Global Value Chains and Female Employment:

The Evidence from Vietnam

Linh Pham, Yothin Jinjarak

Abstract: *What is the relationship between female employment and global value chains (GVCs) in developing countries? Motivated by the rise of offshoring into Vietnam, we study Vietnam's Small and Medium Enterprise (SMEs) from 2011-2015. While female employment has become more prevalent with GVC participation, female workers do not always benefit from increased capital intensity, revenue per worker, and employment size of these SMEs. Intriguingly, the level of SMEs' production technology is negatively associated with female employment share in the sample, suggesting that female employment remains largely in the low value-added activities of the globally-integrated supply chains in Vietnam.*

1. Introduction

Gender equity in the labor markets is an underexplored area of socioeconomic issues due to activities of the global value chains (GVCs) in developing countries. This study's premise is the crossing of development and trade impacts of globalization. Drawn on the task trade theory of Grossman & Rossi-Hansberg (2012), we assess how offshoring from advanced economies is associated with developing countries' increase in female employment, particularly in occupations characterized by manual and routine tasks. Motivated by the remarkable increase in foreign direct investment (FDI) into Vietnam over the past decades, we study to what extent global value chains are associated with the country's female employment across levels of skills and occupations.

Using the firm-level data of the Small and Medium Enterprise Survey in Vietnam in 2011-2015, we analyze the association between GVCs and female employment across industries,

controlling for the intensity of a firm's GVC involvement. Specifically, we examine female employment in terms of the female share of total workforce, skilled workforce (employees with tertiary education), unskilled workforce (employees with no tertiary education), production workforce, and non-production workforce. Our empirical analysis suggests that firms involved in GVCs have a higher share of female employment than non-GVC firms do. GVCs are positively associated with total female employment, female employment of different skill levels and female employment of different job positions. The positive association between GVC involvement and female skilled workforce, female non-production workforce is only observed in firms that have a trade union. We also find that the growth of GVC-involved firms (measured by the increase in capital intensity, per capita sales, total workforce) is negatively associated with the female shares of employment.

Our study focuses on GVCs of small and medium enterprises (SMEs) against the backdrop of existing studies that focus on large domestic and multinational firms: Upward et al. (2013) and Kee & Tang (2016) study the global value chains of large and medium Chinese firms with a minimum US$600,000 sales; Amendolagine et al. (2019) investigate the local sourcing activities of foreign-invested firms in Vietnam and 19 Sub-Saharan countries. In developing countries, SMEs constitute more than 90% of firms (Wang, 2016), and, as shown in Pham & Talavera (2018), a contribution of SMEs is growing in Vietnam. According to the General Statistics Office of Vietnam, 95% of Vietnamese firms are SMEs. Consequentially, the involvement of these SMEs in GVCs plays a significant role in the Vietnam's economy.

Previous studies have extensively explored the link between globalization in terms of trade or foreign investment and female employment (Chen et al., 2013; Ederington et al., 2009; Juhn et al., 2013; Juhn et al., 2014; Kodama et al., 2018; Villarreal & Yu, 2007). Our study on gender inequality in Vietnam contributes to a growing body of literature on the socioeconomic impacts of GVCs in developing countries. This strand of the literature includes, for instance, World Bank (2020) on the importance of GVC-involved firms in improving women's livelihoods; Rocha & Winkler (2019), with cross-sectional data from the World Bank's Enterprise Survey in 64 countries,

on the positive association between GVCs and female employment. By and large, the existing studies evaluate the share of female employment in GVC-involved firms vis-à-vis non-GVC firms, without accounting for the levels of the firm's GVC involvement and interactions with female employment.

Vietnam is quite a special case as foreign direct investment (FDI) increased from 2.8% of GDP in 1990 to 6.1% of GDP in 2015[1], ranking among the top FDI destinations. Global firms such as Samsung, Toyota, Honda, Canon, etc. have been moving their production facilities to Vietnam. The entry of these firms enables local firms to participate in their GVCs. Production and employment of GVCs inevitably influence the activities of both large and small domestic firms in Vietnam. As pointed out by OECD-UNIDO (2019), SMEs can get involved in GVCs through various channels, including "supplying, sourcing from, or partnering with multinationals, or becoming themselves multinationals." In the sample, we find that 11.5% of Vietnamese SMEs involve in some forms in GVCs.

Notwithstanding the fast-growing economy and large inflows of FDI, gender inequality remains an unresolved social issue in Vietnam. Half of the Vietnamese population is women, and according to the International Labor Organization, 64% of Vietnamese women either work as own-account workers or for family. Thus, the majority of women do not have stable employment and rights protected by laws and labor regulations. Vietnamese women are drawn into manufacturing sectors for formal-sector employment. Disappointingly, the share of Vietnamese women occupying managerial positions is very low. In 2015, only 25.8% of managerial positions in Vietnam is occupied by women; the figure is much higher in other ASEAN countries (for example, 46.6%, 32.8%, 29.5%, and 28.4% in the Philippines, Thailand, Cambodia, and Myanmar, respectively).

The rest of this paper proceeds as follows: Section 2 explains the theoretical motivation. Section 3 details the data and descriptive statistics, describing the levels of the firm's GVC

_____

[1] According to the data collected from the World Bank's database.

involvement, and providing the empirical specification. The estimation results are in Section 4. Section 5 discusses our main findings concerning the existing studies. Conclusion is in Section 6.

2. Theoretical motivation

2.1. The theory of task trade

This study is motivated by the task trade theory of Grossman & Rossi-Hansberg (2012). The theory explains the pattern of specialization of tasks in the production process. Unlike standard trade models that emphasize the role of internal economies of scale, the task trade theory focuses on external economies of scale. A firm is more efficient in performing a task in a location given the growth in the scale of performance of that task by other firms in that same location. Local knowledge and specialized expertise are the sources of the spillover effects on the firm's advantage. External economies of scale provide an incentive for firms to be selective in performing a particular set of tasks and offshoring other tasks. Special economic zones such as industrial zones, export-processing zones are the evidence of the benefits of external economies of scale. In the case of Vietnam, all the 63 provinces have at least one special economic zone. Vo (2020) points out that these zones play a significant role in attracting foreign direct investment and fostering international trade of firms.

The model assumes that there are two countries that produce the goods. Two primary factors of production are managers (which incur the fixed cost for the firm) and workers (which incur variable cost for the firm). The two countries are similar in terms of their relative endowment of the two primary factors. The production process is composed of managerial tasks and a continuum of labor tasks. The managerial tasks are carried out in the country of the firm's headquarters, whereas the labor tasks can be carried out in either country by the subsidiaries of the firm or by outside suppliers. When a firm moves its tasks abroad, it faces the issues of coordinating production or communicating with the managers in the home country. The severity of these issues differs by tasks, inducing different offshoring costs for different tasks.

A firm makes a decision on the location of each task by comparing the benefit of external economies of scale and the cost of offshoring. When the latter outweighs the former and the two country have the same number of workers, the labor tasks are retained in the country of the firm's headquarters; in other words, there is no offshoring of tasks. Another scenario is that the number of workers in the two countries is relatively close to each other and offshoring cost is sufficiently high: in this case the country with the higher output and higher wage performs the tasks that have high offshoring costs, leaving the chance for offshoring to take place. If there is a larger endowment of labour overseas firms may decide to perform some labor tasks abroad. In that case, tasks that incur low offshoring cost are implemented in the country with the lower wage and lower output, whereas tasks that incur high offshoring cost are implemented in the country with the higher wage and higher output.

The theory is relevant in explaining the movement of routine and manual tasks of global value chains from developed countries to developing countries. While developed countries perform non-routine and cognitive tasks, the majority of routine and manual tasks are undertaken by developing countries. In the case of Vietnam, those tasks are mostly assembly and require the dexterity or "nimble fingers" of the workers. It is acknowledged that women have an advantage over men in dexterity. Hence, the expansion of sectors performing routine and manual tasks improves female employment. This trend can be observed in some sectors like textiles, apparels, or electronics. According to the statistics from the General Statistics Office in Vietnam, the share of female employment constitutes more than 70% of the sector's total workforce.

2.2. Global value chains and female employment in Vietnam

Vietnam's participation in global value chains provides an example for the task trade theory. Multinational firms from developed economies such as Korea, Singapore, Taiwan, and Japan have expanded their production to Vietnam through offshoring to take advantage of the country's abundant supply of labors. As predicted in the task trade theory, tasks with low offshoring cost, specifically the manual tasks, are offshored to Vietnam, while the cognitive tasks are retained in the firm's headquarters' home countries. These trades in tasks between Vietnam

and head quarter countries characterize the involvement of Vietnam in global value chains of the past 3 decades since its trade and investment liberalization in 1990s.

Vietnam's growth strategy is based on the abundant supply of labor to support the main exporting sectors and attract foreign direct investment. Following this strategy, labor-intensive sectors such as textiles, apparel, leather, and electronics were readily integrated into the global value chains. Appendix A illustrates the backward linkages and forward linkages of 9 major manufacturing sectors in Vietnam; the former measures the import content of Vietnam's exports as a share of the country's total exports, while the latter measures the use of Vietnam's inputs in foreign partners' exports as a share of Vietnam's total exports, and the GVC participation of Vietnam is essentially the sum of these two linkages (Amendolagine et al., 2019) - higher linkage implies a higher level of involvement in GVCs. Based on data from the Trade in Value Added database of the OECD, the participation of textiles, apparel & leather, and electronics in GVCs is more significant than other sectors [e.g., basic metals, chemical and pharmaceutical products, and rubber and plastic products]. In 2015, the share of import content of exports and the share of Vietnam's inputs in foreign countries' exports of textiles, apparel and leather is 11.7% and 1.2%, respectively; while the figures for the electronics sector are 7.2% and 2.2%, respectively [the figures in other sectors are much lower: for basic metals, the backward linkages is 1.3%, while the forward linkages is 0.4%].

