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ARTICLE

The Impact of Chinese Imports on Indian Wage Inequality

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Abstract
The paper seeks to address the growing inequality in wages between skilled and unskilled workers and between male and female workers in India due to a growing import surge from China. The study on wage movements of skilled versus unskilled workers helps us to understand how imports from India's largest trade partner have contributed to relative factor returns in the country's most abundant factor of production. The consideration of wage divergence between male and female workers helps us in determining how significant China's trade is in addressing gender inequality in India's labour market. Our analysis reveals that the import surge from China has minor effects on the growing wage difference between skilled and unskilled workers. However, the effect of the Chinese import surge on wage divergence between male and female workers is significant. The existing literature on the effects of international trade on India labour market is largely silent on the considered aspects.

Keywords Import surge · Skilled and unskilled wages · Gender wage gap

JEL Classification F14 · F16 · C23 · C26

1 Introduction

As more and more countries open up to trade, researchers are getting increasingly interested on the economic impacts of growing international integration on the countries around the world. One of the economic impacts that have attracted considerable attention of researchers over the past few decades is the effects of international trade on the labour market. The chief objective behind such studies is the determination of relative gainers and losers from liberalization and ultimately discerning

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the evolution of earnings inequality in the liberalized nations. Some of this literature examines how international trade has been contributing to the wage movements of skilled and unskilled labour in countries, and how interactions between North (including all 'high income OECD members' as defined by World Bank, or 'developed market economies' as defined by United Nations) and South (including 'developing market economies' as defined by United Nations) have contributed to the observed phenomena.[1] Assessing the movement in wages of skilled vs unskilled labour is important from several perspectives. Firstly, it helps in determining how beneficial international trade is for a country's relatively abundant factor, in terms of factor earnings. Secondly, it helps a country to develop suitable policies to address any growing inequality in the labour market arising out of international trade.

The other existing literature explores the effects of international trade on wages of male and female workers. Opening up the economy through trade is expected to create better job opportunities for women, thereby putting an end towards gender discrimination in terms of lower employment and wages paid to female workers relative to the male workers. Addressing gender discrimination in the labour market and thereby ensuring women's better access to resources is the channel towards establishing a more egalitarian society and promotion of all around growth and development in a country. This paper therefore examines the impact of trade on the labour market from two perspectives: first by considering the wage movements of skilled vs unskilled labour and second by considering the wage movements of female vs male workers. The country of analysis is India, given its growing significance in the world market and its significantly large working population.[2] However, instead of considering India's trade with the rest of the world, we restrict ourselves to a specific country. China is the largest trading partner of India, and its growing importance in India's import basket is evident from Fig. 1.[3]

During the first decade of the 2000s, the surge in Chinese imports into the USA (an increase in volume of 159% in log terms, and from 0.90 to 2.63% as a share of GDP) attracted a lot of attention for its effect on the US economy (see, for example, Autor et al. 2013a, b, 2014, 2016). At the same time, the volume of imports from China into India increased by 374% in log terms and from 0.27 to 2.87% as a share of GDP. Hence, the effect of these imports on the Indian economy is also likely to be substantial and worthy of study.

Focusing on trade between India and China essentially implies that we are not delving into the consequences of trade between 'North' and 'South', but between 'South' and 'South'. Along with the growing import surge from China, India has experienced a diverging wage gap between skilled and unskilled workers over the considered period, as shown in Fig. 2. The wage gap between male and female

[1] Wood (1994) adopts this classification of countries into North and South in his book. In the subsequent discussions, we will adhere to the mentioned classification.

[2] India has the second largest labour force, China being the leading nation.

[3] The data on imports come from the IMF Direction of Trade Statistics database, and the data on Indian and US GDP come from the World Development Indicators database. Note that the data correspond to goods trade only.

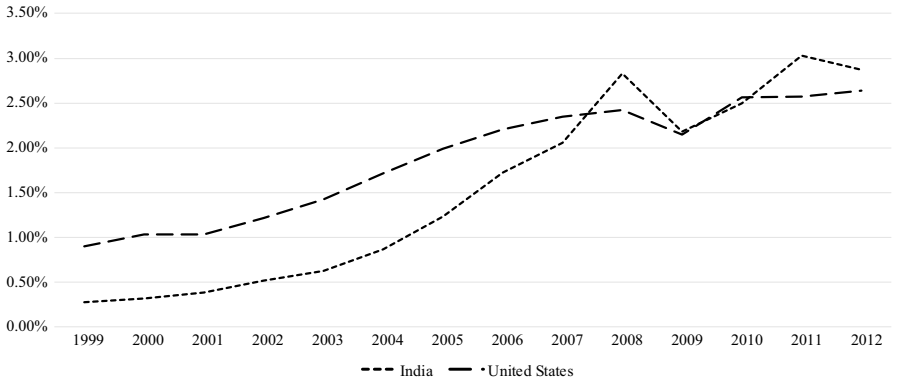

Fig. 1 Imports from China as a percentage of GDP, 1999–2012

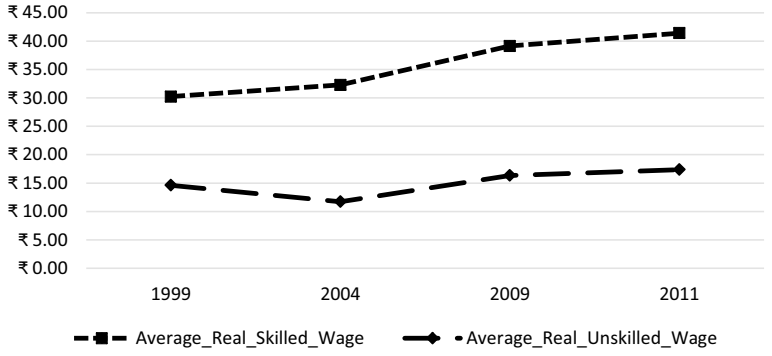

Fig. 2 Divergence between average real wages of skilled and unskilled workers. *Note* Skilled workers are those with at least 12th grade education (aged 18 years and above). The rest are categorized as unskilled workers. The individual-level weekly wage data (in rupees) for workers employed in the formal urban sector from the National Sample Survey Office (NSSO), India, have been transformed into constant prices by considering the consumer price index data (with base year at 2010) from International Financial Statistics (IFS) of the International Monetary Fund (IMF)

