Pakistan, Sudan, Turkey, Uzbekistan

Table 2.10: *Continued*

Orthodox	Belarus, Bulgaria, Ethiopia, Georgia, Greece, Russia, Ukraine,
Protestant	Australia, Barbados, Denmark, Latvia, New Zealand, Norway, Sweden, UK, USA

Note: For country classification, this table only displays the countries included in the meta-regression analysis in this chapter. Figure 2.1 to 2.3 present the results using global data.

a Gradstein *et al.* (2001, p.11) provide the clear definition of the belief classification, Our rule in deciding what is a dominant religion in a given country was that at least 40 percent of the population had to have the same religion, with the second most numerous religion not exceeding 25 percent of the population. It explains the Christian/Judaism grouping, they are grouped together as the size of the two are similar, whereas some other combinations are not grouped into a single category but just treated as mixed.

b It may be seen that some countries (e.g. Czech Republic and Slovakia) appear in multiple categories due to the breakdown of the communist system (transform to Catholic) yet not for all former communist countries (e.g. Hungary and Poland). This is because there are no observations for those countries in the communist period in the meta dataset for this analysis, so catholic was their dominant belief system in the years that data were observed.

Table 2.11: Meta Regression (1963-1999)

Weighting Scheme	No Weights (1)	No. of Estimates in Study (2)	(2)+ Precision of Estimates (3)	(2)+ Square Root of DF (4)
A. Paper				
Author Female	0.0068	0.0129	−0.0109	−0.0020
	(0.0141)	(0.0167)	(0.0145)	(0.0184)
B. Data Set				
New Entries	−0.0778**	−0.0691*	−0.0731**	−0.0693*
	(0.0269)	(0.0285)	(0.0236)	(0.0318)
Public	−0.0474*	−0.0665**	−0.0439	−0.0453*
	(0.0208)	(0.0208)	(0.0315)	(0.0223)
Private	0.0042	−0.0080	0.0351	0.0123
	(0.0276)	(0.0261)	(0.0277)	(0.0238)
Narrow Occ	−0.0567**	−0.0592**	−0.0269	−0.0863***
	(0.0203)	(0.0208)	(0.0245)	(0.0248)
Low Occ	0.0397	0.0541**	−0.0246	0.0703**
	(0.0208)	(0.0203)	(0.0363)	(0.0246)
Medium Occ	−0.0314	−0.0260	−0.0763*	−0.0504*
	(0.0183)	(0.0162)	(0.0350)	(0.0219)
High Occ	−0.1223***	−0.1106***	−0.1278***	−0.1567***
	(0.0194)	(0.0179)	(0.0278)	(0.0194)
Single	−0.1363***	−0.1327***	−0.1165**	−0.1544***
	(0.0237)	(0.0203)	(0.0363)	(0.0399)
Married	0.0697**	0.0670**	0.0480	0.0667
	(0.0266)	(0.0244)	(0.0392)	(0.0498)
Minority	−0.0273	−0.0449	0.0144	−0.0294
	(0.0206)	(0.0240)	(0.0229)	(0.0214)
Majority	0.0092	0.0163	−0.0017	−0.0146
	(0.0199)	(0.0229)	(0.0287)	(0.0213)
Full-Time	0.0112	0.0129	−0.0116	−0.0115
	(0.0134)	(0.0150)	(0.0146)	(0.0171)
C. Method of Estimation				
Bof	0.0147	0.0178	0.0025	0.0064
	(0.0084)	(0.0092)	(0.0027)	(0.0089)
Neumark	0.0342**	0.0192	0.0280**	−0.0055
	(0.0115)	(0.0144)	(0.0086)	(0.0152)
Reimers	−0.0070	0.0016	0.0188	0.0411
	(0.0381)	(0.0275)	(0.0188)	(0.0255)
Cotton	0.0075	−0.0010	0.0110	0.0027
	(0.0234)	(0.0302)	(0.0168)	(0.0277)
Brown	0.0016	0.0034	0.0416*	−0.0171
	(0.0198)	(0.0212)	(0.0194)	(0.0191)
Dummy	0.0078	0.0023	0.0523**	0.0043
	(0.0164)	(0.0190)	(0.0174)	(0.0198)
IV	−0.0070	−0.0116	−0.0659**	−0.0280
	(0.0263)	(0.0350)	(0.0254)	(0.0330)
Panel	−0.0020	0.0125	0.0349	−0.0911*
	(0.0255)	(0.0275)	(0.0559)	(0.0446)

Table 2.11: *Continued*

Weighting Scheme	No Weights (1)	No. of Estimates in Study (2)	(2)+ Precision of Estimates (3)	(2)+ Square Root of DF (4)
Heckman	−0.0168	−0.0255	0.0158*	−0.0493***
	(0.0126)	(0.0213)	(0.0078)	(0.0139)
D. Alternative Measures of Wages				
Not Hourly	0.0125	−0.0043	0.0306	0.0268
	(0.0221)	(0.0294)	(0.0214)	(0.0200)
Hourly Conducted	−0.0072	−0.0304	0.0385*	−0.0099
	(0.0187)	(0.0222)	(0.0166)	(0.0199)
Gross	0.0355	0.0407	0.0775	0.0271
	(0.0279)	(0.0249)	(0.0460)	(0.0366)
Potential Exp	0.0131	0.0403*	−0.0295	0.0047
	(0.0142)	(0.0165)	(0.0180)	(0.0168)
E. Variables for Workers' Characteristics				
Experience	0.0005	−0.0190	−0.0417	−0.0155
	(0.0280)	(0.0277)	(0.0251)	(0.0291)
Race/Immigrant	0.0130	0.0220	0.0064	0.0213
	(0.0160)	(0.0194)	(0.0197)	(0.0176)
Marital Status	−0.0405**	−0.0591***	0.0255	−0.0344*
	(0.0140)	(0.0173)	(0.0160)	(0.0166)
Kid	0.0133	0.0156	−0.0569***	0.0248
	(0.0159)	(0.0183)	(0.0158)	(0.0180)
Marital/Kid	−0.0460	0.0034	0.0136	−0.1200**
	(0.0406)	(0.0456)	(0.0422)	(0.0399)
Training	0.0030	−0.0076	−0.0105	−0.0258
	(0.0391)	(0.0389)	(0.0224)	(0.0222)
Tenure	0.0432***	0.0359*	0.0579***	0.0523***
	(0.0119)	(0.0157)	(0.0155)	(0.0139)
Occupation	0.0040	0.0018	0.0299*	0.0010
	(0.0099)	(0.0113)	(0.0123)	(0.0091)
Industry	0.0134	0.0216	−0.0105	0.0304*
	(0.0142)	(0.0141)	(0.0162)	(0.0141)
Government	0.0018	−0.0131	−0.0238	0.0203
	(0.0175)	(0.0181)	(0.0170)	(0.0188)
Union	0.0314	0.0435	0.0341*	0.0469**
	(0.0178)	(0.0244)	(0.0170)	(0.0174)
Share of Female	0.0542***	0.0540**	0.0462***	0.0577***
	(0.0156)	(0.0188)	(0.0137)	(0.0135)
FT-PT	−0.0144	−0.0056	−0.0209	−0.0172
	(0.0137)	(0.0162)	(0.0131)	(0.0145)
Urban	0.0294	0.0264	0.0138	0.0202
	(0.0156)	(0.0178)	(0.0171)	(0.0157)
Region	−0.0173	−0.0205	0.0099	−0.0179
	(0.0136)	(0.0164)	(0.0152)	(0.0161)
Constant	0.0837	0.0407	0.0200	0.1285
	(0.0708)	(0.0798)	(0.0758)	(0.0695)
N	1532	1532	1072	1225
R^2	0.5085	0.4981	0.7905	0.6019

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: Country and Year dummies are included in all specifications

Table 2.12: The Effect of Exports and Women in National Parliaments on the Residual Gender Wage Gap

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Export	0.0001	−0.0118	−0.0187*	0.0050	−0.0071	−0.0022	−0.0143*	−0.0204**	0.0019	−0.0073
	(0.0089)	(0.0063)	(0.0075)	(0.0058)	(0.0069)	(0.0082)	(0.0064)	(0.0074)	(0.0058)	(0.0066)
Fparl	−0.0016**	−0.0012**	−0.0004	−0.0018***	−0.0009*					
	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0004)					
FparlM						−0.0262*	−0.0218**	−0.0194*	−0.0241**	−0.0248**
						(0.0116)	(0.0084)	(0.0087)	(0.0083)	(0.0086)
FparlH						−0.0234*	−0.0131	−0.0040	−0.0277**	−0.0195*
						(0.0109)	(0.0087)	(0.0096)	(0.0087)	(0.0091)
Constant	0.0293	0.1149	0.1654	0.0574	0.1049	0.0482	0.1314	0.1777	−0.0082	0.0892
	(0.0389)	(0.1172)	(0.1188)	(0.1166)	(0.0763)	(0.0391)	(0.1174)	(0.1187)	(0.0730)	(0.0765)
FE(Continent)	No	Yes	Yes	No	No	No	Yes	Yes	No	No
FE(Income)	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Beliefs Dummy	No	No	Yes	No	Yes	No	No	Yes	No	Yes
N	2181	2181	2176	2181	2176	2181	2181	2176	2181	2176
R^2	0.2999	0.2840	0.3046	0.2849	0.3046	0.2982	0.2834	0.3065	0.2826	0.3061

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Note: The regression includes all the explanatory variables presented in Table 2.3. A set of year dummies is included. To allow for the variations of trade openness and cultural indicators across countries, country dummies are not included.

Table 2.13: The Effect of Imports and Women in National Parliaments on the Residual Gender Wage Gap

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Export	0.0001	−0.0118	−0.0187*	0.0050	−0.0071	−0.0022	−0.0143*	−0.0204**	0.0019	−0.0073
	(0.0089)	(0.0063)	(0.0075)	(0.0058)	(0.0069)	(0.0082)	(0.0064)	(0.0074)	(0.0058)	(0.0066)
Fparl	−0.0016**	−0.0012**	−0.0004	−0.0018***	−0.0009*					
	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0004)					
FparlM						−0.0262*	−0.0218**	−0.0194*	−0.0241**	−0.0248**
						(0.0116)	(0.0084)	(0.0087)	(0.0083)	(0.0086)
FparlH						−0.0234*	−0.0131	−0.0040	−0.0277**	−0.0195*
						(0.0109)	(0.0087)	(0.0096)	(0.0087)	(0.0091)
Constant	0.0293	0.1149	0.1654	0.0574	0.1049	0.0482	0.1314	0.1777	−0.0082	0.0892
	(0.0389)	(0.1172)	(0.1188)	(0.1166)	(0.0763)	(0.0391)	(0.1174)	(0.1187)	(0.0730)	(0.0765)
FE(Continent)	No	Yes	Yes	No	No	No	Yes	Yes	No	No
FE(Income)	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Beliefs Dummy	No	No	Yes	No	Yes	No	No	Yes	No	Yes
N	2181	2181	2176	2181	2176	2181	2181	2176	2181	2176
R^2	0.3000	0.2844	0.3057	0.2847	0.3065	0.2983	0.2837	0.3078	0.2827	0.3079

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: The regression includes all the explanatory variables presented in Table 2.3. A set of year dummies is included. To allow for the variations of trade openness and cultural indicators across countries, country dummies are not included.

3 The Effect of Technical Change on Gender Employment Differentials: The Case of Japan

Summary

- Using data from the Japanese Employment Status Survey in 1987 − 2007 and EUKLEMS, this chapter explores the changes in Japanese regular/irregular employment between male and female workers and the effect of technical development on the changes over time.
- Following the Autor-Levy- Murnane model, decomposition and regression methods are employed to analyse the within and between industry relationship between technical change and changes in workers' characteristics on the one hand, and the changes in the gender regular/irregular employment gap on the other.
- The findings of this chapter indicate that the total gender employment gap in Japan has fallen considerably in the period 1987 − 2007 as a consequence of the crisis and structural changes, as well as the fast growth of irregular employment for women but not for men.
- In addition, rising ICT intensity in sectors only increases the relative demand for female regular employment in sales jobs, while for other jobs it pushes women into irregular jobs, which is opposite to the effect for men.

3.1 Introduction

When it comes to gender parity, Japan seems to face a more blunt version of a trend the rest of the world is experiencing, and has frequently been ranked at the bottom of the world in female relative labour market outcomes and political empowerment (Blau and Kahn, 2003; Daly *et al.*, 2006; Miyoshi, 2008; OECD, 2012; World Economic Forum, 2012, 2013), despite many developed economies having succeeded in closing the gender pay gap and in maximizing the returns on women's investment in their human capital. With the poor government policies, patriarchal expectations, unsupportive work environments, and often undervalued by bosses, many well-educated Japanese women either suffer in low-paid, part-time jobs or are compelled to be in dead-end "office-lady" tracks serving tea for men, and are often pushed off their career once they become mothers, even if they may have outstanding analytical skills and graduate from an elite university (Alter, 2013; Beech, 2013; Haworth, 2013; Hewlett, 2013; Wingfield-Hayes, 2013).

The Japanese labour market takes on a rigid form in favour of the lifetime employment system (*shushin koyo*), the seniority payment principle[17] (*nenko joretsu*), and company-based trade unions (*kigyo-betsu rodo kumiai*), with strong discrimination against women (Peng, 2010; Tachibanaki, 2010; Yashiro, 2011; World Economic Forum, 2012; Beech, 2013; Haworth, 2013; Hewlett, 2013; Wingfield-Hayes, 2013). The advocates of lifetime employment explain various phenomena unique to the Japanese labour market, which are also strongly associated with the severe issue of a dual labour force with respect to regular (primary; *seishain*) and non-regular

[17] Combined with the lifetime employment system, the standard salary is set by employee's seniority and position to encourage employees accumulating their seniority in the same company until retirement.

employment (subordinate; *hiseiki shain*)[18]. Firms rarely dismiss their regular employees, and these workers do not casually quit or change their jobs. They benefit from the seniority system, and the candidates for promotion are also picked from the cluster (Tachibanaki, 2010; Yashiro, 2011). Over the course of the long term recession, commencing in the 1990s, companies have opted to increase the share of non-regular employees to cut labour costs rather than lay off current regular employees, and so a labour market dualism in Japan thus has formed (Doeringer and Piore, 1971; Miyoshi, 2008; Peng, 2010; Steinberg and Nakane, 2011). Non-regular workers comprised about one third of the share of total employment in the 2000s, of which the majority were women and youths (Shinozuka, 2006; Miyoshi, 2008; Peng, 2010; Tachibanaki, 2010; Yashiro, 2011). Their pay is considerably lower than for the regular workers, and the work experience and seniority of non-regular jobs are not positively associated with wages; only regular employment seniority can help increase wages (Shinozuka, 2006; Miyoshi, 2008). This labour market dualism increases the income and social security gap, not only between the regular and non-regular workers, but also between male and female workers, as women comprise the largest share of non-regular employment (Shinozuka, 2006; Miyoshi, 2008; Peng, 2010).

Concentrating on the supply side factors such as the changes in characteristics of men and women, the empirical literature has revealed there is a substantial portion of changes in female relative labour market outcomes remaining unexplained all over the world (Blau and Kahn, 1997, 2003, 2006), which implies the importance of the demand side story. In the case of Japan, a number of studies have attributed the

[18] Those with unlimited employment terms and full time work hours are regarded as regular employees, otherwise they are non-regular employees. Section 3.3 provides a more detailed definition on this point.

great gender pay gap to the disparity of higher education attainment between men and women, to the remarkably lower female labour participation, to the greater share of female part time workers, to the poor gender-specific policies, and possibly to the sexism in the society (Miyoshi, 2008; Abe, 2010; Tachibanaki, 2010; World Economic Forum, 2012; Beech, 2013; Haworth, 2013; Hewlett, 2013; Wingfield-Hayes, 2013). Of these, human capital accumulation has often been pointed out as one of the most important factors driving the changes in the Japanese gender pay gap (Kawaguchi, 2005; Miyoshi, 2008; Abe, 2010; Asano *et al.*, 2010; Ikenaga, 2009, 2011). However, despite the existence of a dual labour force in Japan having been extensively documented (Miyoshi, 2008; Sommer, 2009; Asano *et al.*, 2010; Peng, 2010; Tachibanaki, 2010; Steinberg and Nakane, 2011), most research on the Japanese gender gap in labour market performance does not take into account this issue and hence does not consider shifts within and between job types. This could therefore be another cause of changes in gender differentials.

Furthermore, recent empirical work has shown a growing interest in the effect of the development of technology on the labour market in particular in advanced Western economies. In early studies, the idea of skill biased technical change (SBTC) argues that technology changes have favoured higher-educated skilled workers and been against lower-educated unskilled workers, which has been a key explanation of rising wage inequality (Berman *et al.*, 1994, 1998; Machin and Van Reenen, 1998). As an increase in relative demand for the least-skilled low paid jobs compared to the intermediate level jobs is found, which is not in line with the hypothesis of SBTC, more recently literature has examined the effect of technical change on the demand for different jobs. A hypothesis of task biased technical change (TBTC) put forth by Autor *et al.* (ALM) (2003) argues that technology has replaced the routine tasks which are situated in the middle of wage and skill distribution, and been associated with an increase in relative demand for well-paid skilled jobs and low-paid least skilled jobs − this process causes so-called job polarisation, and this technical change has occurred alongside rising wage inequality.

Hence, the aim of this chapter is to understand how the regular and non-regular employment has been changing differently for male and female workers over time, and to discover the within industry relationship between workers' characteristics changes and technical change. This is the first study using Japan as a case to provide evidence of how the introduction of technology shifts the regular/non-regular employment in the perspective of gender. It will not only focus on the between industry task changes but also on the within industry employment shifts for women relative to men, as many studies have pointed out that the effect of technical change would occur within rather than between industries (Autor *et al.*, 2003; Spitz-Oener, 2006; Goos and Manning, 2007; Black and Spitz-Oener, 2006, 2010; Lindley, 2011). Overall, the results suggest that although the relative proportion of women in employment has increased in Japan, this has not all been in good/regular jobs, with the restructuring of the economy (between sectors) and ICT investment (within sectors) both having some role to play in the rising numbers of non-regular workers, particularly amongst women.

The chapter is organised as follows. Section 3.2 introduces the evolution of Japan's economy. Section 3.3 describes Japan's employment structure and the changing pattern of Japan's labour market between 1987 and 2007. Section 3.4 presents the concept of technical change and the empirical findings. Section 3.5 describes the data sets, and Section 3.6 discusses the conceptual framework. Section 3.7 uses industry level data to examine how the gender employment gap in Japan has been changing within and between sectors; and how the changes in workers' characteristics and ICT intensity have driven the within sector changes. The final section concludes.

3.2 The Evolution of Japan's Economy

In the decades of very strong economic growth following World War II, Japan's gross national product (GNP) reached the second largest in the world in the 1970s. After the Plaza Accord was signed in 1985, Japanese exports were hit hard by the yen appreciating, alongside the economic growth declining by about two percent from 1985 to 1986 (Figure 3.1). The government thus created an incentive for the expansionary monetary policies to offset the stronger yen, and the Bank of Japan lowered the discount rate from 5 percent to 2.5 percent during 1986 and 1987 (Powell, 2002; Koo, 2003). Along with financial deregulation, drastically easing monetary policies, large trade surpluses, and overconfidence of Japan's economy, one of largest financial bubbles in history was created. Aggressive speculation was inevitable, and asset prices inflated particularly in the real estate and stock markets. Contractionary monetary policies were hence implemented to restrain the bubble, and the discount rate was raised five times to 6 percent in the period 1989−1990, then the bubble burst (Powell, 2002; Koo, 2003; Citrin and Wolfson, 2006). The economy then entered the long term recession since the early 1990s, and GDP growth decreased sharply by more than four percentage points between 1990 and 1993, which is known as the "lost decade" in Japan (Hayashi and Prescott, 2002). According to Koo (2003), about 1400 trillion Japanese yen were erased with the combined crash of the stock and real estate markets during the decade, the equivalent of about three years' worth of Japanese GDP of 1989.

In the aftermath of the collapsing bubble, the plummeted value of land and banks' equity portfolios and the persistently high nonperforming loans constrained bank credit and crippled the confidence of household and business. The 1997 Asian Financial Crisis furthermore exacerbated the downturn, detonating a series of bankruptcies of firms and large financial institutes that had substantial investment in Southeast Asia in the early 1990s, leading to the two years' negative GDP growth. Despite the repeated fiscal stimulus packages, where government tried ten stimulus packages with more than one hundred trillion yen in total during the 1990s, the Japanese economy still failed to get away from its trough (Powell, 2002). As part of Japan's quantitative easing policy, the government and the central bank announced that interest rates were reduced to near zero for the purpose of eliminating deflation in 2001, but the strategy failed again. The stock price eventually bottomed out in 2003 following almost 3 percent economic growth and the falling ratio of nonperforming loans at major banks to below 2.5 percent in 2005. The zero rate policy was finally ended in 2006, until the global financial crisis arose in 2008 (Powell, 2002; Koo, 2003; Citrin and Wolfson, 2006; Steinberg and Nakane, 2011).

Domestic demand started playing a key role instead of exports in the development of the Japanese economy since the late 1980s. The excesses of debt, capacity and labour have imposed pressures on the corporate sector since the bubble burst, leading to a reduction in domestic private spending for both consumption and investment. As Figure 3.1 shows, the changing pattern of imports is strongly influenced by the business cycle compared to exports, where for example, the imports increased at a faster pace than the exports since 1986 until the recessionary period began (Citrin and Wolfson, 2006).

Due to the long term sluggish GDP growth since the early 1990s, Japan's unemployment rate went up from 2.1 percent in 1997, to 4.7 percent in 2002, and to 5.6 percent in July 2009 (Powell, 2002; Steinberg and Nakane, 2011). Given the historical and social convention of lifetime employment with the unemployment rate never more than 2.8 percent in the 1980s, the increase to 5.6 percent is significant in Japan (Powell, 2002). The manufacturing and construction industries were hit particularly hard by the recession, alongside a sharp decline in their employment (Figure 3.2). The ongoing structural change, moving away from manufacturing to the service sector, has naturally played a role in explaining the variation across industries, and the bursting bubble accelerated the ongoing decrease in employment in some sectors, of which the employment in manufacturing plummeted by almost eight percentage points between 1987 and 2007 and the construction industry shrank considerably in the period $1997 - 2007$. Along with the rapid growth of the aging population, the rising demand for the service of health care has expanded the sector significantly. Employment in professional and technology related services has also increased following the development of technology.

3.3 The Changing Patterns of Japan's Labour Market

The lifetime employment system (*shushin koyo*), the seniority payment principle (*nenko joretsu*), and company-based trade unions (*kigyo-betsu rodo kumiai*), alongside strong sexism, are the main components of the rigid Japanese labour market. (Peng, 2010; Tachibanaki, 2010; Yashiro, 2011). The lifetime employment system is that the firms recruit a particular amount of new graduates at a fixed time each year, and the employment term is indefinite. Employers prefer to hire new graduates fresh out of high school or university, especially those who have good potential to offer longer term service, and who are easier to mould. With the typical hiring process in Japan, graduates have to find good jobs before graduation during the job hunting period[19], otherwise, the opportunities for being interviewed are limited. The good jobs usually refer to those with unlimited employment terms, with full time work hours, as regular employees (*seishain*). By contrast, those who do not meet the above definitions and with a contract that clearly states the employment terms are regarded as non-regular employees (*hiseiki shain*) (Abe, 2010; Peng, 2010; Tachibanaki, 2010; Yashiro, 2011).

Non-regular employees include several different types: dispatched (*haken*), contract (*keiyaku*), entrusted (*shokutaku*), part time (*pato*), and *arbeit* (*arubaito*/temporary) employees. Dispatched workers are hired by temporary labour agencies and usually dispatched to large manufacturing firms, in which the majority are men (Shire and Van Jaarsvald, 2008; Tachibanaki, 2010). Contract and entrusted employees often refer to people belonging to the company subsequently, where the entrusted workers generally refer to those who are re-employed after retirement as contractors. The growing number of re-employed contract workers has led to an increase in the pension age gradually from 60 to 65 since the late 1980s (Steinberg and Nakane, 2011). Part time *arbeit* employees are usually hired in the service sectors associated with large proportions of women, especially housewives, and are paid less than other types of workers (Tachibanaki, 2010; Steinberg and Nakane, 2011).

The advocates of lifetime employment explain various phenomena unique to the Japanese labour market. Firms rarely dismiss the regular employees as they are

[19] Japanese school starts in April and ends in March. The college students start looking for a job about after summer in the third year (there are four years in Japanese university). Although it is controversial as they are supposed to study while they belong to university, this job hunting (*kigyo-betsu rodo kumiai*) style has been a social convention in Japan. Over time students have started hunting for a job increasingly earlier, as the failure in finding regular jobs would make them to be considered second-rate, which would strongly affect their whole working career as well as their life outside the labour market.

protected by strict employment regulation. These workers do not casually quit or change their jobs as the given company-specialised on-the-job training, and the skills and work experiences they have gained in a particular firm, may not be transferable to another firm. The seniority system is also a matter of fact where these regular workers would immediately lose their accumulation of seniority once they leave a firm (Tachibanaki, 2010; Yashiro, 2011).

In the aftermath of the bubble bursting in the early 1990s, companies have opted to increase their share of non-regular employees to cut labour costs rather than lay off current regular employees. The strict manpower regulations have compelled firms to hoard their regular workforce during the downturn, and thus to cut down the number of job vacancies for regular employees, instead hiring more non-regular workers, who can be legally dismissed and their numbers quickly adjusted to uncertainty about the future (Asano *et al.*, 2010; Tachibanaki, 2010). Besides, a series of deregulations on dispatch workers began to be put in place. According to the Manpower Dispatching Business Act in 1986, dispatched workers could only be employed in 26 occupations requiring highly professional skills. This limitation on occupation field was expanded in 1999, and the manufacturing sector was permitted to hire dispatched workers in 2003, with the extension of maximum contract terms from one to three years (Kuwahara, 2007; Shire and Van Jaarsvald, 2008; Peng, 2010; Steinberg and Nakane, 2011). This deregulation dramatically accelerated the decline of regular employment and the growth of non-regular employment in the 2000s (Table 3.3 and 3.4).

It is very difficult for non-regular workers to convert their contracts to regular ones, and their interests have been largely neglected by government, employers, and trade unions (Peng, 2010, Yun, 2010; Yashiro, 2011). The government has been in close alignment with the large enterprises over the issues of the expansion of non-regular employment and deregulating the restrictions on dispatch agencies and workers' dismissals. Moreover, most mainstream trade unions, usually representing the interests of male regular employees, deem that the growth of non-regular employment is unavoidable as it would protect industrial competitiveness and the benefits of their union members (Peng, 2010; Yun, 2010). A dual labour force hence has been formed in Japan with the shrinking of regular employment (primary), and the expansion of non-regular and temporary employment (subordinate) associated with a massive share of women and youths (Miyoshi, 2008; Peng, 2010; Tachibanaki, 2010; Yashiro, 2011).

The dualization processes began in the mid to late 1980s, with the pace of increase rapid in the late 1990s, where the share of non-regular workers has grown significantly from 18 percent in 1987 to 33 percent of total employment in 2007 (Figure 3.3), and the increase for female workers far exceeds the rise for male workers. In addition, the share of male regular employment has declined at a faster rate than for female workers, which is due possibly to the rapid shrinking of the male-dominated industries, to the increase in the number of part time workers and freeters[20] mainly among young men, and to those who are shifted from regular employees to contractors being offered voluntary retirement packages in the old cohort.

Figure 3.4 shows the changing pattern of regular and non-regular employment across industries. The health care sector stands out with a marked increase in both types of workforce compared to all other industries which have large decreases in regular employees over time, as a consequence of the growth of an ageing population

[20] Freeters are young people who do not have regular employment but who work at one or more part time jobs or at one short term job after another, excluding housewives and students. The term was coined by combining the English word free and German word Arbeiter (worker) (Tachibanaki, 2010).

in Japan (Ikenaga, 2009, 2011; Tachibanaki, 2010), where the employees in this sector are mainly women. With respect to the wholesale and retail trade sector, although the share of regular employment was still relatively large in 2007, the regular workforce is on a trend of being substituted by the non-regular over time, with a decrease in the regular by 4 percentage points and an increase in the non-regular by 3.6 percentage points during the two decades. A growth of non-regular employment is an ongoing phenomenon in almost all industries, particularly where large proportions of women, mainly housewives, are employed as part timers such as in the hotel and restaurant sectors followed by the retail, health care, and the education sectors (Kuwahara, 2007; Tachibanaki, 2010).

As mentioned in the previous section, the combined effects of Japan's structural change and the collapse of the bubble hit the manufacturing sector particularly hard, where the employment losses were concentrated among the regular workers. Considering the ban on hiring dispatched workers in the manufacturing sector was just lifted in 2003, the growth of non-regular employees in the sector is significant in the period of 1997 – 2007. The construction sector has also shown a dramatic contraction between 1997 and 2007, which is very likely continuing. According to Steinberg and Nakane (2011), the loss of employment in the manufacturing and construction industries contributed 87 percent of all job losses from 2007 to 2009. Transport and communication is next in terms of a decreasing regular workforce over time. Moreover, in addition to manufacturing being a male-dominated sector, there are almost no female workers in the construction and transportation sectors due to the heavy reliance on physical strength (Tachibanaki, 2010). These help explain the sharp decline in the male regular employment over the twenty years, especially after 1997 associated with a marked contraction of the manufacturing, construction and transportation sectors.

Many Japanese large corporations adopt a dual-track employment system man-agement (*sogoshoku*) and clerical (*ippanshoku*). The probability of implementing the dual-track system is positively associated with the firm size (Daly *et al.*, 2006; Tachibanaki, 2010), and workers are appointed to one or the other track at the time of their engagement. Management-track employees with a larger share of men are engaged in comparatively higher level tasks, and must accept transferring across the country as required. By contrast, those in clerical-track positions, which are mainly held by women, are involved in relatively general and routine support tasks, and are usually not required to transfer. The decision of Japanese corporations at the time of hiring is strongly driven by individual academic achievement in particular for female employees. As Tachibanaki (2010) states, women who have not graduated from top rank universities are very likely to be employed on the clerical track, in other words, those who only hold high school or junior college diplomas have almost no chance to play managerial roles in the Japanese labour market as they are considered a group of people planning to leave the market in a short time. On the other hand, a career-minded woman, who is ambitious to enter the management track but has been unable to attend a prestigious university, is more likely to find satisfaction at a small and medium size firm.

Gender trends in occupational choice combined with type of employment are similar to those noted with regard to type of industry following the structural changes in Japan (Table 3.1, Panel A). On top of that, the pattern of a dual-track employment system with a gender division is clearly shown, where a much larger share of women is involved in the non-regular clerical track and a relatively higher proportion of men is found on the management track. Although the gender employment gap in professional and managerial jobs has slightly shrunk, it remained large. The impact of recession and industrial structure changes as well as the gender difference in physical strength on occupational choice is clear. Following the expansion of the service industries, the share of sales and service employment especially for non-regular workers has increased dramatically for all workers in particular for women, but with a rapid decline of male regular workers by over five percentage points in production-related occupations.

Turning to the gender employment difference in relation to age groups (Table 3.1, Panel B), there is almost no gap between females and males in the youngest cohort, associated with a large reduction in the share of employment over the twenty years up to 2007. Several possible reasons can help explain the downward trend of youth employment: first, the increase of attainment in higher levels of education postpones their age of first entering the labour market; and fewer job opportunities are offered to youths due to the crisis (Steinberg and Nakane, 2011; Yashiro, 2011). For the age groups after the youngest, the gender differential in both types of employment remains extremely large in particular for those aged $35 - 49$; where the share of regular employment for men was at least 11 percentage points more than for women, but the non-regular workforce remained female-dominated. Note that although the gender gap of total employment in this cohort has been narrowing gradually over the two decades, it is due largely to the substantial decline in male regular employees. Surprisingly, the oldest cohort shows a steady growth of regular workers for both men and women compared to the falling regular employment across most age groups, which is very likely another causal fact to explain why the young generation have been struggling to find a good job during the downturn. Moreover, the share of female regular workers has been relatively stable compared to male workers over time, this reflects the fact that more and more women are choosing their career rather than settling down (Beech, 2013; Haworth, 2013) as in particular there is an uptrend found for female workers in the $25 - 34$ age group.

Looking in Figure 3.5 at the gender employment gap by educational levels, both men and women with higher education have been an increasing proportion of employment compared to the lower level of education, however, the gender gap in the university or graduates category is found to be very large. The gender difference in junior college is also largely associated with a greater share of female workers, where the curricula of junior college frequently focuses on providing for a short term career before marriage or preparation for marriage. As has been mentioned, female educational background at the time of their hiring is critical, the observed large educational gap between men and women helps to explain why the majority of women are in clerical-related occupations but men are in managerial and professional jobs.

Japan is a conservative, patriarchal society, the young are dominated by the old, and the marginalization of women is pervasive. Despite the fact that the share of higher-educated women is rising, most of them have found it difficult to pursue their careers following the poor gender-specific legislations, unsupportive work environments, and social expectations for women. Those women are either shunted into a dead-end supporting track, as "office lady" roles serving tea for men, or pushed into low-paid, non-regular jobs, the reason for them doing these menial jobs are dictated by her gender even if they may have outstanding analytical skills and graduate from an elite university (Beech, 2013; Hewlett, 2013). Moreover, many well-qualified women leave the labour market because of the lack opportunities for career development, the poor family friendly policy provision and the lack of available day-care which together compel them to quit once they have their first child (Haworth, 2013;

Hewlett, 2013; Wingfield-Hayes, 2013).

In order to follow the international commitment for the elimination of gender discrimination, the Equal Employment Opportunity Law (EEO Law hereafter) was passed in 1985 and was enacted in April 1986 in Japan. However, the content itself was very ambiguous, there were no clear Law Articles prohibiting gender discrimination in recruitment, hiring, allocation, and promotion, due to the anger against the law from society. It was worried that women would take over the jobs from the relatively lower qualified men, the enforcement of the law would destroy their traditional social norms or women taking care of homes (Chiou, 2007). As the EEO Law 1985 was unsurprisingly ineffective since then, the Japanese government passed a modification of the EEO Law in 1997, which clearly stated the prohibition against gender discrimination in workplaces, that employers are under the obligation to practice gender equality and have actions to prevent sexual harassment in workplaces, etc. Yet the effectiveness of the law still remains in doubt, as it does not really help change the stereotype of gender roles in the society. Hence in 2002, a policy research institution on equal employment opportunities was established to tackle the persistent gender inequality in the Japanese labour market (*ibid*). The unfriendly work environment and very slow improvement in the concept of gender roles are definitely amongst the main factors making Japanese women unable to remain in the labour market. However, it should also be known that male workers and employers should not always be blamed, since some women decide to only remain in the market until getting married and self select into relatively lower position jobs compared to their education.

Tachibanaki (2010) has brought up another idea about why there is a great amount of women playing a supporting role in the labour market. Following the conventional wisdom in Japan, higher education for women is still largely perceived as giving a better chance to find a better qualified husband who, for instance, works in a prestigious company in a good position. Some women are keen to enter prestigious companies in specific geographical locations, as the chance of finding a "good marriage partner" is higher than in other areas. Hence, some female graduates from elite universities may give up the management-track positions at small and medium size firms but deliberately self-select into clerical jobs. As the tasks are mainly routine and supportive, corporations have been increasing the share of non-regular employees in the clerical track under the long term economic depression. Many female high school and junior college graduates thus are compelled to enter the non-regular clerical track while the regular positions have been occupied by the higher educated women (*ibid*), which results in the marked increase in female non-regular employment in clerical occupations over the twenty years up to 2007 (Table 3.1).

Since the late 1990s, a downward trend in average wages has been revealed in Japan. Between 1997 and 2007 average nominal wages have fallen by 9.4 percent (Steinberg and Nakane, 2011). Various thoughts have been put forward to explain the fall (Sommer, 2009; Steinberg and Nakane, 2011): first, Japanese firms tend to raise bonuses to reward highly performing workers, rather than increase their monthly base wages. The large share of bonus and overtime payments has been cut down during the recession to adjust labour costs for corporations. However, it is found that both negotiated wages and bonuses for regular workers actually rose every year in the period between 1997 and 2007 (Steinberg and Nakane, 2011). Another argument for the falling average wages is that the younger workers who are not so well paid have been replacing the older employees with high payments. This seems not very persuasive as it can be seen in Table 3.1 that the employment of the oldest cohort is much greater than for the young generation. Most empirical studies have reached an agreement that the rapid growth of non-regular employment is the main explanation for the declining average wages and wage inequality in Japan (Shinozuka, 2006; Sommer, 2009; Tachibanaki, 2010; Steinberg and Nakane, 2011). Consistent with this, it is noted that average wages have been falling since the late 1990s, while the share of non-regular workers has been increasing dramatically in the period, where it was about 23 percent of total employment in 1997 rising to 30 percent in 2002, and to 33 percent in 2007 (Figure 3.3).

3.4 The Effect of Technical Change on Jobs

Recent research has shown growing interest in the effect of the declining price of information technology on changes in relative demand for workers with different levels of skill. In earlier studies, the idea of skill biased technical change (SBTC) argued that technical change has resulted in rising wage inequality as it has favoured higher-educated skilled workers and been against lower-educated unskilled workers (Berman *et al.*, 1994, 1998; Machin and Van Reenen, 1998). However, some studies have disagreed with the SBTC hypothesis in explaining the growth of wage inequality (Card and DiNardo, 2002; Lemieux, 2006). For instance, it is observed that although technical change increased the relative demand for the higher-skilled workers in the 1980s, it actually increased the demand for unskilled workers in the other periods in the US[21]. As this phenomenon is difficult to reconcile with the SBTC hypothesis, more recent literature has suggested an alternative effect of technical change on the demand for workers at different levels of the skill and wage distributions. A

[21] It is argued that the rising wage inequality in the 1980s in the US was a temporary phenomenon due possibly to the decrease in the real minimum wage, unionization rate, etc.

hypothesis of task biased technical change (TBTC) put forth by Autor *et al.* (ALM) (2003) argues that the relative demand for workers at the middle of the wage and skill distribution has been decreasing, as the middle paid jobs are usually routine tasks and can be substituted by computers/technology, while the relative demand for those at the top and the bottom have been increasing, leading to job polarization in labour market.

Empirical literature on the issue of technical change resulting in job polarization alongside rising wage inequality has mainly focused on Western economies so far. Categorising the nature of workplace tasks[22], ALM have found evidence of a hollowing out of the US skill distribution as a result of TBTC. A similar story is revealed in the case of Germany by Spitz-Oener (2006), Goos and Manning (2007) for the UK, and Goos *et al.* (2009) for sixteen European countries, with a remarkably greater increase in demand for high paying professional and managerial jobs together with an increase in low paying service jobs and a decrease in many of the middle paying clerical and skilled manual occupations in manufacturing. Goos and Manning (2007) in addition investigate the impact of several potential factors, such as female labour participation, the changing pattern of age and education, and trade, on the composition of the UK labour force, and conclude that even though these factors do somewhat help explain the employment changes in at least some occupations, the ICT based polarisation hypothesis is likely to be the most suitable explanation for job polarisation. Looking at the composition of nine Western European countries, the US and Japanese labour forces, the findings from Michaels *et al.* (2009) are also in line with the TBTC hypothesis. A significantly positive relationship is found between the growth of industry ICT intensity and the change in the share of college

[22] Routine versus non-routine, manual versus information processing.

educated workers, but industries that experienced a growth in ICT experienced falls in relative demand for medium skilled workers. In line with the findings of Goos and Manning (2007), it is also noted that in these skill demand equations, technical change is a stronger explanatory variable than trade.

There is little existing literature exploring the relationship between the growth in ICT and changes in female relative labour market outcomes. Following ALM models, Black and Spitz-Oener (2006, 2010) find evidence of polarisation in employment for both women and men in the German labour market, and this tendency is showing a stronger impact on women than men in recent decades. Women experienced rising relative demand for non-routine analytical and interactive tasks with higher skill requirements. Yet the most significant difference between the genders is that the demand for women in routine tasks has fallen strongly as a consequence of technical change but not for men. They additionally suggest that relative task changes explain the fall in the gender pay gap in recent decades. Lindley (2011) has discovered similar results in the case of the UK labour market, employment polarisation as a consequence of technical change has been only for women but insignificant for men. It is also found that the within industry and occupation changes in the demand for women in moderate computer tasks has grown relative to men, but the share of women in complex computer jobs has declined relative to men, which suggests gender biased TBTC in the UK labour market.

There has been surprisingly little research investigating the effect of technical change on Japanese employment structure, nor literature focusing on the gender perspective. One of the exceptions is Ikenaga (2009), who uses the data sets of the Japanese Population Census for 1980 to 2005 with detailed occupation classification including total employment to investigate whether there is a trend of polarisation in the labour market, and to analyse the relationship between technical change and the trend using the ALM framework. A hollowing out of the Japanese skill distribution is observed, associated with a rising relative demand for tasks at the top and the bottom of the skill distribution and a decline in the middle. Contrary to the findings in Western countries, the between industry changes are found to have a greater impact on the changes in types of tasks than the within industry changes. In addition, the growth of industry ICT intensity has a significantly negative effect on routine tasks, yet a positive effect on non-routine analytic tasks.

A few studies have investigated the relationship between technical change and the relative demand for regular and non-regular employment, nevertheless, the changes in demand for jobs in different skill levels for both types of employment have not yet been exposed. Sunada *et al.* (2004) reveal that the use of ICT standardizing task flows has devalued the accumulated experience of regular workers, reduced the number of regular positions, and increased the relative demand for non-regular workers. Although the changes in industrial composition are a very important factor in explaining the growth of non-regular employment between 1997 and 2006, it is also found that those firms with higher ICT usage are associated with more non-regular employment. Asano *et al.* (2010) reach a similar conclusion where the firms that utilize ICT intensively tend to have the higher share of non-regular workers compared to firms without ICT usage, however, it is also noted that the quantitative effect of technical change on Japanese employment structure is limited.

Most of the literature on Japan's female relative labour market outcomes has focused on supply side explanations such as the changing accumulation of human capital and the significant growth of female labour force participation (Miyoshi, 2008; Abe, 2010; Asano *et al.*, 2010). A number of papers show an awareness of the fast growing non-regular employment arguing it is one of key drivers of the rising income inequality (Shinozuka, 2006; Sommer, 2009; Tachibanaki, 2010; Steinberg and Nakane, 2011). As for the pay differential between regular and non-regular workers, it is large[23] and the wages of regular employees increase with their accumulated seniority and work experience, which have very little effect for non-regular employees in Japan (Tachibanaki, 2006, 2010; Miyoshi, 2008). This labour market dualism in Japan has increased the income and social security disparities, not only between the regular and non-regular employees, but also between the senior and the youngest workers, and between men and women, as the young and women comprise the largest share of non-regular employment (Shinozuka, 2006; Miyoshi, 2008; Peng, 2010). However, there has been little research discovering the implications of the development of the Japanese dual labour market structure in the perspective of gender, nor focusing on how employment status interacts with technical change. Furthermore, along with the effects of global integration, the economic structure of Japan has shifted away from agriculture and toward manufacturing and service sectors, which inevitably leads to a change in the relative demand of the labour force. Empirical literature indicates that moving towards the service sectors has a positive impact on female employment and earnings (Blau and Khan, 1992; Murphy and Welch, 1993), as it increases women's competitiveness to men due to a lower reliance on physical strength.