Figure 1 shows the average share of female employment (in percentage of total employment) on the vertical axis, plotted against the GVC participation indicator (in percentage of total exports) of 9 manufacturing sectors of Vietnam in 2011-2015, based on the average share of female employment from the General Statistics Office of Vietnam. The figure suggests a positive association between the GVC participation and the female labor share. The share of female employment is the highest in electronics at more than 78% in 2011-2015, followed by textiles, apparel and leather, at more than 77%. In contrast, the share of female employment in other sectors such as basic metals, fabricated metal products, chemical and pharmaceutical products, is relatively low.
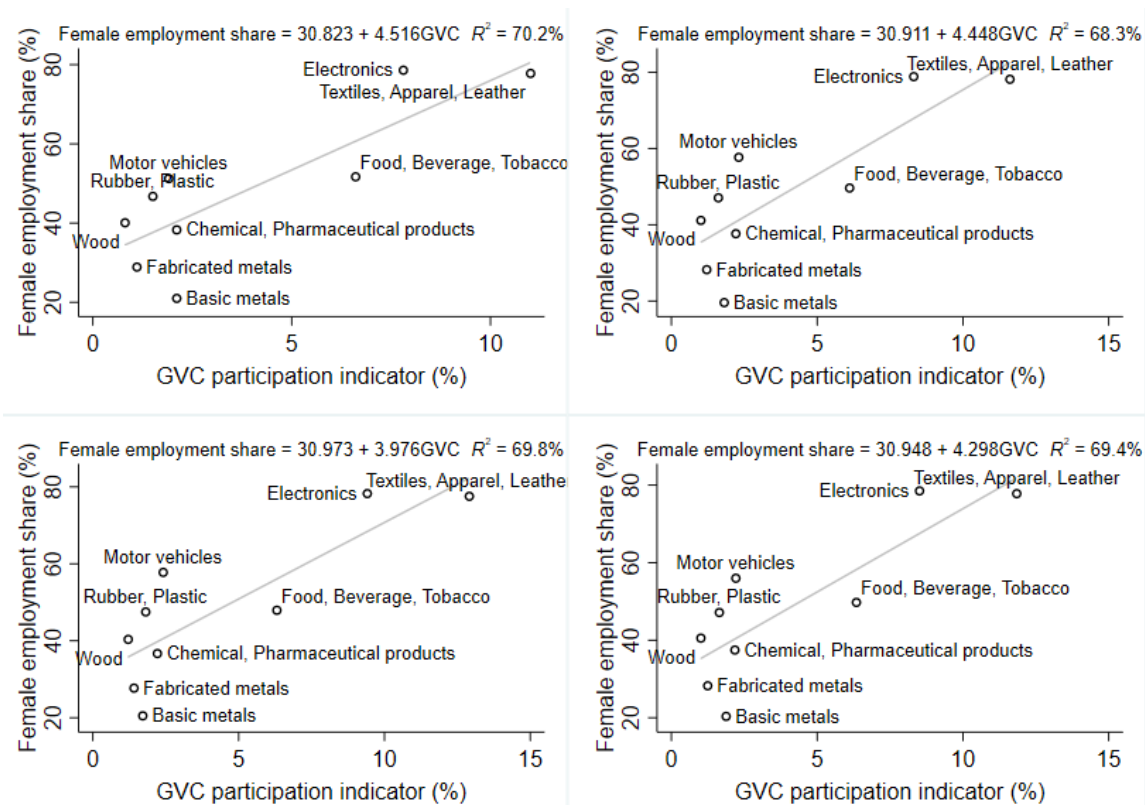
Figure 1. The GVC participation indicator (in percentage of total exports) and the female employment share (in percentage of total employment) in 2011-2015.

There is a positive association between the GVC participation indicator and the female employment share in 2011-2015.

Source: OECD Trade in Value Added database and the General Statistics Office of Vietnam.

As the backward linkages is always higher than the forward linkages, the data suggest that Vietnamese firms mainly participating in GVCs by importing inputs from abroad to undertake assembly tasks. For instance, Samsung, the Korean electronics giant, entered Vietnam in 1995, gradually allocating a third of its output to the production facilities in Vietnam[2]. Interestingly, Korean firms supply most of Samsung's inputs, limiting Vietnamese firms' participation in the upstream parts of Samsung's global value chains. According to the Foreign Investment Agency in Vietnam, Vietnamese firms' involvement in Samsung's GVCs is mostly packaging, labelling or assembling, the tasks considered unskilled and requiring dexterity of female workers in Vietnam.

---

[2] https://www.economist.com/asia/2018/04/12/why-samsung-of-south-korea-is-the-biggest-firm-in-vietnam.

The growth of sectors intensively involved in global value chains has encouraged female labor to the factory works, underlined by the dexterity of women over men in the assembly and sewing tasks. In the textiles and apparel sector, 46.1% of the inputs are imported from foreign suppliers[3], and the finished products can then be exported to large markets such as the United States, EU, and Japan at the competitive prices supported by the low-value-added stage of cutting and sewing in Vietnam, comprising more than 70% of the female labor.

In sum, the task trade theory developed by Grossman & Rossi-Hansberg (2012) sheds light on the link between global value chains and female employment in Vietnam. With the access to abundant supply of low skilled workers, Vietnamese firms perform the tasks that require the dexterity of women and less intensive communication with the firm's headquarters abroad, notably assembly, packaging, and labelling. We next formally examine this relationship by using firm-level data from small and medium-sized enterprises in Vietnam from 2011 to 2015.

3. Methodology

3.1. Data

Our sample comes from the micro-level data of the Small and Medium Enterprise Survey in Vietnam. The survey is conducted biennially under the collaboration of the Central Institute for Economic Management (CIEM), the Institute of Labour Science and Social Affairs (ILSSA), the Development Economics Research Group (DERG) at the University of Copenhagen, and the United Nations University World Institute for Development Economic Research (UNU-WIDER). Nine provinces participating in the survey are Ha Noi[4], Hai Phong, Phu Tho, Nghe An, Quang Nam, Khanh Hoa, Lam Dong, Ho Chi Minh City, and Long An[5] (the population of each province is 7.5 million people, 2.0 million people, 1.4 million people, 3.2 million people, 1.5 million people, 1.2 million people, 1.3 million people, 8.6 million people, and 1.5 million people, respectively).

---

[3] https://www.wto.org/english/res_e/statis_e/miwi_e/VN_e.pdf.

[4] Ha Tay province also participated in the SME Survey. However, this province was officially merged into Hanoi in 2009. Thus, in this study, we merged the information of Ha Tay to Hanoi. Vietnam currently has 63 administrative provinces.

[5] https://www.wider.unu.edu/database/viet-nam-sme-database.

The survey has been carried out every 2 years since 2005. Each round refers to the previous year. Each survey round covers approximately 2,500 to 2,800 non-state manufacturing SMEs in 18 sectors[6]. The survey sample is randomly stratified by the legal status[7] of manufacturing SMEs based on the Establishment Census and the Industrial Census from the General Statistics Office of Vietnam. The on-site identification approach is used to incorporate informal household firms in the sample. In contrast to household firms registered with district authorities, these informal household firms are not registered. Because this study focuses on firms that participate in global value chains, we proceed with the registered firms in the sample (see Table B1 and Table B2 in Appendix B for the distribution of firms by sector and by legal status).

The three rounds of survey in 2011, 2013, and 2015 formed our panel dataset, with the comprehensive information on the exporting, importing, and subcontracting details of firms, serving as the measures of participation in the global value chains. The final (unbalanced) panel sample has 5,747 observations, covering 3,028 firms, an average of 2 observations per firm.

3.2. GVC measurement

There are several approaches to measuring the GVC involvement. The macro-approach uses input-output tables of bilateral trade to measure GVCs (Antràs & Chor, 2013; Hummels et al., 2001; Koopman et al., 2012). This approach allowing for a decomposition of a country's exports into different components such as domestic value added, foreign value added, and other double-counted terms. Yet, the nature of trade statistics and some assumptions of the mathematical frameworks induce the measurement of GVCs to underestimate of overestimate the value added. For instance, Koopman et al. (2012) assumes that the proportion of an

---

[6] 18 sectors include Food and beverages, Textiles, Apparel, Leather, Wood, Paper, Publishing and printing, Refined petroleum, Chemical products, Rubber, Non-metallic mineral products, Basic metals, Fabricated metal products, Electronic machinery, Motor vehicles, Other transport equipment, Furniture, jewellery, Recycling.

[7] The SME survey covers both firms that registered with official institutions (either at district or provincial level) and unregistered households. Unlike unregistered households, registered firms have their own business registration license and tax code.

intermediate input imported from a source country for every industry in a destination country is the same and equal to the proportion of that imported intermediate input of the destination country from that source country, or Hummels et al. (2001) assumes that the proportion of imported intermediates is the same in both production for domestic final demand and production for exports. For a micro-level approach, data are mostly obtained from firm surveys and combined with relevant statistics to account for domestic and foreign value-added contents of firms' exports (Kee & Tang, 2016; Lu et al., 2018; Upward et al., 2013). While the main actors of GVCs are firms, this approach is definitely useful in explaining firm heterogeneity in GVCs. The micro-level approach has its challenges, however, as firm-level data are not always accessible, or in some cases, the data on value-added is insufficient.

We utilize the information in OECD-UNIDO (2019) and the micro-level approach of Veugelers et al. (2013) to measure the involvement of Vietnamese firms in the global value chains focusing on their trade and domestic production linkages. OECD-UNIDO (2019) provides an empirical framework in which small and medium-sized enterprises can get involved in the global value chains according to the extent of their activities in exporting (intermediate or final) products or importing inputs. The GVC involvement can also take place when SMEs supply or source from foreign-owned firms or supply their products to larger domestic firms, which later sell to foreign-owned firms through the domestic linkages. As SMEs become stronger and get larger, they can then play more important role in GVCs by investing abroad and become themselves multinational firms.

We apply the micro-level measure of GVC involvement to the firm-level data from Vietnam's SME survey, aided by the detailed information on the international strategy of firms in the survey. We classify firms into two groups: (i) GVC-involved firms and (ii) non-GVC firms. In the GVC-involved group, three modes of involvement are as follows: (i.a) the lowest level of involvement, designated the single mode, is for firms that either export, or import, or act as an international producer (through outsourcing, offshoring, or foreign direct investment); (i.b) the middle level of involvement, the dual mode, describes firms that perform any two of the three

activities mentioned above; (i.c) the highest level of involvement, the triple mode, is for firms that simultaneously perform all the three activities.

The survey on SMEs in Vietnam also provides information on the domestic linkages of the firms, though more limited than the international dimension. The survey asks about the contribution to the firm's revenue from sub-contracting (outsourcing) services for foreign-owned firms. We treat firms answering this question with a positive value as international producers; 1.3% (72 firms) of the observations is international producers according to this classification in the sample.

Table 1 reports the sample composition, revealling the skewness in the distribution of GVC involvement. We find that 89.12% of Vietnamese SMEs do not get involved in the GVCs, 8.65%, are single-mode firms, and 2.07%, have the medium-level of involvement. The sample contains nine firms that are most intensively involved in GVCs, quite a reasonable figure given the dominance of micro, small, and household firms in Vietnam. As highlighted in OECD-UNIDO (2019) that a large number of SMEs may never participate in GVCs because of the nature and the scale of their business, the statistics of Table 1 are likely to be persisting and consistent with the stylized facts for the majority of developing countries.

Table 1. The distribution of firms by the mode of GVC involvement.

The majority of firms are not involved in GVCs.

Mode	Specification	Firms	Percent
Non-GVC	Neither importer, nor exporter, nor an international producer	5,122	89.12
Single-mode	Either pure importer, or pure exporter, or pure international producer	497	8.65
Dual-mode	Either importer and exporter, or importer and international producer, or exporter and international producer	119	2.07
Triple-mode	Importer, exporter, and international producer	9	0.16

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

3.3. Descriptive statistics

Table 2. Descriptive statistics.

