LUND UNIVERSITY
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The Impact of Trade Openness on the Gender Wage Gap in Urban China, 2002-2013

by

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This paper examines the impact of trade openness on the gender wage gap in urban China after China's accession to the WTO in 2001. Using data from the 2002 and 2013 China Household Income Project (CHIP), this paper uses OLS regression and instrumental variable regression, to analyze the relationship between trade openness and the gender wage gap. The findings are consistent with the neoclassical theory, as the results indicate that trade openness has a positive effect in reducing the gender wage gap in urban China. Moreover, this positive effect tends to slightly increase between 2002 and 2013. Specifically, trade openness is most beneficial in reducing the gender wage gap for low-income level and low-skill level groups. The reliability of these findings is further confirmed by heterogeneity tests and robustness tests. Lastly, based on the empirical results, the paper proposes three types of policy implications.

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A new journey is about to begin, may we all have a bright and promising future.

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1   Introduction

1.1   Background

In recent decades, the impact of trade liberalization on wage inequality has attracted significant attention with the development of globalization (Dreher & Gaston, 2008, Han et al, 2012). As developing economies have become more interconnected through international trade, there has been growing interest in the distributional consequences of trade openness and its impact on the wage gap. Scholars and policymakers have been working through the complex dynamics and different perspectives surrounding this issue, trying to understand whether trade liberalization has increased or reduced wage inequality in the developing countries. Some scholars argue that trade openness will increase income inequality for these countries (Savvides, 1998, Mahesh, 2016, Furusawa et al., 2020). However, holding the opposite view, others argue that trade openness is beneficial in reducing income inequality for less developed economies (Wei & Wu, 2001, Bergh & Nilsson, 2010, Lim & McNelis, 2014). As globalization deepens and more developing countries are undergoing economic transformation, such debate has become more pronounced.

As a representative of developing countries, China has been experiencing reform and opening up since 1978, which marked an important turning point in China's economic development and integration into the global trading system. Following this, China's accession to the World Trade Organization (WTO) in 2001 further prompted China to become a major player in the international trade. Since then, China's trade openness has taken on a new pattern. According to data from the General Administration of Customs of China in January 2023, China has kept its position as the world's largest trader of goods for six years. Figure 1 here shows the remarkable growth of both China's total GDP and international trade, and the trend of trade dependency since 2002. Trade dependency refers to the ratio of a country's total international trade to its total GDP, which is an important indicator of trade openness. In the case of China, the trade dependency has experienced notable changes over the years. Initially, it showed a steady increase from 2002, reaching its peak at over 64% in 2006. This period marked a significant phase of increasing trade openness in China. However, after the peak in 2006, trade dependency starts to decline, although it remains above 35 % until 2021.
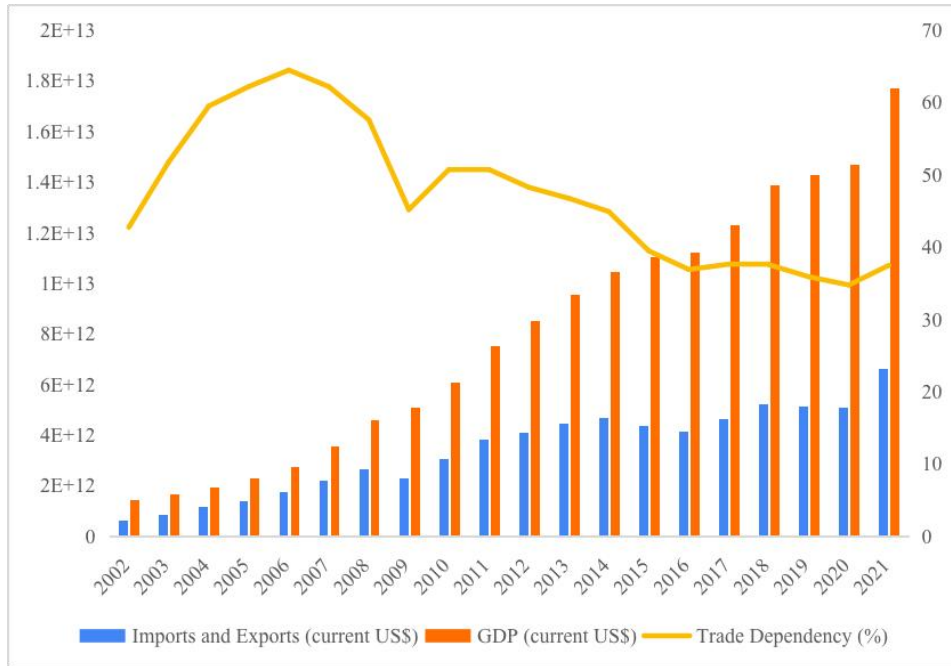
Figure 1 China's GDP and Imports and Exports of goods and services (current US$) and Trade Dependency (% of GDP), 2002-2021

Source: World Bank national accounts data, and OECD National Accounts data files
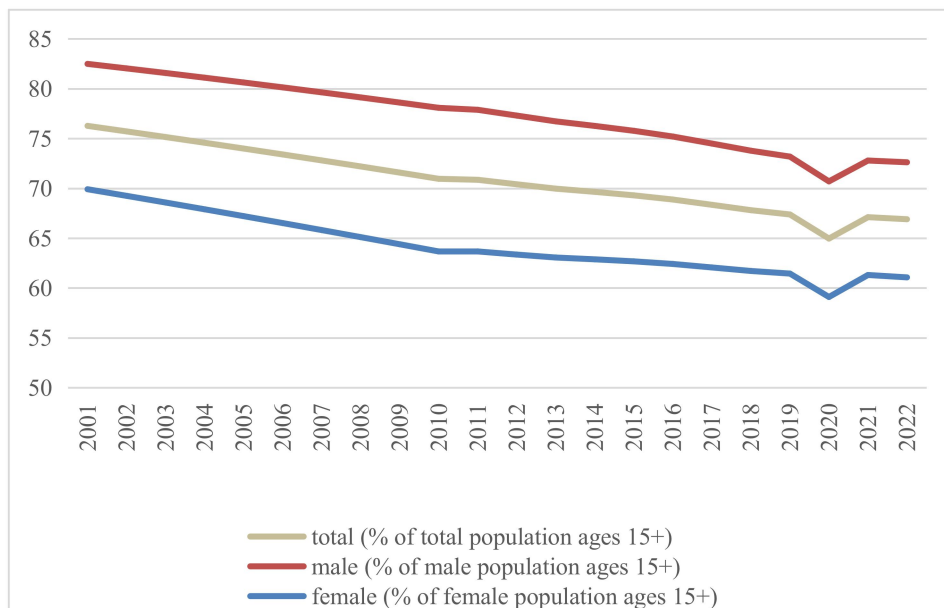
Figure 2 China's Labour force participation rate (modeled ILO estimate), 2001-2022

Source: International Labour Organization. "ILO Modelled Estimates and Projections database (ILOEST)" ILOSTAT

Despite the remarkable performance of China's economic growth since 2001, the impact of trade openness on wage inequality, particularly the gender wage gap, has received equally increasing attention. According to the 2021 Global Gender Gap Report, China only ranked 69th in the indicator of economic participation and opportunity, which shows that Chinese

women are in a disadvantaged position in the labour market. As shown in the Figure 2, from 2001 to 2022, China has seen a steady decline in both overall and gendered labour force participation rates, with large gaps persisting between male and female labour force participation rates over the two decades. In 2001, the gap is more than 16% and by 2022 it has narrowed but still stands at 11.5%. It shows that gender inequality is currently widespread in the labour market, despite the tendency to improve. Additionally, gender inequality extends beyond labour force participation to the gender wage gap. A study by Zhang et al. (2008) shows that from 1988 to 2004, the female to male ratio has dropped from 86.3% to 76.2%. Shi et al. (2011) also find a growing trend of gender wage gap in urban China, as evidenced by a 10.5% gap in 1995, a 17.4% gap in 2002 and a 29.7% gap in 2007. These findings indicate that women in China face significant wage disparities compared to their male counterparts, highlighting the systemic gender inequality prevalent across industries and sectors. Therefore, it is necessary to investigate the impact of trade openness on the gender wage gap in China.

1.2   Aim and Scope

The aim of this paper is to investigate the relationship between international trade and gender wage gap in urban China. Therefore, the research questions are: What is the impact of trade openness on gender wages, does it contribute to the reduction of the gender wage gap? What are the trends in the impact of trade openness on the gender wage gap in China from 2002 to 2013? What are the potential mechanisms underlying the impact of trade openness on the gender wage gap in China? To answer these questions, this paper will study the impact of trade openness on the gender wage gap in urban China by conducting empirical research on the period 2002 to 2013, which covers the 12 years after China's accession to WTO. Based on the data from the 2002 and 2013 China Household Income Project (CHIP), this paper mainly uses OLS regression and instrumental variable regression to analyse the relationship between trade openness and the gender wage gap, and discuss how the impact changes over time.

1.3   Outline of the Thesis

In Chapter 2, we will introduce theoretical explanations of the three types of gender wage differentials and the application of the three types of international trade theory to gender wage differentials. In Chapter 3, we move on to the review of empirical research on the impact of trade openness on the gender wage gap from both global and China's perspectives, together with the discussions about the significance and limitations of the study. In Chapter 4, we provide an overview of the data and methodology used in the empirical research. We present the model, highlight the key variables, and discuss the instrumental variable used in the analysis. In Chapter 5, we comprehensively present the regression results, including the findings from OLS regressions, instrumental variable regressions, heterogeneity tests, and robustness tests. In this chapter, we also analyse the underlying mechanisms that contribute to

these results and provide some ideas for future research directions. Based on the empirical results, in Chapter 6 we provide three policy implications. Finally, there is a conclusion.

2   Theory

The aim of this chapter is to provide a comprehensive theoretical framework for understanding the mechanisms by which trade openness affects the gender wage gap. In this chapter, we will begin by introducing three major theories: human capital theory, discrimination theory, and segregation theory. These theories have been widely discussed in the literature and offer valuable insights into understanding the gender wage gap. However, it is important to note that these theories have primarily focused on individual-level factors and have not been extensively integrated with international trade theory. Therefore, from a macro perspective, the second section will introduce some international trade theories: the Heckscher-Ohlin theory, Non-neoclassical theory and Outsourcing theory, and their application to the issue of gender wage gap.