Against this background, this chapter aims to investigate the changing pattern of the employment polarisation between regular and non-regular workers with respect to between and within industry shifts for women relative to men. It is interesting to

[23] For example, the ratio of hourly wages for part-time female workers to full-time female workers was 65.7% in 2004, and for male workers was 50.6% in 2004 (Tachibanaki, 2010).

understand whether the structural changes give Japanese women better chances to enter a better employment track or it actually pushes women into a more unpleasant situation. Besides, the effects of workers' characteristics changes and technical change on the relative demand for different types of employment between men and women within industry will also be explored, as it has been suggested that the effect of technical change occurs within rather than between industry (Autor *et al.*, 2003; Spitz-Oener, 2006; Goos and Manning, 2007; Black and Spitz-Oener, 2006, 2010; Lindley, 2011). Following the findings in Western economies, it is expected to reveal the shifts in Japan's employment showing a hollowing out across the skill distribution as a consequence of technical change, and perhaps a greater employment polarisation among women relative to men.

3.5 Data

The two data sets used in this study are the Employment Status Survey (ESS) and the EU KLEMS data. Published every five years, the ESS is a large cross section dataset conducted by the Ministry of Internal Affairs and Communications in Japan. It covers approximately 450,000 households in 2007 with respondents who are aged 15 years old or more, but excludes those who are resident in cantonment or ships of the Self-Defence Forces, foreigners and their dependents, and prisoners. The ESS provides information on the condition of the employment structure, such as whether engaged in work, type of employment, industry, occupation, working days and hours, whether wishing to change a job, whether having additional jobs, etc. It also contains personal information on sex, marital status, educational status, relationship to the head of household, etc. This analysis utilizes the published, aggregate ESS[24] data at the industry level in 1987, 1992, 1997, 2002, and 2007 only for those who are employees[25], and covers the variables of type of employment, occupation, sex, age, and education. Marital status is not included due to the data at the two-digit industry level only being available in 2007, which thus is not able to provide the information on changes of workers' marital status over time.

The EU KLEMS database is part of a European Commission financed research project, which aims to support empirical and theoretical research in the field of economic growth and productivity mainly for European Union member states, as well as Japan and the United States. Detailed information on value added, capital investment and compensation, as well as labour inputs at the broadly two-digit industry level from 1970 onwards has been covered in the database, which recruits data from the national statistical office of each country, where the harmonisation of the basic data has been considered in order to create consistent and uniform growth accounts (Timmer *et al.*, 2007). The datasets for Japan's Capital Accounts are mainly constructed using data from the Fixed Capital Formation Matrix (FCFM) in the Input-Output Tables. The Perpetual Inventory Method is employed to build the capital stock measure using the investment flow data for various types of capital. ICT[26] real fixed capital stock share in total capital stock[27], and ICT real gross fixed capital formation share in total capital formation[28] are used as the measure

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[24] Due to the availability of the EES data, this analysis can only measure the changes in employment every five years. It should be acknowledged that quite a lot can change within this period and may hence overlap the spells of important factors on the economy and the labour market. Yet the time of the available datasets actually have quite good coverage for the important events in the Japanese economy (Appendix Table 3.19)

[25] Those who are self-employed are not taken into account in this study.

[26] ICT assets are Computing equipment, Communications equipment and Software.

[27] According to Timmer et al. (2007, p.32), " In the PIM, capital stock is defined as a weighted sum of past investments with weights given by the relative efficiencies of capital goods at different ages."

[28] Note that the gross fixed capital formation can be negative as it "consists of new investments and net sales of second-hand assets" (Timmer et al., 2007, p.39), according to the European System of

of technology intensity at the industry level in this analysis[29]. These measures of ICT have been widely used in the empirical research in recent years (Michaels, *et al.*, 2009; Lindley, 2011; Lindley and Machin, 2011) to examine the impact of the rapid fall in ICT prices and the differences in reliance on ICT usage (sometimes associated with international trade) across industries on changing skill demand in the labour market. Considering that the following analyses are based on the Fixed Effects models, the estimated coefficients will be seen to identify the changes in specific variables within industries. Hence, using the measure of ICT capital stock will be expected to show how the change in employment is caused by the change in the capital stock, and using the measure of ICT capital formation will be expected to show how the change in employment is caused by the rate of change of capital. The stock of the capital may be the more relevant measure in this analysis as capital is expected to last more than one period, though given the fact that the lifespan of capital is declining with the development of ICT, as technology and computers become outdated more quickly, the rate of change is also of interest.

The main idea of this chapter is to consider the relationship between technical change and changes in gender regular/non-regular employment differences in the same industries. This requires the matching of data from these two different sources and at different levels of industry disaggregation. There is a technical issue arising in the construction of the sample, as the industry level in EES is classified according to Japan's Standard Industrial Classification, but the EU KLEMS industries are

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Accounts 1995

[29] The changes in both datasets across one digit industries and time can be seen in Appendix Table 3.6 and 3.7. It is shown that, apart from the government sector (L) in the period of 1987-1997, the share of ICT Capital increases significantly across all industries over time in particular to the Finance and Insurance (J), and Renting Machinery and Equipment, Professional Services (K71t74) industries. It also seems to point out that the growth of the ICT investments were lower for the majority of industries after 1997, when the Asian Financial Crisis happened.

according to the European NACE revision 1 classification.

Aggregate sectors of the ESS data in 1987, 1992, and 1997 can be broken down into around fifty industries at the two-digit level, and in 2002 and 2007 for over one hundred industries at the three-digit level. To enable the estimation to be conducted, the industries therefore are arranged to the lowest possible level of aggregation with a concern for all the included variables. For the EU KLEMS, the available data is for 38 disaggregated industries at broadly two-digit level, and also, due to the unavailability of 2007 data, the 2006 data is employed instead for matching to ESS data for 2007. In order to merge these two data sets, the ESS data has been arranged following the European NACE revision 1 classification (the detailed industries comparison is in Appendix 3A Table 3.12). The detailed definition of dependent and explanatory variables used in this chapter can also be found in Appendix 3A Table 3.11.

3.6 Methodology

3.6.1 Decomposition

This subsection will investigate how the regular/non-regular employment has been changing differently for male and female workers within and between industries by using the Japanese Employment Status Survey in 1987, 1992, 1997, 2002, and 2007. Following ALM (2003), and Black and Spitz-Oener (2006, 2010), the gender employment changes over time can be decomposed as follows:

$$\Delta G_\tau = \Delta\left(E_M - E_F\right)_\tau = \sum{}_j{}^n\left(\Delta E_{igj\tau}\bar{\alpha}_{gj}\right) + \sum{}_j{}^n\left(\Delta\alpha_{igj\tau}\bar{E}_{gj}\right) = \Delta E^b_{ig\tau} + \Delta E^w_{igj\tau}$$
$$j = 1, ..., n\,(n = 38) \qquad \& \qquad \tau = time_2 - time_1 = t - t_{-1} \tag{3.1}$$

where,

ΔG_{τ} is the total change in the gender employment gap in period τ.

$\Delta E_{igj\tau}$ is the change in the different type of employment i (R and NR represents regular and non-regular employees respectively), of gender g (M and F represents male and female workers respectively), in industry j in period τ as a share of aggregate employees.

Note that the equation only focuses on those who are employees, in other words, those who are self-employed or working at home are not taken into account, thus the denominator here is the total employees. For regular employees, it includes regular staff as well as those who are executives of their company or corporation.

$\Delta\alpha_{igj\tau}$ is a measure of the change in the proportion of different type of employment i of gender g in industry j's workforce in period τ.

An overscore denotes an average over time:

$\bar{\alpha}_{gj} = (\alpha_{gjt} + \alpha_{gjt-1}) \div 2$; $\bar{E}_{gj} = (E_{gjt} + E_{gjt-1}) \div 2$

$\Delta E^{b}_{ig\tau}$ reflects the changes in aggregate employees of gender regular/non-regular workers attributable to changes in employment share between industries as a consequence of structural changes.

$\Delta E^{w}_{igj\tau}$ reflects within industry gender regular/non-regular employment changes that result from the changes in workers' characteristics and in the development of technology.

The changes in the gender employment gap can be written as:

$$
\begin{aligned}
\Delta G_\tau &= (E_{RM} - E_{RF})_2 - (E_{RM} - E_{RF})_1 + (E_{NRM} - E_{NRF})_2 - (E_{NRM} - E_{NRF})_1 \\
&\equiv \underbrace{\sum_j \bar{\alpha}_{Mj} \left(E_{RMj2} - E_{RMj1}\right)}_{(1)} - \underbrace{\sum_j \bar{\alpha}_{Fj} \left(E_{RFj2} - E_{RFj1}\right)}_{(2)} \\
&+ \underbrace{\sum_j \bar{\alpha}_{Mj} \left(E_{NRMj2} - E_{NRMj1}\right)}_{(3)} - \underbrace{\sum_j \bar{\alpha}_{Fj} \left(E_{NRFj2} - E_{NRFj1}\right)}_{(4)} \\
&+ \underbrace{\sum_j \bar{E}_{Mj} \left(\alpha_{RMj2} - \alpha_{RMj1}\right)}_{(5)} - \underbrace{\sum_j \bar{E}_{Fj} \left(\alpha_{RFj2} - \alpha_{RFj1}\right)}_{(6)} \\
&+ \underbrace{\sum_j \bar{E}_{Mj} \left(\alpha_{NRMj2} - \alpha_{NRMj1}\right)}_{(7)} - \underbrace{\sum_j \bar{E}_{Fj} \left(\alpha_{NRFj2} - \alpha_{NRFj1}\right)}_{(8)}
\end{aligned}
\tag{3.2}
$$

where, for instance,

E_{RMj2} is the share of male regular employment in industry j in total employees at *time* 2.

α_{RMj2} is the proportion of male regular employment in industry j at *time* 2.

Terms (1) to (4) represent the changes in male and female regular/non-regular employment between industries. The fifth to eighth terms represent within industry gender regular/non-regular employment changes.

A more detailed equation is written as follows:

$$
\begin{aligned}
&\left(\frac{E_{RM}}{T}-\frac{E_{RF}}{T}\right)_2-\left(\frac{E_{RM}}{T}-\frac{E_{RF}}{T}\right)_1+\left(\frac{E_{NRM}}{T}-\frac{E_{NRF}}{T}\right)_2-\left(\frac{E_{NRM}}{T}-\frac{E_{NRF}}{T}\right)_1\\
\equiv&\underbrace{\sum_j\left[\left(\frac{\bar{E}_{Mj2}}{T_{j2}}+\frac{\bar{E}_{Mj1}}{T_{j1}}\right)\div 2\times\left(\frac{E_{RMj2}}{T_2}-\frac{E_{RMj1}}{T_1}\right)\right]}_{(1)}-\underbrace{\sum_j\left[\left(\frac{\bar{E}_{Fj2}}{T_{j2}}+\frac{\bar{E}_{Fj1}}{T_{j1}}\right)\div 2\times\left(\frac{E_{RFj2}}{T_2}-\frac{E_{RFj1}}{T_1}\right)\right]}_{(2)}\\
+&\underbrace{\sum_j\left[\left(\frac{\bar{E}_{Mj2}}{T_{j2}}+\frac{\bar{E}_{Mj1}}{T_{j1}}\right)\div 2\times\left(\frac{E_{NRMj2}}{T_2}-\frac{E_{NRMj1}}{T_1}\right)\right]}_{(3)}-\underbrace{\sum_j\left[\left(\frac{\bar{E}_{Fj2}}{T_{j2}}+\frac{\bar{E}_{Fj1}}{T_{j1}}\right)\div 2\times\left(\frac{E_{NRFj2}}{T_2}-\frac{E_{NRFj1}}{T_1}\right)\right]}_{(4)}\\
+&\underbrace{\sum_j\left[\left(\frac{\bar{E}_{Mj2}}{T_2}+\frac{\bar{E}_{Mj1}}{T_1}\right)\div 2\times\left(\frac{E_{RMj2}}{T_{j2}}-\frac{E_{RMj1}}{T_{j1}}\right)\right]}_{(5)}-\underbrace{\sum_j\left[\left(\frac{\bar{E}_{Fj2}}{T_2}+\frac{\bar{E}_{Fj1}}{T_1}\right)\div 2\times\left(\frac{E_{RFj2}}{T_{j2}}-\frac{E_{RFj1}}{T_{j1}}\right)\right]}_{(6)}\\
+&\underbrace{\sum_j\left[\left(\frac{\bar{E}_{Mj2}}{T_2}+\frac{\bar{E}_{Mj1}}{T_1}\right)\div 2\times\left(\frac{E_{NRMj2}}{T_{j2}}-\frac{E_{NRMj1}}{T_{j1}}\right)\right]}_{(7)}-\underbrace{\sum_j\left[\left(\frac{\bar{E}_{Fj2}}{T_2}+\frac{\bar{E}_{Fj1}}{T_1}\right)\div 2\times\left(\frac{E_{NRFj2}}{T_{j2}}-\frac{E_{NRFj1}}{T_{j1}}\right)\right]}_{(8)}
\end{aligned}
\tag{3.3}
$$

where,

T_{jt} is the total employees in industry j at time t.

3.6.2 Regression

The technical change hypothesis suggests that if the changes in employment composition are as a consequence of technical change or human capital accumulation, the changes should occur within industry. Changes between industries would be result of structural changes or the crisis. In order to explore the implications of the development of the Japanese dual labour market, regression on the pooled data set with time dummies from 1987 to 2007 is thus applied to investigate the within industry relationship between technical change and workers' characteristics changes on the one hand, and the change in the gender employment gap on the other. All the specifications are weighted by the cross-period average of industries' share in total employment with concern for the large variations in the number of persons employed across industries. A clustering approach is also applied, defined as the different sectors, to correct the possible biases in the standard error due to the matching of data from two different sources, where the industries are arranged to the lowest possible level of aggregation. The regression estimation is formed as follows:

$$\Delta E^{w}_{igj\tau} = \beta_0 + \beta_1 \Delta C_{j\tau} + \beta_2 \Delta LF_{gj\tau} + \beta_3 Period_\tau + \varepsilon_{igj\tau} \tag{3.4}$$

where,

The equation is examined separately by gender

$\Delta E^{w}_{igj\tau}$ is the within industry changes in the employment i as a share of employees in industry j, of gender g, in period τ.

$\Delta C_{j\tau}$ is the technical change in industry j in period τ.

$\Delta LF_{gj\tau}$ is the change in workers' characteristics, such as age, education, and occupation, of gender g in industry j in period τ.

$Period_\tau$ is a set of time dummy variables to remove the common time trend for four periods of $1987 - 1992$ (the reference period), $1992 - 1997$, $1997 - 2002$, and $2002 - 2007$.

This subsection is intended to understand the impact of different workers' characteristics on the relative demand for regular/non-regular employment between men and women. It is interested in discovering whether the improvement of educational attainment for women does help them enter the primary labour force while many developed economies have succeeded in maximizing the returns on women's investment in education, and whether the sectors with a rising proportion of female workers on the management track will lead to an increase in female regular employment as they, compared to male managers, may be more likely to support women enter the regular workforce at the time of hiring.

3.6.3 Interaction Terms

The interaction terms are introduced to test whether the changes in Japan's employment structure are in line with the hypotheses of SBTC or TBTC as follows:
For SBTC,

$$\Delta E^{w}_{igj\tau} = \beta_0 + \beta_1 \Delta C_{j\tau} + \beta_2 \Delta LF_{gj\tau} + \beta_3 \Delta Period_{\tau} + \beta_4 \Delta C_{j\tau} \times \Delta Edu_{gj\tau} + \varepsilon_{igj\tau} \quad (3.5)$$

where,
$\Delta Edu_{gj\tau}$ is a set of education groups for non-educated, and primary or junior high school graduates (the reference group), senior high school graduates, higher professional school or junior college graduate, and university or graduate school graduates.

This equation examines whether technical change has favoured higher educated workers but harmed lower educated workers separately by gender. If the SBTC hypothesis is valid the results will show a positive relationship between technical change and higher educated workers, but a negative relationship for lower educated workers.
For TBTC,

$$\Delta E^{w}_{igj\tau} = \beta_0 + \beta_1 \Delta C_{j\tau} + \beta_2 \Delta LF_{gj\tau} + \beta_3 \Delta Period_{\tau} + \beta_4 \Delta C_{j\tau} \times \Delta Occu_{gj\tau} + \varepsilon_{igj\tau} \quad (3.6)$$

where,
$\Delta Occu_{gj\tau}$ is a set of occupation groups for unskilled jobs (i.e. security, agriculture, transport, etc; the reference group), production-related jobs, sales and service, clerical jobs, and professional or managerial jobs. Again, the specification is estimated separately by gender.

Results from this specification will reveal whether technology has replaced the jobs at the middle of the skill distribution which are usually routine tasks. If the TBTC hypothesis is valid, the results will show a pattern that an increase in ICT use will decrease the relative demand for workers in intermediate level occupations, but increase the share of employment in top and low rank jobs.

Overall, the set of analyses in this chapter aim to discover how technological development affects the mobility of the regular and non-regular workers for both genders in Japan, and whether the changing relative demand for different skilled workers is following the SBTC or the TBTC hypothesis. A significant upward trend in the share of non-regular employment with a downward trend in the regular will not be a surprising result considering what has already been observed in the empirical research (Sunada *et al.*, 2004; Asana *et al.*, 2010), as the progress of computerisation simplifies the tasks used to be done by the regular workers and makes the tasks easily substitutable by the non-regular workers. It is also expected to see whether an increase in higher educated women[30] leads to more equal employment between genders in particular to the good jobs (regular/higher-skilled), or it actually pushes more women, those who do not graduate from elite university or do not have a university degree, into bad (non-regular/lower-skilled) jobs, as companies cannot afford many regular positions once they hire a higher qualified and hence more expensive worker. Given the fact that men are more likely to be employed in the industries that are more reliant on ICT (Appendix Figure 3.6, 3.7, and Table 3.13), it may be expected to see that technical change will have a greater impact on male workers by pushing them into the good jobs as the majority of them are involved

[30] With regards to the impact of education on female labour market outcome, more recent studies argue that the returns to education are more dependent on the subject/fields that the individual has studied, and that women are less likely to enrol in the fields which require mathematical skills, which then pushes them away from higher paid, higher status jobs (Carrell *et al.*, 2010; Bertrand *et al.*, 2010). However, this argument cannot be examined in this analysis due to the unavailability of data sources on degree subject.

in more advanced technological usage. Moreover, considering the evidence from the UK that the majority of men in non-routine tasks are involved in moderate and complex computer use, while the majority of women are complements to simple and moderate computerisation (Lindley, 2011), a pattern with a growth of the relative demand for non-regular workers in particular for the routine tasks and amongst women following the ICT investment will very likely be the case for Japan.

3.7 Results

3.7.1 Decomposition

In line with the finding of Ikenaga (2009), most of the aggregate changes in Japan's gender employment gap are observed as changes in regular and non-regular employment between rather than within sectors (Table 3.2 and 3.3). The last row of both tables showing the results for the entire period clearly demonstrates this point, which signifies that the combined effects of structural changes and the business cycle play the main roles in explaining the employment changes in Japan. The total variation of the gender employment gap is considerable, accounting for almost a 12 percentage points change in favour of female workers between 1987 and 2007. The greatest change is found in male regular employees with a dramatic decrease, followed by a marked increase in female non-regular employees. Besides, the gender gap in regular employment grows within sectors in the period of 1992 to 2002 (Table 3.3), with increased demand to hire men as regular workers and women as non-regular, and that was reversed in the final period.

In terms of aggregate variations in the gender gap by different periods, the largest shift is discovered between 1987 and 1992 (Table 3.2 and 3.3, *column one*) associated with a marked growth in the number of female employees for both regular and non-regular in almost all sectors (Appendix 3A Table 3.13) [31], especially for the wholesale and retail sector. The most significant increase in male employment is observed in the manufacturing, construction and business activities, for instance, repair, renting, and computer related activities, sectors in particular for regular workers. Each sector hired more workers for both men and women, but the relatively greater increase in female regular workers results in the lower proportion of male regular employment (first rows in Table 3.2 and 3.3).

A different story is discovered in the following period, although the gender gap in regular employment seems to decrease between sectors in the period $1992-1997$, it has seen a growth within sectors by almost one percentage point (Table 3.3). In addition, the combined effects of economic structural changes and the bursting bubble on changes in employment structure have been discovered in this period, associated with a noticeable decline in the total workforce in manufacturing but increase in the service sectors (Appendix 3A Table 3.13). A much larger number of female regular employees were found losing their jobs compared to men in manufacturing and professional service sectors, which reflects the fact that firms tend to dismiss the women first to cut the labour cost during the crisis as they are usually in supportive positions. Non-regular employment started increasing at a rapid pace in particular in the wholesale and retail, and hotel and restaurant sectors, in which the great share was conducted by women. Note that there was actually a massive increase in female regular employees in the health service sector alongside Japan's population ageing, but the falling number of female workers in other sectors offset this increase, which combined with the vast increases in female non-regular employment results in the lower share of regular employment for both men and women.

[31] The total number of female employees increased from 17,002,000 in 1987 to 20,524,000 in 1992.

The most significant changes in the type of employment for both within and between sectors are revealed in the period 1997 − 2002 (Table 3.2). In the aftermath of the 1997 Asian Financial Crisis combined with the long term recession and structural shifts in Japan, manufacturing, construction, and transportation sectors shrank dramatically during this period. A vast number of male regular employees lost their jobs in these male domains accounting for a 3% decrease in male regular employment between sectors (Appendix 3A Table 3.13) [32]. With a rapid expansion of the service sectors, a considerable number of non-regular workers for both men and women, substituted for the regular ones, were employed in the wholesale and retail sector. Moreover, the number of female regular workers in the health care sector continued growing in this period[33]. Each sector was hiring fewer regular employees but more non-regular on average resulting in a growth of sectors with much higher proportions of non-regular employment (Table 3.2).

Turning to the period 2002−2007, there was a marked increase of regular workers in the professional service and the health care sectors, though the regular employment continued decreasing in almost all other sectors associated with much greater losses for men than women (Appendix 3A Table 3.13). The large job losses for male regular workers in other sectors offset the increase in these two sectors leading to a reduction of total male regular employment in 2007 compared to 2002. In contrast, with a smaller amount of job losses for women, the female regular employment share in total employment increased during the period (Table 3.2). The non-regular employment for both men and women continued increasing at a rapid pace in most sectors, especially for men in the manufacturing sector as a consequence of the

[32] Almost two million male regular workers in these male-dominated sectors lost their job is this period.

[33] The number of female regular employees in the health care sector increased by over 1.5 million.

deregulation on dispatched workers in 2003. The negative sign for females within sectors but positive sign for the between sector change can then be interpreted as each sector hiring fewer regular women on average but a growth of sectors with a higher proportion of regular female workers (Table 3.2).

Overall, the results suggest that the total gender employment differential in Japan has fallen significantly between 1987 and 2007, in which the restructuring of the economy and the crisis play the main role in such changes. The relative proportion of female employment has increased substantially over time, yet this has not all been in good/regular jobs; which is contrary to the empirical literature suggesting that changes in economic structure have a positive effect on female labour market outcomes (Blau and Khan, 1992; Murphy and Welch, 1993). Female non-regular employment has grown rapidly in particular in the wholesale and retail, and hotel and restaurant sectors. Considering that the changes between sectors are as a consequence of structural changes, and the within changes are due to the workers' characteristics or technological changes/demand changes, it is worth noting that the female regular employment within sector changes are much greater than the between changes. It implies that women losing regular jobs is more likely due to their relatively lower human capital accumulation and technical change rather than the effect of economic structural changes. Besides, a rising gender gap within sectors in the period $1992-1997$ (Table 3.3) indicates that firms tend to dismiss female regular workers first during the crisis as they are usually in supportive positions. In contrast, the falling male employment, as well as the rise of the total non-regular employment, is between sectors as a consequence of the restructuring of the economy and the recession in Japan.

3.7.2 Basic Regression Model

Considering that the effects of technical changes and human capital accumulation on the changes in employment composition should occur within industries, the rest of this chapter will focus solely on the within industry changes to explore the relationship between such effects and the development of the Japanese dual labour market.

This subsection is interested in discovering how technical change and the shifting proportion within industries of workers' characteristics are associated with the within industry changes in the Japanese employment (Equation 3.4), where the dependent variables are the changes in the share of employees within two-digit industry levels that were observed in Section 3.7.1. The estimated results with sector Fixed Effects are presented in Table 3.4[34]. The sector Fixed Effects specification is used to control for differences in unobserved characteristics across sectors, which allows the analysis to focus on within sector variations and reduces the risk of omitted variable bias.

The results indicate that those sectors that have increased their share of prime aged workers have seen a rise in female regular employment, but there is no evidence found to suggest that the share of regular jobs for men is influenced by different age cohorts. Male regular employment is increasing in sectors where the share of higher educated graduates is rising, and the results are quite strong across all models. However, better educational attainments do not seem to affect female regular workers in the same way, where changes in the share of junior college and university graduates in sectors have decreased the relative demand for female regular workers by

[34] The OLS results can be seen in Appendix 3A Table 3.14

around one to two percentage points, but the effect of the rising share of senior high school graduates is in the reverse direction. It somewhat confirms the phenomenon Tachibanaki (2010) addressed that firms are compelled to cut their labour costs by offering fewer regular jobs and pushing non-graduate women into non-regular jobs while more regular jobs are occupied by female university graduates, leading to a decrease in the overall share of female regular employment. As for occupation categories, there is only weak evidence, from the OLS estimates (Appendix 3A Table 3.14), that a relative rise in the share of sales/service workers in sectors leads to about a one percentage point increase in the male regular employment. Moreover, the relative demand for female regular workers has seen a decrease in the period between 1997 and 2002 alongside the crisis in Japan.

With respect to the non-regular employment, the share of male non-regular workers is found to be growing in sectors where the share of prime aged workers is increasing. Considering that Table 3.1 has shown that the share of male non-regular employment is mainly contributed to by the youngest cohort (Steinberg and Nakane, 2011), those sectors that have a higher proportion of prime aged workers, who are very likely employed as regular, reduce the vacancies of regular jobs to cut down their labour costs thus increasing the overall share of non-regular workers for men. In addition, consistent with those who noted that the vast majority of female non-regular workers are housewives, sectors that have increased their share of workers in the older cohort have seen a rise in female non-regular employment, although the results are not statistically significant[35]. The effect of higher educational attainments on male non-regular employment in sectors is observed to be negative, but that on women is not very clear. The Fixed Effects and the OLS coefficients

[35] The OLS results are positive and significantly greater than zero (Appendix 3A Table 3.14).

for junior college graduates are observed opposite in sign. It is suggested that a higher proportion of female junior college graduates is associated with higher female non-regular employment, yet if the share of junior college graduates increases within sectors this would decrease the share of female non-regular workers. There is some evidence suggesting that a rising proportion of all types of job except clerks in sectors has increased the relative demand for male non-regular workers. On the other hand, apart from those women who work in managerial/professional positions, changes in other occupations in sectors have raised the share of non-regular employment for women. Male non-regular employment has been in a significantly upward trend especially in the period of $1997-2002$, while the share of female non-regular employment is also found to be increasing between 1992 and 2002.

In summary, the results indicate that firms that have a higher proportion of relatively expensive workers, such as prime aged men and female graduates , tend to cut their labour costs by increasing (decreasing) the share of non-regular (regular) employees. The share of non-regular employment has been increasing in most occupations within sectors for both men and women. It is also revealed that non-regular (regular) employment has grown (fallen) especially in the period of 1997 and 2002, which is consistent with those who noted the impact of the crisis on changes in labour market structure. Besides, technical change seems to have no significant effect on changes in Japan's employment structure.This might be because of their strict workforce regulation limiting the quantitative effects of technical development as Michaels *et al.* (2009) have suggested. The next sections consider whether technical change has had a more specific effect by looking at interactions with other variables.

3.7.3 Testing for Skill Biased Technical Change

The effect of technological development on male employment associated with educational levels seems relatively weak compared to that on women (Equation 3.5). The results from both ICT measures are consistent, regardless that the results with the capital stock measure of ICT (Table 3.5) are relatively stronger than with the capital formation measure of ICT (Table 3.6)[36].

For regular employment, men and women have seen a different trend. While technical change has increased the relative demand for male regular workers in those sectors that have a higher share of well-educated employees, it increases female regular employment only if sectors hire more women who are less educated than junior college. Besides, some evidence suggests that technology has shifted men into, but women out of, regular jobs in those sectors that hire a higher share of junior college graduates. Note that although it shows ICT use strongly moves male junior college graduates into regular jobs, the proportion of men in junior college is very low in Japan, and hence the effect is actually minor. In terms of non-regular employment, the effect of technical change on men associated with workers' educational levels is not statistically significant. In contrast, an increase in ICT use has increased female non-regular employment most in sectors where the share of junior college graduates is rising, and reduced the relative demand of female non-regular employees in those sectors hiring a greater proportion of lower or non educated workers.

Summarizing the results, it is found that, following an increase in ICT intensity, lower or non educated women are more likely to be moved into regular jobs, but

[36] The OLS results can be seen in Appendix 3A Table 3.15 and 3.16

intermediate educated women into non-regular jobs. The effect of technical change associated with educational levels on the male workforce seems relatively weak, but it suggests that technology somewhat benefits better educated men by a rising share of regular employment.

3.7.4 Testing for Task Biased Technical Change

Turning to the interactive effect between technical change and different jobs on the share of employment (Equation 3.6), relatively weak results are again observed for men compared to for women. The positive and significant coefficient on ICTS×Prof (Table 3.7)[37] suggests that an increase in ICT use will increase the share of male regular workers more in sectors that have a higher share of specialist/managerial workers. It signifies that technology has the greatest effect on moving men into sectors that employ a larger proportion of professional workers, which is in line with the TBTC hypothesis that the development of technology raises the relative demand for workers in high skill jobs. By contrast, with the measure of ICT capital formation *ICTF* (Table 3.8)[38], it is suggested that technology has a weak effect on shifting the least-skilled men into regular jobs. The effect of technical change on the relative demand for male regular workers at the middle of the skill distribution is not clear, as the results from the different measures of ICT are not consistent and are statistically insignificant.

As for female regular workers, technology does not seem to have helped high skilled women in the way it does for men. Sectors with a rising share of professional/managerial workers have increased female regular employment by almost 4

[37] The OLS results can be seen in Appendix 3A Table 3.17

[38] The OLS results can be seen in Appendix 3A Table 3.18

percentage points (Table 3.7) where there has been no change in technology, however, the size of this effect falls, as the change in ICT get larger. The results from the measure of ICT capital formation (Table 3.8) additionally reveal that an increase in ICT use has a greater effect on moving women into regular jobs, in those sectors that hire a higher proportion of sales/service workers. Furthermore, some weak evidence indicates that a higher proportion of ICT used will slightly decrease the relative demand for female regular jobs at the very bottom of the skill distribution, such as security, transportation, and agriculture. It has to be noted that these jobs are mainly for men, as Table 3.1 has shown that the share of female regular workers in these occupations is less than one percentage point, which means that the magnitude of technology effects on changes in female employment structure is minor.

In terms of non-regular employment, despite the results for men being not very strong or robust, it somewhat suggests that an increase in ICT use will increase (decrease) the share of male non-regular workers more in sectors that have a higher proportion share of production related (professional) workers (Table 3.7). Besides, some weak evidence found (Table 3.8) that technical change has somewhat reduced the share of male non-regular employment in those sectors increasing their share of unskilled manual workers. For women, the positive and significant coefficient on ICTS$\times$Prof (Table 3.7) strongly demonstrate that a higher proportion of ICT used will increase the share of female non-regular workers more in sectors that have a higher share of professional/managerial workers. Moreover, technology also increases the proportion of non-regular employment in sectors that have a higher share of clerical, and security/driver workers, but decreases the relative demand for the female non-regular workers in sales and service related jobs.

Taken together, it is revealed that technology increases male regular employment in higher-skilled professional and very low-skilled jobs, while for middle-skilled production related jobs it moves men into non-regular jobs, which is in line with the TBTC hypothesis. However, the opposite story is found in the case of women, where the results indicate that technology only increases female regular employment when the share of women in unskilled sales/service jobs is rising, while for other jobs it pushes women into non-regular works. Various notions can be put forth to explain these changing patterns for women. Concerning the findings from Sunada *et al.* (2004), Asano *et al.* (2010), and Lindley (2011), one of the possible explanations is that there is gender biased ICT usage within specialist/managerial occupations as a larger share of women are probably involved in less complex computer tasks relative to men, and those tasks are more likely to be substituted by advanced technology and non-regular workers. Another thought of concern could be that the higher share of women employed in high-skilled, regular jobs would push other women into more difficult situations, as there are then fewer regular jobs available in the market (Tachibanaki, 2010).

3.7.5 Regression of the Within Sector Changes in Different Periods

The results (Table 3.9) are not very strong when the data are broken into different periods. In general, better educational attainment has a positive effect on increasing male regular employment. Looking at the entire period, it suggests that male regular employment is decreasing most in sectors where the share of workers in the older cohort is increasing. A possible explanation could be that firms are forced to cut labour cost by offering fewer regular jobs as more experienced male workers are usually very expensive, hence an increase in the share of old workers leads to less opportunity of being hired as regular employees for the younger workers. Moreover, those sectors that have increased their share of sales/service workers have seen a rise in male regular employment.

Female regular employment is increasing most in sectors where the proportion of professional/managerial workers is rising, the significant effects are found in the entire period and particularly the period 1992 − 1997. An increase in the share of clerical and sales/service workers in sectors is associated with a rising relative demand for female regular workers in the earlier period. Consistent with the trends in terms of educational attainments, sectors that have a greater share of senior high school graduates have seen a rise in female regular employment, but the reverse direction is found for the junior college graduates. It is additionally revealed that technical change has a positive effect on increasing female regular employment in the entire period.

Similar to the previous findings, better educational attainment benefits men by moving them out of non-regular jobs (Table 3.10). Those sectors that have increased their share of professional/managerial and production related workers have seen a rise in male non-regular employment. Furthermore, a higher proportion of prime aged worker hired in sectors increased the relative demand for male non-regular employees in period 1992 − 1997. It implies that firms that had a higher share of prime aged and expensive workers, were apt to offer fewer regular jobs to cut labour cost at the beginning of Japan's recession.

The trends for female non-regular employment are similar to previous findings, where sectors that have seen a rise in their share of elder and less-skilled workers have seen an increase in female non-regular workers. It is again suggested that changes in the number of senior high school graduates have reduced the relative demand for female non-regular employment.

3.8 Conclusion

This is the first study using Japan as a case to explore the impact of technical change on the development of the dual labour market with respect to gender. The aim of this chapter was to discover how the regular/non-regular employment has been changing differently for male and female workers over time in Japan, to find out what are the important factors driving these changes, and how much the variation in the gender regular/non-regular employment gap can be explained by the development of technology, drawing upon two aggregate level data sets from Japan's Employment Status Survey and EU KLEMS for 1987 – 2007.

Following the job-polarisation idea of the Autor-Levy-Murnane model, it is revealed that the total variation of Japan's gender employment gap is remarkable, accounting for an almost 12 percentage points change in favour of female workers between 1987 and 2007. Most aggregate changes are observed between sectors indicating that the restructuring of the economy and the crisis play the main role in the shifts of Japan's workforce structure associated with a marked increase in female non-regular workers and a dramatic decrease in male regular employment since the late 1990s. On the contrary, the rising relative demand for female regular workers is found to be more significant within sectors, which implies that women losing regular jobs is more likely because of their relatively lower human capital accumulation, or due to technology shifts. It is worth noting that the gender gap in regular employment grows within sectors in the period of 1992 to 2002, with an increased demand to hire men as regular workers and women as non-regular, though that was reversed in the final period.

In order to explore the implications of these within industry changes, regression on the pooled data sets with time dummies was undertaken to examine how much of the variation can be explained by the development of workers' characteristics and technology. Interaction terms were used to test whether the changes in Japanese labour market structure are in line with the hypotheses of tasks biased technical change or skill biased technical change.

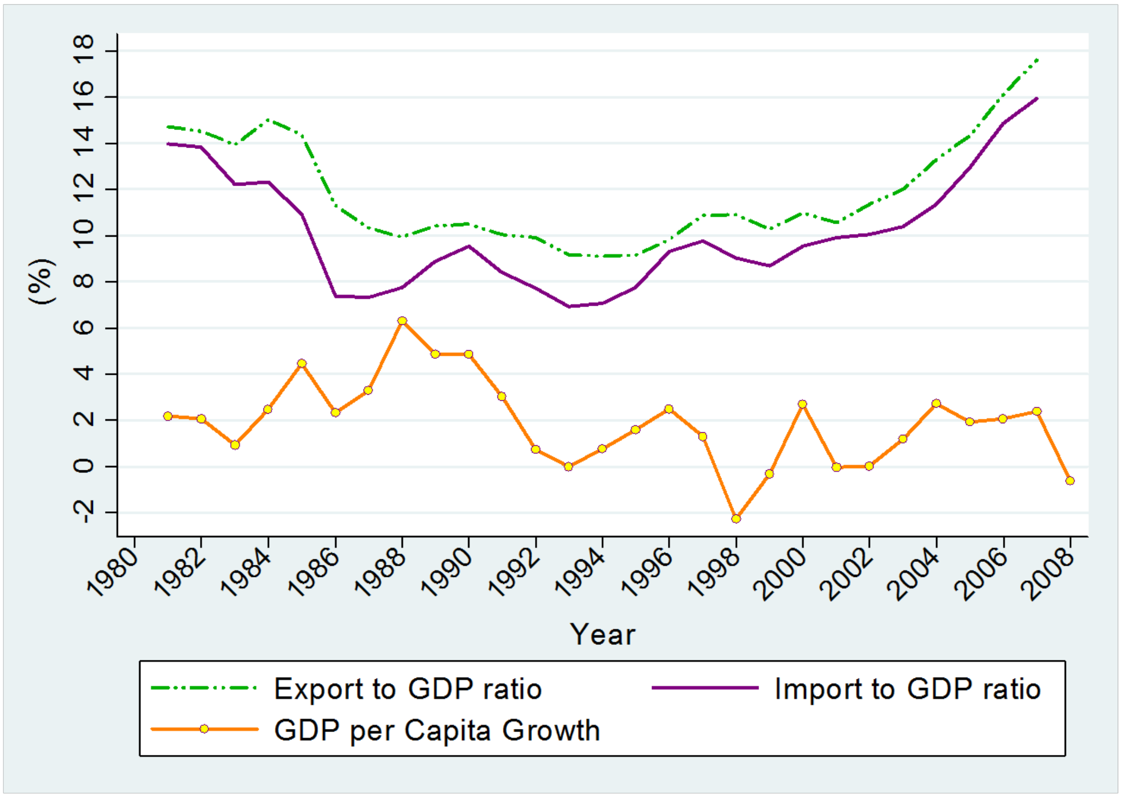
The results indicate that sectors that have larger proportions of higher paid workers, such as prime aged men and female university graduates, are apt to increase (decreasing) their share of non-regular (regular) employment to cut their labour costs. Better educational attainment moves men into regular jobs, but the opposite story is found in the case of women. In addition, the share of non-regular employment has seen an increase in almost all type of jobs for both genders. It is revealed that non-regular (regular) workers have grown (fallen) especially in the period of 1997 and 2002, which corresponds to the duration of Japan's downturn. Besides, the effect of technical change on Japan's employment structure is not statistically significant, which might be because of the strict workforce regulation limiting the quantitative effects of technical development as Michaels *et al.* (2009) have suggested.

The interactive effects between educational levels and technical change seem to have a relatively weak effect on male employment, some weak evidence suggesting that technical change increases male regular employment in sectors associated with a higher proportion of higher educated workers. Female junior college graduates are more likely to be pushed into non-regular jobs following an increase in ICT intensity, which is opposite to the effect for lower educated women.

As for the interactive effect of technical change and different jobs type on the share of employment, it is revealed that industry ICT intensity increases male regular employment in higher-skilled and least-skilled jobs, while for middle-skilled production related jobs it moves men out of regular work, which is in line with the TBTC hypothesis. In contrast, technical change is found strongly to move professional women out of regular into non-regular employment. It implies that there may be a gender bias in ICT usage within higher skilled jobs as a greater share of women are probably engaged in less complex computer tasks relative to men, and those tasks are easier to be substituted by computers and non-regular workers. Besides, the result shows that technology has a great effect on moving women into regular jobs in sectors that hire a larger share of unskilled sales/service workers, while for other jobs it pushes women into non-regular jobs. It is worth noting that there seems to be a pattern of gender segregation with respect to the impact of technical change on the middle and lower skilled jobs. For men, the effect of ICT is found to be statistically significant only on production related and security/driver jobs, but for women, it is significant on clerical and sale/service workers.

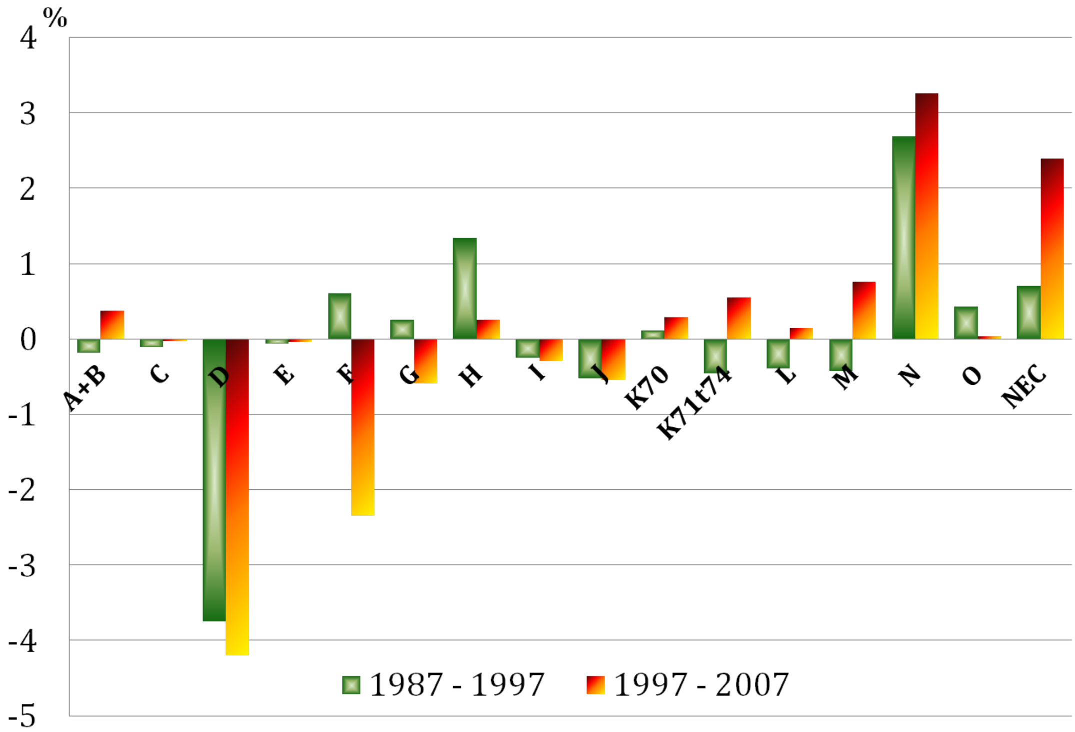
Overall, the results indicate that the total gender employment gap in Japan is falling considerably in the period $1987 - 2007$ as a consequence of the crisis and structural changes. Although the relative proportion of women in employment has increased over time, this has not all been in good/regular jobs. In addition, the results are consistent with the general idea of TBTC with evidence of a gender bias in the rising relative demand for non-routine jobs at the top and the bottom of the skill distribution following an increase in ICT intensity. Thus, a rising ICT usage in sectors only increases the relative demand for female regular employment in sales jobs, and it seems to be pushing most women into non-regular jobs, which is opposite to the effect for men. Note that, with the limitation of the data, it is not clear whether the negative relationship between higher skilled professional women and the regular employment is simply because those women themselves have a higher chance to be employed in non-regular jobs, or that their existence would push increased numbers of other women into non-regular track. However, what is certain is that, on the contrary to other developed countries, many women seem to pay the penalties, rather than gain the bonus, for the rising share of higher skilled women in the Japanese labour market.

