Trade Liberalization in India: Impact on Gender Segregation

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Abstract

This paper explores the gender effects of trade liberalization by looking at changes in gender segregation by occupation and sectors in labor market of India. Trade can impact occupational gender segregation by increasing competition which increases the pressures on domestic and foreign employers in the economy to hire and employ different factors of production (here, specifically men and women) efficiently. The need to compete effectively in this increasingly competitive environment begins to override any gender based preference, making the employers amenable to employing cheaper labor and particularly women. The empirical estimation in this paper exploits the detailed repeated cross sectional data of India's National Sample Survey Organization (NSSO) combined with Census of India data and trade data by UNCTAD. Results indicate that there was relatively more reduction in occupational gender segregation in those areas in urban India which saw greater trade liberalization. Also there comes about an increase in segregation of women into the informal sector of the labor market with greater trade liberalization. These results hold even after we control for human capital factors affecting gender based segregation, comprehensive district/region, industry and time fixed effects.

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1. Introduction

In the last two decades, many developing countries including India have undergone the process of economic liberalization. Trade liberalization was one of the major measures initiated under this process in 1991. Declining trade barriers since the 1990s have led to closer integration of countries' markets and rapid expansion of international trade. In India, average tariff rates (over all industries) have declined from very high levels of 117% in 1990-91 to 60% in 1992 and to a much lower level of 39% by 1999-2000. In subsequent years the average tariff was further reduced to 22% in 2004-05 and to 15% by 2005-06. Besides reducing average tariff levels, trade liberalization has also changed the structure of protection across industries.

There was increased import penetration, substantial export growth, inflow of foreign investment and significantly high levels of economic growth witnessed by the country. GDP grew by 6.7% per year during this phase of rapid trade liberalization. Exports grew at an annual rate of 14% and imports at an average rate of 15% per year during 1992-97[2]. Previous studies have examined the effect of trade reforms on different aspects of the Indian economy: firm productivity (Topalova P (2004)); wage inequality between skilled and unskilled workers (Banga (2005)); poverty (Topalova P (2005)); schooling and child labor (Edmonds et al (2005)) and industry wage premiums (Kumar and Mishra (2008)). These existing studies provide mixed evidence on the effects of trade reforms.

In contrast, the linkages between trade liberalization and gender segregation in the labor market are as yet unexplored for India. This paper takes a step in that direction and demonstrates that trade liberalization does not yield gender neutral results in labor markets; it has different effects on men and women in terms of employment and earnings. In this regard, we specifically try to study if and what impact did trade liberalization have on gender segregation across occupations in the labor market. By gender segregation we refer to the unbalanced distribution of men and women across occupations in a manner inconsistent with their overall shares of employment. Women are segregated into a narrow range of low wage occupations and are employed mostly in informal sectors while men tend to be working in high wage occupations and predominantly in formal sectors.

Gender segregation is widely observed in the labor markets of both developed and developing countries. Most of the studies have focused on the former and thus very little is known about the segregation patterns in developing countries. Estimates have shown that in case of the United States in 2000-01, gender segregation at the level of occupation titles is very high with almost two thirds of working women segregated into 21 out of the 500 occupational categories[3]. Though a decline has been observed in the recent period,

[2] Import penetration ratio increased from 0.10 in 1985 to 0.16 in 1996.

[3]This is based on calculations done from the Wage Project by the U.S. Department of Labor, Bureau of Labor Statistics. http://www.wageproject.org/content/gap/why.php. Previous estimates at the level of job titles have shown that almost 84-92% of the workers are in completely segregated jobs (Bielby and Baron (1984,1986))

segregation still remains a salient feature of the contemporary labor market. Occupational sex segregation calculations for India also support the fact that a very high proportion of the women (62.2% in 1999-00) are employed in typically female or integrated occupations. However the decade of 1990s saw a decline of 9-14% in sex segregation levels with significant regional/district level variations[4]. This period coincides with the trade liberalization phase in India. The factors responsible for the observed fall in gender segregation level include rising levels of educational attainment and human capital of women, increasing presence of feminism, changes in culture and traditions, changes in industrial and occupational structure and perhaps lower levels of gender prejudice on part of the employer, employee or the customer. In this paper we explore how these factors affect gender segregation in the context of trade liberalization in India. Moreover unlike the existing studies on gender segregation which look at segregation at the national level[5] , we conduct the analysis at the more disaggregated level of regions, districts and industries.

Trade can impact occupational gender segregation by changing the regional and industrial market structure through increased domestic competition which creates pressures on domestic and foreign employers in the economy to hire and employ different factors of production (here , specifically men and women) efficiently. The need to compete effectively in this increasingly competitive environment begins to override any gender based preference, making the employers amenable to employing cheaper labor and particularly women. This would affect occupational gender segregation[6]. Changes in the existing occupational

[4] This is based on calculations done using the Employment and Unemployment rounds of India's National Sample Survey data for different years.

[5] See Cartmill (1999), Oliveira (2001), Mora and Castillo (2003), Roos (1985).

[6] There are theories both on the demand side (Discrimination theory by Bergmann, Becker; Statistical discrimination by Phelps & Arrow) and supply side (Neoclassical/Human Capital by Polachek, Mincer) in the literature which explain occupational sex segregation. Supply side theories have been extensively used to explain the observed segregation but many studies have doubted the consistency of these as they fail to explain all the observed occupational sex segregation such as those of women who are well educated and who do not plan work interruptions. For example, the individual-level variables indicated by the neoclassical theory are clearly pertinent to the issue of women's participation in the labor force, but their ability to explain gender segregation within the labor force is minimal. Beller A (1982) not only finds mixed evidence on the human capital factors explaining occupational sex segregation, but also notes that the importance of these factors is declining over time. Her analysis further supports the discrimination explanation of occupational sex segregation given by Bergmann B (1974). England P (1982, 1984) further shows that human capital theory cannot explain bulk of the occupational sex segregation and cannot be associated with higher initial pay or lower penalties for discontinuous employment. The two main predictions of the human capital theory are refuted in the data set used by her in the paper. She finds that the earnings of women in predominantly female occupations do not show higher rates of appreciation or depreciation than in male dominated occupations and women who have spent most time of their post school years out of the labor force are no more apt to be in predominantly female occupations than the women who have been continuously employed. In a later work by Jacobs (1986) he concludes: "*In 1981, assigning to women the age, hours, and educational distributions of men would reduce the degree of segregation by just over 2 percent*". In addition, some studies (Duncan G & Hoffman (1979), Royalty A (1996)) have shown evidence that is consistent with discrimination in access to on the job-training and some have shown it as regards discrimination in promotion (Cabral R et al (1981)).

structure brought about through increasing trade can also effect gender segregation across occupations.

The empirical results in this paper show that occupational gender segregation has declined relatively more in urban areas which witnessed greater fall in net tariffs. The results hold even after we control for the human capital factors affecting gender based segregation and account for comprehensive district/region, industry and time fixed effects.

We exploit the detailed person and household level survey data by National Sample Survey in India and link it to region/district[7] and industrial level tariff changes and trade exposure. More specifically, the empirical methodology used in this paper exploits the geographic and industrial variation in exposure to trade reforms and attempts to discern the effect of trade liberalization on gender segregation across occupations.

In a way this study also explores the interrelation of trade and gender and is part of the broad study area trying to understand the adjustment of labor market in developing countries to trade reforms. To our knowledge, there has been no empirical evidence linking trade reforms to gender segregation in labor market– the only exception being the study by Meyer L.B (2003) where she analyzes 56 countries for the period 1970-90 and shows that global forces reduce occupational sex segregation and inequality. This paper attempts to fill this gap in the literature.

The results from this paper also contribute towards the empirical literature on economics of discrimination. To the extent that gender segregation result from taste based discrimination or statistical discrimination practiced by employers, it is inefficient because it prevents maximization of productive capacity; the fall in gender segregation associated with trade liberalization represents an efficiency gain in the economy. When women are kept out of certain occupations based solely on gender, the best worker is not matched with the most appropriate job and elimination of occupational segregation can increase GDP between 2% and 9 % points (Esteve-Volart (2000), Tzannatos (1999)). Due to data limitations in this paper, we were unable to calculate increase in output associated with this fall in segregation, but previous study by Esteve-Volart (2004) in the context of India finds that a 10% increase in female to male ratio of managers raises nonagricultural output by 2%.[8]

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[7] We also examine changes in occupational sex segregation at individual level by specifically looking at whether trade liberalization through reduction in industrial tariffs facilitates the entry of women into male dominated occupations leading to a fall in the sex differential in the probability of working in a male dominated occupation.

[8] Occupational gender segregation also assumes importance in the sphere of public policy as the observed segregation is an indicator of factor immobility in the economy. It is observed that women are excluded from the 'male-dominated' occupations and males are not preferred in the 'female-dominated' occupations. Also women are concentrated in a narrow range of occupations than men and this further lessens the occupational mobility for them. It results in labor market inefficiency (human resources are wasted as many of the best qualified persons for an occupation may be excluded because of their gender, resulting in a sub-optimal labor market outcome). Many predominantly-male occupations often have higher earning potentials (McLaughlin (1978)), allow for increased occupational mobility (Wolf and Rosenfeld (1978)), and provide greater promotional opportunities (Glass (1990)), Hultin (2003)). Besides this, segregation also affects education of

In addition, this paper goes one step further compared to previous studies that have looked on gender and trade liberalization. It analyzes the effect of trade liberalization on gender segregation which has been identified as a major mechanism through which women are denied access to higher paying and better jobs/sectors thereby resulting in significant gender wage inequality[9]. A recent study by Troske K. et.al (2003) has used employer and employee matched data covering all industries and occupations in the United States and shown that segregation of women into lower-paying occupations, industries, establishments and occupations within establishments, accounts for half of the gender gap in wages with the remaining half being attributable to the individual's gender.[10]

In terms of policy relevance, the empirical results on occupational gender segregation suggest that greater trade openness has led to a fall in gender segregation which might then translate into long term consequences for gender wage inequality and contribute towards the argument favoring trade liberalization in India.

The tariff reduction in India was unanticipated and part of the IMF conditioned program. The policy makers had little room to cater to political interests; from an individual region/district and industry's perspective, the final tariff rates can be considered exogenously determined[11]. Thus the usual problem of the possible endogeneity of trade policy is not a big issue here. The decline in tariff levels and the changes in tariff structure across industries acts as the source of variation to identify the causal effects of trade liberalization policy on gender segregation. Also by focusing on variations within one country, we do not face the problem of inter country related data comparability issues.

However there are several limitations to our study which should be considered. Firstly we restrict the analysis to the tariff measures only and do not take into account the reduction in non-tariff barriers (NTBs) which were also a significant part of the trade liberalization policy. This is due to the non-availability of non tariff barrier data on an annual basis for all industries. However this is not an issue of major concern since the limited data available on NTBs suggest that tariffs and NTBs were positively correlated during the period under consideration. Thus the tariff changes are likely to account accurately for the overall

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women, training of future generations (Anker (1998)), labor force participation rates, social rewards like class standing and prestige, fertility rates and inequality in the society as a whole. Thus segregation is an important labor market characteristic which cannot be underestimated in today's society.

[9] Darity and Mason (1998) note that that the presence of segregation between male and female labor market cannot be explained well by human capital differences between men and women; "women continue to be more concentrated in lower-paying jobs than men with equivalent levels of education".

[10] Other international empirical investigations done have suggested that occupational sex segregation is extremely important in explaining the wage gap, ranging from 12% (Blau et al. (1998)) to as high as 90% (Petersen and Morgan (1995), Tomaskovic-Devey (1993)) of earning differences.

[11] Political economy models of trade policy formulation (Grossman and Helpman (1994)) suggest that trade policy outcome might be an endogenous outcome of a political process. But in case of India, endogeneity is not an issue as discussed in a later section.

measures of trade policy changes[12], though they may overstate the pure tariff effect. Secondly we do not account here for the tariff reductions by other countries which would lead to an increase in our exports, altering the employment and segregation patterns in the domestic labor market. But here again we assume the effects to be generated through the similar mechanisms as through domestic country's tariff reductions. Thirdly we refrain from analyzing the economy wide effects of tariff changes on gender segregation in the more general equilibrium set up as we cannot separate the trade induced effects from other economy wide changes without imposing strong identification assumptions. Fourthly, though we discuss the various mechanisms through which trade liberalization can affect gender segregation, but in this paper, we do not have strong priors on which mechanism would actually be dominating in case of India and causing the estimated effects.

The rest of the paper is organized as follows. Section 2describes the Indian trade liberalization experience; section 3 discusses the various mechanisms through which trade liberalization could impact gender segregation. The sections 4 and 5 looks at the data-variables and the empirical methodology respectively used in the analysis. The results of the empirical estimation are presented in Section 6 of the chapter. Section 7 concludes the chapter.

2. Trade Liberalization in India

2.1 Trade Liberalization Phase

Since Independence from the British rule in 1947, India had a very restrictive trade regime. Average tariff rates were as high as 117% in 1991. Besides high tariff rates, there were also very high non-tariff barriers like restriction of imports and exports to certain sectors, complex import licensing system that covered almost all product categories in intermediate, capital and consumer goods sectors. In the 1980s there was some conscious effort to dismantle the import licensing regime via reductions in the number of products listed under banned/ restricted category and a start to reduction and rationalization of tariff structure. But it was only in early 1990s that any significant changes in the tariff structure came about. The 1991 reforms were much broader both in scope and scale and also initiated a departure from the long existing stringent regime of controls and represented a significant move to a market oriented regime[13].

