WP-2015-018

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Indira Gandhi Institute of Development Research, Mumbai
June 2015
http://www.igidr.ac.in/pdf/publication/WP-2015-018.pdf

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Purna Banerjee and C. Veeramani

Indira Gandhi Institute of Development Research (IGIDR)

General Arun Kumar Vaidya Marg

Goregaon (E), Mumbai- 400065, INDIA

Email(corresponding author): veeramani@igidr.ac.in

Abstract

In the context of increasing contribution of developing countries in world trade, an important question is whether trade can be used as an instrument to stimulate higher participation of women in the labour market? Trade and industrial liberalization undertaken during the 1990s and 2000s marked the end of India's nearly four decade experiment with state directed, heavy industry based, and import substituting industrialization. In this context, we analyse the role of various trade and technology related factors in determining female employment intensity (FEI), in a panel of India's manufacturing industries for the period 1998-2008. We find that import tariff rates exert a negative effect on FEI, supporting the hypothesis that firms, when exposed to international competition, tend to reduce costs by substituting male with female workers. Further, the relative demand for female workers increases to the extent that trade liberalization leads to resource reallocation in favour of unskilled labour intensive industries where India holds comparative advantage. By contrast, greater use of new technology and capital intensive production biases the gender composition of workforce against females. Liberalization has not led to large growth of female employment in India's organized manufacturing sector because the resource reallocation effect has not been strong enough to offset the negative technology effect.

Keywords: female employment intensity, trade liberalization, manufacturing, India

JEL Code: J16, J21, J82, F16, F66

Acknowledgements:

Earlier versions of the paper were presented at the 55th Indian Society of Labour Economics (ISLE) Conference 2013 (JNU, New Delhi), IMR Doctoral Conference, (IIM, Bangalore) and IGIDR Silver Jubilee Conference (IGIDR, Mumbai). The authors are thankful to participants for their helpful comments.

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Purna Banerjee and C. Veeramani

Indira Gandhi Institute of Development Research (IGIDR)

Gen A K Vaidya Marg, Goregaon East, Mumbai - 400065, India

Email: : purna@igidr.ac.in , veeramani@igidr.ac.in

1. Introduction

Promotion of gender equality and empowerment of women is one of the Millennium Development Goals (MDGs) that the international community, under the aegis of the United Nations, has been pursuing since 2000 (UN, 2014). Needless to say, creation of greater employment opportunities for women is crucial for the achievement of this goal. Furthermore, participation of women in productive employment plays an instrumental role in the achievement of several other MDGs such as ending hunger and poverty, reducing child mortality, improving maternal health and attaining universal primary education. A number of studies show that having an independent source of income gives women greater bargaining power within the household, which in turn leads to better health outcomes for children (see Duflo, 2012 for a survey).

In the context of increasing contribution of developing countries to world trade, an important question is whether trade can be used as an instrument to stimulate higher participation of women in the labour market? Greater international integration of the domestic market is expected to improve a country's export competitiveness and growth through efficient resource allocation, greater specialization, diffusion of international knowledge and heightened competition. These changes, in turn, are likely to exert major impacts on employment and other labour market outcomes, which could be gender differentiated. There are four different channels through which trade liberalization can exert a gender differentiated impact on employment: cost reduction effect, resource reallocation effect, technology effect and scale effect. These channels are discussed in detail in Section 2.

India has initiated a process of major structural adjustment since the early 1990s. Trade and industrial liberalization undertaken during the 1990s and 2000s marked the end of India's nearly four decade experiment with state directed, heavy industry based, and import substituting industrialization. The quantitative restrictions (QRs) on importing capital goods and intermediates were mostly dismantled in 1992. However, the ban on importing consumer goods continued, with some exceptions, until the late 1990s. Apart from the removal of QRs, import tariff rates in the manufacturing industries were also gradually reduced. Following the tariff reductions introduced in the March 2007 budget, India has emerged as one of the world's low protection and open industrial economies (Pursell et al, 2007).

A number of empirical studies, reviewed in the next section, show that trade liberalization and export orientation have had a beneficial effect on women's employment opportunities in several developing countries. However, India has witnessed a declining trend in female workforce participation rates since the late 1990s[1]. Further, India's labour force participation rate (LFPR) for women, particularly in the urban sector, is much lower than the norm for countries with similar levels of development (Bhalla and Kaur, 2011; Thomas, 2012). Thus, unlike in the case of other developing countries, liberalization has not led to higher employment opportunities for women in India. However, the trends observed at the aggregate level could mask important heterogeneities across industry groups. In order to understand why trade liberalization in India has failed to generate a beneficial impact on female employment, it is necessary to consider variation across industries both in terms of female employment intensity and degree of trade openness.

In this paper, we analyse the role of various trade and technology related factors in determining female employment intensity (FEI), in a panel of India's organized (formal) manufacturing industries for the period 1998-2008. To the best of our knowledge, these issues have not been empirically

[1] This trend is particularly stark in rural areas. See Mazumdar and Neetha (2011), Chowdhury (2011), Kannan and Raveendran (2012), Chen and Raveendran (2012) and Abraham (2013). Rangarajan et al (2011, 2014) who argue that the declining labour force participation rate (LFPR) of women is mainly on account of withdrawals of women from the workforce due to rising participation in education among young females as well as the general improvement in rural income. While most of these studies posit some possible explanations for the broad trends in female LFPR, there are very few studies that econometrically test the underlying hypotheses using detailed data at the industry level.

examined in the context of India, a country which is home to about 17 percent of the world's female population and to roughly one-third of the world's poor.

The focus of the current work on organized manufacturing industries is motivated by the fact that these jobs are usually more sought after compared to poorly paid informal work. Organized sector jobs provide a number of benefits in terms of higher wages, higher job security, better working conditions and greater opportunities for upward mobility[2]. By contrast, a job in the unorganized sector, more often than not, is a fall back option when formal sector jobs are not available. Understanding the determinants of FEI in the organized manufacturing industries is crucial as higher employment of women in these industries usually reflect broad improvements in the quality of their employment. While data availability dictated the time period of our analysis (1998-2008)[3], it may also be noted that the most far-reaching trade liberalization initiatives, especially in consumer goods industries, were undertaken in India during the study period, since the late 1990s.

The key results from this paper may be summarized as follows. The overall FEI, defined as the share of female employment in total employment, in the formal manufacturing sector in India is quite low at about 11%. However, FEI varies considerably across industries with the values being the highest and growing in industries which are unskilled labour intensive and export oriented. We find that import tariff rates exert a negative effect on FEI supporting the hypothesis that firms, when exposed to international competition, tend to reduce costs by substituting male with female workers. The relative demand for female workers would also increase to the extent that trade liberalization leads to resource reallocation in favour of unskilled labour intensive industries where India holds comparative advantage. The resource reallocation effect, however, has not been strong enough to generate huge employment opportunities for women in India. Inflow of foreign technology, via FDI and capital goods imports, has created a bias against female employment.

[2] For the year 2009-10, organized manufacturing sector accounted for 10.52% of employment and 65.02% of value added in the total manufacturing sector (Kapoor, 2014).
[3] We use data at the 4-digit ISIC level from the UNIDO's industrial database. For India, gender-wise data on manufacturing employment is available at the 4-digit level since 1998 only.

The rest of the paper is organized as follows. Section 2 provides a review of related theoretical and empirical literature. Section 3 provides a descriptive account of the general trends and patterns of female employment in India's organized manufacturing sector. Section 4 sets out the hypotheses concerning the effects of various trade and technology related variables on FEI. This section also provides the definition of the various explanatory variables. Section 5 discusses the regression methodology and data sources. Results of the econometric analysis are discussed in Section 6. Conclusions and implications of the findings are presented in Section 7. A detailed description of data and variables is given in the Appendix (see Table A1).

2. Women's Employment and Trade Liberalization: Theoretical Framework and Empirical Literature

2.1 Theoretical Framework

The various channels through which trade liberalization can result in gender differentiated employment outcome needs clear articulation. Analytically, it is useful to distinguish four separate mechanisms by which a change in trade policy can exert an impact on FEI.

First, trade liberalization has a *cost reduction effect* resulting from heighted competitive pressure from imports. Faced with international competition, firms may adopt a strategy of feminization of labour force as women provide 'cheap and flexible' labour compared to men [Cagatay and Ozler, 1995; Elson, 1999; Standing, 1999]. It has been observed that women workers are intensively employed in industries where profit margins are protected by reducing labour costs, extending hours and decreasing the numbers of formal production workers (Standing, 1999)[4].

[4] Furthermore, an implication of the Becker model of discrimination (1957) is that increased product market competition will drive out costly discrimination against women in the labour market (Black and Brainerd, 2004). Thus, if trade liberalization increases product market competition, employers may find it unaffordable to indulge their "taste for discrimination" leading to an increase in the relative employment of women.

Second, there is a *resource reallocation effect* resulting from trade-induced changes in the pattern of specialization. According to the Heckscher-Ohlin (H-O) model, countries specialize in and export goods that use intensively the factors of production with which they are relatively abundantly endowed. Given that developing countries, like India, are abundantly endowed with unskilled labour, their true comparative advantage lies in industries that intensively use unskilled labour rather than physical capital or skilled labour[5]. Therefore, it may be expected that trade liberalization would stimulate faster growth of unskilled labour-intensive industries in India. This, in turn, can lead to an increase in the relative employment of female workers if, as is often the case, unskilled-labour intensive industries employ more female than male workers. In developing countries, such as India, female employment intensity is generally higher in unskilled -labour intensive industries due to the fact that the average female worker has lower educational attainment, and hence less skilled, than the average male worker[6].

Third, there is a *technology effect* associated with trade liberalization. While cost reduction and resource reallocation effects may imply an increase in FEI, rapid inflow of foreign technology, via FDI and increased imports of capital goods, may create a bias in favour of male employment. This bias could arise because the new technology, mainly designed in the skill abundant industrialized world, is skill-biased and exhibits capital-skill complementarities in production (Krusell et al, 2000)[7]. Thus, the relative demand for male workers may rise if, as is often the case, the skill level of the average male worker is higher than that of the average female worker[8].

[5] Educational attainment data for the 2010 shows than more than half of India's population have either no schooling or only primary attainment (Barro and Lee, 2013).