Figure 3.1: Evolution of Japan's Economy



Source: World Development Indicator Database (2010)

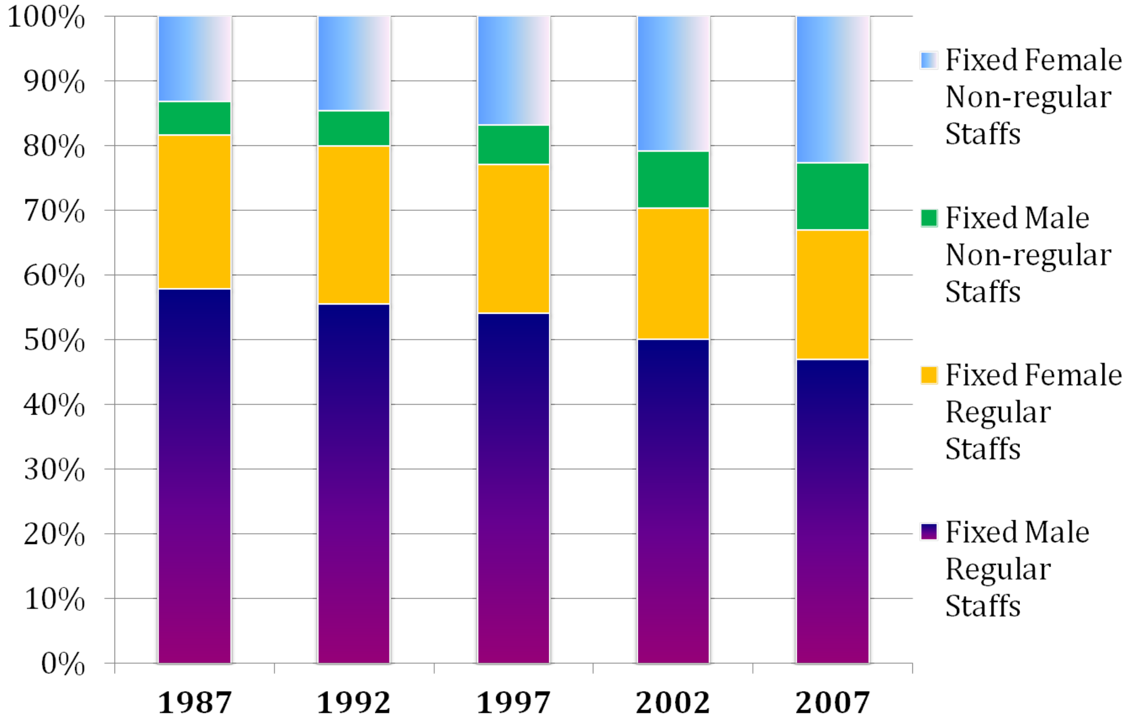
Figure 3.2: Changes in Total Employment



Source: Employment Status Survey (2011); and authors calculations

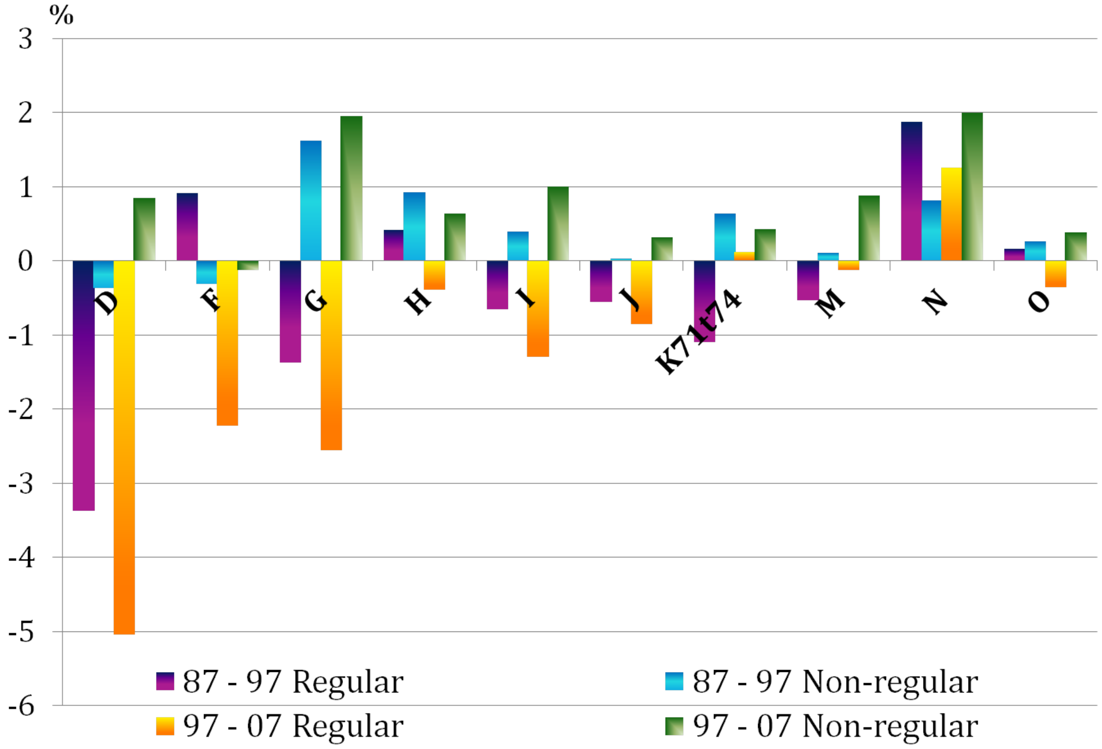
Note: A+B (Agriculture, Forestry, and Fishing); C (Mining); D (Manufacturing); E (Electricity, Gas, Heat Supply and Water); F (Construction); G (Wholesale and Retail Trade); H (Restaurant, Hotel); I (Transportation, Warehousing and Communication); J (Finance and Insurance); K70 (Real Estate Business); K71t74 (Renting of Machinery and Equipment, and Other Business Activities); L (Government NEC); M (Education); N (Medical and Other Health Services); O (Other Community, Social and Personal Services); NEC (Unclassified Industry)

Figure 3.3: Workforce Composition: Regular and Non-regular Employment by Gender



Source: Employment Status Survey (2011); and authors calculations

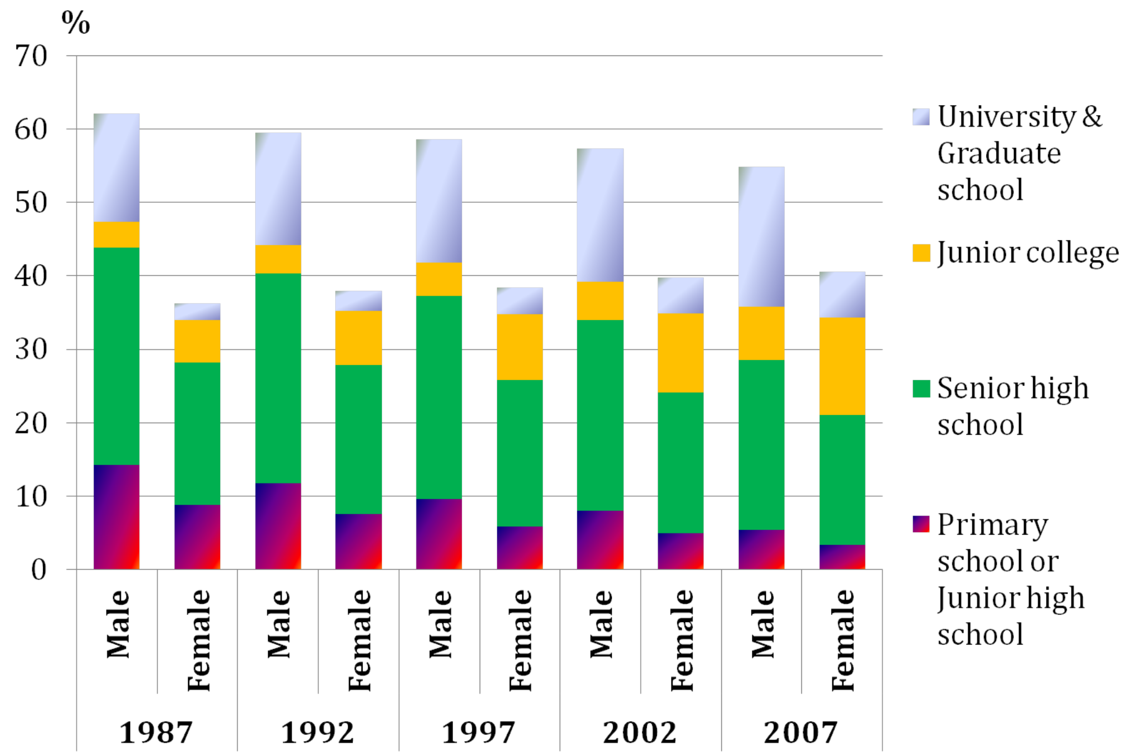
Figure 3.4: Changes in Regular and Non-regular Employment by Industry



Source: Employment Status Survey (2011); and authors calculations

Note: D (Manufacturing); F (Construction); G (Wholesale and Retail Trade); H (Restaurant, Hotel); I (Transportation, Warehousing and Communication); J (Finance and Insurance); K71t74 (Renting of Machinery and Equipment, and Other Business Activities); M (Education); N (Medical and Other Health Services); O (Other Community, Social and Personal Services)

Figure 3.5: Total Employment by Education and Gender



Source: Employment Status Survey (2011); and authors calculations
Note: the total employment includes those who have never attended school

Table 3.1: Distribution of Regular and Non-regular Employment by Gender (%)

	Regular				Non-regular			
	Male		Female		Male		Female	
	1987	2007	1987	2007	1987	2007	1987	2007
Panel A: Occupation								
Prof	10.84	9.53	4.74	5.45	0.48	0.85	0.87	2.18
Clerical	9.74	7.73	9.26	7.51	0.51	1.22	2.86	6.23
Prod	20.64	15.15	4.72	2.08	2.77	4.05	5.28	5.62
Sal&Serv	10.48	9.05	4.63	4.18	0.81	2.36	3.87	7.44
Others	6.21	5.49	0.34	0.80	0.69	1.85	0.27	1.21
Panel B: Age								
15-24	6.48	2.81	6.33	2.44	1.43	2.27	1.41	2.62
25-34	14.53	11.32	5.20	5.46	0.63	1.89	2.04	4.18
35-49	23.78	17.55	7.58	6.19	0.91	1.46	6.67	7.92
Over 50	13.11	15.28	4.57	5.94	2.29	4.71	3.03	7.97
Total	57.91	46.96	23.68	20.02	5.26	10.33	13.15	22.69

Source: Employment Status Survey (2011); and authors calculations

Note:

(1) Prof(Specialist, Technical, Administrative and Managerial); Sal&Serv (Sale and Service); Prod (Production Process and Related); Others (Security, Agriculture, Forestry, Fishery, Transport, Communication, and NEC)

(2) Service workers refers to those who are engaged in personal services, not those professionals are engaged in business services , and thus are considered unskilled workers

Table 3.2: Between and Within Sector Decomposition by Men and Women (%)

	$\Delta E_{ig\tau}$ (1)	$\Delta E^b_{RM\tau}$ (2)	$\Delta E^b_{RF\tau}$ (3)	$\Delta E^b_{NRM\tau}$ (4)	$\Delta E^b_{NRF\tau}$ (5)	$\Delta E^w_{RM\tau}$ (6)	$\Delta E^w_{RF\tau}$ (7)	$\Delta E^w_{NRM\tau}$ (8)	$\Delta E^w_{NRF\tau}$ (9)
87-92	−4.42	−1.74	0.16	0.01	0.68	−1.17	0.08	−0.05	0.54
92-97	−1.42	−1.03	−0.21	0.28	1.35	0.03	−0.94	0.23	0.74
97-02	−2.85	−3.00	−0.86	1.52	2.36	−1.40	−1.60	1.57	1.65
02-07[a]	−3.06	−2.43	0.07	0.91	1.06	−1.23	−0.48	0.94	0.59
87-07	−11.75	−8.35	−0.77	2.71	5.45	−3.71	−3.04	2.81	3.56

[a] Due to the data availability, the decomposition is estimated by 38 sectors. Japanese Employment Status Survey published the data at more disaggregated level with 100 sectors for 2002 and 2007, the decomposition is also checked with 100 sector, the result is as follows:

	$\Delta E_{ig\tau}$	$\Delta E^b_{RM\tau}$	$\Delta E^b_{RF\tau}$	$\Delta E^b_{NRM\tau}$	$\Delta E^b_{NRF\tau}$	$\Delta E^w_{RM\tau}$	$\Delta E^w_{RF\tau}$	$\Delta E^w_{NRM\tau}$	$\Delta E^w_{NRF\tau}$
02-07	−3.06	−2.50	0.06	0.90	1.06	−1.18	−0.44	0.90	0.51

Table 3.3: Gender Differential in Between and Within Sector Decomposition(%)

	$\Delta E_{ig\tau}$ (1)	$\Delta E^b_{RM\tau} - \Delta E^b_{RF\tau}$ (2) − (3)	$\Delta E^b_{NRM\tau} - \Delta E^b_{NRF\tau}$ (4) − (5)	$\Delta E^w_{RM\tau} - \Delta E^w_{RF\tau}$ (6) − (7)	$\Delta E^w_{NRM\tau} - \Delta E^w_{NRF\tau}$ (8) − (9)
87-92	−4.42	−1.91	−0.67	−1.25	−0.59
92-97	−1.42	−0.81	−1.07	0.97	−0.51
97-02	−2.85	−2.14	−0.84	0.21	−0.08
02-07	−3.06	−2.50	−0.16	−0.75	0.34
87-07	−11.75	−7.59	−2.74	−0.67	−0.75

Table 3.4: Basic Regression of Changes in Workers Characteristics and ICT Intensity on Regular and Non-Regular Employment (FE(Sector))

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	−0.0059	−0.0015	0.0099*	0.0082	0.0141***	0.0084*	−0.0074	−0.0063
	(0.0035)	(0.0039)	(0.0047)	(0.0054)	(0.0038)	(0.0042)	(0.0045)	(0.0050)
Agov50	−0.0054	−0.0003	−0.0066	−0.0042	0.0049	−0.0010	0.0068	0.0038
	(0.0044)	(0.0047)	(0.0054)	(0.0057)	(0.0047)	(0.0051)	(0.0052)	(0.0052)
Seni High	0.0217***	0.0176**	0.0196**	0.0198**	−0.0201**	−0.0183**	−0.0120	−0.0115
	(0.0059)	(0.0061)	(0.0065)	(0.0070)	(0.0064)	(0.0065)	(0.0062)	(0.0064)
Juni Colle	0.0247*	0.0235*	0.0080	0.0057	−0.0304**	−0.0307*	−0.0085	−0.0066
	(0.0097)	(0.0115)	(0.0079)	(0.0079)	(0.0105)	(0.0122)	(0.0076)	(0.0073)
Uni&Grad	0.0194**	0.0148*	−0.0124	−0.0050	−0.0164*	−0.0152*	0.0150	0.0047
	(0.0059)	(0.0062)	(0.0111)	(0.0112)	(0.0064)	(0.0066)	(0.0106)	(0.0103)
Prof	0.0071	0.0073	0.0037	0.0013	0.0091	0.0121	0.0083	0.0120
	(0.0065)	(0.0066)	(0.0068)	(0.0068)	(0.0070)	(0.0070)	(0.0065)	(0.0063)
Clerical	0.0069	0.0044	−0.0053	−0.0117	0.0046	0.0080	0.0150*	0.0234***
	(0.0067)	(0.0067)	(0.0063)	(0.0066)	(0.0072)	(0.0072)	(0.0061)	(0.0061)
Sal&Serv	−0.0012	0.0051	−0.0079	−0.0090	0.0188**	0.0122	0.0246***	0.0267***
	(0.0065)	(0.0068)	(0.0054)	(0.0055)	(0.0070)	(0.0073)	(0.0052)	(0.0051)
Product	−0.0005	0.0035	−0.0100	−0.0117	0.0192**	0.0138*	0.0185**	0.0204**
	(0.0053)	(0.0054)	(0.0073)	(0.0070)	(0.0057)	(0.0058)	(0.0070)	(0.0064)
ICTS	0.0032	0.0047	0.0012	0.0007	−0.0026	−0.0035	−0.0037	−0.0030
	(0.0057)	(0.0056)	(0.0052)	(0.0049)	(0.0061)	(0.0059)	(0.0049)	(0.0045)

Table 3.4: *Continued*

	Regular				Non-Regular			
	Male		**Female**		**Male**		**Female**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period2		0.0001		−0.0003		0.0003		0.0004*
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period3		−0.0004		−0.0005**		0.0007**		0.0007***
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period4		−0.0002		−0.0001		0.0004		0.0002
		(0.0003)		(0.0002)		(0.0003)		(0.0002)
Constant	−0.0007***	−0.0006**	−0.0001	0.0001	0.0006**	0.0004	0.0002	−0.0000
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.4297	0.4742	0.3626	0.4437	0.2779	0.3442	0.3208	0.4505

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.5: The Interactive Effect of Technical Change (ICT Capital Stock) and Different Educational Levels on Changes in Regular and Non-Regular Employment (FE(Sector))

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	−0.0045	0.0004	0.0086	0.0070	0.0135***	0.0073	−0.0062	−0.0054
	(0.0035)	(0.0038)	(0.0045)	(0.0052)	(0.0038)	(0.0042)	(0.0042)	(0.0047)
Agov50	−0.0022	0.0027	−0.0071	−0.0046	0.0015	−0.0038	0.0069	0.0039
	(0.0045)	(0.0047)	(0.0052)	(0.0054)	(0.0049)	(0.0051)	(0.0048)	(0.0049)
Seni High	0.0184**	0.0157*	0.0170**	0.0167*	−0.0149*	−0.0148*	−0.0095	−0.0086
	(0.0062)	(0.0063)	(0.0064)	(0.0069)	(0.0067)	(0.0068)	(0.0059)	(0.0062)
Juni Colle	0.0118	0.0053	0.0279**	0.0210*	−0.0236*	−0.0185	−0.0308***	−0.0236**
	(0.0107)	(0.0125)	(0.0091)	(0.0091)	(0.0116)	(0.0136)	(0.0085)	(0.0082)
Uni&Grad	0.0172*	0.0107	−0.0043	0.0013	−0.0146*	−0.0113	0.0081	0.0005
	(0.0066)	(0.0068)	(0.0148)	(0.0145)	(0.0072)	(0.0074)	(0.0138)	(0.0131)
Prof	0.0005	0.0008	0.0195*	0.0177*	0.0159*	0.0185*	−0.0088	−0.0049
	(0.0068)	(0.0067)	(0.0074)	(0.0078)	(0.0074)	(0.0073)	(0.0069)	(0.0071)
Clerical	0.0017	−0.0029	−0.0072	−0.0106	0.0074	0.0130	0.0168**	0.0222***
	(0.0068)	(0.0069)	(0.0063)	(0.0066)	(0.0074)	(0.0075)	(0.0058)	(0.0059)
Sal&Serv	−0.0043	0.0032	−0.0076	−0.0072	0.0220**	0.0146*	0.0240***	0.0247***
	(0.0065)	(0.0066)	(0.0051)	(0.0053)	(0.0070)	(0.0072)	(0.0048)	(0.0047)
Product	−0.0054	−0.0012	−0.0122	−0.0133	0.0236***	0.0183**	0.0211**	0.0223***
	(0.0054)	(0.0054)	(0.0069)	(0.0067)	(0.0059)	(0.0059)	(0.0064)	(0.0060)

Table 3.5: *Continued*

	Regular				Non-Regular			
	Male		**Female**		**Male**		**Female**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICTS	−0.0074	−0.0121	0.0260**	0.0249**	−0.0021	0.0049	−0.0295***	−0.0266**
	(0.0099)	(0.0098)	(0.0087)	(0.0087)	(0.0108)	(0.0107)	(0.0081)	(0.0079)
ICTS×SH	0.2000	0.1384	0.6384*	0.6407*	−0.3623	−0.2646	−0.6331*	−0.6002*
	(0.1721)	(0.1682)	(0.2778)	(0.2742)	(0.1875)	(0.1832)	(0.2581)	(0.2470)
ICTS×JC	1.2100**	1.3535**	−1.2346***	−1.1083***	−0.6750	−0.8958	1.3412***	1.1560***
	(0.4482)	(0.4413)	(0.2947)	(0.2964)	(0.4883)	(0.4808)	(0.2738)	(0.2669)
ICTS×U&G	0.2306	0.3480*	−0.2132	−0.2715	−0.1446	−0.2750	0.1749	0.2083
	(0.1611)	(0.1602)	(0.3679)	(0.3582)	(0.1755)	(0.1746)	(0.3419)	(0.3226)
Period2		0.0001		−0.0001		0.0003		0.0002
		(0.0002)		(0.0002)		(0.0002)		(0.0001)
Period3		−0.0005*		−0.0004*		0.0007**		0.0005**
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period4		−0.0001		0.0000		0.0003		0.0001
		(0.0002)		(0.0002)		(0.0003)		(0.0002)
Constant	−0.0006**	−0.0004	−0.0005*	−0.0003	0.0007**	0.0003	0.0006**	0.0004*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.4799	0.5329	0.4600	0.5157	0.3217	0.3907	0.4561	0.5417

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.6: The Interactive Effect of Technical Change (ICT Capital Formation) and Different Educational Levels on Changes in Regular and Non-Regular Employment (FE(Sector))

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	−0.0054	−0.0013	0.0113*	0.0109	0.0140***	0.0085*	−0.0095*	−0.0095
	(0.0035)	(0.0039)	(0.0047)	(0.0055)	(0.0038)	(0.0043)	(0.0045)	(0.0051)
Agov50	−0.0014	0.0035	−0.0058	−0.0029	0.0030	−0.0026	0.0050	0.0018
	(0.0047)	(0.0050)	(0.0056)	(0.0059)	(0.0052)	(0.0055)	(0.0053)	(0.0054)
Seni High	0.0186**	0.0156*	0.0184**	0.0165*	−0.0191**	−0.0178*	−0.0118	−0.0091
	(0.0061)	(0.0063)	(0.0066)	(0.0072)	(0.0068)	(0.0068)	(0.0063)	(0.0066)
Juni Colle	0.0188	0.0127	0.0158	0.0103	−0.0280*	−0.0260*	−0.0162*	−0.0109
	(0.0100)	(0.0120)	(0.0082)	(0.0083)	(0.0110)	(0.0130)	(0.0077)	(0.0077)
Uni&Grad	0.0214**	0.0176**	−0.0206	−0.0141	−0.0181*	−0.0172*	0.0225	0.0123
	(0.0064)	(0.0066)	(0.0132)	(0.0137)	(0.0070)	(0.0072)	(0.0125)	(0.0126)
Prof	0.0002	0.0007	0.0049	0.0030	0.0116	0.0149	0.0070	0.0105
	(0.0070)	(0.0071)	(0.0070)	(0.0071)	(0.0077)	(0.0077)	(0.0066)	(0.0065)
Clerical	0.0022	−0.0013	−0.0092	−0.0129	0.0051	0.0094	0.0192**	0.0247***
	(0.0075)	(0.0076)	(0.0064)	(0.0066)	(0.0083)	(0.0083)	(0.0060)	(0.0060)
Sal&Serv	−0.0057	0.0015	−0.0130*	−0.0123*	0.0204**	0.0139	0.0301***	0.0302***
	(0.0067)	(0.0071)	(0.0054)	(0.0055)	(0.0074)	(0.0077)	(0.0051)	(0.0050)
Product	−0.0048	−0.0003	−0.0144*	−0.0152*	0.0208***	0.0156*	0.0232***	0.0238***
	(0.0055)	(0.0057)	(0.0072)	(0.0070)	(0.0061)	(0.0063)	(0.0068)	(0.0065)

Table 3.6: *Continued*

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICTF	−0.0007	−0.0031	0.0029	0.0020	−0.0005	0.0004	−0.0028	−0.0019
	(0.0030)	(0.0032)	(0.0034)	(0.0034)	(0.0033)	(0.0034)	(0.0032)	(0.0031)
ICTF×SH	0.0591	0.0455	0.1693	0.1568	−0.0372	−0.0332	−0.1301	−0.1134
	(0.0586)	(0.0589)	(0.1177)	(0.1141)	(0.0645)	(0.0643)	(0.1115)	(0.1050)
ICTF×JC	0.3039	0.3303*	−0.3006*	−0.2354*	−0.1100	−0.1230	0.3070**	0.2254*
	(0.1542)	(0.1519)	(0.1176)	(0.1167)	(0.1698)	(0.1658)	(0.1115)	(0.1074)
ICTF×U&G	0.0270	0.0617	−0.1213	−0.0749	0.0189	−0.0079	0.1412	0.0966
	(0.0841)	(0.0832)	(0.1627)	(0.1592)	(0.0926)	(0.0908)	(0.1543)	(0.1465)
Period2		0.0001		−0.0001		0.0003		0.0003
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period3		−0.0004		−0.0005*		0.0007**		0.0006***
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period4		−0.0001		−0.0001		0.0003		0.0002
		(0.0003)		(0.0002)		(0.0003)		(0.0002)
Constant	−0.0008***	−0.0006**	−0.0000	0.0001	0.0007**	0.0004	0.0001	−0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.4627	0.5021	0.4309	0.4828	0.2838	0.3480	0.4034	0.4889

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.7: The Interactive Effect of Technical Change (ICT Capital Stock) and Different Skill Level Jobs on Changes in Regular and Non-Regular Employment (FE(Sector))

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	−0.0048	0.0002	0.0087*	0.0075	0.0141***	0.0072	−0.0070	−0.0062
	(0.0036)	(0.0039)	(0.0043)	(0.0047)	(0.0039)	(0.0042)	(0.0043)	(0.0045)
Agov50	−0.0045	0.0015	−0.0032	−0.0005	0.0044	−0.0023	0.0018	−0.0011
	(0.0045)	(0.0047)	(0.0057)	(0.0056)	(0.0048)	(0.0050)	(0.0056)	(0.0052)
Seni High	0.0196**	0.0146*	0.0138*	0.0128	−0.0192**	−0.0159*	−0.0056	−0.0040
	(0.0061)	(0.0062)	(0.0065)	(0.0066)	(0.0066)	(0.0066)	(0.0064)	(0.0062)
Juni Colle	0.0227*	0.0184	0.0153*	0.0121	−0.0314**	−0.0281*	−0.0154*	−0.0127
	(0.0100)	(0.0118)	(0.0074)	(0.0071)	(0.0108)	(0.0126)	(0.0072)	(0.0066)
Uni&Grad	0.0163**	0.0109	0.0024	0.0123	−0.0140*	−0.0117	0.0056	−0.0075
	(0.0060)	(0.0061)	(0.0132)	(0.0128)	(0.0065)	(0.0066)	(0.0129)	(0.0120)
Prof	−0.0025	−0.0053	0.0381***	0.0354***	0.0155	0.0223*	−0.0233*	−0.0189*
	(0.0084)	(0.0084)	(0.0094)	(0.0089)	(0.0091)	(0.0090)	(0.0092)	(0.0084)
Clerical	0.0006	−0.0033	−0.0030	−0.0111	0.0120	0.0161*	0.0111	0.0214***
	(0.0073)	(0.0072)	(0.0064)	(0.0065)	(0.0079)	(0.0077)	(0.0063)	(0.0061)
Sal&Serv	−0.0018	0.0050	−0.0059	−0.0085	0.0239*	0.0146	0.0194**	0.0235***
	(0.0085)	(0.0086)	(0.0062)	(0.0060)	(0.0091)	(0.0092)	(0.0060)	(0.0056)
Product	0.0025	0.0071	−0.0056	−0.0058	0.0140*	0.0081	0.0128	0.0122
	(0.0063)	(0.0063)	(0.0082)	(0.0076)	(0.0068)	(0.0068)	(0.0080)	(0.0072)

Table 3.7: *Continued*

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICTS	−0.0012	−0.0006	0.0014	0.0006	0.0035	0.0030	−0.0046	−0.0035
	(0.0061)	(0.0059)	(0.0047)	(0.0043)	(0.0066)	(0.0063)	(0.0046)	(0.0041)
ICTS×Prof	0.5527*	0.7359**	−1.0390***	−1.0733***	−0.4898	−0.6866*	0.9272***	0.9722***
	(0.2774)	(0.2729)	(0.2076)	(0.1915)	(0.2986)	(0.2925)	(0.2032)	(0.1797)
ICTS×Cler	0.3552	0.3167	−0.0314	0.0069	−0.4778	−0.3776	0.1071	0.0651
	(0.3082)	(0.2973)	(0.1427)	(0.1314)	(0.3318)	(0.3188)	(0.1396)	(0.1233)
ICTS×S&S	0.0565	0.1078	0.3345	0.4553	−0.4547	−0.3090	−0.0452	−0.1983
	(0.4405)	(0.4354)	(0.2925)	(0.2715)	(0.4742)	(0.4667)	(0.2864)	(0.2548)
ICTS×Prod	−0.4301	−0.4989	−0.4742	−0.6900	0.5663	0.6277*	0.6329	0.9701
	(0.2781)	(0.2677)	(0.6219)	(0.5968)	(0.2994)	(0.2870)	(0.6088)	(0.5600)
Period2		0.0001		−0.0003		0.0003		0.0004**
		(0.0002)		(0.0002)		(0.0002)		(0.0001)
Period3		−0.0005*		−0.0006***		0.0008***		0.0007***
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period4		−0.0001		−0.0001		0.0003		0.0002
		(0.0002)		(0.0002)		(0.0003)		(0.0002)
Constant	−0.0006***	−0.0005**	−0.0004*	−0.0002	0.0006**	0.0003	0.0005**	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.4710	0.5287	0.5043	0.5956	0.3262	0.4047	0.4458	0.5845

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.8: The Interactive Effect of Technical Change (ICT Capital Formation) and Different Skill Level Jobs on Changes in Regular and Non-Regular Employment (FE(Sector))

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	−0.0051	−0.0009	0.0096*	0.0102	0.0137**	0.0071	−0.0076	−0.0086
	(0.0038)	(0.0042)	(0.0045)	(0.0053)	(0.0041)	(0.0045)	(0.0042)	(0.0048)
Agov50	−0.0024	0.0027	−0.0075	−0.0042	0.0035	−0.0028	0.0074	0.0040
	(0.0048)	(0.0051)	(0.0057)	(0.0059)	(0.0052)	(0.0055)	(0.0052)	(0.0054)
Seni High	0.0201**	0.0170*	0.0249***	0.0215**	−0.0194**	−0.0182*	−0.0183**	−0.0140*
	(0.0064)	(0.0066)	(0.0062)	(0.0068)	(0.0069)	(0.0071)	(0.0057)	(0.0061)
Juni Colle	0.0221*	0.0157	0.0113	0.0072	−0.0285*	−0.0256	−0.0114	−0.0079
	(0.0101)	(0.0122)	(0.0071)	(0.0074)	(0.0110)	(0.0130)	(0.0066)	(0.0067)
Uni&Grad	0.0198**	0.0168**	0.0048	0.0043	−0.0168*	−0.0157*	−0.0073	−0.0092
	(0.0062)	(0.0063)	(0.0135)	(0.0138)	(0.0067)	(0.0067)	(0.0124)	(0.0125)
Prof	0.0007	0.0000	0.0076	0.0059	0.0122	0.0172*	0.0044	0.0078
	(0.0079)	(0.0080)	(0.0069)	(0.0071)	(0.0086)	(0.0086)	(0.0064)	(0.0065)
Clerical	0.0048	0.0021	−0.0081	−0.0117	0.0053	0.0099	0.0149*	0.0205**
	(0.0069)	(0.0071)	(0.0064)	(0.0068)	(0.0075)	(0.0076)	(0.0059)	(0.0061)
Sal&Serv	−0.0027	0.0047	−0.0249***	−0.0224***	0.0188*	0.0095	0.0424***	0.0404***
	(0.0086)	(0.0089)	(0.0060)	(0.0062)	(0.0094)	(0.0096)	(0.0056)	(0.0056)
Product	−0.0051	−0.0006	−0.0109	−0.0117	0.0207**	0.0145*	0.0179**	0.0186**
	(0.0062)	(0.0065)	(0.0071)	(0.0070)	(0.0067)	(0.0069)	(0.0065)	(0.0063)

Table 3.8: *Continued*

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICTF	0.0014	0.0001	−0.0039*	−0.0039*	−0.0002	−0.0001	0.0035*	0.0033*
	(0.0019)	(0.0020)	(0.0015)	(0.0016)	(0.0020)	(0.0022)	(0.0014)	(0.0015)
ICTF×Prof	0.0458	0.0854	−0.3211***	−0.2653***	−0.0383	−0.0856	0.3606***	0.2901***
	(0.1023)	(0.1013)	(0.0718)	(0.0752)	(0.1114)	(0.1086)	(0.0664)	(0.0679)
ICTF×Cler	0.0464	0.0437	−0.0490	−0.0060	−0.0173	−0.0314	0.1326	0.0825
	(0.0880)	(0.0881)	(0.0795)	(0.0802)	(0.0957)	(0.0944)	(0.0735)	(0.0725)
ICTF×S&S	−0.0237	−0.0159	0.4676***	0.4031**	0.0148	0.0734	−0.4836***	−0.4075***
	(0.2002)	(0.1991)	(0.1193)	(0.1210)	(0.2179)	(0.2134)	(0.1103)	(0.1094)
ICTF×Prod	0.0909	0.0758	−0.0576	−0.0854	−0.0181	0.0374	0.1266	0.1586
	(0.1347)	(0.1343)	(0.1410)	(0.1391)	(0.1466)	(0.1439)	(0.1304)	(0.1257)
Period2		0.0001		−0.0001		0.0003		0.0002
		(0.0002)		(0.0002)		(0.0002)		(0.0001)
Period3		−0.0004		−0.0004*		0.0007**		0.0005**
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period4		−0.0001		−0.0001		0.0003		0.0002
		(0.0003)		(0.0002)		(0.0003)		(0.0002)
Constant	−0.0007***	−0.0006**	−0.0001	0.0001	0.0006**	0.0003	0.0002	−0.0000
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.4468	0.4866	0.5102	0.5412	0.2799	0.3518	0.5114	0.5629

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.9: Basic Regression of Changes in Workers' Characteristics and ICT Intensity on Regular Employment at Separated Periods

	Male					Female				
	1987 *to* **1992**	**1992** *to* **1997**	**1997** *to* **2002**	**2002** *to* **2007**	**1987** *to* **2007**	**1987** *to* **1992**	**1992** *to* **1997**	**1997** *to* **2002**	**2002** *to* **2007**	**1987** *to* **2007**
Ag3049	0.0096	−0.0122	−0.0011	0.0380	−0.0007	0.0019	−0.0037	−0.0010	0.0019	−0.0072
	(0.0091)	(0.0077)	(0.0126)	(0.0331)	(0.0083)	(0.0043)	(0.0066)	(0.0153)	(0.0096)	(0.0044)
Agov50	−0.0003	−0.0020	−0.0227	−0.0198	−0.0311**	−0.0060	−0.0058	−0.0163	−0.0203	−0.0226**
	(0.0124)	(0.0088)	(0.0191)	(0.0260)	(0.0104)	(0.0061)	(0.0077)	(0.0191)	(0.0138)	(0.0068)
Seni High	0.0170	0.0211**	0.0064	0.0116	0.0072	0.0109*	0.0024	0.0345	0.0470*	0.0224*
	(0.0122)	(0.0066)	(0.0152)	(0.0148)	(0.0047)	(0.0044)	(0.0050)	(0.0212)	(0.0226)	(0.0086)
Juni Colle	0.0129	−0.0110	−0.0087	−0.0412	0.0123	−0.0011	−0.0071	−0.0142	0.0202	−0.0085*
	(0.0257)	(0.0134)	(0.0198)	(0.0328)	(0.0170)	(0.0063)	(0.0048)	(0.0251)	(0.0143)	(0.0041)
Uni&Grad	0.0204	0.0158*	0.0342	0.0027	0.0345*	0.0227	0.0060	0.0144	0.0462	−0.0012
	(0.0117)	(0.0065)	(0.0180)	(0.0119)	(0.0150)	(0.0137)	(0.0105)	(0.0258)	(0.0311)	(0.0112)
Prof	0.0045	0.0097	−0.0177	0.0267	−0.0103	−0.0081	0.0206***	−0.0050	0.0158	0.0280***
	(0.0161)	(0.0094)	(0.0143)	(0.0309)	(0.0167)	(0.0108)	(0.0051)	(0.0146)	(0.0302)	(0.0049)
Clerical	0.0034	0.0175	−0.0033	0.0128	0.0452	0.0129*	0.0034	−0.0137	−0.0123	0.0006
	(0.0168)	(0.0114)	(0.0109)	(0.0241)	(0.0245)	(0.0054)	(0.0057)	(0.0220)	(0.0116)	(0.0065)
Product	−0.0095	0.0140	0.0087	−0.0133	−0.0096	0.0011	−0.0037	−0.0118	−0.0007	0.0056
	(0.0131)	(0.0099)	(0.0137)	(0.0146)	(0.0169)	(0.0029)	(0.0088)	(0.0209)	(0.0106)	(0.0047)
Sal&Serv	−0.0015	0.0104	0.0028	0.0256	0.0361*	0.0091	0.0112*	−0.0259	−0.0269	0.0107
	(0.0173)	(0.0149)	(0.0107)	(0.0133)	(0.0132)	(0.0107)	(0.0052)	(0.0195)	(0.0230)	(0.0061)
ICTF	0.0045	0.0025	0.0053	0.0087	0.0008	0.0021	−0.0025	−0.0019	0.0014	0.0071*
	(0.0038)	(0.0016)	(0.0063)	(0.0231)	(0.0026)	(0.0013)	(0.0012)	(0.0039)	(0.0039)	(0.0029)
Constant	−0.0003*	−0.0004*	−0.0009**	0.0007	−0.0017*	−0.0002	−0.0001	0.0000	−0.0001	0.0003
	(0.0001)	(0.0002)	(0.0003)	(0.0008)	(0.0007)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0004)
N	37	37	37	37	37	37	37	37	37	37
R^2	0.5270	0.7079	0.5917	0.3803	0.6882	0.5713	0.5914	0.7658	0.8631	0.9309

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 37.