[12] Some studies have alternatively used effective rates of protection as a measure of trade policy. See (Jacob M (2006), Das D (2003)).

[13] Rodrik and Subramanian (2004) distinguish the reforms of the eighties and nineties by describing the former as 'pro-business' and the latter as 'pro-market'. They argue that there came about a structural break in early eighties because there was an attitudinal shift in the government and the reforms focused on increasing profitability of existing firms by easing capacity restrictions and reducing corporate taxes, among other things. The reforms of the 90s allowed more competition and paved the way for entry of new domestic firms and multinational corporations (MNCs) in Indian industries. Also the trade liberalization was part of the so called

A series of domestic and foreign sector crises triggered this significant trade liberalization process in India in 1991. The domestic sector was characterized by a rise in the fiscal deficit (7-8% of GDP), negative industrial growth (-1.3%), soaring inflation (16%) combined with political uncertainty due to assassination of the then prime minister of India, Rajiv Gandhi. Investor confidence had reached its trough. The foreign sector too was suffering from crises due to hikes in oil prices and reduction in repatriation from expatriate workers (due to the Gulf war) in the Middle East which then lead to severe balance of payment crisis. Foreign currency reserves plummeted to about $ 1 billion (or two weeks of imports). To deal with these problems, the government of India introduced unanticipated reform measures under an IMF structural adjustment program in August 1991 which was conditional on introducing macroeconomic stabilization and structural reforms in the industrial and import licensing sector[14], financial sector, tax and trade policies. In particular, the benchmarks for the trade policy included a reduction in level and dispersion of tariffs and a removal of the large number of quantitative restrictions.

Consequently, tariffs and non-tariff barriers across all sectors were drastically reduced and brought to a more uniform level as observed by a decline in dispersion of tariff levels from 1987-1997. Industries with higher tariffs in pre-liberalization period saw greater reductions. The average tariff in manufacturing[15] declined from a high of 117% in 1990-91 to 60% in 1992 and to a much lower level of 39% in 1999-2000. All 26 import licensing lists were eliminated and a negative list (products to be excluded from tariff duty reduction commitments) was established[16]. See Figure 1 for changes in the protection levels (measured by industry tariffs) across manufacturing sector over time. Not only was there increased openness brought about in the manufacturing sector, but also the agricultural sector witnessed a more open and liberal trade policy. Tariff rates were reduced for all agricultural products with the exception of cereals and oil seeds. Non tariff barriers were also subsequently lifted in the late 1990s. In addition, there came about the liberalization of foreign exchange controls and foreign direct investment. Liberalization of foreign investment increased competition through the entry of foreign firms into domestic markets. The gain in momentum in the pace of reforms over the period 1991-96, later slowed down after 1997.

2.2 Review of Literature on Impact of Trade Liberalization in India

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"first generation reforms" which started in 1991-92. The period since 1999-00 is called the period of second generation reforms.

[14] A New Industrial Policy was announced in July 1991. This policy abolished licensing for all but 18 industries; industries restricted for public sector investments were cut from 17 to 8; and allowed small scale enterprises to offer up to 24% of shareholding to large enterprises.

[15] Within the manufactured sector, in the period 1998–2000, the largest share of exports consisted of handicrafts, primarily gems and jewelry (18.0 percent), engineering goods (14.0 percent), ready-made garments (12.3 percent), textile yarn fabrics (11.6 percent), and chemicals and allied products (9.0 percent)

[16] Goods from this negative list could be freely imported along with all other goods, subject to import tariffs.

There have been many studies that have tried to empirically analyze the social impacts of trade liberalization in India. Topalova P (2005) uses a difference-in-differences methodology and shows that the districts that were more exposed to trade liberalization faced a smaller reduction in poverty levels as compared to other districts that had fewer industries exposed to trade liberalization. Edmonds et al. (2005) looked at the effect on children and found that during the period, India experienced significant declines in child labor and increases in schooling attendance, with districts more exposed to tariff cuts observing smaller declines in child labor and smaller increases in school attendance. They suggest that this relationship is driven by the adjustment costs in terms of lost employment opportunities and negative effect on poverty of declining tariffs.

As regards changes in male and female employment due to trade liberalization, Bhaumik (2003) notes that the growth in the workforce share classified as casual accelerated after 1993 as a result of the liberalization policies, with larger increases for female workers compared to their male counterparts in both rural and urban areas. A series of studies have also looked at the impact on gender wage inequality. Jacob. M (2006) finds that industries that were exposed more to trade liberalization from experiencing larger reductions in trade barriers saw higher reductions in the wage differential between men and women. Also the author looked at the wage differential between low and high caste workers and shows that it does not seem to be affected significantly by trade liberalization. Kumar & Mishra (2008) argue in their paper that higher wage premiums occurred in sectors that disproportionately employed unskilled workers which then led to an increase in their relative incomes and a decline in overall wage inequality in the economy.

2.3 Endogenity of Trade Policy

Trade liberalization could be endogenous with gender segregation thereby creating bias in our analysis. Particularly, if increase in competition brought about through trade liberalization (more specifically tariff reduction here) was systematically different in regions and industries facing higher segregation levels as compared to those facing lower segregation, then our estimates would be biased. However the scope for this endogeneity bias is very low in case of the trade liberalization experience in India. Previous literature[17] on trade liberalization in India has shown that the trade reforms were unanticipated and externally imposed. They were brought about as a part of the IMF conditioned program; the external obligations to be met were exogenous and did not permit any political opposition or influence to this policy implementation. Policy makers did not have much room for catering to the special lobby interests from the industrial groups. Also looking at the tariff changes across time post 1991, it can be seen that the movements in tariffs were uniform until 1997 with all industries witnessing a tariff fall in proportion to their initial tariff levels. Post 1997, the tariff changes do appear to lose this uniformity and reflects policy maker's selectivity in

[17] See section 2.2.2 for the previous literature on trade and its affect in India.

setting product tariffs. In a recent study by Topolova P (2005), the author looks at the correlation between future tariffs and current productivity in 1989-96 and post 1997 period. She finds the correlation to be "indistinguishable from zero" for the period 1989-96 and negative post 1997. Figure 2 shows this correlation. For the purpose of this paper since we restrict the use of trade policy variation to 1989-97, we avoid the problem of possible endogeneity in tariff setting that came about post 1997[18]. Also Topolova P (2005) has further looked at the changes in industry tariffs and industry characteristics (employment size, output size, average wage, concentration levels) and found no correlation between the two, thereby further supporting the assumption of exogeneity of tariffs. Tariff and non-tariff barriers were reduced across the board for all industries and our analysis captures the variation in the extent of the net[19] decline in protection in a district/region and across industries. In addition, the trade liberalization phase lasted over several years which provide a second source of variation (across time variation) for the purpose of identifying the trade policy effects.

3. Conceptual Framework

In this section I will summarize the possible mechanisms through which trade liberalization can affect gender segregation.

3.1 Trade and Occupational Sex Segregation

International trade brings about higher levels of competition in the domestic economy which changes the employment and wage patterns significantly. Neoclassical theory by Becker (model of taste[20] based discrimination 1957/71) emphasizes the factors which limit the amount of competition in the labor market or in the product market thereby enabling employers to practice discrimination and causing the observed segregation. A discriminating employer must act as if he were willing to forfeit income to avoid certain transactions (with a certain section of the labor force). Employers who practice employment discrimination (over and above what can be accounted for by productivity differentials between men and women) have a disutility attached to employing women workers in some occupations which denotes their taste preference for men in some occupations and women in other occupations. Women workers get segregated into specific occupations which in most cases are also low paid occupations as compared to men's occupations. Discrimination may further create entry barriers for women into traditionally male occupations and cause them to "crowd" into that

[18] For further details, refer to pages 14-18 of Topolova P (2005).

[19] By net, here we imply aggregated effect of protection by combining all industries in a district/region for the analysis at the sub-state level and the respective industry tariff level for the individual level analysis.

[20] There is no explanation given in the literature for the existing prejudice that some workers, employers or customers do not want to work with or come into contact with members of other racial groups or with women, rather it is simply assumed that there is a 'taste' or preference against people from disadvantaged groups and that this taste can be treated in exactly the same way that economists would analyze individual preferences between goods and services. In this paper, we adopt a similar approach.

subset of occupations where they can freely enter as barriers are low (Bergmann B (1974)). The increased labor supply in that subset of occupations depresses wages there while the limiting labor supply increases the wages in male dominated occupations which the employer has to pay. The employers thus in turn are harmed by this discrimination, as they have to give up some profits to be able to practice discrimination. However they will continue to discriminate as long as the disutility they save from not hiring women workers is greater than lost utility of this sacrifice in profits that they have to make. Industries with higher levels of market power have more latitude with which to engage in such costly practices as discrimination (Shepherd & Levin (1973), Shepherd (1979)).

As a result of the increasing competition brought about by trade liberalization, need to realize profit by competing within the market arena forces employers to hire the cheapest workers available, and thus any potential employer preference based on gender would be overridden by this need to compete effectively. Also if in a competitive labor market, one or even many employers refused to hire women for certain occupations or systematically underestimated their productive potential, then other employers would make higher profits from stepping in and hiring the women workers who had earlier been shunned from some occupations by the discriminating employers. Thus in a perfectly competitive market, non-discriminatory employers gain a cost advantage and ultimately drive discriminating employers out of business. Consequently, in transition, as an economy becomes more competitive, we would expect employer discrimination to decline as the economic rents derived earlier from the discriminatory behavior are reduced. Inefficient firms may be driven out of the market thereby reducing the social costs of production by promoting production based on comparative advantage. Access to export markets may induce increased capacity utilization as well as scale economies which may also increase demand for both male and female labor.

In addition, many times the behavior of an employer is discriminatory not because he is prejudiced against the women workers but because he is ignorant of their true efficiency/productivity (Becker (1957)). Competition brought about through trade liberalization also brings about spread of knowledge that increases monitoring of efficiency and gives employers less opportunity to forgo profits for discrimination as their disutility from hiring women decreases. This fall in employment discrimination would then affect segregation in the labor market.

Increased global economic production resulting from trade liberalization also brings about creation of new jobs (in many cases, low-end jobs) in the manufacturing and service sectors. Many old occupations decline in their relative shares and new occupations emerge[21]. Porter (1990) notes that with the entry of domestic firms into export markets after the trade

[21] Moreover, it is also believed that with the growth in employment, it can be expected that occupational integration of male and female workers would take place because the net growth of employment would favor job mobility and facilitate change in gender composition across occupations (Watts and Rich (1993)).

reforms, new technologies may be absorbed through their contact with international markets. Also not only do firms which face relatively more intense import competition have to innovate in order to keep their efficiency and viability, but also it results in an improvement in the quality of human capital. The improvement in technology of production leads to a rise in the share of professional and technical workers particularly scientists and engineers owing to the emphasis of science and technology.

Besides, changes in degree of occupational gender segregation may occur as a by-product of shifts in the occupation mix of the economy which affect the relative size of predominantly male, predominantly female, and integrated occupations (Fuchs V (1975)). Trade liberalization brings about a shift in the industrial and occupational structure which generates effects on occupational gender segregation. There is increased export production which is characterized by the high intensity[22] of female labor in industries especially agriculture and allied activities, textiles and garments manufacturing and a wide range of other manufacturing activities ranging from micro activities like handicrafts, toys and food processing to assembly line activities like pharmaceuticals, communications and hardware.[23] Also import of large scale machinery and equipment from abroad and trade related work requires financial procedures to be carried out, which then increases particularly the demand for tasks of clerical jobs. This increases the relative demand for women and encourages the domestic employers[24] to use all of the best human resources available for any particular jobs/occupations, and thus they become more willing to employing women[25].

3.2 Trade and Formal-Informal Sector Sex Segregation

Labor market in India consists of formal and informal sector labor markets. Like most developing countries, in India too, formal sector employment is very low and there is a very significant presence of the labor force in the informal sector. The contribution of the informal sector to the total employment in India is as high as 84 % currently in the non-agricultural employment and 93% in the total employment. More specifically women constitute a considerably high proportion: 75% of the women are employed in the informal sector and they constitute 23% of the share of total informal sector employment. The informal sector produces goods and services which may be vertically linked to those in the

[22] Women are often seen as both physically and mentally better suited to perform tedious repetitive tasks and are also considered more docile than men. Specifically, most positions on the low end hierarchy of the occupational structure come under the category of female dominated occupations.

[23] The services sector too has seen increasing participation of women in different occupations.

[24] In addition, the falling trade barriers also encourage multinational corporations to set operations in the domestic economy. These multinational corporations are increasingly characterized by horizontal networks that enable women to work efficiently. Adler and Izraeli (1994:9) discuss how "the international business enterprise is often centered on relationship-building and is based on a structure that is less hierarchical and more circular or team structured." This kind of an organizational structure strengthens the position of the women in the occupational distribution and they are able to function more effectively than men.

