Firm and Labor Adjustments to FDI Liberalization

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Abstract

This paper studies how liberalizing outward foreign direct investments affects manufacturers' engagement in global production and their domestic workers' labor market outcomes. Focusing on a liberalization policy in 2001 by the government of Taiwan that allowed 122 electronic products to be produced in China, we estimate its effect on Taiwanese electronic manufacturers and their domestic workers. Employing a matched difference-in-differences strategy, we find that the manufacturers targeted by the policy were on average 10% more likely to invest in China relative to the non-targeted ones. Correspondingly, the domestic incumbent workers of the targeted manufacturers were on average more likely to change their jobs, remain employed for fewer years, and have lower wages in subsequent years relative to those employed by the non-targeted ones. The worker-level effects of the policy exhibited substantial heterogeneity across the initial wage distribution, with top-decile workers being less affected and the remaining workers experiencing average losses.

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1 Introduction

Foreign production activities by multinational enterprises (MNEs) play a crucial role in the global economy today. According to the OECD, the gross output of foreign affiliates increased from 7 to 20 trillion USD over 2000–2014, which accounted for 12% of global output overall (Cadestin et al., 2018). If the barrier to conducting foreign direct investments (FDI) gets lifted, how would the domestic manufacturers respond? What would happen to their workers in the home country? From a theoretical perspective, domestic manufacturers that are more productive could respond to such opportunities and set up foreign affiliates in order to utilize cheaper production factors abroad. However, the prediction regarding domestic workers is unclear: on the one hand, domestic workers could enjoy higher wages due to their employers' growth (Helpman, Itskhoki and Redding, 2010); on the other hand, they could be replaced by foreign workers if their employers shift production activities abroad. This paper examines these two questions empirically, utilizing novel multinational production data and a liberalization policy in Taiwan that allows 122 electronic products to be produced in China.

To study the effect of outward FDI on firm and worker outcomes, two main challenges are present in the literature: data availability and identification. First, it is difficult to capture the extent of foreign production activities using home country data alone, especially if the major purpose of the FDI is to access the host country market (i.e., horizontal FDI, as in Helpman, Melitz and Yeaple, 2004) or to export to the world market (i.e., export-platform FDI, as in Tintelnot, 2017). Even if firm production activities across locations are observed, the effect of FDI cannot be identified due to the endogenous nature of investment decisions. As theoretical papers on multinational production and FDI (Helpman, Melitz and Yeaple, 2004; Antràs and Yeaple, 2014) have already highlighted, firms self-select into FDI activities based on their unobserved productivity in the face of fixed entry costs. As a result, comparing outcomes of FDI firms versus non-FDI firms reflects not only the causal effect of conducting FDI activities that we seek to capture but also the unobserved productivity differences across firms. One ideal solution would be to randomly distribute licenses for firms to invest abroad, but it is probably not feasible in real life. A second-best solution then is to find a natural experiment that results in some firms conducting FDI but not others.

This paper deals with the challenge of data availability by utilizing novel data sources. At the firm level, we combine multiple data sources covering Taiwanese listed firms and their Chinese affiliates in the electronic manufacturing sector from 1998–2007. They contain balance-sheet information for both the Taiwanese parent firms and their Chinese affiliates, allowing us to examine the extent of outward FDI activities in the electronic manufacturing sector, where China is the predominant destination for outward FDI. At the worker level, we draw on administrative matched employer-employee data in Taiwan to trace the domestic incumbent workers of the parent firms in our firm-level data over the sample period. These sources provide a complete picture of the multinational production activities and associated labor market outcomes for the electronic manufacturing sector in Taiwan.

Furthermore, this paper addresses the identification challenge by studying a rare policy change by the Taiwanese government in 2001 that permitted 122 electronic products to be produced in China. As we argue in detail in Section 2, this policy change is a great natural experiment, as its timing and content were exogenous from the perspective of Taiwanese electronic manufacturers at that time. In addition, during the studied period it significantly reduced the targeted firms' fixed costs to produce their products in China and thus increased their incentives to set up affiliates in China and shift their production there.

To estimate the causal effects of the policy change on firm investment behaviors, we employ a matched difference-in-differences (DID) strategy. We first define the "treatment firms" as the electronic manufacturers that produced products related to the 122 products before the policy change, then match these firms one-to-one with other electronic manufacturers that never produced these products before 2001 but nonetheless exhibited similar characteristics in 1998–2000 (the "control firms"). Then we estimate a standard DID regression on investment outcomes in China, controlling for the yearly Chinese and US import tariffs as well as tariff uncertainties measured by the differences in US normal trade relation (NTR) and non-normal trade relation (NNTR) tariffs at the sector level. The key assumption underlying this strategy is that the treatment firms would have followed the same investment trend as the control firms in the absence of the policy change.[1] We find a quantitatively sizable and

[1]The parallel trends assumption is supported by our event study estimates, as no significant pre-trends are detected. We further perform a sensitivity analysis following Rambachan and Roth (2023) as a robustness

statistically significant response from the electronic manufacturers. At the extensive margin, the treatment firms were on average 10% more likely to start investing in China relative to the control firms; this is over three times higher than the average investment share of the control firms before the policy change. At the intensive margin, the treatment firms tended to hire more workers in China and enjoyed higher total and export sales in both locations.

Following the firm-level results, we then shift our attention to worker-level responses. In particular, we examine how home country workers employed by the treatment and control firms in 2001 (i.e., the "treated" and "untreated" workers) differed in terms of their labor market outcomes in subsequent years after the policy change. Treated workers exhibited significantly higher job transition rates after 2001 relative to untreated workers. The adverse effects were concentrated among those in the middle of the initial wage distribution (25th—75th percentile in 2001): they tended to remain with their initial employer for fewer years and accumulated lower wages there. In contrast, job transitions among workers in the top decile were not statistically significant, while workers in the lowest income percentile were able to offset their losses by moving into other industries despite separating from their initial employer. Overall, the worker-level results indicate that the liberalization policy had a negative average effect, with clear distributional consequences.

Our study contributes to two main strands of research in trade and globalization. The first concerns globalization and the firms' internal organization. Many papers have found that global engagements of firms, either through imports, exports, or FDI, lead to more employment of domestic high-skilled workers and less employment of low-skilled workers (Burstein and Vogel, 2017; Hsieh and Woo, 2005; Hur, Yoon and Ahn, 2019; Bernard and Jensen, 1997; Menezes-Filho and Muendler, 2011; Tsou et al., 2013; Alviarez et al., 2022). Most of the papers do not observe the production activities abroad and thus have not examined the intensive margin of FDI activities. In addition, most of them do not have good exogenous variations to identify the firm investment responses. Some recent exceptions include Alviarez et al. (2022), who take advantage of an inward FDI policy change in China that affects the set of "encouraged" FDI industries and study its impact on structural trans-

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formation in Japan, and Branstetter et al. (2021), who focus on the same policy in Taiwan as our paper and find that outward FDI into China actually decreases overall innovation levels. Our paper complements their findings by utilizing an FDI liberalization episode in Taiwan that creates *within-industry* variations in FDI activities to explore firm investment responses and the labor market effect for domestic incumbent workers.

We also contribute to another strand of the literature on globalization and domestic labor market outcomes. Consistent results across developing and developed countries have shown that regions (Topalova, 2010; Autor, Dorn and Hanson, 2013; Kovak, 2013; Dix-Carneiro and Kovak, 2017) and individuals (Autor et al., 2014; Dix-Carneiro, 2014; Dix-Carneiro and Kovak, 2019) that are initially more exposed to trade liberalization episodes experience declining employment and lower wages in subsequent years. Most of these liberalization episodes are due to either productivity growth from foreign exporters, as the so-called "China shock" in the context of the United States, or policies that reduce import tariffs across sectors, as in the context of India and Brazil. Despite the extensive studies on trade liberalization, the liberalization of outward FDI is less covered in the literature. This paper seeks to fill this gap by examining an FDI liberalization episode and confirms the large redistributive impact of such a policy change on domestic workers.

The rest of the paper is organized as follows. Section 2 introduces the background to Taiwanese outward FDI since the 1990s as well as our firm- and worker-level data. Section 3 describes our empirical strategy and summarizes our firm and worker samples. Section 4 and Section 5 present the results of firm and worker responses to the liberalization policy, respectively. Lastly, Section 6 concludes.

2 Background and Data

2.1 Background to FDI Liberalization in Taiwan

Taiwanese investments in China began under strict regulations in the 1990s. Initially, the Taiwanese government was cautious about investments in China following its economic reforms due to the cross-Strait political tensions. While outsourcing to China was not actively encouraged, it was also not entirely prohibited during this period. After Taiwan abolished foreign exchange controls in 1987, manufacturers sought to capitalize on China's lower labor costs and market proximity, leading to gradual but targeted investments. Prior to 2001, Taiwanese FDI in China predominantly targeted labor-intensive and export-oriented industries such as textiles, toys, plastic and rubber products, and home electronics (Zhang, 2005). Among these, home electronics are particularly relevant to our study. Furthermore, Hsu and Liu (2004) highlighted that electronic parts and components emerged as a key focus of Taiwanese FDI in China during the 1990s.

As Taiwan's economic structure evolved alongside the growth of the global electronics industry, production shifted from low-value-added activities, such as radio and television assembly, to higher-value products like laptops, communication devices, and basic integrated circuits (ICs). However, this transformation raised concerns about Taiwan's increasing reliance on China, particularly in outsourcing high-tech manufacturing. In 1996, Taiwanese President Lee Teng-Hui announced a series of regulations termed "no haste, be patient" that were aimed at mitigating economic risks associated with cross-Strait tensions. The policy resulted in the implementation of stringent regulations to protect industries critical to high technology and basic infrastructure. Key measures included prohibiting the production of 314 products in China, capping single investment projects at 50 million USD, and limiting total firm-level investment in China to no more than 40% of a company's net worth. These restrictions curbed Taiwanese FDI in China's electronics manufacturing sector throughout the late 1990s.

However, the landscape began to shift in the early 2000s. Trade liberalization surged

following the establishment of the World Trade Organization (WTO) in 1995, and offshoring accelerated, with low-cost destinations like China, India, and Southeast Asia emerging as critical players in global supply chains. Taiwanese businesses faced mounting pressure to adapt, as competitors from other countries capitalized on China's low labor costs and its expanding role in global trade. In this context, Taiwan's restrictive FDI policies risked undermining the competitiveness of its export-oriented industries, particularly in electronics.

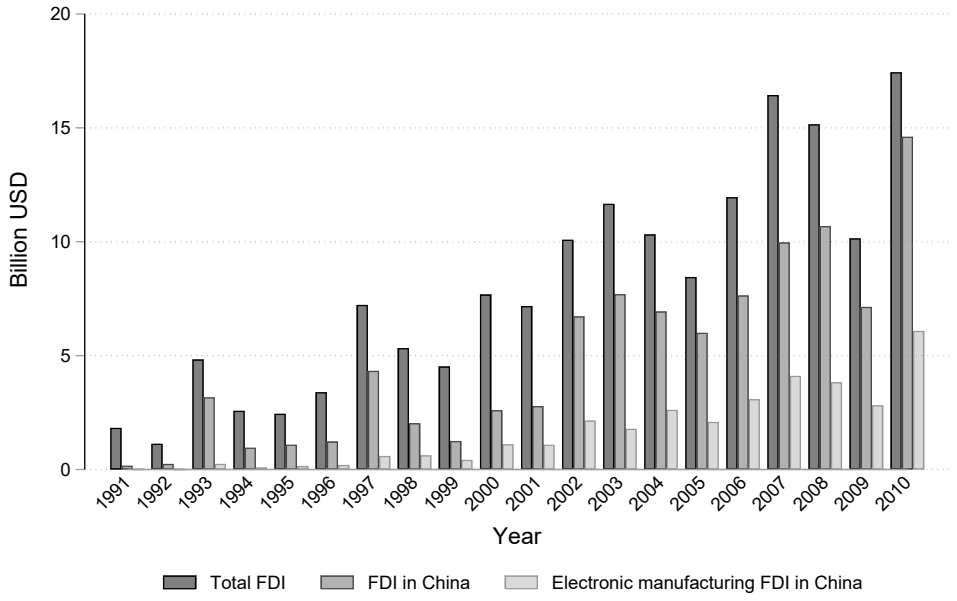
The conflict between Taiwan's economic interests and its political concerns over dependency on China set the stage for the policy of interest, making it inevitable for the Taiwanese administration to strike a balance between these competing priorities. However, as this was the government's first step toward trade liberalization, the selection of products to be liberalized was plausibly exogenous to firms, especially given that the political party responsible for ending the prohibition came to power unexpectedly.

In 2000, Chen Shui-Bian, the leader of the long-time opposition Democratic Progressive Party (DPP), narrowly won the Taiwanese presidential election, marking a significant political transition. His victory ended more than half a century of Kuomintang (KMT) rule on the island. Historically known for its cautious stance toward China, the DPP faced the challenge of balancing its political ideology with mounting business interests and legislative pressures. To address these concerns, the new administration introduced the policy framework "active opening, effective management," signaling a moderated approach to cross-Strait economic relations. Under this policy, the 50 million USD investment cap was alleviated, and a list of 122 high-tech products, including laptops, mobile phones, digital optical drives, computer hardware and software, communication products, and consumer electronics, were allowed to be produced in China starting from 2001.[2] In Figure 1, we can see that the outward FDI amount into China substantially increased after 2001, with a major proportion coming from the electronic manufacturing industry. As shown in Table 1, an average Taiwanese electronic manufacturer employed around 40 full-time workers (12% of total full-time employment in Taiwan) and generated 22.8 million USD in net revenue (8% of total net revenue in Taiwan) in 2005.

[2]The complete list of products is provided in Online Appendix C.

This 2001 policy change provides an excellent natural experiment for studying the impact of FDI liberalization. First, by allowing only a subset of high-tech products to be produced in China, the policy created a clear treatment group (newly-approved products) and control group, facilitating robust comparative analysis. Second, the policy was implemented following the DPP's unexpected presidential victory, a political transition that was expected to be associated with a cautious stance toward China. This context suggests that the policy was unlikely to be a strategic response to specific firm-level lobbying. For these reasons, the policy change can be considered plausibly exogenous from the perspective of Taiwanese electronic manufacturers. However, some contemporaneous events could potentially confound the effects of the policy. These confounding factors are addressed in the following section.