	Mean	SD	Obs	Variable definition
Total-female share	0.370	0.251	5,747	Female share of total workforce
Skilled-female share	0.222	0.379	5,747	Female share of workforce with tertiary education
Unskilled-female share	0.360	0.256	5,747	Female share of workforce with no tertiary education
Female-production share	0.292	0.338	5,747	Female share of production workforce
Female-non-production share	0.466	0.341	5,747	Female share of non-production workforce
GVC	0.133	0.407	5,747	An indicator for GVC involvement equals to zero for non-GVC firms, one for single-mode firms, two for dual-mode firms, three for triple-mode firms
Age	14.7	9.723	5,747	Age of firm
Capital	310.542	651.302	5,747	The ratio of the firm's fixed assets to total workforce
Sales	283,201.02	1,771,589.7	5,747	The ratio of the firm's sales to total workforce
Size	18	32.88	5,747	Total workforce
Owner's manager	0.587	0.492	5,747	An indicator equals one if the gender of the firm's owner or manager is male, and zero otherwise
Special zone	0.059	0.236	5,747	An indicator equals one if the firm locates in a special zone (an export processing zone, or a high-tech zone, or an industrial zone), and zero otherwise
North	0.484	0.500	5,747	An indicator equals one if the firm locates in the North, and zero if the firm locates in the South.

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Table 2 reports descriptive statistics for all firms in the sample. From 2011-2015, 37% of total employment is female, with skilled-female employment represents 22% of the skilled workforce and unskilled-female employment for 36% of the unskilled workforce. The average share of female production labour is 29.2%, while the average share of female non-production labour is 46.6%. Additional firm characteristics include that the average firm's age in the sample is about 15 years, 58.7% of them are male-owned firms. The average size of firms is 18 people. The majority of firms are located in the South (Quang Nam, Khanh Hoa, Lam Dong, Ho Chi Minh City, Long An) (at 51.6%), and not in a special zone (at 94.1%).

A comparison of employment by gender across sectors shows that the average share of female employment is much higher than that of male employment in textiles and apparel, as shown in Figure 2 (detailed t-test provided in Table C1 of Appendix C).

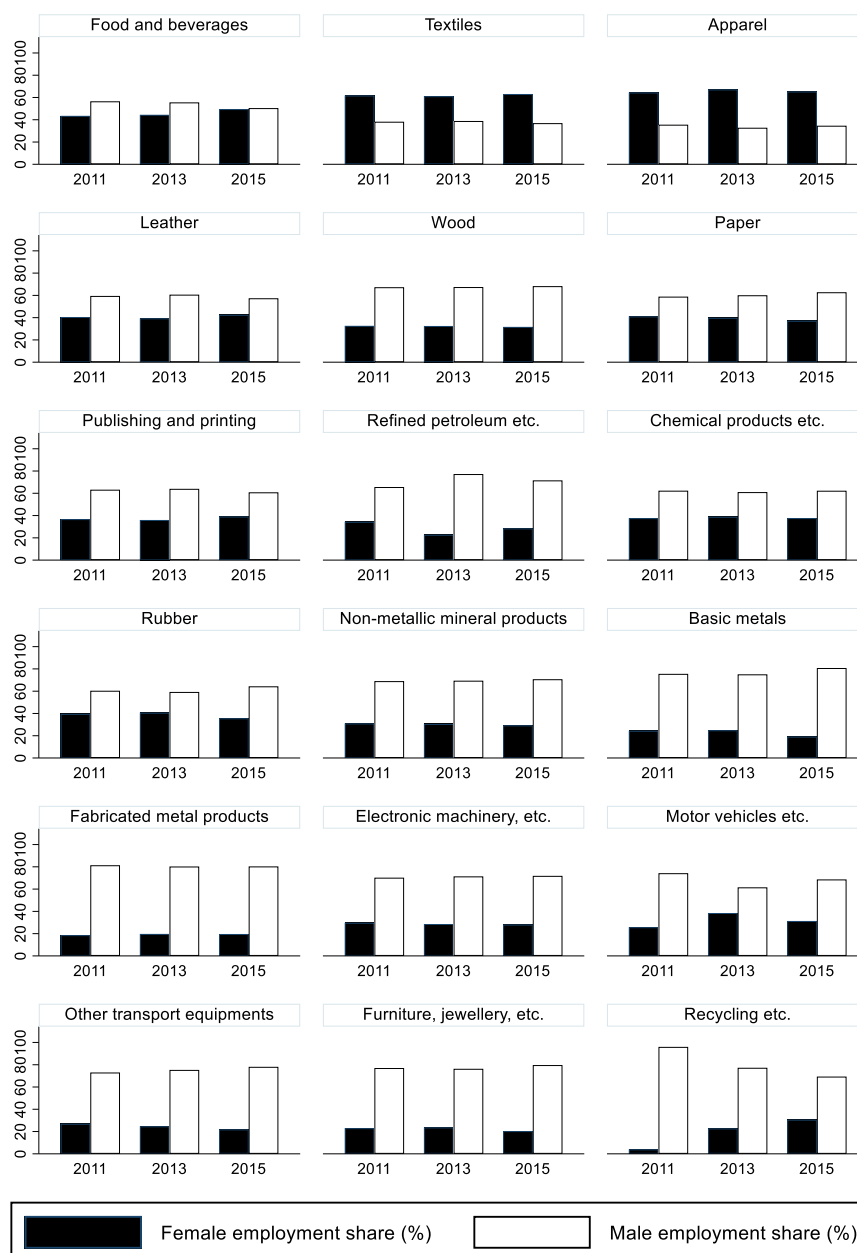**Figure 2.** The share of employment by gender across sectors.

The total-female share is higher in textiles and apparel.

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Figure 3 compares the average share of female employees of firms according to different levels of GVC involvement, suggesting that firms involved in GVCs have a higher average share

of female employment than non-GVC firms (with an exception for the triple-mode firms in 2013, only three firms in this group). From 2011-2015, the average share of total female employment is 35.9% in non-GVC firms, 45.4% in single-mode firms, 50.0% in dual-mode firms, and 58.2% in triple-mode firms. GVC-involved firms differ from non-GVC firms with a higher average share of female employment in the skilled workforce, unskilled workforce, production workforce, and non-production workforce (Figure C1, Figure C2, Figure C3, and Figure C4 in Appendix C).
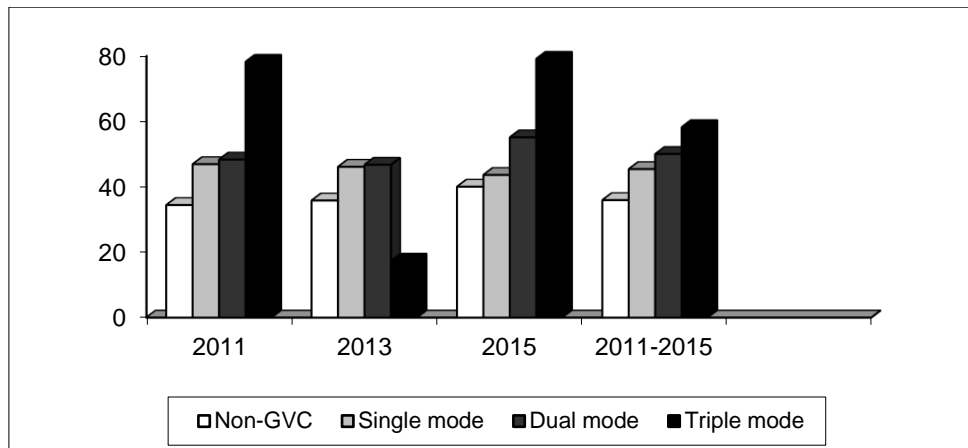

Figure 3. The female employment share of total workforce in 2011-2015.

GVC-involved firms have a higher female employment share than non-GVC firms.

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Notes: This figure compares the female share of total workforce between GVC and non-GVC firms. Sing-mode firms are firms that either export, or import, or act as an international producer (through outsourcing, offshoring, or foreign direct investment). Dual-mode firms are firms that perform any two of those three activities. Triple-mode firms are firms that simultaneously perform all the three activities. Non-GVC firms are firms that neither export, nor import, nor act as an international producer.

3.4. Econometric Approach

To examine the relationship between global value chains and female employment, this study follows the literature on the impact of foreign direct investment and trade on female employment (Chen et al., 2013; Kodama et al., 2018; Villarreal & Yu, 2007). Specifically, the model takes the following form:

$$\text{Female employment share}_{it} = \alpha + \beta X_{it} + \gamma GVC_{it} + \varepsilon_{it} \quad (1)$$

where Female employment share$_{it}$ is female share of total workforce of firm i at time t. X_{it} is a set of firm i's characteristics at time t, including: age; capital intensity measured as total fixed assets

divided by total workforce (in natural logarithm); per capital sales measured as total sales divided by total workforce (in natural logarithm); size measured as total workforce; the gender of the firm's owner or manager (a dummy variable is equal to one if the gender of the firm's owner or manager is male, and zero otherwise)[8], We also control for the difference in culture, history, and business environment of the region that the firm is located, using a dummy variable that is equal to one if the firm is in in the North (Ha Noi, Hai Phong, Phu Tho, Nghe An) and zero if the firm is the South (Quang Nam, Khanh Hoa, Lam Dong, Ho Chi Minh City, Long An). As previous studies report a high share of female employment in special zones in developing countries (Farole & Akinci, 2011; Liberato & Fennell, 2007), we control for the location of the firm in a special zone with a dummy variable that is equal to one if the firm is in either an export processing zone, or a high-tech zone, or an industrial zone, and zero otherwise. In this empirical specification, our variable of interest is GVC_{it}, which represents a set of mutually exclusive dummies identifying the firm's mode of involvement in global value chains, namely the single mode, the dual-mode, and the triple mode. The reference category is the non-GVC mode, which includes firms not involved in the global value chains. ε_{it} is the error term[9].

We are interested in the impact of global value chains on female employment by skill levels in two dimensions. First, for skilled-female employment, the dependent variable is female share of skilled workforce (employees with tertiary education). For unskilled-female employment, the dependent variable is female share of unskilled workforce (employees with no tertiary education). Second, we estimate the model using as dependent variables female share of production workforce, and female share of non-production workforce.

Our sample has 5,747 observations, covering the most recent 3 years of surveys (2011, 2013, 2015). Given the 5-year span, the within-firm variation of the female share is dominated by

---

[8] Becker (1971) states that the gender composition of the firm is affected by the employer's preference for the employee's gender.

[9] ε_{it} is the composite error term which comprises time-constant unobserved factors (v_i) and time-varying unobserved factors (u_{it}). For panel data, fixed effects model is applied if it is assumed that v_i is correlated with explanatory variables. But if there is small variation in variables over time, and if v_i and u_{it} are both assumed to be uncorrelated with explanatory variables, pooled OLS is applied.

its cross-sectional variation among the firms. To control for the role of global value chains on female employment within a sector, we use OLS regression with sector fixed effects, year fixed effects, and sector-year fixed effects.