[25] See Adler and Izraeli (1994). Also see Fontana (2003) for a more detailed review of gender effects of trade liberalization.

formal sector, either as finished or semi-finished goods or compete with those produced in the formal sector.

Trade liberalization may bring about reallocation of labor across formal and informal sector. Informal sector may shrink in size simply because individuals in the informal sector may switch to seek new employment opportunities in the formal export led sector such as food processing, garment manufacturing. There could also result closing down of small informal units[26] because of increasing competition from imported goods. Production from the households may be shifted towards specialized firms (in the formal sector) in order to obtain gains from specialization due to larger scales of production to meet the growing international demands (Goodfriend and McDermott (1995)).

However there is a possibility of growth of the informal sector which has been the case for India in the post trade liberalization period[27]. To reduce the fixed cost of labor, employers may increasingly resort to substituting for regular full time wage and salary earners with fixed wages and fringe benefits with various types of non-regular workers, temporary or part-time workers, piece rate workers, seasonal workers, or home-based production workers in subcontracting or putting out systems[28]. There is an increase in demand for more "flexible" labor that the employers can use more freely to suit their changing needs in an increasingly competitive environment. There comes about a proliferation of forms of flexible subcontracting and outsourcing which reduce costs of production, transfer risks, evade employers' obligation (ILO (2002)). In a very recent study by Marjit, S. and Maiti, D (2008), the authors argue that the expansion of export markets in developing countries leads to division of labor and specialization through the increase in the size of the informal sector. Through their theoretical model, they show that with the rise in the prospect of getting a better price in the international markets, the producers in the formal sector act more like merchants, and subcontract production activities to the informal producers.

Further, the Heckscher-Ohlin theory of trade hypothesizes that free trade causes an increase in demand for (goods produced by and hence) the abundant factor of production in each country. In developing countries (like India), less skilled labor is the abundant factor

[26] In India, most small-scale oil processing businesses have closed down following a change in trade policy that allows imported soya oil from the United States of America (Shiva 2000).

[27] There is great deal of evidence which has shown that besides creation of new jobs in informal sector causing growth of the sector, a significant part of employment was transferred from the formal to informal sector. Van Wersch (1992), Banaji and Hensman (1990) Hensman (1996) show this for the case of textile, bidi, engineering, pharmaceuticals and other industries in India

[28] Also workers in the formal sector may be laid off due to intensified competition and they may then move to the informal sector. This can come about when the lowering of product prices due to intensified import competition increases the chance that the firm will need to fire formal workers in response to demand fluctuations. As a result, the formal workers then attach less value to their current jobs on the fear of being fired and thus require higher wages as an incentive to work in the formal sector (See Goldberg and Pavcnik (2003) for the theoretical model). Their high wage costs can be saved by the employer if the production process among the specialized labor is fragmented into the informal sector (Marjit, S. and Maiti, D. (2006)). Also Attanasio et al. (2004) find evidence suggesting that trade reform increased the size of the informal sectors in Columbia.

and the informal sector is often equated to the less skilled labor with women on average comprising a disproportionate share of less skilled workers. So trade liberalization will increase the relative demand for women and also make it attractive to women who otherwise may remain out of the labor force. Thus the reallocation of labor between formal and informal sectors may be gender differentiated.

For women these informal sector jobs can be attractive, as the "informal" arrangement may allow them to combine paid work with household or child-raising duties[29]. But this benefit could detract from wages and benefits, as enterprises can potentially more easily operate outside labor laws and below legislated minimum wages[30]. Kalpagam (2001) notes that in India, women's absorption in certain export industries like garments, gems and jewellery, and electronics has been high but it is mostly based on contractual employment (which is a significant part of the informal sector), and secondly the nature of work and working conditions are far below the tolerable limits. Women may take over men's jobs in the process of being in-formalized and this is also commonly termed in the literature as 'Feminization of Labor Force' (ILO, 2004), irrespective of the fact which kinds of jobs are being captured by women in the process.[31]

In addition, the loss in market share to the cheaper imports for the local producers results in a reduction in the available jobs in the formal sector. Women are likely to experience more job turnover than men and they are subject to more frequent hiring, firing, and relocation from one job to another[32]. Moreover, as women are mostly small and micro-entrepreneurs, and have poor access to credit, technology and marketing channels, they are more likely to be ill equipped to upgrade their productive activities in the face of increased competition and thus may be unable to participate in the formal sector of the labor market. Any change in gender differential in the probability of working in the informal sector related

[29]Informal labor market in such scenario gives an additional source of flexibility that enables enterprises to vary the volume of employment and it's content to match the fluctuations in export demand. A large share of workforce in key export industries like garment, textiles footwear, electronics and food processing industry in India have seen this phenomenon very significantly. Using NSSO data, it is observed that the share of female employment has increased from 31 per cent of total unorganized manufacturing sector employment during 1994-95 to 34 per cent during 2000-01.

[30] Standing (1989) argues that because of increased global competition employers have put a greater premium on worker's prepared to take low-wage jobs. A study done by Deshpande (2001) for 3 slums in Mumbai city has shown that in the post liberalization period, participation of women in the labor market particularly in the informal sector has increased due to the substitution of cheaper female labor for male labor and partly due to economic distress resulting from loss of employment of male members in their households.

[31] Women constitute a ``cheaper" source of labor, where, *"cheap" labor is deconstructed beyond wage levels to include employee protection, employer's contribution to social wage, taxation, investment and working conditions in combination with non militancy, docility and manual dexterity and conscientious application to often monotonous production process... (Pearson (1998) p. 5).* It is also believed that such feminization is the result of growing flexibility in the labor market whereby women find themselves in traditionally male dominated jobs.

[32] A study from Chile that covers a period of rapid adjustment including that due to trade liberalization shows that firms tend to lay off a slightly higher proportion of female workers when business declines and hire more women when business recovers (Levinsohn (1999) cited in World Bank (2001)).

to the trade liberalization in the industry is considered suggestive of generating an effect on gender segregation.[33]

Thus from the above discussion, we can conclude that there is a theoretical basis for expecting changes in gender segregation with trade liberalization. Through this essay we demonstrate this relation for India.

4 Data and Variables

4.1 Data

I use data from several sources in this paper. The individual level data[34] comes from the NSS's Employment and Unemployment Survey (Schedule 10) of the NSSO (National Sample Survey Organization) conducted by the government of India. These are quinquennial surveys and are divided into four sub-rounds and covers both urban[35] and rural areas. The survey includes information on household characteristics like, household size, principal industry-occupation, social group, monthly per capita expenditure etc., detailed demographic particulars including age, sex, marital status, location, educational level, school attendance, principal and subsidiary status, industry and occupation of the employed etc., and daily time disposition. The survey adopts a stratified two-stage design with four sub-rounds in each survey year[36]. Data is available for the years 1983 (38th round), 1987-88 (43rd round), 1993-94 (50th round) and 1999-2000 (55th round). Thus it covers periods both pre and post trade liberalization experience in India. The data are repeated cross-sections. I restrict the analysis to individuals in the age group 15 to 65 years and to the main 16 states and 2 union territories of the 26 states and 2 union territories that form the Union of India. The omitted states are in north-east India, where frequent insurgency problems may have affected data collection.

As regards the data on the informal sector, a relatively strict way of classifying workers into the formal or informal sector would be to distinguish those workers who are permanent in an organized sector establishments (covered by Annual Survey of Industry

[33] It has also been argued in the literature that the growth of women employment in the informal sector is partly due to the improvements in the measurements of women's activities or extension of the definition of economic activities, and partly due to significant entry of women into the labor market at the face of global structural adjustment whereby it becomes necessary for them to undertake market activities to maintain their families (Charmes (1999)).

[34] For the sub-state level of analysis, the individual and household level data is appropriately aggregated to arrive at measures of factors that influence segregation indices.

[35] An urban area is defined as a town if it met the following conditions: (1) a density of not less than 1000 per square mile, (2) population of at least 5000, (3) three-fourths of the occupations of the working population should be outside of agriculture, and (4) at the discretion of the Superintendent of the State, the place should have a few pronounced urban characteristics and amenities such as newly founded industrial areas, large housing settlements, or places of tourist importance, and other civic amenities. See Bose (1973). Our data set assigns a sector value to all observations

[36] See Appendix 1 for more details about the data.

(ASI), India) from those who work as contract workers or work for the unorganized sector establishments or those who are self employed. Prior to the NSS 55 Employment and Unemployment Survey in India (1999-00), there was no detailed information on the type of establishment a person was employed in. The only categorization was that by principal activity status into the category of self employed (unpaid household and own account workers), casual workers and regular salaried workers. So in the absence of more detailed data on organized and unorganized workers over time (more specifically the pre trade liberalization period) we will resort to using regular salaried workers as a proxy for formal organized sector employment and self employed and casual workers as a proxy for informal workers.

As per the calculations done using the various rounds of National Sample Survey (NSS) data (reported in Table 1C), it can be seen that there has been an increase in 4 percentage points of women employed in the informal sector during our period of study from 77.9% in 1987-88 to 81.9% in 1999-00. The percentage of men employed in the informal sector has remained relatively constant during the same period. This suggests increasing segregation of women into the informal sector.

4.2 Occupational Gender Segregation Measure

Distribution of men and women across occupations can be summarized by segregation indices. We use these segregation indices for our sub-state level of analysis, while the probability of working in a male dominated occupation is used for the individual level analysis. The commonly used segregation indices are the indexes of dissimilarity (*Duncan's index, D* is most common and widely used in this context[37]), Marginal matching and KM index. Each index measures the disparity in the gender shares of employment across occupations[38]. In this paper, we report the results based on the Duncan's dissimilarity index and the ratio index R of segregation[39]. Figure 3 shows the trends in occupational gender

[37] A study by Carrington W & Troske K (1997) suggests that the use of Duncan index as a measure of occupational segregation may be biased when the number of individuals in any given occupation is small as even random allocations of individuals across occupations may generate relatively high levels of dissimilarity purely by chance. However for our study this might not be an issue due to the large sample size nature of the NSS data which are employed to estimate the index.

[38]It is also important to distinguish between the horizontal and vertical aspects of occupational gender segregation. Considerations based on productivity lead to horizontal segregation (men and women employed in different occupations) whereas, vertical segregation (which occurs when men and women may be in the same occupational group but women may be in grades with less pay, lower status or promotion opportunities) results from non-economic motivations representing preferences for men over women in occupations . Anker (1998) suggests that low levels of segregation being observed may actually be due to the inadequate pick up of the "vertical" segregation in horizontal segregation. Vertical segregation by sex has been found to be important in explaining wage differences (Treiman and Hartmann (1981)). Vertical segregation can be analyzed by comparing some typical female and male occupations. But with the kind of data set that is available to us, it makes it difficult to examine and study vertical segregation separately.

[39] See Appendix 1 for details about the formula and construction of these indices.

segregation indices at the all India level during our period of analysis and Figure 4 depicts the geographic variation at the state level in changes in occupational gender segregation levels across time as measured by the Duncan's D index and Margin-free index, R of segregation.

Occupational gender segregation is widely observed in the Indian labor markets with men and women not only found in different occupations, but also within occupations they are found at different grades. Employment distribution by seven major occupation groups (*professional and technical; administrative and managerial; clerical; sales; services; agriculture; and production*), shows wide gender variations in Indian labor market. Women tend to be concentrated in three of the seven major groups (at the 1 digit level of occupational classification): 7.1% of the employed women were in clerical, 16.1% in services and 14.9% as professional and technical workers in 1993-94. Changes in female representation across different occupations in the pre and post liberalization period are depicted in Figure 5. The female representation in different occupational groups relative to their participation in total employment increased both in the professional technical and related workers and in the clerical and related workers over the period. There was also a slight increase seen in sales and service workers which may be due to the fact that these are low-skill, labor-intensive jobs that require little job training or previous experience, and consequently they are vulnerable to fluctuations in demand for labor. It has also been found that, although professional work is basically male dominated, in India and many other Asian countries the proportion of women in this occupation category is normally higher than female participation in all non-agricultural jobs, suggesting an over-representation of women in the professional category. In India, as noted previously, females have also been over represented in the agriculture sector where they work as "unpaid" family workers.

As regards the occupational structure, Figure 6 and 7 shows the distribution of the working population in major occupational groups in 1987-88 and 1999-00. There has not been much change in the occupational structure across time. However this aggregate depiction may be hiding the regional/industrial changes in the occupational structure. To some extent it can be seen that India has undergone a process of 'occupational upgrading', which is characterized by an increased share of higher-status administrative, professional and semi-professional occupations in the labor market.

Table 3 depicts the changes in the sex labels of the occupations at a more disaggregated level of occupational classification (2 digit level) compared to the broad classification at 1 digit level. Majority of the occupations continue to be male dominated over the time period of our analysis though there has been a decrease in the number. There has been a small increase in the number of female dominated occupations (from 17 in 1987-88 to 24 in 1999-00).

For the individual level regressions, we do not have an explicit measure of occupational gender segregation. Instead we construct a gender differential in probability of

working in a male dominated occupation[40] and changes in this gender differential measure are suggestive of changes in occupational gender segregation. This measure is similar to Beller A (1982) where the author studies the impact of Equal Employment Opportunity programs on changes in occupational gender segregation.