Figure 1: Taiwanese yearly outward FDI (Billion USD)



Note: This figure illustrates Taiwanese outward FDI over 1991-2010, which further breaks down into total investment activities in China and electronic manufacturing activities in China. The statistics are downloaded from the Department of Investment Review, Ministry of Economic Affairs, Taiwan.

Table 1: Mean employment and revenue of Taiwanese firms in electronics versus all

	Electronics	All
Employment	42.9	5.1
Revenue	22.8	4.0
Number of firms	10,177	708,322

Note: This table shows the average full-time employment and net revenue for a representative firm in the electronic manufacturing sector versus an unconditional Taiwanese firm in 2005. A full-time worker is defined as a worker whose age was between 31 and 68 and earned at least 190,080 NTD ($\approx 5,900$ USD) annually. The unit for revenue is million USD. The data are sourced from Taiwanese administrative matched employer-employee data compiled by the Fiscal Information Agency, Ministry of Finance, Taiwan.

2.2 Contemporaneous Events

Around the year 2000, there were three additional major events that could affect the incentive for Taiwanese firms to invest in China: (i) Taiwan and China officially joined the WTO, (ii) the United States granted Permanent Normal Trade Relations (PNTR) status to China in October 2000, and (iii) China revised its Catalogue for the Guidance of Foreign Investment Industries in 2002. We briefly provide the background to these three events, and explain why they should not influence the Taiwanese electronic manufacturers differently.

First, although Taiwan and China officially joined the WTO around 2001, the accession process began much earlier and was broadly anticipated. For China, WTO accession marked a key milestone in its "Reform and Opening Up" strategy, and the commitments made during the 15-year negotiation were well-publicized (Branstetter and Lardy, 2008). For Taiwan, joining the WTO was seen as a diplomatic success (Copper, 2019), with efforts beginning in 1992 following its application to the General Agreement on Tariffs and Trade (GATT). Between 1992 and 2001, Taiwan engaged in 11 formal meetings with member states and representatives as part of its accession process. Key milestones included Taiwan's GATT application in 1995, the conclusion of bilateral trade negotiations by 2001, and its WTO membership in January 2002 (World Trade Organization, 2002). Thus, both Taiwan's and China's WTO accessions were long expected and unlikely to affect Taiwanese electronic

manufacturers in fundamentally different ways.

Second, the US granted PNTR status to China in October 2000, which came into effect at the end of 2001. This change, as noted by Pierce and Schott (2016), did not significantly alter US tariffs on Chinese goods. Instead, it mainly reduced uncertainty by eliminating the need for an annual renewal of China's "Normal Trade Relations" (NTR) status. Nevertheless, any resulting reductions in tariffs and trade policy uncertainties could potentially confound the estimated treatment effects in our empirical analysis. To address this concern, we directly control average yearly Chinese import tariffs (on exports from Taiwan), US import tariffs (on exports from China), and the gaps between US NTR and NNTR tariffs in all the empirical specifications.

Lastly, China revised its Catalogue for the Guidance of Foreign Investment Industries in 2002. Following the "Reform and Opening Up" policy, China issued the Catalogue for the Guidance of Foreign Investment Industries in 1995. In the Catalogue, industries are classified as "encouraged," "restricted," and "prohibited." Industries in the "encouraged" category were eligible for various incentive measures, including tariff and value-added tax exemptions within a quota, as well as simplified approval procedures, making them particularly attractive to foreign investors. The electronics manufacturing sector, which is the focus of our study, was classified as "encouraged" from the initial version of the Catalogue in 1995.

As released in the State Council of the People's Republic of China Gazette, the principle of categorizing industries was to promote technological innovation and accelerate the upgrading of domestic industries in China. Clearly, there was a conflict of interest between China and Taiwan in terms of regulating investments. While the Taiwanese government aimed to retain industries with a higher comparative advantage from outsourcing, the Chinese government welcomed high-tech industries such as the semiconductor industry to invest in the mainland.

We observe that the electronic manufacturing sector as a whole falls into the "encouraged" category in the initial version of the Catalogue in 1995. During our sample period (1998–2007), the direction of revisions has been towards further opening up, and the electronic products listed in the initial version remain encouraged. Therefore, the treatment and control

firms were not impacted differently by the 2002 revision of the Catalogue.

2.3 Firm-level Dataset

By focusing on Taiwanese electronic manufacturers who were the target of the 2001 policy, we recorded their production activities from 1998–2007 utilizing two main sources. Their production activities in Taiwan were collected from the Taiwan Economic Journal (TEJ) database, which contains balance-sheet information for all publicly-listed companies in Taiwan (equivalent to the Compustat data in the US); on the other hand, their production activities in China were provided by the Chinese Annual Survey of Industrial Firms (ASIF), which surveys state and non-state firms with more than 5 million RMB in annual sales (Brandt, Biesebroeck and Zhang, 2014).

2.4 Worker-level Dataset

The Fiscal Information Agency (FIA) under the Ministry of Finance in Taiwan provides yearly assembled taxation data starting from 2001. Our main data source for the worker-level analysis consists of the FIA data for individual income tax filing (equivalent to the IRS data in the US). We track the source of all taxable income of individuals in Taiwan and construct a matched employer-employee dataset. With the unique firm identifier, information from the firm-level dataset can be combined with the FIA dataset. For the purpose of this paper, we focus on wage incomes. All workers that receive wage income from a registered firm will be included in our analysis. If the workers become self-employed after leaving the initial firm, we can track their income if the newly-established business is registered at the National Taxation Bureau. Otherwise, they will be considered unemployed.

Some features of the FIA data are worth noting. The advantage of the FIA data is that we can combine datasets for different tax categories and demographic data from other administrative databases in Taiwan with the de-identified individual ID number. By accessing the household registration database, the basic demographic information of workers is also

available, e.g., the age, gender, and marital status of each worker. Despite their advantages, the FIA data do not record information unrelated to tax collection. For example, there are no data for the total working years and the education level of workers. In addition, for each individual, we have no information about the working status prior to 2001. We also acknowledge that we cannot accurately determine the skill level of workers.

3 Empirical Strategy

As introduced in Section 2, the policy in 2001 lowered the barrier for Taiwanese electronic manufacturers to conduct FDI in China. Our goal is to exploit this unforeseen liberalization policy from the firms' perspective and study its effect on the firms and their domestic workers. To achieve this goal, we employ a matched difference-in-differences approach for the firm-level analysis and a cross-sectional regression approach for the worker-level analysis. In the remainder of the section, we explain the empirical approach in detail and then present the summary statistics of the firm and worker samples, respectively.

3.1 Conceptual Framework

In addition to the list of 122 high-tech products newly permitted for production in China in 2001 (see Online Appendix C), the Taiwanese government also released a list of 97 products that remained restricted from FDI in China (see Online Appendix D). This list highlights the industries that consistently faced higher investment barriers. The prohibited products include specific chemical compounds, pharmaceuticals, military-related items, and, most notably, products in the semiconductor sector, where Taiwan holds a significant comparative advantage.

Using the two product lists, we classify Taiwanese electronic manufacturers into three groups: (i) treatment firms: firms that produced products on the 2001 newly-permitted list between 1998 and 2000; (ii) always-permitted firms: firms that did not produce any products on either the newly-permitted list or the prohibited list during the same period; and (iii)

always-prohibited firms: firms that produced products on the prohibited list during the same period.

Conceptually (see Table 2), the treatment firms experienced a reduction in investment costs following the 2001 policy change, while costs remained low for the always-permitted firms and high for the always-prohibited firms. Although both the always-permitted and always-prohibited firms could, in principle, serve as control groups in the difference-in-differences design, we consider the always-permitted firms to be more comparable to the treatment firms and therefore use it as the control group in all subsequent analyses.[3]

Table 2: Conceptual framework

		Electronic manufacturers in Taiwan		
		Treatment firms	Always-permitted firms	Always-prohibited firms
Did they produce the permitted products before 2001?		Yes	No	No
Did they produce the prohibited products before 2001?		Yes/No	No	Yes
Investment cost in China	Before policy change	High	Low	High
	After policy change	Low	Low	High

Note: This table introduces the classification of Taiwanese electronic manufacturers and their (conceptual) investment costs in China based on whether they produced the 122 permitted products and the 97 prohibited products in 1998–2000. The list of permitted products is provided in Online Appendix C, and the list of prohibited products is provided in Online Appendix D.

3.2 Research Design for the Firm-level Analysis

For the firm-level analysis, the main outcomes of interest include measures of outward FDI activities at both the extensive and intensive margins. The extensive margin outcomes include indicators for exiting the market, investing in China, and investing in the same three-digit industry in China. We make a distinction between the last two outcomes to specify whether

[3]In an earlier version of this paper, we used both the always-permitted and always-prohibited firms as the control group and found a slightly larger estimated effect of the liberalization policy.

the outward FDI into China is directly related to the Taiwanese electronic manufacturers' core production activities rather than other purposes, e.g., marketing or retail. The intensive margin outcomes include variables that cover the extent of production activities for the parent firms in Taiwan and the affiliate firms in China, including employment, the wage bill per worker, total sales, and export sales for both the parents and affiliates respectively.

To study the causal effect of the liberalization policy in 2001, we employ a difference-in-differences design. In particular, we define the Taiwanese electronic manufacturers, which had been producing products related to the 122 permitted product categories before the policy change, as the "treatment firms." The electronic manufacturers, which had never produced the 122 permitted products and the 97 permitted products before the policy change (i.e., group (ii) in Table 2), are defined as the "control firms." The key identification assumption here is the parallel trends of firm outcomes, the validity of which will be examined in Section 4.

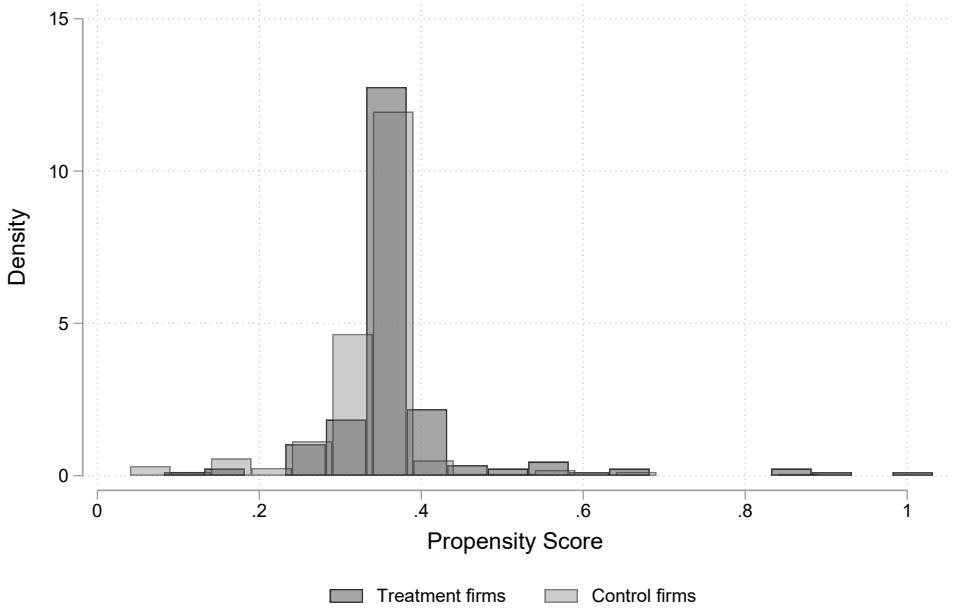
The classification procedure for the electronic manufacturers is conducted by utilizing the product-level sales in the TEJ dataset and manually checking whether each firm had produced any product that has the same keywords as the 122 electronic products in Online Appendix C and the 97 electronic products in Online Appendix D.

3.3 Matching Procedure and Summary of Matched Firm Sample

To ensure that control firms serve as a suitable counterfactual group for treatment firms in the absence of the liberalization policy, we perform one-to-one nearest-neighbor propensity score matching to obtain a firm sample that is balanced along pre-policy observable characteristics (Leuven and Sianesi, 2018). Specifically, the procedure involves (i) estimating a logit regression of the firm treatment status on the average characteristics of the parent firm before the policy change, (ii) calculating the absolute distance between every possible pair of treatment and control firms, and (iii) selecting the control firm with the smallest distance to each treatment firm. The matches are one-to-one, as a control firm will not be matched again once it is already matched to a treatment firm. The characteristics of the

parent firm used for the matching include the number of workers, the wage bill per worker, total sales, and export sales in 1998-2000. We intentionally avoid matching on investment outcomes in China, as they are the main outcomes of interest. The propensity scores, i.e., predicted probabilities of being treated, are illustrated in Figure 2. The common support assumption seems plausible, as the treatment and control firms share overlapping support and have similar distributions.

Figure 2: Propensity scores for the treatment and control firms



The resulting matched sample is summarized for the years 1998-2000 in Table 3. It consists of 174 treatment and 104 control firms each,[4] and the outcomes are now more balanced between the two groups relative to those before matching. The percentages of treatment and control firms conducting outward FDI into China are plotted in Figure 3a and Figure 3b. A common rising trend of outward FDI into China exists for both groups, but it is noticeably higher for the treatment firms that engaged in FDI in the same three-digit industry in China after the policy change in 2001. Our matching procedure seems to have

[4]The number of control firms is less than the number of treatment firms, because 70 of the control firms produced products on the prohibited list before 2001 and thus were excluded from the control group.

achieved a well-balanced sample, as is reflected in the parallel trend before 2001. To address concerns of trade liberalization episodes around this period and firm size differences between the two groups, we control for Chinese and US yearly import tariffs as well as the parent pre-2001 firm-size decile group that interacts with the post-2001 dummy in the firm-level analysis below. Furthermore, we also use the kernel matching method to construct another firm sample for robustness checks to ensure the robustness of our results to different matching methods.