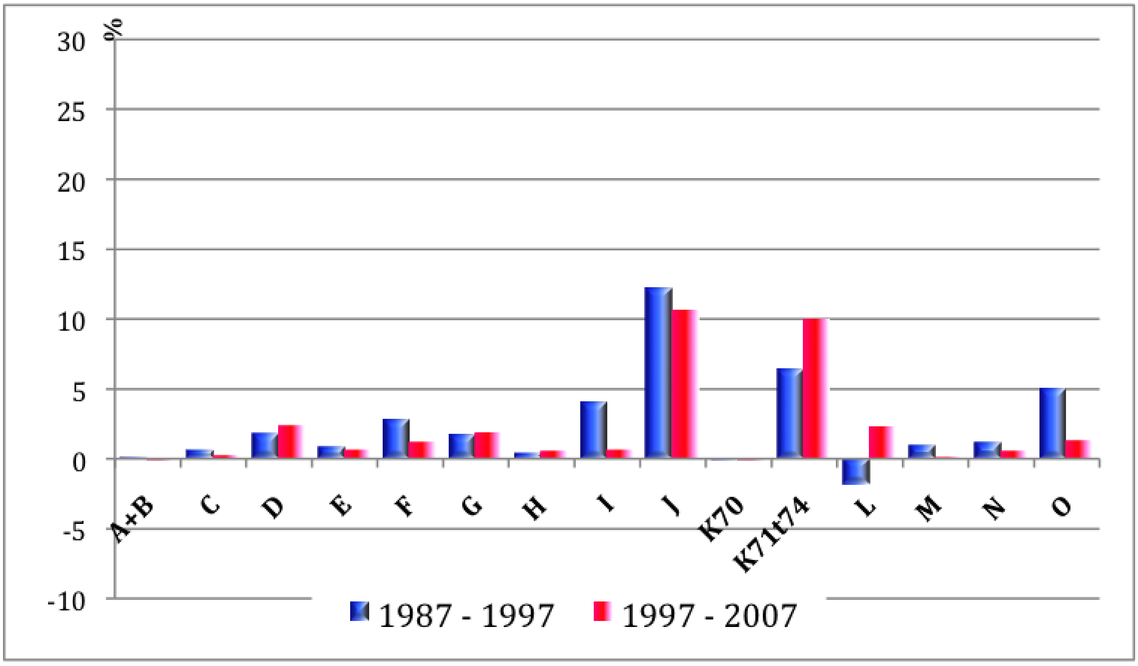
Table 3.10: Basic Regression of Changes in Workers' Characteristics and ICT Intensity on Non-Regular Employment at Separated Periods

	Male					Female				
	1987 *to* **1992**	**1992** *to* **1997**	**1997** *to* **2002**	**2002** *to* **2007**	**1987** *to* **2007**	**1987** *to* **1992**	**1992** *to* **1997**	**1997** *to* **2002**	**2002** *to* **2007**	**1987** *to* **2007**
Ag3049	0.0146	0.0100*	−0.0008	−0.0271	0.0077	−0.0017	0.0052	0.0050	−0.0010	0.0107
	(0.0135)	(0.0040)	(0.0153)	(0.0272)	(0.0074)	(0.0037)	(0.0075)	(0.0179)	(0.0095)	(0.0056)
Agov50	0.0096	0.0014	0.0162	0.0080	0.0179	0.0079	0.0085	0.0234	0.0267	0.0348***
	(0.0144)	(0.0037)	(0.0207)	(0.0214)	(0.0099)	(0.0077)	(0.0093)	(0.0227)	(0.0146)	(0.0094)
Seni High	−0.0304	−0.0135**	−0.0077	−0.0152	−0.0141**	−0.0148*	−0.0034	−0.0326	−0.0468	−0.0300*
	(0.0186)	(0.0039)	(0.0193)	(0.0117)	(0.0049)	(0.0064)	(0.0067)	(0.0235)	(0.0234)	(0.0110)
Juni Colle	0.0169	0.0078	0.0105	0.0252	−0.0122	0.0036	0.0111	0.0120	−0.0255	0.0091
	(0.0300)	(0.0069)	(0.0237)	(0.0269)	(0.0150)	(0.0059)	(0.0056)	(0.0322)	(0.0148)	(0.0055)
Uni&Grad	−0.0190	−0.0084*	−0.0249	−0.0057	−0.0261	−0.0085	−0.0136	−0.0151	−0.0447	−0.0039
	(0.0140)	(0.0035)	(0.0190)	(0.0105)	(0.0133)	(0.0098)	(0.0145)	(0.0276)	(0.0326)	(0.0145)
Prof	0.0203	0.0024	0.0291	−0.0121	0.0328*	0.0113	−0.0109	0.0121	0.0189	−0.0098
	(0.0183)	(0.0045)	(0.0154)	(0.0256)	(0.0148)	(0.0103)	(0.0068)	(0.0191)	(0.0296)	(0.0066)
Clerical	0.0261	−0.0047	0.0146	−0.0003	−0.0196	−0.0016	0.0082	0.0283	0.0189	0.0080
	(0.0148)	(0.0026)	(0.0145)	(0.0211)	(0.0211)	(0.0061)	(0.0095)	(0.0265)	(0.0112)	(0.0117)
Product	0.0337	0.0018	0.0088	0.0279*	0.0251	0.0152***	0.0209*	0.0161	0.0075	0.0061
	(0.0193)	(0.0036)	(0.0203)	(0.0129)	(0.0126)	(0.0038)	(0.0097)	(0.0239)	(0.0100)	(0.0049)
Sal&Serv	0.0329	−0.0040	0.0117	−0.0033	−0.0101	0.0102	0.0042	0.0422	0.0494*	−0.0019
	(0.0200)	(0.0061)	(0.0163)	(0.0101)	(0.0129)	(0.0091)	(0.0078)	(0.0251)	(0.0205)	(0.0095)
ICTF	−0.0028	−0.0008	−0.0032	−0.0047	−0.0041	−0.0002	0.0019	0.0009	−0.0047	−0.0083
	(0.0044)	(0.0008)	(0.0072)	(0.0184)	(0.0020)	(0.0012)	(0.0017)	(0.0048)	(0.0032)	(0.0042)
Constant	0.0004	0.0003*	0.0008**	−0.0005	0.0020**	0.0002	0.0001	−0.0001	0.0001	−0.0006
	(0.0003)	(0.0001)	(0.0003)	(0.0007)	(0.0006)	(0.0002)	(0.0003)	(0.0003)	(0.0001)	(0.0005)
N	37	37	37	37	37	37	37	37	37	37
R^2	0.5147	0.6737	0.2013	0.3679	0.6313	0.6816	0.5641	0.8183	0.8155	0.9067

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 37.

Appendix 3A

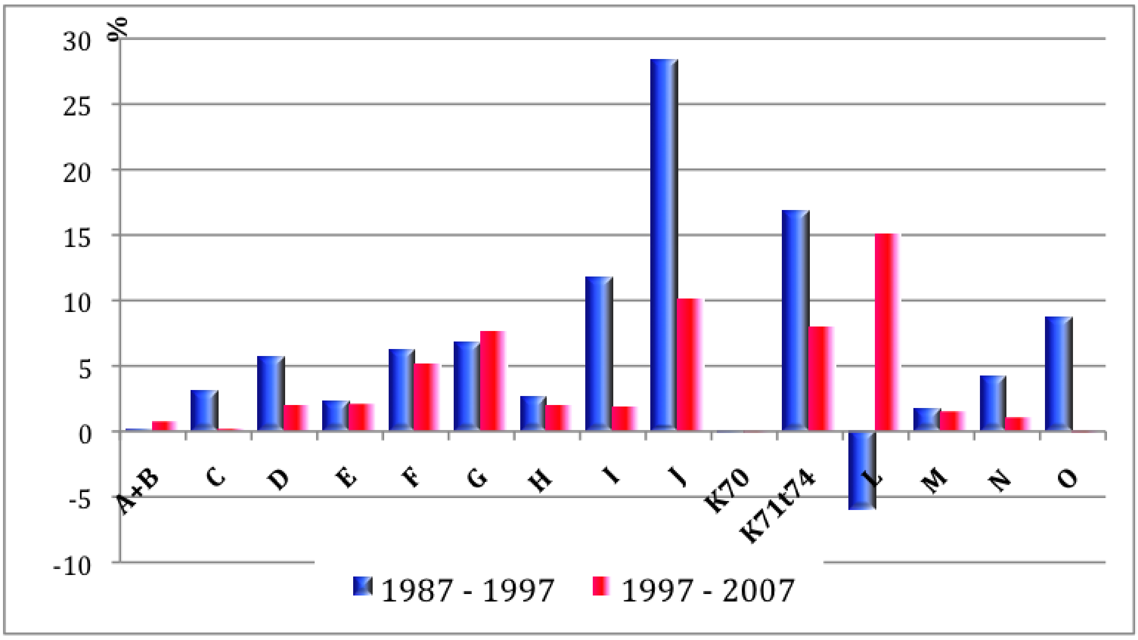
Figure 3.6: Changes in ICT Capital Stock by Industry



Source: EU KLEMS (2011); and authors calculations

Note: A+B (Agriculture, Forestry, and Fishing); C (Mining); D (Manufacturing); F (Construction); G (Wholesale and Retail Trade); H (Restaurant, Hotel); I (Transportation, Warehousing and Communication); J (Finance and Insurance); K71t74 (Renting of Machinery and Equipment, and Other Business Activities); M (Education); N (Medical and Other Health Services); O (Other Community, Social and Personal Services)

Figure 3.7: Changes in ICT Capital Formation by Industry



Source: EU KLEMS (2011); and authors calculations

Note: A+B (Agriculture, Forestry, and Fishing); C (Mining); D (Manufacturing); F (Construction); G (Wholesale and Retail Trade); H (Restaurant, Hotel); I (Transportation, Warehousing and Communication); J (Finance and Insurance); K71t74 (Renting of Machinery and Equipment, and Other Business Activities); M (Education); N (Medical and Other Health Services); O (Other Community, Social and Personal Services)

Table 3.11: Definition of Variables

Sector	
A+B	Agriculture, Forestry, and Fishing
C	Mining
D	Manufacturing
E	Electricity, Gas, Heat Supply and Water
F	Construction
G	Wholesale and Retail Trade
H	Restaurant
I	Transportation, Warehousing and Communicaiton
J	Finance and Insurance Industry
K70	Real Estate Business
K71t74	Renting of Machinery and Equipment, Other Business Activities, and Professional Services NEC
L	Government NEC
M	Education
N	Medical and Other Health Services
O	Other Community, Social and Personal Services
NEC	Unclassified Industry
Agbl30	Age Below 30 *(Reference Group)*
Ag3049	Age Between 30 and 49
Agov50	Age 50 and Over
Low Edu	Non-Educated, Primary School or Junior High School *(Reference Group)*
Seni High (*SH*)	Senior High School
Juni Colle (*JC*)	Junior College
Uni&Grad (*U&G*)	College or University and Graduate School
Prof	Specialist and Technical Administrative and Managerial
Clerical (*Cler*)	Clerical
Product (*Prod*)	Production Process and Related
Sal&Serv (*S&S*)	Sales Personal Service
Other	Security *(Reference Group)* Agriculture, Forestry and Fishery Transport and Communication NEC
ICTS	Technical Change by ICT Capital Stock
ICTF	Technical Change by ICT Capital Formation
Period1	1987 – 1992 *(Reference Group)*

Table 3.11: *Continued*

Period2	$1992 - 1997$
Period3	$1997 - 2002$
Period4	$2002 - 2007$
Period5	$1987 - 2007$

Table 3.12: Matching of Industry Classification

EUKLEMS CODE	EUKLEMS Industry Classification	Japan's Industry arranged by EUKLEMS CODE	Japan's Industry Classificaiton
AtB	**Agriculture, Hunting, Forestry and Fishing**	**A**	**Agriculture**
		A	**Forestry**
		B	**Fishing**
C	**Mining and Quarrying**	**C**	**Mining**
15t16	Food, Beverages, and Tobacco	15 & 16	Manufacturing of Food, Beverages, Tobacco, and Feed
17t19	Textiles, Leather, and Footwear	17t18	Manufacturing of Textile Mill, Apparel, and Other Textile Products
20	Wood and of Wood and Cork	20	Manufacturing of Lumber, Wood, and Furniture Products
21t22	Pulp, Paper, Printing, and Publishing	21	Manufacturing of Pulp, Paper, and Paper Products
		22	Manufacturing of Publishing, Printing, and Allied industries
23t25	Chemical, Rubber, Plastics and Fuel	23t25	Manufacturing of Chemical and allied Products
26	Other Non-Metallic Mineral	26	Manufacturing of Ceramic, Stone, and Clay Products
27t28	Basic Metals and Fabricated Metal	27	Manufacturing of Iron and Steel
		27	Manufacturing of Non-Ferrous Metals and Products
		28	Manufacturing of Fabricated Metal Products
29	Machinery NEC	29	Manufacturing of General-Purpose Machinery
30t33	Electrical and Optical Equipment	31	Manufacturing of Electrical Machinery, Equipment and Supplies

Table 3.12: *Continued*

EUKLEMS CODE	EUKLEMS Industry Classification	Japan's Industry arranged by EUKLEMS CODE	Japan's Industry Classificaiton
		33	Manufacturing of Precision Equipment
34t35	Transport Equipment	34t35	Manufacturing of Transportation Equipment
36t37	Manufacturing NEC; Recycling	36t37	Other Manufacturing
E	**Electricity, Gas, and Water Supply**	**E**	**Electricity, Gas, Heat Supply and Water**
F	**Construction**	**F**	**Construction**
50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	50t52	Maintenance and Repair Business
51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	51	Various Wholesale Trade
52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	52	Food and Beverage Retail
		52	Other Retail
H	**Restaurant and Hotel**	**H**	**Restaurant and Hotel**
60t63	Transportation and Storage	60	Railroad Industry
		60t63	Transportation and Warehousing
64	Post and Telecommunications	64	Communication Industry
J	**Financial Intermediation**	**J**	**Finance and Insurance Industry**
70	Real Estate Activities	70	Real Estate Business
71t74	Renting of Machinery and Equipment	71	Business Service

Table 3.12: *Continued*

EUKLEMS CODE	EUKLEMS Industry Classification	Japan's Industry arranged by EUKLEMS CODE	Japan's Industry Classificaiton
	and Other Business Activities		
		74	Professional Services NEC
L	**Public Admin and Defence; Compulsory Social Security**	**L**	**Government NEC**
M	**Education**	**M**	**Education**
N	**Health and Social Work**	**N**	**Medical and Other Health Services**
O	**Other Community, Social and Personal Services**	**O (90t93)**	**Service Sectors**
		NEC	**Unclassified Industry**

Table 3.13: The Number of Employment by Sectors (1000 persons)

EUKLEM CODE	Industry	Total Workforce				
		1987	**1992**	**1997**	**2002**	**2007**
TOT	Total	46151	52561	54981	54658	57236
A+B	Agriculture, Forestry, and Fishing	454	455	438	450	669
C	Mining	83	54	42	39	29
D	Manufacturing	12705	13825	13078	11470	11214
E	Electricity, Gas, Heat Supply and Water	355	396	388	377	378
F	Construction	4408	5025	5586	4930	4471
G	Wholesale and Retail Trade	8803	10089	10627	10545	10723
H	Restaurant	1527	1616	2555	2760	2807
I	Transportation, Warehousing and Communication	3403	3725	3915	3862	3906
J	Finance and Insurance Industry	1825	1967	1888	1705	1656
K70	Real Estate Business	462	581	613	696	800
K71t74	Renting of Machinery and Equipment, Other Business Activities, and Professional Services NEC	4123	5408	4660	4690	5167
L	Government NEC	1929	2047	2081	2252	2247
M	Education	2007	2106	2160	2516	2682
N	Medical and Other Health Services	1777	2084	3598	4492	5611
O	Other Community, Social and Personal Services	2181	2750	2835	3007	2970
NEC	Unclassified Industry	109	433	517	868	1908

Table 3.13: The Number of Employment by Sectors (1000 persons) *(Continued)*

EUKLEM	Male Regular Workers					Female Regular Workers				
CODE	**1987**	**1992**	**1997**	**2002**	**2007**	**1987**	**1992**	**1997**	**2002**	**2007**
TOT	26726	29178	29763	27369	26879	10929	12858	12626	11084	11459
A+B	255	235	204	191	227	43	55	55	58	151
C	69	45	35	30	23	9	7	5	6	3
D	7812	8425	8133	7027	6652	2811	3129	2666	1925	1701
E	296	336	327	309	319	31	33	34	35	25
F	3156	3606	4083	3520	3188	451	662	720	586	540
G	4727	5086	5054	4590	4344	2133	2534	2364	1878	1918
H	460	425	696	656	621	303	276	440	346	342
I	2807	2925	2967	2630	2466	328	399	411	316	308
J	885	897	911	745	703	780	866	769	590	555
K70	272	324	326	355	379	133	184	188	182	213
K71t74	2104	2552	2349	2460	2599	1154	1547	931	774	886
L	1512	1568	1558	1642	1625	248	274	297	336	341
M	1024	1017	1009	972	989	742	790	802	807	827
N	377	442	666	741	943	1116	1266	2142	2416	2702
O	921	1105	1218	1180	1134	623	753	714	700	676
NEC	49	190	227	321	668	24	83	88	130	272

Table 3.13: The Number of Employment by Sectors (1000 persons) ***(Continued)***

EUKLEM	Male Non-Regular Workers					Female Non-Regular Workers				
CODE	**1987**	**1992**	**1997**	**2002**	**2007**	**1987**	**1992**	**1997**	**2002**	**2007**
TOT	2423	2859	3358	4779	5911	6073	7666	9234	11426	12988
A+B	71	58	59	69	102	85	107	120	132	190
C	4	2	2	2	3	1	0	0	2	0
D	378	455	474	747	1074	1704	1816	1805	1771	1787
E	10	10	10	12	15	18	17	17	21	18
F	639	573	590	631	540	162	184	193	194	204
G	343	436	587	867	1014	1600	2033	2622	3210	3448
H	161	192	306	432	473	603	723	1113	1326	1371
I	153	196	236	466	606	115	205	301	450	525
J	40	33	31	50	58	120	171	177	320	340
K70	20	26	37	77	103	37	47	62	82	105
K71t74	279	396	421	536	660	586	913	959	921	1023
L	58	65	72	74	87	111	140	154	200	194
M	88	102	111	240	277	153	197	238	497	589
N	28	39	84	121	212	256	337	706	1214	1754
O	135	216	260	317	341	502	676	643	809	819
NEC	16	60	78	137	346	20	100	124	280	623

Table 3.14: Basic Regression of Changes in Workers Characteristics and ICT Intensity on Regular and Non-Regular Employment

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	−0.0001	0.0025	0.0082*	0.0048	0.0091	0.0048	−0.0068*	−0.0029
	(0.0042)	(0.0038)	(0.0032)	(0.0030)	(0.0052)	(0.0040)	(0.0031)	(0.0031)
Agov50	−0.0127	−0.0082	−0.0081	−0.0079	0.0104	0.0051	0.0117*	0.0117*
	(0.0067)	(0.0060)	(0.0056)	(0.0048)	(0.0057)	(0.0048)	(0.0050)	(0.0049)
Seni High	0.0141*	0.0132*	0.0175*	0.0197*	−0.0142*	−0.0143*	−0.0129	−0.0155*
	(0.0052)	(0.0052)	(0.0075)	(0.0076)	(0.0053)	(0.0058)	(0.0072)	(0.0070)
Juni Colle	0.0030	0.0013	−0.0086*	−0.0105**	−0.0108	−0.0083	0.0088*	0.0107**
	(0.0074)	(0.0074)	(0.0042)	(0.0032)	(0.0099)	(0.0081)	(0.0042)	(0.0034)
Uni&Grad	0.0153**	0.0120*	−0.0158*	−0.0118	−0.0126*	−0.0117*	0.0216	0.0169
	(0.0054)	(0.0052)	(0.0067)	(0.0084)	(0.0051)	(0.0048)	(0.0107)	(0.0102)
Prof	0.0091	0.0094	0.0167	0.0164	0.0078	0.0099*	−0.0041	−0.0036
	(0.0050)	(0.0048)	(0.0091)	(0.0097)	(0.0043)	(0.0043)	(0.0083)	(0.0088)
Clerical	0.0090	0.0053	0.0003	−0.0030	0.0029	0.0073	0.0105	0.0142*
	(0.0054)	(0.0068)	(0.0050)	(0.0054)	(0.0051)	(0.0057)	(0.0057)	(0.0069)
Sal&Serv	0.0057	0.0101*	−0.0047	−0.0035	0.0117	0.0059	0.0205**	0.0193**
	(0.0056)	(0.0047)	(0.0054)	(0.0047)	(0.0062)	(0.0043)	(0.0057)	(0.0053)
Product	−0.0034	−0.0014	−0.0037	−0.0038	0.0195*	0.0160*	0.0143**	0.0143***
	(0.0057)	(0.0060)	(0.0046)	(0.0044)	(0.0084)	(0.0074)	(0.0040)	(0.0038)
ICTS	0.0035	0.0039	0.0036	0.0046	−0.0034	−0.0035	−0.0043	−0.0055
	(0.0036)	(0.0039)	(0.0029)	(0.0031)	(0.0047)	(0.0045)	(0.0025)	(0.0027)

Table 3.14: *Continued*

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period2		0.0002		−0.0001		0.0002		0.0002
		(0.0001)		(0.0003)		(0.0001)		(0.0002)
Period3		−0.0003		−0.0004		0.0007**		0.0004*
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period4		0.0000		0.0002		0.0002		−0.0002
		(0.0002)		(0.0001)		(0.0001)		(0.0001)
Constant	−0.0003*	−0.0003*	0.0001	0.0002	0.0003*	0.0001	−0.0002	−0.0003
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
N	148	148	148	148	148	148	148	148
R^2	0.3773	0.4104	0.5523	0.6046	0.2551	0.3194	0.5817	0.6417

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.15: The Interactive Effect of Technical Change (ICT Capital Stock) and Different Educational Levels on Changes in Regular and Non-Regular Employment

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	0.0000	0.0024	0.0095**	0.0062	0.0090	0.0052	−0.0080*	−0.0043
	(0.0042)	(0.0038)	(0.0033)	(0.0031)	(0.0050)	(0.0040)	(0.0033)	(0.0032)
Agov50	−0.0117	−0.0075	−0.0082	−0.0076	0.0086	0.0038	0.0116*	0.0112*
	(0.0065)	(0.0059)	(0.0054)	(0.0048)	(0.0056)	(0.0050)	(0.0050)	(0.0051)
Seni High	0.0134*	0.0131*	0.0157*	0.0177*	−0.0116**	−0.0125**	−0.0103	−0.0127*
	(0.0049)	(0.0051)	(0.0068)	(0.0072)	(0.0036)	(0.0044)	(0.0058)	(0.0060)
Juni Colle	−0.0008	−0.0025	0.0041	−0.0003	−0.0091	−0.0064	−0.0033	0.0016
	(0.0093)	(0.0097)	(0.0057)	(0.0078)	(0.0114)	(0.0092)	(0.0048)	(0.0065)
Uni&Grad	0.0165*	0.0125	−0.0124	−0.0082	−0.0129*	−0.0109*	0.0206	0.0154
	(0.0065)	(0.0063)	(0.0107)	(0.0131)	(0.0059)	(0.0048)	(0.0137)	(0.0153)
Prof	0.0070	0.0074	0.0291*	0.0274	0.0119	0.0138	−0.0159	−0.0135
	(0.0068)	(0.0065)	(0.0115)	(0.0138)	(0.0075)	(0.0075)	(0.0106)	(0.0129)
Clerical	0.0077	0.0034	−0.0009	−0.0025	0.0036	0.0090	0.0124	0.0147
	(0.0050)	(0.0059)	(0.0053)	(0.0061)	(0.0055)	(0.0054)	(0.0066)	(0.0080)
Sal&Serv	0.0046	0.0088	−0.0043	−0.0026	0.0137	0.0083	0.0203***	0.0188***
	(0.0065)	(0.0058)	(0.0052)	(0.0049)	(0.0078)	(0.0062)	(0.0051)	(0.0049)
Product	−0.0046	−0.0029	−0.0048	−0.0047	0.0216*	0.0184	0.0152***	0.0150***
	(0.0067)	(0.0073)	(0.0048)	(0.0048)	(0.0103)	(0.0094)	(0.0040)	(0.0039)

Table 3.15: *Continued*

	Regular				Non-Regular			
	Male		**Female**		**Male**		**Female**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICTS	0.0035	0.0016	0.0215*	0.0217*	−0.0083	−0.0045	−0.0215**	−0.0212*
	(0.0107)	(0.0123)	(0.0080)	(0.0096)	(0.0130)	(0.0131)	(0.0072)	(0.0091)
ICTS×SH	0.0738	0.0440	0.4750	0.4425	−0.2715	−0.2123	−0.5365	−0.4866
	(0.1411)	(0.1400)	(0.3114)	(0.2862)	(0.2342)	(0.2159)	(0.3500)	(0.3270)
ICTS×JC	0.3680	0.3755	−0.9187*	−0.7837	−0.1860	−0.2179	0.8962*	0.7245
	(0.4099)	(0.4131)	(0.4218)	(0.5509)	(0.3923)	(0.3943)	(0.4076)	(0.5176)
ICTS×U&G	−0.0273	0.0311	−0.0976	−0.1641	0.0142	−0.0727	−0.0246	0.0462
	(0.1378)	(0.1643)	(0.2681)	(0.2824)	(0.1478)	(0.1551)	(0.2761)	(0.2724)
Period2		0.0002		−0.0000		0.0002		0.0001
		(0.0001)		(0.0003)		(0.0001)		(0.0003)
Period3		−0.0003		−0.0003		0.0006**		0.0003
		(0.0002)		(0.0003)		(0.0002)		(0.0002)
Period4		0.0001		0.0002		0.0001		−0.0002
		(0.0002)		(0.0002)		(0.0001)		(0.0002)
Constant	−0.0003*	−0.0003	−0.0001	−0.0001	0.0004*	0.0002	0.0001	−0.0000
	(0.0001)	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.3832	0.4151	0.5937	0.6336	0.2724	0.3328	0.6187	0.6651

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.16: The Interactive Effect of Technical Change (ICT Capital Formation) and Different Educational Levels on Changes in Regular and Non-Regular Employment

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	0.0001	0.0026	0.0115*	0.0079	0.0089	0.0051	−0.0105*	−0.0064
	(0.0041)	(0.0038)	(0.0045)	(0.0040)	(0.0050)	(0.0038)	(0.0045)	(0.0039)
Agov50	−0.0124	−0.0084	−0.0059	−0.0063	0.0106	0.0057	0.0092	0.0099
	(0.0072)	(0.0066)	(0.0056)	(0.0053)	(0.0061)	(0.0052)	(0.0053)	(0.0058)
Seni High	0.0136*	0.0132*	0.0167	0.0180*	−0.0141**	−0.0146*	−0.0123	−0.0140
	(0.0050)	(0.0052)	(0.0082)	(0.0086)	(0.0048)	(0.0054)	(0.0074)	(0.0077)
Juni Colle	0.0023	−0.0008	−0.0052	−0.0092	−0.0103	−0.0072	0.0053	0.0095*
	(0.0069)	(0.0072)	(0.0055)	(0.0046)	(0.0090)	(0.0072)	(0.0047)	(0.0038)
Uni&Grad	0.0158*	0.0132	−0.0140	−0.0095	−0.0136*	−0.0131*	0.0195	0.0142
	(0.0065)	(0.0066)	(0.0111)	(0.0132)	(0.0057)	(0.0053)	(0.0159)	(0.0171)
Prof	0.0083	0.0090	0.0183	0.0167	0.0074	0.0099	−0.0057	−0.0038
	(0.0057)	(0.0056)	(0.0148)	(0.0160)	(0.0047)	(0.0051)	(0.0132)	(0.0144)
Clerical	0.0090	0.0052	−0.0018	−0.0045	0.0023	0.0065	0.0129	0.0159
	(0.0061)	(0.0066)	(0.0059)	(0.0061)	(0.0066)	(0.0062)	(0.0072)	(0.0081)
Sal&Serv	0.0045	0.0092	−0.0080	−0.0063	0.0122	0.0069	0.0242***	0.0224***
	(0.0060)	(0.0051)	(0.0057)	(0.0056)	(0.0066)	(0.0047)	(0.0059)	(0.0057)
Product	−0.0046	−0.0025	−0.0050	−0.0049	0.0201*	0.0170*	0.0157***	0.0155***
	(0.0057)	(0.0062)	(0.0048)	(0.0048)	(0.0088)	(0.0079)	(0.0041)	(0.0040)

Table 3.16: *Continued*

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICTF	0.0023	0.0011	0.0015	0.0013	−0.0025	−0.0028	−0.0011	−0.0010
	(0.0023)	(0.0027)	(0.0015)	(0.0018)	(0.0019)	(0.0023)	(0.0020)	(0.0021)
ICTF×SH	0.0217	0.0136	0.0347	0.0279	−0.0078	−0.0165	−0.0203	−0.0117
	(0.0342)	(0.0347)	(0.0818)	(0.0698)	(0.0219)	(0.0264)	(0.0881)	(0.0705)
ICTF×JC	0.0167	0.0168	−0.1574	−0.0931	0.0115	0.0227	0.1610	0.0894
	(0.0903)	(0.0946)	(0.1447)	(0.1392)	(0.0755)	(0.0676)	(0.1305)	(0.1330)
ICTF×U&G	−0.0173	0.0006	−0.0987	−0.0698	0.0371	0.0267	0.1021	0.0743
	(0.0647)	(0.0660)	(0.1602)	(0.1858)	(0.0528)	(0.0483)	(0.1575)	(0.1939)
Period2		0.0001		−0.0001		0.0003		0.0002
		(0.0001)		(0.0003)		(0.0001)		(0.0003)
Period3		−0.0003		−0.0004		0.0007*		0.0004*
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period4		0.0001		0.0001		0.0001		−0.0001
		(0.0002)		(0.0001)		(0.0001)		(0.0001)
Constant	−0.0003*	−0.0003	0.0001	0.0003	0.0003**	0.0001	−0.0002	−0.0003
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.3801	0.4074	0.5648	0.6023	0.2560	0.3211	0.5950	0.6374

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.17: The Interactive Effect of Technical Change (ICT Capital Stock) and Different Skill Level Jobs on Changes in Regular and Non-Regular Employment

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	0.0011	0.0043	0.0087*	0.0055*	0.0083	0.0033	−0.0073	−0.0036
	(0.0047)	(0.0041)	(0.0032)	(0.0022)	(0.0055)	(0.0043)	(0.0037)	(0.0030)
Agov50	−0.0126	−0.0076	−0.0107*	−0.0101*	0.0099	0.0040	0.0138*	0.0134*
	(0.0067)	(0.0061)	(0.0048)	(0.0041)	(0.0059)	(0.0052)	(0.0051)	(0.0049)
Seni High	0.0143*	0.0132*	0.0177**	0.0194**	−0.0143*	−0.0141*	−0.0134	−0.0155*
	(0.0053)	(0.0054)	(0.0053)	(0.0061)	(0.0052)	(0.0059)	(0.0072)	(0.0074)
Juni Colle	0.0034	0.0026	0.0023	−0.0001	−0.0114	−0.0098	0.0014	0.0038
	(0.0079)	(0.0075)	(0.0040)	(0.0044)	(0.0109)	(0.0087)	(0.0037)	(0.0041)
Uni&Grad	0.0143*	0.0109	−0.0068	−0.0044	−0.0116*	−0.0103*	0.0148	0.0117
	(0.0059)	(0.0054)	(0.0084)	(0.0085)	(0.0056)	(0.0046)	(0.0135)	(0.0130)
Prof	0.0041	0.0022	0.0358*	0.0356*	0.0128	0.0182	−0.0159	−0.0155
	(0.0085)	(0.0081)	(0.0140)	(0.0149)	(0.0085)	(0.0091)	(0.0144)	(0.0150)
Clerical	0.0077	0.0034	−0.0046	−0.0080	0.0051	0.0101	0.0138*	0.0179*
	(0.0059)	(0.0070)	(0.0054)	(0.0061)	(0.0068)	(0.0070)	(0.0066)	(0.0078)
Sal&Serv	0.0113	0.0151	−0.0093	−0.0077	0.0098	0.0035	0.0243**	0.0228**
	(0.0089)	(0.0079)	(0.0071)	(0.0080)	(0.0100)	(0.0077)	(0.0078)	(0.0080)
Product	−0.0006	0.0020	−0.0093*	−0.0097*	0.0184	0.0142	0.0197***	0.0200***
	(0.0073)	(0.0078)	(0.0042)	(0.0038)	(0.0101)	(0.0092)	(0.0053)	(0.0050)

Table 3.17: *Continued*

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICTS	0.0040	0.0040	0.0009	0.0020	−0.0033	−0.0031	−0.0024	−0.0036
	(0.0043)	(0.0047)	(0.0023)	(0.0026)	(0.0049)	(0.0050)	(0.0020)	(0.0022)
ICTS×Prof	0.2550	0.3594	−0.7169**	−0.6962*	−0.2427	−0.3984	0.4607*	0.4377
	(0.2583)	(0.2606)	(0.2378)	(0.2534)	(0.2739)	(0.2913)	(0.2128)	(0.2207)
ICTS×Cler	−0.0860	−0.1108	0.1120	0.1398	−0.0299	0.0406	−0.0778	−0.1087
	(0.3538)	(0.3998)	(0.1054)	(0.1093)	(0.4062)	(0.4048)	(0.1197)	(0.1189)
ICTS×S&S	−0.4929	−0.4218	0.5358	0.5077	0.2047	0.2429	−0.3976	−0.3708
	(0.4313)	(0.4280)	(0.2784)	(0.2884)	(0.3836)	(0.3501)	(0.3187)	(0.3005)
ICTS×Prod	−0.3093	−0.3630	0.3922	0.4503	0.1960	0.2867	−0.4332	−0.4851
	(0.3679)	(0.3893)	(0.5340)	(0.4108)	(0.4736)	(0.4873)	(0.4540)	(0.3398)
Period2		0.0001		−0.0001		0.0002*		0.0002
		(0.0001)		(0.0003)		(0.0001)		(0.0002)
Period3		−0.0004*		−0.0004		0.0007**		0.0004*
		(0.0002)		(0.0002)		(0.0002)		(0.0002)
Period4		−0.0000		0.0002		0.0002		−0.0002
		(0.0002)		(0.0002)		(0.0001)		(0.0002)
Constant	−0.0003*	−0.0003	−0.0000	0.0001	0.0003*	0.0001	−0.0001	−0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.3972	0.4327	0.6396	0.6900	0.2671	0.3420	0.6212	0.6798

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.18: The Interactive Effect of Technical Change (ICT Capital Formation) and Different Skill Level Jobs on Changes in Regular and Non-Regular Employment

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ag3049	0.0012	0.0038	0.0077**	0.0061*	0.0084	0.0037	−0.0059*	−0.0037
	(0.0046)	(0.0043)	(0.0026)	(0.0029)	(0.0054)	(0.0043)	(0.0023)	(0.0028)
Agov50	−0.0117	−0.0074	−0.0115*	−0.0108*	0.0103	0.0048	0.0155**	0.0151**
	(0.0070)	(0.0063)	(0.0048)	(0.0045)	(0.0060)	(0.0051)	(0.0052)	(0.0053)
Seni High	0.0145**	0.0141*	0.0224**	0.0223*	−0.0139**	−0.0146*	−0.0186**	−0.0190**
	(0.0051)	(0.0054)	(0.0077)	(0.0084)	(0.0049)	(0.0061)	(0.0056)	(0.0062)
Juni Colle	0.0029	−0.0005	0.0024	−0.0007	−0.0109	−0.0081	−0.0024	0.0009
	(0.0065)	(0.0062)	(0.0045)	(0.0047)	(0.0082)	(0.0062)	(0.0048)	(0.0046)
Uni&Grad	0.0146*	0.0126*	0.0047	0.0046	−0.0133*	−0.0123*	−0.0027	−0.0028
	(0.0060)	(0.0056)	(0.0071)	(0.0075)	(0.0061)	(0.0055)	(0.0095)	(0.0100)
Prof	0.0074	0.0072	0.0159	0.0155	0.0090	0.0127	−0.0015	−0.0009
	(0.0061)	(0.0061)	(0.0130)	(0.0148)	(0.0056)	(0.0063)	(0.0114)	(0.0132)
Clerical	0.0079	0.0041	−0.0014	−0.0030	0.0035	0.0090	0.0100	0.0120
	(0.0056)	(0.0069)	(0.0057)	(0.0056)	(0.0054)	(0.0066)	(0.0058)	(0.0073)
Sal&Serv	0.0097	0.0138*	−0.0238***	−0.0208**	0.0091	0.0026	0.0402***	0.0366***
	(0.0077)	(0.0062)	(0.0063)	(0.0068)	(0.0087)	(0.0061)	(0.0072)	(0.0074)
Product	−0.0050	−0.0027	−0.0051	−0.0047	0.0208*	0.0166*	0.0140***	0.0134***
	(0.0062)	(0.0067)	(0.0043)	(0.0046)	(0.0090)	(0.0079)	(0.0033)	(0.0034)

Table 3.18: *Continued*

	Regular				Non-Regular			
	Male		Female		Male		Female	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ICTF	0.0027*	0.0020	−0.0026	−0.0020	−0.0017	−0.0021*	0.0027	0.0018
	(0.0011)	(0.0013)	(0.0020)	(0.0019)	(0.0009)	(0.0009)	(0.0018)	(0.0016)
ICTF×Prof	−0.0509	−0.0268	−0.3272**	−0.2787*	0.0198	−0.0157	0.3333**	0.2760*
	(0.0883)	(0.0854)	(0.0981)	(0.1249)	(0.0836)	(0.0844)	(0.1089)	(0.1291)
ICTF×Cler	0.0129	0.0245	−0.0792	−0.0570	0.0491	0.0119	0.1463*	0.1213
	(0.0838)	(0.0860)	(0.0708)	(0.0699)	(0.0651)	(0.0763)	(0.0625)	(0.0664)
ICTF×S&S	−0.2120	−0.1844	0.5321***	0.4738***	0.1454	0.1655	−0.5301***	−0.4608**
	(0.1763)	(0.1879)	(0.0925)	(0.1065)	(0.1248)	(0.1162)	(0.1241)	(0.1293)
ICTF×Prod	0.0289	0.0104	−0.0065	−0.0251	−0.0212	0.0386	0.0739	0.0963
	(0.1265)	(0.1321)	(0.1002)	(0.1105)	(0.1090)	(0.1252)	(0.1141)	(0.1230)
Period2		0.0001		−0.0001		0.0003		0.0001
		(0.0001)		(0.0003)		(0.0002)		(0.0002)
Period3		−0.0004*		−0.0002		0.0007**		0.0003
		(0.0002)		(0.0003)		(0.0002)		(0.0002)
Period4		0.0000		0.0001		0.0002		−0.0001
		(0.0002)		(0.0001)		(0.0001)		(0.0001)
Constant	−0.0003**	−0.0002	0.0001	0.0001	0.0003**	0.0001	−0.0001	−0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
N	148	148	148	148	148	148	148	148
R^2	0.3875	0.4144	0.6510	0.6638	0.2594	0.3275	0.6790	0.6955

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: NEC sector is omitted from the regression model as the data of technical change is unavailable for the sector, which leads the observations to 148.

Table 3.19: Important Events in the Period of 1987 to 2007 in Japan

Period	Events
1987-1992	
1989	The Bank of Japan implemented serveral contractionary monetary to restrain the economic bubble, raising the discount rate five times to 6 percent in the period 19891990, then the bubble burst. Japanese economy entered its long term recession.
1992-1997	Aftermath of the bursting bubble
1997-2002	
1997	Asian Financial Crisis
	The modification of the EEO Law
1999	Deregulation for dispatched workers
2002-2007	
2003	Stock price start rising
2006	Zero rate policy end

Note: For country classification, this table only displays the countries included in the meta-regression analysis in this chapter. Figure 2.1 to 2.3 present the results using global data.

4 The Evolution of the UK Glass Ceiling

Summary

- Using data from the New Earnings Survey (NES)/Annual Survey of Hours and Earnings (ASHE) and the Labour Force Surveys, this chapter demonstrates how the female relative wage in the top decile of the wage distribution has evolved over the period $1975-2011$.

- A cohort analysis and regression method are adopted to investigate the changing pattern of female relative pay in the top decile of wage distribution in terms of different labour market sectors, occupations, over their working lives, and across generations.

- The findings of this chapter suggest a downward trend for the gender wage differential at both the mean and the top of the wage distribution, yet it remains large. Of these, the differential is found to be lower in professional and technical occupations, while the opposite holds for low-level male-dominated jobs and the top management jobs.

- Although female relative pay was significantly lower in the private sector for the older generations, it has more than caught up the public sector in the current generation. Further evidence confirms that the relative rewards for an individual top-earning woman are now better in the private sector compared to the public sector.

4.1 Introduction

The UK average gender pay gap has often been pinpointed as one of the largest amongst European countries[39] (Eurostat, 2013). Although it has shown some notable decline since the introduction of the Equal Pay Act in the 1970s, the gap has remained substantial[40] over time. Many studies have attributed this remarkably persistent gender gap to a significant proportion of women working part time, educational differences, occupational segregation, and the job characteristics of the workforce (Manning, 2006; Thomson, 2006; Arulampalam *et al.*, 2007; International Trade Union Confederation, 2008; Metro, 2009; Mumford and Smith, 2009; Eurostat, 2013). The Women and Work Commission (2006) suggested the importance of pre-entry labour market policies for reducing occupational gender segregation at the beginning of women's careers through education, by reducing gender stereotyping in schools, and inspiring females to participate in male-dominated fields both for the subject of study and the choice of occupations. In contrast, being sceptical about this idea, Manning (2006) argues that to understand why women are failing to 'get on' in the labour market is much more important than pre-entry considerations. It is found that the gender gap in the employment of managers is significantly large, whereas there was no gap found when examining workers in their early twenties or before, but which becomes dramatically wider after their late twenties (*ibid*). This suggests the existence of a glass ceiling effect[41]. Perfect (2011) also suggests that the

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[39] Across Member States of the European Union the gender pay gap varied with a range of 2% in Slovenia to 27% in Estonia in 2011, with the UK as the sixth largest amongst the 27 countries at about 20% (Eurostat, 2013).

[40] During 1970 – 2010, the UK hourly earnings gap between full-time female and male workers decreased from 36.2% to 15.5%, and the gap between part-time female and full-time male employees decreased from 48.5% to 34.5% (Perfect, 2011).

[41] The term 'glass ceiling' describes the phenomenon whereby women face a barrier to further progress in their career once they have reached a certain level.

greater full-time gender pay differential for the mean rather than for the median[42] is due to the impact of the very high earnings of some male workers with the domination of men in the highest paid occupations and the predominance of women in the lower paying fields. All these indications have shown that to improve the gender parity in Britain, it is very important to understand what has happened at the top of the wage distribution. It hence leads to the broad question of this chapter − how the UK gender gap at the top end of the wage distribution (the 'glass ceiling') has evolved over time.

Following the idea that a glass ceiling occurs at the higher end of the wage distribution, some research has particularly concentrated on investigating female relative labour market outcomes in both pay and employment in specific top-level jobs. It has been concluded that the share of female employment at the highest-level corporate management has played a very important role in lowering gender bias in pay (Elkinawy and Stater, 2011; Matsa and Miller, 2011), as women in the top-ranking positions can be the role models for other women at lower positions in the hierarchy and hence influence choices over their career life, or provide more opportunities for development and sponsorship (Bagues and Esteve-Volart, 2010; Elkinawy and Stater, 2011; Leah, 2011).

Over the last few years, a number of studies have discovered different changing patterns of the average gender pay gap from the perspective of the entire wage distribution in many developed countries. For instance, the gender earnings gap at the mean in Sweden is found to be narrower than in the US, but the gap at the higher end of the wage distribution is much greater in Sweden than the US (Albrecht *et al.*, 2003). Similar stories have also been revealed in several European countries,

[42] In 2010, the UK gender gap for hourly wage was 15.5% at the mean, and was 10.2% at the median.

the US, and Australia for different segments, i.e. different educational groups, occupations, or labour market sectors (Public or Private) (Kee, 2006; Arulampalam *et al.*, 2007; De la Rica *et al.*, 2008; Barón and Cobb-Clark, 2010; Russo and Hassink, 2012; Chzhen and Mumford, 2011), with an increasing gender gap throughout the wage distribution and being particularly greater amongst the highest earners. This phenomenon has been considered corresponding to the term 'glass ceiling' by many researchers (*ibid*) and hence is regarded as a representative of the existence of a glass ceiling.

Such evidence on the existence of the glass ceiling has been discussed extensively in the empirical literature. However, knowledge about where the glass ceiling is located and how it has been changing over time has remained unclear. Moreover, although the link between the cohort effects and the gender gap at mean earnings has been addressed frequently (England 1992; O'Neill and Polachek, 1993, Morgan 1998; Fitzenberger *et al.*, 2002; Manning, 2006), with the higher female relative pay for younger cohorts than older cohorts as a result of the development of female human capital and the lesser discrimination in work environments, most research on the gap at other points of the wage distribution has not yet taken such cohort effects into account. Against this background, with a concern that women may not face only one glass ceiling over the entire wage distribution or in managerial positions but multiple glass ceilings at different job levels (Russo and Hassink, 2012), as well as the quite different shifting patterns of the glass ceilings across the public and the private sectors (Kee, 2006; Arulampalam *et al.*, 2007; Barón and Cobb-Clark, 2010), the main objective of this chapter is to provide detailed information on how the UK gender pay gap at the top end of the wage distribution (the 'glass ceiling') has evolved over the period of $1975-2011$ with respect to different labour market sectors, occupations, and different cohort groups, both within cohorts over their lifetime, and across cohorts. Overall, the results indicate that the top female relative pay in Britain has improved across labour market sectors and occupations, both within cohorts over their lifetime, and across cohorts during the period $1975-2011$. In addition, gender-specific policies seem to be less efficient over recent years in particular for the top-ranking women in the public sector and in the highest-level management jobs. However, what has really kept these women from reaching the highest levels remains obscure and needs to be further investigated.