2.1   Theory on the Gender Wage Gap

2.1.1   Human Capital Theory

Human capital theory is a classical theory used to understand the wage differential between men and women. According to this theory, individuals invest in their education, training and skills in order to increase their productivity and earn higher wages. However, women tend to invest less in human capital due to various social factors such as discrimination and unequal access to education and training. As a result, the gender wage gap can be partly attributed to differentials in human capital between men and women. Becker (1962) believes that individuals make decisions to invest in human capital, such as education and training in order to gain expected returns from these investments. Holding the same viewpoint, Mincer (1974) also provides a classical human capital theoretical framework for understanding the relationship between education, work experience, and earnings. According to Mincer's theory, individuals who invest in their human capital through education and work experience are able to receive higher wages in the labour market because of increased productivity and skills. In this context, the different levels of human capital between male and female can lead to more significant differences in the overall lifetime earnings.

2.1.2   Discrimination Theory

Compared to the human capital theory, even after controlling the productivity characteristics of the labour force, it has been regarded that job discrimination has become a key player in explaining the gender wage gap to a certain extent. Using the decomposition methods, Oaxaca (1973) investigates the causes of the gender wage gap and finds that, other than human capital

characteristics such as education and experience, which can explain a large part of the gender wage gap, there still remain a considerable part that is unexplained. The unexplained part, Oaxaca concludes, could be attributed to discrimination against women, which resulted in lower wages for women, even though they have the same qualities and experience as men. According to Bergmann (1974), the discrimination in the labour market results in lower wages for minorities and women, and that it also benefits employers by allowing them to pay less for jobs that are traditionally held by women or minorities.

2.1.3 Segregation Theory

Based on the discrimination theory, employer discrimination may further result in occupational segregation in the labour market, which is mostly represented by differences between the patterns of interindustry gender wage differentials and differences in the gender wage distribution among different industries (Bergmann, 1974, Fields & Wolff, 1995). This negative effect is also proved by Petersen and Morgan (1995), as they point out that occupational segregation is more important in the gender wage gap than within-job pay discrimination, while institutional segregation is another significant contributor to gender wage gap.

2.2 Theory on International Trade and Gender Wage Gap

2.2.1 Heckscher-Ohlin Theory

Based on the above theories explaining the cause of gender wage gap from an individual perspective, this section will further explain the impact of trade openness on gender wage differentials in the context of macro theories of international trade, the most remarkable of which is the Heckscher-Ohlin theory. According to the Heckscher-Ohlin theory, trade openness will result in an increase in the relative demand for factors of production that are abundant in a country, and a decrease in the relative demand for those that are scarce. Therefore, with the trade opening of developing countries, labour-intensive industries, i.e. manufacturing, will emerge first. In this context, if trade openness primarily affects a country's female labour-intensive industries, then job opportunities for female labour will increase and relative wages will also increase, leading to a decrease in the gender wage gap.

As human capital theory suggests, the level of female labour's human capital is usually lower than that of the male counterpart, while these low-skilled female labour force account for the majority of the workforce in the manufacturing sector. Findlay and Kierzkowski (1983) also state that international trade can increase the demand for skilled labour and result in higher wages for skilled labour relative to unskilled labour, which can provide incentives for investment in human capital. Polachek (2004) also states that as women's education levels increase and their human capital increases, the gender gap between men and women decreases.

Therefore, if trade openness provides an incentive for female labour to increase their human capital, then the relative wages of female labour will increase, finally leading to a decrease in the gender wage gap.

Heckscher-Ohlin theory also applies in the discrimination theory, that increasing competition caused by international trade will help decrease the gender wage gap by reducing the discrimination in the labour market. In a market economy where discrimination costs are relatively high, for example, the costs increase with the development of international trade, the competitive situation will reduce employers' discrimination against women (Becker, 1971). As a country becomes more open to trade, the trade barriers weaken and tariffs decrease. It will lead to an increase in the entry of foreign goods and investment into the local market, resulting in greater competition which can be harmful to the local firms as their profits may decrease. Under this assumption, this situation will prompt these companies to seek ways to reduce costs and maximize profits. One potential cost-cutting strategy is to reduce gender discrimination within their workforce, as it can help to effectively make use of the labour force in order to maximize profits (Black & Brainerd, 2004). In this way, trade openness can be positive in narrowing down the gender wage gap.

2.2.2   Non-neoclassical Theory and Outsourcing Theory

However, there are also theories suggesting that increasing trade openness may worsen gender wage gaps. Non-neoclassical theory suggests that in countries where women have limited bargaining power and are predominantly employed in low-wage and low-status occupations, trade openness may lead to an expansion in the gender wage gap. According to Darity and Williams (1985), competition can contribute to discrimination, this is because when companies face increased competition, they may instead choose to reduce costs by reducing the relative wages of their female labour force. Therefore, trade opening may also exacerbate gender discrimination in the labour market by increasing competition and resulting in a disadvantaged situation of the female labour force.

Moreover, labour-intensive industries in developing countries may undergo transformations, such as upgrading to technology-intensive industries or relocating former labour-intensive industries to other countries. Based on the Outsourcing theory, in the early stages of international trade, enterprises in developed countries would choose to offshore labour-intensive industries to emerging economies, such as India and China, in order to reduce costs (Javalgi et al., 2009). However, as the cost of labour in China increases, the destination of offshoring may move, for instance, from China to other Southeast Asian countries. Besides, if enterprises in China choose to relocate non-skill-intensive activities to lower-wage countries as a response to import competition, trade openness may also lead to a shift in employment towards skilled workers in the industry (Feenstra & Hanson, 1996), which could lead to lower wage or unemployment among low-skilled labour, while most of which are female. Consequently, the gender wage gap also widens in cases where the male workforce regains the advantage as they have higher skill levels.

2.3   Summary

To sum up, in the first section, we have discussed the disadvantages women may face in the job market and the consequent increase in the gender wage gap from three main perspectives: human capital, discrimination and occupational segregation. However, there remains much debate about whether trade openness can improve this gap. On the one hand, according to the Heckscher-Ohlin theory, the concentration of female labour in the manufacturing sector, which is highly affected by trade openness, and the increased cost of discrimination due to international competition can explain the positive effects of trade openness on the relative wages of female labour to a certain extent. On the other hand, according to the Non-neoclassical theory and Outsourcing theory, the risk of increased competition and occupational segregation brought about by trade openness, as well as the risk of decreased wages and unemployment brought about by external factors such as industrial transformation, may all lead to a widening of the gender wage gap.

3   Literature Review

This chapter will review previous empirical studies on the impact of trade openness on gender wage gap. In order to gain a better understanding of the background, in the first section we will first focus on the relationship between economic development and gender inequality. Based on it, we will then look closely at more empirical findings on the impact of trade openness on the gender wage gap. The second section offers a global perspective on this topic, while the third section narrows the focus to the case of China. Both sections discuss the positive and negative effects of trade openness on the gender wage gap, providing a comprehensive analysis.

3.1   Economic Development and Gender Inequality

Previous studies mainly take insight under a broader context, which focus on economic development and gender equality. In fact, the relationship between economic development and gender wage gap is a complex issue, and there is no consensus in the current literature. Some scholars argue that economic growth can create more opportunities for women, particularly in high-skilled occupations, and lead to a narrowing of the gender wage gap. Others contend that rapid economic growth may actually exacerbate existing gender inequalities, as women may be disproportionately employed in low-paid and precarious jobs, and may face greater barriers to accessing high-quality education and training. Moreover, even if women are able to obtain the same level of education and training as men, they may still face discrimination or occupational segregation that limits their earning potential.

The interaction relationship between economic development and gender inequality has been discussed controversially over time. Cuberes and Teignier (2014) provide a comprehensive and critical review by looking into the two-way relationship between gender inequality and economic growth. On the one hand, there has been much debate about how the gender wage gap affects economic growth. For example, according to an empirical research by Seguino (2000a), in export-oriented semi-industrialized countries, gender wage inequality can contribute to GDP growth by conducting a positive impact on the share of investment in GDP. However, Seguino's(2000a) findings have been criticized by Schober and Winter-Ebmer (2011), as they argue that there is no evidence to prove that increased discrimination is caused by higher growth rates. On the other hand, there seems to be not as much discussion about how economic growth affects the gender wage gap as the former. Tzannatos (1999) points out that with economic growth, in a simulated scenario where discrimination is eliminated, women's wages would increase significantly with almost no loss in men's wages. This assumption supports the view that economic growth can reduce gender disparities in the labour market. Ngai and Petrongolo (2017) find in their empirical research that the increase in

the service sector in America in recent decades has a positive effect on narrowing the gender gaps in hours and wages.

Moreover, the effects of globalization and economic growth on gender inequality may differ across countries at different stages of development. Oostendorp (2009) uses a cross-country analysis to examine the relationship between globalization and gender wage differentials, finding that, in richer countries, the intra-occupational gender wage gap tends to decrease with economic development, driven by factors such as increased trade and foreign direct investment (FDI), while it is not the case of less-developed countries. In the case of China and India, Jong-Wha and Wie (2017) suggest that economic development may not necessarily lead to a reduction of gender disparities in the labour market. Rapid economic growth may increase inequality and counterbalance improved education for women, and discrimination and unobserved qualifications may persist despite economic progress. As another representative of developing regions, Africa seems to make no difference. Globalization and economic growth are found not to affect gender equality in non-Sub-Saharan African developing countries, but there is empirical evidence that higher integration into global markets may lead to an increase in gender inequality in Sub-Saharan Africa (Baliamoune-Lutz, 2007).

Over the past two decades, the impact of globalization and international trade on China has been mainly seen in the increasing trade openness and industry development. To better understand the broad issue of economic development and gender inequality, and in line with the quantitative approach of this paper, trade openness as a specific indicator of economic development and trade liberalization, and gender wage gap as a specific indicator of gender inequality, are selected as entry points for this study. Therefore, in the next two sections, we will move to more empirical findings of the impact of trade openness on the gender wage gap, both from a global and a Chinese perspective.

3.2   Trade Openness and Gender Wage Gap: Global Context

3.2.1   Positive Effects

The relationship between trade openness and the gender wage gap is a topic of ongoing debate. On the one hand, some scholars argue that trade openness can lead to increased economic growth, which can in turn lead to increased job opportunities for women and narrowing of the gender wage gap. They suggest that as more women enter the workforce and move into higher-paying industries, the overall level of female earnings will increase and the wage gap will decrease. Additionally, increased competition from international trade can force firms to become more efficient, leading to higher wages for all workers, including women. Some studies suggest that although trade openness may contribute to increased wage inequality overall, it has the potential to address and improve gender wage inequality. For example, based on the matched employer-employee data from manufacturing industry in Germany, Klein, Moser and Urban (2010) find that although the increase in exports increased

wage inequality in skills, exports can help reduce the wage gaps in the manufacturing sector concerning gender and nationality. Brussevich (2018) also points out that, due to the male-dominated situation in the manufacturing sector and the relatively higher costs associated with men's sector transition, there is significant adverse effects on wages and overall well-being experienced by male manufacturing workers impacted by import competition. In this way, these effects contribute to the reduction of the gender wage gap.