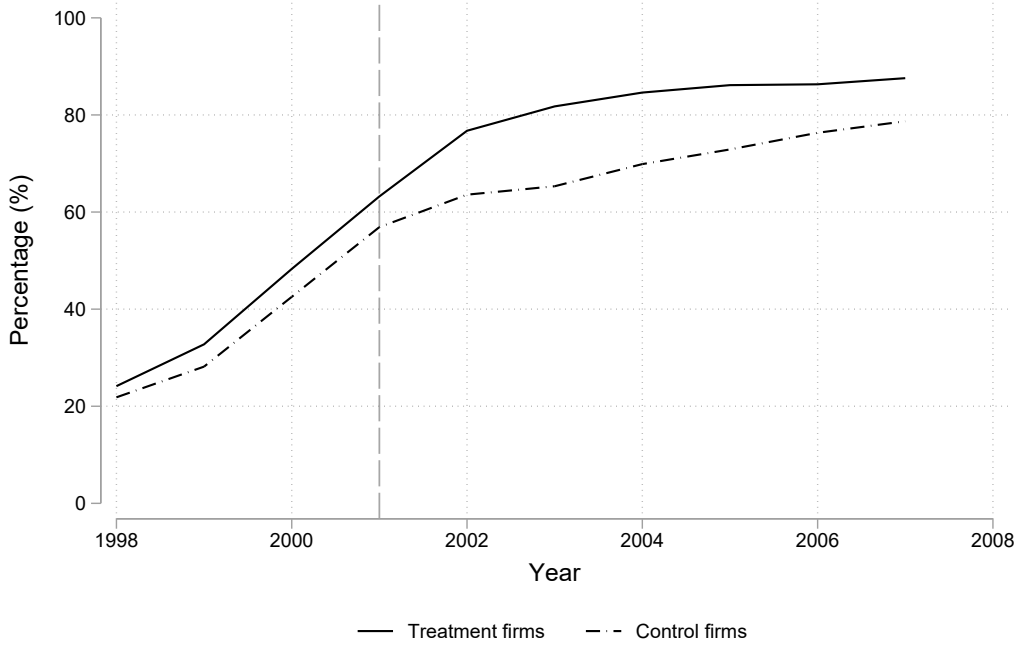
Table 3: Summary statistics of the matched firm sample (1998-2000)

	(1)	(2)	(3)	(4)
	Before matching		After matching	
Group	Treatment	Control	Treatment	Control
CN FDI	0.39	0.41	0.36	0.43
CN FDI SIC3	0.09	0.06	0.05	0.03
Number of affiliates	1.28	1.25	1.28	1.12
Parent employment	474.15	377.84	440.70	348.80
Parent total wage bill	5.61	4.35	5.22	4.25
Parent total sales	71.89	41.73	64.34	41.51
Parent export sales	58.44	30.27	51.67	31.88
Affiliate employment	866.23	797.28	765.86	618.99
Affiliate total wage bill	1.53	1.20	1.35	0.98
Affiliate total sales	67.94	19.42	53.12	20.68
Affiliate export sales	43.65	17.25	28.97	18.41
Observations	190	194	174	104

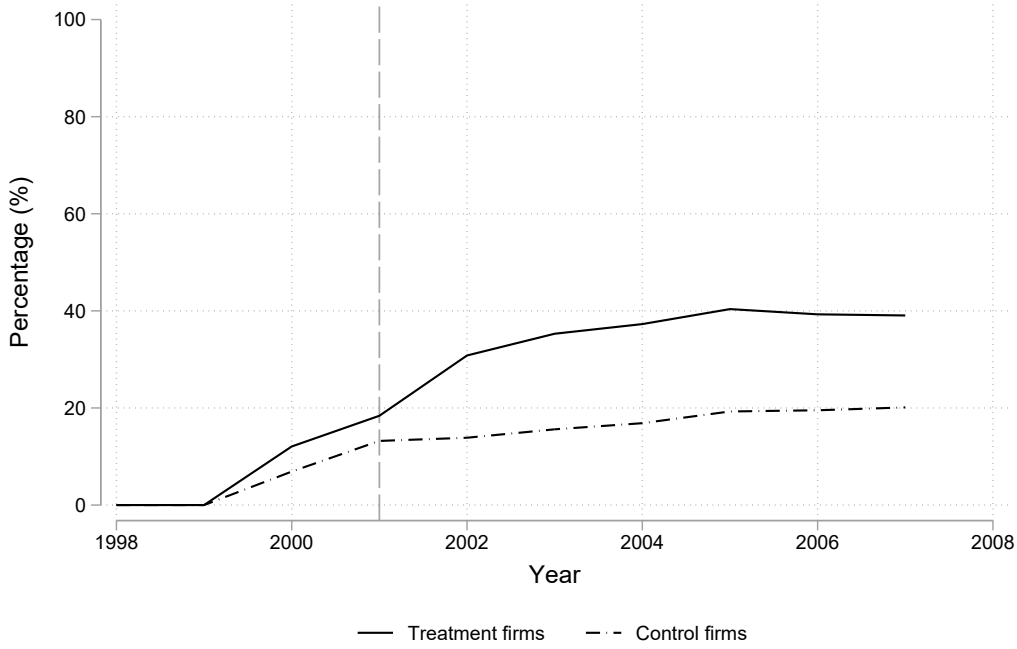
Note: This table shows the summary statistics for the firm sample constructed via one-to-one propensity score matching. "CN FDI" is an indicator of whether a Taiwanese electronic manufacturer conducted FDI in China during the studied period. "CN FDI SIC3" is an indicator of whether a Taiwanese electronic manufacturer conducted FDI in China in the same three-digit industry. "Parent" denotes the parent branch in Taiwan, and "affiliate" denotes the affiliate branch in China. The unit for sales and wages is million USD. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 3: Percentage of FDI in China for treatment and control firms (1998–2007)

(a) Conducting FDI in China



(b) Conducting FDI in the same industry in China



Note: The figures show the percentages of treatment and control firms investing in China over 1998–2007. The firm sample is obtained via one-to-one propensity score matching.

3.4 Research Design for the Worker-level Analysis

To understand how the liberalization policy affected the local workers in Taiwan, a natural approach would be to follow the same strategy as the firm-level analysis and perform a difference-in-differences analysis for the worker sample. Unfortunately, the FIA-matched employer-employee dataset only starts from 2001 (when the policy change happened), so the DID approach is not feasible. Instead, we opt for an approach similar to Autor et al. (2014) by following the incumbent workers' cumulative outcomes from 2001 onward.

The incumbent workers are assigned to treatment and control groups analogously to the firm sample. Specifically, the Taiwanese workers employed by the treatment firms in 2001 are defined as the "treated workers," and those employed by the control firms in 2001 are defined as the "untreated workers." We then compare their cumulative outcomes over 2001–2007 conditional on worker characteristics in 2001, including their age, gender, and marital status, as well as the industry fixed effect of their initial employer. The outcomes of interest are individual outcomes that evaluate their job security and earnings in the labor market, including whether a worker switches jobs, whether he or she is employed, and the wages received in a given year. The key identification assumption here is the conditional independence assumption, which is discussed in detail in Section 5.

Conceptually, the liberalization policy could have first- and second-order effects on the incumbent workers. First of all, the policy lowers the treatment firms' cost of investing in China and shifting their production activities. It would then affect the treated workers directly through higher job losses or lower wages due to decreasing labor demand in Taiwan, leading to fewer years employed and fewer wages accumulated in the initial firm. On the other hand, the policy may also have a second-order effect on workers separated from their initial employers, as being laid off could have adverse effects on re-employment probabilities in the future.

To distinguish the first-order effect from the second-order effect, we further decompose the employment status into four mutually exclusive outcomes: employment years in the initial firm, years outside the initial firm and same industry, years outside the initial firm

and different industries, and years unemployed. Similarly, cumulative wages are decomposed into wages earned in the initial firm, wages earned in the initial industry, and wages earned in different industries. Since the first-order effect is expected to be larger, the negative effect of the policy should be more salient, both on workers' employment years and their wages earned from the initial firm.

3.5 Summary of the Worker Sample

The average characteristics of the worker sample are presented in Table 4. Out of the 278 electronic manufacturers in the one-to-one matched firm sample, we are able to identify 265 of them in the FIA dataset (168 treatment firms and 97 control firms) and collect data for 90,366 workers who worked full time in those firms in 2001 and were within the age range of 22–65 over 2001–2007. The summary statistics indicate a large transition out of the original firms in subsequent years. 65% of the workers left their original firms by 2007, and the numbers for the treated and untreated workers are 68% and 58%, respectively. The mean yearly wages were 16k USD for treated workers and 14k for untreated workers in 2001, and then they became 20k and 17k USD in 2007.

To investigate the heterogeneous treatment effect by initial wage levels, five wage groups are defined based on wage percentiles of the workers in 2001 and are summarized in Table 5. In 2001, the average annual wages were 49k USD for workers in the top decile and 7k USD for workers in the bottom quartile. In 2007, the average yearly wages were 56k USD for workers in the top decile and 10k USD for workers in the bottom quartile.

Table 4: Summary statistics of the worker samples

	All	Treated worker	Untreated worker	T statistics
Male (%)	53.7	54.2	52.7	(-3.94)***
Age in 2001	32.7	32.7	32.8	(0.30)
Wage in 2001	14.9	15.6	13.5	(-14.20)***
Wage in 2007	19.4	20.4	17.3	(-17.71)***
Left initial firm by 2007 (%)	64.6	67.7	58.0	(-28.58)***
Number of workers	90,366	61,468	28,898	

Note: This table presents the summary statistics of incumbent workers employed by the firms included in our sample in 2001. The treated workers are workers employed by the treatment firms in 2001. The untreated workers are workers employed by the control firms in 2001. The unit for wages is thousand USD. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Summary statistics of mean wages by worker group

Group	Percentile in 2001	No. of workers	Wage in 2001	Wage in 2007
1	<p25	23,692	6.66	10.07
2	p25-p50	23,197	9.48	12.35
3	p50-p75	22,486	13.59	18.22
4	p75-p90	13,019	21.54	28.51
5	>p90	7,972	48.58	55.80

Note: This table presents the number of workers and their mean wages, classified by initial income percentile groups. The unit for wages is thousand USD.

4 Firm-level Responses to the Liberalization Policy

With the firm sample obtained via the matching procedure outlined in Section 3.3, we now present how Taiwanese electronic manufacturers responded to the liberalization policy in 2001. In the following, we first lay out the empirical specifications and identification assumption, and then present the empirical results for extensive and intensive outcomes.

4.1 Empirical Specification

To estimate the effect of the liberalization policy on firm investment behavior, we compare Taiwanese electronic manufacturers who had produced related products before the policy change (i.e., the "treatment firms") versus those that had not (i.e., the "control firms"). This motivates the following difference-in-differences (DID) and event-study specifications:

$$Y_{jkt} = \alpha_1 \, Post_t \times Treatment_j + \beta_1 \, Post_t \times NNTR_k + \beta_2 \, \tau_{kt}^{US} + \beta_3 \, \tau_{kt}^{CN} + X_{jkt} + \epsilon_{jkt}, \quad (1)$$

$$Y_{jkt} = \sum_{t'=1998}^{2007} \alpha_{t'} \, Year_{t'} \times Treatment_j + \beta_1 \, Post_t \times NNTR_k + \beta_2 \, \tau_{kt}^{US} + \beta_3 \, \tau_{kt}^{CN} + X_{jkt} + \epsilon_{jkt}, \quad (2)$$

where j indexes the firm, k indexes the industry, and t indexes the year ($t \in [1998, 2007]$). Y_{jkt} denotes the yearly firm outcome, and $Post_t$ is an indicator of year t after 2001. $Treatment_j$ equals one for the treatment firms and zero for the control firms. The $NNTR_k$ are the average gaps between the US normal trade relations (NTR) tariffs and the non-normal trade relations (NNTR) tariffs at the sector level (Feenstra, Romalis and Schott, 2002; Pierce and Schott, 2016). τ_{kt}^{CN} is the average Chinese import tariff on Taiwanese exports, and τ_{kt}^{US} is the average US import tariff on Chinese exports at the sector-year level from the World Integrated Trade Solution (WITS). X_{jkt} includes firm, year, and firm-size-decile-post-2001 fixed effects. The error terms ϵ_{jkt} are clustered at the ISIC four-digit industry level of the parent firms. The parameters of interest are α_1 in Equation (1) and $\{\alpha_{t'}\}$ in Equation (2).

4.2 Identification Assumption

For the parameters of interest to have a causal interpretation, the parallel trends assumption needs to hold; in other words, the treatment firms should follow the same time trend as the control firms in the absence of the policy, conditional upon the NNTR gaps, yearly tariff levels, and pre-policy firm sizes. Under this assumption, α_1 and $\{\alpha_{t'}\}$ can be interpreted as the overall and period-specific average treatment effects on the treated (ATT) for the liberalization policy.[5]

We assert that the parallel trends assumption is valid for the following reasons. First, the matching procedure outlined in Section 3 ensures similarity across observable characteristics between the treatment and control firms before the policy change. As the firms are similar ex ante, it is plausible that the treatment firms would have exhibited the same time trend as the control firms if the policy change had not taken place. As shown later in Figure 4, no pre-trend is spotted in the event study graphs. Second, our focus on the electronic manufacturers and the sole distinction being based on their products produced warrant that other major events during this time (e.g., Taiwan's accession to the WTO in 2001) would not affect the treatment and control firms differently.

With a recent method developed by Rambachan and Roth (2023), we can also allow for linear and non-linear time trends and examine to what extent our results would be affected. This sensitivity analysis is performed in Section 4.5.2 following the firm-level results.