As can be seen from the summary statistics table 1C, the share of male employment in male dominated occupations fell from 75.4 percent in 1987-88 to 69.6% in 1999-00, while the share of female employment in female dominated or integrated occupations fell from 81.4% to 62.2%. Thus, while in 1987-88 more than three fourth of men and women worked in jobs where individuals of the same sex comprised the overwhelming majority of workers; by 1999-00 this was true of only about two-third of each group. Also these changes show that women and, to a lesser extent, men have moved into sex atypical occupations over the time period suggesting a decline in segregation.

4.3 Trade Variable

We in this paper use a measure of trade liberalization/openness similar to the one used in Topalova P. (2005) for our sub-state level (district and region) of analysis. We calculate trade protection for the district/region as employment weighted sum of industry specific tariff:

$$\mathbf{T_{dt} = \Sigma_i\ emply_{id} * tariff_{it} \,/\, \Sigma_i\ emply_{id}} \qquad \mathbf{(1)}$$

where i denotes industry, d denotes a district or region and t denotes time. This trade protection measure does not change with changes in industrial composition associated with the reforms which would be endogenous to changes in factors influencing occupational gender segregation. Here I restrict employment to only the traded goods industry and do not include the non-traded industries[41]. For this, I used the UNCTAD's WITS database and 1991 Census of India data. The WITS (World Integrated Trade Solutions) database gave me the annual tariff rates for 5000 product lines at the 6 digit level of the Indian Trade Classification Harmonized System (HS) Code. I matched these 5000 product lines to the 3

[40] To construct this, we first classified all the 2-digit occupation codes into male and female dominated occupations using a baseline definition (based on 1987-88 division of men and women into different occupations and in the labor force). If men and women were equal in all respects relevant to the labor market, the expected fraction of women in any given occupation would be approximately equal to the fraction in the labor force. Using the proportion of the labor force which was male in 1987-88 as the reference point (88%), a male (dominated) occupation is defined as one in which men's share of employment in the occupation exceeds their share in the labor force by 5 percentage points (allowing 5 percentage points for random deviations). If the male share of the employment in a particular occupation is between 5 percentage points higher or 5 percentage points lower than their share in the labor force, then it is called an integrated occupation.

[41] By the traded goods sector here we refer to the broad category of the tradable manufacturing and agricultural sector and exclude the services sector. Topolova P (2005) also constructs a trade measure with taking the non-traded sector (services sector) also into account by assigning zero tariff rates to industries in this sector. This results in average tariff levels in all industries when both traded and non-traded sector is taken into account that are much lower than those when just the traded goods sector is taken into account. The variation in tariff levels when only the traded goods industries are taken into account is not influenced by the size of the non-traded goods sector

digit NIC (National Industrial Classification) codes using the concordance of Debroy and Santhanam (1993). The average industry level tariffs at the 3 digit NIC code were calculated by taking a simple average of tariffs of all the products belonging to a particular industry. The 1991 Census of India gives the industrial employment levels at the 3 digit NIC code for the districts which can then also be used to construct the same for regions. This pre liberalization industrial employment levels (corresponding to 1991 census estimates) acts as weights in the construction of the trade variable[42]. Table 2 summarizes the average tariff levels at the district and region level for the pre and post liberalization period calculated using the above formula.

For the individual level of analyses, I use the industry tariff corresponding to the 3-digit NIC code of the individual's industry of employment. The changes in tariff levels (from the pre-liberalization to the post-liberalization period) were applied at the industrial level, but were uniform across districts. Concordance tables were used to convert all the industry codes into their NIC-87 and NIC-98 equivalents.

4.4 Controls

We adequately control for the supply side variables based on the neoclassical/human capital explanations of occupational gender segregation. At the sub-state level, these include district/region level child dependency ratios, relative education levels of the working group of individuals, participation of females[43] in the employed group. At the individual level, we control for personal demographic characteristics like age, education dummies for each level of education completed, marital status (equals one if married and zero otherwise), social group and a vector of household characteristics such as size, dependency ratio, sex of household head dummy (equals one if head of household is a male, zero otherwise) and other household characteristics. The summary statistics of the various control variables used in the paper are listed in Table 1B and 1C.

The state in India has played an active role in the regulation of employment, wages and conditions of work in the manufacturing sector (more specifically the organized manufacturing). India experienced a series of labor market reforms initiated by these state governments during the 1980s and 1990s (period partly coinciding with the trade liberalization phase). This partial overlap of trade liberalization phase and labor market reforms may make it difficult for us to separate out or find any effects of trade liberalization on occupational gender segregation. To deal with this issue, we include the state level labor market deregulation indices calculated by Besley and Burgess (2002)[44]. Also the cross

[42] States in India and thus districts and regions vary in terms of their levels of industrialization and the kinds of industries that they have. However the changes in trade protection were at the industrial level and applied uniformly across all states.

[43] I expect the sign of the coefficient on this variable to be negative as bargaining power of women will increase with an increase in their relative numbers which would lessen the discrimination they face in the labor market.

[44] They classify Indian states as pro-worker, pro-employer or neutral, based on amendments of the Industrial Disputes Act

sectional and industry wise variation in our tariff measure helps us identify this impact more clearly. Thus, though the effect of trade liberalization varied across industries, it is presumed that neither the effect of labor market reforms vary in any systematic way across industries, nor were these effects related systematically to tariff cuts in each industry.

5 Empirical Methodology

5.1 Impact on Occupational Sex Segregation

The empirical methodology used in this paper attempts to exploit the variation in the industrial composition of employment across districts/regions[45] in India that existed at the time of trade liberalization. This variation is used to calculate the district/region's exposure to international trade. Thus, although the tariff and non-tariff barriers were reduced uniformly across all districts/regions, the net effect of these reductions on aggregate district/region trade levels was dependent on the industrial composition in the district/region prior to the reduction. The trade liberalization experience in India can be considered as exogenous based on the discussion in section 2 of this paper. So the period before the reform and after the reform can be taken as a natural experiment.

The identification strategy used here is similar to Topolova P (2005) where the author exploits the geographic differences in levels of trade liberalization. Here, we correlate the changes in a district/region's exposure to international trade based on the composition of district/region's industrial employment before liberalization (more specifically, in 1991) with changes in our main variable of interest: *occupational gender segregation index*[46]. The baseline econometric specification is of the form:

$$\mathbf{SI_{dt}} = a_0 + a_1 * \mathbf{T_{dt}} + a_2 * \mathbf{T_{dt}} * \mathbf{PL} + a_3 * \mathbf{X_{dt}} + \gamma_t + \delta_d + \varepsilon_{dt} \qquad (2)$$

where $\mathbf{SI_{dt}}$ is the district/ region level measure of occupational gender segregation such as Duncan's Dissimilarity Index, Ratio Index and $\mathbf{T_{dt}}$ is district/region exposure to international trade at time t.

The main coefficient of interest a1 captures the average effect of trade protection/trade openness on our district/region level gender segregation measure. $\mathbf{X_{dt}}$ is a vector of district/region level aggregated socio demographic and socio economic characteristics. The inclusion of district/region fixed effects[47] $\boldsymbol{\delta_d}$ will account for the district-specific heterogeneity in determinants of gender segregation and time fixed effect $\boldsymbol{\gamma_t}$ will capture the macroeconomic shocks like business cycle fluctuations and changes in labor

[45] See Appendix 1 for description about sub-state unit of analysis.

[46] To make sure that my results are not driven by particular choice of gender segregation index, I conduct the empirical estimation using different indices of segregation. Though the quantitative results differ based on the level of occupational classification (1 digit or 2-digit) used and the gender segregation index used, but qualitative conclusion is essentially the same. Also, more disaggregated the level of classification of occupations used; higher are the calculated segregation indexes. I calculate the segregation indices using both the 1-digit and 2-digit level of occupational classification.

[47] This would imply a different intercept for each district/ region in the estimation.

markets that could also affect occupational gender segregation equally across India. To examine any heterogeneity in the effect of trade policy (overall effects of lowered protection after trade liberalization) on occupational gender segregation over time, the trade policy variable is interacted with a post-liberalization dummy PL (which takes the value one in the post-reform period i.e., post-1991 and zero otherwise). We cluster the standard errors at the state level since the outcomes across districts/regions within a state may be correlated due to correlation of industrial composition within a state. We do the analysis for urban India[48].

We also analyzed occupational gender segregation changes at individual level in the urban manufacturing sector in India[49]. Since we do not have an explicit measure of occupational gender segregation at the individual level, we make use of a linear probability model[50] similar to Beller A. (1982) to conduct the analysis at the individual level. In this model, we consider the dependent variable as a binary variable indicating whether an individual i of sex s is employed in a male dominated occupation (for example, the probability of a female being employed in a male dominated occupation or the probability of a male being employed in a male dominated occupation). Thus the probability of a working female (male) employed in a male occupation in industry j in district d is estimated as a function of tariff measure in the industry, socio-demographic controls, industry and district fixed effects. The baseline specification here takes the following form:

For sex=male and female,

$$\mathbf{Prob}_{ijt} = b_0 + b_1 * \mathbf{T}_{jt} + b_2 * \mathbf{X}_{it} + \gamma_t + \delta_s + \eta_j + \varepsilon_{ijt} \qquad (3)$$

where $\mathbf{Prob}_{ijt}$ is an indicator variable which takes a value 1 if an individual i in industry j at time t of a particular sex is employed in a male dominated occupation, $\mathbf{T}_{jt}$ measures the tariff level in individual i's respective industry of employment j at time t and hence captures the exposure of individual's industry of employment to international trade at time t. Also we

[48] Since industries are located differently in geographic and social space with the workers in the rural areas being drawn from the social groups with more traditional values as compared to urban areas, we would expect that the urban industrial strata might have greater changes in levels of occupational segregation than rural industrial strata. Also the relatively little rural-urban migration in India surrounding trade liberalization episode (Topalova P (2004b)), makes it possible to consider the urban and rural labor markets as segmented and thus experiencing different responses to tariff changes (especially in the initial phase of the trade reforms).

[49] Manufacturing sector in urban areas was most commonly affected by trade liberalization and as a result most of the studies in the literature have focused on these two segments[49]. As per estimates, the manufacturing sector appears to have responded significantly to the reforms and the consequent competitive pressures in the domestic and international market with the annual growth rate increasing from -3.7% in 1991-92 to 4.2% in 1992-93. Subsequently the manufacturing sector output grew at an appreciably high rate of around 10.4% per annum. The theories about trends in gender segregation applies mostly specifically to competition in manufacturing sector and may not apply with equal force to the agricultural sector. To explain this, it can be argued that the degree to which competitive forces drive employers to find the lowest-wage worker for a given job applies more to the manufacturing economy because the contribution of family members to farm work is often outside the cash nexus of a broad economy.

[50] We also estimated the model using probit specifications and got similar marginal affects.

restrict the analysis to the manufacturing sector[51] here. It is assumed that lower tariff rates imply higher competition within an industry. $\mathbf{X_{it}}$ is a vector of personal demographic characteristics consisting of the individual characteristics like age, education dummies for each level of education completed, marital status (equals one if married and zero otherwise), social group and a vector of household characteristics such as size, dependency ratio, sex of household head dummy (equals one if head of household is a male, zero otherwise)[52] and other household characteristics. Industry fixed effects ($\boldsymbol{\eta_j}$) and state fixed effects ($\boldsymbol{\delta_s}$) are included in all specifications to control for variation in economic activity across industries and states respectively, resulting from differences in industry specific policies, state-level institutions[53], and other potentially unobserved industry and state level characteristics. $\boldsymbol{\gamma_t}$ represent the time fixed effect which account for the macroeconomic shocks that affect all industries.

Estimating the above equation separately for the male and female across two time periods: pre and post liberalization and comparing the b_1 coefficients for the two groups of gender across time, would give an estimate of the effect of the trade liberalization measure on the gender differential in the probability of a working woman and man employed in a male occupation[54]. Based on the above specification, the gender differential in probability of working in a male dominated occupation will be $\mathbf{b_{1,t}^{m} - b_{1,t}^{f}}$ in the pre-liberalization period and $\mathbf{b_{1,t+1}^{m} - b_{1,t+1}^{f}}$ in the post-liberalization period where m denotes male, f denotes female and t denotes time period. Since the residual errors of the gender regressions are likely to be contemporaneously correlated, the equations were jointly estimated using Zellner's seemingly unrelated regression (SURE) technique[55] (Zellner (1962)) to get more efficient estimates than simple OLS. The change in gender differential over time is denoted by:

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[51] Issues of occupational sex segregation and discrimination are not as relevant for agricultural labor where mostly family labor is employed and also there is underreporting of agricultural labor for women.

[52] All individual level regressions are weighted using sample weights provided in the NSSO data for each of the relevant years in our data sample and these weights correct for the fact that the proportion of individuals and households in each sample differs from the proportion in the true population. Thus using these weights makes the coefficients nationally representative.

[53] The state fixed effects will also capture the geographic differences in traditions and values among the social groups belonging to the area.

[54] Any changes in occupational structure that comes about will be captured by the coefficient from the estimation using the male data as most men are employed in male dominated occupations (Beller A (1982)).