Because of the skew distribution of observations by GVC mode (as shown in Table 1), we differentiate the involvement of firms in GVCs into two bins, namely the GVC group and the non-GVC group. A binary dummy variable GVC is equal to one for a firm identified as either the single-mode, or dual-mode, or triple-mode, and equal to zero otherwise.

We also consider a possible simultaneity between a firm's GVC participation and its female employment. The gender structure may influence the firm's choice in GVC participation, especially for sectors such as textiles and apparel. To address the issue of simultaneity, we perform the two-stage least squares (2SLS) estimation as a robustness check, using an instrument for the firm's involvement in GVCs. Basco & Mestieri (2013); World Bank (2016) highlight an important role of information and communication technology (ICT) in enabling cross-border trade by reducing transaction costs. Thus, we use the ICT index at provincial level as the instrument for the involvement of a firm in GVCs[10]. The underlying assumption for the exclusion restriction of this instrument is that the ICT index at provincial level is not correlated with the share of female employees at firm level. There is no clear and persuasive explanation of how the development of information and communication technology at provincial level can affect the firm's female employment other than through the firm's trade linkage and domestic linkage, taking in account other factors. However, we acknowledge it is impossible to satisfy the exclusion restriction completely.

Our model specification using this instrumental variable approach takes the following form:

The first-stage equation:

$$GVC_{it}=\lambda X_{it} + \theta ICT_{ipt} +\omega_{it} \quad (2)$$

---

[10] The data on the ICT index at the provincial level is collected from the Ministry of Information and Communication.

The second-stage equation:

Female share$_{it}$ = α + βX_{it} + γ$\widehat{GVC_{1t}}$ + ε$_{it}$ (3)

In equation (3) of the second stage, ICT$_{ipt}$ is the ICT index at provincial level; $\widehat{GVC_{1t}}$ is the fitted value from the first stage regression where GVC is regressed on the ICT index at provincial level and other control variables (included in equations (1)).

For further robustness checks of the regression results, we control for the impact of female employment at the sectoral level and firm innovation. Vietnam SME's survey provides information on 3 forms of firm innovation: introducing new products, improving existing products, planning to start new projects. We therefore check for the robustness of our main findings in all the three cases of firm innovation. Textiles and apparel are the two sectors that have the highest share of female employment in the sample (more than 60 percent). To address the concern that the pattern of the links between GVC involvement and female employment is mainly driven by textiles and apparel, we exclude these two sectors from the sample for another robustness check.

In the next part of the analysis, we examine the role of firm heterogeneity in the relationship between global value chains and female employment. To account for firm heterogeneity in terms of scale, we successively add an interaction term between GVCs and capital intensity, per capita sales, size into equation (1). Our coefficient of interest is the coefficient of the interaction term. A positive coefficient indicates an increase in female employment when GVC-involved firms grow, and a negative coefficient indicates the reverse trend. We also account for the role of trade union by estimating equation (1) for firms with a trade union and firms without a trade union separately.

4. Findings

4.1. Baseline regressions

The pooled OLS results for the impact of GVC involvement on total female employment, female skilled workforce and female unskilled workforce are reported in Table 3. Column (1), column (3), and column (5) show the results when the GVC variable is a categorical dummy indicating different levels of the firm's GVC involvement; the reference category is non-GVC firms.

The estimates in column (1) suggest that dual-mode firms have the largest impact on total female employment compared to firms having other modes of global value chain involvement. The dual mode's positive and significant coefficient implies that all things being equal, the female share of dual-mode firms is, on average, 7.4 percentage-point higher than that of firms not getting involved in GVCs. Single-mode firms also have a higher share of female employment, 5.7 percentage points more than non-GVC firms. The estimates in column (3) and column (5) report a significant and positive association between GVC involvement and the female share of skilled workforce, as well as the female share of unskilled workforce in single-mode and dual-mode firms.

Recall the skewness of firms' distributions by their level of GVC involvement (88.46% of firms are not involved in GVC, while only 0.17% of firms have triple mode), next, we group the categorical GVC dummies into a binary dummy, equal to one if the firm has either one of the three modes of GVC involvement (GVC-involved firm), and zero otherwise (non-GVC firm). The estimates in column (2), column (4), and column (6) suggest that GVC-involved firms have a higher share of total female employment, both skilled and unskilled female employment than non-GVC firms. These findings support the task trade theory: developing countries like Vietnam has a comparative advantage in labor-intensive industries like textiles and apparel, thereby specializing in the manual tasks that require a large number of female workers with dexterity or "nimble fingers." Therefore, firms involved in GVCs prominently feature a higher share of female employment.

Table 3 also points to the role of other firm's characteristics. *Age*: the estimates indicate an association between a firm's age and female employment: younger firms tend to have a higher share of skilled females and a lower share of total females and unskilled females. *Capital intensity*: there is no significant association between capital-intensive industries and the female share of total workforce and unskilled workforce, while the association is negative in the case of the female share of skilled workforce. These estimates are similar with previous findings on female employment concentration in less capital intensive firms (Chen et al., 2013; Ederington et al., 2009). *Per capita sales*: When per capita sales increases, the female share of total workforce and

unskilled workforce declines while the female share of the skilled workforce increases. *Firm size and location*: large firms and firms located in the northern part of Vietnam have a higher share of female employment. Skilled-female employment is higher in firms located in special zones. *Owner's gender*: male-owned firms have a lower share of female employment than female-owned firms. This finding is in line with that of Carrington & Troske (1995): female-owned firms employ higher female employment shares than male-own firms.

Table 3. The impacts on the female employment share.

GVCs are positively associated with the female share in total, skilled, and unskilled workforce.

	Female share of total workforce		Female share of skilled workforce		Female share of unskilled workforce	
	(1)	(2)	(3)	(4)	(5)	(6)
Single	0.057***		0.105***		0.054***	
	(0.011)		(0.021)		(0.012)	
Dual	0.074***		0.074*		0.076***	
	(0.023)		(0.038)		(0.024)	
Triple	0.123		0.091		0.114	
	(0.091)		(0.131)		(0.098)	
Binary GVC		0.061***		0.100***		0.058***
		(0.011)		(0.020)		(0.011)
Age	0.001***	0.001***	-0.003***	-0.003***	0.001***	0.001***
	(0)	(0)	(0.001)	(0.001)	(0)	(0)
Capital intensity	-0.002	-0.003	-0.008*	-0.008*	-0.003	-0.003
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
Sales	-0.026***	-0.026***	0.042***	0.042***	-0.030***	-0.029***
	(0.004)	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)
Size	0.001***	0.001***	0.002***	0.002***	0.001***	0.001***
	(0)	(0)	(0)	(0)	(0)	(0)
North	0.032***	0.032***	0.022*	0.022*	0.030***	0.030***
	(0.007)	(0.007)	(0.012)	(0.012)	(0.007)	(0.007)
Special zone	0.008	0.007	0.124***	0.124***	0.004	0.003
	(0.014)	(0.014)	(0.025)	(0.025)	(0.015)	(0.015)
Owner's gender	-0.105***	-0.105***	-0.036***	-0.036***	-0.106***	-0.106***
	(0.007)	(0.007)	(0.011)	(0.011)	(0.007)	(0.007)
Obs	5,747	5,747	5,747	5,747	5,747	5,747
R-squared	0.361	0.361	0.187	0.186	0.367	0.367

Notes: Robust standard errors clustered at the firm level are in parentheses. In column 1, column 3, and column 5, the independent variable GVC is a set of self-exclusive dummies identifying the firm's mode of involvement in global value chains, including single-mode, dual-mode, and triple-mode. In column 2, column 4, and column 6, the independent variable GVC is a binary dummy variable. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour); per capita sales (the log of total sales to total labour); size (total labour); a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. A constant term, sector, year, sector-year dummies are included. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively.

Figure 4 illustrates the association between the average share of female employment and the average share of firms involved in global value chains across sectors in 2011-2015. Sectors with a larger share of firms involved in GVCs are also sectors with a larger share of female employment, notably textiles and apparel.
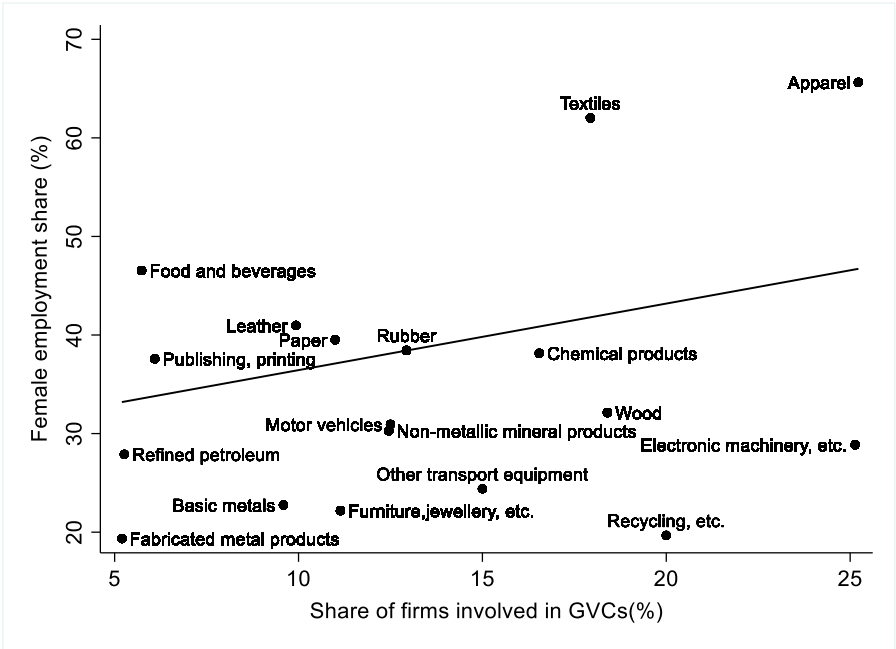

Figure 4. The total-female share and the share of GVC-involved firms across sectors.

Sectors intensively involved in GVCs feature a high total-female share.

We further analyze the link between global value chains and female job positions by comparing the impact of the firm's involvement in GVCs on the female share of production labour and non-production labour. Column (1) and column (2) of Table 4 reports the results of the OLS regression across the GVC modes when the dependent variable is the female share of production workforce. Column (1) shows that triple-mode firms have a higher share of female production labour than non-GVC firms. The coefficients of single-mode and dual-mode firms are positive as well, indicating a positive association between the level of firms' involvement in GVCs and the female share of production workforce. When GVC involvement is a binary dummy, the results in column (2) suggest a positive correlation between GVCs and female production labour: the female share of production workforce in GVC-involved firms is 7.2 percentage-point higher than that of non-GVC firms. The estimates in column (4) suggest that GVC-involved firms also have a higher

female share of non-production workforce than non-GVC firms. Nevertheless, in column (3) we observe that only single-mode firms outweigh non-GVCs firms in terms of the female share of non-production workforce. For the two more intensive levels of GVC involvement, the association between GVCs and the female share of non-production workforce is insignificant. The positive association between the involvement in GVCs and female non-production workers is driven by single-mode firms.

Table 4. The link between global value chains and female job position.