4.3 Extensive Margin Outcomes

We first look at the extensive margin outcomes, including whether firms exit the market, conduct FDI in China, and conduct FDI in the same or different three-digit industry in China. The corresponding DID estimates for Equation (1) are presented in Table 6. In column (1), the treatment firms do not seem to be different in terms of the exit margin relative to the control firms. However, we do see in column (2) that the treatment firms

[5] In the event-study graphs below, the $\{\alpha_{t'}\}$ are adjusted with respect to the one before the policy, i.e., α_{2000}.

were on average 8% more likely to invest in China. In particular, the treatment firms were on average 10% more likely to invest in the *same* three-digit industry in column (3); this magnitude is three times bigger than the mean of the control firms before 2001. This result is consistent with the argument that the liberalization policy drove the firms that had produced related products to start investing in China and manufacture those related products after the policy change. Lastly, column (4) shows that the treatment firms did not invest more in the other three-digit sectors than the control firms. The event study graphs following Equation (2) in Figure 4 convey a similar message, where higher propensities to invest in China, particularly in the same industry after 2001, are observed for the treatment firms. Trade policy uncertainty (measured by the NNTR gaps) and the US import tariffs did not have a significant impact, while higher Chinese import tariffs discouraged Taiwanese FDI in the same sector.

4.4 Intensive Margin Outcomes

To understand how firms responded to the policy at the intensive margin, we restrict our sample to the firms with positive investments in China throughout the sample period (1998–2007) and study their outcomes, including employment, wage bill per worker, total sales, and export sales for both the parent firms in Taiwan and their affiliates in China. The DID estimates for all outcomes in the level with the pre-policy mean for the control firms are presented in Table 7. Despite lower statistical power due to fewer observations, the DID estimate for employment shows that the Chinese affiliates of the treatment firms more than tripled their hiring relative to the average of their counterparts before the policy change. For the production outcomes, the treatment firms enjoyed a sizable increase in sales for both the parent and affiliate branches; in particular, export sales of the treatment firms in both locations increased more than ten-fold relative to the pre-policy control mean, echoing the export-oriented feature of the new outward FDI induced by the policy.

Regarding the impact of trade liberalization, the estimates of sectoral average tariffs and NNTR gaps also show intuitive signs. Firms in sectors with higher US and Chinese im-

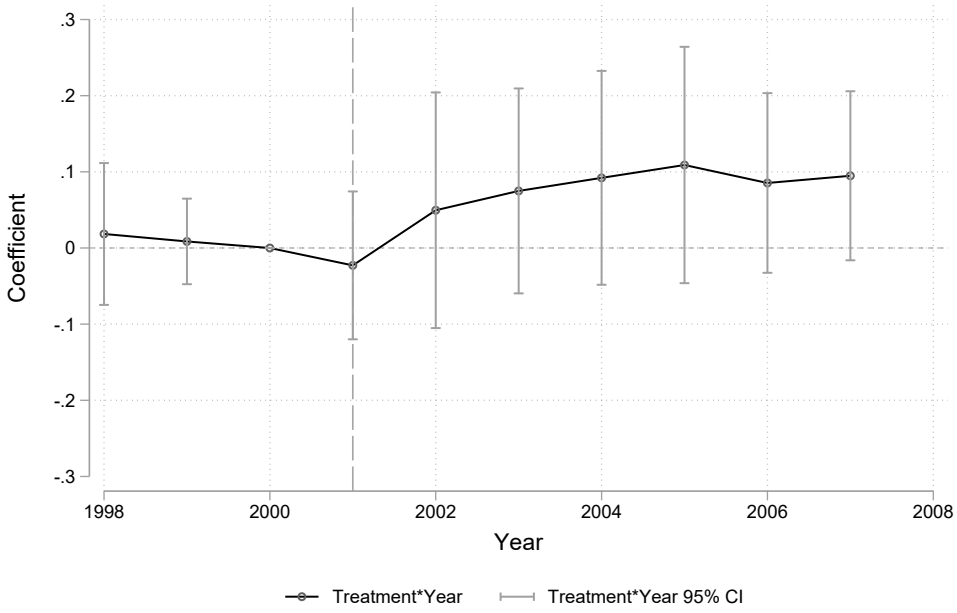
Table 6: Effect of the liberalization policy on firm extensive margin outcomes

	(1) Exit	(2) CNFDI	(3) CNFDI SIC3	(4) CNFDI NOT SIC3
Treatment*Post	-0.002	0.084*	0.101**	-0.017
	(0.005)	(0.042)	(0.045)	(0.056)
US NNTR Gap*Post	-0.000	-0.003	0.001	-0.005
	(0.000)	(0.003)	(0.002)	(0.003)
US Import Tariffs	-0.004	0.003	-0.069	0.073
	(0.024)	(0.040)	(0.062)	(0.084)
CN Import Tariffs	-0.001	-0.012	-0.019**	0.008
	(0.001)	(0.008)	(0.007)	(0.006)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Size*Post FE	Yes	Yes	Yes	Yes
Pre-policy control mean	0.000	0.413	0.032	0.381
Observations	2780	2780	2780	2780

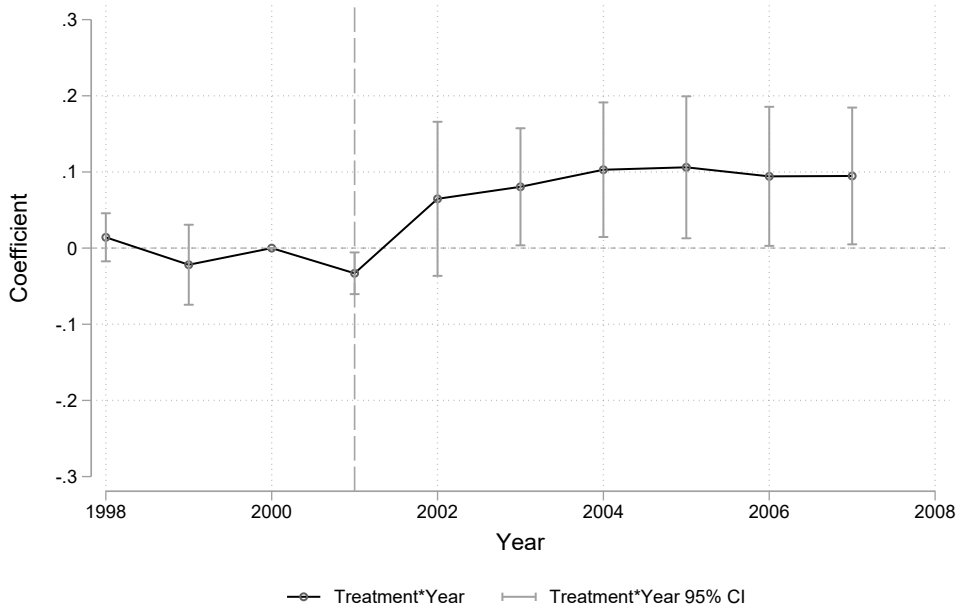
Note: This table shows the DID estimates α_1 in Equation (1) for firm extensive margin outcomes. Exit is an indicator of a firm that exists in the data in the previous year but disappears in the current year. CN FDI denotes a firm investing in China in a given year. CNFDI (NOT) SIC3 denotes a firm investing in China in the same (different) three-digit industry as the parent firm in a given year. The pre-policy control mean is the mean outcome for the control firms over 1998-2000. Standard errors are clustered at the ISIC four-digit industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 4: Event study graph for firm extensive margin outcomes

(a) Conducting FDI in China



(b) Conducting FDI in the same three-digit industry in China



Note: The figures illustrate the event-study estimates $\{\alpha_{t'}\}$ in Equation (2). The point estimates are adjusted with respect to one year before the policy change, such that α_{2000} equals zero.

port tariffs saw muted employment growth in China, while firms in sectors facing a larger reduction in trade policy uncertainty after 2001 (i.e., the sectors with higher NNTR gaps) significantly increased their employment in both Taiwan and China. This echoes the conventional wisdom that increased uncertainty induces hysteresis behavior and discourages firm investments (Dixit and Pindyck, 1994).

4.5 Robustness of Firm-level Responses

4.5.1 Robustness to Alternative Matching Method

To test the robustness of our estimates of the firm-level response to the liberalization policy, we first perform the same analysis on an alternative firm sample obtained via the kernel matching method. The matching procedure is the same as the one-to-one matching described previously in Section 3.3 except for step (iii); rather than picking only the closest control firm in absolute distance to each treatment firm, the kernel matching method instead gives a weight to every control firm, with the closer one receiving a larger weight according to a chosen kernel function.[6] A summary of the kernel matching sample is provided in Table 12 of Appendix B.1.1. The results that are analogous to Tables 6 and 7 using the kernel matching sample are provided in Tables 13 and 14 of Appendix B.1.1. The estimates for the extensive margin outcomes align reasonably well; in particular, the DID estimate for investing in the same three-digit industry in China is also 10%. For the intensive margin outcomes, the estimates from the kernel matching sample reflect a consistent story: the treatment firms have a tendency to significantly raise their hiring in China and enjoy higher export sales in both locations.

4.5.2 Robustness to Relaxing the Parallel Trends Assumption

The key identifying assumption of the DID and event-study estimates is the parallel trends assumption, i.e., the treatment firms would have followed the same time trend as the control

[6] We employ the *psmatch2* package in Stata (Leuven and Sianesi, 2018). The kernel function is the default Epanechnikov kernel.

Table 7: Effect of the liberalization policy on firm intensive margin outcomes

(a) Parent firms in Taiwan

	(1) Employment	(2) Wage bill per worker	(3) Total sales	(4) Export sales
Treatment*Post	87.2	-1.3*	908.6***	882.6***
	(334.7)	(0.6)	(207.1)	(209.1)
US NNTR Gap*Post	7.4*	0.2***	6.5	6.5
	(3.7)	(0.0)	(8.0)	(7.7)
US Import Tariffs	-60.0	2.8***	-215.6*	-205.6*
	(130.7)	(0.7)	(101.3)	(101.6)
CN Import Tariffs	12.2	0.2*	-1.1	-0.1
	(7.5)	(0.1)	(11.8)	(11.7)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Size*Post FE	Yes	Yes	Yes	Yes
Pre-policy control mean	907.4	12.7	96.4	76.0
Observations	269	269	269	269

(b) Affiliate firms in China

	(1) Employment	(2) Wage bill per worker	(3) Total sales	(4) Export sales
Treatment*Post	2529.9**	-0.4	625.0**	605.7*
	(688.9)	(0.6)	(241.1)	(249.3)
US NNTR Gap*Post	116.9**	-0.1***	5.0	3.4
	(37.7)	(0.0)	(4.2)	(4.4)
US Import Tariffs	1762.6	-0.3	-10.5	-20.8
	(1162.2)	(0.4)	(69.2)	(64.0)
CN Import Tariffs	133.4	0.0	20.6*	17.6
	(138.7)	(0.0)	(10.3)	(9.9)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Size*Post FE	Yes	Yes	Yes	Yes
Pre-policy control mean	699.0	1.8	23.9	22.0
Observations	269	269	269	269

Note: This table shows the DID estimates α_1 in Equation (1) for firm intensive margin outcomes. The sample is restricted to firms which have investments in China throughout the sample period (1998–2007). Firms that report missing values on the outcomes of interest are also excluded. The unit for wage bill per worker is thousand USD and the unit for sales is million USD. Standard errors are clustered at the ISIC four-digit industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

firms if the policy change in 2001 had not taken place. Although we could never directly test this assumption, it is not likely to hold if there is a significant pre-trend before the policy change occurs. For example, if we saw that the treatment firms already had a higher tendency to invest in China relative to the control firms before 2001, then it is hard to believe that the two groups would exhibit the same behavior in the absence of the policy. As shown in Figure 4, there are no significant pre-trends associated with the two investment outcomes.

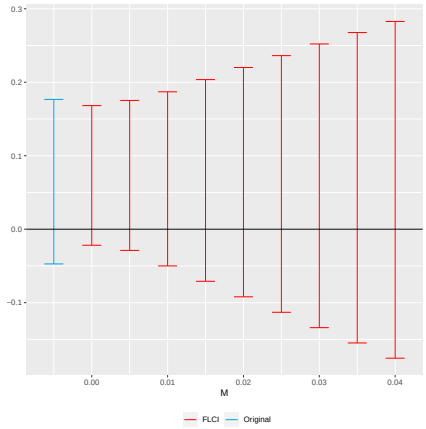
To provide a stricter examination, we perform a sensitivity analysis using the *HonestDiD* package developed by Rambachan and Roth (2023). The main idea of this method is to relax the parallel trends assumption and allow for post-treatment differences in trends that are "close" to the estimated pre-trend, in linear or non-linear fashions. We apply the method to examine each event-study estimate after 2001 in Equation (2), i.e., $\{\alpha_t\}$. The results are shown in Figure 5. The coefficients in blue are the original estimates, and those in red are the estimated confidence sets allowing for trends, with M indicating the degree of non-linearity of the trends. It can be seen that all event-study estimates are robust to allowing for linear trends (i.e., the confidence sets when $M = 0$) but become less so as the trends become more and more non-linear. Nonetheless, most of the non-linear confidence sets cover our original estimates and thus are consistent with our main results. Overall, we are confident in concluding that our firm-level results are robust.

4.5.3 Additional Robustness Checks

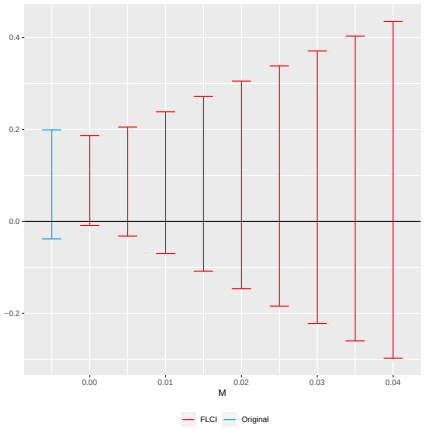
In Appendix B.1.2, we utilize an FDI destination list from the Ministry of Economic Affairs (MOEA) to conduct a placebo test for Taiwanese investments into countries other than China. The results indicate that there was no impact on investments in other countries, confirming that the FDI liberalization policy mainly reduced the investment barriers into China and not elsewhere.