[6] As per the NSSO data, the average woman had 2.1 years lesser education than the average man in 2007-08 (Bhalla and Kaur, 2011). Fontana (2009) reviewed a large number of studies covering many countries and concludes that trade liberalization benefits women the most in countries that are abundant in unskilled labour and have a comparative advantage in the production of basic manufactures (Fontana, 2009). This is because women are disproportionately represented among unskilled workers.

[7] Capital-skill complementarity implies that the elasticity of substitution between capital equipment and unskilled labour is higher than that between capital equipment and skilled labour (Krusell et al, 2000).

[8] Even if male and female workers possess the same level of skill, employers may still prefer male workers for technology intensive tasks. The theory of statistical discrimination provides an explanation for this preference. This theory states that when employers have limited information about individual job seekers, they tend to use easily observable characteristics such as gender or race to infer the expected productivity of individuals (Arrow, 1973; Aigner and Cain, 1977). In the case of technology-intensive (high-skilled) jobs, firms may attempt to minimize training and replacement costs by choosing workers with low quit propensity. Thus, if the perceived quit propensity is higher for women workers, employers may adopt a skill

Finally, there is also a *scale effect* which arises, *ceteris paribus*, when trade liberalization causes an overall expansion of output and employment. The scale effect could be gender neutral if employment for males and females grow at the same rate. Since we have no strong priors regarding the direction of the relationship between scale and FEI, we leave this to be determined empirically.

Thus, on theoretical grounds, trade liberalization can exert a positive or negative impact on aggregate female employment depending on the relative strength of the different channels. While the cost reduction and resource reallocation effects can raise the employment share of women workers, the technology effect can act as a countervailing force. There is a need to empirically analyse the different channels through which liberalization affects female employment and this provides the motivation for analysing the role of trade and technology related variables in influencing FEI.

2.2. Review of Related Empirical Studies

Aside from the theoretical reasons outlined in the previous section, there exists strong empirical evidence suggesting that trade liberalization exerts differential impact for male and female employment[9]. Based on a cross country analysis, Cagatay and Ozler (1995) concluded that countries that have undertaken structural adjustment programs have recorded an increase in the female share of their labour force. In the context of developing countries, in particular, the forces of global integration have generally had a beneficial effect on women's employment (Wood, 1991; Joekes, 1995; Mehra and Gammage, 1999; Nordas, 2003; Fontana 2009). The employment gains for women have been driven by export-oriented industries, such as clothing, footwear and electronics assembly,

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retention strategy by hiring male workers for tasks that involve high training and replacement costs. Given the social customs related to marriage, child bearing and child rearing in developing countries such as India, employers may believe that women are more likely to quit a job than man is. Therefore, women are likely to get relegated to the technologically simpler tasks (with lower training and replacement costs) while men perform technologically complex tasks.

[9] Keeping with the focus of the present paper, our review is confined to empirical studies analyzing the impact of trade liberalization on female employment in the manufacturing sector. Studies focusing other sectors (agriculture, services and informal sector) are not taken into account. In any case, employment gains for woman worker through export-orientation appear to be more common in the manufacturing sector than in other sectors (Fontana, 2009). Also, studies analyzing the impact of trade on gender wage inequality are not considered here. Interested readers are referred to Duflo (2012), who provides a comprehensive survey.

mostly based in export processing zones. Women comprise between 53% and 90% of the employed in many export sectors in middle-income developing countries (Korinek, 2005). These findings are consistent with the prediction of the H-O model that opening up trade would lead to an expansion of unskilled labour intensive industries in developing countries. Women workers benefit from this process as their employment is largely concentrated in unskilled labour-intensive industries[10].

In addition to the cross country studies referred above, a number of country case studies also found that trade liberalization had a positive effect on women's employment opportunities via export expansion. The gains in female employment are particularly pronounced in the four East Asian Tigers (Hong Kong, Singapore, South Korea and Taiwan). Between 1966 and 1996, female labour force participation rate increased from 24.2 percent to 51.5 percent in Singapore, from 32.6 percent to 45.8 percent in Taiwan and from 31.5 percent to 48.7 percent in South Korea. For Hong Kong, this proportion increased from 36.8 percent in 1961 to 49.2 percent in 1996 (Chu, 2002). In line with the experience of East Asia, South East Asian countries (Malaysia, Indonesia, Philippines and Thailand) have witnessed a substantial increase in female employment in labour-intensive export-oriented industries (Pearson 1998, Fontana 2009). While South Asia as a group records lower FEI compared to East and South East Asia, export oriented garment industries of Bangladesh and Sri Lanka have recorded significant increase in female employment (Mehra and Gammage, 1999; Nordas, 2003; Rahman and Islam, 2013).

The major non-Asian developing countries where export expansion led to higher FEI include Mauritius (Sub-Saharan Africa), Mexico (Latin America) and Turkey. There exists a consensus that mobilization of female labour in the export processing zones played a key role in the export success of Mauritius since the mid-1970s (Milner and Wright, 1998; Subramanian and Roy, 2001; Nordas, 2003). Aguayo-Tellez et al (2010) find that women's relative employment position improved

[10] The cross-country analysis by Wood (1991) found that expansion of manufactured exports to developed countries (North) has been strongly associated with increases in the female intensity of manufacturing employment in the developing countries (South). On the other hand, trade expansion with developing countries was found to exert a negative effect on FEI in most developed countries (Kucera and Milberg, 2007).

significantly in Mexico during the 1990s, a period that witnessed major trade liberalization under NAFTA. Their empirical analysis showed that trade liberalization resulted in substantial labour reallocation across industries, shifting employment towards initially female-intensive sectors. They also find that Mexico's tariff reduction as well as its access to the US market via exports led to greater employment opportunities for women[11]. Cagatay and Berik (1991) and Ozler (2000) found that greater export orientation was positively associated with female employment share in Turkish manufacturing. Baslevent and Onaran (2004), however, find that a general positive effect of export orientation is only observed in the case of non-married women in Turkey. In the case of married women, the positive effect is limited to only conventionally female-dominated industries and with a time lag.

While trade liberalization is likely to raise women's employment in the early phase of export-driven growth in developing countries, the process can be reversed in the later phases as export production is restructured and becomes technologically more sophisticated. As noted in the case of the East Asian and South-East Asian economies, there has been a process of de-feminization of the workforce as the country proceeds on the development path (Berik, 2005). In South Korea, for example, female employment expanded significantly during the 1970s and early 1980s when export production was concentrated in labour intensive and low technology industries such as garments, footwear and simple consumer goods (Kim and Kim, 1995; cited in Mehra and Gammage (1999)). However, the number of female workers declined considerably during the late 1980s and early 1990s as South Korea's export composition changed in favour of technologically sophisticated products such as semi-conductor devices and computer products. Similar trends were also observed in the export processing zones of countries such as Mexico, Mauritius, Malaysia and Singapore (Fontana, 2009).

As noted earlier, unlike in the case of other developing countries, liberalization has not led to higher employment opportunities for women in India. Why has liberalization failed to generate a beneficial impact on female employment? The impact of trade liberalization on aggregate female employment is

[11] See Nordas (2003) for reference to the earlier studies on Mexico.

determined by the relative strengths of different channels. For example, we may not observe an increase in aggregate FEI if the technology effect dominates over other effects. While trade liberalization might have led to an increase in FEI in some industry groups, technology related factors may be forcing females out of employment in other industries. The trends observed at the aggregate level could mask important heterogeneities across industry groups. Thus, in order to properly understand the impact of liberalization on FEI, it is necessary to consider heterogeneities across industries as well as the relative importance of different channels. To the best of our knowledge, these issues have not been empirically examined in the context of Indian industries[12].

3. Female Employment in Manufacturing: General Trends and Patterns

3.1 Aggregate Trends

Figure 1 depicts the trends in the number of male and female workers engaged in India's organized manufacturing sector during the period 1998-2008. As expected, the number of female workers lags far behind male workers, for e.g., 1.2 million female workers were employed in 2008 compared to 9.7 million male workers. During the beginning of the period, the number of female workers declined from about 1.1 million in 1998 to 0.8 million in 1999. Detailed examination of data shows that this decline was entirely driven by just one industry group – tobacco products (ISIC 1600) – where the number of female employees declined dramatically from more than 0.3 million in 1998 to less than 0.09 million in 1999[13]. Subsequently, since 1999, female as well as male employment registered an increase at 4% per annum. Since male employment grew at the same rate as female employment, female employment intensity (FEI) remained roughly constant during 1999-2008 (see Figure 1). It is evident that FEI in Indian manufacturing, with an average value of 11.3% for 1999-2008, is quite low by international standards. Thus, at the aggregate level, we do not observe a process of feminization in

[12] A few of the existing econometric studies focus on the importance of supply side factors related to demography, control over assets, socio-cultural factors, household characteristics etc. in explaining the labour force participation rate (LFPR) for women (Bhalla and Kaur, 2011; Srivastava and Srivastava, 2010).

[13] The 'bidi' manufacturing industry accounts for over 90% of female employment in the group 'tobacco products'. The employment decline in tobacco is mainly driven by 'bidi' manufacturing, an industry which traditionally employs large number of female workers. This industry also experienced a significant decline in the value of output in this period.

India's organized manufacturing sector. However, as noted earlier, the trends observed at the aggregate level could mask important heterogeneities across industry groups, to which we turn now.

Insert Figure 1 here

3.2 Gender-wise Distribution of Workers across Industry Groups

Having shown the aggregate trends, we now turn to discuss the gender-wise distribution of workers across industry groups (at the 2-digit ISIC level) within manufacturing for selected years - 1999, 2003 and 2008[14]. In order to view labour market changes through the lens of Heckscher-Ohlin model, it is useful to club industries based on their trade orientation and factor intensity. To this end, industries at the 4-digit ISIC level are classified into three broad groups based on trade orientation: exporting, import competing and non-competing[15]. Further, we classify industries into three factor intensity based groups: primary & resource intensive, unskilled labour intensive and capital intensive[16].

Table 1 reports the percentage share of female (male) workers in different industry groups in total female (male) manufacturing employment[17]. The table also contains information regarding the share

[14] As noted above, female employment declined sharply in 1999 over the previous year, which can be clearly seen as an aberration from the general trend (see Figure 1). We choose 1999, instead of 1998, in order to avoid any bias from this change caused by just one industry group (tobacco products).