GVCs is positively associated with the female share of production and non-production workforce.

	Female share of production workforce		Female share of non-production workforce	
	(1)	(2)	(3)	(4)
Single	0.068***		0.037***	
	(0.015)		(0.014)	
Dual	0.088***		0.006	
	(0.028)		(0.024)	
Triple	0.183*		0.005	
	(0.102)		(0.063)	
Binary GVC		0.072***		0.032**
		(0.014)		(0.013)
Control variables	Yes	Yes	Yes	Yes
Observations	5,747	5,747	5,747	5,747
R-squared	0.231	0.231	0.293	0.293

Notes: Robust standard errors clustered at the firm level are in parentheses. In column 1, column 3, and column 5, the independent variable GVC is a set of self-exclusive dummies identifying the firm's mode of involvement in global value chains, including single-mode, dual-mode, and triple-mode. In column 2, column 4, and column 6, the independent variable GVC is a binary dummy variable. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour); per capita sales (the log of total sales to total labour); size (total labour); a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. A constant term, sector, year, sector-year dummies are included. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively.

4.2. Robustness checks

We address the possible endogeneity of the firm's involvement in GVCs for a robustness check. The simultaneity of the firm's gender-structure and its involvement in global value chains remains an open question in the literature to the best of our knowledge. The firm's gender-structure may influence its participation in GVCs, rendering thereby the positive correlation between GVCs and female employment share in Vietnam. To address the endogeneity concern, we apply the 2SLS approach using the ICT index at provincial level as an instrument. The

estimated results of the first step are in Table D1 in Appendix D. The results show that the development of ICT at provincial level is positively associated with the firm's GVC involvement. This fitted value of GVC enters equation (2) of the second stage.

Table 5 reports the 2SLS estimates. Because there is only one instrument for global value chains, the model is exactly identified – we cannot perform the over-identification tests. The *Hausman Chi-square test* confirms the endogeneity of the endogenous regressor GVC in all model specifications. The *Crag-Donald Wald F* statistic and the *Kleibergen-Paap Wald rk F* statistic are greater than 10, thereby rejecting the null hypothesis of the weak instrument. Additionally, the *Kleibergen-Paap Wald rk LM* statistic of under-identification shows that the null hypothesis of under-identification can be rejected. The coefficient of GVCs is positive and significant in all columns, suggesting a positive association between global value chains and the female share of total employment, skilled employment, unskilled employment, production workers and non-production workers. The findings are consistent with the OLS approach.

A potential important variable that could be omitted is the share of female employment at sector level. The argument is that the gender-structure of the firm can be determined by the gender-structure of the sector that the firm operates in. The estimates in Panel A of Table D2 suggest that GVCs and female employment links remain robust after we control for this variable.

We further control for the impact of firm innovation by adding a dummy on firm innovation to equation (1). We examine 3 forms of innovation separately, in terms of improving existing products, upgrading technologies, and planning to start new projects. The estimates in Panel B, Panel C, Panel D of Table D2 suggest that GVCs and female employment links remain robust in all model specifications.

Another concern is that our findings are primarily driven by textiles and apparel which are the two sectors employing the biggest share of female employment and clearly illustrate a positive correlation between GVCs and female employment as shown in Figure 4. Hence, we exclude these two sectors from the sample and re-perform the OLS regression. The results are reported in Panel E of Table D2. We still find positive estimates of similar magnitude in this scenario.

Table 5. The links between global value chains and female employment- The 2SLS approach.

The 2SLS estimates are consistent with the OLS estimates.

The first-stage equation: $GVC_{it} = \lambda X_{it} + \theta ICT_{ipt} + \omega_{it}$

The second-stage equation: $Female\ share_{it} = \alpha + \beta X_{it} + \gamma \widehat{GVC_{1t}} + \varepsilon_{it}$

	Female share of total workforce		Female share of skilled workforce		Female share of unskilled workforce		Female share of production labour		Female share of non-production labour	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
GVC	0.468***		0.813***		0.431**		0.631**		0.594**	
	(0.178)		(0.308)		(0.174)		(0.246)		(0.244)	
Binary GVC		0.698**		1.213**		0.643**		0.941**		0.887**
		(0.283)		(0.488)		(0.274)		(0.390)		(0.388)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kleibergen-Paap rk LM	14.166***	10.270***	14.166***	10.270***	14.166***	10.270***	14.166***	10.270***	14.166***	10.270***
Cragg-Donald Wald F	20.950	15.810	20.950	15.810	20.950	15.810	20.950	15.810	20.950	15.810
Kleibergen-Paap rk Wald F	14.258	10.283	14.258	10.283	14.258	10.283	14.258	10.283	14.258	10.283
Endogeneity	8.173***	8.382***	9.614***	9.635***	6.677***	6.879***	7.826***	8.031***	8.577***	8.479***
Obs	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5747	5,747	5,747

Notes: Robust standard errors clustered at the firm level are in parentheses. In column 1, column 3, column 5, column 7, and column 9, the independent variable GVC is a set of self-exclusive dummies identifying the firm's mode of involvement in global value chains, including single, dual-mode, and triple mode. In column 2, column 4, column 6, column 8, and column 10, the independent variable GVC is a binary dummy variable. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour; per capita sales (the log of total sales to total labour); size (total labour); a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. A constant term, sector, year, sector-year dummies are included. The null hypothesis of the Kleibergen-Paap rk LM test assumes that the structural equation is underidentified. The null hypothesis of the Crag-Donald Wald F statistic and the Kleibergen-Paap Wald rk F assumes that the correlation between the instrument and the regressor is weak. The null hypothesis of the Hausman test for endogeneity assumes that the regressor is exogenous. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively. R^2 of the 2SLS regression not reported: Woolridge (2012) notes that R^2 from IV estimation can be negative, and it "has no natural interpretation"

4.3. Potential mechanism of the impacts

In the previous sections, we point out a positive association between female employment and GVC involvement. The next question is why the female shares of employment are higher in GVC-involved firms than those in non-GVC firms. In Setion 4.2 we exclude textiles and apparel to prove that the links between GVCs and female employment is not driven by female-intensive sectors. Consistent with the theoretical motivation, we further clarify our previous argument that Vietnamese firms mainly participate in low-value added and manual stages of the production process. Specifically, we incorporate a variable of technology and its interaction with the binary dummy of GVC involvement into equation (1). Following Juhn et al.(2014) we denote the natural logarithm of the value of equipment and machinery as technology. The estimates in Table 6 show a negative association between technology and the female share of total employment, unskilled employment, and production employment, whereas the association is positive for skilled and non-production female labour. Thus, the development of technology poses a threat of job loss to unskilled females and production females. However, our special interest in given to the coefficient of the interaction of technology and GVC involvement. In all 5 columns is Table 6, the coefficient of the interaction is negative, suggesting that the increase in technology upgrading of GVC-involved firms is associated with a decline in the female shares[11]. Our findings support the argument that GVC-involved firms in Vietnam concentrate on low-value added stages of the production process, which depend more on manual labour than on technology. A similar mechanism in another labour-intensive country has been pointed out in Chen et al. (2013) which examines female employment of exporting firms in China.

---

11 We also use the log of the ratio of the value of equipment and machinery to total labour as another proxy for technology. The estimates are given in Table D3. The coefficients of the interaction term are still negative, except in the case of production females where the coefficient is insignificant. The results still prove that GVC-involved firms in Vietnam mainly focus on manual tasks. Note that in our model specification, we already control for firm size.

Table 6. Mechanism of the impacts of GVCs on female employment.

Technology upgrading of GVC-involved firms is negatively associated with female employment.

	Female share of total workforce	Female share of skilled workforce	Female share of unskilled workforce	Female share of production workforce	Female share of non-production workforce
Binary GVC	0.148***	0.343***	0.131***	0.172***	0.214***
	(0.036)	(0.063)	(0.038)	(0.048)	(0.041)
Technology	-0.005**	0.059***	-0.008***	-0.008**	0.019***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Binary GVC*Technology	-0.013***	-0.042***	-0.011**	-0.015**	-0.029***
	(0.005)	(0.009)	(0.005)	(0.007)	(0.006)
Observations	5,747	5,747	5,747	5,747	5,747
R-squared	0.363	0.233	0.370	0.233	0.301

Notes: Robust standard errors clustered at the firm level are in parentheses. The independent variable GVC is a binary dummy. Technology is calculated as the log of the value of equipment and machinery. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour; per capita sales (the log of total sales to total labour); size (total labour); an interaction term between GVC dummy and either capital intensity or per capita sales of size; a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. A constant term, sector, year, sector-year dummies are included. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively.

4.4. Firm characteristics

To account for firm heterogeneity in terms of scale, we include in our estimation an interaction of the binary GVC dummy variable with capita intensity, per capita sales, and size one at a time. Panel A, panel B, panel C in Table 7 report the estimates in terms of firm heterogeneity in capita intensity, per capita sales, and size respectively. *Capital intensity, per capita sales:* The female share of total workforce, unskilled workforce, production workforce, and non-production workforce decrease with the growth of capital intensity of GVC-involved firms. There is no significant change in the effects of GVC involvement on the female share of skilled workforce when capital intensity or per capita sales increases. *Size:* When GVC-involved firms get bigger, there is a decrease in the female share of skilled employment and nonproduction workers, whereas the female share of total workforce, unskilled workforce, and production workforce remain unchanged. Our findings uncover that although the involvement of firms in GVCs is positively associated with the female shares, the growth of GVC-involved firm bring no benefit to female workers. These findings add further evidence on the task trade theory that a developing country like Vietnam is in charge of manual tasks in product fragmentation.

Next, we differentiate the links between GVC involvement and female employment between firms that have a trade union and firms that have no trade union. 82% of firms in the sample have a trade union. Table 8 reports the estimates for the 2 subsamples separately. GVC involvement is positively associated with the female share of total workforce, unskilled workforce, and production workforce in both categories of firms. We only observe a positive association between GVC involvement and the female share of skilled employment and non-production labour in firms that have a trade union. For the latter category, the association is insignificant. These findings indicate that trade union plays a significant role in improving employment for women.

Table 7. Controlling for firm heterogeneity in terms of scale.

The growth of GVC-involved firm brings no benefit to female workers.