workers in India in Fig. 3 also does not show any signs of convergence over the period considered. In this scenario, our objective in this paper is to determine to what extent the import surge from China has contributed to the Indian labour market outcomes. Lack of sufficient literature in this respect has been a motivation for us.

Our analysis reveals that the contribution of import surge from China towards the growing wage difference between skilled and unskilled workers is insignificant. However, the effect of the Chinese import surge on wage divergence between male and female workers is significant. Section 2 presents a brief review of the literature on the impact of trade on wages of skilled vs unskilled workers and on the wages of male vs female workers. In Sect. 3, we elaborate on the methodology and data. In Sect. 4, we present the results, and finally in Sect. 5 we conclude.

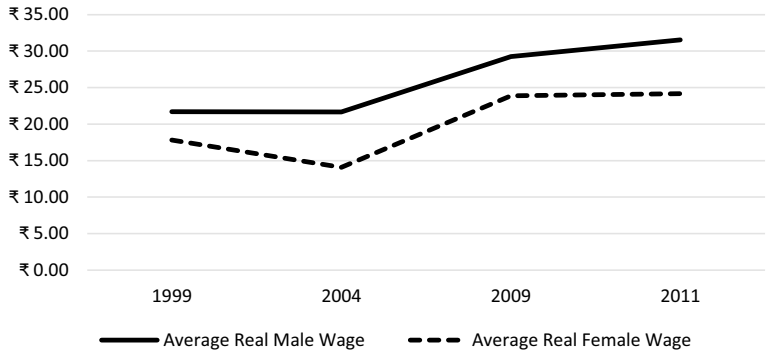

Fig. 3 Wage gap between male and female workers. Note: Individual-level weekly wage data (in rupees) are from NSSO, India. They have been transformed into constant prices with consumer price index data (base year 2010) from IFS, IMF

2 Review of the Literature

In this section, we present a brief review of the existing literature on the effects of international trade firstly on the wages of skilled vs unskilled workers and secondly on the wages of male vs female workers.

2.1 Literature on Wage Inequality between Skilled and Unskilled Labour

The story of trade expansion between countries in North and countries in South and its consequence on factor payments has been developed in a Heckscher–Ohlin–Samuelson framework. Considering skilled and unskilled workers to be two factors of production, a country abundant in unskilled workers (South) will export unskilled labour-intensive products, and a country abundant in skilled workers (North) will export skilled labour-intensive products. With a simultaneous removal of import tariffs on unskilled labour-intensive products in North and on skilled labour-intensive products in South, the wage gap between skilled and unskilled workers will rise in North and fall in South. A substantial amount of literature can be identified which explores the effects of trade expansion between North and South on the movement of factor payments in the countries concerned, with some confirming the theoretical predictions while some contradicting the predictions (Bound and Johnson 1992; Katz and Murphy 1992; Lawrence and Slaughter 1993; Leamer 1993; Berman et al. 1994; Sachs and Shatz 1994; Cragg and Epelbaum 1996; Anderton and Brenton 1999; Hanson and Harrison 1999; Feliciano 2001; Anderton et al. 2002; Mazumdar and Quispe-Agnoli 2002; Egger and Stehrer 2003; Attanasio et al. 2004; Robertson 2004; Edwards and Lawrence 2010; Antonelli and Quatraro 2010).

However, the issue of trade liberalization and its consequence on factor payments has not been limited to North–South trade only, but has also been extended to South–South trade or analysing the consequences of trade expansion between developing market economies. According to Davis (1996), a country could experience a

decline in the relative wages of unskilled labour if it is unskilled labour abundant in 'global' sense, but skilled labour abundant relative to the other countries lying in the same cone of diversification. In fact, according to Wood (1994), in Korea, Taiwan and Singapore, a declining wage inequality was observed soon after they shifted to export-oriented strategies. However, in the late 1980s the inequality seemed to increase as these countries shifted to more skill-intensive products, with the production of previously manufactured unskilled labour-intensive products being taken up by other East Asian countries who were gradually adopting export-oriented policies. Among the Southern nations, India forms an important case because of its involvement in numerous multilateral and regional trade agreements, and the latter's consequences on the conditions of its abundant working population. As a result, different studies have explored the issue from various perspectives (Dutta 2004a, b; Banga 2005; Reilly and Dutta 2005; Kumar and Mishra 2008; Chamarbagwala 2006; Chamarbagwala and Sharma 2011, Marjit 2003; Marjit et al. 2007; Marjit and Kar 2009). But these papers have not explored how India's growing trade relations with countries of a similar economic standard have affected the Indian labour market. In terms of factor endowments, China is very similar to India. But at the same time China is the biggest import partner of India. Hence, Chinese imports may have some impact on the relative wages of skilled and unskilled workers. The existing literature notes that Indian firms are more oriented towards capital and skilled labour-intensive technologies than large labour-intensive technologies. The opposite would be noticed in case of China. India's intricate pro-labour legislations, well-developed financial markets and the education system geared towards the generation of skilled personnel are all responsible for creation of large firms with higher capital and skill intensity (Wei and Balasubramanyam 2015).[4] Given the circumstances, it needs to be seen whether India's imports of relatively unskilled labour-intensive commodities from China are contributing towards India's growing wage inequality. By addressing this issue, the current paper hopes to add to the existing literature on trade and wage gap between skilled and unskilled workers in India.