The next section of the chapter presents the empirical findings relating to the gender gap across the wage distribution as well as the evidence on glass ceilings. Section 4.3 describes the data sets and some of their important features that need to be taken into account when interpreting the results, and section 4.4 discusses the conceptual framework. Section 4.5 applies a comprehensive descriptive analysis showing how the glass ceilings have been changing differently for different cohort groups, and for both full-time and part-time workers in different labour market sectors over their life cycles. Section 4.6 uses individual level panel data to examine how female relative wages within the top decile of the female wage distribution have been changing within particular occupations, age groups and age cohorts associated with their employment status (full-time/part-time), and the sectors and the region they work. Section 4.7 then examines the relationship between women's characteristics including demographic factors and the location of the glass ceiling at the occupational level. The final section concludes.

4.2 Literature Review

In recent years, the empirical literature on the gender pay differentials has shown a growing interest in the relatively high-performing female workforce. It is argued that there seems to be an effect that keeps women from reaching the top in that the career progression of women seems very likely to stop once they have reached a certain level of management and public service positions – that is they are facing an invisible glass ceiling. However, although the concept of the term 'glass ceiling' is clear, there is no precise definition for it, leading to the empirical research in relation to the 'glass ceiling' from different aspects. For instance, some studies concentrate on the female relative labour market outcomes in specific top-level jobs, arguing that if there is a gender gap in employment or wage within those jobs, the existence of a glass ceiling is suggested. Some others investigate the shifting magnitude of the gender wage differential across the entire distribution by applying an Oaxaca-Blinder type decomposition within a quantile regression framework, proposing that if the gender differential increases moving up the pay distribution, the glass ceiling exists.

4.2.1 Female Relative Labour Market Outcomes in Top-Level Jobs

Looking at three top corporate jobs in Denmark, Smith *et al.* (2011) find evidence of glass ceilings associated with a large estimated gender wage gap amongst CEOs in 2000 private firms, as well as sticky floors[43] in response to a substantial gender differential for Vice-Directors, and potential top executives. It is indicated that although the proportion of women in the three top corporate jobs has been

[43] In contrast to the 'glass ceiling', the term 'sticky floor' refers to the existence of a wider gender gap at the lower end of the wage distribution.

increasing over time, the persistent gender pay gap suggests that Danish women are still unable to chip away at the glass ceiling. A similar story is revealed in the US by Elkinawy and Stater (2011), with the wages of female executives about five percent lower than their male counterparts in the period $1996-2004$. The authors conclude that the male-dominated governance structures may be the important factor in explaining why full gender pay equity has not occurred together with the better representation of female executives. With a concern that the magnitude of the gender wage gap varies at different levels of executives, Bugeja *et al.* (2012) focus only on CEOs in a sample of 291 US firms between 1998 and 2010. Their results show there is no gender gap in CEO compensation indicating the absence of gender bias in pay once women have been able to reach the very top ladder of corporate management.

A few studies have suggested a strong link between the share of women at the highest-level of corporate management/the decision-making position and the glass ceiling effects. It is put forward that gender parity in top management can crack the glass ceiling from above. Top-ranking women can help other women at lower ranks move to the top by being effective role models, affecting choices of other women over their career life, or providing more opportunities for development and sponsorship (Bagues and Esteve-Volart, 2010; Elkinawy and Stater, 2011; Leah, 2011). Some supporting evidence is found in the case of the US $-$ Matsa and Miller (2011) observe a positive relationship between the share of women on corporate boards and the share of women in top management, and Elkinawy and Stater (2011) find that the firms with more male-dominated boards are associated with a larger gender pay gap. On the contrary, Bagues and Esteve-Volart (2010) reach the opposite conclusion when investigating the relationship between gender differences in the chances of success for positions in the four major Corps of the Spanish Judiciary and the gender of their examiners. It is found that candidates are less likely to be employed where the share of the evaluators of the same gender as the candidates is higher. Further evidence suggests this occurrence is due to the overestimation of male candidates by female-majority committees.

4.2.2 The Gender Gap across the Wage Distribution

Using the quantile regression framework, Albrecht *et al.* (2003) observe strong evidence for a glass ceiling effect in Sweden with a rising gender gap throughout the wage distribution. The gap is particularly wide amongst the highest earners, and the effect has been increasing over time. Besides, the results of the Oaxaca-Blinder decomposition indicate that the gender gap at the top end of the wage distribution is primarily a result of the gender differential in returns to labour market characteristics rather than their educational and demographic differences. Chzhen and Mumford (2011) also discover a glass ceiling effect for female full-timers in Britain, with the effect significantly associated with high-skilled occupations and workers having managerial duties. They additionally suggest the gender gap along the wage distribution would vanish if the rewards to characteristics for British female full-timers were the same as for their male counterparts.

Some studies further point out that multiple glass ceilings seem to exist in different segments of the labour market rather than there being a single glass ceiling over the entire wage distribution. In the case of Australia, the findings from Kee (2006) indicate the existence of a glass ceiling in the private sector but an absence in the public sector. By contrast, Barón and Cobb-Clark (2010) observe the glass ceiling effects in both sectors, besides, a positive relationship between occupational segregation and female relative pay is observed for almost all women except those in the top-paid jobs. Both the papers agree that the more pronounced gender wage differential in the private sector can be ascribed to the more intensive enforcement of gender-specific policies together with the specific wage-setting mechanisms in the public sector. Moreover, in line with the findings of Albrecht *et al.* (2003), these two studies have found that educational and demographic differences are unimportant factors in explaining the gender gap at the top end of the wage distribution, whereas Barón and Cobb-Clark (2010) additionally discover that labour market experience has a strong impact on female wages in the private sector.

Looking at eleven European countries, Arulampalam *et al.* (2007) reveal the existence of a glass ceiling for most of the countries, including Britain, with the exceptions being Ireland and Spain. The estimated wage gap at the top end of the distribution is found to be greater in the private sector than in the public sector apart from in Denmark and Finland. Moreover, it is suggested that the countries which have more generous family friendly policies (e.g. Denmark and the Netherlands) are associated with a larger gender gap at the top of the earnings distribution but a smaller gap at the bottom. With regards to different educational levels in Spain, De la Rica *et al.* (2008) discover the gender differential grows when moving up the pay distribution for the high educational group, but for the low educational group, it grows when moving down the pay distribution. Investigating the shifting gender wage gap in both vertical (inter-job levels) and horizontal (intra-job levels) margins, Russo and Hassink (2012) find the existence of glass ceilings at both margins in the Netherlands. The growing unexplained portions of the gap across both inter- and intra- job levels indicate that women face multiple glass ceilings – one for each job level.

4.2.3 Cohort Effects on the Glass Ceiling

There has been little literature exploring the relationship between the glass ceiling effect and the cohort effect. One of the exceptions is Morgan (1998), who uses data for $1982-1992$ for the US to examine whether the full-time gender gap for engineers is a result of the effects of glass ceiling[44] or cohort. The findings indicate that the gender pay differential for US engineers is a result of a cohort rather than a glass ceiling effect, as the time that women started their career is more important than the length of their career for earnings penalties, in that female engineers who started working later face a lower gender gap than those that started earlier.

Fitzenberger *et al.* (2002) apply a comprehensive descriptive analysis to investigate the gender wage differential across the distribution in different skill groups over the lifecycle and birth cohorts in West Germany in the period $1975-1995$. It is observed that the female lifecycle wage growth is much lower than their male counterparts, and the growth for female part-timers is lower than for female full-timers. By contrast, female wage growth alongside a time trend has been found to be stronger than for their male counterparts in the lower parts wage distribution, particularly for those in lower- and medium-skilled groups, but it is much less beneficial in the upper part of the distribution. Finally, they found no evidence to support the hypothesis that female relative wages in West Germany are driven by cohort effects.

[44] The hypothesis of the glass ceiling effect in this paper is "Women professionals (engineers) face a glass ceiling regardless of when they started their careers (i.e., male-female earnings differentials increase over time for all cohorts)" (Morgan, 1998, p.482).

4.2.4 Limitations of the Empirical Literature and the Motivations behind this Chapter

All of the above studies have revealed very good insights about the existence of a glass ceiling. However, information about the location of the ceiling and how it has been moving over time has not been a focus of any of them. This chapter thus aims to provide more detailed information on how the UK glass ceiling has evolved over time and to determine the important factors that explain these changing patterns. By a glass ceiling, the idea is to look at the location of the earnings of a woman at the top decile of the female wage distribution, in terms of her position in the male wage distribution. If there is no glass ceiling, the wage of the woman at the 90$^{\text{th}}$ percentile of the female wage distribution will also be at or about the 90$^{\text{th}}$ percentile of the male wage distribution. However, if this well-paid woman is at a much lower position in the male pay distribution, this would suggest that the top-ranking women are hitting a glass ceiling, and there are many men paid above them. As the analysis is concerned with what has happened to the top decile and within the top decile group, it will mainly focus on the top female relative wage and therefore is silent on the shifting gender differential elsewhere in the wage distribution.

Although evidence on cohort effects on the average gender wage gap has often been discussed (England 1992; O'Neill and Polachek 1993, Morgan 1998; Manning, 2006), there has been surprisingly little research considering such effects on the gap at the top end of the wage distribution. This chapter will thus investigate the shifting glass ceiling for different cohorts, both within cohorts across their lifetime, and across cohorts, to find out whether the changing pattern of female relative pay at the 90$^{\text{th}}$ percentile of the wage distribution is similar to the pattern of the average gender differential. The analysis will also be undertaken for different segments of the labour market, as the sizes of, and the changes in, the gender gap and the glass ceiling are quite different across the public and the private sectors (Kee, 2006; Arulampalam *et al.*, 2007; Barón and Cobb-Clark, 2010), and women may face multiple glass ceilings at different occupations, rather than just one glass ceiling across the whole wage distribution or in managerial positions (Russo and Hassink, 2012). Thus, the effects of full-time employed status, regional setting, educational levels, marital status, and the presence of children on the changing positions of the glass ceiling will also be explored.

4.3 Data

The data for the analysis in this chapter comes from two sources. The primary source is the New Earnings Survey (NES)/Annual Survey of Hours and Earnings (ASHE), which supplies rich information on hourly earnings of individuals covering the years $1975-2011$. The major drawback of this survey is its lack of demographic information especially for the measurement of education and family status. The successive Labour Force Surveys $1983 - 2011$ hence serve as a supplement to the demographic data for the multivariate analysis, by matching the two-digit occupation groups to construct a consistent occupation-level panel dataset[45]. The sample of this analysis for both datasets is restricted to individuals in the 16 to 59 age bracket, considering that women were entitled to claim state pension at age 60 in Britain until 2010.

[45] Both the NES/ASHE and the LFS are collapsed down to the two digits occupation level, and the resulting data sets appended together to create an occupation level data set. Since both use the standard occupational classifications, there is little risk here of using data from multiple sources. Appendix Table 4.14 provides the information for the matched occupation-level panel dataset in the period $1975-2011$. The significant smaller number of observations for the variable indicating the presence of children in the family (*Kid*) is due to the data not being available until 1983. This study hence restricts the matched dataset to the period 1983 2011.

4.3.1 The New Earnings Survey

The New Earnings Survey (NES) and its successor the Annual Survey of Hours and Earnings (ASHE) is one of the largest consistent surveys providing the most accurate information on individual earnings in the UK. It is a panel dataset that was launched in 1968, and has been carried out annually since 1970, although computerized data is only available after 1975. The ASHE, developed from the earlier NES, replaced the NES in 2004 and is conducted in April of each year. The survey has taken the form of a 1% fixed sample of the workforce, with the National Insurance numbers (NINO) of respondents that end in a specific pair of digits. Information is collected from employers on earnings and paid hours, usually sent directly from their payroll records ensuring the accuracy of the data. The sample does not contain any jobs within the armed forces and company directors treated as self-employed as it is a survey of employee jobs. In addition, individuals would not be included if their earnings were reduced due to sickness, short-time working, or temporary withdrawal from the labour force, etc. A comparable back series for $1998 - 2003$ by applying ASHE methodology to the NES data has been created by the Office for National Statistics (ONS), this analysis hence uses the NES for the period $1975 - 1997$ and the ASHE and its comparable data from 1998 onwards.

Regardless of the accuracy of the NES/ASHE data, some things have to be borne in mind while interpreting the results and comparing the earnings at different time points. One of the concerns is that the ASHE contains important improvements over the NES, for instance, the sample coverage of ASHE is larger than NES, and sampling weights on ASHE correspond to the number of jobs in the Labour Force Survey (Bird, 2004). It is suggested that the part-time workers are under-sampled in the NES as many of their earnings are under the minimum threshold for the payment of national insurance (Elias and Gregory, 1994 cited in Williams, n.d., p.18), though such problems have been solved in the survey design of ASHE. Thus some discontinuities may be found between pre- and post-1997 periods and/or pre- and post-2004 periods as a result. Besides, one of the major shortcomings of the NES/ASHE is its lack of demographic socioeconomic characteristics of individuals. In particular to measure education and family status, a supplement to the demographic information would be required for further analysis.

The analysis of this chapter is based upon hourly earnings[46] allowing the inclusion of part-time workers to discover how the UK gender gap at the top end of the wage distribution within different segments has evolved over time. The wage has been adjusted by the Retail Prices Index (RPI) inflation and is given in 1987 prices. The rich information of individuals from the NES/ASHE datasets also enables the implementation of cohort analysis to explore the shifting patterns of the glass ceiling in different sectors and occupations for different cohort groups, both within cohorts over their lifetime, and across cohorts.It is worth noting that the use of the NES/ASHE dataset means that all the analyses in this chapter are conditional upon being employed in the first place, as the information is directly collected from employers. This will cause some concerns in interpreting the results, for instance, as there are no data for those who are unemployed, the results associated with part-time employment can only be compared to the full-time, and so greater penalties to part-time work might be the inevitable consequence despite the fact that the part-time employed may be better off then the unemployed.

Data Cleaning

Considering what has been noted by the ONS (2003) there are some cases

[46] Bonus or ex gratia payments are not included, as the analysis focuses on guaranteed payments

where the same NINO may belong to different individuals, leading to the same ID number in the datasets shared by different individuals. A data cleaning procedure is thus necessary to be conducted before carrying out the estimations. There are several types of miscoding found.

The most typical one is that for some individuals, age is coded the same in 2004 and 2005, due possibly to the replacement of the NES by the ASHE in 2004. This can be simply corrected by creating a new age series variable calculated by taking their age when first observed as a starting point, then each subsequent time they are observed adding on the number of years between that observation and their previous observation. By doing this, however, more needs to be taken into account. It is essential to assure that the first occurrence for each individual is not miscoded. There are some instances found where the age of the first occurrence for some individuals was coded mistakenly and followed by the real/correct sequence of age (i.e. an individual was 55 years old in 1975, but 23 in 1976, 24 in 1977, and so on). This single noise in first occurrence is dropped as it is not certain whether this single observation is simply miscoded or actually belongs to another employee. In contrast, if it is the case that the same ID number is shared by different people, one of them is retained with the same ID and the others are assigned new ID numbers. Besides, a minority of individuals are dropped because their ages and gender fluctuate throughout the lifetime leaving no possible treatment for miscoding. The new age and sex variables were not constructed before these noises had been cleaned.

4.3.2 The Labour Force Survey

The Labour Force Survey (LFS) is a nationally representative survey of the UK population which was first conducted in 1973, under the terms of the Treaty of Rome to monitor regional unemployment. It was carried out every two years until 1983 before becoming annual. A quarterly element and a panel component were then introduced in 1992. The LFS is based upon a stratified sample and the data includes sampling weights to assure that statistics that are representative of the underlying population can be computed. The surveys are questionnaires, completed by proxies on behalf of individuals, or self-reported by respondents[47]. Each quarterly LFS sample consists of five waves, and each wave is interviewed in five consecutive quarters. It results in the sample containing multiple observations on the same person, and hence, the data for this analysis only includes the observations from their first interview. Also only data from 1983 onwards are used as the information for the presence of children in the family is not available until 1983.

4.3.3 Creating a Consistent Occupational Classification

Three occupational classification systems, KOS, SOC90 and SOC2000, have been applied within the NES/ASHE series. Occupations are coded to KOS in the period 1975 – 1990, to SOC90 from 1991 to 2000, and to SOC2000 for 2001 onwards. The 1990 NES contains double-coded information to both KOS and SOC90 classifications, and the 2000 NES gives double-coded data for SOC90 and SOC2000. These hence provide a mapping matrix to construct a consistent occupation classification system based upon the observed frequencies of an occupation in one occupational

[47] This analysis does not adopt the LFS pay data, due to the use of proxies causing a concern for the accuracy of individual wages, which may mislead the results

category being classified under the other system. All the occupations are recoded to the two-digit SOC90 classification throughout 1975 – 2011.

As for the LFS series, four occupational classification systems, CO80, Condensed SOC, SOC90 and SOC2000, have been used. Occupations for the data of 1983 and 1984 are coded to CO80, and of 1985 – 1990 are under the Condensed SOC system. Both of the classifications can be simply mapped to the KOS and then recoded to SOC90. Following the same procedure, the 2001 onwards data applying the SOC2000 classification have been recoded to the two-digit SOC90 system. Overall, 76 occupations are left in each survey year.

4.3.4 Creating the Relative Wage Data (The Measure of the 'Glass Ceiling')

Unlike most of the empirical research focusing on the existence of the glass ceiling and where the widest gaps are throughout the overall wage distribution, the main idea of this chapter is to discover the shifting position of the glass ceiling over time. In other words, it aims to find out where the earnings of a well-paid woman would rank on the men's scale, and also to explore whether the female earnings at the top end of the distribution have been increasing relative to men's, over the period in which it is already known that the ratio of female to male wages at the mean has been rising. To examine this, it is required to construct a random variable by calculating the cumulative distribution function (CDF) of the income of a comparison group relative to a reference group. A set of observations, the relative data, is produced by this calculation called the"grade transformation" (Handcock and Morris, 1998), which represents the mapping of scores in one distribution to the percentile position in another distribution. Thus it is the rank of the original comparison value related to the CDF of the reference group.

To be more formal, let F_0 and F represent the CDF of hourly earnings for men as the reference group and for women as the comparison group respectively. The F_0 and F are assumed absolutely continuous with common support. For any female wage, Y, from F, this can be transformed to a random variable RD by applying the male CDF, F_0 (Cwik and Mielniczuck, 1989 cited in Handcock and Morris, 1998, p.59):

$$RD = F_0 (Y) \tag{4.1}$$

RD is continuous within outcome space $[0, 1]$. The set of observations for RD is referred to as the relative data. In this analysis, it is the CDF of the female real hourly wage compared to the male real hourly wage within a particular birth cohort k at age a for the cohort analysis (more detailed discussions are in Section 4.4.1) or for a specific occupation/cohort/age cohort) j at time τ for the regression estimations (more detailed discussion are in Sections 4.4.2 and 4.4.3). In practical terms, it represents the proportion of men paid less than Y, where the Y in most cases in this analysis is considered as the wage at the 90^{th} percentile of the female distribution.

The empirical research related to the top income distribution or the glass ceiling usually uses the 90^{th} percentile as a set point. Ideally a more sufficient analysis on the top earners could be looking at the different points within the top decile of the wage distribution (i.e. the comparison between the 90^{th}, 95^{th} and the 99^{th} percentiles) as the changing patterns of the glass ceilings may be quite different at each of the points especially the highest one percent. It is known that the income growth within the top one percent of the wage distribution has been changing dramatically over the most recent decades across the world (Atkinson et al., 2011), which may be interesting to discover what these changes would do to female relative incomes. Yet as the analysis in the chapter is aimed at those who are employed to investigate how in general the top female labour incomes, particularly from their wage, are associated with those of male workers, the analysis is thus mainly focussed on the 90^{th} percentile of the female distribution. Nevertheless, with a concern that focussing only on the average pay gap at the 90^{th} percentile of the wage distribution might miss important information, the individual-level panel regression will consider the relative wage of every female individual whose earnings are within the top decile of the female wage distribution (Section 4.4.2 gives more detailed explanation on this point).

4.4 Methodology

4.4.1 The Cohort Analysis

Cohort analysis provides a framework for determining age, period, and cohort effects simultaneously on substantive issues. In most cases, taking any one of these effects into account without considering the others is a misleading evaluation.

Age effects demonstrate intra-cohort changes showing what happens as people age. They compare, for instance, the wages of the $1960 - 1964$ birth cohort at age $25 - 29$ with the wages of that cohort 10 years later when its cohort members would then be aged $35 - 39$, and compares them both with the same cohort 10 years later at age $45 - 49$. Yet obviously as people age, time is changing too. It is difficult to separate the effects, but it needs to be known whether the wage changes observed over the lifecycle are due to their age or is it a real wage increase over time experienced by all ages.

Cohort effects demonstrate the shifts of the same age category in different birth cohorts. For instance, it compares the wages of those aged $25-29$ in the $1960-1964$ birth cohort with those aged $25-29$ in the $1965-1969$ cohort, and compares them both with the same age group in the $1980-1984$ cohort group. Yet again, observing different cohorts at the same age means the date must be different, so there could be time effects again. As simple as it may seem, it is actually difficult to identify the effects of age, period, and cohort effects in standard cohort tables and graphs, which still remains a complication in cohort analysis to date.

In the typical notation of an age-period-cohort model:

$$Y_{ijk} = \beta_0 + A_i + P_j + C_k + \varepsilon_{ijk} \tag{4.2}$$

where Y_{ijk} denotes the real hourly earnings in the i^{th} age group, j^{th} period and k^{th} cohort; β_0, the intercept; A_i is a set of age dummies with the estimates of a_i for the effect of the i^{th} age category (i = *1,2,...,I*); P_j is a set of time dummies with the estimates of p_j for the effect of the j^{th} period (j = *1,2,...,J*); C_k is a set of birth cohorts dummies with the estimates of c_k for the effect of the k^{th} birth cohort (k = *I-i+j* when I = *1,2,...,I*); and ε_{ijk} is the error term.

It is obvious that there is a linear dependency between age, period and cohort effects, and so the estimates of a_i, p_j, and c_k are non-identifiable, or unique (where $cohort = period - age$). Much discussion has been had to develop various techniques to overcome this statistical confounding. One of the commonly used strategies is to drop one additional dummy variable of a specific group, assuming the two omitted dummies have equivalent behaviour. Note that this can only be fulfilled under the condition that the effects of age, period, and cohort are only additive $-$ each of the effects must be consistent over the range of the others. The unique effects would then be possible to be observed with this assumption (Thomas, *et al.*, 1994; Leung, *et al.*, 2002), though whether these restrictions are realistic still remains of much concern. For this reason, this analysis will not only strictly rely on statistical models but also consider different dimensions through graphical and theoretical grounds to guide possible interpretation of the changing patterns in the data.

On the basis of the NES/ASHE datasets, a cohort analysis is conducted to study the behaviour of lifecycle earnings/glass ceilings profiles. As the term is generally used, a cohort consists of a group of individuals followed over time. The average real hourly earnings and the top female relative wage (90^{th} percentile) for a cohort have been followed from the time it enters the labour market at the age of 16 until the age of 59. Individuals are grouped into 5-year age groups (from $16-19$, $20-24$,...., $55-59$ years old), and the birth cohort groups are divided into 5-year intervals from $1920-1924$ to $1985-1989$.

It has been well-documented that the average woman who entered the labour market later faces fewer career obstacles and a lower gender gap than did those who entered earlier as the work environment becomes less discriminatory (England, 1992; O'Neill and Polachek, 1993; Morgan, 1998). This chapter emphasises the shifting glass ceiling for different cohorts groups, both within cohorts across their lifetime, and across cohorts, to find out whether the changing pattern of female relative pay at the 90^{th} percentile of the wage distribution is similar to the pattern at the average.

The graphical analysis is conducted separately for both males and females, and for both full-time and part-time workers. With the significantly larger number of female part-timers, research on labour market outcomes usually pays more attention to the women who work part-time but ignores men who work part-time. Although the number of male part-timers has been very small in Britain[48] over time, neglect-

[48] The proportion of female part-timers in employment in the public sector was 0.134 in 1975 and

ing them in the analysis might lead to "the possibility that the relationship between earnings and gender is confounded with the relationship between earnings and occupation or working part-time" as Mumford and Smith (2009, p.i57) have stated. The analysis is also undertaken separately for the public and private sectors as it has been noted previously that the size of, and the changes in, the gender gap and the glass ceilings are quite different across the sectors (Kee, 2006; Arulampalam *et al.*, 2007; Barón and Cobb-Clark, 2010), due possibly to the stringently enforced gender equality law as well as relatively less influence from the market economy on the wage settings in the public sector than in the private sector.

4.4.2 Regression: Relative Position Changes by Individuals

Considering that women may not only face one glass ceiling across all the wage distribution, but multiple glass ceilings in different segments of the labour market, this subsection carries out more detailed investigation on all the female individuals whose earnings are within the top decile of the female wage distribution. Drawing upon the NES/ASHE, regression of the individual panel datasets with time dummies from 1975 to 2011 is thus applied to examine, within particular occupation (age groups, age cohorts), the relationship between female workers' characteristics on the one hand, and the relative percentile position of a well-paid woman in the male wage distribution on the other. Ideally, a more efficient way would compare a top-ranking female individual to the male distribution in the same occupation-age-cohort cell, but the cell sizes would be too small to obtain accurate estimates of the distribution of wages within each cell. The dependent variable is generated

increased to 0.266 in 2010, and of male part-timers was 0.004 in 1975 and increased to 0.033 in 2010; the proportion of female part-timers in employment in the private sector was 0.089 in 1975 and increased to 0.194 in 2010, and of male part-timers was 0.004 in 1975 and increased to 0.072 in 2010 (Appendix 4A Table 4.6) by calculating where the wage of a woman within the top decile of the distribution in her specific occupation (age, cohort) group would rank on the men's scale in the same group at each time point.

The regression estimation is formed as follows:

$$RD_{ij\tau} = \beta_0 + \beta_1 Age_{i\tau} + \beta_2 Cohort_i + \beta_3 Period_\tau + \beta_4 LF_{i\tau} + \varepsilon_{ij\tau} \tag{4.3}$$

where

i is the female individual whose income is within the top decile of the female wage distribution.

j is the particular occupation, age or cohort group

τ is the time.

$RD_{ij\tau}$ represents the position of the female individual i in the male pay distribution in the same specific group j, at time τ.

$Age_{i\tau}$ is a set of age dummy variables with 10-year intervals that the female individual i belong to, at time τ.

$Cohort_i$ is a set of cohort dummy variables with 10-year intervals that the female individual i belong to.

$Period_\tau$ is a set of time dummy variables to remove the common time trend for four periods of $1975 - 1984$ (the reference period), $1985 - 1994$, $1995 - 2004$, and $2005 - 2011$.

$LF_{i\tau}$ is the working status of the female individual i, such as working as full-time, in the public sector, and in London, at time τ.

$\varepsilon_{ij\tau}$ is the error term.

4.4.3 Regression: Relative Position by Occupations

This chapter is also interested to determine how the educational levels, marital status, and the presence of children of top women would affect the locations of the glass ceiling in occupations. With a consistent occupation classification, it is possible to construct an occupation panel dataset by matching the NES/ASHE to the LFS to study the relationship between demographic characteristics and the shifting pattern of the glass ceiling within occupations. Overall, there are 76 occupation categories in 29 years from 1983 to 2011, resulting in 2204 observations. Note that some observations will be omitted from the estimated models as the data for the presence of children in the family and marital status are not fully available in the form of two-digit occupations in the earlier years. Moreover, a lower number of observations in the specification for the part-time relative wage position will occur owing to the missing information on part-time workers in some occupations at some time points.

This subsection applies the constructed occupation-level panel datasets to discover the extent to which the changes in female employment with specific characteristics will affect the changes in the UK glass ceilings in occupations during the period 1983 – 2011. In order to determine the presence of glass ceilings, the dependent variables are measured by the positions of women at 90^{th} percentile of the female wage distribution, for the total, full-time, and part-time women respectively, in the total male wage distribution in each occupation (two-digit) at each time point. The independent variables, except the measure of femaleness (Female) at the occupational level (the share of women in the total employment), are the proportions of female workers with particular characteristics in the total female employment within a given occupation-year.

$$
\begin{aligned}
RD_{wg\tau} = \beta_0 + \beta_1 Female_{g\tau} + \beta_2 Age_{g\tau} + \beta_3 Edu_{g\tau} \\
+\beta_4 Family_{g\tau} + \beta_5 LF_{g\tau} + \beta_6 Period_{\tau} + \varepsilon_{wg\tau}
\end{aligned}
\tag{4.4}
$$

where

w represents the earnings of full-time, part-time, or all working women.

g is the two-digit occupation.

τ is the period of year.

$RD_{wg\tau}$ represents the position of the 90^{th} percentile female wage w, in the male wage distribution in occupation g, at time τ.

$Female_{g\tau}$ is the proportion of women in total employment in occupation g, at time τ.

$Age_{g\tau}$ is the share of female employees in the specific age group in the total female employment in occupation g, at time τ.

$Edu_{g\tau}$ is the share of female employees who hold qualifications of first degree or above in the total female employment in occupation g, at time τ.

$Family_{g\tau}$ are the family status controls, such as marital status and the presence of children at home as a share of the total female employment in occupation g, at time τ.

$LF_{g\tau}$ is the working status, such as working as full-time, in the public sector, and in London, as a share of the total female employment in occupation g, at time τ.

$Period_{\tau}$ is a set of time dummy variables to remove the common time trend for four periods of $1983-1989$ (the reference period), $1990-1996$, $1997-2003$, and $2004-2011$.

$\varepsilon_{wg\tau}$ is the error term.

The analysis not only examines the changing glass ceiling in occupations as a whole but also separately by different levels of occupation to see how the glass ceiling is changing for the women at different levels of occupation, where the 'top' occupations are defined as the first three categories of one-digit occupations, which are managers, professional occupations, and associate professional and technical occupations, the 'middle' the next three – clerical and secretarial occupations, craft and related occupations, and personal and protective service occupations, and the 'bottom' the final three – sales occupations, plant and machine operatives, and elementary occupations.

4.5 Cohort Analysis

4.5.1 The Mean Wage

Starting with the type of trend that most research on earnings changes has dealt with to date, Figures 4.1 to 4.3 depict age-earnings profiles in terms of real hourly wages for the sample of full-time and part-time workers in both public and private sectors between 1975 and 2011. The curves correspond to birth cohorts, and are labelled according to the range of years during which a cohort member would have been born. Each cohort is first observed when individuals are aged $16 - 19$, or their age in the first year of data for the older cohorts, and then in subsequent five-year widows throughout their lives corresponding to the five-year cohort groups and time periods.

Figure 4.1 suggests clear age effects in overall results that show that mean hourly earnings have a tendency to increase with age, reflecting the premium on experience and knowledge acquired throughout workers' lifetimes. The rise in female wages with age has been quite concentrated with the most pronounced changes amongst those under age 30 with more modest gains for older women. For women, the overall level of part-time earnings is lower than for full-time women by about 1 to 2 pounds. Despite the fluctuation for the part-timers (due to small numbers, see Appendix 4A Table 4.6), a substantial increase in male wages until aged in their 40s is found, followed by a much gentler decline in their 50s. Note that the part-time male wages are close to and even exceed full-time wages, reflecting the fact that men working part-time are not necessarily found to be in low-level jobs.

With each successive cohort generally showing real wage rates greater than the preceding cohort, positive cohort effects are revealed, with those born after 1960 experiencing a rather slower growth across cohorts, so that the gains for the 1980s cohorts are less than for the older cohorts. For full-time workers, the rise in wages across cohorts has been gradual and similar in size for both genders, while for the part-timers, the men have experienced a different pattern to the women. The shifts in part-time male earnings across cohorts are obscured until age 35, before starting to grow significantly. Combining the age and cohort effects provides a measure of trend wage rates for each age group, which suggests a more pronounced increase within the $30-59$ age group for both sexes working full-time, by at least 3 pounds between the most recent and the oldest cohorts, following a relatively smaller change for those aged $16-24$.

The changing patterns of the gender pay gap throughout workers' lifecycles are similar for all cohorts, as the gaps seem not exist for those under age 25 but continuously widen afterwards. Nevertheless, the gender differential for those aged over 30 has been on a downward trend: for prime-aged full-time workers (those in their mid 30s and 40s) women were paid about 70 percent of male wages amongst those born in the late 1930s and 1940s, but this has moved up to at least 77 percent for those born after 1960.

In the public sector (Figure 4.2), unlike what have seen in the previous pictures, the growth of female earnings continues with age even after age 30, with only one pound difference between the full-time and the part-time workers. This somewhat reflects the positive impact of collective bargaining, nationally agreed pay scales, government objectives and policies, where the gender-specific policies, such as anti-discrimination laws, equal employment opportunities, parental leave schemes, and the provisions of childcare, are more stringently enforced in the public sector (Kee, 2006; Arulampalam *et al.*, 2007; Barón and Cobb-Clark, 2010). As for the men, following a similar pattern to Figure 4.1, the better gains have been for the part-time workers in particular to those in their late 30s and above (though recall again that the numbers of men in part-time work are very small, so that the results may not be very robust (Appendix 4A Table 4.6).

Showing a broad increase in the average hourly wages, except for those born in the 1980s, cohort effects are observed, and are similar in size for both genders who work full-time. The most noticeable changes across cohorts are found for those aged over 40, where the wages have gone up by at least 3 pounds to about 8.5 pounds for men and to around 7 pounds for women. On top of that, the growth seems at a faster pace for those born before 1950 compared to the younger cohorts. As regards part-time employees, the results also indicate that the pay rates of each successive cohort are generally higher than those of the preceding cohort, even though the shifts for men have not followed a uniform pattern. Overall, based upon the very small number observations, it is somewhat suggested that some part-time prime-aged men are paid extremely highly, receiving over 12 pounds per hour in some specific cohorts. Over the 37-year period, the gender wage gap in the public sector has narrowed remarkably for full-time workers, but not clearly for the part-timers alongside dramatic fluctuations of the male wages. For instance, changing from 15 percent to naught, the disappearance of the gender gap for the full-timers is most pronounced at age $16-29$. Moreover, for those in their 30s and 40s, women were paid about 80 percent of men's wages in the oldest cohort, which increased to over 85 percent for the most recent cohort.

Turning to the private sector (Figure 4.3), regardless of some complex patterns for women, the full-time earnings generally have seen a significant increase with age amongst the young, followed by some stability and then a minor dip for the oldest workers. The part-time earnings for men change in a similar way to the previous findings for public sector workers, with a dramatic increase after their late 30s, but for women they grow at a very slow pace hovering around a consistently low-level. With an approximate rise of 4 pounds to just less than 8.5 pounds for the men and to 6.5 pounds for the women, cohort effects are found to be most pronounced for the aged 30s women and the 40s men. In addition, the increases over cohorts appear mostly absent to those born after 1960 and the earnings of the 1980s cohorts have fallen behind earlier cohorts. It is worth pointing out that the lifecycle earnings profiles of the full-time women of the 1960s and later cohorts are quite different from their predecessors, whose earnings increased more gradually, but for the younger, a sharp increase is found in their 20s followed by a modest decline at childrearing age.

There are some indications that, over the 37-year time span, the wage differential between the full-time and the part-time women has widened in the private sector. Following a significant growth of the full-time average real wage but almost no change in the part-time real wage, the differential has gone up by 10 percent across cohorts, but the reverse is true in the public sector. Moreover, a positive age effect and negative cohort effect on the gender pay gap are revealed, in spite of the unclear patterns for the part-timers. For instance, for full-time employees, the gender inequality of the earliest cohorts increased from about 15 percent in their 20s to around 35 percent for those aged over 30; and of the most recent cohorts, it increased from nearly zero to around 10 percent from age 20 to 30 and hovered around 30 percent for the older workers. As for the part-timers, the inequality declined from over 30 percent to almost zero across cohorts for those in their 20s, and from about 40 to below 25 percent for those in their 30s.

To sum up, the effects of age, cohort and period on the UK average wage in the period $1975 - 2011$ are clearly evident. Apart from the part-time men, who experience a rather slow growth at a young age with a surge in their late 30s and 40s, the rise of wages is observed consistently and gradually over the lifetime in the public sector, but quite concentrated amongst the young followed by some stability and a tendency to decline for the old in the private sector. Similar in size for both genders, positive cohort effects appear weaker for those born after 1960 with some evidence suggesting a negative effect for the 1980s cohorts. Besides, the most noticeable change over cohorts is found for those over age 40 in the public sector, and for the aged 30s women and the 40s men in the private sector. Note that regardless of the inferior pay in the private sector, the amount of wage growth over cohorts is higher than in the public sector, suggesting narrowing full-time wage differences between the sectors over time. Moreover, the overall level of female part-time earnings is lower than for full-timers by about 1 to 2 pounds, along with a rising difference between them across birth cohorts in the private sector, but for men the part-time wage is close to or surpasses the full-time rate. It implies that although there is only a small share of men working part-time, many of them have been hired in high level jobs.

Alongside a slower growth of female wages, the gender average wage gap in Britain has continuously increased at around ages in the late 20s, the childrearing age, which is especially explicit in the private sector. This suggests that women's earnings are subject to their family commitments, and that they tend to be more disadvantaged in the private sector than in the public sector. It also implies that women have seen only limited wage progress as many of them hold low-level jobs, some maybe hired at a higher level and be desperate for a better paid position but facing a wage barrier − a glass ceiling. Besides, the gaps are driven by a cohort effect, with the younger cohorts of women paid better than the older cohorts relative to men and that these relative wage gains extend across the lifecycles. Compared to the public sector, the gender gap, decreasing more significantly in size, has been found to be wider for full-time workers, but narrower for the part-timers in the private sector both within cohorts over their lifetime, and across cohorts.

4.5.2 The Locations of Glass Ceilings

Figures 4.4 to 4.5 present the positional changes in the male wage distribution of the higher paid women (at the 90^{th} percentile of the female wage distribution), observed during the period 1975 − 2011. If the earnings of the woman at the 90^{th} percentile of the female wage distribution are at a much lower position in the male wage distribution, this would suggest that the top-ranking women are hitting a glass ceiling, and there are many men paid above them. These plots will provide some insights on the general idea of the changing patterns of the glass ceiling for different cohort groups, both within cohorts over their lifetime, and across cohorts in the public and the private sectors. As in the previous section, the lines correspond to separate birth cohorts, observed first when aged $16-19$, or their age in the first year of data, and then in five-year intervals, corresponding to five-year age intervals and time periods. The glass ceilings are calculated in four specifications in order to have a more detailed investigation: (i) the position of the 90$^{\text{th}}$ percentile female full-time wage in the full-time male wage distribution (Full-Time/ Full-Time); (ii) the position of the 90$^{\text{th}}$ percentile female full-time wage in the overall male wage distribution (Full-Time /Total); (iii) the position of the 90$^{\text{th}}$ percentile female part-time wage in the part-time male wage distribution (Part-Time/ Part-Time); and (iv) the position of the 90$^{\text{th}}$ percentile female part-time wage in the overall male wage distribution (Part-Time /Total).

Figure 4.4 reveals clear age effects in the public sector that show the position of the glass ceiling has experienced a U-shaped pattern, falling across prime ages, with a gentle rebound at older ages. For full-time workers, the top-ranking female incomes are relatively low for the new entrants, and then catch up with the men's in their early 20s with a minor dip around age 30. Conversely, the part-time starting wages appear similar or even higher than their male counterparts (Part-Time/ Part-Time) followed closely by a precipitous decline. Note that a slightly more modest fall, especially for those in the age 20s bracket, is shown in the comparison of the top part-time women to the total men (Part-Time/Total), which confirms what was observed from the previous section that the part-time men do fare better than the full-timers in the public sector and their wages start to grow dramatically in their 20s.

With each successive cohort broadly situating at a higher position in the male wage distribution than the preceding cohorts, the positive cohort effects (increases between successive cohorts) on the glass ceilings are found to be more pronounced for those born before 1960 and the part-timers. In contrast to the top tenth full-time women, whose relative earnings have hovered around the 80th to 91st percentile of the male pay distribution, the lifecycle earnings profiles of the top part-time women of the 1960s and later cohorts are quite different from their predecessors. In particular, the top decile of female relative pay increases significantly with age for the 1950s and earlier cohorts, with a range from a low of the 25th to a high of the 75th percentile of the male part-time wage distribution, but decreases with age for the later cohorts with a range from a high of the 95th to a low of the 65th percentile. In the private sector (Figure 4.5), the position of the glass ceiling has seen a tendency to lower (i.e. women doing relatively less well) with age, before starting to rise again slightly when women are aged in their 50s. The top percentile female incomes for the full-time new entrants are found to be similar to their male counterparts, followed by a decline at age 30 and rebound in their 40s. Unlike what was observed in the public sector, the high-paid part-time women seem, in general, to be faring relatively close to their male counterparts (Part-Time/ Part-Time), despite the inconsistent changing patterns over the lifecycle for different cohort groups. However, in the other comparison (Part-Time/ Total), the top female part-time earnings drop dramatically with age and remain at below the 70th percentile of the overall male wage distribution after their early 20s, suggesting the part-time wages for both genders are considerably lower in the private sectors.

Similar to the previous findings, the results pinpoint the 1960 born as the watershed for the changes in the top female relative incomes. Compared to the younger cohorts, the top decile of female incomes ranked considerably low on the men's scale for those born before 1960 with the significant increases in this relative position between cohorts. For the full-timers, the well-paid women in the 1930s cohorts gained only better than 40 to 68 percent of the men, while those born in the 1960s and later cohorts have been better than over 80 percent of men throughout their lifetime. As for the part-time comparison, the female relative earnings fluctuates with age for those in the earlier cohorts, but remain stable at around the 80^{th} to 90^{th} percentile for the recent cohorts.

Taken together, the results have demonstrated the significant effects of age, cohort and period on the shifting glass ceilings over the period $1975-2011$ in Britain. It is worth noting that the figures for the private sector are very different to those in the public sector, with women having more catching up to do in the private sector. The top female relative pay in both sectors has a tendency to initially decline with age, followed by a gentle rebound at older ages, which is especially pronounced for the part-time workers. Similar to the findings for the changes in average wages, positive cohort effects on the position of glass ceilings appear stronger for those born before 1960, for whom the most noticeable change is found for those aged in their late 20s to 40s and those working in the private sector. The 90^{th} percentile female full-time wage in the public sector has hovered around the 80^{th} to 91^{st} percentile of the male wage distribution across cohort groups, and in the private sector, it has increased by over 40 percentile points to above the 80^{th} percentile. As for the part-timers, the extent of the rising position of glass ceilings across cohorts is similar in both sectors, with some evidence suggesting that men fare much better in the public sector than other workers, but both genders are paid considerably lower than full-timers in the private sector.