	Female share of total workforce	*Female share of skilled workforce*	*Female share of unskilled workforce*	*Female share of production workforce*	*Female share of non-production workforce*
Panel A: Capital intensity					
Binary GVC	0.155***	0.114	0.158***	0.187***	0.109**
	(0.036)	(0.072)	(0.037)	(0.048)	(0.043)
Capital	-0.001	-0.007*	-0.001	0.004	0
	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)
Binary GVC*Capital	-0.020***	-0.003	-0.021***	-0.024**	-0.016*
	(0.007)	(0.014)	(0.007)	(0.009)	(0.008)
Observations	5,747	5,747	5,747	5,747	5747
R-squared	0.362	0.186	0.368	0.232	0.293
Panel B: Sales					
Binary GVC	0.340***	0.183	0.365***	0.446***	0.326**
	(0.117)	(0.221)	(0.125)	(0.161)	(0.131)
Sales	-0.023***	0.043***	-0.025***	-0.028***	0.009*
	(0.004)	(0.007)	(0.004)	(0.006)	(0.006)
Binary GVC* Sales	-0.023**	-0.007	-0.025**	-0.030**	-0.024**
	(0.009)	(0.018)	(0.010)	(0.013)	(0.011)
Observations	5,747	5,747	5,747	5,747	5,747
R-squared	0.362	0.186	0.368	0.232	0.294
Panel C: Size					
Binary GVC	0.073***	0.206***	0.066***	0.085***	0.075***
	(0.014)	(0.026)	(0.014)	(0.018)	(0.017)
Size	0.001***	0.003***	0.001***	0.001***	0.001***
	(0)	(0)	(0)	(0)	(0)
Binary GVC*Size	0	-0.003***	0	0	-0.001***
	(0)	(0)	(0)	(0)	(0)
Observations	5,747	5,747	5,747	5,747	5,747
R-squared	0.361	0.196	0.367	0.231	0.295

Notes: Robust standard errors clustered at the firm level are in parentheses. The independent variable GVC is a binary dummy. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour; per capita sales (the log of total sales to total labour); size (total labour); an interaction term between GVC dummy and either capital intensity or per capita sales of size; a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. A constant term, sector, year, sector-year dummies are included. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively.

Table 8. Controlling for firm heterogeneity in terms of trade union.

Trade union plays a significant role in improving employment for women in GVCs.

	Female share of total workforce	Female share of skilled workforce	Female share of unskilled workforce	Female share of production workforce	Female share of non-production workforce
Panel A: Trade union					
Binary GVC	0.062***	0.090***	0.060***	0.061***	0.049***
	(0.013)	(0.026)	(0.014)	(0.018)	(0.017)
Observations	4,729	4,729	4,729	4,729	4,729
R-squared	0.361	0.183	0.368	0.232	0.315
Panel B: No trade union					
Binary GVC	0.042**	0.022	0.044**	0.069***	-0.005
	(0.017)	(0.030)	(0.018)	(0.022)	(0.016)
Observations	730	730	730	730	730
R-squared	0.377	0.127	0.372	0.379	0.178

Notes: Robust standard errors clustered at the firm level are in parentheses. The independent variable GVC is a binary dummy. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour; per capita sales (the log of total sales to total labour); size (total labour); a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. We divide the sample into 2 subsamples: firms that have a trade union and firms that have no trade union. A constant term, sector, year, sector-year dummies are included. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively.

4.5. Discussion

Several studies consider globalization a driver for improvement in female employment in developing countries. Villarreal & Yu (2007) argue that, in Mexico, foreign-invested firms and exporting firms employ a higher share of women than domestic firms and non-exporting firms at any level of occupation. Related to our findings, the preference for female employees in these firms results from the job requirement rather than other firms' characteristics. Juhn et al. (2013) point out that employers' preference for male employees mostly exists in Mexico's production jobs because of the heavy work nature. For non-production jobs in Mexico, like managerial position, there is no gender preference. It is plausible that reduced export tariff encourages new firms' entrance into the market. With new competition, firms upgrade their technology, which, in turn, lower the demand for labour-intensive skills, and lessen the gender discrimination. A supportive evidence is the positive association between a decline in tariff and the female employment in production jobs. Alternatively, Chen et al. (2013) argue that, under the competition pressure from globalization, firms with gender bias are likely to incur higher costs. Their empirical analysis suggests that female employees' share in foreign firms and exporting firms is higher than that in non-exporting domestic firms in China.

Our findings on the positive association between GVCs and female employment are consistent with those of Villarreal & Yu (2007) and Juhn et al. (2013) and highlight the nature of the jobs that induce gender preference. However, unlike Jun et al. (2013) which suggests a complementarity between technology and female employment, we find that female employment in Vietnam is concentrated in GVC-firmed with low level of technology development to perform manual, low-value added tasks. In light of the task trade theory, Vietnamese women perform manual tasks that requires their dexterity ("nimble fingers") in the production process. Hence, GVCs are positively associated with the female share of production workforce. Furthermore, the growth of GVC-involved firms does not benefit female workers.

Despite the importance of female participation in GVCs (Bamber & Staritz, 2016), the existing evidence on the impact of international trade and foreign direct investment focusing on

GVCs and women empowerment is not many. Rocha & Winkler (2019) study the link between GVCs and female employment by using a cross-section of manufacturing firms in 64 developing and emerging countries drawn from the World Bank's Enterprise Survey. Their empirical findings suggest that the female share of GVC-involved firms is 4.0 percentage points higher than that of non-GVC firms. They controlled for firm characteristics (i.e., sales, capital intensity, productivity), using a dummy variable if a firm exports and imports as a proxy for its GVC involvement. Wang et al. (2017) point out that female jobs grow faster than male jobs in manufacturing for global supply chains in China, explaining a positive correlation between GVCs and female employment. The paper uses trade ratio to gross domestic product (GDP) as a proxy for global supply chain trade.

Compared to previous studies, our dummy of GVC involvement is broader and captures the intensity of GVC involvement. By controlling for the intensity of a firm's GVC involvement, the analysis adds another layer to the evidence on global value chains' gender-impact. The panel data used in our analysis incorporate the variations of the female shares, the involvement of the firm in GVCs, and other control variables. We also control for a variety of firm heterogeneities including capital intensity, per capita sales, size, and trade union to examine the variations of the impacts across different GVC-involved firms.

5. Conclusion

As production technologies and automation continue to improve, women performing manual tasks are at risk of being replaced. According to some estimates, about 40 million to 160 million women would have job transition by 2030 (Madgavkar et al. (2019); McKinsey Global Institute). GVC or not, women gain minimal skills participating in routine and manual tasks and become less versatile and adaptive in the job market. More education and training to upgrade their skills, including the reskilling programs, benefit women in their long-term career outlook in the coming decades.

This paper studies the empirical linkages between the global value chains and the prevalence of manual and routine tasks in developing economies motivated by the task trade

theory of Grossman & Rossi-Hansberg (2012). Using Vietnam's panel data on SMEs from 2011-2015, the main findings suggest that GVC is positively associated with the female share of total employment, skilled employment, unskilled employment, production workforce and non-production workforce. However, the growth of GVC-involved firms in terms of size, capital intensity, per capita sales is also associated with a decline in the female shares of employment. The findings reveal a developing country's reality, which typically fosters economic integration based on its labour-intensive advantages. Global value chains create more jobs for the virtue of women's dexterity but fall short of embracing the female employees in the development of firms.

While the use of Vietnam's SME database has its limitation, it sheds light on the impact of GVCs on female employment. Future studies looking at firms across the spectrum of sizes and activities in the supply chains may provide useful details on the linkages between global value chains and female employment in developing countries, including Vietnam and others.

References

Amendolagine, V., Presbitero, A. F., Rabellotti, R., & Sanfilippo, M. (2019). Local sourcing in developing countries: The role of foreign direct investments and global value chains. *World Development*, *113*, 73–88. https://doi.org/10.1016/j.worlddev.2018.08.010

Antràs, B. P., & Chor, D. (2013). Organizing the Global Value Chain. *Econometrica*, *81*(6), 2127–2204. https://doi.org/10.3982/ecta10813

Bamber, P., & Staritz, C. (2016). *The Gender Dimensions of Global Value Chains Inclusive Economic Transformation* (Issue September).

Basco, S., & Mestieri, M. (2013). Heterogeneous Trade Costs and Wage Inequality: A Model of Two Globalizations. *Journal of International Economics*, *89*(2), 393–406. https://doi.org/10.1016/j.jinteco.2012.09.003

Carrington, W. J., & Troske, K. R. (1995). Gender segregation in small firms. *Journal of Human Resources*, *30*(3), 503–533. https://doi.org/10.2307/146033

Chen, Z., Ge, Y., Lai, H., & Wan, C. (2013). Globalization andChen, Z., Ge, Y., Lai, H., & Wan, C. (2013). Globalization and Gender Wage Inequality in China. World Development, 44, 256–266. https://doi.org/10.1016/j.worlddev.2012.11.007 Gender Wage Inequality in China. *World Development*, *44*, 256–266. https://doi.org/10.1016/j.worlddev.2012.11.007

Ederington, J., Ederington, J., Minier, J., Minier, J., Troske, K. R., & Troske, K. R. (2009). Where the Girls Are: Trade and Labor Market Segregation in Colombia. *IZA Discussion Paper*, *4131*.

Farole, T., & Akinci, G. (2011). *Special Economic Zones: Progress, Emerging Challenges, and Future Directions*. The International Bank for Reconstruction and Development/The World Bank.

Grossman, G. M., & Rossi-Hansberg, E. (2012). Task Trade Between Similar Countries. *Econometrica*, *80*(2), 593–629. https://doi.org/10.3982/ecta8700

Hummels, D., Ishii, J., & Yi, K. M. (2001). The nature and growth of vertical specialization in world trade. *Journal of International Economics*, *54*(1), 75–96. https://doi.org/10.1016/S0022-1996(00)00093-3

Juhn, C., Ujhelyi, G., & Villegas-Sanchez, C. (2013). Trade liberalization and gender inequality. *American Economic Review*, *103*(3), 269–273. https://doi.org/10.1257/aer.103.3.269

Juhn, C., Ujhelyi, G., & Villegas-Sanchez, C. (2014). Men, women, and machines: How trade impacts gender inequality. *Journal of Development Economics*, *106*, 179–193. https://doi.org/10.1016/j.jdeveco.2013.09.009

Kee, H. L., & Tang, H. (2016). Domestic value added in exports: Theory and firm evidence from China. *American Economic Review*, *106*(6), 1402–1436. https://doi.org/10.1257/aer.20131687

Kodama, N., Javorcik, B. S., & Abe, Y. (2018). Transplanting corporate culture across

international borders: Foreign direct investment and female employment in Japan. *World Economy*, *41*(5), 1148–1165. https://doi.org/10.1111/twec.12612

Koopman, R., Wang, Z., & Wei, S. J. (2012). Estimating domestic content in exports when processing trade is pervasive. *Journal of Development Economics*, *99*(1), 178–189. https://doi.org/10.1016/j.jdeveco.2011.12.004

Liberato, A. S. Q., & Fennell, D. (2007). Gender and Well-being in the Dominican Republic: The Impact of Free Trade Zone Employment and Female Headship. *World Development*, *35*(3), 394–409. https://doi.org/10.1016/j.worlddev.2006.11.003

Lu, Y., Shi, H., Luo, W., & Liu, B. (2018). Productivity, financial constraints, and firms' global value chain participation: Evidence from China. *Economic Modelling*, *73*(February), 184–194. https://doi.org/10.1016/j.econmod.2018.03.015

Madgavkar, A., Manyika, J., Krishnan, M., Ellingrud, K., Yee, L., Woetzel, J., Chui, M., Hunt, V., & Balakrishnan, S. (2019). *The future of women at work* (Issue June). https://www.mckinsey.com/~/media/McKinsey/Featured Insights/Gender Equality/The future of women at work Transitions in the age of automation/MGI-The-future-of-women-at-work-Exec-summary.ashx

OECD-UNIDO. (2019). *Integrating Southeast Asian SMEs in Global Value Chains: Enabling Linkages with Foreign Investors*. www.oecd.org/investment/Integrating-Southeast-Asian-SMEs-in-global-value-chains.pdf

Ozler, S. (2000). Export orientation and female share of employment: Evidence from Turkey. *World Development*, *28*(7), 1239–1248. https://doi.org/10.1016/S0305-750X(00)00034-6

Pham, T., & Talavera, O. (2018). Discrimination, Social Capital, and Financial Constraints: The Case of Viet Nam. *World Development*, *102*, 228–242. https://doi.org/10.1016/j.worlddev.2017.10.005

Rocha, N., & Winkler, D. (2019). *Trade and Female Labor Participation Stylized Facts Using a Global Dataset* (Issue Policy Research Working Paper 9098). http://www.worldbank.org/prwp.