However, few points need to be noted before we proceed with our analysis. India is characterized by a rigid labour market contributing to the immobility of labour within the country. Hence, the Heckscher-Ohlin model which corresponds to the long-run effects of trade and therefore considers perfect factor mobility within a country may not be ideal to study the incidence of wage inequality with trade liberalization in India. We therefore need to consider short- and medium-run models where factors are immobile or at least not perfectly mobile between sectors in a country. But if factors of production are immobile within a country, then it is possible to incur sector-specific returns.[5] Our consideration of sector-specific returns brings into

[4] Amiti and Freund (2010) note China's processing exports to be more skill intensive than non-processing exports. China being the production house for multinationals from USA and EU adds value to the skill-intensive intermediates imported from the parent companies in USA and EU. It is therefore likely that the country's processing exports would be more skill intensive.

[5] The moment we consider short- and medium-run models with factor immobility between sectors in a country, the Stolper–Samuelson theorem ceases to be valid. The Stolper–Samuelson theorem is a long-run model with perfect factor mobility across sectors, so that there could be no changes in sector-specific factor returns in a country with trade liberalization but only changes in overall factor returns.

limelight the industry the wage premium theory. Industry wage premium refers to a part of the workers' wage which can be explained by the workers' industry affiliation only, but not by workers' characteristics such as age, gender and education. Thus, given the feature of rigidity in Indian labour market, movement in industry wage premiums rather than in average wages due to trade liberalization seems to be more appropriate.

Before discussing how trade liberalization may affect industry wage premiums, it is relevant first to have a look at how labour market models recognized the importance of wage premiums, whereby workers are being paid wages above the competitive rates.

In standard competitive models, inter-industry wage differences could arise from differences in labour quality requirements such as different levels of skills. This explanation implies that workers with similar levels of skills must be paid the same across industries. However, this theory does not explain why the workers in all kinds of occupations in some industries are paid much more than in other industries. This brings us to the other competitive explanations for industry wage differentials. First, there are non-pecuniary aspects of work that have direct effects on the worker's utility. Skilled workers in hazardous industries may be paid more than the similarly skilled workers in industries with non-hazardous working conditions. Second, sometimes technical workers in some industries need to have special skills which may not be required in other industries (Dickens and Katz 1987). Because they have to invest in skills that are not easily transferrable to other sectors, they must be compensated for that investment. The third competitive explanation of wage differentials relates to differences due to labour demand or supply across sectors and/or imperfect labour mobility. Later on, a number of alternative theories on wage differentials have looked into the importance of efficiency wages and unions on explaining why firms pay above the competitive wages and why these effects differ across industries (Katz 1986; Stiglitz 1986; Yellen 1984; Dickens 1986). The efficiency wage theory realizes that firms find it profitable to offer wages above the competitive wages as such an action is expected to enhance labour productivity. In this context, the efficiency wage theory assumes that firms and industry characteristics are associated with industry wage premiums.[6]

Given the labour market models which recognize the existence of industry wage premiums, we may reconcile them with existing models on international trade. As already noted, industry wage premiums are consistent with short- and medium-run models of trade. In short- and medium-run models of trade, if the factor markets are perfectly competitive and labour is immobile across sectors, wages are determined by product price and the marginal product of labour. In this situation, wages in an industry increase along with industry tariff changes. This outcome is consistent

[6] There are different variants of efficiency wage models—the shirking model, the turnover model, the adverse selection model and the sociological model (Dickens and Katz 1987). According to the shirking model, wages would be high where monitoring is difficult. According to the turnover model, wages would be high where turnover and training costs are high. According to the adverse selection model wages would be high where it is difficult to assess workers' quality. According to sociological models, firms necessitating team work may pay higher wages.

with the predictions of the Ricardo-Viner specific factors model that trade liberalization will decrease the factor returns in previously protected industries. But in imperfectly competitive product and factor markets, trade liberalization may also affect factor returns through union bargaining power and trade-induced productivity improvements (Pavcnik et al. 2004). Trade unions may succeed in extracting higher rents in industries with greater trade liberalization. Evidence of positive association between trade liberalization and productivity improvements due to increased competition has also been documented in the existing literature (Harrison 1994; Krishna and Mitra 1998; Kim 2000; Pavcnik 2002; Fernandes 2001; Hay 2001; Muendler 2002). Hence, industry affiliation is an important medium through which trade liberalization may affect wages in short- and medium-run models. However, it may not be possible to predict in advance the direction of changes in workers' wages if the industry affiliation of a worker is considered.

Considering industry wage premiums also allows us to infer whether workers in heavily protected industries earn more than the workers in less protected industries after controlling for human capital characteristics of workers. Wage premiums therefore help in determining the changes in relative wages of skilled or unskilled workers, as more trade liberalization in industries with higher proportions of skilled labour will produce either a decrease (according to Ricardo-Viner model) or an increase (on account of union pressure or productivity improvements due to increased import competition) in their relative wages. In this paper, with the industry wage premium theory at the background, we therefore try to assess the impact of enhanced Chinese imports on wages of Indian workers classified on the basis of skill levels.