In addition, international trade is also likely to reduce the gender wage gap through biased technological progress. For example, Juhn et al. (2014) find that, affected by declining export tariffs, Mexican exporters have improved the wages and employment of blue-collar women by choosing to upgrade their technology and thereby increase their relative productivity, as evidenced by a 7.6 percent increase in female wages for every 10 percent increase in machinery value. In a specific case of unemployment, Kongar's (2006) study explores the effect of rising import competition on gender wage and employment differentials in the U.S. manufacturing industry from 1976 to 1993. The findings support the hypothesis that increased import competition reduces the demand for workers in low-wage production roles, which are predominantly occupied by women. The study reveals that as a result of unemployment among low-wage women in the manufacturing sector, the average wage of remaining women increased, leading to a reduction in the gender wage gap.

3.2.2   Negative Effects

On the other hand, other scholars argue that trade openness can lead to an increasing gap in the gender wage. They suggest that trade liberalization can lead to increased competition in industries that traditionally employ more women, such as textiles and garments, leading to a decline in wages in these industries. Additionally, firms may favour men in higher-paying jobs due to cultural or social norms, leading to a widening of the wage gap. Furthermore, women may face more challenges in accessing education and training programs, which could limit their ability to move into higher-paying industries.

Sauré and Zoabi's (2014) study examines the relationship between international trade and gender wage gap, as well as female labour force participation. They use bilateral trade data for the United States and Mexico to explore the impact of trade on female labour force participation and relative wage using cross-state variation in the U.S. exposure to trade with Mexico. Their findings suggest that in high-income economies, trade with low-income countries tends to increase the gender wage gap and decrease female labour force participation. Juhn, Ujhelyi and Villegas-Sanchez (2013) examine the impact of trade liberalization on the gender wage gap in Mexico. Using a panel of Mexican firms and tariff reductions associated with NAFTA, their model suggests that tariff reductions lead to improvements in women's relative wages and employment in blue-collar jobs, as new technologies reduce the demand for manual labour skills. However, the gender wage gap in white-collar jobs persists.

Focusing on the manufacturing sector, Joekes (1995) states that the increase in women's employment in export-oriented industries did not necessarily lead to an improvement in their working conditions and wages. Instead, women often worked in low-paying and precarious

jobs, and their employment was vulnerable to fluctuations in global demand. Under this scenario, trade openness may worsen the gender wage gap. This view is supported by Berik, Rodgers, and Zveglich (2004). They use micro-level data from six countries in East Asia to investigate whether trade openness leads to increased gender wage discrimination. The study's findings suggest that trade openness can indeed exacerbate gender wage discrimination. Specifically, the authors find that women in export-oriented sectors experience a larger gender wage gap than women in non-export sectors. The authors argue that this is because export-oriented sectors tend to be male-dominated and have lower wages, while non-export sectors offer women higher wages and greater opportunities for upward mobility.

The situation is widespread in many developing countries. In the case of India's manufacturing sector, Menon and Van der Meulen Rodgers (2009) developed a theoretical model of competition and industry concentration and used data from India's National Sample Survey Organization household survey merged with trade and production data from 1983 to 2004 to test the model. The results of ordinary least-squares (OLS) and fixed effects regressions indicate that trade openness is associated with larger gender wage gaps in India's concentrated manufacturing industries. The study provides evidence that increasing competitive forces from trade liberalization have negative effects on women's relative wages and employment in India's manufacturing sector. In the case of Egypt, El-Hamidi (2008) analyzed the impact of trade liberalization on gender wage inequality using data from the Egyptian Labour Market Panel Survey and finds evidence of gender wage discrimination in both the tradable and non-tradable sectors, with the gender wage gap increasing over time and being higher in the tradable sector. In the case of the two Newly Industrialized Economies, Korea and Taiwan, Seguino (2000b) finds that the gender wage gap decreased with shifts from agriculture to industry and services, and as women's education and work experience improved. However, trade and investment liberalization widened the gender wage gap due to the declining demand for female labour and the increasing supply of low-wage female workers in export-oriented industries.

There are also studies that argue that trade liberalization may have different effects on the gender wage gap, depending on the sectoral characteristics and the economic conditions of a specific country. For example, Artecona and Cunningham (2002) investigated the impact of trade liberalization on the gender wage gap in Mexico. The authors used data from Mexican National Employment Surveys conducted between 1987 and 1999, and estimated the gender wage gap by occupation and industry before and after the implementation of trade liberalization policies. The study found that the gender wage gap decreased in industries that experienced increased exports and foreign direct investment, while the gap increased in sectors that were more protected from international competition.

3.3 Trade Openness and Gender Wage Gap: The Case of China

3.3.1 Positive Effects

The positive impact of trade openness on the gender wage gap in China also varies across industries and sectors, for example, the increase in foreign-owned enterprises can improve the gender wage gap by increasing female labour force participation. Chen, Ge, Lai, and Wan (2013) examine the relationship between globalization and gender inequality in the Chinese labour market using an enterprise-population-level dataset. Their findings suggest that foreign and exporting firms tend to employ more female workers compared to domestic non exporters. Moreover, foreign participation and export orientation within the same region and industry significantly contribute to female employment and help reduce the gender wage gap. Using population and enterprise census data from 1990 to 2005, Wang, Kis-Katos, and Zhou (2020) found that in the long run, import competition helps narrow the gender employment gap, with more women employed in the local economy and formal private industrial enterprises. It is also shown that competitive pressures from trade led to the expansion of female-intensive industries, a shift in sectoral gender segregation, a reduction in gender discrimination in the labour market, technological upgrading through computerization, and overall income growth. This finding is consistent with Becker's (1971) view and the theories of human capital and competition as a disincentive to discrimination.

Moreover, the impact of trade opening on the gender wage gap in China appears to be a dynamic process that may present different effects in different stages. Braunstein and Brenner (2007) examine the impact of foreign direct investment (FDI) on gender wages in urban China using household survey data and province-level macro-data from 1995 and 2002. They find that FDI has a significant positive effect on both male and female wages in both years. In 1995, women experienced greater benefits from FDI than men; however, by 2002, the gender-based advantages had reversed, and men were found to have experienced larger wage gains from FDI than women. Similar findings have also been found by Ng (2007), that he finds that there is a consistent male earnings premium in China from 1988 to 1997, with the gender earnings gap narrowed in the early stages of the reform, but as the reform progressed, the difference increased again. These findings suggest that the impact of trade openness on the gender wage gap in China is not constant and may change with the degree of openness.

3.3.2   Negative Effects

While trade openness may be beneficial to a country's economy, a market-oriented economic environment cannot guarantee an improvement in gender wage inequality. Liu, Meng and Zhang (2000) claim that privatization and marketization of the economy leads to larger wage differentials, which is far more than the increase caused by increased gender discrimination. In addition, educated or skilled workers are perceived to be more negatively affected by trade openness. As suggested by the human capital theory, with an increasing demand for higher-skilled workers in the manufacturing sector, the relative wages of the male workforce with higher skills increase, widening the gap with female wages. He (2007) conducted a study using a difference-in-difference approach to investigate the impact of trade liberalization on the gender wage gap across education levels in China during the first period of trade liberalization from 1988 to 1995. The results indicate that as import openness increases, the gender wage gap widens considerably for the less educated, whereas the trend is reversed for the more educated. The negative impact of trade opening on gender wage inequality also

differs between sectors and enterprises in China. Iwasaki and Ma's (2020) study presents a comprehensive meta-analysis of the gender wage gap in China, utilizing data from more than 300 primary studies conducted between 1995 and 2018. They find that, compared to urban areas and state-owned enterprises (SOEs), wage discrimination against women is more evident in rural areas and private-owned enterprises (POEs).

3.4   Research Significance

Most existing research has focused on the relationship between gender wage gap and economic development, often emphasizing how the gender wage gap would hinder or promote economic development. Due to the lack of discussion in the effects of trade liberalization on gender wage gap, there remains much space to explore. Besides, the existing studies mainly focus on developed countries, while the research is limited within the scope of developing countries, providing an opportunity for further investigation. Therefore, this paper serves as a perspective from China to focus on the impact of trade openness on the gender wage gap in urban China from 2002 to 2013. Additionally, some studies focus only on the gender wage gap in a single year, while this paper will analyse data from 2002 and 2013, providing a comparative perspective that can focus on the dynamics of the impact of trade openness on the gender wage gap. This paper will also adopt various regression approaches such as OLS regression, instrumental variable regression and quantile regression, together with heterogeneity and robustness tests, which will make the findings more comprehensive and robust. Afterall, the findings of this study may provide insights into potential policies and interventions that can help to reduce the gender wage gap and promote more equitable outcomes for women in the labour market.

3.5   Research Limitations

Afterall, it should be noted that there still remain many limitations in this study. Firstly, the research is only based on the cross-sectional data from two years, 2002 and 2013, covering only 12 provinces and municipalities, instead of the total of 34 provincial administrative regions in China. In this situation, the data here may not be comprehensive and updated enough. Additionally, though this paper has accounted for the effect of geographic factor in the instrumental variable regressions, it failed to further divide the regions to observe the heterogeneity of the effect within different regions. As mentioned above, this is because the range of provinces used in this paper is not complete and may not provide an accurate overview of the actual situation in each region. Therefore, future research is needed to expand the time and space range of the data to provide a better understanding of the dynamics of gender wage gap in China. Finally, this empirical research didn't investigate how the effects of trade openness on gender wage gap varied for worker with different jobs from the perspectives of job segregation and industry segregation, which remains much scope to explore in the future.

4 Methodology and Data

4.1 Methodology

To explore the impact of trade openness on gender wage gap in urban China, this paper will conduct an empirical research based on the data from China Household Income Project (CHIP), while macroeconomic indicators such as GDP and trade volume will also be included in the database in this paper. Firstly, this paper will investigate the primary impact of trade openness on wage by conducting pooled ordinary least squares (OLS) regressions using mixed cross-sectional data from 2002 and 2013 surveys. Furthermore, an additional instrumental variable will be introduced in the two-stage least squares (2SLS) regressions to further confirm the findings from the OLS regressions. This paper will also include additional heterogeneity and robustness tests to ensure more specific and reliable conclusions.