[55] This accounts for the possible existence of interdependence between male and female probability of working in a male dominated occupation at a particular time and across time periods, as the same unobservable factors which affect men's probability may also be affecting women's probability. This technique is also attractive since appropriate F statistics for testing the significance of difference (which here is the gender differential in probability of working in a male occupation as discussed previously) in the response of each dependent variable to the independent variables across equations is available as a by-product of the analysis. Ordinary least squares (OLS) will give unbiased estimates but may be compromising on efficiency. Inefficiency of the OLS estimates results due to its failure to take account of the possible correlation between the error terms among the equations. The seemingly unrelated regression technique is statistically the soundest since it provides efficient estimates by taking into account possible error correlation.

$$(b_{1,t+1}^{m} - b_{1,t+1}^{f}) - (b_{1,t}^{m} - b_{1,t}^{f}) \quad (4)$$

Negative value of this change would imply a fall in gender differential in probability of working in a male dominated occupation as a function of trade liberalization and thus suggest falling occupational gender segregation over time.

As an additional step, I also combined the observations of both the gender groups and across time periods, creating a pooled cross sectional data set (with the cross sectional units being the gender groups here) and re-estimated the model to determine the effect of tariff reduction on the female probability of working in a male dominated occupation across industries. Specifically here, I include a female dummy, and interaction term of female dummy with post liberalization dummy and tariff rates. The female dummy variable is included to support our assumption of there being gender differences in the probability of being employed in a male dominated occupation. This interaction terms account for the difference in the impact of trade liberalization across the two gender groups. The empirical specification takes the following form:

$$Prob_{ijt} = c_0 + c_1 * F_i + c_2 * T_{jt} + c_3 * F_i * T_i + c_4 * T_{jt} * PL * F_i + c_5 * X_{it} + \gamma_t + \delta_s + \eta_j + \varepsilon_{ijt} \quad (5)$$

The main variable of interest in the pooled cross sectional analysis is the interaction of the female dummy with the tariff level and the interaction of the female dummy with tariff level and post liberalization dummy as these indicate the impact of a change in the degree of protection on the relative probability of employment of females in male dominated occupations across different industries. Increased competition brought about due to falling tariff levels and thus more openness in industries will force employers to be less discriminatory in their hiring decisions and therefore females will experience an increase in their relative probability of working in a male dominated occupation compared to males. We include the industry fixed effects to account for the unobserved industry specific heterogeneity in the determinants of the probability of working in a male occupation.

5.2 Impact on gender segregation across sectors

To study the differential effect of trade liberalization on gender across sectors, we follow an empirical strategy similar to the one discussed above in the individual level analysis section of occupational sex segregation. The only change we make is that we look at the probability of an individual working in an industry in the informal sector and see its relationship with the trade openness levels in the industry and how it differs across gender. Empirically the specification would look as follows: ***For sex=male and female***,

$$Prob_{ijt} = d_0 + d_1 * T_{jt} + d_2 * X_{it} + \gamma_t + \delta_s + \eta_{jt} + \varepsilon_{ijt} \quad (6)$$

where $Prob_{ijdt}$ is an indicator variable which takes a value 1 if an individual i employed in industry j at time t is working in the informal sector. The coefficient d_1 captures the impact of trade openness on sectoral employment choice. Since individual employment status may vary along with different industries across time, we include industry-time fixed effects (η_{jt})

which allow us to capture the possible policy impact on different industries. We use the SURE method to estimate the changes in gender differential in informal sector employment probability.

Again we also estimated the above equation using the method of pooled cross sections similar to the one we used to study occupational sex segregation at the individual level. The empirical specification takes the following form:

$$\mathbf{Prob_{ijt} = e_0 + e_1 * F_i + e_2 * T_{jt} + e_3 * F_i * T_i + e_4 * T_{jt} * PL * F_i + e_5 * X_{it} + \gamma_t + \delta_s + \eta_j + \varepsilon_{ijt}} \quad \mathbf{(7)}$$

where $Prob_{ijt}$ is an indicator variable which takes a value 1 if the individual employed in industry j in time t is in the informal sector and 0 otherwise. Here we will see the relationship between trade openness and gender differences in the probability of working in the informal sector in an industry.

6 Empirical Results

6.1 Occupational Sex Segregation

Our results are presented in Table 4.1-4.4. For the sub-state level of analysis, we report the estimation results at the urban region level in table 4.1 and at the urban district level in Table 4.2. We report these results separately for "all industries combined" and just "manufacturing industries". Looking first at Table 4.1 column 1-2, the positive coefficient on the region level trade protection measure implies that the decline in protection (measured by the decline in region level employment weighted average of tariff levels as calculated using equation 1) leads to fall in occupational gender segregation. Thus those urban regions that experienced a relatively more decline in trade protection levels saw a higher fall in gender segregation. Calculations based on the estimates show that a 10 percentage point fall in protection level across the region leads to a decline of 4.3 percentage point in the region gender segregation index as measured by the Index of dissimilarity, D. The results for R index of occupational gender segregation are higher with a 10 percentage point fall in region protection level leading to a 14 percentage point fall in gender segregation.

When I perform the empirical analysis for the manufacturing sector separately, we find stronger and again statistically positive significant relationship between region trade protection and occupational gender segregation (column 3-4 in Table 4.1). The point estimates are similar in sign and significance when we study the relationship between district level trade openness and changes in occupational gender segregation (sub-state analysis conducted at the district level in table 4.2).

For individual level analysis, the results are presented in Table 4.3-4.4. Column 1-4 in Table 4.3 present the effect of industry tariff levels on the probability of working in a male dominated occupation for men and women separately and over the two time period (pre and post liberalization). The coefficient estimates show a negative relationship between industry

tariff levels (measure of trade protection) in an industry and probability of working in a male dominated occupation in the industry for the female group in both the time periods. For males, in the pre liberalization period, lower tariff levels leads to higher probability of working in a male dominated occupation, while in the post liberalization period, the relationship between tariff levels and this probability becomes positive.

To calculate the impact of trade liberalization (measured by the fall in industry tariffs) on the sex differential in probability of working in a male dominated occupation, we estimate the 4 equations jointly using the SURE method thereby accounting for the cross equation correlation between the error terms. Column 5 in the table presents the coefficient estimates from the SURE method. Comparing the coefficients over time for the gender groups and running the test for difference in these gender probabilities, i.e. testing for $\mathbf{[(b_{1,t+1}^{m} - b_{1,t+1}^{f}) - (b_{1,t}^{m} - b_{1,t}^{f})] < 0}$ gives us a negatively significant coefficient, suggesting fall in gender differential due to trade liberalization. Calculations based on the estimates show that a one standard deviation fall in average industry tariff level (or equivalently a fall in industry tariff by 32.2 percentage points) led to a 1.7%[56] fall in gender differential in probability of working in a male dominated occupation. This fall in gender differential suggests a rising representation of women in male jobs in those industries which experience greater trade liberalization (fall in tariff levels) as compared to others.

Table 4.4 gives the estimates from a pooled cross sectional analysis of the relation between industry tariff (measure of trade protection) and gender probability of an individual working in a male dominated occupation in an industry. Firstly, as expected there is significantly negative coefficient on the female dummy in all regressions, which shows the lower probability for a women to work in a male dominated occupation relative to a male in an industry. Also there is seen to be significantly negative relationship between industry tariff and probability of working in a male dominated occupation for both gender groups. Thus a decline in industry tariff leads to an increase in probability of working in a male dominated occupation for both the gender groups. This could be accounted for partly by the definition of sex dominance used in the paper. Since as per table 3, majority of the occupations are male dominated, the negative coefficient on the industry tariff variable could simply be capturing the increased probability of getting employed for both gender groups in industries where tariffs have fallen. However the main variables of interest in this specification for our

[56]This was calculated by substituting the coefficient estimates from the SURE Estimation in column 5 in table 4.3 into equation 4. The value of change in gender differential in probability of working in a male dominated occupations is equal to [(-0.1133-(-0.1335))-(-0.1257-(-0.1978))] =-0.0519 and this is significant at the 5% level of significance. Multiplying this change by the one standard deviation change in tariff (which is 32.2 percentage points) gives us 1.7%. Also if we simply calculate this change in gender differential using the coefficient estimates from the columns 1-4 in table 4.3 where we estimate the equations separately for the gender groups and across time period (without accounting for the cross equation error terms correlation) we get a similar estimate of a one standard deviation change in industry tariff resulting in a 2.5 % decline in the gender differential in probability of working in a male dominated occupation.

study are the industry tariff variable interacted with female dummy variable. The combined effect of lower protection (lower tariff rates here) on female probability of working in a male dominated occupation, relative to the male probability is given by the sum of *IndustryTariff*FemaleDummy* variable (two way interaction) and *PostLibDummy*Female Dummy*IndustryTariff* variable (three way interaction). The negatively significant coefficient on the two way interaction terms implies that a fall in protection levels as measured by the decline in industry tariffs has a positive effect on the relative probability of a women working in a male dominated occupation across industries. Also in the post liberalization period, a relative fall in the industry tariff level increases the females' relative probability of working in a male dominated occupation (indicated by the negative though insignificant coefficient on the three-way interaction term) across industries. Many of the coefficients on the interaction terms match their expected signs but and not significant. This could be due to a high degree of correlation between the various two-way and three-way interaction terms that is causing the significance to drop in few cases. The estimated coefficients ranges from -0.1122 (column 5) to -0.1729 (column 3) which implies that for a 10% point fall in industry tariff level leads to a 1.1% to 1.7% increase in a women's probability of working in a male occupation relative to the male's probability (or equivalently, a one standard deviation fall in average industry tariffs leads to 3.6% to 5.5% rise in the relative probability).

The coefficients of the control variables (not reported in the paper) in all our specifications and for both sub-state and individual level of analysis are significant and match the signs we expected a priori. The closer the gaps between female and male educational attainment, the lower is the occupational gender segregation. There is observed a negative relation between variables that indicate a weaker attachment to labor force for women and the occupational gender segregation. The coefficients on the marital variable, number of children are both negative and significant.

6.2 Formal-Informal Sector

The results are presented in Table 4.5 and 4.6. Table 4.5 presents the results from the SURE method of estimation of gendered impact of trade liberalization on the informal sector participation. Columns 1-4 in Table 4.5 present the result of estimating equation 3 separately for males and females and for the two time periods in our study (pre liberalization and post liberalization period). There is seen to be a negative relationship between industry tariff level and probability of working in the informal sector in the industry, for both males and females in the two time periods. However coefficient of industry tariff level in column 1 suggests that this relationship was not significant for males in the pre liberalization period whereas for females there is highly significant relationship in both the pre and post liberalization period.

To calculate the impact of trade liberalization (measured by the fall in industry tariffs) on the sex differential in probability of working in the informal sector in an industry, we estimate the 4 equations jointly using the SURE method thereby accounting for the cross

equation correlation between the error terms. Column 5 in Table 4.5 presents the coefficient estimates from the SURE method. Comparing the coefficients over time for the gender groups and running the test for difference in these gender sex probabilities, i.e. testing for $[(d_{1,t+1}^{m} - d_{1,t+1}^{f}) - (d_{1,t}^{m} - d_{1,t}^{f})] > 0$ (based on equation 5) gives us a positively significant coefficient, suggesting a rise in gender sex differential in probability of working in the informal sector due to trade liberalization. Calculations based on the estimates show that a one standard deviation fall in average industry tariff level led to a 0.6 %[57] rise in gender differential in probability of working in the informal sector in an industry.

Looking at the coefficient estimates from the pooled cross section in Table 4.6, we see that females have a higher probability of working in the informal sector compared to the males (as indicated by the positively significant coefficient on female dummy). The negatively significant coefficient on the industry tariff measure implies that as the industry tariff falls, the probability of working in the informal sector increases for both the gender groups. This is due to the expansion of the informal sector which takes place with trade liberalization (discussed in section 2.3.2 in this chapter). Estimates suggest that a one percentage point decline in tariff in a given industry is associated with a 0.2 percentage point increase in probability of working in the informal sector. This is equivalent to 6.9 percent (0.2154*0.322) increase in the probability of informal employment for both the gender groups in an industry that experienced a one standard deviation (32.2 percentage point) decline in tariffs.