[15] In order to classify industries according to trade orientation, we follow the methodology proposed by Krueger (1981) (see also Krueger et al 1981; Erlat, 2000). Let $C \equiv Q - (X - M)$ stands for consumption, where Q is production, X is exports and M is imports. Then, T is defined as: $T = (C - Q)/C = (M - X)/(Q - X + M)$. If the value of T is less than zero, we say that the industry in question is 'exporting'. Based on the extent to which imports dominate over exports, industries with values of T greater than zero are classified into two categories: import competing and non-competing. We consider 0.30 as the cut-off and classify all industries with values of T above this cut-off as non-competing, while industries with T lying between 0 and 0.30 are classified as import competing.

[16] We closely follow the factor intensity classification of International Trade Centre (ITC), adapted by Hinloopen and van Marrewijk (2008). The classification is available at: (http://www2.econ.uu.nl/users/marrewijk/eta/intensity.htm) (Viewed on 14 June 2014). A total number of 240 items, at the 3-digit SITC level, have been grouped into five categories: primary, natural-resource intensive, unskilled-labour intensive, human capital-intensive, technology-intensive, and unclassified. For our purpose, we have matched the 3-digit SITC codes with the 4-digit ISIC codes. Our definition of capital-intensive sector includes the industries belonging to technology as well as human capital- intensive groups. We have also clubbed the primary and natural resource-intensive groups.

[17] Percentage share of female employment in a given industry group i is defined as: $fs_i = \left(fw_i \big/ \sum_i fw_i \right) \times 100$, where the numerator, fw_i, is the number of female workers employed in industry group i while the denominator is the total female employment in manufacturing. The percentage share of male employment has been calculated in the similar manner.

of different industry groups in manufacturing value added. It is clear that female employment is highly concentrated in a handful of industries while male employment shows greater dispersion. Just six industry groups accounted for about 84% of female employment in 2008, which includes Food and beverages (24%), Wearing apparel (23%), Textiles (18%), Chemicals (8%), Tobacco products (6%), and Leather products (5%). These industries, however, accounted for only 45% of total male employment. Male employment tends to be concentrated in sectors such as Machinery, Transport equipment, Rubber and plastics, Metal products etc.

Insert Table 1 here

In Table 2, we present the distribution of female manufacturing workers across the industry groups classified on the basis of trade orientation and factor intensity. It is evident that the exporting sector is the largest contributor of employment for both female and male workers. However, female workers are more heavily concentrated in this sector compared to their male counterparts and increasingly so. For example, in 2008, a whopping 86% of the total female workers were engaged in the exporting sector while the corresponding figure for the male workers was 73%. Within the exporting sector, female workers are mainly employed in unskilled labour-intensive industries, increasing its share in total female employment from 33% in 1999 to 46% in 2008 (Table 3)[18]. The import competing sector stands next to exporting sector both for females and males.

Finally, comparing the changes in the distribution of employment with that of real value added in Table 2, we can observe an important contrast in the growth pattern of male and female employment. While female workers are increasingly getting concentrated in slow growing unskilled-labour intensive exporting industries, male employment growth is seen primarily in fast growing capital intensive exporting industries.

[18] Within the exporting sector, the pattern of male employment looks completely different from that of female employment. Male workers in the exporting sectors are increasingly concentrated in capital-intensive industries, with a share of 32% in 1999 and 39% in 2008 (Table 2). In contrast, capital-intensive exporting industries accounted for just 12% of total female workers both in 1999 and 2008.

Insert Table 2 here

3.3 Female Employment Intensity

Figure 2 depicts the values of FEI in percentage terms across factor intensity based groups[19]. For the period 1999-2008, the average value of FEI is the highest in unskilled labour intensive sector (19.3%) followed by primary & resource-intensive sector (16.4%) and capital-intensive sector (5.1%). In order to capture this pattern clearly, we regress FEI on factor-intensity based dummies (see Column 1, Table 3). We include dummies for unskilled-labour intensive and capital-intensive industries while the group of primary & resource-intensive industries is taken as the base for comparison. As expected, unskilled labour-intensive sector dummy shows a statistically significant positive coefficient while that for capital-intensive sector shows a significant negative coefficient. Thus, compared to primary & resource-intensive group, FEI is higher in unskilled labour-industries and lower in capital-intensive industries.

During the period 1999-2008, FEI in the unskilled labour intensive sector increased steadily while it remained broadly unchanged in primary & resource-intensive sector (see Figure 2)[20]. By contrast, FEI in the capital-intensive sector declined from 5.7% in 1999 to 4.2% in 2008. Industries in the unskilled labour intensive sector are replacing male workers with female workers while the opposite seems to be occurring in the capital-intensive industries.

Insert Table 3 here

[19] Appendix Table A2 reports the values FEI at the 2-digit ISIC level.
[20] The sharp decline in 1999 in primary& resource intensive sector is due to the major fall in female employment in tobacco industry.

As can be seen in Figure 3, the exporting sector employs female labour more intensively, compared to other trade orientation based sectors[21]. A regression of FEI on trade orientation based dummies show that exporting industries employ female labour more intensively compared to non-competing and import competing industries (see Column 2, Table 2). The group of non-competing industries is taken as the base for comparison in this regression. The higher coefficient of exporting sector dummy is expected as these industries are mostly unskilled-labour intensive.

Insert Figure 3 here

Table 4 shows FEI for factor intensity groups within each of the trade orientation based sectors. It may be seen that *FEI* within each of the trade orientation sectors does vary depending upon the factor intensity of different industries. The value of FEI in unskilled labour intensive exporting industries increased from 16.3% in 1999 to as high as 23% in 2008 while it declined from 4.2% to 3.4% in capital-intensive exporting industries[22]. In order to capture these differences more clearly, we run a regression of FEI on separate factor intensity dummies within exporting and import competing sectors with non-competing sector as a whole being taken as the base for comparison (see Columns 3, 6 and 9 in Table 3). The dummy for unskilled labour-intensive exporting industries yields a statistically significant positive coefficient while that for capital-intensive exporting industries shows a negative coefficient. Thus, it is clear that, within the exporting sector, unskilled labour-intensive industries employ female workers more intensively than capital-intensive industries.

Insert Table 4 here

[21] The initial dip in FEI in the exporting sector is due to the employment fall in the tobacco industry in 1999.

[22] Detailed examination of data at the 4-digit level shows that within the group of unskilled-labour intensive exporting sector, FEI is the highest in 'Manufacture of wearing apparel' (ISIC 1810), which is the second largest contributor of employment within the group. However, the industries responsible for the rising FEI in unskilled-labour intensive exporting group were (i) 'preparation and spinning of textile fibers, weaving of textiles' (ISIC 1711), and (ii) 'finishing of textiles' (1712). Within the import competing sector, we find that FEI are either stagnant or declining in nearly all industries at the 4-digit level.

Further, it may be noted that capital-intensive exporting industries employ relatively fewer female workers compared to non-competing sector as a whole. Irrespective of trade orientation, primary & resource-intensive industries employ fewer female workers compared to unskilled labour intensive industries. Compared to capital-intensive industries, however, primary & resource-intensive industries show higher *FEI* in both exporting and import-competing sectors.

Overall, it is clear that women are intensively employed in unskilled labour intensive exporting industries where India has a comparative advantage. By contrast, import competing and non-competing industries record lower FEI. Irrespective of trade orientation, capital-intensive industries tend to employ relatively more male workers. This is consistent with the argument that technological modernization generally creates a bias in favour of male workers. While certain industry subgroups indeed witnessed a process of feminization, trade liberalization did not lead to a major overall employment gain for female workers as the traditionally female worker intensive industries recorded lower growth rate of output compared to male worker intensive industries. Thus, contrary to the expectation, the reallocation effect does not seem to have been favourable for women workers in India. In the concluding section, we provide an explanation for this unexpected outcome.

It is clear that there exist considerable variation in the gender composition of workforce across industries and that industry-specific factors related to trade orientation and technology plays an important role in determining this variation. The rest of the paper deals with an econometric analysis of the industry-specific determinants of FEI in a panel of Indian manufacturing industries.

4. Hypothesis and Variables

In what follows, we set out various hypotheses concerning the impact of different trade and technology related characteristics on FEI across industries. Formulation of the hypotheses and choice of the corresponding variables have been motivated in the light of our earlier discussion of the various channels through which trade liberalization can exert an impact on FEI.

(a) Cost Reduction Effect

Since the onset of the trade liberalization process, firms in India's domestic industries, which had been operating under protective umbrellas, have been forced to respond to competitive pressure from imports. Removal of product market distortions, through reduction of tariff and non-tariff barriers, has compelled domestic producers to rationalize their production structure and reduce costs. In several economies, this led to higher female employment since women provide 'cheap and flexible' labour (Standing, 1999). In order to capture the cost-reduction effect of trade liberalization on female employment we use the variable TAR_{it} defined as the average import tariff rate in industry *i* and year *t*.

(b) Resource reallocation effect

As discussed earlier, given the abundance of unskilled labour in the country, India's comparative advantage lies in industries which intensively employ this factor. Thus, trade liberalization would lead to specialization and expansion of unskilled labour-intensive industries. The process of resource reallocation, along the lines of comparative advantage, in turn, implies higher employment opportunities for women assuming that the demand for women workers is concentrated at the lower end of the skill spectrum. In order to capture this effect, we employ a variable EO_{it} defined as the ratio of exports to output in industry *i* at time *t* ($EO_{it} = \frac{Gross\ Exports_{it}}{Output_{it}}$). The values of EO_{it}, which measures the export orientation of an industry, are generally higher in industries where a country has comparative advantage – that is, unskilled labour-intensive industries in the case of developing countries like India. Thus, we expect that EO_{it} would influence FEI positively.