4.2 Data Source

The main data source for the empirical research and regression analysis is the China Household Income Project (CHIP). Until 2022, this survey covers the databases of 1988, 1995, 1999, 2002, 2007, 2013 and 2018, including the surveys of rural population, urban population and migrant population, with the individual, employment and household information. Since the focus of this paper is on the impact of China's trade openness on the gender wage gap since 2002, and foreign trade may have a greater impact on urban labour than rural, this paper will restrict the focus to the urban samples. To ensure the reliability of the results, only data from 2002 and 2013 are selected for regression and comparison studies in this paper due to the inconsistency of province codes in the databases of 2007 and 2018. Both surveys in 2002 and 2013 employ a systematic sampling method to collect data from 12 provinces or municipalities in China. Moreover, the datasets had been divided into three regions: East, West and Middle to conduct further regional comparisons.

Specifically, this paper will focus on the urban residents in China who are currently employed in the local province and have income during the survey, with an age group from 18 to 60. During the data cleaning, the key variable wage has been tailored to reduce the impact of outliers and extreme values on the empirical results. After data cleaning, the 2002 database includes 9953 samples, with 4428 females and 5525 males, while the 2013 database includes 6016 samples, with 2659 females and 3357 males. Lastly, the main sources of the macroeconomic data, such as the amount of trade, GDP in each province, GDP per capita and industry structure, are the regional annual statistics and statistical yearbooks from the National Bureau of Statistics of China.

4.3 Model and Variables

The model in this paper is based on Mincer's (1974) classical model of individual labour earnings, with a reference to Hering and Poncet (2010)'s economic geography model, which links wages to individual characteristics and market access. The following OLS model is used for regressions for the mixed cross-sectional data in each year:

$$lnWage_{ic} = \alpha_0 + \alpha_1 Open_c + \alpha_2 Hc_{ic} + \alpha_3 X_{ic} + \alpha_4 Job_{ic} + \alpha_5 Region_{ic} + \varepsilon_i$$

On the left side of this model, the dependent variable $lnWage_{ic}$ is the log of hourly wage, that is calculated by the data of individual's annual income, monthly working days and daily working hours, where annual income refers to total individual income including bonuses and allowances for the year. In order to reduce the impact of the differences in working hours between men and women on income, this paper uses the hourly wage as the indicator to investigate the wage gap.

On the right side of the equation, the key explanatory variable, $Open_c$ refers to the trade dependency of each province or municipality, which calculated by the ratio of total amount of trade imports and exports to the regional GDP. This variable aims to measure the level of trade openness in this region. The higher the trade dependency, the higher degree of trade openness.

Among the other control variables, Hc_{ic} represents the human capital characteristics of the individuals, including education (*edu*), working experience (*exp*) and squared working experience (*exp2*). The variable *edu* is the number of years of education, which is a continuous variable. The variable *exp* is the number of working years at the time of survey. According to the human capital theory, both education and working experience have significant impacts on an individual's wages. A higher level of education indicates a higher level of human capital, which is conducive to higher wages, and therefore the difference in education levels between men and women is one of the major causes of the gender wage gap. The effect of working experience on wages is nonlinear. In the early stage, when working experience increases, the wage will also increase; however, the wage may fall later as individual getting older even with increasing experience. Women may suffer interruptions in their experience at work due to childbirth, and have less earnings, thus increasing the gender wage gap.

X_{ic} here includes two variables, *marriage* and *health*. As for the *marriage*, this paper recodes the marital status into two types: unmarried or separated and married or cohabiting. According to the theory of human capital, marriage and childbirth can cause career interruptions for women, thus reducing their human capital accumulation and wages. Besides, the segregation theory suggests that married women are more likely to choose occupations that are traditionally considered "lighter" or less physically demanding due to societal expectations and the division of labour within the family, resulting in a lower wage. The stereotypes caused by the above compound the gender discrimination inherent in the labour market and place married women in an even more disadvantaged position. Based on these assumptions, we believe that marriage also play an important role in explaining gender wage

gap. Moreover, *Health* here is based on the data from self-perceived health status, as we assume that the health condition of the labour force is related to one's job choice and productivity, and employer discrimination, which in turn affect one's wage.

Job$_{ic}$ includes three more variables about job, including *sector*, *enterprise* and *contract*. As mentioned above, there is also an effect of job segregation on the gender wage gap. Sector refers to the sector in which the labour force works, which has been divided into three types: public sector, private and other sector, and foreign-owned sector. It is assumed that the labour force working in foreign-owned enterprises is more likely to be affected by trade openness. Enterprise refers to the size of the enterprise and is divided into three types: large, medium and small, based on the number of people, as trade openness may have different impacts on different sizes of enterprises. Contract refers to the type of employment contract, which is also divided into three types: fixed or long-term, short-term or temporary, and none or other. Compared to men, women are more likely to take on temporary or part-time work due to family responsibility, resulting in lower wages (Kalleberg et al., 2000), while one with a long-term contract is expected to be more motivated and productive and gain higher wages.

Region$_c$ refers to regional variables including *lnGDP$_{pc}$* and *structure*, which aim to investigate the role of regional factors. *lnGDP$_{pc}$* is the log of GDP per capita in each province. Different regional economic development levels may affect the overall wages in the labour market. For example, women in more developed regions may have higher possibility for higher wages, thus reducing the gender wage gap. The structure is the share of the secondary sector in regional GDP, as an indicator for the regional industrial structure. As mentioned above, the demand for male and female labour and wage rates varies between industries, so regional industry structure may also have an impact on the gender wage gap. Lastly, *εi* is the error term.

Table 1 shows the descriptive statistics for the variables used in the analysis for two different time periods, 2002 and 2013. As stated before, Open stands for trade dependency. As can be seen, trade dependency has the greatest level of variability in the data, followed by import dependency and, finally, export dependency. *lnGDPpc* stands for the log of GDP per capita, with a standard deviation of 0.56, indicating a large gap in GDP per capita across provinces. This is followed by a description of the variables concerning the personal characteristics of women and men respectively. Specifically, the mean value of *lnWage* indicators that the gender wage gap exists in both years, with men earning higher hourly wages than women. For male and female workers, the *lnWage* has significantly increased for both genders, with females from 1.41 to 2.46 and males from 1.60 to 2.73, while the standard deviation for both genders remain fairly constant. This trend shows that the gender wage gap has seen a slight expansion over 11 years. There are also variations observed in other indicators such as marriage, education level and working experience. These results suggest that further regression and analysis on the relationship between trade openness and the gender wage gap is necessary, which is the focus of this paper.

Table 1 Descriptive Statistics of the Key Variables

	Variables	2002					2013				
		N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
province	Open	10158	0.34	0.42	0.04	1.35	7071	0.41	0.44	0.08	1.24
	lnGDPpc	10158	9.12	0.56	8.47	10.37	7071	10.66	0.4	10.07	11.51
	structure	10158	0.46	0.05	0.35	0.54	7071	0.47	0.1	0.22	0.55
	lnWage	4428	1.41	0.72	-0.36	3.17	3462	2.46	0.77	0.04	4.49
female	marriage	4535	0.87	0.34	0.00	1.00	3488	0.86	0.35	0	1
	health	4535	2.62	0.57	1.00	3.00	3488	2.8	0.44	0	3
	edu	4535	11.36	2.89	0	23	3473	11.82	3.36	0	22
	exp	4492	18.22	9.03	0.00	40.00	3488	9.82	8.9	0	44
	exp2	4492	413.50	330.47	0.00	1600.00	3488	175.63	265.02	0	1936
	sector	4492	0.95	0.82	0.00	3.00	3481	1.61	0.55	0	3
	enterprise	4492	1.44	0.79	0.00	3.00	3015	1.21	0.58	0	3
	contract	4492	1.51	0.80	0.00	3.00	3048	1.71	0.83	0	3
	lnWage	5525	1.60	0.67	-0.36	3.17	4409	2.73	0.75	0.04	4.49
male	marriage	5623	0.89	0.31	0.00	1.00	4434	0.87	0.33	0	1
	health	5623	2.67	0.53	0.00	3.00	4435	2.79	0.46	0	3
	edu	5623	11.48	3.06	0	23	4414	11.74	3.24	0	21
	exp	5592	21.63	9.83	0.00	43.00	4435	12.56	10.51	0	44
	exp2	5592	564.41	412.11	0.00	1849.00	4435	268.09	361.88	0	1936
	sector	5592	0.94	0.80	0.00	3.00	4428	1.55	0.55	0	3
	enterprise	5592	1.61	0.88	0.00	3.00	3798	1.35	0.74	0	3
	contract	5592	1.38	0.73	0.00	3.00	3852	1.59	0.82	0	3

4.4   Instrumental Variable

To solve the potential inferior problem in dealing with international trade, one common solution is to use the instrumental variable. As this paper aims to examine the impact of trade openness on wages, the instrumental variable needs to be related to trade openness and exogenous to individual wages. According to Brülhart (2011), regions that have easier access to foreign markets, such as those located near borders or ports, will benefit the most from trade liberalization. Therefore, a common approach is to adopt a geographic proximity, that is the linear distance from the city to the coastal port, as an instrumental variable. Frankel and Romer (1999) introduce "great-circle distance" as a proximity approach for measuring the effects of geographical features in the relationship between global trade and economic growth. Later Wei and Wu (2001) also adopt this geographical proximity in investigating determinants for the different participation of cities in international trade under the topic of the impact of globalization on income inequality in China. In their research, they take the

distance of each city from three main seaports, Qingdao, Shanghai and Shenzhen (as an alternative of Hongkong), as their instrumental variable.

Accordingly, this paper will use the distance from each province to Shanghai as an instrumental variable. (According to the cargo throughput of coastal ports recorded in the China Statistical Yearbook), the largest seaport in China in 2002 the Shanghai Port, while in 2013 it changed to the Ningbo Zhoushan Port, with the Shanghai Port being in second place in these two years. Considering the outstanding economic status of Shanghai and the fact that the direct distance between Shanghai and Ningbo is less than 150 km, this paper will use the Shanghai Port as the major representative of the seaports. The variable Distance is the direct distance from the capital city of each province to Shanghai, calculated from the latitude and longitude location of each city. To test the validity of the instrumental variable, we conducted two analyses in Stata. Firstly, we examined the correlation between the instrumental variable and the explanatory variable. The result revealed a low degree of correlation, indicating that the instrumental variable is not strongly correlated with the explanatory variable. Next, we also performed a Hausman test in Stata to test the endogeneity of the instrumental variable. The result indicated no statistically significant difference between the coefficients estimated by IV regression and OLS regression, suggesting that there is no endogeneity issue with the instrumental variables used in our analysis. Based on the above discussion and analysis, the log of Distance, *lnDistance*, will be used as the instrumental variable in this paper.