Figure 5: Sensitivity analysis: Relaxing the parallel trends assumption

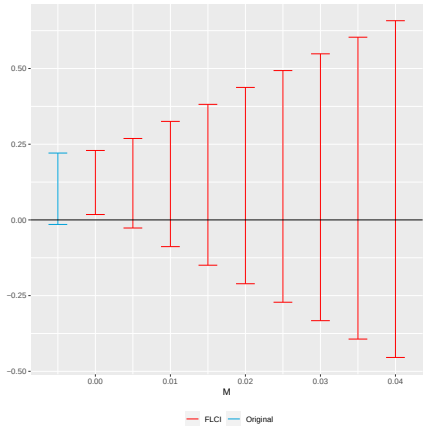
(a) Year 2002



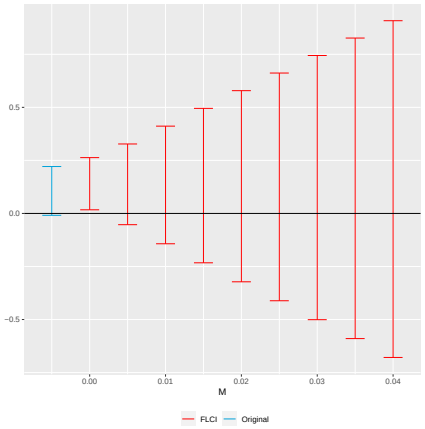
(b) Year 2003



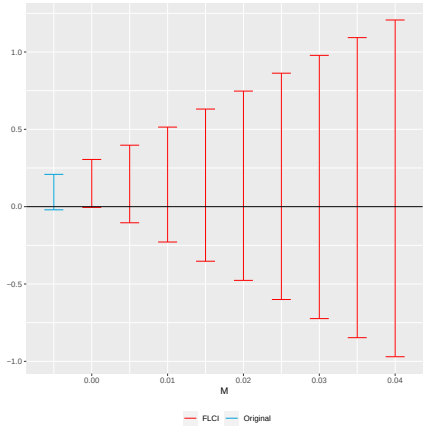
(c) Year 2004



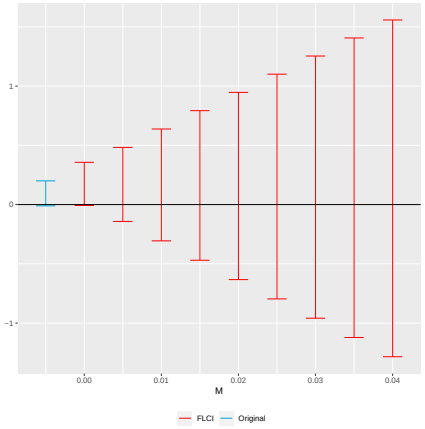
(d) Year 2005



(e) Year 2006



(f) Year 2007



Note: The above figures show the sensitivity analysis following the method by Rambachan and Roth (2023) for each of the yearly estimates $\{\alpha_{t'}\}_{2002}^{2007}$ in Figure 4b. The intervals in blue are the confidence intervals of the original estimates, and the intervals in red are the confidence sets allowing for linear and non-linear time trends. When $M = 0$, the interval corresponds to the confidence set with a linear time trend. The time trend becomes more non-linear as M becomes larger.

5 Worker-level Responses to the Liberalization Policy

After examining the firm-level responses to the liberalization policy in Section 4, we move on to the worker sample to study the effect of the policy on the domestic incumbent workers, i.e., the Taiwanese workers employed by the electronic manufacturers in our firm sample at the onset of the policy in 2001. We first introduce the empirical specifications, then explain the identification assumptions needed to establish causal claims for the regression parameters, and finally present the results as well as the robustness checks.

5.1 Empirical Specification

As discussed in Section 3.4, the FIA matched employer-employee data start from 2001 (i.e., the year when the policy change took place), so our empirical strategy is to compare the cumulative outcomes over 2001–2007 for the treated and untreated workers conditional upon their demographic characteristics. This implies the following regression specification:

$$Y_{ijkt} = \alpha_t \, Treated_j + \delta_{1t} \, NNTR_k + \delta_{2t} \, \Delta\tau_k^{US} + \delta_{3t} \, \Delta\tau_k^{CN} + X_{ijk2001} + \zeta_{ijkt}, \tag{3}$$

where i indexes incumbent workers, j indexes worker i's initial employer in 2001, k indexes employer j's initial industry in 2001, and t indexes years following the policy change ($t \in [2002 - 2007]$). Y_{ijkt} are the cumulative outcomes up to year t for worker i originally employed by firm j in the four-digit industry k in 2001. $Treated_j$ denotes whether firm j is a treatment firm, and $X_{ijk2001}$ is a set of firm and worker demographic characteristics in 2001, including their initial employer's size decile group, and their own age, age squared, gender, and marital status. The statistical error ζ_{ijkt} is clustered at the level of SIC four-digit industries.[7] Following a similar approach by Dix-Carneiro and Kovak (2019), we estimate Equation (3) for each year t to obtain the coefficients of interest $\{\alpha_t\}$, which reveal the effect of the liberalization policy on the treated workers relative to the untreated workers up to year $t \in [2002, 2007]$.

[7] The full name of SIC is the Standard Industrial Classification of Taiwan.

To investigate the heterogeneous treatment effects of the policy based on the initial wage level and gender, we further run the following specifications:

$$Y_{ijk2007} = \alpha\, Treated_j + \sum_g \beta_g\, Treated_j \times WG_{ig2001} + \gamma\, WG_{ig2001} + \delta_1\, NNTR_k + \delta_2\, \Delta\tau_k^{US} + \delta_3\, \Delta\tau_k^{CN} + X_{ijk2001} + \zeta_{ijk}, \quad (4)$$

$$Y_{ijk2007} = \alpha\, Treated_j + \beta\, Treated_j \times Male_i + \gamma\, Male_i + \delta_1\, NNTR_k + \delta_2\, \Delta\tau_k^{US} + \delta_3\, \Delta\tau_k^{CN} + X_{ijk2001} + \zeta_{ijk}, \quad (5)$$

where $Y_{ijk2007}$ represents the cumulative outcomes over 2001–2007, WG_{g2001} denotes whether worker i belongs to wage percentile group g in 2001 as defined in Table 5, and $Male_i$ is an indicator of whether worker i is male. The parameters of interest are α and $\{\beta_g\}$. The first parameter reflects the average effect of the policy for a reference group,[8] and the latter demonstrates the policy effect (for wage group g or male workers) relative to the reference group.

5.2 Identification Assumption

To identify the causal parameters $\{\alpha_t\}$ in Equation (3) as well as α and $\{\beta_g\}$ in Equations (4) and (5), the conditional independence assumption is needed. It requires that a worker's treatment status be independent of his or her potential outcomes conditional upon the observable characteristics. In other words, whether a worker is employed by a treatment or control firm at the onset of the policy is "as if" random given their individual characteristics and industry fixed effects. With this assumption, $\{\alpha_t\}$ can be interpreted as the per-period average treatment effect (ATE), and $\{\beta_g\}$ denotes the conditional average treatment effects (CATE) of the liberalization policy.

We argue that the conditional independence assumption is plausible for the following reasons. First, as we explained in Section 2, the policy change can be viewed as an exogenous

[8] The reference group for Equation (4) is the top-decile wage group, and the reference group for Equation (5) is female workers.

event from the perspective of the electronic manufacturers. With the same reasoning, the workers employed by those firms in 2001 also cannot anticipate the policy change in advance.[9] The matching procedure further strengthens the exogeneity of the policy, as the treatment and control firms are ex-ante similar from the perspective of the workers. In addition, the control variables including the four-digit industry fixed effects, and the worker characteristics account for the potential threat of selection on observables.

Nevertheless, it is a valid concern that workers might still self-select into the treatment and control firms based on some unobserved characteristics. For example, there may be systematic differences in their education levels or family resources, which are unobserved from the matched employer-employee data but could still affect their employment decisions and future labor outcomes. We deal with this concern by performing two robustness checks. The first check is to use a different worker sample consisting of incumbent workers in the kernel-matching firm sample ("the kernel-matching worker sample"). For the second check, we control the financial assets of workers' parents by taking advantage of the kinship information provided by the FIA. This control variable serves as a proxy of the workers' education levels and family resources; however, it would be a bad proxy for older workers whose parents had already passed away by the year 2001. Therefore, this specification is provided as a robustness check rather than the main results.

5.3 Baseline Results

The average effect of the liberalization policy on workers' cumulative outcomes from 2001 to 2007 is presented in Table 8. A key finding is that the policy shock significantly increased job transitions: treated workers experienced, on average, a 15% higher cumulative job transition rate than untreated workers,[10] conditional upon import tariffs, NNTR gaps, firm-size fixed effects, and individual characteristics. This increase in job transitions suggests that the liberalization policy disrupted employment stability, possibly leading to involuntary separations among workers in the electronics sector. However, the aggregate impact on cumulative

[9] The policy was officially announced in November 2001.

[10] $15\% = 0.158/1.039$.

years of employment and wages is less apparent.

It can also be seen in Table 8 that the exposure to higher US import tariffs on Chinese exports has a significant negative effect on overall employment duration and is positively associated with the number of years unemployed, indicating adverse labor market consequences. Furthermore, the US NNTR gap that captures the reduction in trade policy uncertainty is negatively associated with job transitions and positively associated with years employed in the initial firm and industry, suggesting that a reduction in trade policy uncertainty can have a positive impact on employment in general. The result is consistent with the firm-level analysis reported in Table 7. By contrast, the effect of Chinese import tariffs is less clear. An increase in Chinese tariffs on Taiwan's exports could incentivize firms in Taiwan to retain more production domestically rather than shifting activities to China. However, most estimated effects of Chinese import tariffs are statistically insignificant, except for a positive coefficient on years employed in the initial firm, suggesting some evidence of employment retention in response to higher tariffs on Taiwan's exports.

To understand the dynamic impact over time, we estimate Equation (3) for each cumulative outcome from 2001 through $t \in [2002, 2007]$ and report the coefficients α_t. Figure 6a confirms that treated workers consistently experienced higher job transition rates throughout the period. Figures 6b and 6c further demonstrate that treated workers were more likely to exit their initial employers and, as a result, accumulated fewer wages from those jobs. These results underscore that the policy had distinct distributional consequences depending on workers' initial wage levels and job positions.

Table 8: Effect of the liberalization policy on worker cumulative outcomes (2001–2007)

(a) Job transitions and years employed by destination

	Job transitions	Years employed				Years unemployed
		Overall	Initial firm	Initial industry	Other industries	
Treated	0.158**	-0.016	-0.267	0.127	0.124	0.016
	(0.058)	(0.043)	(0.138)	(0.074)	(0.127)	(0.043)
US NNTR Gap	-0.006*	-0.003	0.015*	0.012*	-0.030***	0.003
	(0.003)	(0.002)	(0.007)	(0.005)	(0.009)	(0.002)
US Import Tariffs	-0.006	-0.090**	-0.062	0.240***	-0.268*	0.090**
	(0.036)	(0.030)	(0.102)	(0.058)	(0.111)	(0.030)
CN Import Tariffs	-0.011	-0.008	0.034*	0.001	-0.043	0.008
	(0.007)	(0.005)	(0.016)	(0.012)	(0.022)	(0.005)
Size FE	Yes	Yes	Yes	Yes	Yes	Yes
Control mean in 2007	1.039	6.279	4.516	0.377	1.386	0.721
Observations	90,366	90,366	90,366	90,366	90,366	90,366

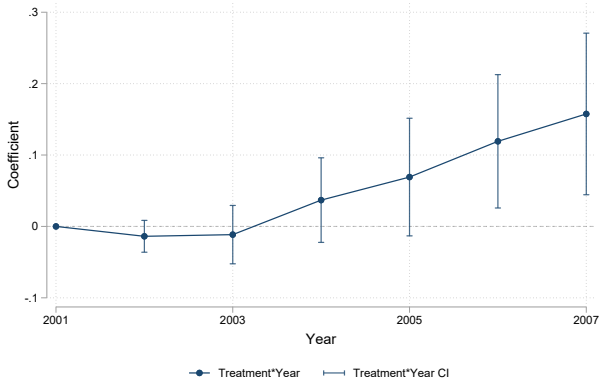
(b) Normalized wages by destination

	Wages earned			
	Overall	Initial firm	Initial industry	Other industries
Treated	0.230	-0.103	0.195	0.138
	(0.209)	(0.151)	(0.111)	(0.188)
US NNTR Gap	-0.010	0.012	0.016	-0.038**
	(0.010)	(0.007)	(0.008)	(0.011)
US Import Tariffs	-0.222	-0.155	0.299**	-0.367*
	(0.117)	(0.141)	(0.088)	(0.139)
CN Import Tariffs	-0.032	0.025	0.002	-0.059
	(0.022)	(0.016)	(0.017)	(0.030)
Size FE	Yes	Yes	Yes	Yes
Control mean in 2007	6.797	4.857	0.440	1.500
Observations	90,366	90,366	90,366	90,366

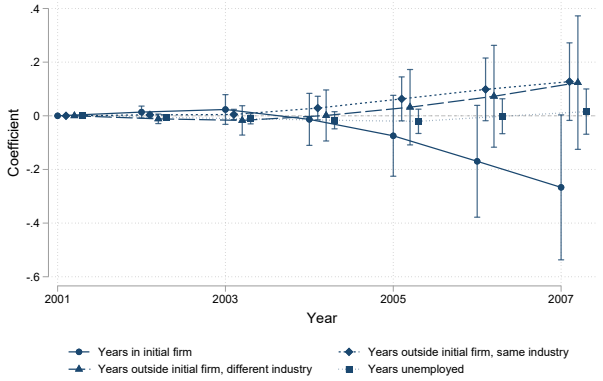
Note: This table presents the regression estimates of the policy's effect on workers' cumulative outcomes over 2001—2007. Outcomes include the total number of job transitions, cumulative years employed, years unemployed, and normalized cumulative wages (relative to 2001 wages). Job transitions are the total number of job changes from 2001 to 2007. Self-employed individuals are treated as unemployed. Control variables include worker age, age squared, gender, marital status, average yearly Chinese import tariffs (on exports from Taiwan), US import tariffs (on exports from China), the gaps between US NTR and NNTR tariffs, and firm-size decile group. Standard errors are clustered at the SIC four-digit industry level. The control mean refers to the average outcome for untreated workers. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 6: Worker cumulative outcome by year

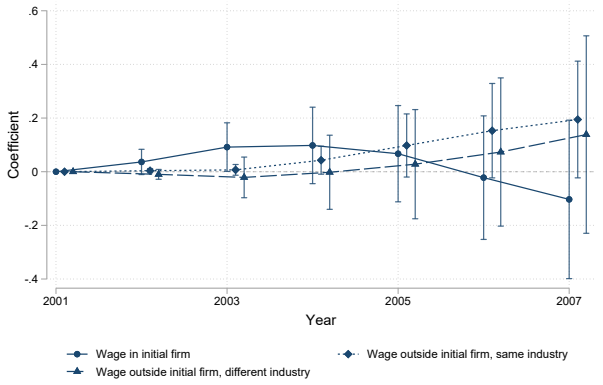
(a) Job transitions



(b) Employment years by destination



(c) Wages by destination



Note: The figures show the yearly estimates $\{\alpha_t\}_{2001}^{2007}$ in Equation (3) for worker cumulative outcomes.