The counterpart of above argument is that India has a comparative disadvantage in capital and skill intensive industries. Thus, trade liberalization may lead to a contraction of capital and skill intensive industries and India is expected to become a net importer of these products. We use import penetration rate (IM_{it}), defined as the ratio of imports to apparent consumption in industry *i*, as an explanatory variable ($IM_{it} = \frac{Gross\ Imports_{it}}{Apparent\ consumption_{it}}$ where the denominator is measured as the difference between output and net exports). Values of IM_{it} are expected to be higher in industries where India has a comparative disadvantage – that is capital and skill-intensive industries. These industries are likely to exhibit capital-skill complementarities in production and hence lower FEI. We expect this variable to exert a negative effect on FEI.

A high level of fragmentation (vertical specialization) based trade, which occurs when countries specialize in particular stages of a good's production sequence rather than in the entire good, has been an important feature of globalization (Feenstra, 1998; Hummels et al, 2001; Athukorala, 2011). This type of trade is the result of the increasing interconnected production processes that form a vertical trading chain stretching across many countries, with each country specializing according to factor intensities involved at different stages in production. Fragmentation of production process into smaller and more specialized components allows firms to locate parts of production in countries where intensively used resources are available at lower costs.

Labour abundant countries like India tend to specialize in low skilled labour-intensive activities involved in the production of a final good while the capital and skill-intensive activities are being carried out in countries where those factors are abundant. Thus, international firms might retain skill and knowledge-intensive stages of production (such as R&D and marketing) in the high-income headquarters (e.g., the U.S.A, E.U and Japan) but locate all or parts of their production in low wage countries like India. These arguments imply that a higher degree of participation in global production sharing leads to an expansion of low skilled production processes in India, which, in turn, increases FEI. As a proxy for the extent of participation in global production sharing, we use a variable denoted as GPS_{it}, which is defined as the ratio of imported to total intermediate inputs used in industry i and year t ($GPS_{it} = \frac{Imported\ Intermediate\ Inputs_{it}}{Total\ Intetmediate\ Inputs_{it}}$). We expect this variable to be positively associated with FEI.

(c) Technology Effect

Liberalization can induce transfer of new technology from developed to developing countries via FDI and capital goods imports. The new technology could be male-worker-biased for the reasons discussed earlier. In order to analyse the foreign technology effect on FEI, we include two variables: (*i*) capital goods import intensity (CGI_{it}) defined as the ratio of capital goods imports to total sales in an industry ($CGI_{it} = \frac{Capital\ Goods\ Imports_{it}}{Total\ Sales_{it}}$) and (*ii*) extent of multinational involvement (FOR_{it}) defined as the ratio of foreign firms' output to total industry output, ($FOR_{it} = \frac{Output\ of\ Foreign\ Firms_{it}}{Total\ Output_{it}}$). We expect that industries with greater intensity of capital goods imports and with a greater degree of multinational involvement are likely to employ fewer number of female workers compared to their male counterparts. Therefore, the coefficients of these variables are expected to yield negative signs.

(d) Scale Effect

We include real value of output ($RO_{it} = \frac{Output(in\ nominal\ terms)_{it}}{Wholesale\ Price\ Index_{it}}$) to account for the scale effect. As discussed earlier, the scale effect could be gender neutral if employment for males and females grow at the same rate. This implies that we should expect the estimated coefficient of RO_{it} to be statistically indistinguishable from zero. Our descriptive data analysis in the previous section, however, indicated that female workers are increasingly getting concentrated in slow growing industries while male employment growth is seen primarily in fast growing industries. In this case, we may expect the variable RO_{it} to show a statistically significant negative coefficient.

(e) Other Industry Controls

In addition to industry group dummies, we use a number of other variables to control for industry characteristics. All the regression specifications include relative wages (REW_{it}) – the ratio of average female wage rate to average male wage rate in industry *i* and year *t* ($REW_{it} =$

$\frac{Average\ Female\ Wages_{it}}{Average\ Male\ Wages_{it}}$). We expect REW_{it} to be negatively related to FEI as an increase in the relative wages of female workers may induce firms to hire fewer female workers compared to males.

In order to capture the effect of an industry's skill intensity, we use the variable NPW_{it}, defined as the ratio of non-production workers to total workforce ($NPW_{it} = \frac{No.\ of\ Non{-}Production\ Workers_{it}}{Total\ Employment_{it}}$). A higher value of this variable means that the industry in question is more skill intensive as it employs relatively more non-production workers, who are more skilled, compared to production workers. Thus, NPW_{it} is expected to exert a negative influence on FEI. We also consider the impact of R&D intensity by including the variable RDI_{it}, defined as industry *i*'s expenditure on R&D divided by its total sales. We expect this variable to be negatively associated with FEI.

In the aftermath of trade liberalization in India, it has been noted that, several industries have been increasingly resorting to informalization of their workforce (Saha et al, 2013). Typically, the relatively more technologically intensive tasks, which require higher skill and training, have been reserved for the permanent/formal workers. In contrast, the production tasks carried out by unskilled labour have been informalized by employing workers on temporary/contractual basis. In order to measure the degree of informalization in an industry, we use the variable INF_{it}, defined as the ratio of contract workers to total workforce ($INF_{it} = \frac{No.\ of\ Contract\ Workers_{it}}{Total\ Employment_{it}}$). Since women workers are mostly engaged in unskilled labour-intensive tasks, we expect this variable to be negatively correlated to FEI.

5. Methodology and Data

The dependent variable in our econometric analysis, FEI ($FEI_{it} = \frac{No.\ of\ Female\ Workers_{it}}{Total\ Employment_{it}}$) defined as the ratio of female employment to total employment), is measured for 125 manufacturing industries at the 4-digit ISIC level for the period 1998-2008. The final dataset used for the regression analysis is an unbalanced panel with nearly 1200 observations. The basic regression equation used to test the hypotheses described above is the following:

$$FEI_{it} = +\gamma_I + \gamma_t + \beta_1 TAR_{it} + \beta_2 EO_{it} + \beta_3 IM_{it} + \beta_4 GPS_{it} + \beta_5 CGI_{it} + \beta_6 FOR_{it} + \beta_7 REW_{it} + \beta_8 RO_{it} + \beta_9 NPW_{it} + \beta_{10} RDI_{it} + \beta_{11} INF_{it} + \varepsilon_{it} \quad (1)$$

where, Υ_I, and Υ_t, are coefficients of the industry group and year-specific dummies, respectively, while ε_{it} is the usual error term.

Note that our dependent variable (FEI) is fractional and bounded between zero and one, and so the standard linear models may not provide an accurate picture of the effects of a given explanatory variable on FEI throughout the entire distribution of the explanatory variable (Papke and Wooldridge, 1996, 2008). Furthermore, the predicted values of FEI from an OLS regression cannot be guaranteed to lie between zero and one. In such cases, it is more appropriate to use the fractional logit model[23]. Given these concerns, the regression equation, specified above, has been estimated using alternative model specifications – fractional logit, Least Square Dummy variable (LSDV) method, and tobit.

Another important consideration in the econometric estimation is the level of disaggregation at which we introduce industry fixed effects in the model. The effect of trade related variables on FEI can be analysed by exploiting the variation in the data along two dimensions – that is, variation *within* industries overtime versus variation *between* industries. For example, the within industry variation captures the possibility that FEI increases as trade barriers in an industry fall and/or the industry improves its export performance. Whereas, the between industry variation can be utilized to analyse whether export oriented industries exhibit higher FEI as compared to import competing industries. Inclusion of industry fixed effects at the 4-digit level means that we are essentially focussing on 'within' variation in the data as the industry dummies would absorb all cross sectional variation. However, this approach is not appropriate in our case as industry affiliation at the 4-digit level explain

[23] Alternatively, censored regression models such as Tobit has been used in some studies. However, it may be noted that Tobit specification is not applicable in cases where values beyond the censoring point are infeasible, as is the case with FEI (Papke & Woolridge, 1996).

most of the variation in FEI[24]. Once the 4-digit dummies are included, the model may not be able to identify the impact of trade and technology related variables which, by their very nature, change relatively slowly over time. Thus, our specification does not include 4-digit industry fixed effects as it may defeat the very purpose of our analysis – that is, to study the impact of trade and technology related industry characteristics on FEI. However, we have included industry group dummies at the 2-digit ISIC level[25].

Data on employment, according to ISIC Rev 3 nomenclature, came from the UNIDO's industrial database, INDSTAT 4. Explanatory variables have been constructed using data from different sources such as the UN-COMTRADE database, Annual Survey of Industries (ASI) from the Central Statistical Organization (CSO), and Prowess database from the Centre for Monitoring Indian Economy (CMIE). These sources provide data according to different commodity classification systems. We have built a harmonised dataset by mapping the various classification systems with the ISIC Rev 3 codes, the details of which is discussed in Appendix. Table A1, A3 and A4 in the Appendix provide further details on variable construction, data sources, summary statistics and correlation matrix of the variables included in the regression model. Overall, the correlation coefficients among the explanatory variables are not very high except those between IM and EO (0.6130) and RDI and FOR (0.5751). For the regression analysis, all explanatory variables in ratios have been converted to percentages so as to make the coefficients of these variables comparable to that of tariff rate, the latter being always defined in percentage terms.

6. Regression Results

Table 5 reports results of Fractional Logit and LSDV model specifications. The results from the Tobit specifications have been reported in Table A5 in the Appendix. At the outset, it may be noted that

[24] A regression analysis of FEI on 4-digit level industry dummies yield an adjusted R^2 value of 0.8388. This means that industry affiliation at the 4-digit level explain about 84% of the variation in FEI.

[25] The amount of variation in FEI explained by membership in a particular 2-digit industry is much small since the adjusted R^2 for a regression using 21 dummy variables to control for the 22 industry groups at the 2-digit ISIC level is only 0.2870. Inclusion of industry group dummies at the 2-digit level allows us to control for the influence of time invariant factors operating at the relatively aggregate level of industrial grouping – for example, the influence of industry group associations.

different models give broadly similar results with respect to the signs and statistical significance of the explanatory variables. For each model, the first five columns in Table 5 include industry group dummies while the last column replaces these with factor-intensity dummies. These dummies are included to control for time invariant sector specific effects on *FEI*.