5 Discussion and Analysis of Results

5.1 Full-sample Regression Results

5.1.1 The Impact of Trade Openness on the Gender Wage Gap: OLS Regression

Table 2 Overall impact of trade openness on wage by gender (OLS regression), 2002 and 2013

Year	2002		2013	
VARIABLES	lnWage			
	female	male	female	male
Open	0.597***	0.481***	0.245***	0.213***
	-15.23	-13.54	-3.91	-3.8
marriage	0.043	0.166***	0.082**	0.107***
	-1.41	-5.23	-2.21	-2.98
health	0.021	0.030**	0.126***	0.068***
	-1.36	-2.12	-4.37	-2.89
edu	0.067***	0.061***	0.070***	0.064***
	-21.18	-22.94	-15.21	-16.13
exp	0.013***	0.016***	0.019***	0.026***
	-3.24	-4.28	-3.92	-7.23
exp2	0	-0.000*	0	-0.001***
	-0.33	(-1.82)	(-1.22)	(-4.98)
sector	-0.120***	-0.117***	0.04	0.039*
	(-10.33)	(-10.72)	-1.57	-1.66
enterprise	0.043***	0.060***	0.073***	0.057***
	-3.75	-6.63	-3.46	-3.84
contract	-0.207***	-0.135***	-0.130***	-0.111***
	(-16.78)	(-11.07)	(-6.99)	(-6.79)
lnGDPpc	-0.042	0.049*	0.125*	0.222***
	(-1.40)	-1.83	-1.81	-3.58
structure	-1.595***	-1.030***	-0.373**	0.044
	(-9.43)	(-6.99)	(-1.97)	-0.26
Constant	1.579***	0.483*	-0.189	-1.078
	-5.38	-1.85	(-0.25)	(-1.59)
Observations	4,428	5,525	2,659	3,357
R-squared	0.381	0.321	0.311	0.28

(1) Trade Dependency

As shown in the Table 2, there is a significant positive relationship between trade openness and wages for both genders in both 2002 and 2013. The coefficients for both men's and women's wages are significant at the 1% level, thus increasing trade openness contributes to higher wages for both genders. Specifically, in 2002, each 1% increase in trade openness increases women's wages by 0.597% and men's wages by 0.481%, while in 2013, the increases turn to be 0.245% for female and 0.213% for male. Therefore, the positive effect of trade openness for women is higher than that for men in both years, indicating that trade openness is more beneficial to women. However, the extent of the positive impact of trade openness on women's and men's wages changed in 2013 as international trade deepened, as evidenced by the fact that the positive impact of international trade became lower in 2013. Moreover, the coefficient difference between the wages of men and women is greater in 2002, indicating that the positive impact of international trade on women is more pronounced in 2002 compared to 2013. The results here are consistent with our previous discussion and assumptions about the positive effects of trade openness on gender wage gap, that increasing trade openness can improve the level of women's wage. While more specific mechanisms remain to be explored further, trade openness has contributed to a higher relative wage for women and a reduction in the gender wage gap, whether due to the rise in women's human capital or the demand for female labour in industry. In this way, we can preliminarily conclude that, from 2002 to 2013, trade openness has a positive effect on narrowing down the gender wage gap in China.

(2) Other Control Variables

Apart from trade openness, we can also observe the impact of some other factors on gender wages in this table. For example, there shows a clear significant "marriage premium" for men's wage in 2002, while in 2013, although there is significant positive effect of marriage on wages for both men and women, the positive effect remains more pronounced for men. In fact, married men have long been considered to have a 'marriage premium', one example of which is higher hourly wages compared to women (Waite, 1995). Women, however, do not seem to have the same 'premium' as married women are assumed to devote more time to the family and may be discriminated against by employers, resulting in lower wages. Even within the female group, the absolute gender wage gap is larger for married women than for unmarried women in China (Hughes and Maurer-Fazio, 2002), which further suggests that marriage will lead to the widening of gender wage gap between men and women.

Besides, there is a reversal in the effect of health status on the gender wages: In 2002, the positive effect of health status on men's wages is greater and more significant, however, by 2013, with both significant, the coefficient for women is 0.126, much larger than the 0.068 of men, which indicates that the positive effect of health status on women's wages is greater than that of men. Our primary finding is in line with Halima and Rococo's (2014) study, as they find in the case of France that, after excluding selection bias and productivity gaps, the wage rate for those in poor health is 14. 2% lower than for those in good health, half of which should be attributed to discrimination. Therefore, as for the gender wage gap with the consideration of health condition, it is possible that women pay more attention to their health condition to be more competitive on the job market and earn higher wages.

Among the human capital indicators, education and working experience present different pictures. The increase in education level has a significant positive effect on the wage levels of both men and women in 2002 and 2013, with the positive effect being more pronounced for women. This positive effect increased slightly from 2002 to 2013, but the difference between the male and female groups remained the same. The findings here suggest that education can result in higher rates of wage return for women in urban China. It is in line with DiPrete and Buchmann's (2006) finding that the return to education in wages is higher for women than men, especially for higher education. Miki and Yuval (2011) also point out that women tend to reduce the gender wage gap by gaining higher education level, which is proved to be effective for women with strong skills. The trends we observe here also indicates that the steadily higher returns to education for Chinese women contribute to a sustainable reduction in the gender wage gap. While the increase in working experience has an equally significant positive effect on the wage of both genders, in contrast to the education level, the positive impact of working experience is greater for men and also grow faster. These findings suggest that, holding the same years of work experience, women tend to receive lower wage returns compared to men. This disparity may be influenced by factors such as occupational interruptions due to the marital break, the type of women's job and potential gender discrimination in the workplace. What's more, with the accumulating of working experience, the gender wage gap will even broaden (Myck & Paull, 2001).

Moreover, enterprise here refers to firm size based on the number of employees, and the results above suggest that the larger the firm in which the labour force is employed, the higher the wages. This finding is consistent with Brown and Medoff (1989) and Oi and Idson (1999), that there is a positive relationship between firm size and wages, which is referred to as the "size-wage premium". The size-wage premium is partly due to the higher productivity of workers in larger firms, which may be due to the availability of better technology, greater opportunities for specialization, and more efficient management practices (Oi and Idson, 1999). According to human capital theory, workers with high skill levels could earn higher wages. Therefore, as larger companies usually require a more specialized and skilled workforce, they will offer higher wages to attract talented employees. However, in contrast to 2002, by 2013 the positive effect of firm size on the wages of the female workforce is higher than that of men. This may be due to the fact that as trade openness increases, larger firms discriminate less against the female workforce in order to reduce their costs, as suggested by Becker (1971). Thus, it is possible that increased firm size could also be beneficial in reducing the gender wage gap.

Another important indicator is contract, which is the type of contract and reflects the change in impact from stable (fixed or permanent) to unstable (no contract) contracts. It is clear that unstable contracts have a significant negative impact on wages for both genders, although the negative impact declined from 2002 to 2013. Notably, the adverse effect is greater for women than men. For example, in 2013, the coefficient for women is -0.130 and for men, it is -0.111. Although previous research has pointed out that women is more likely to held temporary or part-time job, we assume that disparity may also be related to discrimination. Besides, women with temporary contracts are also more likely to be weaker in bargaining, resulting in lower wages and broader gender wage gap.

5.1.2 The Impact of Trade Openness on the Gender Wage Gap: Instrumental Variable Regression

As introduced above, in this section we introduce the straight-line distance from the provincial capital city to the main seaport, Shanghai, and take its logarithm as our instrumental variable. The Table 3 shows that after introducing the instrumental variable *lnDistance* to the model, the results become more significant and thus further confirmed the previous results from the OLS regressions. More specifically, in 2002 and 2013, the positive effect of trade openness to the wages is greater for both genders. In 2002, with each 1% increase in the trade openness, there is a significant 0.675% increase in women's wage and a significant 0.607% in men's wage. The trend is similar with that of the OLS model. In 2013, the increase brought by the trade openness declines to 0.350% for female and 0.274% for male, both remain relatively significant though. In both years, we can still observe a relative advantage of women's wage as a result of increasing trade openness. The results of other control variables are also consistent with the outcome in the first section. Therefore, we can once confirm that the relatively positive impact of trade openness on women's wages persists after controlling for human capital factors, personal and occupational factors, and region-related factors.

What's more, although both being more favourable to women, it is worth noting that after the introduction of the instrumental variable, the trend in the difference in the between-group coefficients for gender wages has changed towards a more positive direction. In the OLS regressions, the disparity is 0.116 in 2002, higher than the 0.032 in 2013. While in the IV regressions here, the disparity turns to 0.068 in 2002, slightly lower than the 0.076 in 2013. This change for gender wages indicates a potentially significant development: the positive impact of trade openness on gender wages have strengthened further over time in urban China. Our finding here is consistent with the views of neoclassical theory. According to the Heckscher-Ohlin theory of international trade, as trade openness progresses, it may lead to greater opportunities for women in sectors that benefit from international trade, leading to higher wages and a narrower gender wage gap. Also, from the perspective of Becker's (1971) human capital theory, greater exposure to global markets and competition can provide an incentive for companies to hire more women and to reduce gender-based wage gaps in order to reduce the discrimination cost. Therefore, we can conclude that trade openness has positive effects in narrowing the gender wage gap in urban China.

Table 3 Overall impact of trade openness on wage by gender (2SLS regression), 2002 and 2013

Year	2002		2013	
VARIABLES	lnWage			
	female	male	female	male
Open	0.675***	0.607***	0.350**	0.274**
	-6.33	-5.31	-2.42	-2.09
marriage	0.045	0.165***	0.091**	0.134***
	-1.47	-5.2	-2.55	-4.03
health	0.023	0.033**	0.121***	0.059**
	-1.46	-2.28	-4.22	-2.54

edu	0.068***	0.061***	0.069***	0.062***
	-21.13	-22.97	-15.86	-16.29
exp	0.013***	0.016***	0.019***	0.027***
	-3.16	-4.18	-4.02	-7.36
exp2	0	-0.000*	0	-0.000***
	-0.39	(-1.74)	(-1.14)	(-4.75)
sector	-0.120***	-0.117***	0.036	0.035
	(-10.37)	(-10.74)	-1.41	-1.44
enterprise	0.045***	0.064***	0.075***	0.056***
	-3.83	-6.61	-3.51	-3.73
contract	-0.206***	-0.137***	-0.129***	-0.109***
	(-16.66)	(-11.13)	(-6.94)	(-6.68)
lnGDPpc	-0.094	-0.032	0.041	0.177
	(-1.30)	(-0.42)	-0.32	-1.54
structure	-1.660***	-1.110***	-0.289	0.094
	(-8.82)	(-6.81)	(-1.35)	-0.49
Constant	2.038***	1.207*	0.694	-0.505
	-3.12	-1.78	-0.54	(-0.43)
Observations	4,428	5,525	2,659	3,357
R-squared	0.38	0.319	0.311	0.279

5.2 Heterogeneity Tests

As we have discussed in the literature review section, although the overall positive effect of trade openness on reducing gender wage gap has been found in the above results, this effect could vary across different groups. Therefore, in this section, we will focus on the groups with different skill levels and income levels to further discuss and analyse the heterogeneous impact of trade openness.