5.4 Heterogeneity

To further investigate the worker effect, we divide workers into five groups based on their initial wage percentiles and estimate the interaction between the treatment status and wage group. In these regressions, treated workers in the top wage decile serve as the reference group. The results, presented in Table 9, underscore that middle-income workers were disproportionately affected by the policy, even though the average wage and employment effects appear muted. Panel (a) of Table 9 shows that the treated workers in the middle and lower wage quartiles experienced higher job transition rates and shorter employment durations with the initial employer relative to the untreated workers. Most evidently, the bottom quartile and the 25th–50th wage percentile groups experienced 21% and 28% higher job transition rates than the untreated workers;[11] furthermore, treated workers in the 2nd wage quartile remained 14% fewer years in the initial firm relative to the untreated workers.[12] Consistent with the main results, the negative effect on employment status is most evident in years of employment at the initial firm. By contrast, the policy's effects on years employed in the initial firm were not statistically significant for treated workers in the top wage decile.

Panel (b) of Table 9 reveals substantial heterogeneity in wage responses across the wage distribution. Treated workers in the 25th–50th and 50th–75th percentile groups earned cumulative wages from their initial employer that were 9% and 5% lower, respectively, than their untreated counterparts.[13] In 2001, workers in the 25th–50th group earned an average annual salary of about USD 9,500; thus, the estimates imply a total wage loss of 4,200 USD from their initial employer over the seven-year period.[14] However, workers in the bottom wage quartile, despite experiencing wage losses from their initial firms, appear to have offset these losses by earning significantly more in other industries.

These patterns help explain why the overall wage effects of the policy appear muted. The aggregate estimates mask offsetting wage losses at initial employers and gains from

[11] The percentages are calculated as follows: $21\% \approx \frac{0.195+0.028}{1.039}, 28\% \approx \frac{0.267+0.028}{1.039}$.

[12] $-14\% \approx \frac{-0.646+0.023}{4.516}$.

[13] The percentages are calculated as follows: $9\% \approx \frac{-0.801+0.360}{4.857}, 5\% \approx \frac{-0.592+0.360}{4.857}$.

[14] Δ Salary $= (-0.801 + 0.360) \times 9,500 \approx -4,200$ USD, where -0.801 and 0.360 are the treatment effect estimates.

reallocation. This suggests that many treated workers, especially those facing adverse shocks at their initial firms, managed to reallocate to other sectors. These findings may reflect both low labor market frictions and broader structural changes in Taiwan's economy during the trade liberalization period, which enabled some displaced workers to reallocate across sectors without large long-term earning losses.

Apart from the initial wage level, we also explore the heterogeneity by worker gender following Equation (5). Table 10 shows that female workers in the treatment group experienced more negative effects than male workers. The treated female workers experienced a 25% higher job transition rate, remained employed 12% fewer years in the initial firm, and earned 10% lower wages than those earned in the initial firm compared to untreated workers.[15] This can be attributed to the well-documented observation that a larger proportion of female workers are employed in occupations with higher substitutability than male workers (Blau and Kahn, 2017), making them more vulnerable to unemployment during economic shocks. This is consistent with our findings, which reveal that lower wage percentiles, where female workers are overrepresented, experience greater adverse effects post-policy. Furthermore, the existing literature indicates that during economic shocks, female workers are more likely to voluntarily leave the labor force due to factors such as family responsibilities (Adda, Dustmann and Stevens, 2017) or fertility decisions (Keller and Utar, 2022), further compounding the negative effects of the policy on this group.

An additional approach is adopted to examine worker heterogeneity. We employ the causal forests method (Wager and Athey, 2018) to estimate the conditional average treatment effect (CATE) of the policy on workers. These estimates also point to substantial heterogeneity by initial wage and gender. Details of the method and results are provided in Appendix A.

The results presented above convey stark differences in the policy's effects on domestic incumbent workers. On the one hand, treated workers in the top wage decile appear to have benefited from the liberalization policy in terms of job stability and earnings. These individuals were likely to be well-educated, highly skilled, and employed in occupations

[15] The percentages are calculated as follows: $25\% \approx \frac{0.261}{1.039}, -12\% \approx \frac{-0.557}{4.516}, -10\% \approx \frac{-0.489}{4.857}$.

less exposed to competition from Chinese affiliates, such as researchers or managers. On the other hand, the policy led to higher job transitions, shorter employment durations, and lower cumulative wages for treated workers in the middle of the income distribution. Treated workers in the bottom wage quartile also experienced more job transitions and shorter tenures at their initial firms, although these effects are not statistically significant. However, their overall wage outcomes did not decline significantly, this being largely because they were more likely to reallocate to other industries. In fact, treated workers in the bottom wage decile earned more in other industries, offsetting losses from their initial employers. This pattern suggests greater mobility and reallocation among middle- and lower-wage workers, possibly reflecting weaker attachment to their original jobs or greater flexibility in adjusting to structural change.

5.5 Robustness of Worker-level Response

5.5.1 Robustness to Alternative Worker Sample

Analogous to the firm analysis, we create another worker sample with workers employed by the firms from the kernel-matching sample for robustness checks. Their average characteristics are summarized in Table 16 of Appendix B.2. We then run the same regressions in Equation (3) and Equation (4) using this alternative sample. The results are presented in Tables 18, 19, and 20. The robustness check generates similar results. Treated workers experienced more job transitions and on average remained employed for fewer years both overall and in the initial firm. The negative wage effects are concentrated among workers with initial wages ranked in the 25th-90th percentiles, while the treated workers from the top decile are better off.

5.5.2 Robustness to Additional Controls

To address unobserved worker characteristics that could affect both their employment decisions and future outcomes, we control for the total assets of workers' parents utilizing the

Table 9: Heterogeneous effect of the liberalization policy: Initial wage level

(a) Job transitions and years employed by destination

	Job transitions	Years employed				Years unemployed
		Overall	Initial firm	Initial industry	Other industries	
Treated*<p25	0.195*	0.086	-0.486	0.129	0.443	-0.086
	(0.097)	(0.106)	(0.274)	(0.067)	(0.224)	(0.106)
Treated*p25-p50	0.267*	-0.083	-0.646*	0.103	0.460*	0.083
	(0.108)	(0.090)	(0.268)	(0.090)	(0.229)	(0.090)
Treated*p50-p75	0.177*	-0.128	-0.386	0.007	0.251	0.129
	(0.085)	(0.080)	(0.214)	(0.066)	(0.168)	(0.080)
Treated*p75-p90	-0.079	0.016	0.237	-0.114*	-0.107	-0.016
	(0.086)	(0.033)	(0.184)	(0.056)	(0.139)	(0.033)
Treated	0.028	-0.043	0.023	0.074	-0.140	0.043
	(0.086)	(0.046)	(0.233)	(0.061)	(0.230)	(0.046)
Size FE	Yes	Yes	Yes	Yes	Yes	Yes
Control mean in 2007	1.039	6.279	4.516	0.377	1.386	0.721
Observations	90,366	90,366	90,366	90,366	90,366	90,366

(b) Normalized wages by destination

	Wages earned			
	Overall	Initial firm	Initial industry	Other industries
Treated*<p25	0.174	-0.626	0.177	0.623*
	(0.241)	(0.333)	(0.110)	(0.258)
Treated*p25-p50	-0.168	-0.801**	0.128	0.504
	(0.261)	(0.291)	(0.128)	(0.267)
Treated*p50-p75	-0.377	-0.592*	-0.015	0.230
	(0.230)	(0.231)	(0.087)	(0.206)
Treated*p75-p90	-0.366*	-0.048	-0.145	-0.173
	(0.169)	(0.206)	(0.083)	(0.162)
Treated	0.351	0.360	0.137*	-0.147
	(0.259)	(0.287)	(0.054)	(0.308)
Size FE	Yes	Yes	Yes	Yes
Control mean in 2007	6.797	4.857	0.440	1.500
Observations	90,366	90,366	90,366	90,366

Note: This table presents the regression estimates of the heterogeneous effects of the 2001 FDI liberalization policy on incumbent workers' cumulative outcomes, differentiated by their initial wage percentiles in 2001. Outcomes include the total number of job transitions, cumulative years employed, years unemployed, and normalized cumulative wages (relative to 2001 wages). Job transitions are the total number of job changes from 2001 to 2007. Self-employed individuals are treated as unemployed. Control variables include worker age, age squared, gender, marital status, their initial employer's average yearly Chinese import tariffs (on exports from Taiwan), US import tariffs (on exports from China), the gaps between US NTR and NNTR tariffs, and firm-size decile group. Standard errors are clustered at the SIC four-digit industry level. The control mean refers to the average outcome for untreated workers.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: Heterogeneous effect of the liberalization policy: Worker gender

(a) Job transitions and years employed by destination

	Job transitions	Years employed				Years unemployed
		Overall	Initial firm	Initial industry	Other industries	
Treated*Male	-0.194***	0.192***	0.547***	-0.105*	-0.250***	-0.192***
	(0.042)	(0.053)	(0.117)	(0.045)	(0.070)	(0.053)
Treated	0.261***	-0.117	-0.557***	0.183*	0.256*	0.117
	(0.060)	(0.0656)	(0.144)	(0.0786)	(0.109)	(0.066)
Size FE	Yes	Yes	Yes	Yes	Yes	Yes
Control mean in 2007	1.039	6.279	4.516	0.377	1.386	0.721
Observations	90,366	90,366	90,366	90,366	90,366	90,366

(b) Normalized wages by destination

	Wage earned			
	Overall	Initial firm	Initial industry	Other industries
Treated*Male	0.523***	0.728***	-0.044	-0.161
	(0.142)	(0.153)	(0.060)	(0.105)
Treated	-0.048	-0.489**	0.218*	0.224
	(0.206)	(0.150)	(0.106)	(0.153)
Size FE	Yes	Yes	Yes	Yes
Control mean in 2007	6.797	4.857	0.440	1.500
Observations	90,366	90,366	90,366	90,366

Note: This table presents the regression estimates of the heterogeneous effects of the liberalization policy on workers' cumulative outcomes by worker gender. Outcomes include the total number of job transitions, cumulative years employed, years unemployed, and normalized cumulative wages (relative to 2001 wages). Job transitions are the total number of job changes from 2001 to 2007. Self-employed individuals are treated as unemployed. Control variables include worker age, age squared, gender, marital status, average yearly Chinese import tariffs (on exports from Taiwan), US import tariffs (on exports from China), the gaps between US NTR and NNTR tariffs, and firm-size decile group. Standard errors are clustered at the SIC four-digit industry level. The control mean refers to the average outcome for untreated workers. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

individual wealth data from the FIA. Parents' wealth can serve as a proxy for the resources of a worker's family and are positively correlated with the worker's education level. The results with parents' wealth controlled are presented in Table 11. Again, the estimates are all similar in sign and magnitude to our main results.

Overall, our results are consistent with the idea that FDI liberalization would trigger manufacturing firms to move their production to low-cost countries and reduce their employment in the home country, hurting in particular the incumbent workers with lower initial wages in terms of job security, who are likely to be low-skilled or less educated. The workers in the top wage decile who are mostly in charge of management and R&D activities are less affected and may even benefit, as their employers gain higher profits from cost reductions and rising sales, thereby increasing the demand for headquarter services in the home country.

Table 11: Robustness check: Worker average effect with parents' wealth controlled

(a) Job transitions and years employed by destination

	Job transitions	Years employed				Years unemployed
		Overall	Initial firm	Initial industry	Other industries	
Treated	0.158**	-0.014	-0.262	0.130	0.118	0.014
	(0.057)	(0.045)	(0.139)	(0.076)	(0.134)	(0.045)
Size FE	Yes	Yes	Yes	Yes	Yes	Yes
Control mean in 2007	1.039	6.279	4.516	0.377	1.386	0.721
Observations	90,366	90,366	90,366	90,366	90,366	90,366

(b) Normalized wages by destination

	Wages earned			
	Overall	Initial firm	Initial industry	Other industries
Treated	0.225	-0.101	0.198	0.128
	(0.222)	(0.147)	(0.115)	(0.201)
Size FE	Yes	Yes	Yes	Yes
Control mean in 2007	6.797	4.857	0.440	1.500
Observations	90,366	90,366	90,366	90,366

Note: This table presents the regression estimates of the policy's effect on workers' cumulative outcomes over 2001—2007 with parent's wealth controlled. Control variables include worker age, age squared, gender, marital status, average yearly Chinese import tariffs (on exports from Taiwan), US import tariffs (on exports from China), the gaps between US NTR and NNTR tariffs, firm-size decile group of the initial employer, and parents' wealth in 2003 (which is the earliest wealth data we have access to). Standard errors are clustered at the SIC four-digit industry level. The control mean refers to the average outcome for untreated workers. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6 Conclusion

FDI activities are a crucial component of the global economy. However, episodes of FDI liberalization are much less studied than trade liberalization episodes such as import competition. The theoretical prediction for the causal effect of such liberalization policies on worker outcomes is unclear due to the competing forces of firm growth and worker replacement. Taking advantage of novel data sources that cover Taiwanese public electronic manufacturers and their affiliates in China as well as their workers in Taiwan, our paper examines a policy change by the Taiwanese government in 2001 that provides a subset of Taiwanese electronic manufacturers with extra incentives to conduct FDI in China.