The variable TAR_{it} is included to capture the cost-reduction effect of tariff reduction on *FEI*. We find that this variable is negative and significant in all models giving credence to our hypothesis. In the LSDV specification (see column 7), the estimated coefficient is -0.0002, which means that a 10 percentage point decline in tariff rates would increase the ratio of female to total employment by 0.002, which is not trivial given that the average value of FEI in our sample is only 0.068. The corresponding fractional logit coefficient (see column 1) is larger (-0.0016) but the magnitude of the coefficient is not directly comparable to the estimate from the LSDV model (Papke & Woolridge, 2008). However, the average marginal effects (AME) of the fractional logit regression can be compared to the LSDV estimates and we find that the AME estimates, reported in Table 6, are similar in magnitude to the LSDV estimates. Thus, firms tend to reduce costs by substituting male with female workers as they are exposed to increased international competition through tariff reduction.

In order to gauge the importance of resource reallocation effect on FEI, we have included the variables EO_{it}, IM_{it} and GPS_{it}, all of which yield expected signs with statistical significance in most of the specifications. We find that *FEI* is higher in industries characterized by higher export orientation (EO_{it}) and greater participation in global production sharing (GPS_{it}). These results are consistent with the argument that female workers are intensively employed in unskilled labour-intensive tasks, where developing countries have comparative advantages. The magnitude of the coefficient in the LSDV model suggests that a 10 percentage increase in EO_{it} (percentage share of exports in output) would increase FEI by about 0.007, a practically important effect (see column 7 in Table 5). For a similar specification of the fractional logit model, the AME of EO_{it} is about 0.006, which is comparable to the LSDV estimate (see column 1 in Table 6).

Quantitatively, the effect of GPS_{it}, the share of imported intermediates in total intermediate inputs, appears even higher than that EO_{it}. As expected, greater import penetration (IM_{it}) exerts a negative effect on *FEI*, which is consistent with the argument that import competing industries in developing countries are skill and technology intensive and hence employ fewer female workers compared to males. The magnitude of IM_{it}'s coefficient is broadly comparable with that of EO_{it} but, as expected, with the opposite signs. Overall, these results imply that employment opportunities for women workers in developing countries would increase to the extent trade liberalization leads to an expansion of unskilled labour-intensive production activities in these countries.

The variables EO_{it} and IM_{it} are potentially collinear as we have noted a high degree of correlation between them (see the correlation matrix in Appendix). Thus, we have run specifications by alternatively dropping EO_{it} and IM_{it} and we find that the sign of these variables remain the same and statistically significant (see columns 2, 3, 8 and 9 in Table 5). However, the point estimates turned out to be smaller when we include only one of these variables compared to the specifications where we include both. This is not surprising given that these variables exert opposite effects on the dependent variable: while EO_{it} is positively related to FEI, the other variable IM_{it} exerts a negative effect. Thus, due to the high degree of correlation between EO_{it} and IM_{it}, when only one of these variables is included it could be capturing the effect of the excluded variable as well.

In order to examine the impact of new technology, we include the variables CGI_{it} and FOR_{it}. The variable representing the extent of multinational involvement ($FOR_{it.}$) yields statistically significant negative coefficient in all specifications, which is consistent with the hypothesis that new technology is biased against female workers. The variable representing capital goods import intensity (CGI_{it}) shows similar results in the LSDV regressions. This variable shows the expected negative coefficient also in the fractional logit regression (see column 4 and 6) but not in all specifications[26]. Overall, these results suggest that use of newer technology creates a bias against female employment.

[26] CGI_{it} shows negative coefficient in the tobit specifications though not always statistically significant at the acceptable level.

The variable measuring the intensity of R&D (RDI_{it}) shows a significant negative coefficient in the fractional logit specifications[27]. The non-production worker ratio (NPW_{it}), which is supposed to control for the skill intensity of industries, is highly significant with the expected negative sign in all specifications. The negative coefficients of skill and R&D variables provide further credence to the view that employers prefer to employ men in technology-intensive tasks.

The logarithm of the variable RO_{it}, representing real value of output, is negative and statistically significant in most of the fractional logit specifications, which is in line with our observation, based on descriptive data analysis, that female workers are increasingly getting concentrated in slow growing industries while male employment growth is seen primarily in fast growing industries[28]. The fast growing industries in India are either skilled labour-intensive or capital-intensive but not the traditional labour intensive industries (Panagariya, 2008). Thus, it is not surprising that, in contrast to the experience of other developing countries, female employment has not increased significantly in India under trade liberalization.

As expected, the variable REW_{it} is negative and significant in all specifications indicating that a rise in women's relative wages would reduce their share in manufacturing employment. Finally, the variable representing the degree of informalization in an industry (INF_{it}) shows a significant negative coefficient giving credence to the view that establishments are contracting out unskilled-labour intensive and routine tasks where female workers are intensively employed. It has been argued that India's rigid labour laws create incentives for firms to minimize hiring of regular workers by resorting to informalization. Our analysis shows that female workers disproportionately bear the burden of this process as their jobs are becoming increasingly informal.

[27] However, the variable RDI_{it} fails to achieve statistical significance in the LSDV models when FOR_{it} is included as an explanatory variable. This is due to the fact that these two variables are highly correlated (r = 0.58). RDI_{it} always shows statistical significance when FOR_{it} is dropped.

[28] However, this variable is statistically indistinguishable from zero in LSDV and Tobit specifications (except in one of the Tobit specifications where industry fixed effects are not included).

Insert Tables 5 and 6 here

7. Conclusion and Discussion

The employment effects of trade liberalization are not gender neutral and it can vary significantly across industries. This paper analyses the role of different industry characteristics, in terms of trade orientation, technology intensity and other factors, in determining female employment intensity (*FEI*) in a panel of Indian manufacturing industries during 1998-2008, a period which witnessed significant trade liberalization in India.

Our econometric analysis provides support for the hypothesis that tariff reduction would cause greater employment opportunities for female workers as firms substitute male workers with low cost female labour. We also find that the resource reallocation effect – that is, faster growth of unskilled labour intensive industries, where India has a comparative advantage - contributes to female employment growth. Further, greater participation in global production networks, along the lines of comparative advantage, is found to increase *FEI*. By contrast, greater use of new technology and capital intensive production would bias the gender composition of workforce against females.

Thus, trade liberalization can contribute positively or negatively towards overall female employment depending on the relative importance of these opposing channels. While the cost reduction effect resulting from heighted competitive pressure and resource reallocation effects stimulate greater female employment, the technology channel works in the opposite direction. The fact that, at the aggregate level, we fail to observe large growth of female employment in India's organized manufacturing during post liberalization period may imply that the negative technology effect may have been offsetting the positive effects of trade liberalization on women's employment.

The resource reallocation effect has not been strong enough to generate huge employment opportunities for women at the aggregate level. This is consistent with the observation that the pattern of India’s industrial specialization shows a fundamental disconnect with its relative endowments in that despite being a labour-abundant country, India tends to specialize in capital and skill intensive industries and services (Kochhar et al 2006; Panagariya, 2008; and Krueger, 2010). The fast growing exports from the country are either skilled labour-intensive (such as drugs and pharmaceuticals and fine chemicals) or capital-intensive (such as automobiles and parts). The share of capital-intensive products in India’s manufacturing export basket more than doubled from about 23% in 1990 to nearly 54% in 2010 while the share of unskilled labour-intensive products nearly halved from 43% to 22% (Veeramani, 2012). Due to its idiosyncratic specialization, India has also been locked out of the vertically integrated global supply chains in manufacturing industries (Veeramani, 2013; Athukorala, 2014).

Thus, it is plausible to argue that the low growth of FEI in Indian industries is a consequence of idiosyncrasies in the pattern of India’s industrial development. India’s industrial structure has been built during the import substitution period by following a strategy which can be characterized as ‘comparative-advantage-defying’. While the earlier policy regime created a bias in favour of capital and skill intensive manufacturing, the reforms since 1991 have not been comprehensive enough to reduce, let alone remove, this bias. Though the post-1991 policy changes have gone a long way toward product market liberalization by easing the entry barriers, the factor markets (labour and land) are still plagued by severe distortions and policy induced rigidities. In particular, India’s archaic labour laws create severe exit barriers and hence discourage large firms in manufacturing from choosing labour-intensive activities and technologies (Panagariya, 2007). Trade liberalization by itself does not guarantee specialization in line with the comparative advantage of a country if other policies militate against the efficient pattern of resource allocation.

India’s labour laws, by encouraging capital-intensive production, provide an incentive to employ relatively more male workers. It has also been noted that, due to rigid labour laws, there is significant informalization of labour force in India’s formal manufacturing industries. Our econometric analysis suggests that this process of informalisation has been occurring mainly at the cost of regular employment for female workers. A flexible labour market, with appropriate social safety nets, is a crucial necessary condition for the growth of formal manufacturing sector employment for female workers in India.

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Tables

Table 1 : Distribution of Workers across Industry Groups (Percentage Shares)

ISIC Code	Description	Female Workers			Male Workers			Value Added Share		
		1999	2003	2008	1999	2003	2008	1999	2003	2008
15	Food and beverages	25.99	25.84	24.08	15.98	15.76	13.34	10.53	8.15	8.16
16	Tobacco products	10.50	12.09	5.64	5.44	5.54	4.04	2.11	2.09	1.60
17	Textiles	11.96	14.49	18.46	16.75	16.09	12.76	8.42	7.28	4.72
18	Wearing apparel, fur	18.29	20.78	22.65	2.02	2.93	3.86	1.95	1.56	1.70
19	Leather, leather products and footwear	3.72	3.28	5.33	1.28	1.73	1.98	0.84	0.67	0.68
20	Wood products (excl. furniture)	0.61	0.38	0.36	0.64	0.67	0.66	0.24	0.22	0.17
21	Paper and paper products	1.13	1.19	1.25	2.35	2.44	2.25	1.55	1.77	1.47
22	Printing and publishing	0.54	0.53	0.56	1.56	1.60	1.27	1.56	1.46	0.80
23	Coke, refined petroleum products, nuclear fuel	0.22	0.17	0.15	0.99	1.08	1.16	3.48	11.80	13.12
24	Chemicals and chemical products	12.07	9.03	7.76	10.14	9.83	9.11	22.94	18.04	15.61
25	Rubber and plastics products	1.60	1.36	1.93	3.67	3.94	4.25	3.79	3.33	3.59
26	Non-metallic mineral products	3.15	2.46	2.35	6.01	6.37	7.78	5.22	4.43	7.10
27	Basic metals	1.04	0.48	0.71	8.80	7.96	9.30	12.45	14.25	14.57
28	Fabricated metal products	0.64	0.49	0.65	3.89	4.09	5.18	2.47	2.44	3.38
29	Machinery and equipment n.e.c.	0.66	0.54	0.71	6.56	5.81	7.78	6.04	5.19	7.70
30	Office, accounting and computing machinery	0.38	0.22	0.16	0.20	0.29	0.19	0.28	0.80	0.33
31	Electrical machinery and apparatus	1.34	1.25	1.51	3.33	3.08	3.41	3.64	3.12	4.03
32	Radio, television and communication equipment	2.38	1.62	1.39	1.33	1.29	1.26	2.02	2.01	2.30
33	Medical, precision and optical instruments	1.21	0.79	0.73	0.83	0.86	0.74	0.90	0.97	0.78
34	Motor vehicles, trailers, semi-trailers	0.61	0.62	1.14	4.01	4.17	5.20	5.15	6.15	4.78
35	Other transport equipment	0.22	0.20	0.14	2.60	2.57	2.26	2.64	3.00	2.43
36	Miscellaneous manufacturing	1.75	2.19	2.35	1.62	1.90	2.22	1.77	1.28	0.99