2.2 Literature on the Gender Wage Gap

The existing literature, both theoretical and empirical, has tried to shed some light on the issue of trade liberalization and the consequent wage gap between male and female workers. In the Heckscher-Ohlin-Samuelson framework, trade liberalization tends to narrow the gender wage gap in an unskilled labour abundant country. As an unskilled labour abundant economy opens up to trade and specializes in unskilled labour-intensive products, demand for unskilled labour will increase relative to skilled labour, producing increased relative wages for unskilled labour. As women are mostly in unskilled labour-intensive jobs, due to gender inequalities in access to resources, education and time, wages of women will rise relative to men, leading to decreased gender wage gap. Becker (1957) argues that trade liberalization produces greater competition which attempts to minimize cost by allocating labour to most productive use. Hence, trade liberalization would then decrease gender wage gap by addressing the inefficient allocation of labour which could arise out of gender discrimination. Becker, however, predicted that the gender wage gap would not change in highly concentrated industries which are not open to trade. They still would continue to discriminate between male and female employees.

On the contrary, Menon and Rodgers (2009) develop a theoretical model by incorporating features of a discriminatory firm within a competitive market framework

to show that the neoclassical predictions of a reduction in wage gap due to trade liberalization need not always hold. The gender wage gap may widen or narrow depending on changes in the discrimination coefficient.[7] Although competition from trade reduces the profit of the firms in concentrated sectors, if they are highly biased against female workers, they may still continue to discriminate by maintaining male wages at the expense of female wages. Under such circumstances, the discrimination coefficient rises and the gender wage gap may widen. This finding would be consistent with the fact that female labour force has lower bargaining power and is usually concentrated in lower paying jobs. Juhn et al. (2014) build a model to demonstrate the effects of trade-induced skill-biased technical change on gender inequality. They argue that trade liberalization produces technological upgrading which reduces the need for physically demanding skills in blue collar jobs, thereby increasing the relative share of female workers and their productivity. An increase in productivity is associated with a rise in relative wages for female workers. In white collar jobs, on the contrary, trade liberalization is unlikely to have any effect on the relative importance of physically demanding skills. Hence, the relative position of women in terms of their employment share and wages would not change.

Relevant empirical literature documents evidence in favour of either a declining or a growing wage gap. Oostendorp (2009) determined the impact of globalization (through trade openness and FDI net inflows) on 83 countries and 161 occupations. He found a narrowing impact of trade and FDI net inflows on the wage gap between male and female workers in low skill occupations for both low-income and high-income countries. In high skill occupations, he did not find any significant effect of trade on the wage gap but a widening effect of net FDI inflows on the wage gap only in low-income countries. Black and Brainerd (2004) focused on the impact of trade on wage discrimination against women workers in US industries. They found that the gender wage gap narrowed faster in concentrated industries exposed to trade shocks than in competitive industries exposed to trade shocks. Benguria and Ederington (2017) investigate the effects of growing Chinese imports on wage inequality between male and female workers in Brazil. They found that greater trade exposure was associated with a declining gender wage gap. This decline was induced by the movement of female workers into higher paying jobs, as well as by higher overall wages in female-oriented occupations. Juhn et al. (2014) find empirical support for their theoretical model using firm-level data for Mexico. They note that firms entering export market upgrade their technology, which complements more employment of women workers in blue collar jobs and their higher relative wages.

Artecona and Cunningham (2002) examined the impact of trade liberalization on the gender wage gap in the manufacturing sector of Mexico. A comparative analysis on wages on the basis of gender differences before and after Mexico's trade liberalization seems to suggest that the wage gap has increased. However, the rising wage gap was more due to a higher skill premium awarded to men. Evidence was found

[7] Firms with higher discrimination coefficient employ relatively fewer females and pay them lower wages, contributing to higher gender wage gap. It takes a value between 0 (no discrimination) and positive infinity.

in support of a reduction in wage discrimination due to trade liberalization. But a lack of simultaneous attempts to improve the skill levels of women has triggered a diversion of female wages to male wages. Berik et al. (2004) attempted to test the hypothesis that wage discrimination by sex is incompatible with trade-induced competitiveness for Korea and Taiwan during 1980s and 1990s. They instead found that greater openness in concentrated industries in both countries was associated with a rising gender wage gap. Yamamoto (2007) tests Becker's hypothesis for Japan in industries employing high techniques of production (concentrated) and in industries employing low techniques of production (competitive). On the basis of rising export shares, he found the gender wage gap widened in low-tech industries and narrowed in high-tech industries. The gender wage gap, however, has widened in all industries on account of increased import competition.

Similar studies on India can be identified. For instance, Menon and Rodgers (2009) test their theoretical model on the Indian labour market. They find evidence of a widening gender wage gap in India's concentrated manufacturing industries. Reilly and Dutta (2005) examined the relationship between gender pay gaps in India and trade liberalization measures at industry-specific levels. However, they do not find any significant influence of trade on the gender wage gap. But these papers did not consider the fact that the effects of trade expansion on the gender wage gap may vary depending upon the trading partners and the composition of trade. Some countries may play a significant role in influencing the wage gap, while the role played by some other countries may be insignificant. It is this gap in the existing literature we fulfil by analysing the effects of India's trade with its largest import partner China, on former's gender wage gap.

3 Methodology and Data

In order to discern the effect of Chinese imports on Indian industry wage premiums, we adopt the two-step estimation procedure developed by several previous studies (see Gaston and Trefler 1994, Attanasio et al. 2004, Goldberg and Pavcnik 2005, Pavcnik et al. 2004, and Kumar and Mishra 2008). Let there be $i=1,2,\ldots,n$ workers in industry $j=1,2,\ldots,k$. We index $\ln\left(w_{ij}\right)$ as the natural logarithm of the weekly wages of worker i in industry j. H_{ij} is a vector of worker i's characteristics in industry j, such as education, age, gender and geographic location. I_{ij} is the jth industry dummy for worker i.