The DID estimates at the firm level confirm a large treatment effect for the treatment firms, which reallocated their production resources to China at both extensive and intensive margins. Moreover, the worker-level analysis indicates substantial heterogeneous effects of the policy, where the incumbent workers in the top decile of initial wages benefited and the other workers lost out following the implementation of the policy. This result echoes the theoretical predictions from classic trade models that trade liberalization creates winners and losers. From an aggregate perspective, a large-scale FDI liberalization episode such as the one experienced in Taiwan since the 2000s could substantially affect the overall income distribution and inequality of the society as a whole.

We acknowledge that the magnitude and accuracy of the estimated effects appear sensitive to the choice of control firms. In previous versions of this paper, we used all electronic manufacturers in our full sample that had never produced the 122 high-tech products as the control group and found a larger and more significant treatment effect, especially for worker outcomes. The main concern is that some of these firms had been producing products that were always prohibited from producing in China throughout the sample period, and thus would not be an appropriate comparison to the treatment firms. After dropping these firms from the control group, the average wage effect of the policy becomes insignificant, while large heterogeneity across initial wages still remains.

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Appendices

A Estimation of CATE Using Causal Forests

A.1 Outline of the Method

We apply the causal forests method (or generalized random forests, GRF) developed by Wager and Athey (2018) and Athey, Tibshirani and Wager (2019) to our incumbent worker sample and estimate the conditional average treatment effect (CATE) of the 2001 liberalization policy.[16] The method utilizes the algorithm of random forests to estimate CATE. Similar to random forests, subsamples are randomly drawn from the main sample to train decision trees. However, rather than splitting the tree to minimize the sum of squared residuals in the outcome within each node, the splits are chosen so as to maximize the differences in treatment effects between nodes. Once the training is done, the prediction of CATE for a test example can be made by "pushing down" the test example from top to bottom for each tree and calculating the weighted treatment effects with weights given by the share of times that the test example falls into the same leaf as the training samples.

A.2 Results

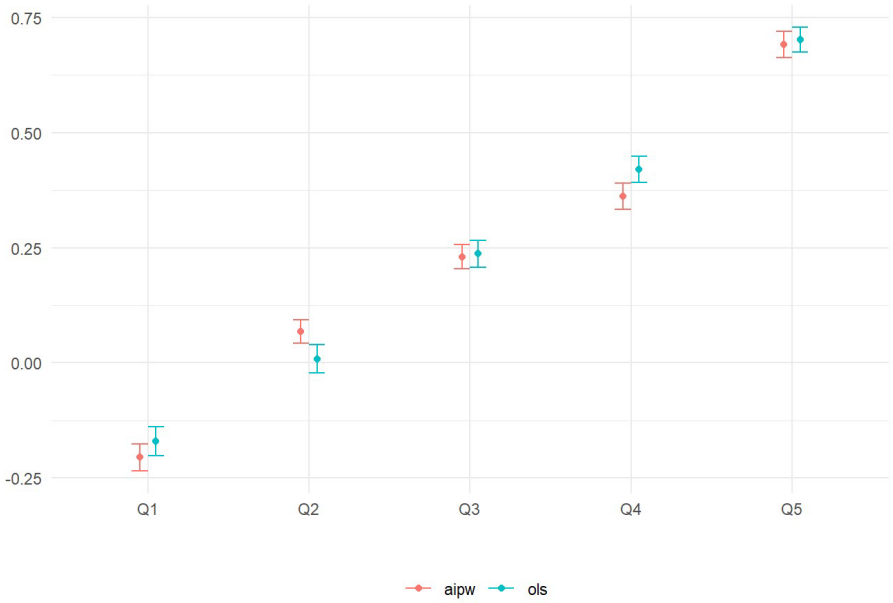
We implement the GRF package in R using our incumbent worker sample. Three cumulative outcomes over 2001–2007 are our focus: job transitions, employment years, and normalized wages. Worker characteristics of interest include their initial wages in 2001, gender, marital status, and age. Four-digit industry dummies (for their initial employers in 2001) are also added to the model to control for industry fixed effects.

The individual CATE estimates for each outcome are predicted and summarized in quintiles from the smallest to the largest in Figures 7, 8, and 9. Large heterogeneity is spotted in Panel A for all three outcomes, as the estimates go from significantly negative to significantly positive. The average worker characteristics for each CATE quintile are presented in Panel B. Echoing our regression-based heterogeneity analysis in Section 5, male workers and workers with higher initial wages tended to have fewer job transitions, more employment years, and higher cumulative wages.

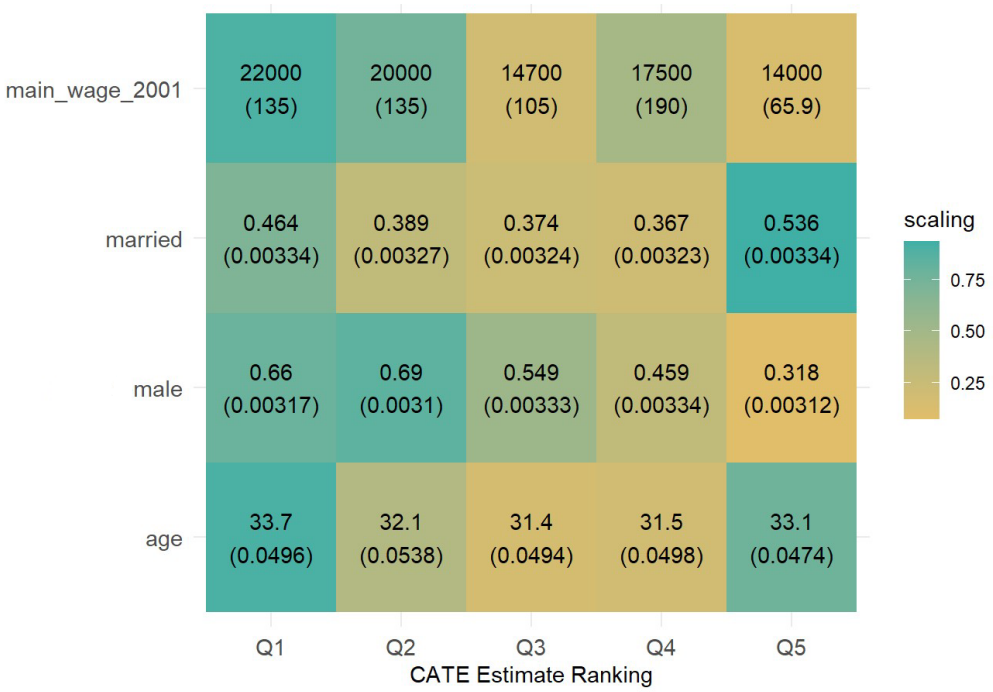
[16] Readers who are interested in the details of the method can read the original papers and refer to the package codebook online: https://grf-labs.github.io/grf/REFERENCE.html#general-algorithm.

Figure 7: CATE estimates using causal forests: Cumulative job transitions

(a) Average CATE quintiles by ranking



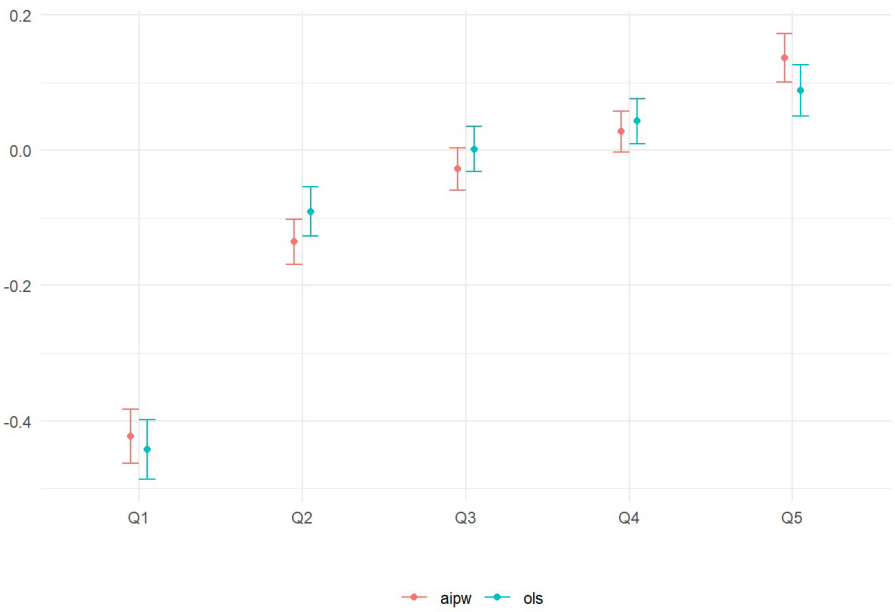
(b) Average covariate values by CATE quintile



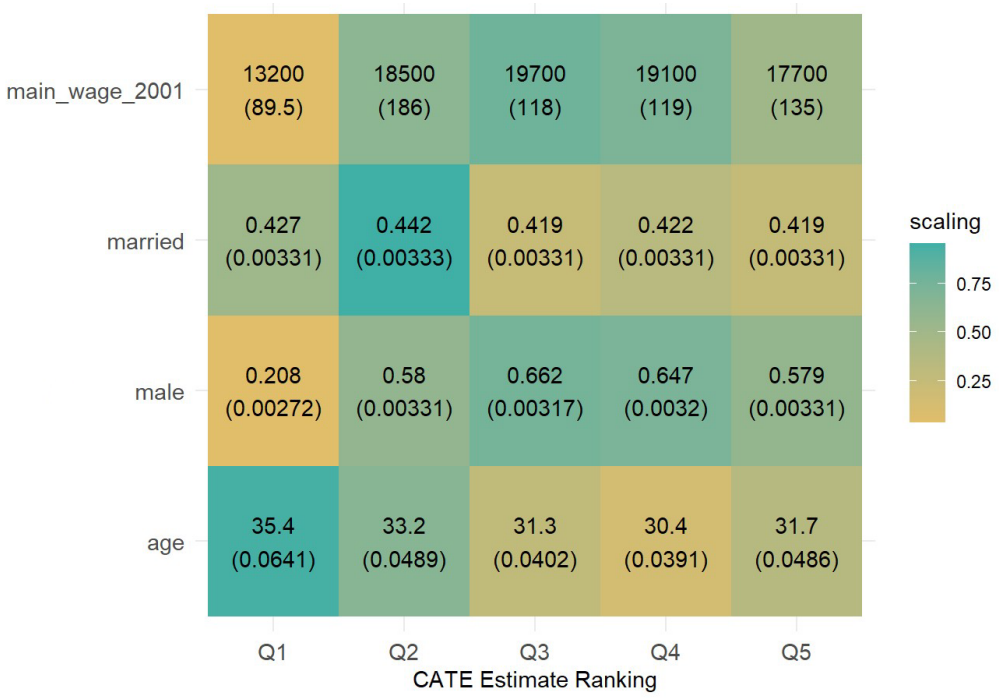
Note: This figure presents the conditional average treatment effect (CATE) estimates of the 2001 liberalization policy on workers' cumulative job transitions, obtained using causal forests. The individual CATE estimates are summarized in quintiles and ranked from smallest to largest. Two methods to predict CATE are presented in Panel a: the out-of-bag predictions following the procedure of Chernozhukov et al. (2018) and the predictions using augmented inverse-propensity weighting (AIPW) following Athey, Tibshirani and Wager (2019). In Panel b, the average worker characteristics are shown, with their standard deviations in parentheses. The unit for the worker's initial wages is USD.

Figure 8: CATE estimates using causal forests: Employment years

(a) Average CATE quintiles by ranking



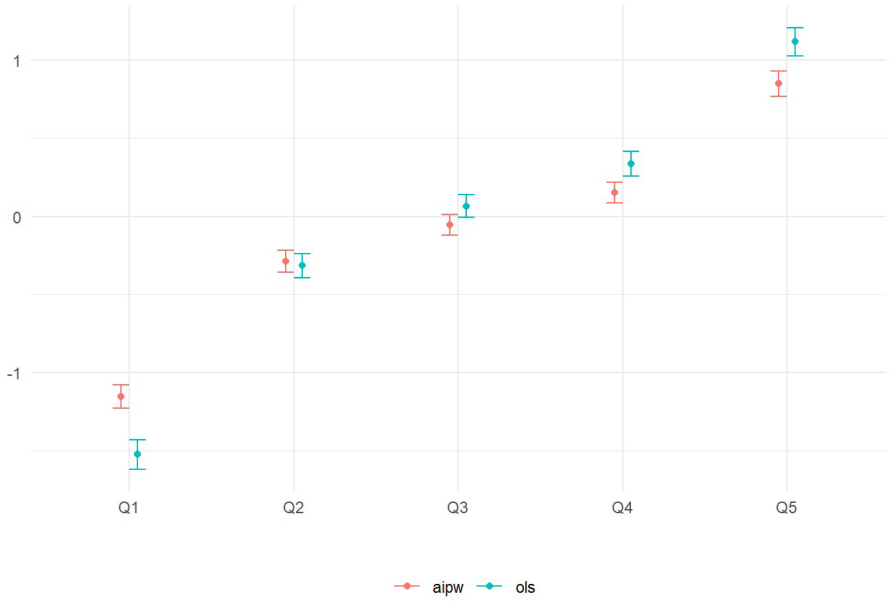
(b) Average covariate values by CATE quintile