Table 2: Distribution of Workers across Trade Orientation and Facto-Intensity Based Industry Groups (Percentage Shares)

	Female Workers			Male Workers			Value Added Share		
Industry Groups	1999	2003	2008	1999	2003	2008	1999	2003	2008
Exporting	**81.23**	**85.26**	**86.38**	**72.51**	**73.94**	**73.22**	**64.20**	**69.42**	**68.58**
Primary&Resource Intensive	35.82	37.37	29.19	19.67	19.57	16.00	10.47	8.32	7.36
Unskilled Labour Intensive	33.38	37.81	45.56	20.45	20.76	18.15	12.38	10.17	7.16
Capital Intensive	12.03	10.09	11.63	32.39	33.61	39.08	41.35	50.94	54.06
Import Competing	**16.14**	**12.41**	**11.02**	**22.68**	**21.35**	**22.32**	**29.54**	**25.04**	**25.08**
Primary&Resource Intensive	2.18	1.79	1.74	5.09	5.17	4.82	4.25	4.30	4.65
Unskilled Labour Intensive	0.26	0.22	0.30	0.26	0.28	0.43	0.13	0.20	0.18
Capital Intensive	13.70	10.40	8.98	17.33	15.90	17.07	25.15	20.54	20.25
Non Competing	**2.63**	**2.33**	**2.60**	**4.81**	**4.71**	**4.46**	**6.26**	**5.54**	**6.34**
Primary&Resource Intensive	0.45	0.51	0.62	0.38	0.42	0.27	0.28	0.18	0.13
Unskilled Labour Intensive	0.48	0.62	0.73	0.42	0.78	0.89	0.33	0.39	0.33
Capital Intensive	1.70	1.19	1.26	4.02	3.51	3.30	5.64	4.97	5.88

Table 3: Impact of Trade Orientation and Factor Intensity on Female Employment Intensity (*FEI*)

	(1)	(2)	(3)
ES Dummy × PRIS Dummy			0.0655***
			(0.0117)
ES Dummy × ULIS Dummy			0.0848***
			(0.0129)
ES Dummy × CIS Dummy			-0.0089
			(0.0054)
ICS Dummy × PRIS Dummy			0.0229***
			(0.0078)
ICS Dummy × ULIS Dummy			0.0799**
			(0.0336)
ICS Dummy × CIS Dummy			0.0065
			(0.0062)
ULIS Dummy	0.0367***		
	(0.0137)		
CIS Dummy	-0.0479***		
	(0.0071)		
ES Dummy		0.0271***	
		(0.0062)	
ICS Dummy		0.0138**	
		(0.0058)	
Constant	0.1010***	0.0551***	0.0539***
	(0.0110)	(0.0108)	(0.0102)
Year Dummies	Yes	Yes	Yes
Observations	1,193	1,193	1,193
R-squared	0.0980	0.0120	0.1110
Pseudo R-squared			

***, ** and * indicate significance at the 1, 5 and 10% levels, respectively

Standard errors have been reported in parenthesis. Robust standard errors were calculated in the case of the OLS and Fractional Logit specifications.

Notes: ULIS Dummy = Unskilled Labour Intensive Sector Dummy; CIS Dummy = Capital Intensive Sector Dummy; ES Dummy = Exporting Sector Dummy; ICS Dummy = Import Competing Sector Dummy; PRIS Dummy = Primary & Resource Intensive Sector Dummy

Table 4: Female Employment Intensity (*FEI*) across Trade Orientation and Facto-Intensity Based Industry Groups (in % terms)

Industry Groups	1999	2003	2008
Exporting	**11.77**	**13.09**	**12.33**
Primary & Resource Intensive	17.81	19.96	17.86
Unskilled Labour Intensive	16.27	19.21	23.04
Capital Intensive	4.23	3.77	3.43
Import Competing	**7.81**	**7.05**	**5.56**
Primary & Resource Intensive	4.85	4.33	4.11
Unskilled Labour Intensive	10.49	9.07	7.83
Capital Intensive	8.60	7.87	5.90
Non Competing	**6.11**	**6.07**	**6.51**
Primary & Resource Intensive	12.56	13.85	21.25
Unskilled Labour Intensive	12.07	9.49	8.91
Capital Intensive	4.78	4.25	4.35

Table 5: Determinants of Female Employment Intensity (FLE), Fractional Logit and LSDV Models

	Fractional Logit						LSDV					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TAR	-0.0016* (0.0010)	-0.0022** (0.0010)	-0.0010 (0.0010)	-0.0017* (0.0010)	-0.0022** (0.0010)	-0.0027** (0.0011)	-0.0002*** (7.26e-05)	-0.0003*** (7.47e-05)	-0.0003*** (7.59e-05)	-0.0002*** (7.22e-05)	-0.0003*** (7.96e-05)	-0.0003*** (8.06e-05)
EO	0.0102*** (0.0018)		0.0031* (0.0017)	0.0101*** (0.0019)	0.0094*** (0.0018)	0.0052** (0.0025)	0.0007*** (0.0002)		0.0002** (0.0001)	0.0007*** (0.0002)	0.0008*** (0.0002)	0.0004** (0.0002)
IM	-0.0128*** (0.0021)	-0.0054*** (0.0017)		-0.0118*** (0.0021)	-0.0119*** (0.0021)	-5.76e-05 (0.0023)	-0.0007*** (0.0002)	-0.0002** (9.93e-05)		-0.0007*** (0.0002)	-0.0008*** (0.0001)	-0.0001 (0.0001)
GPS	0.0182** (0.0082)	0.0169** (0.0081)	0.0137* (0.0081)	0.0170** (0.0083)	0.0221** (0.0090)	-0.0021 (0.0038)	0.0011* (0.0006)	0.0010* (0.0006)	0.0009 (0.0006)	0.0011* (0.0006)	0.0013** (0.0006)	-0.0004 (0.0003)
FFOR	-0.0283*** (0.0042)	-0.0296*** (0.0043)	-0.0287*** (0.0043)			-0.0321*** (0.0066)	-0.0007*** (0.0002)	-0.0008*** (0.0002)	-0.0008*** (0.0002)			-0.0010*** (0.0002)
CGII	0.0239* (0.0125)	0.0200 (0.0126)	0.0172 (0.0129)	-0.0139 (0.0104)		-0.0240 (0.0168)	-0.0008 (0.0006)	-0.0008 (0.0006)	-0.0011* (0.0006)	-0.0012*** (0.0005)		-0.0026*** (0.0008)
RDI	-0.9450*** (0.2550)	-0.8030*** (0.2510)	-0.8030*** (0.2710)		-1.3600*** (0.3630)	-0.0273 (0.3660)	0.0004 (0.0111)	0.0002 (0.0108)	0.0014 (0.0112)		-0.0266** (0.0104)	0.0048 (0.0145)
NPW	-0.0851*** (0.0075)	-0.0885*** (0.0073)	-0.0874*** (0.0074)	-0.0847*** (0.0075)	-0.0970*** (0.0090)	-0.0838*** (0.0065)	-0.0043*** (0.0005)	-0.00450*** (0.0005)	-0.0044*** (0.0005)	-0.0044*** (0.0005)	-0.00433*** (0.0006)	-0.0045*** (0.0005)
INF	-0.0299*** (0.0024)	-0.0297*** (0.0026)	-0.0298*** (0.0026)	-0.0307*** (0.0025)		-0.0300*** (0.0025)	-0.0025*** (0.0003)	-0.0025*** (0.0003)	-0.0025*** (0.0003)	-0.0025*** (0.0003		-0.0021*** (0.0003)
REW	-0.0036** (0.0016)	-0.0036** (0.0016)	-0.0045*** (0.0016)	-0.0049*** (0.0016)	-0.0057*** (0.0018)	-0.0074*** (0.0018)	-0.0002** (6.90e-05)	-0.0002*** (6.88e-05)	-0.0002*** (6.99e-05)	-0.0002*** (7.01e-05)	-0.0002*** (7.26e-05)	-0.0003*** (8.32e-05)

Log_RO	-0.0911*** (0.0251)	-0.0714*** (0.0248)	-0.0595** (0.0246)	-0.0854*** (0.0255)	-0.0235 (0.0296)	-0.0210 (0.0310)	-0.0025 (0.0018)	-0.0020 (0.0018)	-0.0007 (0.0017)	-0.0022 (0.0018)	-0.00211 (0.0020)	0.00212 (0.0019)
PRIS Dummy						0.5740*** (0.0823)						0.0420*** (0.0065)
ULIS Dummy						0.0190 (0.1570)						0.0156 (0.0155)
Constant	1.9480*** (0.3620)	1.8730*** (0.3640)	1.6550*** (0.3720)	1.940*** (0.3670)	0.9000** (0.3900)	0.6730 (0.4450)	0.3280*** (0.0284)	0.3330*** (0.0285)	0.3090*** (0.0282)	0.3250*** (0.0283)	0.2670*** (0.0281)	0.2280*** (0.0265)
Industry Group Dummies	Yes	Yes	Yes	Yes	Yes		Yes		Yes	Yes		
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1179	1179	1179	1179	1179	1179	1179	1179	1179	1179	1179	1179
R-squared							0.5120	0.5030	0.5040	0.5080	0.4290	0.3350

***, ** and * indicate significance at the 1, 5 and 10% levels, respectively

Robust standard errors have been reported in parenthesis..