We can estimate the industry wage premiums by means of the following regression for each year t in the first step:

$$\ln\left(w_{ij}\right) = \beta_0 + \beta_H H_{ij} + wp_j I_{ij} + \varepsilon_{ij} \tag{1}$$

The coefficient of industry dummy, wp_j, captures that part of the variations in worker i's wage attributable to the worker's affiliation to industry j only.

In the second step, the estimated wp_j are pooled over time and the estimates are regressed upon τ_{jt} which represents the industry tariff to determine how trade liberalization through changes in tariff rates has been impacting industry wage premiums.[8]

$$wp_{jt} = \beta_0 + \beta_p \tau_{jt} + \gamma_t + \delta_j + u_{jt} \tag{2}$$

The coefficient β_p estimates the effects of changes in tariffs on the industry wage premium. γ_t is the year fixed effects and controls for time-varying aggregate shocks to the economy, such as changes in the exchange rate. δ_j represents the time-invariant industry characteristics. As an alternative, we also estimate Eq. (2) by considering Chinese imports into India as a measure of trade exposure, instead of industry tariff rates.

A negative (positive) sign for β_p implies that if trade liberalization in the form of lower import tariff rates is more in unskilled labour-intensive sectors, the wage of unskilled labour relative to the all industry average will rise (fall), leading to decreased (increased) wage inequality. If trade liberalization is more in sectors employing more skilled labour, a negative (positive) sign will imply that wages of skilled labour will rise (fall) relative to the all industry average. Hence, wage inequality will increase (decrease). The negative sign of β_p is consistent with a productivity improvement argument associated with increased import competition or possibly with a union pressure argument, while the positive sign of β_p is more in line with the predictions of Ricardo-Viner model. However, if higher imports are considered as an indicator of trade liberalization, then a negative (positive) sign of β_p will imply that more imports from unskilled labour-intensive sectors will lead to increased (decreased) wage inequality, while more imports from skilled labour-intensive sectors will lead to decreased (increased) wage inequality. In this respect, the negative sign is consistent with the predictions of Ricardo-Viner model, while the positive sign is consistent with the productivity improvement argument associated with increased import competition or possibly a union pressure argument.

Given the fact that the dependent variable in our second-stage regression has been estimated from the first-stage regression, the procedure introduces additional noise in the second-stage regression model. As a result, the second-stage estimator may have a larger variance (Pavcnik et al. 2004). The industry wage premiums will have heteroscedastic error terms and will depend upon the variance of estimated wp_j from regression Eq. (1). We address heteroscedasticity by using robust estimate of standard errors while estimating the regression Eq. (2).[9]

The problem with the estimation of Eq. (2) is that the level of protection in an industry could be endogenous. Politicians may choose to protect more an industry with low average wages (Gaston and Trefler 1994). Moreover, the level of protection may be correlated with unobserved industry factors, e.g. industry lobbying. In the presence of such endogeneity, the estimated coefficient β_p may be biased and

[8] As an alternative as suggested by Attanasio et al. (2004), we could also regress $\ln(w_{ij})$ directly upon the industry tariffs in regression (1) and examine the changes in outcome.

[9] If there is serial correlation also, both can be addressed by computing robust standard errors.

inconsistent. The problem can be overcome by 2SLS method in which we instrument the variable for trade protection by another variable. Following Autor et al. (2013a, b, 2014, 2016), the instrument that we choose is the Chinese imports into other developing countries in Asia in a manner that we describe below.

Thus, the modified regression equation to be estimated in the second step can be represented as:

$$wp_{jt} = \beta_0 + \beta_p P_{Ojt} + \gamma_t + \delta_j + u_{jt} \tag{3}$$

P_{Ojt} is a predicted value of Chinese exports by sector to India, formed by regressing Chinese exports by sector to India on corresponding exports to developing countries other than India.

To assess the effect of Chinese imports on the gender wage gap in India, we regress the individual wages in India on Chinese imports into India by sector, a female dummy variable, an interaction term between these two independent variables to determine the complementarity between them, and a vector of control variables such as year, sector, district and education. The regression equation is as follows:

$$w_{ijt} = \beta_0 + \beta_M M_{jt} + \beta_F F_i + \beta_{INT} F_i M_{jt} + \beta_X X'_{ijt} + u_{ijt} \tag{4}$$

We further check the robustness of our results by using an instrumental variable approach similar to Autor et al. (2013a, b, 2014, 2016). The chosen instruments are again Chinese exports to other developing countries in Asia.

The household-level data on weekly earnings of urban workers and their characteristics, e.g. education, age, gender, state of residence, on the basis of National Industrial Classification (NIC) of Economic Activities, are compiled from the Employment–Unemployment surveys conducted by the National Sample Survey Organization (NSSO) of Government of India. Data from four rounds of the survey have been used in our analysis—the 55th round (1999–2000), 61st round (2004–05), 66th round (2009–10) and 68th round (2011–12). Our sample consists of only regular wage and salaried employees.[10]

The data on imports are from UN COMTRADE database. The data on ad valorem tariff rates are from the UNCTAD TRAINS database. Both can be accessed online from World Bank's World Integrated Trade Solution Web site.

4 Results

In this section, we present the results for industry wage premiums and gender wage inequality.

[10] Regular workers are identified to be those engaged in formal sectors. Informal sector workers are not included as a part of analysis. The NSSO, under the Ministry of Statistics and Program Implementation of the Government of India, conducts large-scale household surveys on various socio-economic indicators at regional, subregional and all India level.