Overall, the results confirm that younger generations of women in Britain have done better relative to men than the older generations no matter whether we consider the average or the top-earners, but the pace of improvement has stagnated for those born after 1960. According to Manning (2006), the pronounced increase in female relative earnings across older cohorts can be largely attributed to the strong impact of the 1970 Equal Pay Act on reducing the discriminatory work environment, whereas the cause of the slow progress of women in the current generation is more subtle and difficult to influence directly by policy. Besides, the more significant rise in female employment for the earlier cohorts than the latter has also played an important role in explaining theses patterns.

In line with the previous findings (Kee, 2006; Arulampalam *et al.*, 2007; Barón and Cobb-Clark, 2010), the size of and the changes in the gender gap at both the mean and the top of the wage distribution have shown very different behaviours between the public and the private sectors. The results in general suggest that the wage settings in the UK are subject to government objectives and policies in the public sector and to the market economy in the private sector. For instance, female relative pay has been relatively stable over the lifecycles in the public sector, but a notable decline in pay at childrearing age has been observed in the private sector. In addition, although women do fare better in the public sector both within cohorts over their lifetime, and across cohorts, it has been seen that top female wages relative to men have more catching up to do in the private sector across cohorts. It seems not only to indicate the absence of the between sectors wage gap for the current generation of women, but also that the work environment discrimination in Britain has been significantly lessened over time. However, the extremely high earnings for male part-timers in the public sector seems to be trying to tell another story. It seems like the highest paid jobs in the public sector are more likely to be part-time and to be held by men.

4.6 The Shifting Patterns of the UK Glass Ceilings by Occupations, Age and Cohort Groups at Individual Levels

The previous section provides evidence that the changes in the gender gap both on average and at the top-end of the pay distribution have varied noticeably by age, birth cohort, full-time/part-time work, and public/private sector. The remainder of the chapter conducts a more comprehensive analysis particularly focusing on the changes within two-digit occupations. The concern is that women may not only face one glass ceiling across all the wage distribution, but multiple glass ceilings at different job levels (Russo and Hassink, 2012). Thus this section explores the changes in the UK glass ceiling in more detail by two-digit occupations. It estimates where a well-paid (90^{th} percentile) women would rank on the men's scale in each occupation, and to what extent the age and cohort groups and other workers' characteristics will affect the ranks over the period of $1975 - 2011$.

4.6.1 Descriptive Analysis

Table 4.1 presents the ratios of female-to-male average hourly wages within one-digit occupations over the 37-year period. The results somewhat support the contention that women's pay disadvantage depends upon the jobs they hold. Women on average are paid much closer to men in professional and the clerical related occupations than in other occupations. However, their average relative pay in the professional occupations has been found to be declining over time, and women working in the highest-level of occupation (*Soc 1 managers*) have achieved limited wage progress, despite the fact that a substantial increase in the earnings ratio has been observed in all other occupations (except professional occupations).

With respect to the changes in the positions of the 90^{th} percentile woman in the male pay distribution, as shown in Table 4.2, in all cases, the top women have been paid considerably lower in the men's distribution, regardless of the significant increase within the same jobs, indicating the existence of glass ceilings in different occupations. It is not surprising that the high-end female relative pay is much lower in the male dominated[49] occupations, such as managers, craft, and machine operatives. However, the noticeably lower pay in the clerical occupations[50] confirms the empirical statement that in the female-dominated occupations the lower level jobs have been held by the majority of women (Black and Spitz-Oener, 2010; Lindley, 2011).

4.6.2 Relative Position Changes by Individuals

It has already been seen that there are significant differences in the location of glass ceilings by different age, birth cohort, and segment of labour market, which leads to a question whether these differences partly reflect the effects of other factors. This sub-section is therefore interested in whether there are differences by each of age, birth cohort, and occupation once the others are controlled for and once factors such as full-time/part-time status, public/private sector, and region are controlled for. To examine the position of women in a particular occupation (age, cohort group), the wage of each well-paid woman within the top decile of that distribution is observed, and then used to determine where that wage would put her in the distribution of male wages *within the same specific group* (occupation, age or cohort) at each time point over the period $1975 - 2010$. This is then used as the dependent

[49] In craft and related occupations, men (women) represent 15.8% (1.8%) in 1975 and 5.4% (0.3%) of total employment in 2010, and in machine operative occupations, men (women) represent 13.6% (4.4%) in 1975 and 5.2% (1.1%) of total employment in 2010 (Appendix 4A Table 4.7)

[50] The share of clerical women (men) in total employment was about 14.2% (6.2%) in 1975, and declined to 11.3% (5.9%) in 2010 (Appendix 4A Table 4.7)

variables in the individual-based regressions, allowing an examination of how her characteristics determine her position within such a group (Equation 4.3).

The estimated results with different specifications are shown in Table 4.3[51], where the first two columns present the changing relative wage position within particular occupations, the next two are the within-age-group changes, and the final two the within-cohort-group changes. In each case, the first column shows the results from an OLS specification, and the second column from an individual Fixed Effects specification, which allows for the analysis focusing on within individual variation and reduce the risk of omitted variable bias due to unobserved heterogeneity. Note that the interpretation of the same variable will vary in different specifications. If one looks at the coefficients of the age categories for example, columns 1 and 2 compare women at a given age to the average male distribution across all ages in the same occupation (since the comparison is within occupations in those columns), but columns 3 and 4 look at a woman of a given age and compare her position to the male distribution of men in the same age group (since those columns look within age group).

Looking within occupations (*columns 1 and 2*), it can be seen that a top woman earns significantly less than a larger proportion of the men in the craft and machines operatives occupations, compared to a well-paid woman in other occupations. Thus, her pay relative to the male wage distribution in these two occupations is lower than if she is engaged in managerial jobs (the base occupation) by 7 to 10 percentage points and significantly different from zero. To be more specific, the estimations with two-digit occupational dummies (Appendices Table 4.8) indicate that her rel-

[51] Table 4.3 shows the results with two omitted cohort variables in order to avoid the linear dependency as mentioned in the Methodology section. It actually does not make any difference where the extra omitted category is chosen (See Appendix 4A Table 4.9 and 4.10).

ative pay is especially lower in the low-level male-dominated jobs (*SOCs 81-86*), in particular in the metal-making jobs (*SOC 83*). However, the positive Fixed Effects coefficients suggest a rise in her relative wage if she moves into those low-level occupations. This suggests that a top woman working in those lower-skilled jobs has lower unobserved characteristics, and hence lower relative wages, than women in other jobs, but that she would be paid higher in such jobs than she would elsewhere.

Corresponding to Table 4.2, it seems that a higher-paid woman gains slightly better in the professional and technical occupations, where the difference in her relative position between each of these two and the base occupation (*managers*) is at least 5 percentage points and significantly greater than zero. Although the sizes of the coefficients for occupations in *SOCs 20-39* are not dramatically higher, they are positive and rather stable within that group, compared to other occupations. What has to be noted here is that the well-paid women have struggled to catch up their male counterparts in the very top jobs within all occupations, but they are doing remarkably better relative to the men within most of the occupations compared to the highest management occupations (*SOC 10*).

The top female relative pay increases with age within occupations, and the younger cohorts are in a better position relative to men than the older cohorts[52]. Working in London will benefit a well-paid woman, and her wage is significantly increasing over time. Moreover, it is found that the relative position of a top full-time women is lower than of a part-time woman by about 1.6 percentage points, and her position will decline by 2.5 percentage points when moving from part-time to full-time work as the Fixed Effects coefficient has shown, which somewhat implies

[52] Note that the Fixed Effects estimates of cohorts are expected to be dropped, as it is not possible for an individual to move from one birth cohort to another.

that part-time work does not seem to hurt the top women in the way it hurts the average women, suggesting that the women who earn more per hour may choose to work part-time. This finding is consistent with Chzhen and Mumford (2011) who found that amongst the top earners, many more part-timers than full-timers have young children, suggests that part-time work is a choice, and that with the arrival of children, these top earning women can afford to change to part-time work, in order to spend more time with their family.

Turning to the comparisons within specific age groups (*columns 3 and 4*), the wage of a top woman is found to be ranking at a higher point in the distribution of male wages in the same age group at younger ages, where, for instance, her relative wage in her 20s is higher than when in her 50s by about 6.7 percentage points. Besides, the top women face the greatest gender pay gap over their lifecycles when they move into their 40s. This is consistent with the findings in previous sections that female wages grow at a much slower pace and remain at a similar level from their 30s onwards, while men start experiencing a significant increase to a peak in their 40s. Within the same age group, a top woman working in the professional occupations will be paid closer to men than in the other occupations. In addition, it is found again that the top full-time women are at a lower position in the male wage distribution in the same age group than part-time women, and those working in London are at a higher position than in other areas. Although it has been well documented that the mean gender gap is narrower in the public sector (Weichselbaumer and Winter-Ebmer, 2005), as the gender-specific policies are more stringently enforced, it does not seem to happen at the higher end of the wage distribution. Thus, it is revealed that, for those in the public sector, the relative position of the top women is lower than those in the private sector by about at 1.6

percentage points.

To a significant degree, the positions of glass ceilings are driven by cohort effects. *Columns 5 and 6* clearly reveal that the incomes of well-paid women in the younger cohorts are associated with a better rank on the pay scale of men in the same cohort. With respect to the changes over the lifecycle within the cohorts, the higher-paid women at young ages have obtained a higher position in the male wage distribution, followed by a lower point in their 30s and 40s, with a rebound in their 50s. Similar to the previous results, the top women working in the professional occupations or in London will fare better relative to men in the same cohort than those who are not, and their pay is positively related to the time trend. On the contrary, the top women working full-time or in the public sector will move down the male pay scale.

To sum up, the results suggest significant independent differences across occupations, age groups, and birth cohorts when the other two, plus additional factors, are controlled for. It indicates that a higher-paid woman is more advantaged, relative to men, in professional and technical occupations, but is relatively more disadvantaged in low-level male-dominated jobs (*SOCs 5 and 8*) and the top management jobs (*SOC 1*), than in the other occupations. In contrast to the very low female employment in *SOC 5 and 8* occupations (Table 4.7), with evidence that the top female relative wages in *SOC 2* are notably higher than those in *SOC 1* despite the similar share of women in both occupations, the results seems to imply that a top-ranking woman has been paid significantly less well than men particularly in the highest-level management than in other jobs. It is also suggested that she would be paid much closer to her male counterparts at age $16 - 29$, but then face the largest gap of her lifetime in her 40s. In line with the previous findings (England 1992; O'Neill and Polachek 1993, Morgan 1998; Fitzenberger *et al.*, 2002; Manning, 2006), a positive cohort effect on the UK glass ceilings is observed, each generation of women having done better relative to men than the previous generation.

As for other factors, working in London and the time trend have positive effects on the top female relative pay, in contrast, working full-time or in the public sector is negatively associated with the relative pay. With supporting evidence from Chzhen and Mumford (2011), a negative coefficient on the full-time variable is likely to suggest that being in part-time work does not cause a lower position in the wage distribution, just that the highest female earners are more likely to choose part-time (and so less likely to choose full-time) work due possibly to the family commitments. Furthermore, in contrast to previous empirical works (Weichselbaumer and Winter-Ebmer, 2005; Kee, 2006; Arulampalam *et al.*, 2007; Barón and Cobb-Clark, 2010), it is found that the top female relative pay seems to be higher in the private sector than in the public sector, which somewhat implies that the highest paid British women working in the latter sector are less likely to be able to move up to the very top jobs. What might have kept those women from reaching the top in the public sector is quite subtle, but there are still several possible explanations that can be offered. One might be the negative impact of the more stringently enforced use of family friendly policies, as Gupta *et al.* (2006) point out that the absence from paid employment for shorter or longer periods is much more harmful for women at the top of the hierarchy than women at the bottom of the labour market. It might also be because the governance structures have remained male-dominated (Elkinawy and Stater, 2011), and better paid jobs in the public sector seem more likely to be part-time according to the descriptive findings in previous section, and a top-ranking woman would be more likely to encounter a taste for discrimination regarding to the part-time jobs.

4.7 The Shifting Patterns of the UK Glass Ceilings by Occupations, Age and Cohort Groups at Occupation Levels

This aim of this subsection is to discover how the changing proportion within occupations of women with specific characteristics, in particular education, marital status and the presence of children in the family, is associated with changes in the UK glass ceilings at different levels of occupation between 1983 and 2011. The dependent variables, the glass ceilings, are measured by the positions of the 90^{th} percentile of female wages, for the total, full-time, and part-time women respectively, in the overall male wage distribution in each occupation (two-digit) at each time point (Equation 4.4). The estimated results for different specifications are shown in Tables 4.4 and 4.5.

For Table 4.4, the estimated results in the first two columns show, for all workers, the changing relative positions associated the changing proportion of women with specific characteristics. The next two columns focus on full-time workers only, and the final two restrict the analysis to part-timers. In each case, the first column presents the results from an OLS specification, and the second column for an occupational Fixed Effects specification, allowing the analysis to emphasise within occupational variations. The significant and positive sign for the *Female* coefficient in *column 5* indicates that the occupations that have a greater share of women benefit the top part-time female relative wage, but seem to hurt the overall and the full-time wages, though the effects are not statistically significant (*columns 1 and 3*). The occupational Fixed Effects coefficients show that the high-end female earnings will go down when the share of women in occupations is rising (*columns 2, 4, and 6*). This suggests that those occupations that are hiring more women are hiring lower paid women, so that the wage at the 90^{th} percentile falls.

The rank of top female earnings is lower on the men's scale in occupations that have higher female employment in full-time compared to part-time work (*odd columns*), while the positive Fixed Effects coefficients suggest that the effect of a rising full-time female share is in the opposite direction, where a percentage point increase in the full-time employment rate of women improves the overall relative position of the 90$^{\text{th}}$ percentile woman by 0.14 percentage points (*column 2*). These results suggest that looking across occupations, there must be some unobserved feature of occupations with a high proportion of full-timers that is associated with lower relative pay for women. However, looking within occupations, the Fixed Effects estimates suggest that the glass ceiling will still be lifted in those occupations that have increased their full-time female employment.

A higher proportion of women in an occupation who are younger than age 50, working in the public sector and holding a higher qualification are all positively associated with the location of the glass ceiling for almost all specifications. The proportion of women working in London and the family factors do not seem to have too much influence on the relative positions in the occupations, with some weak evidence suggesting that the glass ceiling will be at a lower position for the female part-timers in occupations that have a greater share of women working in London. Also, a percentage point increase in the employment of mothers will lead to a decline in the glass ceiling for the full-timers by 0.04 percentage points as the Fixed Effects coefficient shows in *column 4*.

Table 4.5 gives the results from the estimates of the shifting glass ceilings for overall wages in different levels of occupations. The first two columns provide the results for interpreting how the changing proportion of women with specific characteristics will lead to changes in the location of glass ceilings within the 'top' occupations managers, professional, and associate professional and technical occupations, the next two explain the relative changes in glass ceilings in the 'middle' occupations clerical and secretarial, craft related, and personal and protective service occupation, while the final two columns are for the 'bottom' occupations sales, plant and machine operatives, and elementary occupations. Similar to the previous table, the first columns in each case are the results from an OLS specification, and the second columns from an occupational Fixed Effects specification.

A positive relationship between the location of the glass ceiling and the total female employment is discovered in the top-level occupations, but a negative relationship in the middle and the bottom level occupations. This suggests that top women are paid better when there are more female managers and professionals, but more lower-ranked women do not provide any benefit. On top of that, the Fixed Effects coefficients indicate that a rising proportion of women strongly hurts the income of the well-paid women in the middle occupations. Similar to previous findings, looking across occupations, those occupations, except at the top, that have a greater proportion of full-time women have seen the 90^{th} percentile of female wages rank lower on the men's scale. However, the ranking position will move up by about 0.25 percentage points in the middle and high occupations for each percentage point increase in the proportion of full-time women within occupations, as the Fixed Effects estimates have shown in *column 2 and 4*. Women fare significantly better in the middle and the low-level occupations when a greater proportion of women are working in the public sector, but it seems unlikely to benefit those women in the top-level occupations in Britain. This corresponds to some extent with what was observed in the previous sections, that men have held the better paid higher level jobs in the public sector, especially for the part-timers, leading to a more difficult situation for the top women in that sector.

As for the matter of age, it is found that the greater share of younger women in the middle or bottom occupations is strongly associated with higher relative wage rates, but the young do not seem to benefit that much from their age in the top occupations, with some evidence to suggest that a rising proportion of younger women in the top occupations will decrease the top female relative pay. In addition, the top women are paid relatively better in occupations that have hired more women who are well-educated and working outside London, and their relative wages have been increasing across all levels of occupations over time. The effects of the family elements are still weak, with evidence suggesting that each percentage point rise in the share of mothers in occupations reduces the female relative pay by about 0.08 percentage points in top-level occupations.

In summary, the estimated results for the top occupations and for the remainder are somewhat different, both for the overall relative wage and for full-time and part-time relative wages[53] measured separately. For instance, the top-ranking woman in general tends to be more disadvantaged in the female-dominated occupations at the lower level, but the reverse seems to be true for those in the top occupations. This corresponds to the empirical literature (Bagues and Esteve-Volart, 2010; Elkinawy and Stater, 2011; Leah, 2011) that when more women are able to move up to the highest-level occupations, this will lift the position of the glass ceiling.

It is also worth noting that the impact of working full-time on the location of the glass ceiling has been observed to be opposite in sign in the individual-level and occupational level Fixed Effects results. It is suggested that an individual high-earning woman may maximise her own utility by choosing to work part-time, though

[53] See Table 4.11 and 4.12 in Appendix 4A

the occupation level Fixed Effects results show that women as a whole will be better off when a higher proportion of them work full-time, which is a case of individual self-interest versus the common good.

Besides, strong evidence indicates that a greater share of women working in the public sector in the top occupations hurts the high-end female relative pay, while it raises the pay in the other occupations[54]. This has confirmed the findings in the previous sections that although the gender-specific policies are more stringently enforced in the public sector, it does not seem to help improve the gender equality for the best paid women (those at the top end of the wage distribution in the top-level occupations) within this sector. Alongside a rather weak effect found in the high level occupations, it is likely that the well-paid younger women would fare better in the middle and the low-level occupations.

Better education and working outside London are suggested to lift the position of the glass ceiling in all occupations, however the effects of family status are quite weak, in general decreasing the relative pay of high-earning women[55]. It has to be borne in mind that the results are conditional upon being in employment, upon being in specific occupational groups, and upon those women at the 90th percentile of the female wage distribution in specific occupations across the two digit occupational levels. Hence, the lack of significance of the family related variables should be seen as having no effect only on the women who are studied who are paid amongst the highest in the particular occupation - rather than for women in general. What is more, it has been seen that the results for the returns to female characteristics in

[54] These phenomena are also true in the specifications for the top full-time and part-time female relative wages (See Table 4.11 and 4.12 in Appendix 4A)

[55] There is a little evidence suggesting that a greater proportion of mothers working in low-level jobs is associated with higher part-time female pay at the top end of the distribution (Table 4.12 in Appendix 4A)

the top occupations are fairly weak compared to that for the middle and bottom occupations, which implies that the gender wage differential at the very top levels has been driven by other unobserved factors.

4.8 Conclusion

The aim of this chapter was to discover how the UK gender pay gap at the top end of the distribution (the 'glass ceiling') has evolved over the period of $1975-2011$ with respect to different labour market sectors, occupations, and different cohort groups, both within cohorts over their lifetime, and across cohorts. The research was based upon a set of descriptive, graphical and statistical analyses with a concern that there may be a misleading conclusion due to the linear dependency between age, birth cohort and time periods. The results are consistent across all the sections. Specifically, the graphic cohort analysis set a firm ground for the following analyses, revealing that although the gender wage inequality in the public sector remained considerably lower over time, the female relative pay at the top of the earnings distribution in the private sector has been increasing dramatically across the age and cohort groups. It also reveals the considerably higher wage that male part-timers have been paid in the public sector. These findings support the estimated results from regression analysis that a higher paid woman will be significantly better off working in the private sector.

It is found that the British women in general are paid much closer to men in professional and technical occupations, but significantly less than men in low-level male-dominated jobs and the top management jobs, compared to other occupations. These patterns are especially explicit for the female top earners. The results show that an individual higher-waged woman fares pronouncedly lower than their male counterpart in top managerial jobs, yet if the proportion of female employment grows in these jobs their relative wage increases. It implies that if there are more women able to move into the highest jobs, a narrower gender pay gap can be expected. However, if more women are engaged in clerical occupations, a lower female relative wage for the top-ranking women will be seen, as majority of them are involved in lower level tasks in these female-dominated occupations.

With respect to the public and the private sectors, very different patterns are discovered across cohorts and occupations. Female relative pay has been relatively stable over their lifetime in the public sector due possibly to collective bargaining, nationally agreed pay scales, and the enforcement of female friendly policies within the sector, but a notable decline in pay at childrearing age has been observed in the private sector. As for cohort effects, it has been seen that top female wages relative to men have reached a similar level in the private sector as in the public sector, thus leaving the absence of a between-sectors wage gap for the current generation of women. The evidence from further regression analysis confirms this point that a top-ranking woman is now rewarded better in the private sector than if she works in the public sector. Moreover, it is found that if there are more women engaged in the top-level occupations in the public sector, the top female relative wage will fall. It seems to imply that the top paid British women working in the public sector are struggling to move up into the highest occupations together with the male-dominated governance structures, resulting in their lower relative wages. It also implies that the positive impact of gender equality-related policies is less significant on the top-ranking women. This might be because of the inefficiency of the policy itself, but may also be because some women might take a longer time out of the labour market as a result of more generous female friendly regulations in the public sector, leading to their lower human capital accumulation and hence hurt their opportunity of being promoted, as well as their wages.

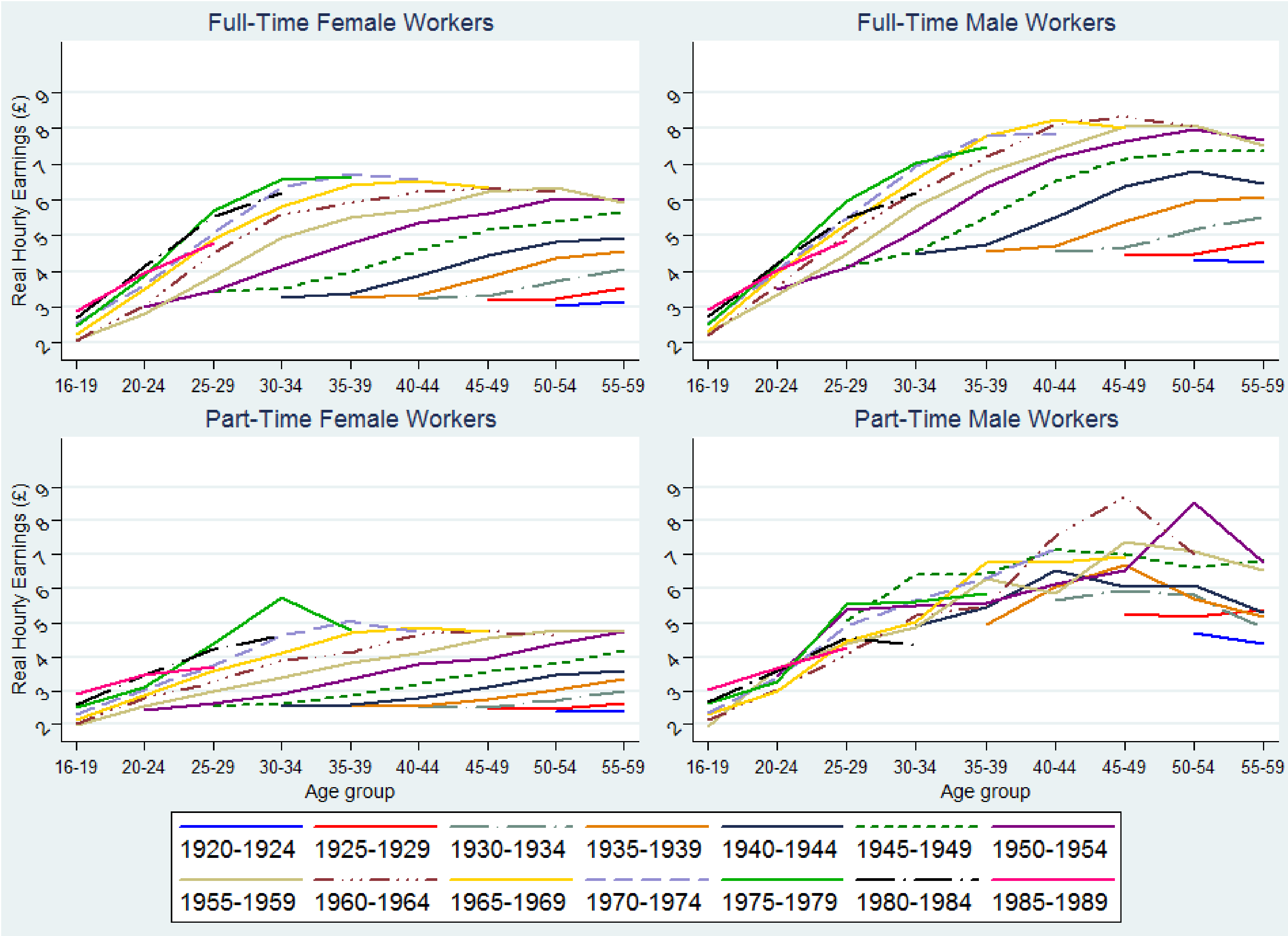
Furthermore, the results indicate that although a majority of women will be better off under full-time employment and a higher share of women engaged in full-time work, some evidence suggests that an individual female top earner does not necessarily receive a pay penalty for moving from full-time to part-time employment. It implies that an individual high-earning woman may maximise her own utility by choosing to work part-time since she may be better able to afford the change. Besides, younger women, better education and working outside London are suggested to have a positive impact on the position of the glass ceilings in all occupations, whereas the effects of family status are quite weak with only limited evidence suggesting the presence of children to have a negative effect.

Overall, the results suggest that although the gender wage gap at both the mean and the top of the wage distribution has been narrowing over the period $1975-2011$, it remains significantly large in particular for the top women. Equality policies do benefit the majority of women but seem to be unlikely to help in explaining the slow progress of women in current generations and in the highest-level management jobs. However, what has really kept these women from reaching the top especially in the public sector, and what has driven the stagnant wage growth for the recent generations is subtle, which hence needs to be further investigated.

Acknowledgements

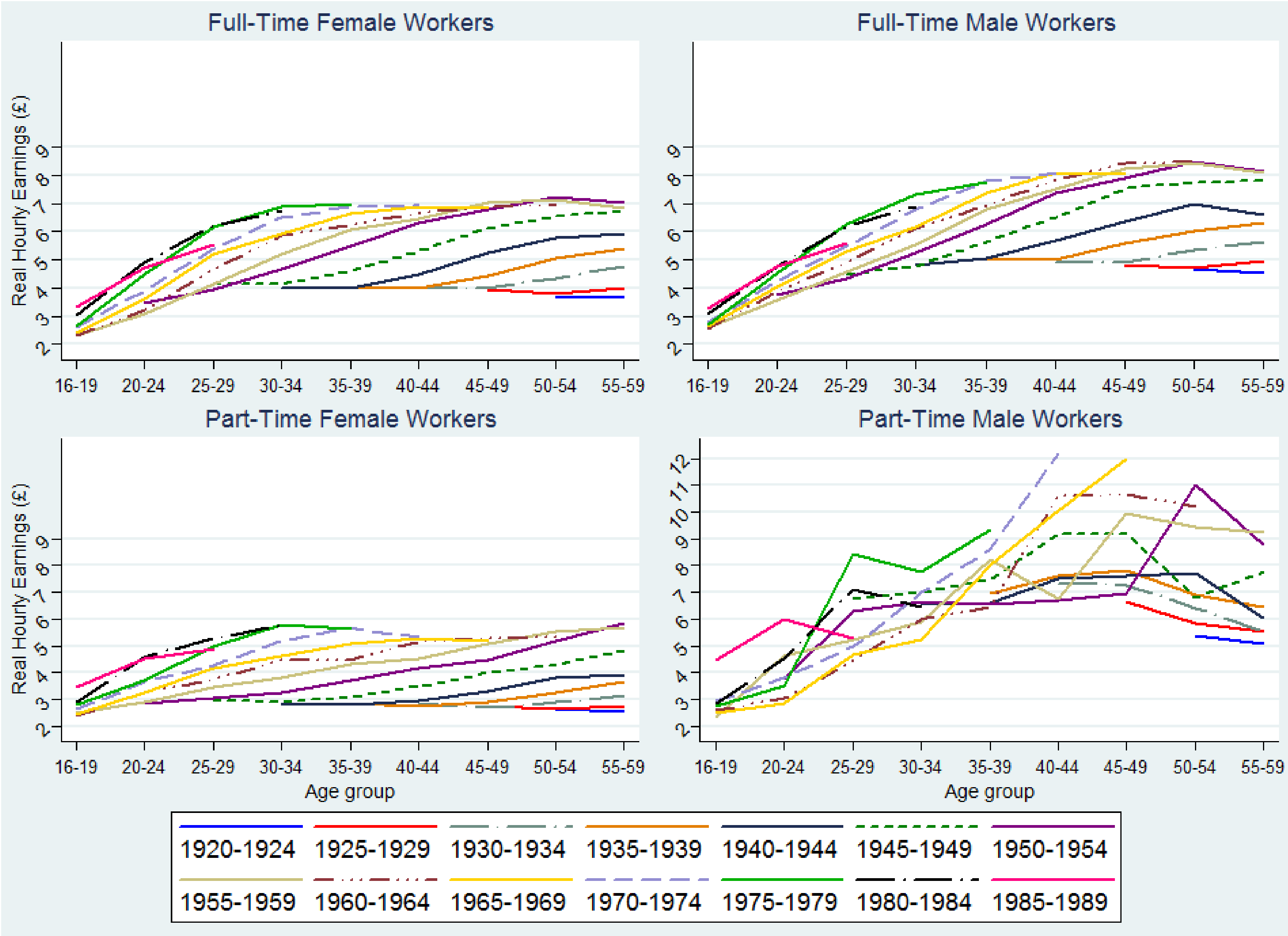
This work was based on data from the New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE), produced by the Office for National Statistics (ONS) and supplied by the Secure Data Service at the UK Data Archive. The data are Crown Copyright and reproduced with the permission of the controller of HMSO and Queen's Printer for Scotland. The use of the data in this work does not imply the endorsement of ONS or the Secure Data Service at the UK Data Archive in relation to the interpretation or analysis of the data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.

Figure 4.1: Average Real Hourly Wages in the Whole Economy



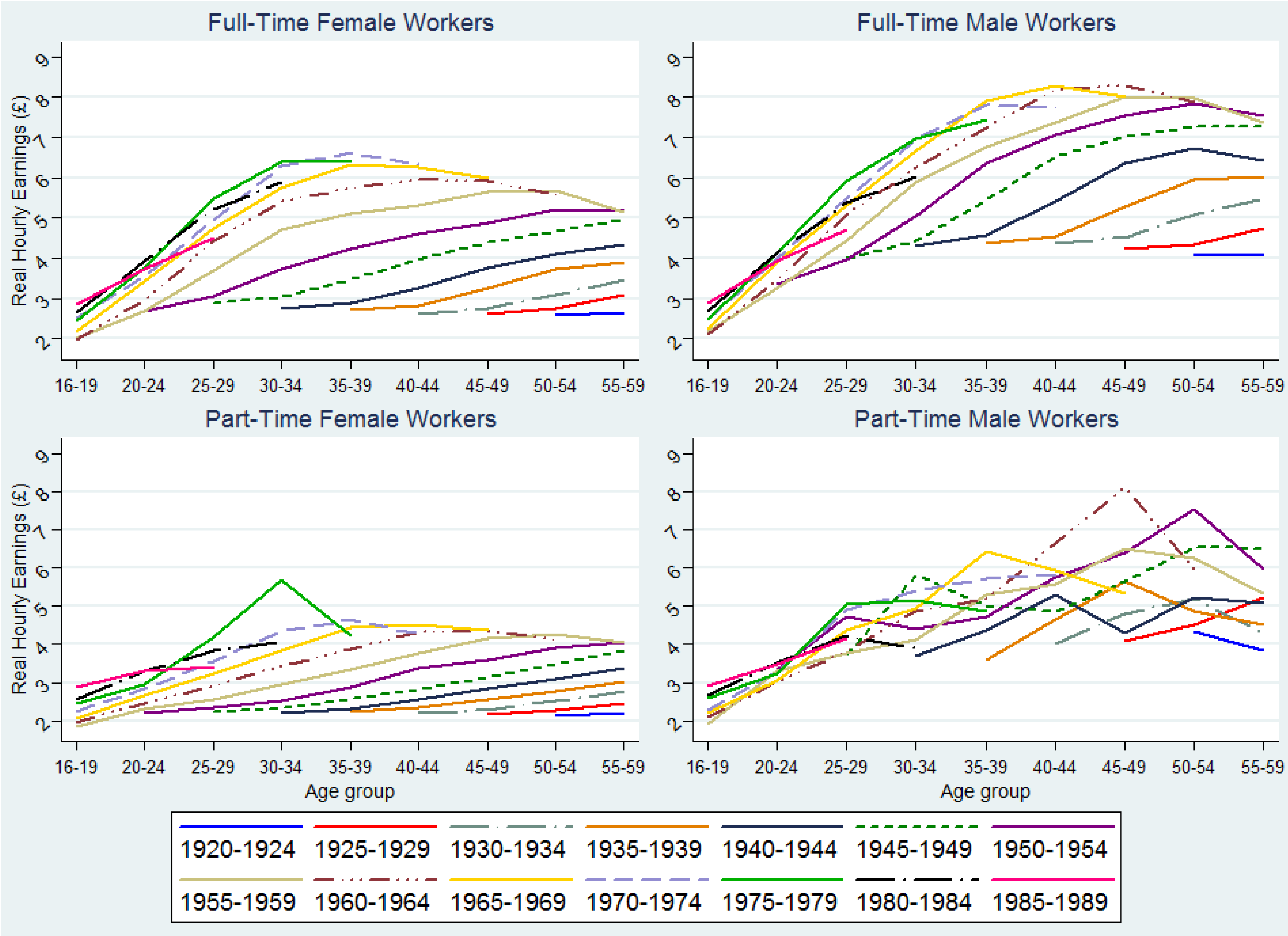
Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Figure 4.2: Average Real Hourly Wages in the Public Sector



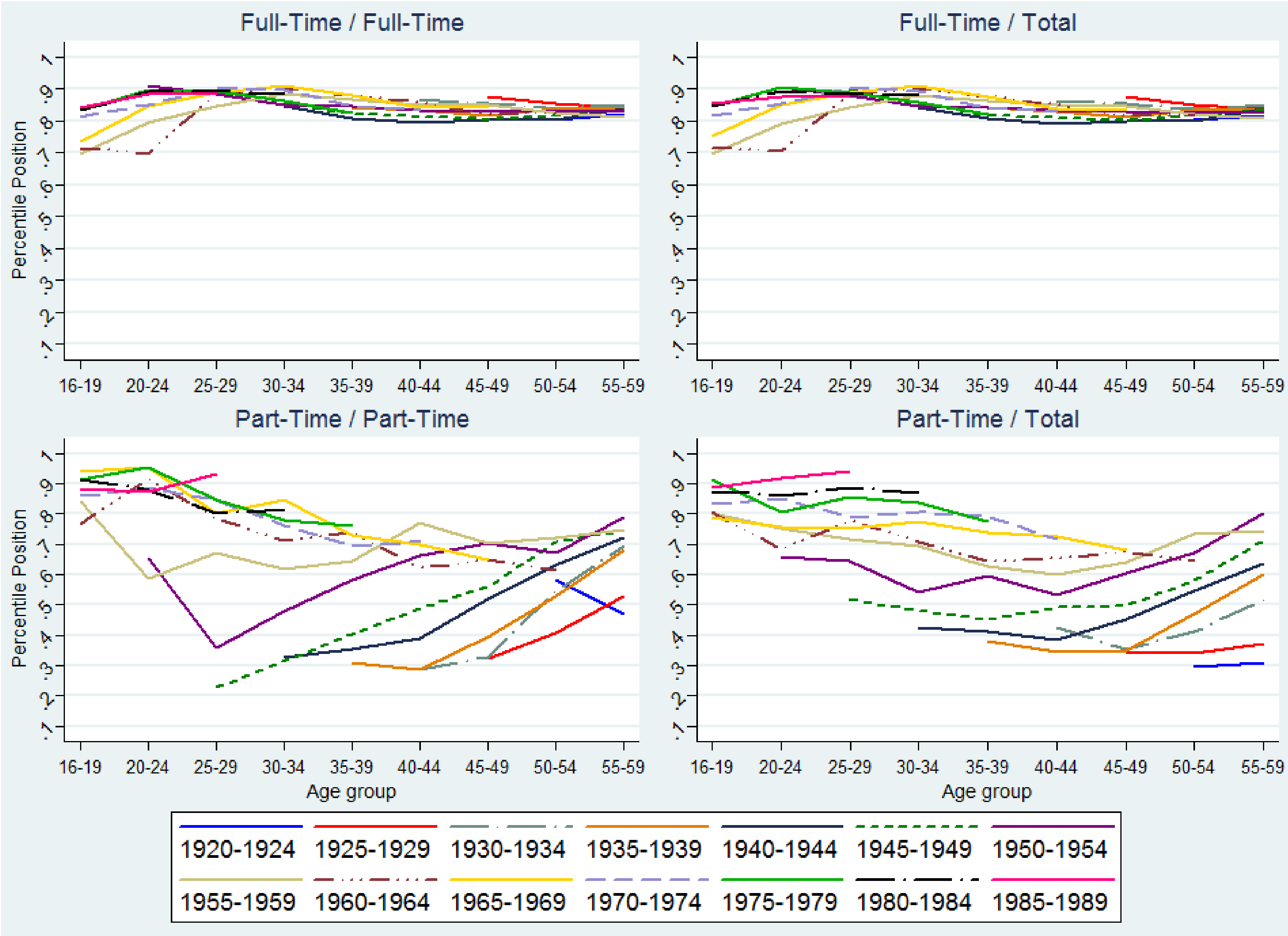
Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Figure 4.3: Average Real Hourly Wages in the Private Sector



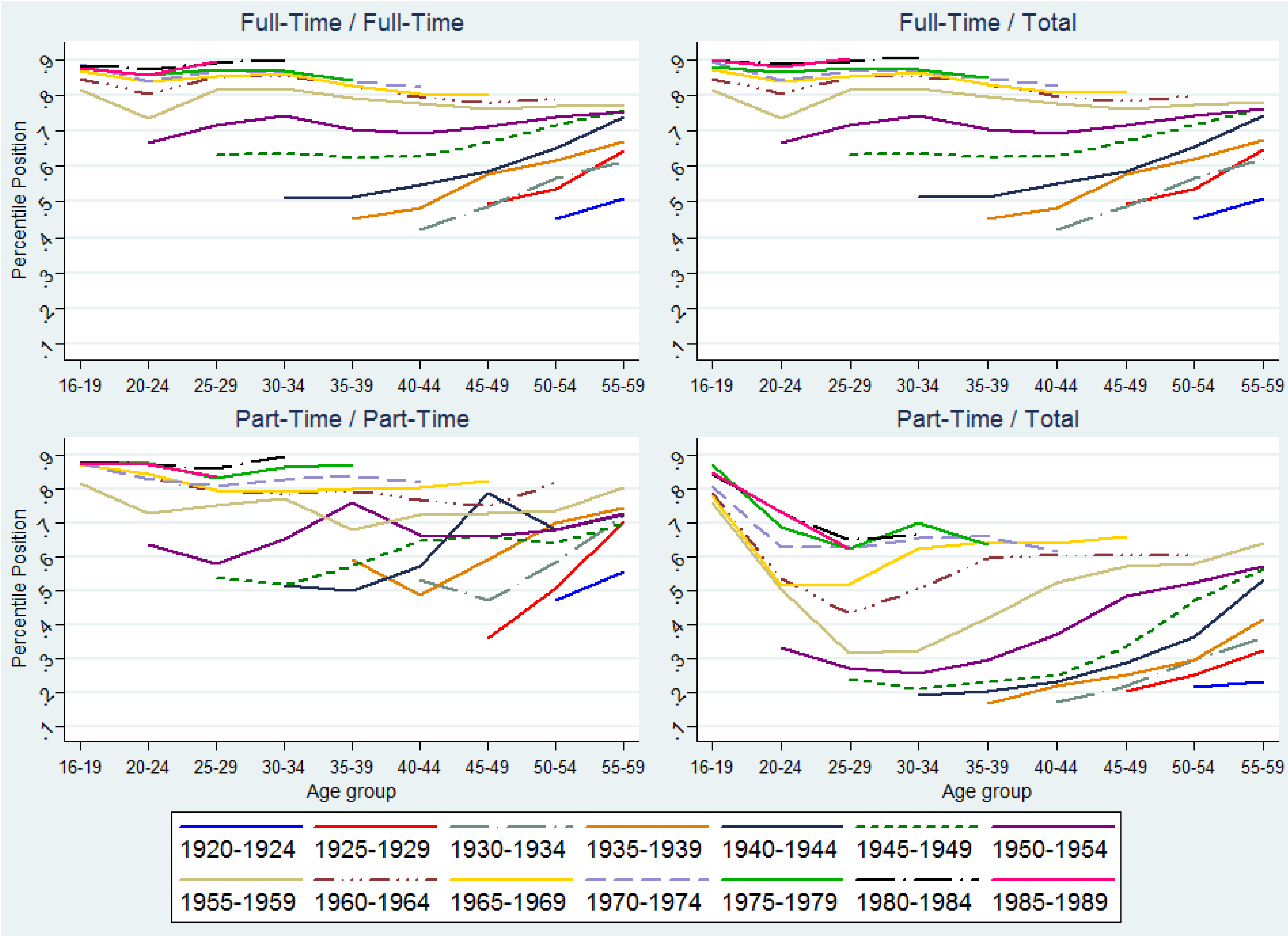
Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Figure 4.4: The 90$^{\text{th}}$ percentile Female Relative Wages in the Public Sector



Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Figure 4.5: The 90th percentile Female Relative Wages in the Private Sector



Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Table 4.1: Female/Male Wage Ratio

Soc	Occupation	1975	1980	1990	2000	2010
1	Managers	0.63	0.67	0.66	0.70	0.70
2	Professional	0.95	0.91	0.92	0.91	0.90
3	Technical	0.72	0.70	0.72	0.78	0.86
4	Clerical	0.78	0.82	0.86	0.94	0.95
5	Craft	0.63	0.65	0.64	0.69	0.86
6	Personal Service	0.69	0.65	0.63	0.67	0.77
7	Sales	0.50	0.55	0.56	0.68	0.82
8	Machine Operatives	0.67	0.71	0.71	0.74	0.81
9	Other	0.74	0.73	0.73	0.77	0.84

Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Table 4.2: The Position of the 90th Percentile Woman in the Male Wage Distribution by Occupations