Table 6: Average Marginal Effects of Fractional Logit Model						
	(1)	(2)	(3)	(4)	(5)	(6)
TAR	-0.0001* (5.43E-05)	-0.0001** (5.82E-05)	-5.7E-05 (5.98E-05)	-9.6E-05* (5.55E-05)	-0.0001** (5.86E-05)	-0.0002** (6.88E-05)
EO	0.0006*** (0.0001)		0.0002* (9.78E-05)	0.0006*** (0.0001)	0.0006*** (0.0001)	0.0003** (0.0002)
IM	-0.0007*** (0.0001)	-0.0003*** (9.91E-05)		-0.0007*** (0.0001)	-0.0007*** (0.0001)	-3.43E-06 (0.0001)
GPS	0.0011** (0.0005)	0.0010** (0.0005)	0.0008* (0.0005)	0.0010** (0.0005)	0.0013** (0.0005)	-0.0001 (0.0002)
FFOR	-0.0016*** (0.00024)	-0.0017*** (0.0003)	-0.0017*** (0.0003)			-0.0019*** (0.0004)
CGII	0.00138* (0.0007)	0.0012 (0.0007)	0.0010 (0.0008)	-0.0008 (0.0006)		-0.0014 (0.0010)
RDI	-0.0545*** (0.0147)	-0.0464*** (0.0145)	-0.0464*** (0.0156)		-0.0798*** (0.0214)	-0.0016 (0.0218)
NPW	-0.0049*** (0.0004)	-0.0051*** (0.0004)	-0.0051*** (0.0004)	-0.0049*** (0.0004)	-0.0060*** (0.0005)	-0.0050*** (0.0004)
INF	-0.0017*** (0.0001)	-0.0017*** (0.0002)	-0.0017*** (0.0002)	-0.0018*** (0.0002)		-0.0012*** (0.0002)
REW	-0.0002** (9.02E-05)	-0.0002** (9.05E-05)	-0.0003*** (9.21E-05)	-0.0003*** (9.16E-05)	-0.0003*** (0.0001)	-0.0004*** (0.0001)
Log_RO	-0.0053*** (0.0015)	-0.0041*** (0.0015)	-0.0034** (0.0014)	-0.0049*** (0.0015)	-0.0014 (0.0017)	-0.0012*** (0.0019)
PRIS Dummy						0.0342*** (0.0049)
ULIS Dummy						0.0011 (0.0093)

***, ** and * indicate significance at the 1, 5 and 10% levels, respectively
Robust standard errors have been reported in parenthesis.

Figures

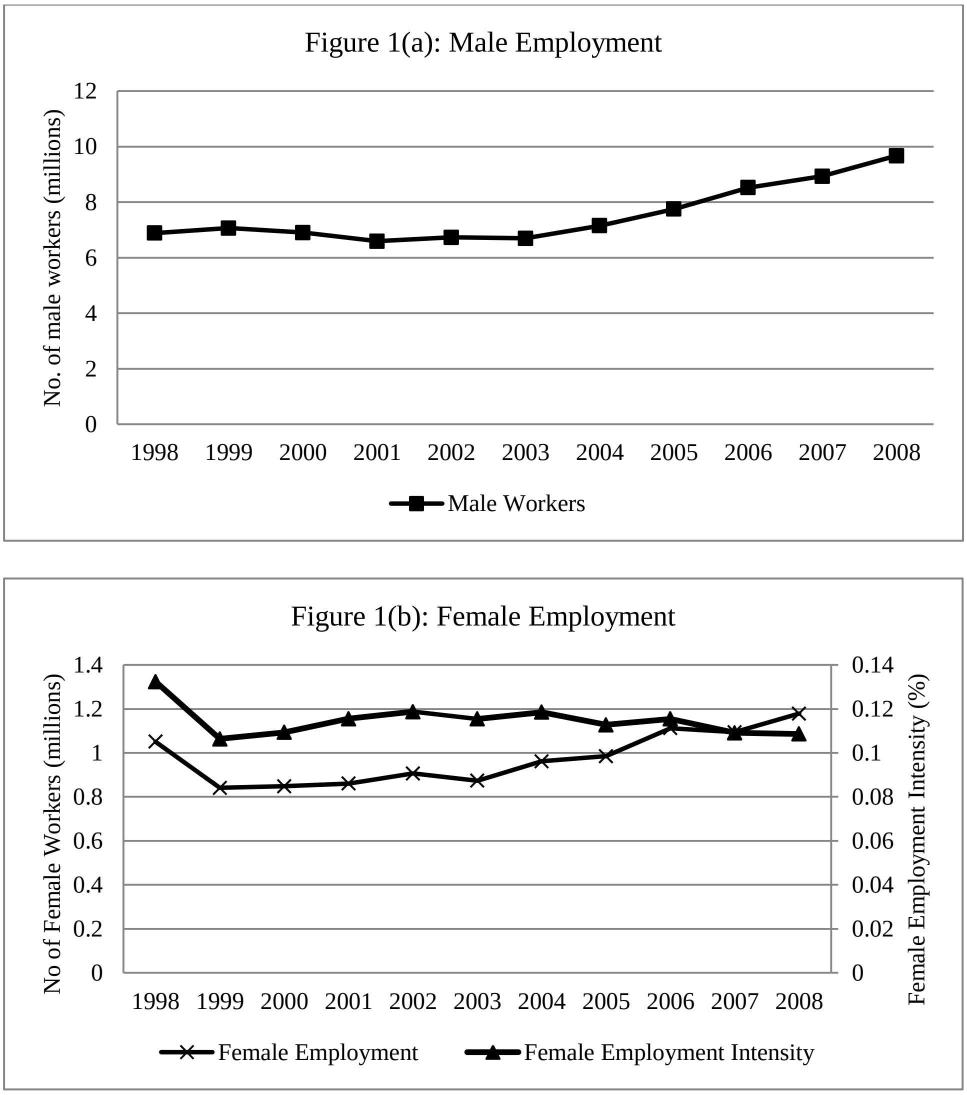

Figure 1: Trends in Male and Female Employment, 1998-2008

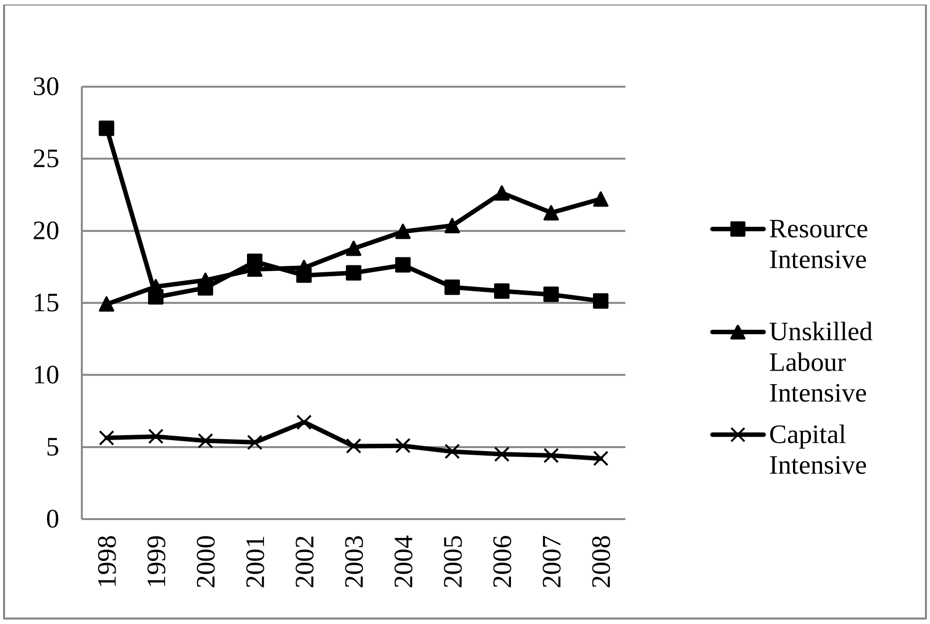

Figure 2: Female Employment Intensity (FEI) across Factor Intensity Based Groups (%)

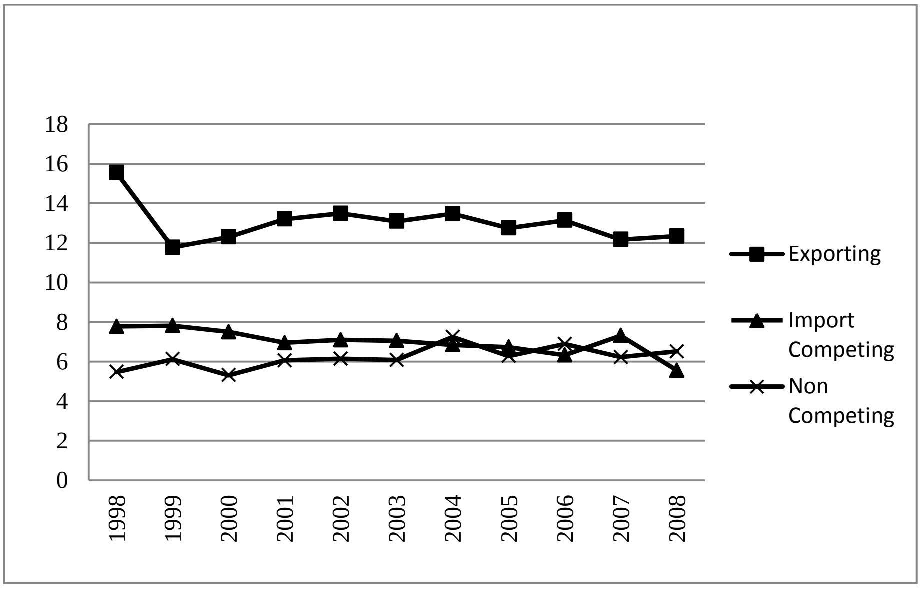

Figure 3: Female Employment Intensity (FEI) across Trade Orientation Based Groups (%)

Appendix

Database

The dependent variable FEI is measured using data on employment, according to ISIC Rev 3 nomenclature, from the UNIDO's industrial database, INDSTAT 4. This data at 4-digit level of disaggregation is available for the period 1998-2008, which is the period of our study. The explanatory variables used in the regression analysis have been constructed using data from different sources. Data on exports and imports, which is used for measuring the variables EO and IM, came from UN-COMTRADE database, accessed using World Integrated Trade Solution (WITS) software from the World Bank. The WITS software provides a concordance between SITC and ISIC, which allows us to directly retrieve trade data according to the ISIC Rev 3 system. The WITS database also provides access to UNCTAD-TRAINS database on import tariff rates. We have retrieved this data (used for measuring TAR) from WITS as per ISIC Rev 3. While UNCTAD-TRAINS provides the data on tariff rates according to HS classification, it was possible to retrieve this data according to ISIC as WITS makes use of a concordance table between the two classification systems.