5.2.1 Skill Levels

According to human capital theory, wages are determined by labour's skill levels and education levels. This theory suggests that individuals with higher levels of human capital, such as advanced degrees or specialized training, are likely to earn higher wages compared to those with lower levels of human capital. Consequently, the impact of trade openness on wages also tends to vary across different skill levels, leading to gender wage heterogeneity among workers. Considering that skill level is hard to measure directly, previous research usually use education level as an indicator of skill level, as education is regarded to be closely related to one's ability in practical. Therefore, in this section we will also define skill levels based on educational levels and divide the sample into three groups: low-skilled, medium-skilled and high-skilled workers.

Table 4 Impact of trade openness on wage by gender at different skill levels (2SLS regression), 2002 and 2013

lnWage	Low-skilled		Medium-skilled		High-skilled	
	female	male	female	male	female	male
Open (2002)	0.562**	0.295	0.660***	0.679***	0.24	0.447
	-2.2	-1.05	-5.53	-5.23	-0.4	-1.24
Open (2013)	0.406	-0.013	0.441**	0.385**	0.407	0.38
	-1.01	(-0.04)	-2.41	-2.24	-1.49	-1.64

(Note: See Appendix 3 for the complete table)

As can be seen in the Table 4, the relationship between the impact of trade openness on wages and skill levels is non-linear. Specifically, the positive impact of trade openness on wages is highest and most significant for medium-skilled labour force. In 2002, with 1% increase in trade openness, there is a significant 0.660% increase in women's wage, a little lower than the 0.679% increase in men's wage. However, among the medium-skilled workers, the situation turns to be more favourable for women, with a 0.441% increase for women and 0.385% increase for men. This reversal trend also shows in the high-skilled group, though not significant. Besides, it is interesting to figure out that the only negative coefficient in the results appears in the low-skilled male group in 2013, though very slight and insignificant. Compared to it, women with low skill tends to be positively affected by trade openness in both years but only being significant in 2002.

In China, it is obvious that since 2002, the opening up of trade has contributed to the rapid growth of manufacturing in China, which requires a large number of lower-skilled female labour. As a result, women in this group have more job opportunities, thus reducing the gender wage gap. This finding is supported by Chen et al. (2013), as they claim that globalization and open economy can bring more job opportunities to low-skilled women and reduce the gender wage gap. This is also true in the case of Mexico, where Borraz and Lopez-Cordova (2007) state that regions with better participation in the global economy provide more jobs for women with lower levels of education than those with higher levels of education. Hegewisch and Hartmann (2014) also find a smaller wage penalty for women with low and medium skill jobs from a perspective of occupation segregation. Therefore, we can reach the conclusion that trade openness is effective in reducing gender wage gap among all three groups, especially in the low-skilled group.

However, from 2002 to 2013, the positive impact of trade opening on low- and medium-skilled women declined, possibly because the previous wage premium diminished as industries developed and labour demand changed. On the one hand, the occupational segregation can lead to a concentration of these women in low-wage jobs, despite the increased job opportunities brought about by trade liberalization. On the other hand, as China's industries progressed, standards for workforce skills may also be higher, while the widening wage gap between high-skilled and low-skilled workers may reduce the positive impact of trade openness on women's wages. According to the outsourcing theory, the transition of labour market to skilled worker lays adverse effect on unskilled worker, while in our case, the lower-skilled women will face a disadvantage situation if outsourcing continue developing in China. This assumption is also proven in the case of Thailand, as

Chongvilaivan and Thangavelu (2012) find that a 2.5% increase in wage gap between skilled and unskilled workers is brought by a 1% increase in the provision of outsourcing. Therefore, future attention is also needed to systematically address gender wage gaps at different skill level groups.

5.2.2   Income Levels

Apart from skill levels, it is also necessary to provide further insights into the effects of trade openness at different income levels to better understand the concrete impact of trade openness on gender wage gaps. One common approach is to conduct quantile regression, which is used to examine how different quantiles of the dependent variable are influenced by the independent variables. It is introduced by Koenker and Bassett (1978) and is seen as a extension for conditional OLS model (Koenker & Hallock, 2001). This approach has been applied to measure the gender wage gap in many previous studies, both present solid results (Garcia et al. 2001, Jaumotte et al.,2013). Following the same approach, here we also conduct a quantile regression based on three quintiles of annual income, which are q10, q50 and 90, while q10 represents the lowest 10% income group, and q90 the highest 10% income group. The aim is to examine the impact of trade openness on gender wage gap at different income levels respectively.

Table 5 Impact of trade openness on wage by gender at different income levels (quantile regression), 2002 and 2013

lnWage	q10		q50		q90	
	female	male	female	male	female	male
Open (2002)	0.523***	0.413***	0.589***	0.497***	0.730***	0.655***
	-6.46	-6.24	-12.78	-14.57	-9.26	-9.97
Open (2013)	0.450***	0.192	0.187***	0.229***	0.279**	0.296**
	-4.96	-1.38	-2.65	-5.01	-2.27	-2.21

(Note: See Appendix 4 for the complete table)

As the Table 5 shows, the positive effects of trade openness on all three income quartile groups are mostly significant in both years. In 2002, the positive impact of trade openness increased as income levels increased and is most beneficial for the top 10% income level. The situation is different in 2013, when trade openness is most beneficial for improving the wage of female group at the last 10% income level and the wage of male group at the top 10% income level. More importantly, it is clear that trade openness is more helpful in reducing the gender wage gap for lower income groups in both years. This finding is consistent with both the findings regarding skill levels and neoclassical theory, since income is regarded to be the return of education and skills according to the human capital theory.

It is also interesting to note that in 2013, trade openness seems not able to reduce the gender wage gap among middle- and upper-income groups. Actually, there already exists a debate on 'glass ceiling' or 'sticky floor' effect in the discussion of gender wage gap, that is, whether the gender wage gap is greatest for the top group or the bottom group among the income distribution. This perspective may partly explain our findings, since if gender wage inequality

is more pronounced in the highest income groups, it would diminish part of the positive effects of trade openness. The 'glass ceiling' issue in China in 2013 has been found in many European countries like Sweden, and some Asian countries like Japan (Albrecht et al., 2003, Arulampalam et al., 2007, Christofides et al., 2013, Hara, 2018). Hara (2018) points out that this phenomenon is caused by gender promotion gap. Due to gender discrimination, women may not have access to more opportunities for promotion than men, which can result in their wages peaking at a lower level than men's, widening the gender wage gap in the upper income groups. From a human capital perspective, as wages are highly related to human capital, this transition between 2002 and 2013 could be attributed to the expansion of higher education and the increased demand for highly skilled labour. With the expansion of higher education, the proportion of women with higher education has increased, but they fail to obtain the same returns as men due to gender discrimination. In addition, unlike the wider acceptance of women in lower-skilled occupations, there may be more evident gender segregation in higher-skilled occupations, which results in a higher barrier for women to enter higher-paid, higher-skilled occupations. These factors all lead to the weakening of the positive effects of trade openness on the gender wage gap for highest income groups.

5.3   Robustness Tests

In the above sections we have analysed the basic regression results and heterogeneity. To enhance the accuracy and reliability of the model and to mitigate the potential biases and outliers in the empirical results, this section will focus on two robustness tests. The first test concerns adjusting the age group of the women to 18 to 55 years old, providing a more specific analysis. The second test will replace the wage variable with total annual income as the dependent variable, allowing us to explore the impact on a broader measure of earnings. We will present and discuss the results of these two tests to clarify the robustness and consistency of our findings.

5.3.1   Age Range

In our previous analysis, to maintain the consistency of the sample, this paper restricted the age range to 18-60 years for both male and female samples. However, it is important to note that women in China typically retire at a younger age than men, with most retiring at age 55. As a result, the wages of women between the 55-60 years old may decline and be lower than that of men over 55 years old. Therefore, in this section we reset the age range for women to 18-55 years, while the age range for men remains to be 18-60 years. Table 6 shows that, after resetting the age range for women to 18-55, the results here align with that of the OLS regressions. In both years, the positive effects of trade openness on women's wage outweighs the effects on men's, suggesting that women benefit more from trade liberalization. Specifically, for each 1% increase in the trade openness, the female wage rate increased by 0.662% in 2002 and 0.375% in 2013, both significant. Therefore, we may suggest that trade openness can also help reducing the gender wage gap among the working population.

Table 6 The impact of trade openness on wage by gender: adjusted female age range (2SLS regression), 2002 and 2013

Year	2002		2013	
lnWage	female	male	female	male
Open	0.662***	0.607***	0.375***	0.274**
	-6.2	-5.31	-2.61	-2.09
marriage	0.053*	0.165***	0.092***	0.134***
	-1.71	-5.2	-2.59	-4.03
health	0.022	0.033**	0.129***	0.059**
	-1.42	-2.28	-4.47	-2.54
edu	0.067***	0.061***	0.070***	0.062***
	-20.82	-22.97	-15.85	-16.29
exp	0.012***	0.016***	0.018***	0.027***
	-2.78	-4.18	-3.86	-7.36
exp2	0	-0.000*	0	-0.000***
	-0.71	(-1.74)	(-0.92)	(-4.75)
sector	-0.123***	-0.117***	0.043*	0.035
	(-10.52)	(-10.74)	-1.67	-1.44
enterprise	0.045***	0.064***	0.070***	0.056***
	-3.84	-6.61	-3.3	-3.73
contract	-0.205***	-0.137***	-0.128***	-0.109***
	(-16.50)	(-11.13)	(-6.93)	(-6.68)
lnGDPpc	-0.087	-0.032	0.016	0.177
	(-1.20)	(-0.42)	-0.12	-1.54
structure	-1.635***	-1.110***	-0.27	0.094
	(-8.65)	(-6.81)	(-1.26)	-0.49
Constant	1.977***	1.207*	0.909	-0.505
	-3.01	-1.78	-0.71	(-0.43)
Observations	4,384	5,525	2,617	3,357
R-squared	0.379	0.319	0.309	0.279

5.3.2   Annual Income

Although as stated before, many studies have used the hourly wage rate as the indicator for studying the gender wage gap, here we use income as an alternative of hourly wage to confirm the robustness of our previous findings. Here we find that, compare to that of wage, the positive effect of trade openness on wage has increased for both genders when we use annual income as the indicator. In 2002, the coefficient of impact of trade openness on women's wages is a 0.811, much larger than the 0.645 for men. While in 2013, the coefficient is 0.279 for women and 0.214 for men. Besides, the disparity in coefficients between men and women has also widened in 2002, further confirming the findings obtained from the OLS regressions.