Table 1 Estimated correlation coefficients between shares of skilled workers and import exposure indicators

Variable	Chinese imports into India	Ad valorem tariff rates
Shares of skilled workers	0.1548***	−0.0813
	(<0.001)	(0.066)

Figures in parentheses are corresponding p values. ***$p < 0.01$

Table 2 Summary statistics on estimated industry wage premiums

	Observations	Mean	Standard deviation	Minimum	Maximum
Industry wage premium	1138	6.571012	0.5971393	3.251949	9.081638

4.1 Chinese Imports and Industry Wage Premium

Before proceeding with the analysis, we determine the pairwise correlation of the industry-wise share of skilled workers (defined as those with an education of at least 12th standard—the end of secondary school) in total workers with Chinese imports into India and the Indian ad valorem import tariff rates. Simultaneously, the correlation of industry-wise share of unskilled workers (those with education of less than 12th standard) with Chinese imports into India and the Indian ad valorem import tariff rates are ascertained. The coefficients presented in Table 1 imply that in contradiction to our predictions, India applies higher tariffs on imports from unskilled labour-intensive sectors and imports less from such sectors. It imports more from the skilled labour-intensive sectors while applying lower tariffs on imports of such sectors from China.[11] However, it is to be noted that coefficients with respect to tariff rates are not significant, although they have expected signs. Henceforth, we do not report the results with respect to ad valorem tariff rates on Chinese imports.

4.1.1 Two-Stage Regression Estimates

On estimating regression Eq. (1), we arrive at our estimates for industry wage premiums. Table 2 presents the summary statistics on estimated industry wage premium.

The results of the second-stage regression (Eq. 2) are reported in Table 3. We consider both a fixed effects and a random effects model.

The estimated coefficient for Chinese imports into India is positive, implying that more imports are associated with higher relative industry wage premiums. Since according to our database, India has been importing more from skilled labour-intensive sectors over the considered years, the higher wages of corresponding skilled

[11] These results are, however, not necessarily in contradiction to China's comparative advantage in low-skill labour-intensive products as China is involved in significant volume of processing trade, with the intermediate stages being consistent with the country's factor abundance (Amiti and Freund 2010).

Table 3 Regression results corresponding to Eq. (2)

	Industry wage premium	
	Fixed effects	Random effects
Log of Chinese exports to India	0.0010282	0.0010282
	(0.940)	(0.949)
Constant	6.174977***	5.946732***
	(<0.001)	(<0.001)
Observations	514	514
R-squared	0.4298	0.6254
F-stat	144.81***	

P values in parentheses

***$p<0.01$, **$p<0.05$

workers relative to industry average are consistent with the productivity improvement argument associated with increased import competition or possibly with a union pressure argument. This would accordingly lead to increased wage inequality. However, the estimate is not statistically significant, nor is it very large. Hence, this mechanism is not very important.

4.1.2 Instrumental Variable Estimation

Our estimates of the effect of Chinese exports to India on industry wage premiums almost certainly suffer from an endogeneity problem. It could be that depth of Chinese import penetration into a given sector in India is affected by existing wages in that industry as much as the reverse. Also, despite our use of sector and time dummy variables in the estimation, there are undoubtedly some omitted variables that could also be affecting our estimates.

To correct for this potential issue, we use a technique similar to that used in Autor et al. (2013a, b, 2014, 2016) and instrument for Chinese exports to India using the sum of Chinese exports to South Korea, Bangladesh and Sri Lanka by sector during the same time period. These three countries also experienced similar surges in imports from China. Furthermore, they are also three Asian countries that, like India and China, are members of the Asia–Pacific Trade Agreement (APTA, also known as the Bangkok Agreement) regional trading bloc.[12] It is therefore likely that China's exports to these countries will be highly correlated with its exports to India, making these variables potentially strong instruments. However, it seems unlikely that they would have any effect on wages in India except through their correlation with Chinese exports to India.

[12] Mongolia and the Lao PDR are also APTA members, but are excluded from this analysis due to a lack of adequate trade data. As noted below, the three countries included are sufficient for our instrumental variables analysis.

Table 4 Regression results corresponding to Eq. (3)

	Fixed effects		Random effects	
	First-stage regression log of Chinese exports to India	Second-stage regression industry wage premium	First-stage regression log of Chinese exports to India	Second-stage regression industry wage premium
Log of Chinese exports to India		0.00225 (0.910)		−0.00113 (0.691)
Log of Chinese exports to APTA countries	0.512*** (<0.001)		0.868*** (<0.001)	
Year 2004	0.747*** (<0.001)	0.0428 (0.238)	0.537*** (0.00282)	0.0469 (0.107)
Year 2009	1.580*** (<0.001)	0.589*** (<0.001)	1.246*** (<0.001)	0.599*** (<0.001)
Year 2011	1.941*** (<0.001)	0.829*** (<0.001)	1.487*** (<0.001)	0.831*** (<0.001)
Constant	1.889*** (0.000112)	6.178*** (<0.001)	−0.824*** (<0.001)	6.197*** (<0.001)
Observations	1138	1138	1138	1138
R-squared	0.283			
Number of ISIC 3.1 Sectors	308	308	308	308
F-stat	81.42***			

P values in parentheses

***$p < 0.01$, **$p < 0.05$

We test these hypotheses formally in the first column of Table 4.

A fixed effects estimator is used to regress Chinese exports to the other APTA countries on Chinese exports to India by sector-year. The coefficients on this variable are significant, and the F-statistic from the first-stage regression is 81.42, which indicates that this instrument is very strong.