Soc	Occupation	1975	1980	1990	2000	2010
1	Managers	0.60	0.61	0.65	0.74	0.76
2	Professional	0.75	0.67	0.75	0.82	0.82
3	Technical	0.65	0.64	0.74	0.77	0.81
4	Clerical	0.50	0.60	0.73	0.77	0.83
5	Craft	0.47	0.49	0.59	0.76	0.85
6	Personal Service	0.62	0.61	0.68	0.78	0.83
7	Sales	0.42	0.60	0.69	0.77	0.80
8	Machine Operatives	0.38	0.47	0.54	0.62	0.79
9	Other	0.54	0.55	0.71	0.72	0.85

Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Table 4.3: Individual Level Determinants of Well-Paid Women's Position in the Male Wage Distribution

	Occupation		**Age**		**Cohort**	
	(1)	(2)	(3)	(4)	(5)	(6)
1920s & 1930s cohorts are omitted						
1940s cht	0.0215∗∗∗	.	−0.0123∗∗∗	.	0.0056∗∗∗	.
	(0.0019)	.	(0.0017)	.	(0.0017)	.
1950s cht	0.0355∗∗∗	.	0.0014	.	0.0436∗∗∗	.
	(0.0020)	.	(0.0017)	.	(0.0017)	.
1960s cht	0.0504∗∗∗	.	0.0103∗∗∗	.	0.0662∗∗∗	.
	(0.0025)	.	(0.0021)	.	(0.0020)	.
1970s cht	0.0662∗∗∗	.	0.0057∗	.	0.0895∗∗∗	.
	(0.0029)	.	(0.0024)	.	(0.0023)	.
1980s cht	0.0837∗∗∗	.	0.0040	.	0.1172∗∗∗	.
	(0.0035)	.	(0.0027)	.	(0.0026)	.
1990s cht	0.1042∗∗∗	.	−0.0143∗∗∗	.	0.1130∗∗∗	.
	(0.0049)	.	(0.0033)	.	(0.0032)	.
Age50s is omitted						
Age 40s	−0.0112∗∗∗	−0.0164∗∗∗	−0.0114∗∗∗	−0.0176∗∗∗	−0.0198∗∗∗	−0.0196∗∗∗
	(0.0011)	(0.0010)	(0.0009)	(0.0006)	(0.0009)	(0.0006)
Age 30s	−0.0239∗∗∗	−0.0386∗∗∗	0.0230∗∗∗	0.0088∗∗∗	−0.0077∗∗∗	−0.0090∗∗∗
	(0.0015)	(0.0015)	(0.0012)	(0.0009)	(0.0012)	(0.0009)
Age 20s	−0.0453∗∗∗	−0.0756∗∗∗	0.0674∗∗∗	0.0582∗∗∗	0.0082∗∗∗	0.0058∗∗∗
	(0.0020)	(0.0019)	(0.0015)	(0.0010)	(0.0015)	(0.0010)
Age 10s	−0.0575∗∗∗	−0.1094∗∗∗	0.1025∗∗∗	0.0951∗∗∗	0.0257∗∗∗	0.0149∗∗∗
	(0.0031)	(0.0042)	(0.0019)	(0.0017)	(0.0020)	(0.0016)
Managers is omitted						
Profession	0.0619∗∗∗	0.0545∗∗∗	0.0122∗∗∗	−0.0076∗∗∗	0.0131∗∗∗	−0.0068∗∗∗
	(0.0018)	(0.0031)	(0.0009)	(0.0010)	(0.0009)	(0.0011)
Technical	0.0542∗∗∗	0.0712∗∗∗	−0.0311∗∗∗	−0.0154∗∗∗	−0.0302∗∗∗	−0.0145∗∗∗
	(0.0017)	(0.0028)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Clerical	0.0280∗∗∗	0.1074∗∗∗	−0.0504∗∗∗	−0.0309∗∗∗	−0.0496∗∗∗	−0.0285∗∗∗
	(0.0016)	(0.0024)	(0.0010)	(0.0011)	(0.0010)	(0.0011)
Craft	−0.0696∗∗∗	0.0373∗∗∗	−0.0518∗∗∗	−0.0231∗∗∗	−0.0473∗∗∗	−0.0182∗∗∗
	(0.0037)	(0.0064)	(0.0025)	(0.0048)	(0.0028)	(0.0041)
Personal	0.0357∗∗∗	0.1150∗∗∗	−0.0272∗∗∗	−0.0218∗∗∗	−0.0219∗∗∗	−0.0175∗∗∗
	(0.0017)	(0.0031)	(0.0014)	(0.0024)	(0.0015)	(0.0026)
Sales	0.0223∗∗∗	0.0954∗∗∗	−0.0275∗∗∗	−0.0197∗∗∗	−0.0247∗∗∗	−0.0149∗∗∗
	(0.0017)	(0.0029)	(0.0014)	(0.0018)	(0.0014)	(0.0019)
Machine	−0.0986∗∗∗	0.0165∗∗	−0.0596∗∗∗	−0.0265∗∗∗	−0.0579∗∗∗	−0.0227∗∗∗
	(0.0029)	(0.0051)	(0.0023)	(0.0050)	(0.0026)	(0.0050)
Others	0.0400∗∗∗	0.1415∗∗∗	−0.0377∗∗∗	−0.0257∗∗∗	−0.0385∗∗∗	−0.0176∗∗
	(0.0018)	(0.0036)	(0.0023)	(0.0056)	(0.0026)	(0.0066)
Full-time	−0.0159∗∗∗	−0.0250∗∗∗	−0.0090∗∗∗	−0.0174∗∗∗	−0.0082∗∗∗	−0.0139∗∗∗
	(0.0007)	(0.0011)	(0.0006)	(0.0007)	(0.0007)	(0.0008)
Public	0.0016	0.0017	−0.0163∗∗∗	0.0025∗	−0.0156∗∗∗	0.0010
	(0.0009)	(0.0016)	(0.0007)	(0.0010)	(0.0007)	(0.0011)
Work London	0.0073∗∗∗	0.0113∗∗∗	0.0166∗∗∗	0.0074∗∗∗	0.0150∗∗∗	0.0051∗∗∗
	(0.0011)	(0.0015)	(0.0009)	(0.0009)	(0.0009)	(0.0009)

Table 4.3: *Continued*

	Occupation		**Age**		**Cohort**	
	(1)	(2)	(3)	(4)	(5)	(6)
1975-1984 are omitted						
1985-1994	0.0623***	0.0500***	0.0125***	0.0078***	−0.0015	−0.0051***
	(0.0012)	(0.0012)	(0.0008)	(0.0007)	(0.0008)	(0.0008)
1995-2004	0.1063***	0.0906***	0.0310***	0.0274***	−0.0032**	−0.0009
	(0.0015)	(0.0016)	(0.0012)	(0.0009)	(0.0012)	(0.0010)
2005-2011	0.1139***	0.0979***	0.0389***	0.0397***	−0.0144***	−0.0004
	(0.0019)	(0.0019)	(0.0015)	(0.0011)	(0.0015)	(0.0011)
Constant	0.7172***	0.7217***	0.8427***	0.8552***	0.8485***	0.8952***
	(0.0021)	(0.0029)	(0.0016)	(0.0015)	(0.0016)	(0.0015)
FE(Individual)	No	Yes	No	Yes	No	Yes
N	229167	229167	228110	228110	228140	228140
R^2	0.3626	0.2058	0.3304	0.1326	0.3148	0.0422

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Table 4.4: Occupational Level Determinants of the Position of the Glass Ceiling

	Total		Full-time		Part-Time	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	−0.0203	−0.1760***	−0.0158	−0.1857***	0.1349***	−0.0751
	(0.0106)	(0.0307)	(0.0106)	(0.0318)	(0.0176)	(0.0563)
Full-time	−0.1630***	0.1363***	−0.2386***	0.0125	−0.3110***	−0.0192
	(0.0205)	(0.0307)	(0.0209)	(0.0329)	(0.0347)	(0.0592)
Public	0.0857***	0.0322	0.0767***	0.0400*	0.0063	0.0082
	(0.0106)	(0.0187)	(0.0107)	(0.0194)	(0.0187)	(0.0381)
Age50s is omitted						
Age 40s	0.2629***	0.0533	0.3261***	0.1287**	0.2436**	0.3235***
	(0.0515)	(0.0452)	(0.0531)	(0.0477)	(0.0901)	(0.0880)
Age 30s	0.4185***	0.0656	0.4139***	0.0944*	0.7969***	0.5289***
	(0.0421)	(0.0420)	(0.0425)	(0.0436)	(0.0781)	(0.0873)
Age 20s	0.4861***	0.0566	0.4891***	0.0974*	0.4393***	0.2104**
	(0.0379)	(0.0411)	(0.0384)	(0.0427)	(0.0661)	(0.0802)
Age 10s	0.1935**	−0.0248	0.2020***	0.0154	0.0316	0.0453
	(0.0606)	(0.0588)	(0.0610)	(0.0610)	(0.1053)	(0.1123)
Work London	−0.0526	0.0172	−0.0244	0.0034	−0.1913*	0.0123
	(0.0508)	(0.0444)	(0.0511)	(0.0460)	(0.0878)	(0.0858)
Degree	0.0388*	0.0331	0.0358*	0.0593*	0.1747***	−0.0642
	(0.0151)	(0.0270)	(0.0153)	(0.0279)	(0.0260)	(0.0512)
Married	−0.0106	−0.0102	−0.0147	−0.0146	0.0110	−0.0021
	(0.0128)	(0.0099)	(0.0129)	(0.0103)	(0.0216)	(0.0185)
Kid-16-Fmly	−0.0080	−0.0338	−0.0111	−0.0372*	0.0181	−0.0016
	(0.0223)	(0.0182)	(0.0225)	(0.0189)	(0.0381)	(0.0348)
1983-1990 is omitted						
1991 − 1997	0.0636***	0.0781***	0.0538***	0.0683***	0.0567***	0.0809***
	(0.0079)	(0.0063)	(0.0080)	(0.0066)	(0.0134)	(0.0120)
1998 − 2004	0.1246***	0.1373***	0.1067***	0.1181***	0.1321***	0.1829***
	(0.0081)	(0.0069)	(0.0082)	(0.0072)	(0.0140)	(0.0136)
2005 − 2011	0.1741***	0.1786***	0.1467***	0.1515***	0.2124***	0.2587***
	(0.0084)	(0.0075)	(0.0085)	(0.0078)	(0.0143)	(0.0143)
Constant	0.4191***	0.5372***	0.4896***	0.6184***	0.2618***	0.2469**
	(0.0353)	(0.0397)	(0.0355)	(0.0412)	(0.0612)	(0.0776)
FE(Occupation)	No	Yes	No	Yes	No	Yes
N	2149	2149	2149	2149	2091	2091
R^2	0.3193	0.3393	0.2957	0.2803	0.3445	0.3022

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: Kid-16-Fmly is the presence of children under the age of 16 in family.

Table 4.5: Occupational Level Determinants of the Position of the Glass Ceiling, by Occupational Groups

	Top		**Middle**		**Bottom**	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.0992***	−0.0519	−0.0320*	−0.2603***	−0.0629*	−0.1047
	(0.0221)	(0.0525)	(0.0152)	(0.0651)	(0.0257)	(0.0564)
Full-time	0.0499	0.2552***	−0.0564	0.2478***	−0.2919***	0.0419
	(0.0503)	(0.0556)	(0.0338)	(0.0552)	(0.0397)	(0.0529)
Public	−0.0294*	−0.0035	0.1195***	0.0737*	0.1920***	−0.0486
	(0.0143)	(0.0267)	(0.0190)	(0.0330)	(0.0309)	(0.0466)
Age50s is omitted						
Age 40s	−0.0134	−0.0793	0.0550	0.0120	0.6867***	0.2154**
	(0.0773)	(0.0731)	(0.1035)	(0.0938)	(0.0936)	(0.0811)
Age 30s	0.0230	−0.1997**	0.4483***	0.3515***	0.6775***	0.0701
	(0.0656)	(0.0680)	(0.0882)	(0.0908)	(0.0798)	(0.0750)
Age 20s	0.0350	−0.1352	0.3753***	0.1138	0.7917***	0.0054
	(0.0622)	(0.0734)	(0.0746)	(0.0803)	(0.0673)	(0.0716)
Age 10s	−0.0566	−0.3735	0.2399*	0.0350	0.3167**	−0.0414
	(0.2366)	(0.2059)	(0.0963)	(0.0992)	(0.1072)	(0.1010)
Work London	−0.1893**	−0.0859	−0.0540	0.2212	0.1386	0.0573
	(0.0620)	(0.0594)	(0.1315)	(0.1151)	(0.1036)	(0.0942)
Degree	0.0793***	−0.0210	0.1651*	0.0838	0.2979**	0.0402
	(0.0168)	(0.0308)	(0.0750)	(0.0694)	(0.0905)	(0.0892)
Married	−0.0044	0.0028	−0.0238	−0.0024	−0.0230	−0.0302
	(0.0182)	(0.0149)	(0.0216)	(0.0180)	(0.0239)	(0.0185)
Kid-16-Fmly	−0.0103	−0.0792*	−0.0628	−0.0290	0.0393	0.0002
	(0.0378)	(0.0328)	(0.0380)	(0.0338)	(0.0375)	(0.0301)
1983-1990 is omitted						
1991 − 1997	0.0579***	0.0842***	0.0519***	0.0672***	0.0707***	0.0738***
	(0.0113)	(0.0100)	(0.0131)	(0.0111)	(0.0159)	(0.0126)
1998 − 2004	0.0899***	0.1305***	0.1329***	0.1487***	0.1238***	0.1135***
	(0.0121)	(0.0122)	(0.0138)	(0.0122)	(0.0164)	(0.0134)
2005 − 2011	0.1191***	0.1615***	0.1836***	0.1878***	0.1692***	0.1636***
	(0.0143)	(0.0152)	(0.0148)	(0.0133)	(0.0165)	(0.0138)
Constant	0.5844***	0.6151***	0.4392***	0.4272***	0.2155**	0.5413***
	(0.0727)	(0.0739)	(0.0654)	(0.0762)	(0.0697)	(0.0652)
FE(Occupation)	No	Yes	No	Yes	No	Yes
N	799	799	735	735	615	615
R^2	0.2425	0.3297	0.3987	0.4337	0.4510	0.3306

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: Kid-16-Fmly is the presence of children under the age of 16 in family.

Appendix 4A

Table 4.6: Proportion of Workers in the Public and the Private Sectors

	Male			Female		
	1975	**1990**	**2010**	**1975**	**1990**	**2010**
Panel A: Public Sector						
Full-Time	0.570	0.425	0.300	0.292	0.343	0.402
Part-Time	0.004	0.009	0.033	0.134	0.223	0.266
Total	0.574	0.434	0.332	0.426	0.566	0.668
Panel B: Private Sector						
Full-Time	0.652	0.606	0.473	0.256	0.283	0.261
Part-Time	0.004	0.009	0.072	0.089	0.101	0.194
Total	0.656	0.615	0.545	0.344	0.385	0.455

Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Table 4.7: Proportion of Workers in Total Employment by Occupation

		Male			Female		
Soc	**Occupation**	**1975**	**1990**	**2010**	**1975**	**1990**	**2010**
1	Managers	0.066	0.077	0.089	0.013	0.029	0.058
2	Professional	0.049	0.054	0.051	0.020	0.027	0.055
3	Technical	0.041	0.053	0.048	0.029	0.052	0.069
4	Clerical	0.062	0.054	0.059	0.142	0.160	0.113
5	Craft	0.158	0.105	0.054	0.018	0.011	0.003
6	Personal Service	0.028	0.032	0.044	0.029	0.042	0.095
7	Sales	0.024	0.027	0.044	0.033	0.045	0.074
8	Machine Operatives	0.136	0.107	0.052	0.044	0.031	0.011
9	Other	0.063	0.048	0.043	0.045	0.047	0.038

Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); and authors calculations

Table 4.8: Individual Panel Regression on the Changes in the Position of the Glass Ceiling (2-digit Occupations)

	Occupation		**Age**		**Cohort**	
	(1)	(2)	(3)	(4)	(5)	(6)
1920s & 1930s cohorts are omitted						
1940s cht	0.0221***	.	−0.0138***	.	0.0043**	.
	(0.0017)	.	(0.0016)	.	(0.0016)	.
1950s cht	0.0343***	.	−0.0017	.	0.0414***	.
	(0.0019)	.	(0.0016)	.	(0.0016)	.
1960s cht	0.0484***	.	0.0068***	.	0.0649***	.
	(0.0022)	.	(0.0020)	.	(0.0019)	.
1970s cht	0.0641***	.	0.0015	.	0.0882***	.
	(0.0027)	.	(0.0023)	.	(0.0022)	.
1980s cht	0.0817***	.	−0.0005	.	0.1166***	.
	(0.0032)	.	(0.0026)	.	(0.0025)	.
1990s cht	0.1020***	.	−0.0191***	.	0.1133***	.
	(0.0047)	.	(0.0032)	.	(0.0031)	.
Age50s is omitted						
Age 40s	−0.0101***	−0.0155***	−0.0128***	−0.0176***	−0.0215***	−0.0197***
	(0.0010)	(0.0010)	(0.0008)	(0.0006)	(0.0008)	(0.0006)
Age 30s	−0.0227***	−0.0372***	0.0204***	0.0090***	−0.0109***	−0.0090***
	(0.0014)	(0.0014)	(0.0011)	(0.0009)	(0.0012)	(0.0009)
Age 20s	−0.0453***	−0.0766***	0.0667***	0.0590***	0.0062***	0.0064***
	(0.0018)	(0.0018)	(0.0014)	(0.0010)	(0.0015)	(0.0010)
Age 10s	−0.0562***	−0.1151***	0.1075***	0.0986***	0.0283***	0.0163***
	(0.0029)	(0.0040)	(0.0018)	(0.0017)	(0.0020)	(0.0016)
SOC10 is omitted						
Soc11	0.0607***	0.1005***	−0.0509***	−0.0145***	−0.0499***	−0.0129***
	(0.0069)	(0.0066)	(0.0030)	(0.0024)	(0.0031)	(0.0025)
Soc12	0.0863***	0.0862***	0.0045	0.0021	0.0032	0.0016
	(0.0062)	(0.0052)	(0.0025)	(0.0020)	(0.0025)	(0.0020)
Soc13	0.0162*	0.0581***	−0.0170***	−0.0083***	−0.0179***	−0.0097***
	(0.0064)	(0.0057)	(0.0027)	(0.0021)	(0.0027)	(0.0022)
Soc14	0.1290***	0.1754***	−0.0258***	−0.0105*	−0.0281***	−0.0105*
	(0.0084)	(0.0093)	(0.0048)	(0.0047)	(0.0051)	(0.0045)
Soc15	−0.0112	0.0407	−0.0035	−0.0050	−0.0042	0.0005
	(0.0405)	(0.0277)	(0.0065)	(0.0065)	(0.0069)	(0.0077)
Soc16	−0.0058	0.1005*	−0.0117	0.0058	−0.0111	0.0178
	(0.0493)	(0.0487)	(0.0133)	(0.0172)	(0.0158)	(0.0112)
Soc17	0.0734***	0.1385***	−0.0287***	−0.0145***	−0.0288***	−0.0111***
	(0.0065)	(0.0060)	(0.0032)	(0.0028)	(0.0032)	(0.0028)
Soc19	0.0676***	0.0849***	−0.0158***	−0.0114***	−0.0154***	−0.0102***
	(0.0069)	(0.0063)	(0.0029)	(0.0023)	(0.0030)	(0.0024)
Soc20	0.0829***	0.0969***	−0.0203***	−0.0203***	−0.0213***	−0.0197***
	(0.0076)	(0.0104)	(0.0034)	(0.0034)	(0.0034)	(0.0035)
Soc21	0.1416***	0.1572***	−0.0168***	−0.0121***	−0.0174***	−0.0106***
	(0.0074)	(0.0085)	(0.0033)	(0.0029)	(0.0033)	(0.0029)

Table 4.8: *Continued*

	Occupation		Age		Cohort	
	(1)	(2)	(3)	(4)	(5)	(6)
Soc22	0.0905*** (0.0076)	0.0883*** (0.0133)	0.0222*** (0.0031)	−0.0157*** (0.0036)	0.0212*** (0.0031)	−0.0123*** (0.0035)
Soc23	0.1316*** (0.0063)	0.1705*** (0.0069)	−0.0045 (0.0025)	−0.0067* (0.0026)	−0.0028 (0.0026)	−0.0052 (0.0027)
Soc24	0.0938*** (0.0077)	0.0927*** (0.0103)	0.0076* (0.0030)	−0.0095* (0.0041)	0.0055 (0.0031)	−0.0100* (0.0040)
Soc25	0.0993*** (0.0073)	0.1154*** (0.0060)	−0.0087** (0.0028)	−0.0154*** (0.0024)	−0.0105*** (0.0029)	−0.0151*** (0.0024)
Soc26	0.1006*** (0.0157)	0.1226*** (0.0133)	−0.0212*** (0.0059)	−0.0229*** (0.0058)	−0.0238*** (0.0060)	−0.0184*** (0.0056)
Soc27	0.1068*** (0.0116)	0.1220*** (0.0126)	−0.0311*** (0.0068)	−0.0260*** (0.0058)	−0.0298*** (0.0070)	−0.0226*** (0.0055)
Soc29	0.1661*** (0.0066)	0.2287*** (0.0076)	−0.0266*** (0.0039)	−0.0223*** (0.0039)	−0.0233*** (0.0040)	−0.0203*** (0.0039)
Soc30	0.0852*** (0.0083)	0.1543*** (0.0098)	−0.0517*** (0.0039)	−0.0343*** (0.0042)	−0.0495*** (0.0039)	−0.0302*** (0.0045)
Soc31	0.0685*** (0.0159)	0.1347*** (0.0209)	−0.0565*** (0.0076)	−0.0217* (0.0088)	−0.0571*** (0.0071)	−0.0135 (0.0108)
Soc32	0.1405*** (0.0071)	0.1664*** (0.0071)	−0.0201*** (0.0030)	−0.0197*** (0.0027)	−0.0197*** (0.0031)	−0.0174*** (0.0028)
Soc33	−0.0239 (0.0361)	−0.0872 (0.0697)	−0.0032 (0.0110)	0.0094 (0.0095)	−0.0012 (0.0097)	−0.0067 (0.0088)
Soc34	0.1232*** (0.0062)	0.1961*** (0.0059)	−0.0672*** (0.0026)	−0.0289*** (0.0029)	−0.0651*** (0.0027)	−0.0274*** (0.0031)
Soc35	0.0553*** (0.0110)	0.1186*** (0.0121)	−0.0210*** (0.0058)	−0.0154** (0.0054)	−0.0226*** (0.0054)	−0.0165** (0.0056)
Soc36	0.0377*** (0.0067)	0.0586*** (0.0060)	−0.0082** (0.0029)	−0.0104*** (0.0023)	−0.0094** (0.0030)	−0.0109*** (0.0023)
Soc37	0.1397*** (0.0064)	0.2156*** (0.0061)	−0.0660*** (0.0031)	−0.0336*** (0.0033)	−0.0637*** (0.0033)	−0.0282*** (0.0034)
Soc38	0.1481*** (0.0069)	0.1754*** (0.0105)	−0.0129*** (0.0036)	−0.0151*** (0.0035)	−0.0123*** (0.0037)	−0.0155*** (0.0034)
Soc39	0.1122*** (0.0066)	0.1813*** (0.0065)	−0.0315*** (0.0031)	−0.0186*** (0.0030)	−0.0348*** (0.0031)	−0.0187*** (0.0029)
Soc40	0.1361*** (0.0062)	0.2489*** (0.0055)	−0.0776*** (0.0028)	−0.0429*** (0.0026)	−0.0779*** (0.0030)	−0.0369*** (0.0027)
Soc41	0.0892*** (0.0062)	0.1940*** (0.0055)	−0.0622*** (0.0027)	−0.0363*** (0.0023)	−0.0609*** (0.0027)	−0.0347*** (0.0024)
Soc42	0.1026*** (0.0065)	0.2177*** (0.0061)	−0.0638*** (0.0034)	−0.0410*** (0.0041)	−0.0649*** (0.0036)	−0.0379*** (0.0037)
Soc43	0.1065*** (0.0061)	0.2180*** (0.0055)	−0.0422*** (0.0027)	−0.0289*** (0.0027)	−0.0411*** (0.0027)	−0.0274*** (0.0027)
Soc44	0.1402*** (0.0064)	0.2730*** (0.0067)	−0.0752*** (0.0040)	−0.0506*** (0.0056)	−0.0767*** (0.0045)	−0.0463*** (0.0056)
Soc45	0.0605*** (0.0062)	0.1477*** (0.0060)	−0.0653*** (0.0027)	−0.0353*** (0.0027)	−0.0638*** (0.0028)	−0.0334*** (0.0027)

Table 4.8: *Continued*

	Occupation		Age		Cohort	
	(1)	(2)	(3)	(4)	(5)	(6)
Soc46	−0.0041	0.1145∗∗∗	−0.0726∗∗∗	−0.0373∗∗∗	−0.0721∗∗∗	−0.0337∗∗∗
	(0.0068)	(0.0072)	(0.0039)	(0.0051)	(0.0040)	(0.0050)
Soc49	−0.0114	0.0851∗∗∗	−0.0538∗∗∗	−0.0276∗∗∗	−0.0528∗∗∗	−0.0237∗∗∗
	(0.0077)	(0.0075)	(0.0034)	(0.0034)	(0.0036)	(0.0034)
Soc50	0.0432∗	0.2010∗∗∗	−0.0189	0.0050	−0.0465∗	−0.0386
	(0.0193)	(0.0249)	(0.0138)	(0.0301)	(0.0195)	(0.0355)
Soc51	0.0629∗∗∗	0.1246∗∗∗	−0.0625∗∗∗	−0.0217∗	−0.0544∗∗∗	−0.0137
	(0.0125)	(0.0151)	(0.0066)	(0.0087)	(0.0074)	(0.0078)
Soc52	0.1170∗∗∗	0.2180∗∗∗	−0.0426∗∗∗	−0.0230∗∗	−0.0414∗∗∗	−0.0162∗
	(0.0129)	(0.0133)	(0.0051)	(0.0075)	(0.0046)	(0.0067)
Soc53	−0.0218	0.0482	−0.0567∗∗∗	−0.0419	−0.0529∗∗∗	−0.0374
	(0.0258)	(0.0303)	(0.0132)	(0.0247)	(0.0161)	(0.0284)
Soc54	0.0463∗	0.1741∗∗∗	−0.0391∗	0.0063	−0.0408∗	−0.0109
	(0.0221)	(0.0362)	(0.0152)	(0.0243)	(0.0170)	(0.0317)
Soc55	−0.0357∗∗∗	0.1245∗∗∗	−0.0853∗∗∗	−0.0589∗∗	−0.0801∗∗∗	−0.0253
	(0.0074)	(0.0108)	(0.0046)	(0.0208)	(0.0060)	(0.0195)
Soc56	−0.0830∗∗∗	0.0300∗	−0.0728∗∗∗	−0.0426∗∗	−0.0696∗∗∗	−0.0395∗∗∗
	(0.0112)	(0.0138)	(0.0084)	(0.0133)	(0.0096)	(0.0100)
Soc57	0.0271	0.2630∗∗∗	−0.0669∗∗∗	−0.0766	−0.0893∗∗∗	.
	(0.0361)	(0.0341)	(0.0134)	(0.0412)	(0.0154)	.
Soc58	0.0366∗∗	0.2166∗∗∗	−0.0503∗	−0.0903∗∗∗	−0.0676∗	0.0630∗∗∗
	(0.0122)	(0.0262)	(0.0209)	(0.0037)	(0.0277)	(0.0136)
Soc59	0.0432∗∗∗	0.1811∗∗∗	−0.0481∗∗∗	−0.0255∗	−0.0464∗∗∗	−0.0390∗∗∗
	(0.0127)	(0.0125)	(0.0055)	(0.0102)	(0.0059)	(0.0082)
Soc61	0.1196∗∗∗	0.1847∗∗∗	−0.0490∗∗∗	−0.0351∗∗∗	−0.0403∗∗∗	−0.0272∗∗∗
	(0.0072)	(0.0113)	(0.0030)	(0.0042)	(0.0033)	(0.0048)
Soc62	0.1062∗∗∗	0.2444∗∗∗	−0.0678∗∗∗	−0.0225∗∗∗	−0.0625∗∗∗	−0.0227∗
	(0.0064)	(0.0070)	(0.0047)	(0.0061)	(0.0053)	(0.0090)
Soc63	0.1773∗∗∗	0.2795∗∗∗	−0.0139∗∗∗	−0.0181∗	−0.0175∗∗∗	−0.0222∗∗
	(0.0072)	(0.0116)	(0.0037)	(0.0078)	(0.0036)	(0.0078)
Soc64	0.0801∗∗∗	0.2109∗∗∗	−0.0464∗∗∗	−0.0304∗∗∗	−0.0431∗∗∗	−0.0210∗∗∗
	(0.0063)	(0.0063)	(0.0036)	(0.0055)	(0.0037)	(0.0052)
Soc65	0.1043∗∗∗	0.2316∗∗∗	−0.0263∗∗∗	−0.0144∗	−0.0268∗∗∗	−0.0144∗
	(0.0063)	(0.0067)	(0.0038)	(0.0066)	(0.0039)	(0.0071)
Soc66	0.1210∗∗∗	0.2480∗∗∗	−0.0318∗∗∗	−0.0242	−0.0292∗∗∗	−0.0240∗
	(0.0072)	(0.0132)	(0.0060)	(0.0144)	(0.0059)	(0.0114)
Soc67	0.0815∗∗∗	0.2291∗∗∗	−0.0696∗∗∗	−0.0281	−0.0680∗∗∗	−0.0360
	(0.0080)	(0.0112)	(0.0088)	(0.0407)	(0.0124)	(0.0348)
Soc69	0.1279∗∗∗	0.2448∗∗∗	−0.0480∗∗∗	−0.0330∗∗∗	−0.0335∗∗∗	−0.0157
	(0.0072)	(0.0087)	(0.0043)	(0.0084)	(0.0051)	(0.0088)
Soc70	0.1181∗∗∗	0.1631∗∗∗	−0.0268∗∗∗	−0.0208∗∗∗	−0.0240∗∗∗	−0.0144∗∗∗
	(0.0082)	(0.0089)	(0.0044)	(0.0040)	(0.0044)	(0.0041)
Soc71	0.0565∗∗∗	0.1424∗∗∗	−0.0282∗∗∗	−0.0169∗∗∗	−0.0290∗∗∗	−0.0164∗∗∗
	(0.0065)	(0.0065)	(0.0030)	(0.0030)	(0.0030)	(0.0032)
Soc72	0.0787∗∗∗	0.2160∗∗∗	−0.0564∗∗∗	−0.0406∗∗∗	−0.0535∗∗∗	−0.0283∗∗∗
	(0.0062)	(0.0059)	(0.0029)	(0.0037)	(0.0030)	(0.0038)

Table 4.8: *Continued*

	Occupation		**Age**		**Cohort**	
	(1)	(2)	(3)	(4)	(5)	(6)
Soc73	0.0587∗∗ (0.0214)	0.1608∗∗∗ (0.0300)	−0.0137 (0.0155)	0.0017 (0.0233)	−0.0215 (0.0120)	−0.0020 (0.0146)
Soc79	0.1347∗∗∗ (0.0070)	0.2250∗∗∗ (0.0084)	−0.0242∗∗∗ (0.0044)	−0.0249∗∗∗ (0.0048)	−0.0254∗∗∗ (0.0044)	−0.0176∗∗∗ (0.0043)
Soc80	0.0200∗ (0.0088)	0.1554∗∗∗ (0.0098)	−0.0715∗∗∗ (0.0064)	−0.0504∗∗∗ (0.0145)	−0.0657∗∗∗ (0.0073)	−0.0264 (0.0135)
Soc81	−0.0838∗∗∗ (0.0141)	0.1127∗∗∗ (0.0198)	−0.1048∗∗∗ (0.0203)	−0.0098 (0.0253)	−0.1030∗∗∗ (0.0199)	−0.0181 (0.0237)
Soc82	−0.0877∗∗∗ (0.0093)	0.0675∗∗∗ (0.0102)	−0.0735∗∗∗ (0.0065)	−0.0230 (0.0119)	−0.0765∗∗∗ (0.0073)	−0.0267∗ (0.0128)
Soc83	−0.3000∗∗∗ (0.0292)	−0.1066∗∗ (0.0402)	−0.0826∗∗ (0.0288)	−0.0231∗∗∗ (0.0029)	−0.0942∗∗ (0.0302)	−0.0332∗∗∗ (0.0030)
Soc84	−0.1100∗∗∗ (0.0131)	0.0596∗∗∗ (0.0156)	−0.0975∗∗∗ (0.0103)	−0.0607 (0.0355)	−0.1042∗∗∗ (0.0124)	−0.0892 (0.0472)
Soc85	−0.0861∗∗∗ (0.0076)	0.0882∗∗∗ (0.0097)	−0.0830∗∗∗ (0.0051)	−0.0600∗∗∗ (0.0102)	−0.0747∗∗∗ (0.0060)	−0.0455∗∗∗ (0.0123)
Soc86	−0.0464∗∗∗ (0.0069)	0.1088∗∗∗ (0.0078)	−0.0825∗∗∗ (0.0041)	−0.0520∗∗∗ (0.0076)	−0.0807∗∗∗ (0.0048)	−0.0349∗∗∗ (0.0076)
Soc87	0.1586∗∗∗ (0.0071)	0.2682∗∗∗ (0.0104)	−0.0348∗∗∗ (0.0097)	−0.0046 (0.0100)	−0.0322∗∗∗ (0.0085)	−0.0079 (0.0082)
Soc88	0.1462∗∗∗ (0.0189)	0.1926∗∗∗ (0.0229)	−0.0541∗∗∗ (0.0053)	−0.0276 (0.0191)	−0.0616∗∗∗ (0.0070)	−0.0349 (0.0200)
Soc89	−0.0368∗∗∗ (0.0092)	0.1095∗∗∗ (0.0108)	−0.0581∗∗∗ (0.0069)	−0.0256∗ (0.0111)	−0.0583∗∗∗ (0.0093)	−0.0357∗∗ (0.0115)
Soc90	0.1711∗∗∗ (0.0088)	0.3226∗∗∗ (0.0219)	−0.0616∗∗∗ (0.0110)	−0.0275∗∗ (0.0104)	−0.0452∗∗ (0.0167)	−0.0133 (0.0186)
Soc91	0.0211 (0.0112)	0.1765∗∗∗ (0.0145)	−0.0424∗∗ (0.0146)	−0.0203 (0.0192)	−0.0379∗ (0.0169)	−0.0421 (0.0247)
Soc92	−0.0108 (0.0331)	0.0888 (0.0595)	−0.0236 (0.0124)	−0.0172∗∗∗ (0.0041)	−0.0293∗∗ (0.0113)	0.0094 (0.0056)
Soc93	0.0058 (0.0245)	0.1192∗∗∗ (0.0305)	−0.0917∗∗∗ (0.0199)	−0.1315∗∗∗ (0.0137)	−0.0925∗ (0.0407)	−0.1048∗∗∗ (0.0260)
Soc94	0.1228∗∗∗ (0.0075)	0.2522∗∗∗ (0.0118)	−0.0524∗∗∗ (0.0064)	−0.0343 (0.0177)	−0.0692∗∗∗ (0.0063)	−0.0126 (0.0133)
Soc95	0.1025∗∗∗ (0.0062)	0.2570∗∗∗ (0.0061)	−0.0551∗∗∗ (0.0035)	−0.0280∗∗∗ (0.0065)	−0.0537∗∗∗ (0.0038)	−0.0169∗ (0.0073)
Soc99	0.0744∗∗∗ (0.0105)	0.2055∗∗∗ (0.0139)	−0.0659∗∗∗ (0.0114)	−0.0685∗∗∗ (0.0169)	−0.0675∗∗∗ (0.0085)	−0.0675∗∗ (0.0257)
Full-time	−0.0157∗∗∗ (0.0007)	−0.0229∗∗∗ (0.0011)	−0.0110∗∗∗ (0.0006)	−0.0176∗∗∗ (0.0007)	−0.0099∗∗∗ (0.0006)	−0.0140∗∗∗ (0.0008)
Public	−0.0099∗∗∗ (0.0009)	−0.0018 (0.0015)	−0.0090∗∗∗ (0.0008)	0.0025∗ (0.0010)	−0.0094∗∗∗ (0.0008)	0.0009 (0.0011)
Work London	0.0124∗∗∗ (0.0011)	0.0113∗∗∗ (0.0014)	0.0146∗∗∗ (0.0009)	0.0071∗∗∗ (0.0009)	0.0129∗∗∗ (0.0009)	0.0048∗∗∗ (0.0009)

Table 4.8: *Continued*

	Occupation		Age		Cohort	
	(1)	(2)	(3)	(4)	(5)	(6)
1975-1984 is omitted						
1985-1994	0.0605***	0.0485***	0.0112***	0.0078***	−0.0034***	−0.0052***
	(0.0011)	(0.0012)	(0.0008)	(0.0007)	(0.0008)	(0.0008)
1995-2004	0.1043***	0.0911***	0.0271***	0.0267***	−0.0081***	−0.0016
	(0.0014)	(0.0015)	(0.0011)	(0.0009)	(0.0011)	(0.0010)
2005-2011	0.1123***	0.0990***	0.0356***	0.0390***	−0.0194***	−0.0011
	(0.0018)	(0.0018)	(0.0014)	(0.0011)	(0.0014)	(0.0011)
Constant	0.6631***	0.6216***	0.8605***	0.8593***	0.8668***	0.8988***
	(0.0063)	(0.0056)	(0.0028)	(0.0024)	(0.0028)	(0.0024)
FE(Individual)	No	Yes	No	Yes	No	Yes
N	229167	229167	228110	228110	228140	228140
R^2	0.4339	0.2684	0.3644	0.1375	0.3457	0.0463

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Table 4.9: Individual Panel Regression on the Changes in the Position of the Glass Ceiling (2 Age Dummies Omitted)

	Occupation		Age		Cohort	
	(1)	(2)	(3)	(4)	(5)	(6)
1920s cohorts is omitted						
1930s cht	0.0032	.	−0.0078**	.	0.0021	.
	(0.0026)	.	(0.0025)	.	(0.0025)	.
1940s cht	0.0184***	.	−0.0235***	.	−0.0020	.
	(0.0025)	.	(0.0023)	.	(0.0024)	.
1950s cht	0.0296***	.	−0.0133***	.	0.0310***	.
	(0.0026)	.	(0.0023)	.	(0.0023)	.
1960s cht	0.0408***	.	−0.0084***	.	0.0474***	.
	(0.0027)	.	(0.0025)	.	(0.0025)	.
1970s cht	0.0548***	.	−0.0155***	.	0.0674***	.
	(0.0031)	.	(0.0027)	.	(0.0027)	.
1980s cht	0.0700***	.	−0.0198***	.	0.0909***	.
	(0.0035)	.	(0.0029)	.	(0.0029)	.
1990s cht	0.0888***	.	−0.0406***	.	0.0829***	.
	(0.0049)	.	(0.0034)	.	(0.0033)	.
Age40s & Age50s are omitted						
Age 30s	−0.0129***	−0.0202***	0.0348***	0.0289***	0.0116***	0.0131***
	(0.0009)	(0.0010)	(0.0007)	(0.0006)	(0.0008)	(0.0007)
Age 20s	−0.0317***	−0.0534***	0.0817***	0.0827***	0.0322***	0.0326***
	(0.0014)	(0.0015)	(0.0010)	(0.0009)	(0.0010)	(0.0009)
Age 10s	−0.0422***	−0.0839***	0.1193***	0.1244***	0.0529***	0.0448***
	(0.0026)	(0.0041)	(0.0014)	(0.0016)	(0.0015)	(0.0016)
Managers is omitted						
Profession	0.0623***	0.0546***	0.0123***	−0.0075***	0.0129***	−0.0069***
	(0.0018)	(0.0031)	(0.0009)	(0.0010)	(0.0009)	(0.0011)
Technical	0.0542***	0.0713***	−0.0309***	−0.0154***	−0.0300***	−0.0144***
	(0.0017)	(0.0028)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Clerical	0.0282***	0.1078***	−0.0500***	−0.0303***	−0.0481***	−0.0273***
	(0.0016)	(0.0024)	(0.0010)	(0.0011)	(0.0010)	(0.0011)
Craft	−0.0695***	0.0374***	−0.0515***	−0.0231***	−0.0459***	−0.0176***
	(0.0037)	(0.0064)	(0.0025)	(0.0049)	(0.0028)	(0.0041)
Personal	0.0359***	0.1157***	−0.0271***	−0.0213***	−0.0214***	−0.0168***
	(0.0017)	(0.0031)	(0.0014)	(0.0024)	(0.0015)	(0.0026)
Sales	0.0225***	0.0961***	−0.0274***	−0.0193***	−0.0242***	−0.0142***
	(0.0017)	(0.0029)	(0.0014)	(0.0018)	(0.0014)	(0.0019)
Machine	−0.0986***	0.0165**	−0.0592***	−0.0258***	−0.0560***	−0.0216***
	(0.0029)	(0.0051)	(0.0023)	(0.0050)	(0.0026)	(0.0050)
Others	0.0403***	0.1418***	−0.0375***	−0.0250***	−0.0372***	−0.0166*
	(0.0018)	(0.0036)	(0.0023)	(0.0056)	(0.0026)	(0.0066)
Full-time	−0.0158***	−0.0247***	−0.0090***	−0.0171***	−0.0081***	−0.0135***
	(0.0007)	(0.0011)	(0.0006)	(0.0007)	(0.0007)	(0.0008)
Public	0.0017*	0.0013	−0.0163***	0.0020	−0.0154***	0.0004
	(0.0009)	(0.0016)	(0.0007)	(0.0010)	(0.0007)	(0.0011)
Work London	0.0072***	0.0116***	0.0164***	0.0071***	0.0143***	0.0047***
	(0.0011)	(0.0015)	(0.0009)	(0.0009)	(0.0009)	(0.0009)

Table 4.9: *Continued*

	Occupation		**Age**		**Cohort**	
	(1)	(2)	(3)	(4)	(5)	(6)
1975-1984 are omitted						
1985-1994	0.0648***	0.0555***	0.0165***	0.0147***	0.0032***	0.0020*
	(0.0011)	(0.0012)	(0.0007)	(0.0008)	(0.0008)	(0.0008)
1995-2004	0.1121***	0.1013***	0.0384***	0.0408***	0.0072***	0.0131***
	(0.0014)	(0.0016)	(0.0010)	(0.0010)	(0.0011)	(0.0010)
2005-2011	0.1221***	0.1133***	0.0491***	0.0587***	0.0003	0.0195***
	(0.0017)	(0.0018)	(0.0013)	(0.0011)	(0.0013)	(0.0012)
Constant	0.7093***	0.6981***	0.8420***	0.8277***	0.8370***	0.8658***
	(0.0026)	(0.0027)	(0.0022)	(0.0014)	(0.0022)	(0.0015)
FE(Individual)	No	Yes	No	Yes	No	Yes
N	229167	229167	228110	228110	228140	228140
R^2	0.3620	0.2036	0.3289	0.1239	0.3096	0.0305