Table 7 Impact of trade openness on annual income and wage by gender (2SLS regression), 2002 and 2013

	lnIncome		lnWage	
	female	male	female	male
Open (2002)	0.811***	0.645***	0.662***	0.607***
	-7.76	-5.82	-6.2	-5.31
Open (2013)	0.279*	0.214	0.375***	0.274**
	-1.85	-1.62	-2.61	-2.09

(Note: See Appendix 5 for the complete table)

5.4 Future Research Directions

The above findings suggest that an increase in trade dependency is effective in improving the relative wages of women in urban China and in reducing the gender wage gap. However, the research in this paper provides only one perspective, and there remains more scope for future research. Firstly, apart from trend dependency, we can also extend to multidimensional indicators, such as foreign direct investment (FDI) and tariff reductions, to analyse whether there is a difference in the impact of trade liberalization on gender wage gap under different indicators. For example, Sharma (2020) finds that although FDI leads to more jobs for unskilled women, it exacerbates the gender wage gap, while Mukhopadhyay and Chaudhuri (2013) state that a reduction in tariffs may have a mitigating effect on gender wage inequality. Besides, future studies can also focus on specific industries, for example, export-oriented industry. For instance, Domínguez-Villalobos and Brown-Grossman (2010) have found an adverse effect of export orientation on gender wage equality in the case of Mexico. Last but not least, sectoral segregation is also a topic worth discussing. For example, the impact of trade openness in female-intensive sectors (FIS) and male-intensive sectors (MIS) has also been discussed (Berik, 2000, Sauré & Zoabi, 2014). As China undergoes shifts in its industrial structure and experiences changes in labour skill demand, it is expected that situations in these sectors may also change. Consequently, it becomes essential to further observe the long-term dynamics of the gender wage gap in light of these transformations.

6 Policy Implications

This chapter is intended to provide some policy implications for policy makers to create an enabling environment that promote gender wage equality in the context of trade openness. Based on the analysis and discussion above, we have found that trade openness is more beneficial for increasing women's wage and narrowing down the gender wage gap in urban China. Therefore, as international trade continues to develop, it is important to implement more favourable policies to enhance the positive effects of trade openness on reducing gender wage inequality in China. Specifically, this section highlights three policy implications:

Firstly, government should help improve the education level of the female workforce and further support them to improve their skills in the labour market. In the empirical results, we have found that there is an "education premium" on women's wages, which indicates that increasing women's education level is beneficial for increasing women's earnings. Therefore, the government should focus on increasing female enrolment and increase public financial expenditures for female population, such as providing more student loans for women. In addition, the government can provide more training programs for the female working population to enhance their work capacity and competitiveness. Improving women's skill levels during China's industrial development transition can also expand women's job opportunities and reduce the negative effects brought about by occupational segregation and gender discrimination.

Secondly, government should regulate companies to provide more equal working conditions and benefits for women. Given that empirical studies have shown that the impact of trade openness on reducing the gender wage gap in high-income groups is still limited, it becomes to encourage enterprises to provide equal career development and promotion opportunities for women, such as ensuring equal pay for equal work, transparent promotion processes and fair evaluations. The "marriage premium" for men found in previous results also shows that women are very likely to suffer wage penalty due to family responsibility and motherhood. Therefore, it is important to ensure that the company reduces gender discrimination and guarantees equal pay for equal work for women.

Lastly, government should formulate and refine laws and regulations which promote gender wage equality. We have found that unstable contracts have a relatively more negative impact on women, suggesting that unstable, informal employment is disadvantageous in reducing the gender wage gap. Therefore, the government should target to improve labour laws and regulations, raise the minimum wage and improve the regulation of the labour market. Another important aspect is to strengthen social safety nets and welfare programs targeted towards low-skilled women. This can include expanding access to health care, childcare support, which is critical to ensuring their well-being and enabling them to fully participate in the labour market.

7 Conclusion

In conclusion, this paper has examined the impact of trade openness on the gender wage gap in urban China. Based on the data from the China Household Income Project (CHIP) in 2002 and 2013, this paper has conducted empirical research by using models including OLS, 2SLS and quantile regressions to reach the findings, and discusses the trends and mechanisms underlying the effects. In response to the questions in the introduction, we have found that, trade openness has a positive impact on wages for both genders, but the positive impact is more pronounced for women's wages. Therefore, trade openness contributes to reducing the gender wage gap in urban China. This finding is in line with the assumptions of the neoclassical theory and many literatures emphasizing the role of trade openness in promoting gender wage equality (Becker, 1971, Black & Brainerd, 2004, Chen et al., 2013). After controlling for human capital factors, individual characteristics, job characteristics and regional factors, the positive effect of trade openness on women's wages remains significant and robust. Moreover, after introducing the instrumental variable, distance from the provincial capital city to the main seaport, we have also observed a slight increasing trend in this positive effect over the period 2002-2013. Furthermore, the results of the heterogeneity tests show that trade openness has a differential impact on gender wage gaps across skill and income level groups. Specifically, increasing trade openness is most beneficial in reducing the gender wage gap for both the low-skilled and low-income level groups. Finally, robustness tests concerning the age range and income indicator further confirm the robustness and reliability of the above findings.

Overall, this study contributes to the understanding of the relationship between trade openness and the gender wage gap in urban China since 2002. As the above chapter suggests, we expect that by promoting trade openness and applying policies that support women's participation and empowerment in the labour market, policymakers can effectively contribute to narrowing the gender wage gap and promoting gender equality in China. We also expect the results of this paper could provide some policy references for developing countries facing similar situations. However, it must be acknowledged that the study has its limitations. The analysis focused on China's urban population and may not have examined the dynamics in rural areas. Additionally, the scope of the study is limited to a specific time period and future research could explore longer-term trends and examine the impact of trade opening on the gender wage gap across regions and industries.

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Appendix

Appendix 1 Description of Key Variables

Main Variables	Description	Data Source	Criteria/Notes
Wage	Hourly wage	CHIP	Calculated from an individual's annual income, the number of months worked per year and the number of days and hours worked per month
lnWage	log of hourly wage	CHIP	
Open	Trade Dependency	National Bureau of Statistics of China	Calculated by the ratio of trade imports and exports to GDP
marriage	Marital status: 0 "Unmarried, separated and others" 1 "Married or cohabiting"	CHIP	Recode: ①First marriage ②Divorced and remarried ③Widowed and remarried ④Cohabitation ⑤Separated ⑥Divorced ⑦Widowed ⑧Unmarried ⑨Others
health	Health condition: 1 "poor" 2 "average" 3 "good"	CHIP	Recode: ①very good ②good ③average ④bad ⑤very bad
education	Education level: 1"middle school and below" 2"high school and colledge" 3"bachlor and above"	CHIP	Recode: ①Uneducated ②Elementary school ③Junior high school ④High school ⑤Vocational high school/technical school ⑥Secondary school ⑦College School ⑧Undergraduate School ⑨Graduate School
exp	Working experience	CHIP	
exp2	Squared working experience	CHIP	
sector	Type of enterprise: 1 "public sector" 2 "private sector and others" 3 "foreign-owned sector"	CHIP	Recode: ① party and government authorities and groups ② public institution ③ state-owned enterprises ④Other joint-stock enterprises ⑤Collective enterprises ⑥Sino-foreign joint or fully foreign-owned enterprises ⑦Private enterprises ⑧Land contractors ⑨Others
enterprise	Enterprise size by number of employees: 1 "small enterprise" (1-500) 2 "medium enterprise" (500-1000) 3 "large enterprise" (>1000)	CHIP	Statistical Classification of Small, Medium and Large Enterprises (2017), National Bureau of Statistics of China
contract	Contract type: 1 "fixed or long-term" 2 "short-term or temporary" 3 "none or others"	CHIP	
province	Province/city code	CHIP	31 provinces/cities in 2002, 2013
GDPpc	GDP per capita	National Bureau of Statistics of China	Calculated by the ratio of regional GDP to total population at the end of the year
structure	Share of secondary sector in GDP	National Bureau of Statistics of China	The secondary sector refers to mining, manufacturing, electricity, gas and water production and supply, and construction
Distance	Minimum distance from provincial capitals to Shanghai	Baidu Map City Center Latitude and Longitude Relationship	Inter-city distances calculated by using latitude and longitude

Appendix 2 Descriptive Statistics for Key Variables

	Variables	2002					2013				
		N	Mean	SD	Min	Max	N	Mean	SD	Min	Max
province	Open	10158	0.34	0.42	0.04	1.35	7071	0.41	0.44	0.08	1.24
	lnGDPpc	10158	9.12	0.56	8.47	10.37	7071	10.66	0.4	10.1	11.5
	structure	10158	0.46	0.05	0.35	0.54	7071	0.47	0.1	0.22	0.55
	lnWage	4428	1.41	0.72	-0.36	3.17	3462	2.46	0.77	0.04	4.49
	marriage	4535	0.87	0.34	0.00	1.00	3488	0.86	0.35	0	1
female	health	4535	2.62	0.57	1.00	3.00	3488	2.8	0.44	0	3
	edu	4535	11.36	2.89	0	23	3473	11.82	3.36	0	22
	exp	4492	18.22	9.03	0.00	40.00	3488	9.82	8.9	0	44
	exp2	4492	413.50	330.47	0.00	1600.00	3488	175.6	265	0	1936
	sector	4492	0.95	0.82	0.00	3.00	3481	1.61	0.55	0	3
	enterprise	4492	1.44	0.79	0.00	3.00	3015	1.21	0.58	0	3
	contract	4492	1.51	0.80	0.00	3.00	3048	1.71	0.83	0	3
	lnWage	5525	1.60	0.67	-0.36	3.17	4409	2.73	0.75	0.04	4.49
male	marriage	5623	0.89	0.31	0.00	1.00	4434	0.87	0.33	0	1
	health	5623	2.67	0.53	0.00	3.00	4435	2.79	0.46	0	3
	edu	5623	11.48	3.06	0	23	4414	11.74	3.24	0	21
	exp	5592	21.63	9.83	0.00	43.00	4435	12.56	10.51	0	44
	exp2	5592	564.41	412.11	0.00	1849.00	4435	268.1	361.9	0	1936
	sector	5592	0.94	0.80	0.00	3.00	4428	1.55	0.55	0	3
	enterprise	5592	1.61	0.88	0.00	3.00	3798	1.35	0.74	0	3
	contract	5592	1.38	0.73	0.00	3.00	3852	1.59	0.82	0	3