Thanh, V. T. (2020). *Enhancing Inter-Firm Linkages through Clusters and Digitalisation for Productivity Growth* (ERIA Discussion Paper Series, Issue 309).

Upward, R., Wang, Z., & Zheng, J. (2013). Weighing China's Export Basket: The Domestic Content and Technology Intensity of Chinese Exports. *Journal of Comparative Economics*, *41*(2), 527–543. https://doi.org/10.1016/j.jce.2012.07.004

Veugelers, R., Barbiero, F., & Blanga-Gubbay, M. (2013). Meeting the Manufacturing Firms Involved in GVCs. In R. Veugelers (Ed.), *Manufacturing Europe's Future*.

Villarreal, A., & Yu, W. H. (2007). Economic globalization and women's employment: The case of manufacturing in Mexico. *American Sociological Review*, *72*(3), 365–389. https://doi.org/10.1177/000312240707200303

Wang, L., Karji, S., Jha, S., & Meurs, M. (2017). *How Women Have Fared with the Rise of the People's Republic of China in Global Supply Chain Trade. 514*.

Wang, Y. (2016). What Are the Biggest Obstacles to Growth of SMEs in Developing Countries? – An Empirical Evidence from an Enterprise Survey. *Borsa Istanbul Review*, *16*(3), 167–176. https://doi.org/10.1016/j.bir.2016.06.001

Woolridge, J. M. (2012). Chapter 15. Instrumental Variables and Two Stage Least Squares. In *Introductory Econometrics: A Mordern Approach* (5th ed., pp. 512–553). South-Western Cengage Learning. https://doi.org/10.1192/bjp.111.479.1009-a

World Bank. (2016). *World Development Report 2016: DIgital Dividends*.

World Bank. (2020). *World Development Report 2020: Trading for Development in the Age of Global Value Chain*.

Appendix A.

GVC participation indicators of manufacturing sectors in Vietnam, 2015.

Sector	Backward linkages (%)	Forward linkages (%)	GVC participation (%)
Textile, Apparel, Leather	11.7	1.2	12.9
Rubber, Plastic	1.5	0.3	1.8
Basic metals	1.3	0.4	1.7
Chemical, Pharmaceutical products	1.5	0.7	2.2
Motor vehicles	1.4	1	2.4
Electronics	7.2	2.2	9.4
Food, Beverage, Tobacco	5.6	0.7	6.3
Paper, Printing	0.2	0.1	0.3
Fabricated metals	1.2	0.2	1.4

Source: OECD Trade in Value Added database.

Notes: The backward linkages measure the import content of Vietnam's exports as a share of the country's total exports. The forward linkages measure the use of Vietnam's inputs in its foreign partners' exports as a share of Vietnam's total exports. The GVC participation is the sum of these two linkages.

Appendix B.

Table B1. Distribution of firms by sector.

Sector	Firms	Percent
Food and beverages	1,569	27.30
Textiles	223	3.88
Apparel	333	5.79
Leather	141	2.45
Wood	500	8.70
Paper	191	3.32
Publishing, printing	197	3.43
Refined petroleum	19	0.33
Chemical products	139	2.42
Rubber	402	6.99
Non-metallic mineral products	273	4.75
Basic metals	73	1.27
Fabricated metal products	1,039	18.08
Electronic machinery, etc.	187	3.25
Motor vehicles	40	0.70
Other transport equipmentS	20	0.35
Furniture, jewellery, etc.	386	6.72
Recycling, etc.	15	0.26

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Table B2. Distribution of firms by legal status.

Legal status	Firms	Percent
Household firm	3,063	53.30
Private firm	546	9.50
Partnership/Cooperative firm	172	2.99
Limited liability firm	1,638	28.50
Joint-stock firm	328	5.70

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Appendix C.

Table C1. The difference in employment share by gender across sectors.

Sector	Firms	Female	Male	Difference	t-value
Food and beverages	1,569	0.465	0.535	-0.070	-9.012***
Textiles	223	0.620	0.380	0.240	10.038***
Apparel	333	0.656	0.344	0.313	16.041***
Leather	141	0.410	0.590	-0.181	-6.057***
Wood	500	0.321	0.679	-0.358	-22.725***
Paper	191	0.395	0.605	-0.210	-10.846***
Publishing, printing	197	0.376	0.624	-0.248	-11.933***
Refined petroleum	19	0.279	0.721	-0.442	-9.443***
Chemical products	139	0.382	0.618	-0.236	-10.397***
Rubber	402	0.385	0.615	-0.231	-16.279***
Non-metallic mineral products	273	0.303	0.697	-0.394	-21.841***
Basic metals	73	0.228	0.772	-0.545	-20.773***
Fabricated metal products	1,039	0.194	0.806	-0.613	-75.884***
Electronic machinery, etc.	187	0.289	0.711	-0.422	-20.856***
Motor vehicles	40	0.309	0.691	-0.381	-8.029***
Other transport equipments	20	0.244	0.756	-0.512	-10.881***
Furniture, jewellery, etc.	386	0.222	0.778	-0.556	-38.074***
Recycling, etc.	15	0.197	0.803	-0.607	-7.837***

Notes: The table reports the t-test result. The null hypothesis of the t-test assumes that there is no difference in the means of female employment and male employment. *, **, and *** denote significance at 10%, 5% and 1% level, respectively.
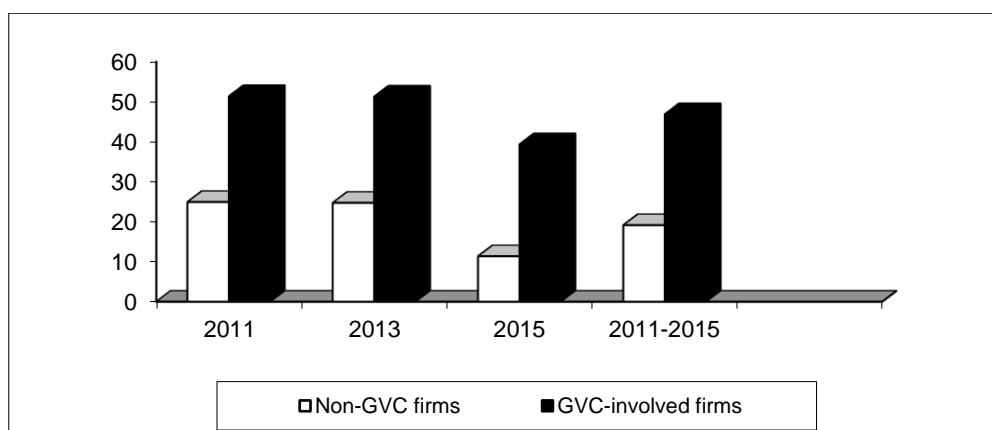
Figure C1. The female share in skilled workforce in 2011-2015.

GVC-involved firms have a higher female share in skilled workforce than non-GVC firms.

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Notes: This table compares the female share in skilled workforce between GVC and non-GVC firms. The share female share in skilled workforce is measured as the female share of workforce with tertiary education. GVC-involved firms are firms that export, and/or import, and/or act as an international producer (through outsourcing, offshoring, or foreign direct investment). Non-GVC firms are firms that neither export, nor import, nor act as an international producer.

Figure C2. The female share in unskilled workforce in 2011-2015.

GVC-involved firms have a higher female share in unskilled workforce than non-GVC firms.

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Notes: This table compares the female share in unskilled workforce between GVC and non-GVC firms. The female share in unskilled workforce is measured as the female share of the workforce with no tertiary education. GVC-involved firms are firms that export, and/or import, and/or act as an international producer (through outsourcing, offshoring, or foreign direct investment). Non-GVC firms are firms that neither export, nor import, nor act as an international producer.
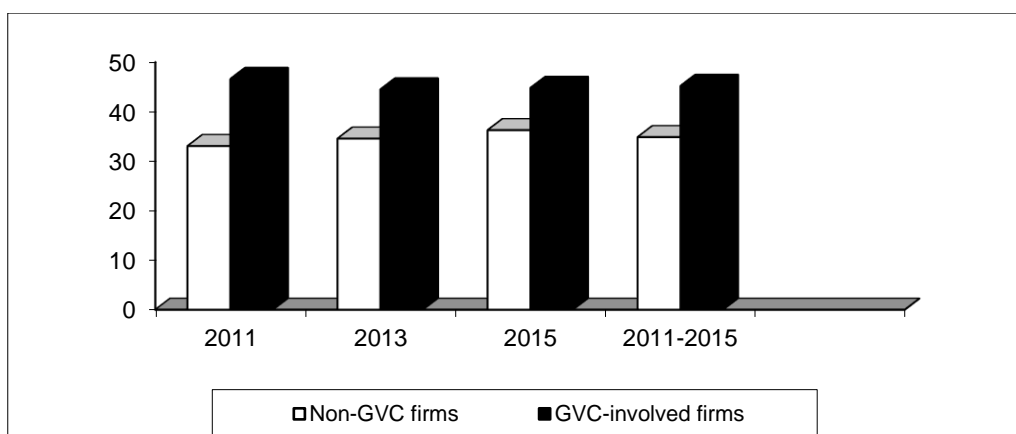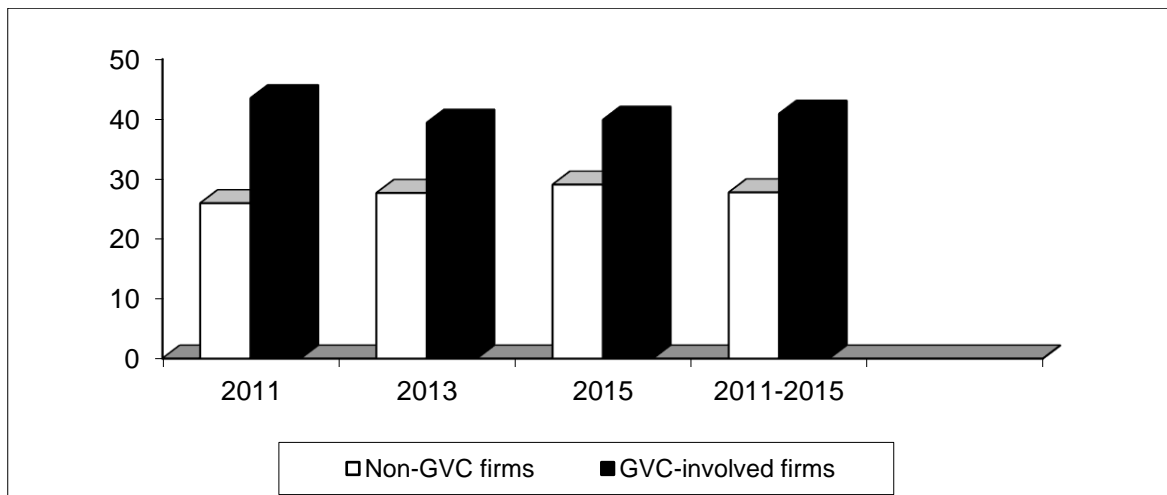
Figure C3. The female share in production workforce in 2011-2015.