The variables FOR, CGI and RDI are obtained using the Prowess database (which provides detailed balance sheet information for firms listed in India's stock exchanges) from CMIE. The variables NPW, INF and REW are from the Annual Survey of Industries (ASI) from the Central Statistical Organization (CSO). Both Prowess and ASI report data according to National Industrial Classification (NIC), which is very similar to ISIC Rev 3 system. The variable GPS is measured using data from World Input Output Database (WIOD). The WIOD classification is more aggregated than 4-digit ISIC level. We have calculated GPS as per the WIOD classification, which has been matched to the 4-digit ISIC codes using a concordance table. Thus, values of GPS are identical for all 4-digit codes within a given WIOD industry group. Finally, the variable RO is calculated using output (nominal) data from INDSTAT 4. The nominal output values have been converted to real values using relevant WPI from Reserve Bank of India (RBI). See Table A1 for further details related to variable definition, data sources etc.

Table A1: Variables and Data Sources

Notation	Definition	Data Source	Industrial Classification	Remarks
FEI	Female employment divided by total employment	UNIDO's industrial database, *INDSTAT 4*		
TAR	Simple average import tariff rate	UNCTAD-TRAINS DATABASE accessed using WITS		Tariff values for 1998 and 2003 were not available. For these years, we use the average of the values from the year before and after it. E.g. for the year 1998, we use the average of the 1997 and 1999 values
EO	Exports as a share of output	Export data from COMTRADE-WITS and output data from UNIDO	ISIC	
IM	Imports divided by domestic demand	Import data from COMTRADE-WITS and output data from UNIDO		Domestic demand is calculated as the difference between output and net exports
RO	Real Value of Output	Output data from UNIDO and Wholesale Price Index from RBI's DBIE		The DBIE industry codes were matched with relevant 4 digit ISIC codes.
GPS	Ratio of Imported Intermediate Inputs to Total Intermediate Inputs Used	World Input Output Database (WIOD)	WIOD classification	WIOD classification is more aggregated than 4-digit ISIC level. We have calculated GPS as per the WIOD classification, which has been matched to the 4-digit ISIC codes using a concordance table. Thus, values of GPS are identical for all 4-digit codes within a given WIOD industry group.
FOR	Sales of Foreign Firms/Total Sales			Foreign firms are identified as those with 25% or more of foreign equity shares
CGI	Capital goods imports / sales	CMIE's PROWESS Database		
RDI	Expenditure on R&D/Total Sales			
NPW	Number of non-production workers / Total workers		NIC	Matching of NIC codes with that of ISIC codes are straightforward as the nomenclature of the two classifications are very similar up to the 4-digit level.
INF	No. of contract workers / Total workers	Annual Survey of Industries (ASI)		
REW	Relative Wages			

Table A2: Female Employment Intensity across Industry Groups (2-digit ISIC)

ISIC Codes	Description	1999	2003	2008
15	Food and beverages	16.22	17.63	17.71
16	Tobacco products	18.68	22.18	14.28
17	Textiles	7.84	10.52	14.71
18	Wearing apparel, fur	51.86	48.10	41.16
19	Leather, leather products and footwear	25.68	19.84	24.26
20	Wood products (excl. furniture)	10.23	6.91	6.11
21	Paper and paper products	5.41	5.98	6.19
22	Printing and publishing	3.99	4.15	5.02
23	Coke, refined petroleum products, nuclear fuel	2.57	2.02	1.53
24	Chemicals and chemical products	12.42	10.71	9.21
25	Rubber and plastics products	4.93	4.32	5.14
26	Non-metallic mineral products	5.87	4.80	3.47
27	Basic metals	1.39	0.77	0.90
28	Fabricated metal products	1.91	1.55	1.48
29	Machinery and equipment n.e.c.	1.18	1.19	1.08
30	Office, accounting and computing machinery	17.95	8.88	9.31
31	Electrical machinery and apparatus	4.57	5.05	5.00
32	Radio, television and communication equipment	17.52	14.13	11.64
33	Medical, precision and optical instruments	14.76	10.78	10.52
34	Motor vehicles, trailers, semi-trailers	1.78	1.90	2.54
35	Other transport equipment	1.00	1.03	0.73
36	Furniture; manufacturing n.e.c.	11.39	13.06	11.19

Table A3: Summary Statistics

Variables	Mean	Standard Deviation	Minimum Value	Maximum Value
FEI	0.0677	0.0920	0.0000	0.7254
TAR	27.7350	21.4140	0.0000	217.3550
GPS	13.8732	8.4081	3.4687	68.3724
EO	16.8008	19.4710	0.0069	99.6691
IM	20.0611	22.4990	0.0187	99.9393
FOR	2.7711	10.4782	0.0000	83.0697
RDI	0.0557	0.1790	0.0000	1.6683
CGI	0.2579	1.8094	0.0000	29.9026
NPW	26.3046	8.8745	2.7904	68.5331
INF	25.0623	15.3790	0.0000	76.6020
REW	64.5656	28.8461	0.0000	412.6299
log RO	13.2339	1.7225	5.5595	17.8306

Table A4: Correlation Matrix												
	FEI	***TAR***	***GPS***	***EO***	***IM***	***FOR***	***CGI***	***RDI***	***NPW***	***INF***	***REW***	***log RO***
FEI	1											
TAR	0.0560	1										
GPS	-0.1080	-0.3200	1									
EO	0.1275	-0.1925	0.0840	1								
IM	-0.0762	-0.2886	0.1945	0.6130	1							
FOR	-0.1362	-0.0390	0.0177	-0.0915	-0.0528	1						
CGI	-0.0342	-0.0161	0.0958	-0.0018	0.0028	0.1165	1					
RDI	-0.0992	-0.0532	0.0154	-0.0563	-0.0476	0.5751	0.3423	1				
NPW	-0.4209	-0.1168	0.0094	-0.1153	0.1997	-0.0004	-0.072	-0.0052	1			
INF	-0.1759	-0.0113	0.1037	-0.0455	-0.1306	0.0959	0.0245	0.0706	-0.2712	1		
REW	-0.1669	-0.1441	0.1084	0.0002	0.1420	0.1663	0.0395	0.1721	0.0919	-0.0276	1	
log RO	-0.0411	-0.0521	0.0842	-0.1233	-0.1817	-0.1183	0.0096	-0.0816	0.0137	0.1856	0.0555	1

Table A5: Determinants of Female Employment Intensity: Tobit Models						
	Tobit					
	(1)	(2)	(3)	(4)	(5)	(6)
TAR	-0.0002** (0.0001)	-0.0003** (0.0001)	-0.0002* (0.0001)	-0.0002* (0.0001)	-0.0025** (0.0001)	-0.0003** (0.0001)
EO	0.0007*** (0.0002)		0.0002** (0.0001)	0.0007*** (0.0002)	0.0008*** (0.0002)	0.0004*** (0.0002)
IM	-0.0007*** (0.0002)	-0.0002* (0.0001)		-0.0007*** (0.0002)	-0.0008*** (0.0002)	-0.0001 (0.0002)
GPS	0.0011** (0.0006)	0.0011** (0.0006)	0.0010* (0.0006)	0.0012** (0.0006)	0.0014** (0.0006)	-0.0004 (0.0003)
FFOR	-0.0007*** (0.0002)	-0.0008*** (0.0003)	-0.0008*** (0.0003)			-0.0010*** (0.0003)
CGII	-0.0008 (0.0012)	-0.0008 (0.0012)	-0.0011 (0.0012)	-0.0013 (0.0011)		-0.0027* (0.0014)
RDI	-0.0005 (0.0155)	-0.0007 (0.0156)	0.0005 (0.0156)		-0.0274* (0.0145)	0.0057 (0.0161)
NPW	-0.0045*** (0.0003)	-0.0046*** (0.0003)	-0.0046*** (0.0004)	-0.0045*** (0.0003)	-0.0045*** (0.0003)	-0.0050*** (0.0003)
INF	-0.0025*** (0.0002)	-0.0025*** (0.0002)	-0.0025*** (0.0002)	-0.0026*** (0.0002)		-0.0021*** (0.0002)
REW	-0.0001* (7.58e-05)	-0.0002** (7.63e-05)	-0.0002** (7.63e-05)	-0.0002** (7.54e-05)	-0.0002* (8.17e-05)	-0.0003*** (8.17e-05)
Log_RO	-0.0012 (0.0017)	-0.0007 (0.0017)	0.0006 (0.0016)	-0.0010 (0.0017)	-0.0007 (0.0018)	0.0029** (0.0015)
PRIS Dummy						0.0433*** (0.0064)
ULIS Dummy						0.0159 (0.0098)

Constant	0.312*** (0.0255)	0.316*** (0.0257)	0.292*** (0.0253)	0.309*** (0.0255)	0.249*** (0.0272)	0.217*** (0.0238)
Industry Group Dummies	Yes	Yes	Yes	Yes	Yes	
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,179	1,179	1,179	1,179	1,179	1,179
Pseudo R-squared	-0.387	-0.378	-0.378	-0.383	-0.302	-0.219

***, ** and * indicate significance at the 1, 5 and 10% levels, respectively

Standard errors have been reported in parenthesis.