Appendix 3 Impact of trade openness on wage by gender at different skill levels (2SLS regression), 2002 and 2013

	2002					
	Low-skilled		Medium-skilled		High-skilled	
lnWage	female	male	female	male	female	male
Open	0.562**	0.295	0.660***	0.679***	0.24	0.447
	-2.2	-1.05	-5.53	-5.23	-0.4	-1.24
marriage	-0.034	0.114	0.063*	0.160***	0.036	0.188**
	(-0.46)	-1.51	-1.7	-4.1	-0.36	-2.35
health	0.045	0.004	0.025	0.054***	-0.061	0.014
	-1.43	-0.13	-1.34	-2.82	(-1.22)	-0.34
edu	0.025**	0.019**	0.050***	0.041***	0.012	0.022**
	-2.4	-1.97	-9.16	-8.37	-0.72	-2.03
exp	0.013	0.014*	0.013**	0.019***	0.017	0.009

	-1.5	-1.83	-2.47	-3.97	-1.21	-0.93
exp2	0	0	0	-0.000**	0	0
	-0.66	(-0.33)	-0.32	(-1.99)	(-0.27)	(-0.09)
sector	-0.108***	-0.112***	-0.112***	-0.114***	-0.055	-0.043
	(-4.19)	(-4.93)	(-8.12)	(-8.37)	(-1.33)	(-1.44)
enterprise	0.075***	0.074***	0.042***	0.059***	0.013	0.057**
	-2.91	-3.55	-3	-4.93	-0.31	-2.2
contract	-0.177***	-0.128***	-0.203***	-0.144***	-0.390***	-0.021
	(-7.69)	(-6.10)	(-13.31)	(-8.75)	(-5.26)	(-0.47)
lnGDPpc	-0.023	0.163	-0.081	-0.068	0.216	0.035
	(-0.14)	-0.93	(-0.98)	(-0.78)	-0.59	-0.15
structure	-2.102***	-0.838***	-1.599***	-1.268***	-0.265	-0.914**
	(-5.54)	(-2.72)	(-6.78)	(-5.97)	(-0.43)	(-2.12)
Constant	1.799	-0.226	2.086***	1.746**	0.176	1.255
	-1.25	(-0.15)	-2.71	-2.17	-0.05	-0.61
Observations	1,089	1,531	2,995	3,304	339	685
R-squared	0.303	0.268	0.32	0.275	0.306	0.204

	2013					
	Low-skilled		Medium-skilled		High-skilled	
lnWage	female	male	female	male	female	male
Open	0.406	-0.013	0.441**	0.385**	0.407	0.38
	-1.01	(-0.04)	-2.41	-2.24	-1.49	-1.64
marriage	0.023	0.181***	0.100**	0.101**	0.120*	0.131**
	-0.28	-2.66	-2.06	-2.15	-1.81	-2
health	0.115**	0.122***	0.138***	0.046	0.092	-0.01
	-2.19	-3.2	-3.32	-1.31	-1.56	(-0.19)
edu	0.028*	0.042***	0.042***	0.047***	0.050***	0.065***
	-1.77	-2.87	-4.44	-5.43	-3.48	-4.72
exp	0.023**	0.027***	0.017***	0.028***	0.023**	0.020***
	-2.28	-4.21	-2.65	-5.29	-2.26	-2.69
exp2	0	-0.000**	0	-0.000***	0	-0.000*
	(-1.27)	(-2.45)	(-0.57)	(-3.42)	(-0.45)	(-1.74)
sector	-0.05	0.045	0.008	0.016	0.211***	0.096**
	(-0.78)	-0.82	-0.23	-0.46	-4.46	-2.25
enterprise	0.076	0.053	0.057**	0.053**	0.117***	0.055**
	-1.34	-1.59	-2.03	-2.42	-3.19	-2.14
contract	-0.029	-0.057**	-0.144***	-0.132***	-0.173***	-0.149***
	(-0.81)	(-2.09)	(-5.83)	(-5.57)	(-3.64)	(-3.52)
lnGDPpc	-0.156	0.5	-0.026	0.06	0.028	0.051
	(-0.42)	-1.62	(-0.16)	-0.38	-0.12	-0.27
structure	0.327	0.64	-0.17	0.178	-0.252	-0.195
	-0.56	-1.35	(-0.58)	-0.66	(-0.64)	(-0.55)

Constant	2.782	-4.241	1.649	0.903	0.989	1.207
	-0.76	(-1.37)	-0.98	-0.56	-0.41	-0.62
Observations	649	886	1,382	1,753	628	718
R-squared	0.045	0.158	0.204	0.185	0.269	0.256

Appendix 4 Impact of trade openness on wage by gender at different income levels (quantile regression), 2002 and 2013

	2002					
Quantile	q10	q50	q90	q10	q50	q90
lnWage		female			male	
Open	0.523***	0.589***	0.730***	0.413***	0.497***	0.655***
	-7.17	-11.23	-9.49	-5.41	-10.5	-10.51
marriage	0.071	0.025	0.051	0.199***	0.144***	0.195***
	-1.08	-0.69	-1.16	-3.05	-4.03	-3
health	0.003	0.041**	0.025	0.055*	0.038**	0.009
	-0.1	-2.21	-1.11	-1.73	-2.5	-0.38
edu	0.073***	0.065***	0.057***	0.064***	0.063***	0.055***
	-12.11	-17.25	-15.89	-11.14	-18.02	-11.33
exp	0.020**	0.013***	0.009	0.029***	0.012***	0.007
	-2.38	-3.12	-1.48	-4.1	-2.79	-1.03
exp2	0	0	0	-0.000***	0	0
	(-0.38)	-0.63	-0.53	(-3.04)	(-0.30)	-0.53
sector	-0.175***	-0.153***	-0.070***	-0.184***	-0.144***	-0.047**
	(-6.96)	(-10.49)	(-3.52)	(-9.98)	(-8.66)	(-2.18)
enterprise	0.078***	0.035**	0.040**	0.076***	0.065***	0.049***
	-3.7	-2.05	-2.36	-4.65	-5.66	-3.34
contract	-0.225***	-0.232***	-0.168***	-0.225***	-0.123***	-0.051**
	(-7.66)	(-14.61)	(-6.27)	(-8.53)	(-7.14)	(-1.98)
lnGDPpc	0.017	-0.041	-0.109*	0.096	0.032	-0.052
	-0.35	(-1.09)	(-1.74)	-1.58	-1.02	(-0.93)
structure	-1.509***	-1.568***	-1.388***	-0.963***	-0.946***	-0.626***
	(-8.64)	(-9.37)	(-3.98)	(-5.58)	(-6.97)	(-2.77)
Constant	0.221	1.623***	2.763***	-0.692	0.594*	1.814***
	-0.52	-4.52	-4.38	(-1.10)	-1.73	-3.48
Observations	4,428	4,428	4,428	5,525	5,525	5,525

	2013					
Quantile	q10	q50	q90	q10	q50	q90
lnWage		female			male	
Open	0.450***	0.187***	0.279***	0.192	0.229***	0.296***
	-4.59	-3.07	-2.93	-1.59	-5.29	-2.8

marriage	0.106*	0.048	0.083	0.084	0.126***	0.206***
	-1.86	-1.42	-1.26	-0.89	-4.42	-3.09
health	0.207***	0.119***	0.075	0.115***	0.080***	0.028
	-3.41	-3.63	-1.09	-2.59	-4.9	-0.48
edu	0.078***	0.064***	0.074***	0.075***	0.064***	0.062***
	-9.15	-15.26	-9.59	-9.19	-21.24	-9.2
exp	0.021***	0.015***	0.029***	0.037***	0.023***	0.018***
	-2.96	-2.68	-4.25	-4.64	-8.3	-3.06
exp2	0	0	-0.000*	-0.001***	-0.000***	-0.000**
	(-0.73)	(-0.26)	(-1.86)	(-3.85)	(-4.22)	(-2.13)
sector	0.072	-0.008	0.101	0.072*	0.019	0.062
	-1.31	(-0.26)	-1.59	-1.66	-0.66	-1.49
enterprise	0.04	0.063***	0.091***	0.008	0.060***	0.050**
	-0.87	-4.01	-3.12	-0.36	-5.1	-2.16
contract	-0.196***	-0.147***	-0.095**	-0.162***	-0.091***	-0.111***
	(-6.36)	(-7.74)	(-2.02)	(-6.70)	(-5.38)	(-3.08)
lnGDPpc	-0.075	0.178**	0.059	0.191	0.186***	0.232***
	(-0.58)	-2.41	-0.41	-1.31	-3.3	-2.87
structure	-0.109	-0.304	-0.600*	-0.338	0.08	0.491*
	(-0.41)	(-1.55)	(-1.69)	(-1.11)	-0.57	-1.78
Constant	0.87	-0.425	1.202	-1.289	-0.635	-0.521
	-0.6	(-0.49)	-0.74	(-0.80)	(-1.06)	(-0.62)
Observations	2,659	2,659	2,659	3,357	3,357	3,357

Appendix 5 Impact of trade openness on annual income by gender (2SLS regression), 2002 and 2013

Year	2002		2013	
lnIncome	female	male	female	male
Open	0.811***	0.645***	0.279*	0.214
	-7.76	-5.82	-1.85	-1.62
marriage	0.087***	0.246***	0.085**	0.185***
	-2.9	-7.9	-2.29	-5.51
health	0.039**	0.047***	0.122***	0.070***
	-2.56	-3.32	-4.07	-2.97
edu	0.062***	0.056***	0.065***	0.055***
	-19.85	-21.6	-14.32	-14.24
exp	0.012***	0.021***	0.029***	0.030***
	-2.99	-5.74	-5.83	-8.27
exp2	0	-0.000***	-0.000***	-0.001***
	-0.58	(-3.45)	(-3.03)	(-6.12)
sector	-0.095***	-0.091***	0.089***	0.077***
	(-8.33)	(-8.56)	-3.31	-3.12

enterprise	0.051***	0.062***	0.080***	0.062***
	-4.42	-6.56	-3.6	-4.03
contract	-0.159***	-0.067***	-0.138***	-0.132***
	(-13.22)	(-5.65)	(-7.18)	(-8.01)
lnGDPpc	-0.215***	-0.066	0.062	0.199*
	(-3.05)	(-0.90)	-0.46	-1.71
structure	-1.572***	-1.037***	-0.387*	0.057
	(-8.54)	(-6.50)	(-1.73)	-0.29
Constant	10.601***	8.956***	8.162***	6.982***
	-16.54	-13.58	-6.06	-5.9
Observations	4,479	5,578	2,661	3,358
R-squared	0.331	0.284	0.286	0.264