GVC-involved firms have a higher female share in production workforce than non-GVC firms.

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Notes: This table compares the female share in production workforce between GVC and non-GVC firms. The female share in production workforce is measured as the female share of the production positions. GVC-involved firms are firms that export, and/or import, and/or act as an international producer (through outsourcing, offshoring, or foreign direct investment). Non-GVC firms are firms that neither export, nor import, nor act as an international producer.
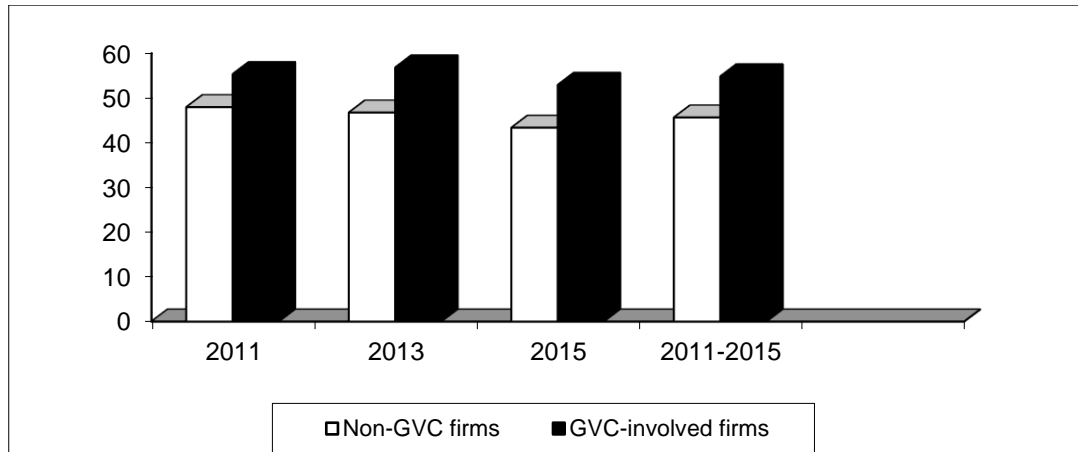
Figure C4. The female share in non-production workforce in 2011-2015.

GVC-involved firms have a higher female share in non-production workforce than non-GVC firms.

Source: Authors' calculations based on the Small and Medium Enterprise Survey in 2011-2015.

Notes: This table compares the female share in non-production workforce between GVC and non-GVC firms. The female share in non-production workforce is measured as the female share of the non-production positions. GVC-involved firms are firms that export, and/or import, and/or act as an international producer (through outsourcing, offshoring, or foreign direct investment). Non-GVC firms are firms that neither export, nor import, nor act as an international producer.

Appendix D.

Table D1. Results of the first-stage regression *(Dependent variable: Global value chains).*

The first-stage equation: $GVC_{it} = \lambda X_{it} + \theta ICT_{ipt} + \omega_{it}$

	(1)	(2)
ICT	0.234***	0.157***
	(0.062)	(0.049)
Age	0	0
	(0)	(0)
Capital intensity	-0.011**	-0.009**
	(0.005)	(0.004)
Sales	0.050***	0.040***
	(0.008)	(0.007)
Size	0.005***	0.003***
	(0)	(0)
North	-0.039***	-0.018*
	(0.013)	(0.010)
Special zone	0.112***	0.108***
	(0.043)	(0.033)
Owner's gender	-0.009	-0.008
	(0.012)	(0.009)
R^2	0.243	0.229
Obs	5,747	5,747

Notes: Robust standard errors clustered at the firm level are in parentheses. . In column 1, the dependent variable GVC is a set of self-exclusive dummies identifying the firm's mode of involvement in global value chains, including single-mode, dual-mode, and triple-mode. In column 2, the dependent variable GVC is a binary dummy variable. The independent variable of interest is the ICT index at provincial level. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour); per capita sales (the log of total sales to total labour); size (total labour); a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. In all regressions, sector, year, sector-year dummies are included. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively.

Table D2. Other robustness checks

	Female share in total workforce		Female share in skilled workforce		Female share in unskilled workforce		Female share in production workforce		Female share in non-production workforce	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Sector's female employment is added										
Single	0.057***		0.105***		0.054***		0.068***		0.037***	
	(0.011)		(0.021)		(0.012)		(0.015)		(0.014)	
Dual	0.074***		0.074*		0.076***		0.088***		0.006	
	(0.023)		(0.038)		(0.024)		(0.028)		(0.024)	
Triple	0.123		0.091		0.114		0.183*		0.005	
	(0.091)		(0.131)		(0.098)		(0.102)		(0.063)	
Binary GVC		.061***		0.100***		0.058***		0.072***		0.032**
		(.011)		(0.020)		(0.011)		(0.014)		(0.013)
Obs	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747
R-squared	0.361	0.361	0.187	0.186	0.367	0.367	0.231	0.231	0.293	0.293
Panel B: Innovation-Introducing new technologies is added										
Single	0.057***		0.105***		0.054***		0.068***		0.038***	
	(0.011)		(0.021)		(0.012)		(0.015)		(0.014)	
Dual	0.074***		0.071*		0.077***		0.087***		0.007	
	(0.023)		(0.038)		(0.024)		(0.029)		(0.024)	
Triple	0.123		0.089		0.114		0.182*		0.007	
	(0.091)		(0.131)		(0.098)		(0.102)		(0.064)	
Binary GVC		0.061***		0.099***		0.058***		0.072***		0.032**
		(0.011)		(0.020)		(0.012)		(0.014)		(0.013)
Obs	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747
R-squared	0.361	0.361	0.187	0.187	0.367	0.367	0.231	0.231	0.293	0.293
Panel C: Innovation-Improving existing products is added										
Single	0.057***		0.104***		0.053***		0.067***		0.037***	
	(0.011)		(0.021)		(0.012)		(0.015)		(0.014)	
Dual	0.073***		0.071*		0.075***		0.087***		0.005	
	(0.023)		(0.038)		(0.024)		(0.028)		(0.024)	
Triple	0.122		0.089		0.113		0.181*		0.005	
	(0.089)		(0.134)		(0.096)		(0.101)		(0.063)	
Binary GVC		0.060***		0.099***		0.057***		0.072***		0.031**
		(0.011)		(0.020)		(0.011)		(0.014)		(0.013)
Obs	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747
R-squared	0.362	0.362	0.188	0.188	0.368	0.368	0.232	0.231	0.293	0.293
Panel D: Innovation-Planning to start new projects is added										
Single	0.057***		0.103***		0.054***		0.067***		0.036***	
	(0.011)		(0.021)		(0.012)		(0.015)		(0.014)	
Dual	0.074***		0.072*		0.076***		0.088***		0.005	
	(0.023)		(0.038)		(0.024)		(0.028)		(0.024)	
Triple	0.122		0.074		0.114		0.178*		0.001	
	(0.091)		(0.131)		(0.098)		(0.103)		(0.063)	
Binary GVC		0.060***		0.098***		0.058***		0.072***		0.031**
		(0.011)		(0.020)		(0.011)		(0.014)		(0.013)
Obs	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747	5,747
R-squared	0.361	0.361	0.189	0.189	0.367	0.367	0.231	0.231	0.293	0.293
Panel E: Textiles and Apparel are excluded										
Single	0.061***		0.107***		0.059***		0.071***		0.038**	
	(0.012)		(0.023)		(0.013)		(0.016)		(0.015)	
Dual	0.062**		0.032		0.065**		0.084**		-0.008	
	(0.030)		(0.044)		(0.031)		(0.036)		(0.028)	
Triple	0.167		0.151		0.158		0.246**		-0.005	
	(0.109)		(0.132)		(0.117)		(0.120)		(0.078)	
Binary GVC		0.062***		0.096***		0.061***		0.075***		0.030**
		(0.012)		(0.022)		(0.013)		(0.016)		(0.014)
Obs	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191	5,191
R-squared	0.283	0.283	0.178	0.177	0.289	0.289	0.145	0.144	0.287	0.287

Notes: Robust standard errors clustered at the firm level are in parentheses. In column 1, column 3, column 5, column 7, and column 9, the independent variable GVC is a set of self-exclusive dummies identifying the firm's mode of involvement in global value chains, including single-mode, dual-mode, and triple-mode. In column 2, column 4, column 6, column 8, and column 10, the independent variable GVC is a binary dummy variable. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour); per capita sales (the log of total sales to total labour); size (total labour); a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. A constant term, sector, year, sector-year dummies are included. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively.

Table D3. Technology is the log of the ratio of the value of equipment and machinery to total labor.

Technology upgrading of GVC-involved firms is negatively associated with female employment.

	Female share of total workforce	Female share of skilled workforce	Female share of unskilled workforce	Female share of production workforce	Female share of non-production workforce
Binary GVC	0.109***	0.181***	0.103***	0.126***	0.113***
	(0.028)	(0.048)	(0.029)	(0.035)	(0.032)
Technology	-0.016***	0.035***	-0.019***	-0.024***	0.006
	(0.003)	(0.005)	(0.003)	(0.005)	(0.004)
Binary GVC*Technology	-0.014*	-0.025**	-0.013*	-0.015	-0.024***
	(0.007)	(0.013)	(0.007)	(0.009)	(0.008)
Observations	5,747	5,747	5,747	5,747	5,747
R-squared	0.367	0.195	0.374	0.238	0.294

Notes: Robust standard errors clustered at the firm level are in parentheses. The independent variable GVC is a binary dummy. Technology is calculated as the log of the ratio of the value of equipment and machinery to total labor. Other firm-level control variables include: age; capital intensity (the log of fixed assets to total labour; per capita sales (the log of total sales to total labour); size (total labour); an interaction term between GVC dummy and either capital intensity or per capita sales of size; a dummy on the northern region; a dummy on the location in a special zone; a dummy on the gender of the owner. A constant term, sector, year, sector-year dummies are included. *, **, and *** denote significance at 10%, 5%, and 1% level, respectively.