However, the coefficients of interest to study the gendered impact of trade liberalization on informal sector employment are the two-way and three-way interaction terms *IndustryTariff*female dummy* and *IndustryTariff *female dummy*post liberalization dummy*. These coefficients are negative thereby implying that lower is the tariff in an industry (in other words, higher is the trade liberalization and lower is the trade protection measure) , higher is the probability of a female (relative to a male) wo rking in that industry to be employed in the informal sector. Also in the post liberalization period, a fall in the tariff level increases the relative probability of females working in the informal sector of the industry (as indicated by the negatively significant coefficient on the three-way interaction term in column 5 of Table 4.6). Again as in the case of the empirical results on occupational sex segregation, some of the coefficients on the interaction terms match their expected signs but

[57]This was calculated by substituting the coefficient estimates from the SURE Estimation in column 5 in table 4.5 into the formula for sex differential in probability of working in the informal sector in an industry $[(d_{1,t+1}^{m} - d_{1,t+1}^{f}) - (d_{1,t}^{m} - d_{1,t}^{f})]$. The value of change in sex differential in probability of working in the informal sector in an industry is equal to [(-0.4124-(-0.4817)-(-0.0497-(-0.0986))] =-0.021 and this is significant at the 5% level of significance. Multiplying this change by the one standard deviation decline in tariff (which is 32.2 percentage points) gives us 0.6%. Also if we simply calculate this change in sex differential using the coefficient estimates from the columns 1-4 in table 4.5 where we estimate the equations separately for the gender groups and across time period (without accounting for the cross equation error terms correlation) we get a much higher estimate of a one standard deviation decline in industry tariff resulting in a 4.8 % increase in the sex differential in probability of working in the informal sector in an industry.

are not significant due to the high degree of correlation between the various two way and three way interaction terms (that causes the significance to drop in few cases). The estimates show that a one standard deviation decline in industry tariff level (32.2 percentage point decline) can lead to an increase in probability of a female working in the informal sector relative to a male by 9.4%[58]

2.7 Conclusion

The paper makes a departure from the previous studies of trade and gender and demonstrates the effect of trade liberalization in India on gender segregation in the labor market. It is asserted and supported by the empirical results in the paper that trade liberalization influences gender segregation in the labor market. Our results show, higher is the trade liberalization in a region/district/industry, lower is the occupational sex segregation. Also there comes about an increase in segregation of women into the informal sector of the labor market with greater trade liberalization. These results hold even after we control for all observable productive characteristics of men and women. The results also add weight to the demand side theories which play an important role in addition to the supply side theories in explaining gender segregation.

Similar to other rapidly growing economies, in India too women act as a direct source of cheap labor, especially in export manufacturing industries. In fact, women's labor is central to factories that produce or assemble commodities for the global market. This also leads to economic growth and increased opportunities in paid employment for women affecting gender segregation. Higher levels of international trade and investment resulting from trade liberalization decrease gender segregation by drawing more women into traditionally male-dominated manufacturing and service sectors. Companies are motivated to reduce discrimination toward women as competition increases among businesses worldwide and consequently employers becoming more willing to employing women, in order to efficiently use all the human resources available.

I find that trade liberalization in India in the 1990s impacted the significantly prevailing gender segregation. Through my analysis that is conducted at both a sub-state level (regions and districts) and at individual level, I show that occupational sex segregation is negatively correlated with trade liberalization measure (higher the trade liberalization/openness, lower is the occupational gender segregation). Lower protection brought about by fall in tariff levels brings about a relative fall in occupational gender segregation index and the gender differential in male and female probability of working in a male dominated occupation. Districts/regions/industries which continue to face lower competition levels and thus experience higher market power can use the resources from the super normal profits they earn to engage in costly inefficient practices of discrimination

[58] This is calculated by adding the coefficient of the two way and three way interaction terms in column 5 of table 4.6 (-(0.2154) + (-0.0792)) and multiplying this by the one standard deviation change in tariffs (32.2 percentage points=0.322).

which lead to occupational sex segregation. Despite the observed decrease in occupational gender segregation, one needs to be careful here, as though the relative female employment in different occupations may be increasing, the quality of female employment i.e. types of jobs, earnings and benefits etc. and how the jobs with some positive qualities are distributed among men and women may not be improving. Thus there could be an increase in the quantity but decrease in the quality of jobs due to increased competition which could disproportionately affect women, given their labor market disadvantage. The reallocation of labor between formal and informal sector of the labor market results due to trade liberalization which is seen to increase the relative participation of women in the informal sector of the labor market. The need for increased competitiveness brought about by trade liberalization has resulted in the employer offering women more flexible forms of employment such as seasonal employment and day-contracting or piece-based remuneration (informal sector employment), which may generate negative impacts on female labor market.

Figures and Tables

Table 1A: Summary Statistics for Urban India & at Region Level

	Year & NSS Round		
	1987-88	**1993-94**	**1999-00**
Variable	43rd Round	50th Round	55th Round
	All Industries		
D-Index of Segregation	0.4154(0.1030)	0.4137(0.1222)	0.3964(0.1020)
R-Index of Segregation	1.7000(0.8742)	2.0916(1.5482)	1.5797(1.232)
DS-Index of Segregation	0.4378(0.0998)	0.4300(0.1154)	0.4169(0.0929)
Net Tariff (Traded Industries)	0.8661(0.0661)	0.5969(0.0253)	0.3246(0.0332)
Female Share Labor Force	0.1794(0.0708)	0.1873(0.0644)	0.1826(0.0656)
Female-Male Secondary Education	0.8305(0.4768)	0.6919(0.1930)	0.7112(0.2151)
Percent Manufacturing	0.2666(0.0972)	0.2373(0.0964)	0.2409(0.0867)
Percent Services	0.6052(0.1203)	0.6307(0.1041)	0.6598(0.0957)
State Family Structure	1.8319(0.3421)	1.5275(0.3422)	1.3604(0.3151)
Female-Male Population Ratio	0.9113(0.0858)	0.9164(0.0901)	0.9261(0.0718)
	Manufacturing Industries		
D-Index of Segregation	0.4611(0.2071)	0.4567(0.1635)	0.4391(0.1749)
R-Index of Segregation	2.6035(0.7293)	2.7706(1.3038)	2.3838(1.3827)
DS-Index of Segregation	0.5995(0.1546)	0.5362(0.1296)	0.5229(0.1302)
Net Tariff	0.8859(0.0475)	0.6035(0.0177)	0.3479(0.0183)
Female Share Labor Force	0.1815(0.0703)	0.1865(0.0636)	0.1842(0.0673)
Female-Male Secondary Education	0.8213(0.4757)	0.6735(0.1870)	0.6921(0.2113)
State Family Structure	1.8319(0.3421)	1.542(0.3347)	1.3604(0.3151)

Note: Mean (Standard Deviation)

Table 1B: Summary Statistics for Urban India & at District Level

	Year & NSS Round	
	1987-88	**1999-00**
Variable	43rd Round	55th Round
	All Industries	
D-Index of Segregation	0.5284(0.1698)	0.4879(0.1885)
R-Index of Segregation	2.9282(0.8927)	2.6159(1.700)
DS-Index of Segregation	0.5629(0.1387)	0.5566(0.1460)
Net Tariff (Traded Industries)	0.8595(0.0938)	0.3331(0.0451)
Female Share Labor Force	0.1808(0.0898)	0.1674(0.0879)
Female-Male Secondary Education	0.7365(0.6894)	0.6267(0.3354)
Percent Manufacturing	0.2654(0.1313)	0.2410(0.1185)
Percent Services	0.5835(0.1473)	0.6488(0.1369)
State Family Structure	2.009(0.6228)	1.5624(0.6202)
Female-Male Population Ratio	0.9219(0.1316)	0.9192(0.1265)
	Manufacturing Industries	
D-Index of Segregation	0.5849(0.2312)	0.5179(0.2497)
R-Index of Segregation	2.4937(0.9640)	2.3857(1.7227)
DS-Index of Segregation	0.3759(0.1968)	0.3321(0.1954)
Net Tariff	0.8331(0.1009)	0.3202(0.0419)
Female Share Labor Force	0.1902(0.08364)	0.1804(0.0841)
Female-Male Secondary Education	0.6727(0.6014)	0.6239(0.2885)
State Family Structure	2.0189(0.5597)	1.548(0.5898)

Note: Mean (Standard Deviation)

District Identifier does not exist for the NSS 50th Round (1993-94)

Table 1C: Summary Statistics for Individual Level Analysis (Urban Manufacturing)

	Year & NSS Round					
	1987-88		1993-94		1999-00	
Variable	43rd Round		50th Round		55th Round	
	Female	**Male**	**Female**	**Male**	**Female**	**Male**
Age	32.0	34.4	32.8	34.7	32.5	34.7
General Education Proportion (%)						
Illiterate, No Formal &Below Primary	62.6	32.7	57.3	27.3	50.5	19.9
Primary	16.7	21.4	15.8	16.0	9.8	12.8
Middle	9.8	16.5	12.0	18.4	16.2	19.7
Secondary & High Secondary	7.3	19.4	9.8	25.4	14.6	30.7
Graduate & Post Graduate	3.5	9.8	5.1	12.7	16.1	16.8
Technical Education Proportion (%)	5.9	2.3	2.5	8.6	5.9	10.9
Married (%)	58.8	72.9	59.1	73.7	61.1	73.1
Religion (%)						
Hindu	71.5	73.8	73.5	77.5	79.8	78.7
Others	28.5	26.2	26.5	22.5	20.2	21.3
Employed in Male Dominated Occupation (%)	18.5	75.4	20.9	71.1	37.8	69.6
Employed in Female & Integrated Occupation (%)	81.4	24.6	79.1	28.9	62.2	28.3
Employed in Formal Sector (%)	22.0	48.8	20.9	51.9	18.1	48.5
Employed in Informal Sector (%)	77.9	51.2	79.0	48.1	81.9	51.5
Average Industry Tariff	0.8933(0.3272)		0.6061(0.1704)		0.4207(.3119)	

Note: Mean (Standard Deviation)

Table 2: Summary Statistics on Urban Tariff Measures

	1987-88	1999-00
	Pre-Liberalization	**Post-Liberalization**
District Level		
Average Tariff	0.2090(0.0124)	0.0730(0.0133)
(Including Traded & Non-traded goods)		
Average Tariff	0.8595(0.0938)	0.3331(0.0451)
(Only traded goods)		
Region Level		
Average Tariff	0.213 (0.0234)	0.076(0.0187)
(Including Traded & Non-traded goods)		
Average Tariff	0.8661(0.0661)	0.3246(0.0332)
Only traded goods)		

Note: Mean Tariff (Standard Deviation)

Workers in non-traded industries (service, trade, transportation, construction, workers in growing of cereals & oilseeds) are assigned zero tariffs in all years in this measure. Average tariff on traded goods is employment-weighted tariff over the set of traded industries (i.e. it abstracts from individuals working in non-traded industries in a given district/region). All means are weighted. The tariff measure for 1987/88 round is based on tariff information for 1990. Tariff measure for 1999/00 round is based on tariff information for 1997.