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Table 4.10: Individual Panel Regression on the Changes in the Position of the Glass Ceiling (2 Period Dummies Omitted)

	Occupation		Age		Cohort	
	(1)	(2)	(3)	(4)	(5)	(6)
1920s cohorts is omitted						
1930s cht	0.0415∗∗∗	.	0.0048∗	.	0.0121∗∗∗	.
	(0.0026)	.	(0.0024)	.	(0.0025)	.
1940s cht	0.0863∗∗∗	.	−0.0018	.	0.0136∗∗∗	.
	(0.0024)	.	(0.0023)	.	(0.0023)	.
1950s cht	0.1188∗∗∗	.	0.0152∗∗∗	.	0.0517∗∗∗	.
	(0.0025)	.	(0.0023)	.	(0.0024)	.
1960s cht	0.1552∗∗∗	.	0.0288∗∗∗	.	0.0743∗∗∗	.
	(0.0028)	.	(0.0024)	.	(0.0024)	.
1970s cht	0.1853∗∗∗	.	0.0274∗∗∗	.	0.0976∗∗∗	.
	(0.0032)	.	(0.0026)	.	(0.0026)	.
1980s cht	0.2179∗∗∗	.	0.0287∗∗∗	.	0.1253∗∗∗	.
	(0.0036)	.	(0.0028)	.	(0.0028)	.
1990s cht	0.2502∗∗∗	.	0.0135∗∗∗	.	0.1211∗∗∗	.
	(0.0050)	.	(0.0033)	.	(0.0033)	.
Age50s is omitted						
Age 40s	−0.0335∗∗∗	−0.0319∗∗∗	−0.0154∗∗∗	−0.0203∗∗∗	−0.0211∗∗∗	−0.0178∗∗∗
	(0.0010)	(0.0011)	(0.0007)	(0.0007)	(0.0008)	(0.0007)
Age 30s	−0.0648∗∗∗	−0.0695∗∗∗	0.0150∗∗∗	0.0032∗∗∗	−0.0087∗∗∗	−0.0054∗∗∗
	(0.0014)	(0.0016)	(0.0010)	(0.0010)	(0.0011)	(0.0010)
Age 20s	−0.1029∗∗∗	−0.1212∗∗∗	0.0564∗∗∗	0.0502∗∗∗	0.0072∗∗∗	0.0109∗∗∗
	(0.0018)	(0.0020)	(0.0012)	(0.0012)	(0.0013)	(0.0012)
Age 10s	−0.1293∗∗∗	−0.1692∗∗∗	0.0879∗∗∗	0.0841∗∗∗	0.0247∗∗∗	0.0213∗∗∗
	(0.0030)	(0.0044)	(0.0015)	(0.0017)	(0.0017)	(0.0018)
Managers is omitted						
Profession	0.0625∗∗∗	0.0556∗∗∗	0.0123∗∗∗	−0.0075∗∗∗	0.0128∗∗∗	−0.0069∗∗∗
	(0.0019)	(0.0031)	(0.0009)	(0.0010)	(0.0009)	(0.0011)
Technical	0.0546∗∗∗	0.0705∗∗∗	−0.0309∗∗∗	−0.0154∗∗∗	−0.0304∗∗∗	−0.0145∗∗∗
	(0.0017)	(0.0028)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Clerical	0.0268∗∗∗	0.1054∗∗∗	−0.0508∗∗∗	−0.0312∗∗∗	−0.0493∗∗∗	−0.0282∗∗∗
	(0.0016)	(0.0024)	(0.0010)	(0.0011)	(0.0010)	(0.0011)
Craft	−0.0737∗∗∗	0.0329∗∗∗	−0.0531∗∗∗	−0.0231∗∗∗	−0.0468∗∗∗	−0.0180∗∗∗
	(0.0037)	(0.0064)	(0.0025)	(0.0048)	(0.0028)	(0.0041)
Personal	0.0353∗∗∗	0.1150∗∗∗	−0.0273∗∗∗	−0.0219∗∗∗	−0.0219∗∗∗	−0.0173∗∗∗
	(0.0017)	(0.0031)	(0.0014)	(0.0023)	(0.0015)	(0.0026)
Sales	0.0206∗∗∗	0.0934∗∗∗	−0.0272∗∗∗	−0.0196∗∗∗	−0.0246∗∗∗	−0.0149∗∗∗
	(0.0017)	(0.0030)	(0.0014)	(0.0018)	(0.0014)	(0.0019)
Machine	−0.1018∗∗∗	0.0125∗	−0.0611∗∗∗	−0.0268∗∗∗	−0.0571∗∗∗	−0.0224∗∗∗
	(0.0029)	(0.0052)	(0.0023)	(0.0050)	(0.0026)	(0.0049)
Others	0.0391∗∗∗	0.1407∗∗∗	−0.0378∗∗∗	−0.0258∗∗∗	−0.0381∗∗∗	−0.0173∗∗
	(0.0018)	(0.0036)	(0.0023)	(0.0056)	(0.0026)	(0.0066)
Full-time	−0.0162∗∗∗	−0.0248∗∗∗	−0.0091∗∗∗	−0.0174∗∗∗	−0.0081∗∗∗	−0.0139∗∗∗
	(0.0007)	(0.0012)	(0.0006)	(0.0007)	(0.0007)	(0.0008)
Public	−0.0004	−0.0026	−0.0168∗∗∗	0.0021∗	−0.0155∗∗∗	0.0012
	(0.0009)	(0.0017)	(0.0007)	(0.0010)	(0.0007)	(0.0011)

Table 4.10: *Continued*

	Occupation		Age		Cohort	
	(1)	(2)	(3)	(4)	(5)	(6)
Work London	0.0065***	0.0093***	0.0164***	0.0070***	0.0150***	0.0053***
	(0.0011)	(0.0015)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
1975-1984 & 1985-1994 are omitted						
1995-2004	0.0416***	0.0348***	0.0181***	0.0185***	−0.0024***	0.0048***
	(0.0010)	(0.0010)	(0.0007)	(0.0006)	(0.0007)	(0.0006)
2005-2011	0.0341***	0.0316***	0.0231***	0.0288***	−0.0136***	0.0066***
	(0.0013)	(0.0014)	(0.0010)	(0.0009)	(0.0010)	(0.0009)
Constant	0.7199***	0.7927***	0.8454***	0.8672***	0.8405***	0.8874***
	(0.0026)	(0.0027)	(0.0022)	(0.0014)	(0.0022)	(0.0015)
FE(Individual)	No	Yes	No	Yes	No	Yes
N	229167	229167	228110	228110	228140	228140
R^2	0.3642	0.1868	0.3284	0.1310	0.3154	0.0415

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$

Table 4.11: Occupational Panel Regression on the Changes in the Full-Time Glass Ceiling by Occupational Levels

	Top		Middle		Bottom	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.0469*	−0.0950	−0.0171	−0.3765***	−0.0232	−0.0426
	(0.0223)	(0.0524)	(0.0156)	(0.0681)	(0.0258)	(0.0592)
Full-time	−0.1797**	0.0145	−0.0856*	0.2077***	−0.3566***	−0.1122*
	(0.0552)	(0.0632)	(0.0347)	(0.0579)	(0.0399)	(0.0555)
Public	−0.0458**	−0.0063	0.1287***	0.0886*	0.2022***	−0.0473
	(0.0145)	(0.0267)	(0.0195)	(0.0346)	(0.0311)	(0.0489)
Age50s is omitted						
Age 40s	0.0964	0.0082	0.0914	0.0473	0.6807***	0.2898***
	(0.0798)	(0.0756)	(0.1063)	(0.0980)	(0.0941)	(0.0851)
Age 30s	0.0504	−0.1531*	0.3949***	0.3412***	0.6766***	0.1521
	(0.0652)	(0.0686)	(0.0907)	(0.0950)	(0.0802)	(0.0787)
Age 20s	0.0599	−0.0741	0.3397***	0.1037	0.7601***	0.0807
	(0.0622)	(0.0741)	(0.0766)	(0.0839)	(0.0676)	(0.0751)
Age 10s	−0.1552	−0.3942	0.3461***	0.1303	0.1989	−0.1414
	(0.2330)	(0.2054)	(0.0989)	(0.1038)	(0.1077)	(0.1061)
Work London	−0.1133	−0.0703	0.0723	0.2238	0.0754	−0.0617
	(0.0611)	(0.0593)	(0.1349)	(0.1203)	(0.1041)	(0.0989)
Degree	0.0711***	−0.0151	0.1917*	0.1060	0.3343***	0.1134
	(0.0165)	(0.0307)	(0.0770)	(0.0726)	(0.0910)	(0.0936)
Married	−0.0237	−0.0127	−0.0113	0.0021	−0.0268	−0.0309
	(0.0180)	(0.0149)	(0.0223)	(0.0189)	(0.0240)	(0.0194)
Kid-16-Fmly	−0.0211	−0.0621	−0.0562	−0.0481	0.0292	−0.0034
	(0.0373)	(0.0327)	(0.0390)	(0.0353)	(0.0377)	(0.0316)
1983-1990 is omitted						
1991 − 1997	0.0409***	0.0710***	0.0597***	0.0719***	0.0513**	0.0500***
	(0.0112)	(0.0101)	(0.0135)	(0.0117)	(0.0160)	(0.0133)
1998 − 2004	0.0633***	0.1087***	0.1249***	0.1369***	0.1007***	0.0838***
	(0.0122)	(0.0124)	(0.0142)	(0.0127)	(0.0165)	(0.0141)
2005 − 2011	0.0803***	0.1332***	0.1561***	0.1620***	0.1390***	0.1274***
	(0.0145)	(0.0155)	(0.0152)	(0.0139)	(0.0166)	(0.0145)
Constant	0.7950***	0.7977***	0.4649***	0.5210***	0.3110***	0.6275***
	(0.0729)	(0.0759)	(0.0671)	(0.0795)	(0.0700)	(0.0685)
FE(Occupation)	No	Yes	No	Yes	No	Yes
N	799	799	735	735	615	615
R^2	0.2307	0.2874	0.3461	0.3674	0.4664	0.2845

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: Kid-16-Fmly is the presence of children under the age of 16 in family.

Table 4.12: Occupational Panel Regression on the Changes in the Part-Time Glass Ceiling by Occupational Levels

	Top		Middle		Bottom	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	0.3623***	−0.1216	0.1222***	0.2887*	0.0065	−0.0381
	(0.0422)	(0.1075)	(0.0263)	(0.1123)	(0.0399)	(0.1005)
Full-time	−0.1549	0.1037	−0.3072***	−0.0004	−0.4706***	−0.1140
	(0.0967)	(0.1209)	(0.0588)	(0.1005)	(0.0622)	(0.0993)
Public	−0.1119***	−0.0789	0.0407	0.1569**	0.0064	−0.1270
	(0.0316)	(0.0680)	(0.0333)	(0.0604)	(0.0482)	(0.0839)
Age50s is omitted						
Age 40s	−0.0415	0.6001***	0.0601	0.0991	0.8320***	0.3374*
	(0.1557)	(0.1586)	(0.1932)	(0.1774)	(0.1469)	(0.1465)
Age 30s	0.8449***	0.9556***	0.5951***	0.3043	0.7360***	0.1477
	(0.1400)	(0.1562)	(0.1626)	(0.1676)	(0.1385)	(0.1570)
Age 20s	0.1836	0.3809*	0.3872**	0.1262	0.6269***	0.0723
	(0.1298)	(0.1646)	(0.1326)	(0.1482)	(0.1060)	(0.1308)
Age 10s	0.0077	0.3594	0.1210	−0.0417	0.2431	0.0217
	(0.4601)	(0.4290)	(0.1790)	(0.1822)	(0.1683)	(0.1820)
Work London	−0.3713**	−0.1692	−0.2227	0.4540	0.1952	0.3886*
	(0.1213)	(0.1278)	(0.2662)	(0.2416)	(0.1617)	(0.1681)
Degree	0.1686***	−0.0443	−0.1163	0.0474	0.0311	−0.0349
	(0.0335)	(0.0656)	(0.1319)	(0.1247)	(0.1365)	(0.1485)
Married	0.0286	0.0234	0.0015	0.0383	−0.0087	−0.0373
	(0.0353)	(0.0313)	(0.0376)	(0.0319)	(0.0378)	(0.0335)
Kid-16-Fmly	0.0585	−0.0548	−0.1251	−0.1165	0.1292*	0.0753
	(0.0756)	(0.0727)	(0.0671)	(0.0607)	(0.0593)	(0.0551)
1983-1990 is omitted						
1991 − 1997	0.0365	0.0839***	0.0324	0.0585**	0.1068***	0.1167***
	(0.0218)	(0.0217)	(0.0230)	(0.0200)	(0.0252)	(0.0231)
1998 − 2004	0.0814***	0.1784***	0.1561***	0.1987***	0.1811***	0.2069***
	(0.0244)	(0.0278)	(0.0245)	(0.0225)	(0.0263)	(0.0249)
2005 − 2011	0.1284***	0.2457***	0.2930***	0.2776***	0.2527***	0.2667***
	(0.0290)	(0.0342)	(0.0259)	(0.0244)	(0.0258)	(0.0248)
Constant	0.2717	−0.0011	0.3999***	0.1548	0.1307	0.3450**
	(0.1446)	(0.1631)	(0.1186)	(0.1405)	(0.1092)	(0.1192)
FE(Occupation)	No	Yes	No	Yes	No	Yes
N	767	767	717	717	607	607
R^2	0.3452	0.3153	0.3837	0.3841	0.3584	0.3005

Standard errors in parentheses * $p < 0.05$, ** p< 0.01, *** $p < 0.001$
Note: Kid-16-Fmly is the presence of children under the age of 16 in family.

Table 4.13: Descriptive Statistics

	Obs.	Mean	Standard Deviation
ASHE/NES			
Age 50s	2781	0.17	0.09
Age 40s	2781	0.24	0.09
Age 30s	2781	0.25	0.09
Age 20s	2781	0.28	0.13
Age 10s	2781	0.05	0.07
Full-time	2781	0.76	0.17
Part-time	2781	0.24	0.17
Public	2781	0.30	0.30
Private	2781	0.70	0.30
Work London	2781	0.04	0.05
Female	2781	0.35	0.29
Managers	2776	0.12	0.32
Professional	2776	0.12	0.32
Technical	2776	0.13	0.33
Clerical	2776	0.11	0.31
Craft	2776	0.13	0.34
Personal Service	2776	0.11	0.31
Sales	2776	0.07	0.25
Machine Operatives	2776	0.13	0.34
Other	2776	0.09	0.28
LFS			
Degree	2299	0.16	0.21
Single	2304	0.39	0.18
Married	2304	0.43	0.24
Kids	2160	0.35	0.12

Source: New Earnings Survey (NES) / Annual Survey of Hours and Earnings (ASHE) (2013); Labour Force Survey(LFS); and authors calculations

Table 4.14: Definition of 2-digit SOC90 Occupational Classification

Major Group 1		**Managers and Administrators**
	10	General Managers and Administrators in National and Local Government, Large Companies and Organisations
	11	Production Managers in Manufacturing, Construction, Mining and Energy Industries
	12	Specialist Managers
	13	Financial Institution and Office Managers, Civil Service Executive Officers
	14	Managers in Transport and Storing
	15	Protective Service Officers
	16	Managers in Farming, Horticulture, Forestry and Fishing
	17	Managers and Proprietors in Service Industries
	19	Managers and Administrators N.E.C.
Major Group 2		**Professional Occupations**
	20	Natural Scientists
	21	Engineers and Technologists
	22	Health Professionals
	23	Teaching Professionals
	24	Legal Professionals
	25	Business and Financial Professionals
	26	Architects, Town Planners and Surveyors
	27	Librarians and Related Professionals
	29	Professional Occupations N.E.C.
Major Group 3		**Associate Professional and Technical Occupations**
	30	Scientific Technicians
	31	Draughtspersons, Quantity and Other Surveyors
	32	Computer Analyst/Programmers
	33	Ship and Aircraft Officers, Air Traffic Planners and Controllers
	34	Health Associate Professionals
	35	Legal Associate Professionals
	36	Business and Financial Associate Professionals
	37	Social Welfare Associate Professionals
	38	Literary, Artistic and Sports Professionals
	39	Associate Professional and Technical Occupations N.E.C.
Major Group 4		**Clerical and Secretarial Occupations**
	40	Administrative/Clerical Officers and Assistants in Civil Service and Local Government
	41	Numerical Clerks and Cashiers
	42	Filing and Records Clerks
	43	Clerks (Not Otherwise Specified)

Table 4.13: *Continued*

	44	Stores and Despatch Clerks, Storekeepers
	45	Secretaries, Personal Assistants, Typists, Word Processor Operators
	46	Receptionists, Telephonists and Related Occupations
	49	Clerical and Secretarial Occupations N.E.C.
Major Group 5		**Craft and Related Occupations**
	50	Construction Trades
	51	Metal Machining, Fitting and Instrument Making Trades
	52	Electrical/Electronic Trades
	53	Metal Forming, Welding and Related Trades
	54	Vehicle Trades
	55	Textiles, Garments and Related Trades
	56	Printing and Related Trades
	57	Woodworking Trades
	58	Food Preparation Trades
	59	Other Craft and Related Occupations N.E.C.
Major Group 6		**Personal and Protective Service Occupations**
	61	Security and Protective Service Occupations
	62	Catering Occupations
	63	Travel Attendants and Related Occupations
	64	Health and Related Occupations
	65	Childcare and Related Occupations
	66	Hairdressers, Beauticians and Related Occupations
	67	Domestic Staff and Related Occupations
	69	Personal and Protective Service Occupations N.E.C.
Major Group 7		**Sales Occupations**
	70	Buyers, Brokers and Related Agents
	71	Sales Representatives
	72	Sales Assistants and Check-Out Operators
	73	Mobile, Market and Door-To-Door Salespersons and Agents
	79	Sales Occupations N.E.C.
Major Group 8		**Plant and Machine Operatives**
	80	Food, Drink and Tobacco Process Operatives
	81	Textiles and Tannery Process Operatives
	82	Chemicals, Paper, Plastics and Related Process Operatives
	83	Metal Making and Treating Process Operatives
	84	Metal Working Process Operatives
	85	Assemblers/Lineworkers
	86	Other Routine Process Operatives
	87	Road Transport Operatives
	88	Other Transport and Machinery Operatives

Table 4.13: *Continued*

89	Plant and Machine Operatives N.E.C.
Major Group 9	**Other Occupations**
90	Other Occupations in Agriculture, Forestry and Fishing
91	Other Occupations in Mining and Manufacturing
92	Other Occupations in Construction
93	Other Occupations in Transport
94	Other Occupations in Communication
95	Other Occupations in Sales and Services
99	Other Occupations N.E.C.

5 Conclusion

5.1 Summary of Empirical Findings

5.1.1 Chapter 2

The first empirical study of this thesis conducted two stages of analysis. Firstly, it aimed to investigate the variation in the magnitude of the estimated gender 'discrimination' in relation to the settings of the estimated wage models across different empirical papers and a broad range of countries; and secondly, the impact on such variation of trade globalisation and cultural differences was examined. A set of meta-data for $1963 - 2007$ was constructed, followed by the estimations using meta-regression analysis (MRA). The results found in the first empirical study of this thesis indicate that the variations in the estimated gender wage residual are strongly influenced by the type of data set (the sample) used and the control variables included in the estimated models. Studies concentrating on a sample of new entrants in the labour market, non-married individuals, the public sector, a specific occupation, and high-prestige occupations produce lower gender wage residuals, whereas the reverse holds true for those focusing on married women and the private sector. This implies that there are some more unobserved characteristics in these two segments driving the lower female relative pay, which might be the attitudes towards careers of married women, the relatively looser equal pay policy enforcement in the private sector compared to the public sector, or discrimination against married women in the labour market. Moreover, including a measure of potential experience increases the unexplained portion of the gender pay gap by around 3 percentage points, while the omission of real experience, marital status, and the presence of children are associated with a smaller unexplained gap. This suggests that estimating models including less precise measures of labour market attachment are likely to overstate the magnitude of gender wage residual, and this magnitude decreases if the models include fewer characteristics in relation to female disadvantages.

In terms of trade globalisation, it is found that greater openness in general decreases the international gender wage differential overall, where a one percent increase in trade will decrease the differential by about one to two percentage points. However, different patterns are discovered across different income levels and development categories. Trade openness reduces the gender gap for countries in high and low income categories, with some weak evidence that the trade effect is much stronger in low income, and developing countries. By contrast, the introduction of trade significantly increases the unexplained portion of the gender wage differential in lower-middle income groups, where a one percent rise in the share of international trade increases the differential by 5 to over 7 percentage points. This indicates that trade liberalisation together with the diffusion of technology decreases the relative demand and wages for unskilled workers, where the majority of women might be found in this group of countries, which hence leads to a higher wage inequality. The results also indicate that changes in the economic structure moving towards the service sectors benefited women in terms of their wages. As women may have a comparative advantage in the service sectors, even in unskilled nursing or servicing jobs, but a disadvantage in the labour-intensive agriculture and male-dominated manufacturing sectors, the expansion of the service sectors results in an increased demand and thus wages for female labour and in a lower gender pay gap.

Furthermore, this study has analysed the impact of the development of social openness, by using the share of women in national parliaments as a proxy, and social conventions on female relative wages. The results suggest that more women in national parliaments in general decreases the gender wage differential, yet different patterns have been found across different cultural backgrounds. An increase in the share of female politicians in Protestant countries significantly decreases the gender differential, while the reverse holds true for the Communist, Confucianism, Muslim, and Mixed countries. As for different income level categories, a higher share of female politicians does not seem to have much impact on the narrowing gender wage gap in higher income categories, while such effects are found to be much stronger in the low income countries.

5.1.2 Chapter 3

Along with the integration of the world economy, the development of economic structure, and the spread of technology, the supply of and the demand for labour have inevitably changed, which is reflected in the changes in female relative labour market outcomes in both employment and wages, and the results presented in Chapter 2 of this thesis somewhat confirm this point. The analysis in the second empirical (Chapter 3) within this thesis demonstrates the impact of the development of technology on the changes in demand for male and female workers at different skill levels in primary (regular) and subordinate (non-regular) labour market segments in Japan, using two aggregate level data sets from Japan's Employment Status Survey and EU KLEMS over the period $1987 - 2007$. The results of this analysis indicate that the total gender employment gap in Japan has fallen considerably by almost 12 percentage points in favour of female workers in the period $1987 - 2007$, as a consequence of a series of Japanese and Asian crises and structural changes. Most of the aggregate changes in employment are observed between sectors, as well as being due to the fast growth of non-regular employment for women, but not for men. Moreover, the gender gap in regular employment increased within sectors during the recession between 1992 and 2002, with an increased demand to hire men as regular workers and women as non-regular workers, which implies that women losing regular jobs is more likely because of their relatively lower human capital accumulation – as the skilled female labour supply can not keep up with the demand alongside the development of technology.

However, better education attainment does not seem to improve gender parity in Japan in terms of employment, moving men into regular jobs whereas the reverse is observed in the case of women. The results in addition suggest that firms that have higher proportions of higher waged workers (e.g. female university graduates and prime aged men) tend to increase (decrease) the share of non-regular (regular) employment to reduce their labour costs. With respect to the impact of technical changes, it is found that industry ICT intensity increases male regular employment in higher-skilled and least-skilled jobs and decreases middle-skilled jobs. However, technical change only increases the relative demand for female regular employment in lower-skilled sales jobs, and it seems to be pushing most women into non-regular jobs. These findings are in line with the general idea of task-biased technical change (TBTC) with a suggestion of gender bias in the rising relative demand for non-routine jobs at the top and the bottom of the skill distribution following an increase in ICT intensity.

5.1.3 Chapter 4

The findings in Chapter 3 of this thesis highlight that the correlation between higher female human capital accumulation and female labour market outcomes does not seem necessarily to be positive. Therefore, the third empirical study (Chapter 4) provides some understanding of how the labour market outcomes of top ranking female workers, whose wages are in the top decile of the female wage distribution and who are usually higher skilled than the average woman, have been changing over their lifetime and across different generations within different labour market sectors and occupations, using the UK as an example. The analysis drew upon two datasets, the New Earnings Survey (NES)/Annual Survey of Hours and Earnings (ASHE) and the Labour Force Surveys, between 1975 and 2011. The results indicate that although the gender wage gap at both the mean and the top of the wage distribution has been decreasing over time, it remains large. A top-ranking woman fares better in professional and technical occupations, but worse in low-level male-dominated jobs and the top management jobs, compared to other occupations. Of these, if there are more women hired in the high level occupations, top female relative pay will increase significantly, reflecting the fact that more women moving up to the highest level occupations will lift the glass ceiling. However, an increase in the share of women in clerical occupations is associated with lower female relative pay at the top of the wage distribution, which is consistent with the empirical evidence that the majority of lower level jobs in the female-dominated occupations have been held by women (Black and Spitz-Oener, 2010; Lindley, 2011).

In terms of female relative pay over their lifetime and across generations, very different patterns are observed between the public and the private sectors. Gender wage differentials in the public sector in general have been relatively lower and relatively stable throughout working lives and across different generations, while it has been seen that top female wages relative to men have caught up more in the private sector after the pay was significantly lower for the older generation.

Further analysis on this point suggests that the relative wage for a high-earning individual woman is now higher in the private sector than if she works in the public sector. Besides, although a majority of top ranking women have benefited from a higher share of female employment in the public sector, it does not seem to hold true for those highest status women, who have engaged in the top-level occupations and whose wages are in the top decile of the distribution. A younger age and better education are found to have a positive impact on women's wages, whereas the effects of family status are quite weak with limited evidence suggesting the effect of the presence of children to be negative. Moreover, the results indicate that women as a whole will be better off when a higher proportion of them work full-time, yet an individual highest female earner may maximise her own utility by choosing to work part-time due possibly to family commitments.

5.1.4 Overall Summary

In summary, economic integration via international trade, the development of economic structure, and the spread of technology all play important roles in explaining the variations in female relative labour market outcomes, although they do not benefit all women. Trade openness in general reduces the gender gap across all income levels, except those classified as lower-middle income countries. The development of technology with a rising demand for skilled workers increases the gender wage gap in the middle income countries, and pushes the majority of women into bad/non-regular jobs in Japan. Conflicting evidence is observed in terms of female employment in the higher skilled occupations, a larger share of women hired in these jobs being associated with an increase in the top female relative pay in Britain, yet the opposite story is found for Japanese women in general. Although working in the public sector benefits women on average in terms of their wages, it does not seem to hold true for the highest status women whose pay is at the top decile of the wage distribution as the findings for the UK suggested. Contrary to popular belief, better investment in education does not necessarily lead to more gender parity in the labour market, as a higher share of well-educated women in Japan is associated with a higher share of women in the bad/non-regular jobs. Furthermore, it seems that more women involved in national parliament in the relatively conservative countries does not help improve gender equality in their labour market.

5.2 Implications of Findings

5.2.1 Implications of the Development of the World Economy and Technology

As outlined in the introduction to the thesis, the effects of increasing globalisation and the diffusion of technology are not independent. Globalisation has assisted the diffusion of the use of technology, and technological development has assisted the intensification of trade and financial connections between countries, therefore changing the structure of the labour market and the compensations of workers. In general, trade openness together with technical change would lead to a rising relative demand for skilled workers internationally (skill-biased technical change), as a consequence of a shift in intermediate inputs, which are relatively high skill-intensive goods from a developing country's point of view, from developed to developing countries, and an improvement of skill in developed countries to reduce the future threat of imitation, resulting in a rising wage inequality in such countries. This thesis has analysed the impact of trade openness on the gender wage inequality across different income levels and status of development. The findings in this thesis suggest that the effect of trade openness is positively associated with the narrowing of gender pay differentials in the higher and the low income countries, yet such an effect is found to be very weak in the high income and advanced countries, which may imply that the variations in female relative pay in these countries are more subject to the pressure within the countries or to female labour force characteristics. By contrast, the introduction of trade is found to have a greater impact on increasing the gender wage residual in the lower-middles income countries, which is in line with existing empirical evidence (Davis, 1996; Feenstra and Hanson, 1996; Berman and Machin, 2000, 2004; Acemoglu, 2003; Xu, 2003; Goldberg and Pavcnik, 2004, 2007; Conte and Vivarelli, 2007) that middle income countries are facing the contraction of both high and low skill intensity sectors as a result of trade liberalisation together with the diffusion of technology, which leads to a lower relative demand and wages for unskilled workers as well as a higher wage inequality. If the majority of women in those lower-middle countries are less well educated, who are very likely to be shunted into the lower paid, unskilled jobs, and if the female labour supply has not been able to keep up with the relative demand for skilled workers in those countries, a larger gender pay gap will hence be the inevitable result.

However, the argument of skill-biased technical change does not seem to be valid within the developed countries (Autor *et al.*, 2003; Black and Spitz-Oener, 2006, 2010; Spitz-Oener, 2006; Goos and Manning, 2007; Lindley, 2011), and a more nuanced concept of tasked-biased technical change is hence developed, where technology has replaced the middle-skilled routine tasks, and increased the relative demand for well-paid skilled jobs and low-paid least skilled jobs. In the case of Japan, the results found in this thesis indicate that the effect of technical change on changes in Japan's employment structure do not seem strong, which might possibly be due to their strict workforce regulation limiting the quantitative effects of technical development as Michaels *et al.* (2009) have suggested. However, some strong evidence was found in Chapter 3 that the introduction of technology has put the majority of Japanese women in a worse situation in their labour market. A rising ICT intensity has a great effect on moving women into regular jobs in sectors that hire a larger share of unskilled sales/service workers, while strongly moving professional women out of regular into non-regular employment. It implies that there is possibly a gender bias in ICT usage within higher skilled jobs as a larger proportion of women might be engaged in less complex computer tasks than men, and those tasks are more easily substituted by advanced technology/computers and non-regular workers.

5.2.2 Labour Market Implications

The standard human capital model predicts that investments in human capital, such as formal education or on-the-job training, can promote labour productivity and hence accelerate the growth of income (Mincer, 1958; Schultz, 1961; Becker, 1964). Thus, if more women have better educational attainment, a lower gender wage differential could be expected. However, the analysis in this thesis found this may not always be true. The findings in this thesis indicate that better education attainment does increase the relative wages for the top ranking British women and help the Japanese men move into good/regular jobs, yet a higher proportion of well-educated women in the Japanese labour market seems to push themselves and other women into the bad/non-regular jobs. It may imply that the majority of women in Japan have engaged in subordinate tasks regardless of whether they have high working skills or if they have graduated from elite universities, due to the strong social convention of gender division, and hence they are more likely to be dismissed during the downturn and be substituted by advanced technology/computers. It may also imply that, owing to the specific structure of the Japanese labour market, firms tend to provide fewer regular positions if there are more expensive workers hired; in other words, these higher-skilled higher-waged women occupy the good pay slots and hence reduce the opportunities for other less-skilled women being hired in good jobs.

The occupation and the task in which a woman is engaged strongly determine her relative wage. Due partly to the lower gender differentials in human capital accumulation, women in higher level jobs usually fare more equally relative to their male counterparts, compared to women in lower level jobs. Besides, a greater share of women in higher positions will likely improve the gender parity in labour market outcomes, as they may benefit other women by being role models or being less gender biased during the hiring process (Matsa and Miller, 2011; Elkinawy and Stater, 2011). Conflicting evidence for this is observed in this thesis.

The results in Chapter 2 indicate that, across a broad range of countries, the unexplained portion of the gender pay gap is significantly narrower if the estimated wage models only focus on the higher-prestige occupations, implying there are fewer unobserved factors driving the gap within these occupations. It is found to be partly true in the case of the UK, where the raw female relative wages at both the mean and the top end of the wage distribution are much higher in the professional occupations but significantly lower in the top managerial jobs. Besides, the results from further analysis indicate that an individual female top earner who undertakes a top manager's role is more likely to face a wage barrier than if she works in other jobs. Yet it is also found that if the share of women in the higher level occupations increases, the wage for top ranking women will be improved. It implies that although the gender pay differential in the very top managerial jobs is significantly large, if there are more women able to move into the highest jobs, more equal pay between genders can be expected.

However, a different story is found in Japan, where the results from Chapter 3 indicate that the greater the proportion of women engaged in the higher occupations, then a greater proportion of women will be moved from regular to non-regular employment. This is again very likely because firms are not able to afford more higher-waged regular jobs if there is already a large number of expensive employees, and this seems to also hold true in the case of Japanese male employment. Hence, the findings in this thesis somewhat imply that the differences between countries, culture, and labour market structure are playing a very important role in the variations of labour market outcomes in particular for the top-level jobs.

Many empirical studies have demonstrated that women hired in the public sector are more likely to be paid similar to men, due to the more intensive enforcement of gender-specific policies together with the specific wage-setting mechanisms (Kee, 2006; Barón and Cobb-Clark, 2010). The findings from the first empirical study in this thesis have confirmed this point, that the international gender pay residual on average is significantly lower in the public sector. However, a more complex pattern is found in the case of the UK. The results from Chapter 4 indicate that the gender gap in the public sector at both the mean and at the top end of the wage distribution has been significantly lower and constant over time, across generations and over workers' lifetimes. Female relative pay was significantly lower for the older generations, and the falls during the child bearing age have been pronounced across all birth cohorts, in the private sector. However, this sector has seen a significant catch up for the top female wages relative to men across generations, decreasing the difference in the differentials between sectors.

The evidence from further analysis reveals that an individual top female earner is now rewarded better in the private than in the public sector, and that a higher share of women hired in the top-level occupations in the public sector is negatively associated with the top female relative wage. It implies that the highest paid British women working in the public sector suffer from being unable to move up to the very top occupations, which hence affects their relative wages. It also implies that although gender equality-related policies do benefit the majority of women in the UK, they have less impact for the women who have engaged in the highest positions in the public sector.

Furthermore, although women's pay penalties due to moving from full-time to part-time jobs have been extensively discussed (Connolly and Gregory, 2008; Manning, 2006; Manning and Petrongolo, 2008), the existence of such a penalty does not seem to be always the case. The findings from the cross-country analysis (Chapter 2) and from the UK (Chapter 4) do suggest that a majority of women will be better off under full-time employment as well as when a higher proportion of them are working full-time. However, some evidence from the UK also suggests that being part-time employed does not hurt the wage for an individual top-ranking woman. It implies that, for those high-earning women, part-time work is a choice as they are more able to afford to change to part-time work, in order to spend more time with their family.

5.2.3 Implications of Institutional and Cultural Constraints

Previous research has indicated that the enactment of gender equality and family friendly policies will have positive implications on female relative labour market outcomes (Kee, 2006; Manning, 2006; Barón and Cobb-Clark, 2010; World Economic Forum, 2013). The findings in this thesis have somewhat confirmed this argument. The majority of women do benefit from the positive impact of gender-specific policies, especially for those working in the public sector compared to the private sector, and for the old generations alongside a significant wage growth over time.

However, it is also found from the UK case (Chapter 4) that the effects on the current generations are significantly weaker, which implies that the cause of the slow progress of women in the current generation is more subtle and difficult to be influenced directly by policy. Furthermore, it has been observed that the women in the top-level occupations in the public sector seem to face more difficulties to improve their career status. This may be due possibly to the negative implications of stringently enforced use of policies (Gupta *et al.*, 2006) on the working mothers as they may take a longer time out of labour force, which is found more harmful for the women at higher position than others (Gupta *et al.*, 2006; Swaffield, 2007). It also suggests that the current gender related policies focus on the average woman, but seem to ignore the benefit of the top ranking women, perhaps as they might be thought not to have such needs. Yet the findings imply that to help women break the glass ceilings a more effective policy is required.

The effects of cultural differences on the variations of female relative labour market outcomes have been found to be significant, even if such effects are difficult to quantify. The findings in the first empirical study suggest that although the development of social openness is in general positively associated with gender pay parity, it seems rather unlikely to happen in the relatively conservative countries. Of these, Japan and South Korea, which are strongly influenced by Confucianism, have often been pointed out as having an unfriendly work environment against women, regardless that they are classified as developed and advanced for a long period of time. It implies that although these countries have been through a significant development of their economy, their societal development has changed more slowly.

In Japan's patriarchal social system, the young are dominated by the old, and the subordinate roles of women can be clearly seen from the second empirical study in this thesis. With a large share of good/regular jobs occupied by the old, young Japanese workers, both men and women, have found difficulty moving into this domain. Gender differentials in Higher Education investment are also significant, due possibly to the influence of the social norms that women should focus on their household responsibility rather than their career, and of the strong gender stereotype coupled with occupational segregation (Becker, 1985). Women may have less incentive to invest in education, when they realise that a great amount of higher educated women are unable to break out the trap nor improve their working status. These results imply that social conventions have a great impact of women's performance in the labour market throughout different dimensions.

5.2.4 Summary of Implications

In summary, the results found in this thesis indicate that the variation of female relative labour market outcomes has been driven strongly by both economical and sociological channels. Although the development of the world economy and technology following the expansion of the service sector has created vast job opportunities, these seem not to be distributed equally between men and women. That is, the findings in this thesis tend to suggest that, when the global economy increases the relative demand for both lower and higher status jobs and gives rewards biased toward skilled workers, where female supply has failed to keep up with the demand for the latter, a persistently high gender wage differential is the inevitable result.

However, things may not go as well as expected, even when female supply in higher skilled workers is growing. At least, it is not the case for Japan, where many women seem to pay the penalties, rather than gain the bonus, for the rising share of higher skilled women in the labour market. Besides, there may be more difficulties out there for those women who are engaged in top-level jobs. In the case of the UK, the gender wage gap at the higher end of the wage distribution is significantly large, and women suffer from being unable to climb up to better positions especially in the top managerial jobs and in the public sector where gender policies are more stringently enforced.

What has made these higher skilled women be in an unfavourable situation and kept them from reaching the top is subtle, with societal constraints and ineffective policies maybe having played some roles. The results in this thesis seem to imply that although a more stringent enforcement of gender policies can ensure women are paid more equally, it has also limited their wage growth. It is additionally suggested that the government may need to think about whether they are actually aiming at the right target to improve female relative labour market outcomes. Furthermore, cultural changes in attitude towards women's role are needed. Instead of only asking women themselves to be more work oriented to promote their status in the labour market, perhaps men could also think about being more home oriented.

5.3 Limitations of Thesis

The aim of the first empirical analysis (Chapter 2) in this thesis is to investigate the variations of gender 'discrimination' across a broad range of countries over the period of 1963 – 2007, and how much these variations can be explained by trade liberalisation and cultural differences. The limitation of this chapter is from using meta-regression analysis (MRA), which relies on published papers, resulting in the sample being biased towards English speaking countries in particular to the US and towards high income countries. The analysis adopts a weighting scheme to cope with the issue of the lack of independence of the estimates as there are some data points conducted by the same study. Some of the estimates are quite weak and inconsistent, hence the interpretation of the results focuses solely on those that are significant and consistent across all specifications.

The sample being biased towards high income countries has also caused some concerns for the examination of trade and social openness, as the results might be weaker or less relevant for other countries. This disadvantage is especially explicit for the estimation of social openness into many different cultural dimensions. Furthermore, different measures for trade openness have been considered through the process of estimation in this chapter, as it has been suggested that the measure of the ratio of trade to GDP may reflect a wide range of factors other than trade globalisation (Dollar and Kraay, 2004). The measure of average tariff rates should also be considered. However, the availability of tariffs data is very imperfect, only 1988 onwards data is available with many data points missing, especially for developing countries. This makes the analysis unable to identify the effect of trade openness across different income levels, and hence this measure is finally not included.

The aim of the second empirical study (Chapter 3) within this thesis is to explore the changes in the Japanese gender employment differential together with the development of technology. The limitation of this chapter is the use of aggregated data. The results can only predict overall changes in regular and non-regular employment within or between sectors without a clear pattern about individuals' characteristics. For instance, it is found that a higher proportion of female university graduates and professional workers within sectors increases female non-regular employment. Yet it is not clear whether better education does push these women into bad jobs or their existence makes other female workers struggle. It is also not known about individuals' computer skills coupled with the tasks in which they are engaged, which is an important factor in the analysis of technical change.

The third empirical study (Chapter 4) in this thesis uses cohort analysis to examine how the UK gender gap at the top end of the wage distribution has evolved with respect to different labour market sectors, occupations, and different cohort groups, both within cohorts over their lifetime, and across cohorts. This methodology suffers from a linear dependency between age, period and cohort effects, where *cohort* = *period-age*. Hence, the analysis in this chapter adopts a commonly used strategy, that is, to omit one additional dummy variable of a specific group, assuming the two dismissed dummies have equivalent behaviour. Considering this point, a rich graphical analysis is conducted across different dimensions to guide possible direction of the changing patterns in the data and help interpret the results from statistical models.

As the primary data source, the New Earnings Survey (NES)/Annual Survey of Hours and Earnings (ASHE) suffers from its lack of demographic information, the results are unable to identify how a top-ranking female individual's educational level and marital status would affect her wage relative to men. The successive Labour Force Surveys are employed as a supplement with the demographic data for the occupation-level panel analysis. However, the estimates for family status from this analysis are very weak. Besides, there is a lack of part-time workers' information in particular for males, leading to a lower reliance on the part-time wage comparison between genders.

5.4 Implications for Further Research

The results from the first empirical study (Chapter 2) in this thesis suggest that although the situations in individual countries vary, there are some common characteristics that can explain the general pattern of gender wage differentials across a broad range of countries at different levels of development. Further work needs to be done to explore the gender pay gap across different regional and sectoral dimensions and its association with globalisation, together with the situations of individual countries in relation to the structure of their economy. The findings in this chapter underscore the importance of international comparisons to understand more detail about the impact on female relative labour market outcomes of the imports and exports of skilled- and unskilled- intensive sectors, and tariffs on different commodities.

The results found in Chapter 3 suggest that further work needs to be done to indentify the returns to productivity characteristics for individual women and young workers in Japan. It is interesting to understand, apart from the fact that the vacancies of good/regular jobs have been occupied by the older men together with strong sexism in the labour market, what other factors have driven women and young workers being unable to enter the regular labour market. Although there have been many articles discussing about the work-life decisions that women make with a small sample of fieldwork (Haworth, 2013; Hewlett, 2013; Wingfield-Hayes, 2013), a more comprehensive survey on women's attitude towards work and family is also needed.

The findings in the third empirical study (Chapter 4) indicate that further work needs to be done to understand the outcomes of top-ranking male part-timers and their relationship to female workers in particular in the public sector. The empirical evidence has been largely silent on this point but focused solely on female part-time workers. If it is true there is a larger number of extremely high paid jobs particularly held by men in the public sector, this will be a very interesting dimension to explore in terms of understanding the lower outcomes of female workers. Moreover, it is found that there is a very different pattern for the variation of top female relative wages between the public and the private sectors, and so further work needs to be done to investigate top-ranking women's performance in these sectors separately.

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