The second column shows the results from a 2SLS panel data regression of industry wage premiums in India on Chinese exports to India, which are, in turn instrumented for by Chinese exports to the other countries. As we see here, similar to the findings in Table 3, the coefficient on Chinese exports by sector is positive, implying that Chinese imports are not contributing to decreased wage inequality, as India imports more of skilled labour-intensive products. These results are consistent with the Ricardo-Viner model, but we cannot make any definite claim as the coefficient is insignificant and close to zero.[13]

In the third and fourth column of Table 4, we repeat this analysis with a random effects estimator using 2SLS. The results are not substantially different. The first-stage regression shows that Chinese exports to other APTA members are highly predictive of Chinese exports to India. However, the instrumented variable of Chinese exports to India is not predictive of industry wage premiums in India, as shown in the fourth column.

4.2 Chinese Imports and Gender Wage Gap

The wage differential for male vs. female workers in India is rather large. In our data, the overall wage differential is 38.2% across the entire sample (see Column 1 of Table 5). When we add controls for education, sector and district (Column 2), the differential falls slightly, but not very greatly, to 35.9%. Notably, while wages are increasing throughout the data sample, the wage differential is increasing in percentage terms as well. We therefore look to see if there is any causal link between the growth in Chinese exports to India and the growth in wage inequality by sex in India.

We begin by noting that imports from China have little to no impact on average wages in India. In Column 3 of Table 5, which only uses year controls, we find that there is a modestly negative correlation between imports and wages. However, due to the absence of any control variables, we cannot make causal claims from this result. When we add education, sector, and district controls in Column 4, the coefficient on imports becomes virtually zero and insignificant. Hence, while imports from China are associated with lower wages in India, this association can be better explained by the types of goods that India is importing, rather than a causal effect of Chinese imports on Indian wages.

However, while average wages do not appear to be affected by Indian imports from China, the wage differential between male and female workers is. In Column 5 of Table 5, we regress the log of wages on a female dummy variable, the log of

[13] Differences in sample sizes between Tables 3 and 4 may also account for differing results.

Table 5 Sex and import value regressions corresponding to Eq. (4)

	Log of wages	Log of wages	Log of wages	Log of wages	Log of wages	Log of wages
Female dummy variable	−0.382***	−0.359***			−0.357***	−0.335***
	(<0.001)	(<0.001)			(<0.001)	(<0.001)
Log of imports from China			−0.0206***	−0.00302	−0.0196***	−0.0014
			(<0.001)	(0.209)	(<0.001)	(0.557)
Female–imports interaction					−0.0258***	−0.0089***
					(<0.001)	(<0.001)
Constant	6.347***	5.905***	6.350***	5.863***	6.417***	5.956***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Year controls	X	X	X	X	X	X
Education controls		X		X		X
District controls		X		X		X
Sector controls		X		X		X
Observations	98,360	98,285	98,360	98,285	98,360	98,285
R-squared	0.239	0.517	0.237	0.506	0.258	0.517

P values in parentheses

***$p < 0.01$, **$p < 0.05$

imports from China and an interaction term between the two while controlling only for year. The wage differential is large and significant on its own, and the coefficient on imports is also negative and significant. Most interestingly, the coefficient on the interaction term is also negative and significant. Therefore, not only are these variables important determinants of wages in India on their own, but they seem to have complementary effects on each other.

Column 6 repeats this analysis, but adds education, sector and district control variables. As with the previous columns, adding the extra controls makes the coefficient on imports virtually zero and insignificant while slightly reducing the size of the (still large and significant) average wage differential. Despite the coefficient on imports becoming insignificant, the coefficient on imports interacted with a female dummy variable remains negative and significant at the 1% level. While the size of the coefficient seems at first to be small with a value of -0.00,887, it is still economically meaningful. The standard deviation of the import variable across sectors within a year is 461%. Therefore, an increase in one standard deviation in a sector's imports leads to a 4.09% increase in the wage differential between men and women (more than 12% of the average wage differential). Also, the average sector's imports from China increased by 257% between 1999 and 2011. Using this number, the average sector's wage differential would increase by about 2.28% due to an increase in Chinese imports.[14]

We could provide a plausible explanation for the documented negative association between Chinese imports and female wages in India. If females in the urban formal sector of India are disproportionately employed in skilled labour-intensive jobs, then imports of more skilled labour-intensive products from China would disproportionately depress the wages of female workers following the Ricardo-Viner model of trade and contribute to the gender wage gap. Table 6 shows the fraction of both male and female workers in our data in skilled and unskilled labour. Our data support the view that in urban formal sector, women are disproportionately sorted into skilled employment, while men are disproportionately sorted into unskilled labour-intensive jobs.

We can justify our findings by noting Saure′ and Zoabi (2014). According to them, female labour-intensive jobs in formal sector are capital intensive, while male labour-intensive jobs are labour intensive (physically demanding). Hence, relatively more women could be employed in skilled labour-intensive jobs, while more men in unskilled labour-intensive jobs. Hence, if India imports more of skilled labour-intensive products from China, there would be a tendency for female wages to be negatively affected.

[14] 4.09% = 461% * − 0.00887 (that is, the average within-year standard deviation of imports across sectors, times the coefficient on imports interacted with female dummy variable) and 2.28% = 257% * − 0.00887 (the average increase in imports within a sector between 1999 and 2001, times the coefficient on imports interacted with female dummy variable).