Figure 1: Trends in Average Nominal Tariffs across time

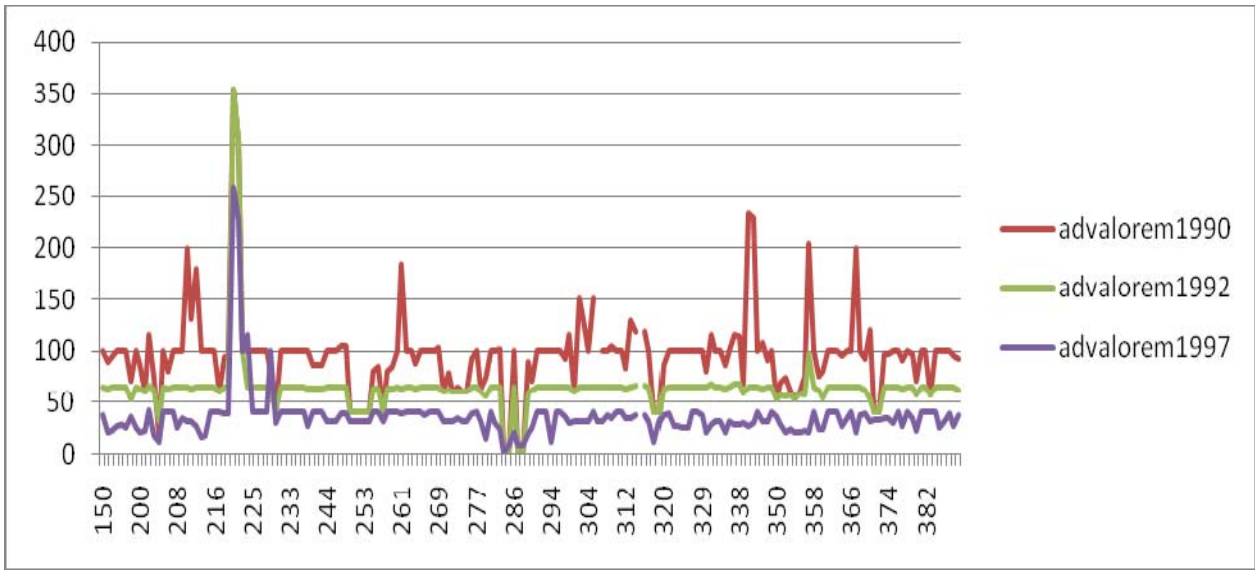


Figure 2: Correlation of Industry Tariffs between 1987-88 and 1997-98

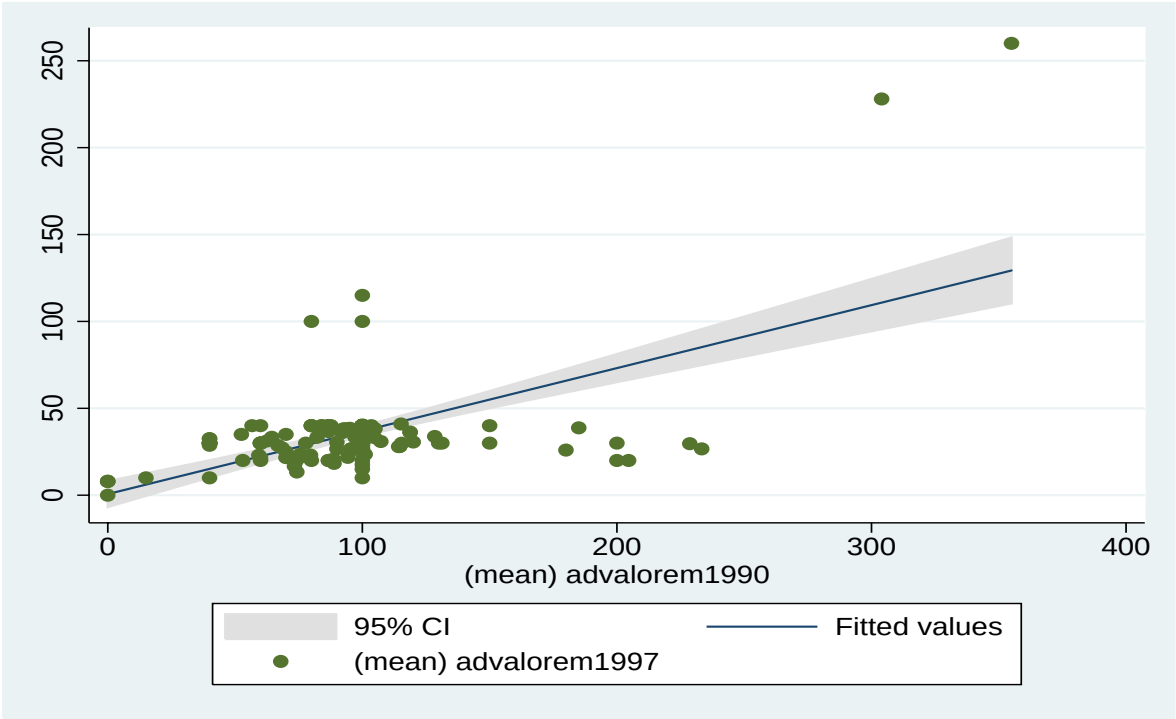


Figure 3: Occupational Gender Segregation Index for Urban India across time

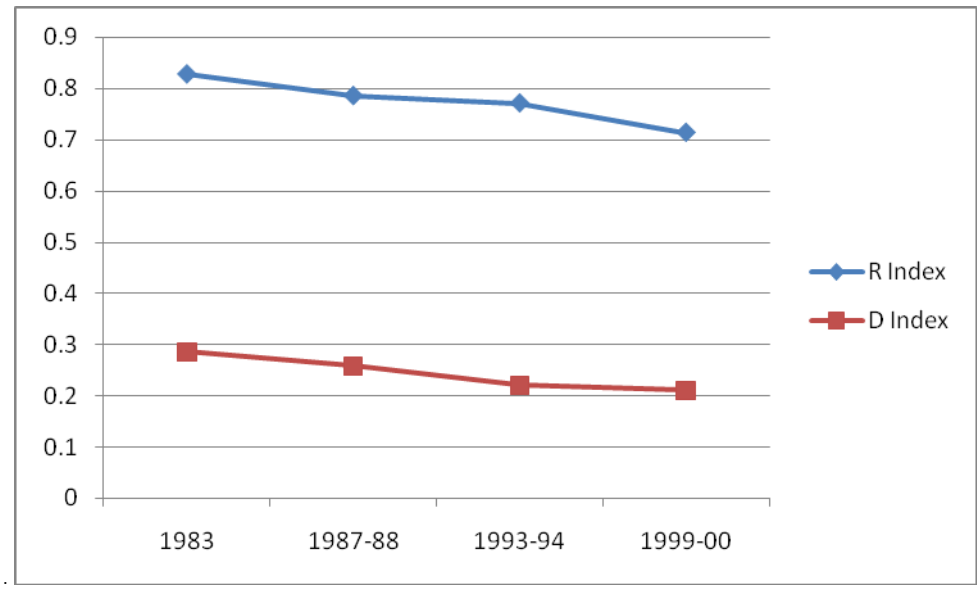


Figure 4: Geographic variation in changes (between 1987-88 and 1999-00) in Indices of Occupational Gender Segregation across Different States in India

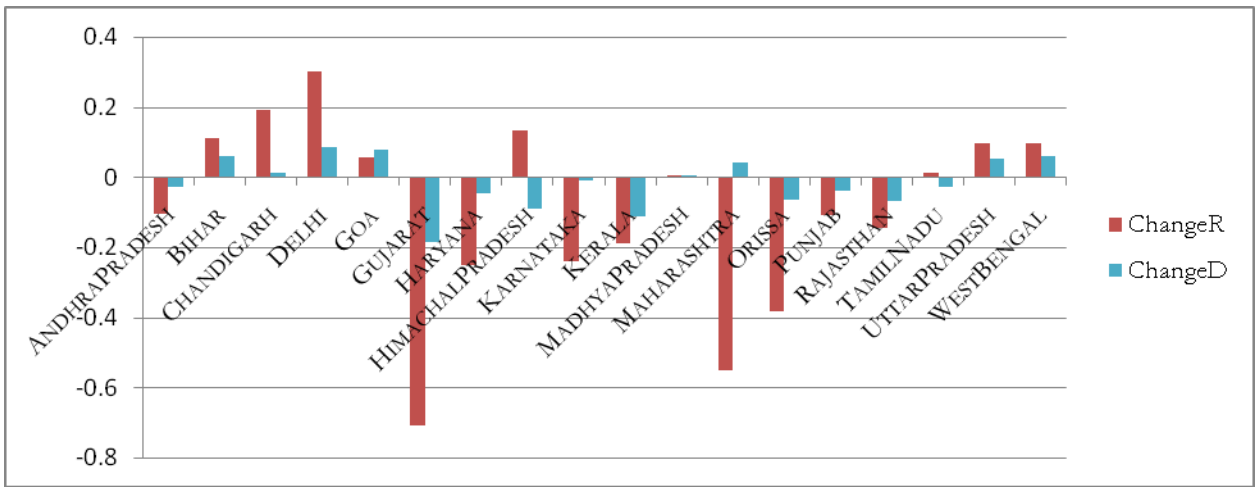


Figure 5: Occupational Structure in Urban India across time- All Industries

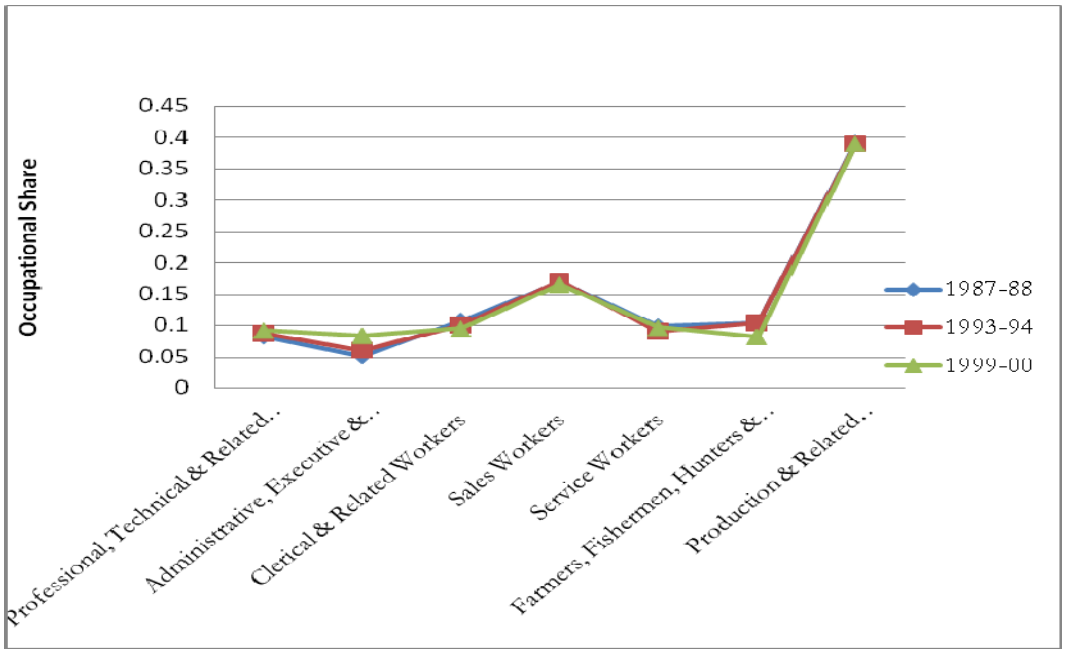


Figure 6: Occupational Structure in Urban India across time-Manufacturing Industry

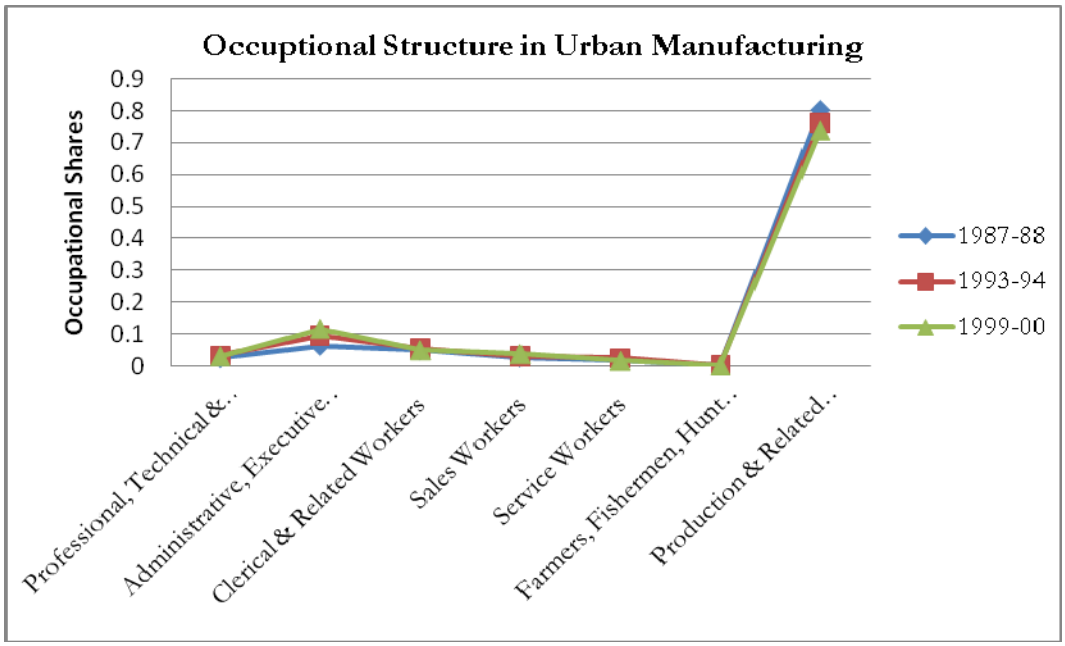
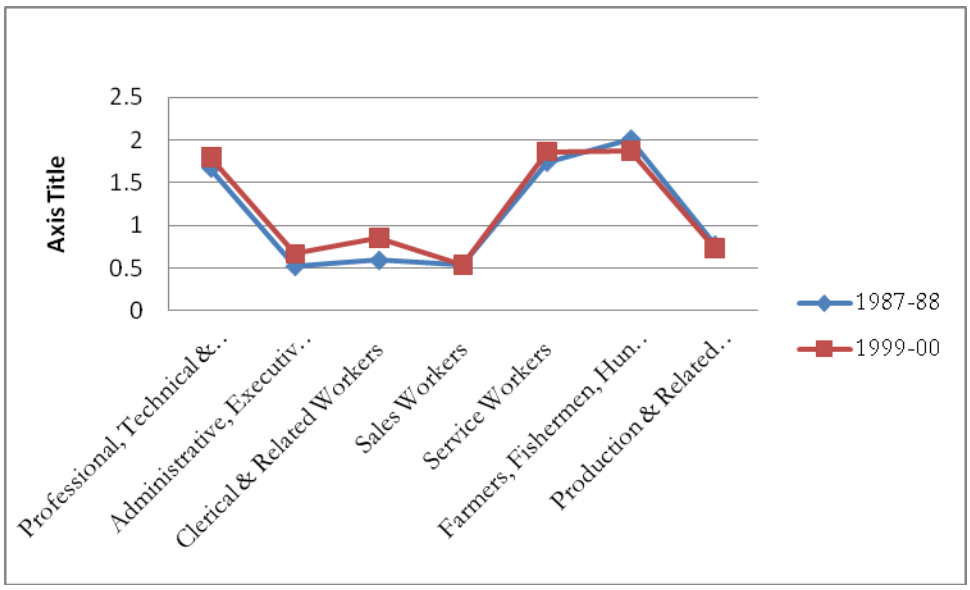


Figure 7: Female Representation Ratio in Urban India



Note: The representation ratio of women in an occupation describes the extent to which women are underrepresented (ratio < 1) or overrepresented (ratio > 1) relative to women's share in total employment and is calculated as the percentage of women in an occupation divided by the percentage of women in total employment. In the occupational segregation literature, an occupation is said to be female dominated if the representation ratio of women is equal to or greater than 1.5. If the representation ratio of women is equal to or less than 0.5, the occupation is labeled as male dominated and the occupation is considered gender integrated if the representation ratio of women is between 0.5 and 1.5

Table 3: Changes in the Sex Labels of 2-digit Detailed Occupations

	All India			
Sex Label	**1983**	**1987-88**	**1993-94**	**1999-00**
Male Dominated	78	63	62	57
Integrated	09	20	20	19
Female Dominated	13	17	18	24
Total	100	100	100	100

Note: These numbers represent the number of occupations in each category over time based on the 2-digit level of occupational classification.