Table 6 Skilled versus unskilled workers

Proportion of skilled male workers	Proportion of unskilled male workers	Proportion of skilled female workers	Proportion of unskilled female workers
0.452962582	0.547037418	0.51477291	0.48522709

Table 7 First-stage instrument regressions

	Sex and import interaction	Log of import value
Sex and APTA Export interaction	0.871***	
	(<0.001)	
Exports to APTA Countries		1.010***
		(<0.001)
Constant	0.173**	−2.357***
	(0.0395)	(<0.001)
Year controls	X	X
Education controls	X	X
District controls	X	X
Sector controls	X	X
Observations	98,285	98,285
R-squared	0.969	0.979

P values in parentheses

***$p<0.01$, **$p<0.05$

4.2.1 Instrumental Variable Estimation

While we use several control variables in the regressions above, it is still possible that our regressions are suffering from omitted variables bias. Therefore, we again use an instrumental variables technique similar to that used by Autor et al. (2013a, b, 2014, 2016) analysis of the 'China Shock' in the USA; we instrument for Chinese exports to India using Chinese exports to similar countries. In this case, we again use the APTA member nations—South Korea, Sri Lanka and Bangladesh—as reference countries.

Other APTA members' imports of Chinese goods and services serve as good instruments for our analysis. These imports will be strongly correlated with Indian imports from China. Furthermore, especially once we add our other control variables, it seems unlikely that other countries' imports of Chinese goods and services could affect wages in India except as mediated by Indian imports from China.

The results of the first stage of our instrumental variables regression based on a fixed effects model[15] are given in Table 7. Because Indian imports from China appear twice in our main wage regression—once separately and once interacted with the worker's sex—we create two sets of instruments. The first is that the APTA members' imports from China interacted with the sex of the Indian worker for that observation. The second is the APTA members' imports separately. As we can see from the table, both sets of instruments are highly correlated with the variables that they instrument for.

[15] Because there were significant differences in Table 5 between the regressions that used all fixed effects controls and those that did not, we report only the fixed effects regressions in this section.

Table 8 Instrumental variables regressions

	Log of wages	Log of wages	Log of wages	Log of wages
Log of import value (instrumented)	−0.0249***	−0.00139	−0.0211***	−0.000466
	(<0.001)	(0.759)	(<0.001)	(0.918)
Female dummy variable	−0.425***	−0.359***	−0.355***	−0.332***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Female and import interaction (instrumented)			−0.0276***	−0.00971***
			(<0.001)	(<0.001)
Constant	6.438***	5.929***	6.423***	5.943***
	(<0.001)	(<0.001)	(<0.001)	(<0.001)
Year controls	X	X	X	X
Education controls		X		X
District controls		X		X
Sector controls		X		X
Observations	98,360	98,285	98,360	98,285
R-squared	0.255	0.517	0.258	0.517

P values in parentheses

***$p<0.01$, **$p<0.05$

Table 8 shows the results of the second-stage regressions based on a fixed effect model. These results are not greatly changed from the results in Table 5, indicating that omitted variables bias is probably not a first-order concern. Columns 1 and 2 of the table show the regression without an interaction term and both without and with the education, district and sector controls, respectively. Columns 3 and 4 include the interaction term.

We focus on the results in the last column that includes the interaction term and all controls. Again, the coefficient on the female dummy variable is negative, significant and large, indicating a wage differential of over 33%. The coefficient on the (now instrumented) imports from China by sector is again virtually zero and insignificant. However, the coefficient on the female dummy interacted with imports from China (now instrumented) is once again negative and significant. Its magnitude is also slightly larger than the coefficient from the analogous regression in Tables 5 and 6.

While a coefficient of −0.00971 seems small, again, this must be noted in comparison with the large increase in Indian imports from China during the sample period. The within-year variation of imports across sectors in India is about 461%. If we move from a sector with a relatively low level of imports from China to a sector with imports one standard deviation higher, then the increase in wage differential will be 4.48%. The average increase in imports within sectors across the sample time period is about 257%. Therefore, the average sector experiences an increase of 2.50% in the wage differential (or about 7.5% of the total differential) attributable

to imports from China during the sample time period.[16] Because of our instrumental variables procedure, we can claim that there is good evidence of a causal link between the increase in Indian imports from China and these changes in the wage differential both across and within sectors.

5 Conclusion

In this article, we try to determine the effects of a Chinese import surge on wage movements in India by differentiating between workers in different industries as a means of exploring the changes in the wage premiums between skilled and unskilled workers in India. We also determine the effects of Chinese imports on the wage divergence between male and female workers. The existing literature on the exposure of the Indian labour market to international trade is silent on the considered points. We considered the industry wage premium, given the rigid labour market conditions in India. Our data analysis reveals that the Chinese import surge is not significantly effective in influencing the wage movements of workers across different industries in India and that this channel is not particularly effective at explaining the wage gap between skilled and unskilled workers in India. However, once we go deeper and try to analyse the data at a more disaggregated level, we find that its contribution towards the gender wage gap in India is significant both statistically and economically. Our results are restrictive in the sense that we limit our data set to the formal sector only. Considering data from the informal sector may produce more robust results, but we are constrained by availability of exhaustive data on informal sector workers. However, our extensive control variables, plus our instrumental variables procedure, give us confidence that we are making claims that can plausibly apply to the Indian labour market as a whole. Furthermore, we have considered sectoral import data from China without any consideration for processing trade, whereby intermediate goods are imported into a country, assembled and re-exported. China is involved in a substantial amount of this type of trade. If that is taken into account, the Chinese exports into India may have a different skill composition when looked at through the lens of value-added. In either case, the effect on wages across industries in India appears to be insignificant, but it is widening the wage gap between the sexes in India.

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[16] 4.48% = 461% * − 0.00971 (that is, the average within-year standard deviation of imports across sectors, times the coefficient on imports interacted with female dummy variable) and 2.50% = 257% * − 0.00971 (the average increase in imports within a sector between 1999 and 2001, times the coefficient on imports interacted with female dummy variable).

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