ESTIMATION RESULTS: Sub-State Level

Table 4.1: Effect of Trade Liberalization on Occupational Gender Segregation at the Urban Region Level (Panel Data Estimation)

Dependent Variable:	All Industries#		Manufacturing Industries	
Occupational Sex Segregation Index	D Index	R Index	D Index	R Index
	(1)	(2)	(3)	(4)
Trade Protection	**0.4373***	**1.401****	**0.7548****	**6.4378****
	(1.77)	(2.02)	(2.26)	(1.82)
Demographic & Socioeconomic Controls+	Yes	Yes	Yes	Yes
Other Controls	Yes	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Regions	59	59	59	59
Observations	177	177	177	177
Adjusted R squared	0.6658	0.6914	0.7758	0.7763

Note: t-statistics are reported in parenthesis, *** p<0.01, ** p<0.05, * p<0.1. Clustering of standard errors was done at the region level

By All Industries here, I mean all tradable industries in the agricultural and manufacturing sector. As mentioned earlier in the paper, I exclude the non-tradable sector which includes the services sector.

+ Here Demographic and Socio-Economic controls include measure of region/district level family structure, share of female in the labor force, relative education/human capital levels of men and women, share of agricultural sector, manufacturing sector, and service sector. Other Controls include, measure of state labor laws and region/district level unemployment rates.

Table 4.2: Effect of Trade Liberalization on Occupational Gender Segregation at the Urban District Level (Panel Data Estimation)

Dependent Variable:	All Industries#		Manufacturing Industries	
Occupational Sex Segregation Index	D Index	R Index	D Index	R Index
	(1)	(2)	(3)	(4)
Trade Protection	**0.2146*** **	**2.5761*** **	**0.3264** **	**1.4610***
	(3.26)	(2.87)	(2.49)	(1.80)
Demographic & Socioeconomic Controls+	Yes	Yes	Yes	Yes
Other Controls	Yes	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Regions	319	319	319	319
Observations	638	638	638	638
Adjusted R squared	0.7206	0.7345	0.3876	0.3951

Note: t-statistics are reported in parenthesis, *** p<0.01, ** p<0.05, * p<0.1. Clustering of standard errors was done at the district level. # By All Industries here, I mean all tradable industries in the agricultural and manufacturing sector. As mentioned earlier in the paper, I exclude the non-tradable sector which includes the services sector. + Here Demographic and Socio-Economic controls include measure of region/district level family structure, share of female in the labor force, relative education/human capital levels of men and women, share of agricultural sector, manufacturing sector, and service sector. Other Controls include, measure of state labor laws and region/district level unemployment rates.

ESTIMATION RESULTS: Individual Level

Table 4.3: Seemingly Unrelated Regression (SURE) estimates at the Individual Level- Occupational Gender Segregation

Dependent Variable:	Male Equation	Female Equation	Male Equation	Female Equation	**SURE**
Probability of working in	Pre Liberalization		Post Liberalization		
Male Dominated Occupation	(1)	(2)	(3)	(4)	(5)
Industry Tariff	**-0.0567****	-------	-------	------	-0.1257
	(-2.43)				(-1.38)
Industry Tariff	-------	**-0.2168*****	-------	-------	**-0.1978****
		(-3.57)			(-2.11)
Industry Tariff	-------	-------	**0.0133*****	--------	**-0.1133****
			(2.47)		(-2.12)
Industry Tariff		--------	--------	**-0.0657****	**-0.1335*****
				(-2.34)	(-2.89)
Demographic & Socioeconomic Controls	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	------	------	Yes	Yes	Yes
Observations	11188	2497	15613	3057	32355
Adjusted R squared	0.535	0.5069	0.4286	0.4147	----

Note: t-statistics are reported in parenthesis, *** p<0.01, ** p<0.05, * p<0.1. The above results in column 1-4 are from estimating equation 3 for males and Females separately and for the pre and post liberalization period. Column 5 presents the results from the joint estimation of equation 3 for males and females and the two time periods using the SURE method. Clustering of standard errors was done at the industry level. Since the system of equations was unbalanced due to unequal number of observations, for the SUR estimation the data was reshaped and rescaled using Stata's xtgee command to fit the model and obtain estimates utilizing all the available data and thus preventing potential loss in efficiency. For the pre-liberalization we have one year of data (1987-88) and for post liberalization, we have two years of data (1993-94 and 1999-00)

Table 4.4: Pooled Cross Sectional Regression estimates at the Individual Level –Occupational Gender Segregation

Dependent Variable: Probability of Working in Male Dominated Occupation	(1)	(2)	(3)	(4)	(5)
Female Dummy	-0.2013***	-0.2050***	-0.2853***	-0.2733***	-0.2175***
	(-5.10)	(-5.00)	(-4.84)	(-4.80)	(-2.92)
Industry Tariff		**-0.0589*** **	**0.1906*** **	**-0.1932*** **	**0.1536*** **
		(-3.89)	(-4.68)	(-4.92)	(-3.47)
Female Dummy *Industry Tariff			**-0.1729*** **	**-0.1728*** **	**-0.1122* **
			(-2.93)	(-2.92)	(-1.65)
Postlib Dummy* Female Dummy				-0.0118	-0.0678
				(-0.29)	(-0.69)
Female Dummy*Industry Tariff* Postlib Dummy					-0.0606
					(-0.67)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Demographic & Socioeconomic Controls	Yes	Yes	Yes	Yes	Yes
Observations	36869	32355	32355	32355	32355
R squared	0.3132	0.3368	0.3378	0.3378	0.3378

Note: t-statistics are reported in parenthesis, *** p<0.01, ** p<0.05, * p<0.1. Clustering of standard errors was done at the industry level.

Table 4.5: Seemingly Unrelated Regression (SURE) estimates at the Individual Level- Informal Sector Gender Segregation

Dependent Variable:	Male Equation	Female Equation	Male Equation	Female Equation	**SURE**
Probability of working in	Pre Liberalization		Post Liberalization		
Informal Sector in an Industry	(1)	(2)	(3)	(4)	(5)

Industry Tariff	-0.1084	-------	-------	------	**-0.0497*** **
	(-1.48)				(-4.13)
Industry Tariff	-------	**-0.1672*** **	-------	-------	**-0.0986*** **
		(-11.61)			(-4.49)
Industry Tariff	-------	-------	**-0.2370*** **	--------	**-0.4124*** **
			(-22.86)		(-5.96)
Industry Tariff		--------	--------	**-0.4462*** **	**-0.4817*** **
				(-4.37)	(-5.43)
Demographic & Socioeconomic Controls	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	------	------	Yes	Yes	Yes
Observations	12651	2690	19957	3785	39083
Adjusted R squared	0.3475	0.3699	0.2558	0.4100	----

Note: t-statistics are reported in parenthesis, *** p<0.01, ** p<0.05, * p<0.1. The above results in column 1-4 are from estimating equation 6 for males and females separately and for the pre and post liberalization period. Column 6 presents the results from the joint estimation of equation 5 for males and females and the two time periods using the SURE method. Clustering of standard errors was done at the industry level. Since the system of equations was unbalanced due to unequal number of observations, for the SUR estimation the data was reshaped and rescaled using Stata's xtgee command to fit the model and obtain estimates utilizing all the available data and thus preventing potential loss in efficiency. For the pre-liberalization we have one year of data (1987-88) and for post liberalization, we have two years of data (1993-94 and 1999-00)

Table 4.6: Pooled Cross Sectional Regression estimates at the Individual Level – Informal Sector Gender Segregation

Dependent Variable: Probability of Working in Informal Sector in an Industry	(1)	(2)	(3)	(4)	(5)
Female Dummy	0.1608***	0.1812***	0.2332***	0.2583***	0.1845***
	(4.78)	(4.89)	(4.49)	(4.40)	(3.76)
Industry Tariff		**-0.2435*** **	**-0.1608*** **	**-0.1608*** **	**-0.2154*** **
		(-3.89)	(-4.68)	(-4.92)	(-3.47)
Female Dummy *Industry Tariff			**-0.1220** **	**-0.1220** **	-0.0429
			(-2.05)	(-2.04)	(-0.80)

Postlib Dummy* Female Dummy				-0.0249	0.0489
				(-0.56)	(0.65)
Female Dummy*Industry Tariff* Postlib Dummy					**-0.0792****
					(-1.95)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes	Yes
Observations	45002	39083	39083	39083	39083
R squared	0.2480	0.2745	0.2748	0.2748	0.2749

Note: t-statistics are reported in parenthesis, *** p<0.01, ** p<0.05, * p<0.1.
Clustering of standard errors was done at the industry level.

Appendix 1

A: Calculating Occupational Sex Segregation Index

In the standard literature, the Classification of Occupations (NCO) categorizes occupations into 10 basic divisions (at one digit level, which are further categorized into groups and families at 2 digit and 3 digit levels respectively) based on the fundamental criterion of the type of work performed. Workers engaged in the same type of work are grouped together irrespective of the industrial classification of the establishments they are engaged in. The National Classification of Occupations (1968) in India classifies occupations (at the 1 digit level) into the following **10 basic divisions:**

Division 0-1: Professional, Technical and Related Workers
Division 2: Administrative, Executive and Managerial Workers
Division 3: Clerical and Related Workers
Division 4: Sales Workers
Division 5: Service Workers
Division 6: Farmers, Fishermen, Hunters, Loggers and Related Workers
Division 7-8-9: Production and Related Workers, Transport Equipment Operators and Laborers
Division X: Workers not classified by occupations

I calculate the segregation indices using both the 1-digit and 2-digit level of occupational classification. The three most widely used occupational sex segregation indexes in the literature are:

(1) **Index of dissimilarity, D (Duncan and Duncan, 1955)** defined as follows:

$$D = \sum_{j=1}^{i} \left| (F_j / \sum_{j=1}^{j} F_j) - (M_j / \sum_{j=1}^{j} M_j) \right| \cdot \frac{1}{2}$$

where F_j and M_j are the respective frequency of women and men in an occupational category j. The index measures the proportion of either men or women who would have to change occupational categories in order for the two gender groups to have an equal occupational distribution.

(2) **Size standardized index of dissimilarity, DS** (e.g. Gibbs, 1965; Jacobs and Lim, 1995) is defined as follows:

$$DS = \sum_{j=1}^{i} \left| \left[(F_j/T_j) / \sum_{j=1}^{j} (F_j/T_j) \right] - \left[(M_j/T_j) / \sum_{j=1}^{j} (M_j/T_j) \right] \right| \cdot \frac{1}{2}$$

where, F_j and M_j are the respective frequency of women and men in an occupational category j and T = M + F. Although the DS resolves problems associated with variations in occupational structure across places, it treats each category as if it is of the same size. Thus, it inflates the impact of small occupational categories and devalues the impact of large occupational categories. Charles and Grusky (1995) also discuss how the DS is also dependent on the female labor force participation rate. So its value will change when this rate changes, but all else remains the same.

(3) **Ratio index, R** defined as follows:

$$R = 1/J \sum_{j=1}^{j} \left| \ln(F_1/M_j) - \left[1/J \sum_{j=1}^{j} \ln(F_j/M_j) \right] \right|$$

where M, F and j are the same as in the previous equations. The values of the ratio index (R) represent the sum of occupational-specific deviations from proportional representation of the two sexes. In other words, the

value represents the factor by which women in a specific district/region are disproportionately represented in an average occupational category. In a fully integrated market R = 0 (exp R = 1). Despite its apparent advantage, the R index, like the DS, gives each category of occupations equal weight.

B: Sub-State Levels in India

The hierarchy structure of government in India has the Central government at the top, which is then followed by the State government and then the District administration. I accounted for the changes in the district boundaries by constructing consistent district identifiers using the Maps of India website and Census Atlases. Since district identifiers are not available for 2 of the 4 NSS rounds data that are available for use, I have done the sub-state analysis at the level of two different geographical units: region and district level. For our district level analysis in the urban sector, I can use only two rounds of the data available as opposed to being able to use 3 rounds of data for region level analysis.

In the NSS data used in the paper, the first-stage units in the sub rounds are census villages in the rural sector and the NSSO urban frame survey (UFS) blocks in the urban sector. In 1993-94 (Round 50 of NSS), the survey covered more than 69000 rural and 46000 urban households. The latest round of NSS that is now available for corresponds to 2004-05 (61st round). I recently acquired access to the same and plan to incorporate that into my future analysis in the paper.

The 2 included union territories are Delhi and Chandigarh. Delhi is included because it is the capital of India and also one of the four major metropolitans of India (the other 3 major metropolitans: Chennai, Kolkata and Mumbai are included in the respective districts considered in our study). Chandigarh is included on the grounds that it serves as the capital to the two North Indian states of Punjab and Haryana. Delhi now falls under the category of a State and not a Union territory.

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