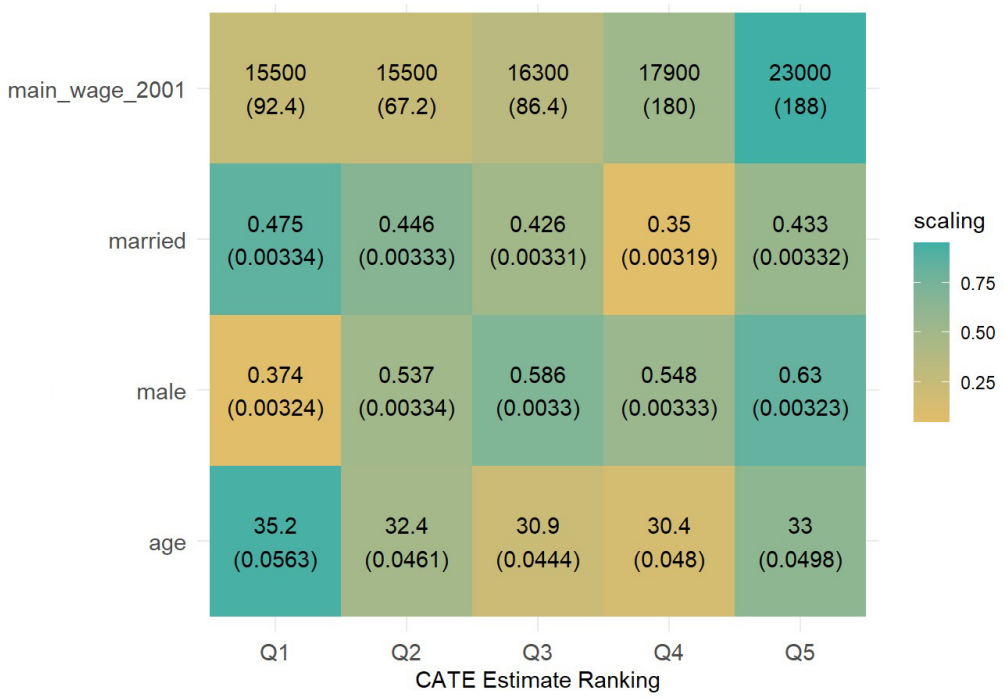
Note: This figure presents the conditional average treatment effect (CATE) estimates of the 2001 liberalization policy on workers' cumulative years of employment, obtained using causal forests. The individual CATE estimates are summarized in quintiles and ranked from smallest to largest. Two methods to predict CATE are presented in Panel a: the out-of-bag predictions following the procedure of Chernozhukov et al. (2018) and the predictions using augmented inverse-propensity weighting (AIPW) following Athey, Tibshirani and Wager (2019). In Panel b, the average worker characteristics are shown, with their standard deviations in parentheses. The unit for the worker's initial wages is USD.

Figure 9: CATE estimates using causal forests: Normalized wages

(a) Average CATE quintiles by ranking



(b) Average covariate values by CATE quintile



Note: This figure presents the conditional average treatment effect (CATE) estimates of the 2001 liberalization policy on workers' cumulative normalized wages, obtained using causal forests. The individual CATE estimates are summarized in quintiles and ranked from smallest to largest. Two methods to predict CATE are presented in Panel a: the out-of-bag predictions following the procedure of Chernozhukov et al. (2018) and the predictions using augmented inverse-propensity weighting (AIPW) following Athey, Tibshirani and Wager (2019). In Panel b, the average worker characteristics are shown, with their standard deviations in parentheses. The unit for the worker's initial wages is USD.

B Additional Robustness Results

B.1 Additional Robustness Checks for Firm-level Analysis

B.1.1 Alternative Matching Method

To examine the robustness of our firm-level results to alternative matching methods, we perform the kernel matching method on the treatment and control firms based on the same pre-policy observable characteristics. Table 12 summarizes the firm-level variables before and after matching. The treatment and control firms share closer pre-policy characteristics after matching, in particular, the tendency to invest in the same industry in China.

Table 12: Summary statistics of the kernel-matching firm sample (1998-2000)

	(1)	(2)	(3)	(4)
	Before matching		After matching	
Group	Treatment	Control	Treatment	Control
CN FDI	0.39	0.41	0.36	0.41
CN FDI SIC3	0.09	0.06	0.05	0.04
No. of affiliates	1.28	1.25	1.28	1.19
Parent employment	474.15	377.84	440.70	378.45
Parent total wage bill	5.61	4.35	5.22	4.39
Parent total sales	71.89	41.73	64.34	33.97
Parent export sales	58.44	30.27	51.67	23.03
Affiliate employment	866.23	797.28	765.86	539.80
Affiliate total wage bill	1.53	1.20	1.35	0.89
Affiliate total sales	67.94	19.42	53.12	16.11
Affiliate export sales	43.65	17.25	28.97	13.75
Observations	190	194	174	184

Note: This table shows the summary statistics for the firm sample constructed using the kernel matching method. "CN FDI" is an indicator of whether a Taiwanese electronic manufacturer conducted FDI in China, and "CN FDI SIC3" is an indicator of whether a Taiwanese electronic manufacturer conducted FDI in China in the same three-digit industry. "Parent" denotes the parent branch in Taiwan, and "affiliate" denotes the affiliate branch in China. The unit for sales and wages is million USD. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 13: Robustness check: Firm extensive margin outcomes (kernel-matching sample)

	(1) Exit	(2) CNFDI	(3) CNFDI SIC3	(4) CNFDI NOT SIC3
Treatment*Post	0.000	0.050	0.100**	-0.050
	(0.004)	(0.041)	(0.044)	(0.052)
US NNTR Gap*Post	-0.000	-0.002	0.002	-0.004
	(0.000)	(0.003)	(0.002)	(0.003)
US Import Tariffs	-0.000	0.006	-0.062	0.068
	(0.021)	(0.048)	(0.060)	(0.089)
CN Import Tariffs	-0.001	-0.006	-0.014**	0.008
	(0.001)	(0.008)	(0.007)	(0.006)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Size*Post FE	Yes	Yes	Yes	Yes
Pre-policy control mean	0.000	0.390	0.035	0.355
Observations	3580	3580	3580	3580

Note: This table shows the DID estimates α_1 in Equation (1) for firm extensive margin outcomes. Exit is an indicator of a firm that exists in the data in the previous year but disappears in the current year. CN FDI denotes a firm investing in China in a given year. CNFDI (NOT) SIC3 denotes a firm investing in China in the same (different) three-digit industry from the parent firm in a given year. The pre-policy control mean is the mean outcome for the control firms over 1998-2000. Standard errors are clustered at the ISIC four-digit industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 14: Robustness check: Firm intensive margin outcomes (kernel-matching sample)

(a) Parent firms in Taiwan

	(1) Employment	(2) Wage bill per worker	(3) Total sales	(4) Export sales
Treatment*Post	-189.5	-1.0	736.3**	731.5**
	(314.4)	(0.8)	(205.8)	(206.6)
US NNTR Gap*Post	6.2	0.2***	17.2*	17.2*
	(4.6)	(0.1)	(8.0)	(7.7)
US Import Tariffs	2.1	2.2**	3.5	6.1
	(80.5)	(0.8)	(106.1)	(105.5)
CN Import Tariffs	15.6	0.2	-4.7	-3.7
	(9.7)	(0.1)	(14.6)	(13.7)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Size*Post FE	Yes	Yes	Yes	Yes
Pre-policy control mean	739.9	12.0	64.6	47.1
Observations	367	367	367	367

(b) Affiliate firms in China

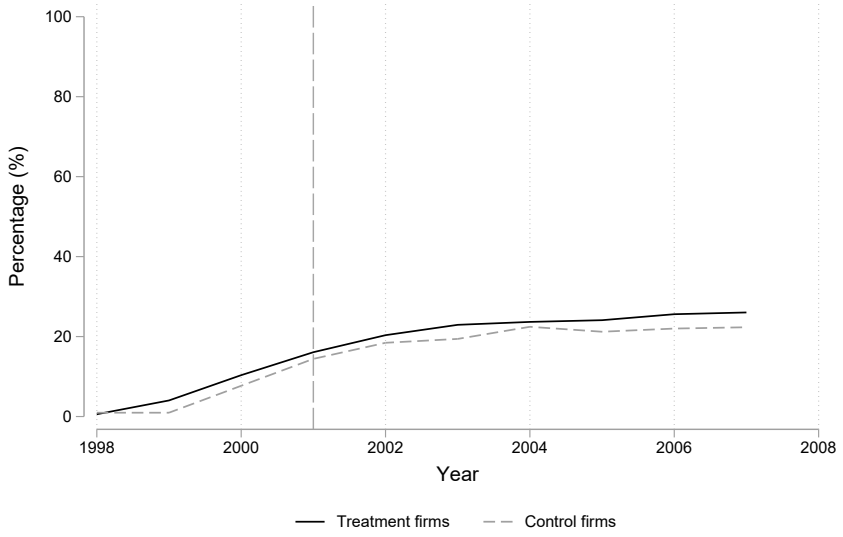
	(1) Employment	(2) Wage bill per worker	(3) Total sales	(4) Export sales
Treatment*Post	2970.6***	-1.0	674.2*	652.9*
	(630.6)	(0.5)	(291.7)	(303.4)
US NNTR Gap*Post	155.1***	-0.1***	15.6*	13.5*
	(40.6)	(0.0)	(6.6)	(6.7)
US Import Tariffs	1910.0	-0.5	91.3*	80.2**
	(1086.7)	(0.4)	(42.8)	(31.3)
CN Import Tariffs	128.8	0.0	12.8**	10.0**
	(89.7)	(0.0)	(4.4)	(3.7)
Year FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Size*Post FE	Yes	Yes	Yes	Yes
Pre-policy control mean	629.1	1.7	19.3	17.0
Observations	367	367	367	367

Note: This table shows the DID estimates α_1 in Equation (1) for firm intensive margin outcomes. The sample is restricted to firms that have investments in China throughout the sample period (1998–2007). Firms that report missing values in the outcome of interest are also excluded. The unit for wage bill per worker is thousand USD and The unit for sales is million USD. Standard errors are clustered at the ISIC four-digit industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.1.2 Placebo Test of Investments into Alternative Locations

We use the FDI destination list of Taiwanese public firms provided by the Ministry of Economic Affairs (MOEA) and perform a placebo test focused on Taiwanese outward FDI to destinations other than China. Based on these data, we construct an indicator that identifies whether a firm from our one-to-one matched sample invested outside of China in a given year.[17] Figure 10 illustrates the percentage of treatment and control firms with investments outside China between 1998 and 2007. While treatment firms are, on average, slightly more likely to invest in other regions compared to control firms, there is no notable increase before or after 2001.

Figure 10: Non-China FDI for treatment and control firms (1998–2007)



Note: The figures show the percentages of treatment and control firms investing outside of China over 1998–2007. The firm sample is obtained via one-to-one propensity score matching.

To determine whether the liberalization policy influenced firm investments in destinations beyond China, we apply the same DID specification as Equation (1). Table 15 presents estimates from various specifications. The results are generally small and statistically insignificant, indicating that the policy had no observable impact on FDI to other destinations. However, we do find that firms operating in sectors subject to higher US import tariffs (on

[17] A limitation of these data is the inability to observe when a firm closes down an affiliate. For the purpose of this analysis, we assume that firms do not shut down affiliates during the sample period once they are established.

exports from China) are more likely to invest in alternative destinations. This observation aligns with the notion that Taiwanese firms use China primarily as an export platform.

Table 15: Placebo test: Non-China FDI

	NON-CN FDI		
Treatment*Post	0.009	0.018	0.019
	(0.033)	(0.031)	(0.032)
CN Import Tariffs			-0.004
			(0.006)
US Import Tariffs			0.064**
			(0.022)
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Size*Post FE	No	Yes	Yes
Pre-policy control mean	0.032	0.032	0.032
Observations	2780	2780	2780

Note: This table shows the DID estimates α_1 in Equation (1) for firm extensive margin outcomes. "NON-CN FDI" denotes a firm investing in non-China destination countries in a given year. Tariffs are in percentage points. The pre-policy control mean is the mean outcome for the control firms over 1998-2000. Standard errors are clustered at the ISIC four-digit industry level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B.2 Additional Robustness Checks for Worker-level Analysis

The worker sample in the main analysis tracks workers employed in 2001 by firms in the one-to-one propensity score matching sample, where only the closest matches are retained and others are discarded. In the robustness check, we instead track workers employed in 2001 by firms in the kernel-matched sample, where all control units are retained and weighted based on their similarity to treated units.

Table 16: Summary statistics of the kernel-matching worker sample

	All	Treated worker	Untreated worker	T statistics
Male (%)	51.6	54.2	50.3	(15.55)***
Age in 2001	32.0	32.7	31.6	(31.40)***
Wage in 2001	15.8	15.6	15.9	(2.68)**
Wage in 2007	21.5	20.4	22.0	(12.20)***
Left initial firm by 2007 (%)	57.3	67.6	51.6	(65.46)***
Number of workers	174,242	61,578	112,664	

Note: This table presents the summary statistics of incumbent workers employed by the firms included in our kernel-matching sample in 2001. The treated workers are workers employed by the treatment firms in 2001. The untreated workers are workers employed by the control firms in 2001. The unit for wages is thousand USD. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 17: Summary statistics of mean wages by worker group (kernel-matching sample)

Group	Percentile in 2001	No. of workers	Wage in 2001	Wage in 2007
1	<p25	44,650	6.70	10.34
2	p25-p50	44,116	9.82	13.52
3	p50-p75	43,391	14.07	19.82
4	p75-p90	25,565	22.14	31.65
5	>p90	16,520	51.10	61.25

Note: The unit for wages is thousand USD.

Table 18: Robustness check: Worker average effect (kernel-matching sample)

(a) Job transitions and years employed by destination

	Job transitions	Years employed				Years unemployed
		Overall	Initial firm	Initial industry	Other industries	
Treated	0.235***	-0.067	-0.437***	0.071	0.299*	0.067
	(0.042)	(0.047)	(0.099)	(0.087)	(0.124)	(0.047)
US NNTR Gap	-0.007**	-0.000	0.017**	0.014**	-0.032***	0.000
	(0.003)	(0.002)	(0.006)	(0.005)	(0.009)	(0.002)
US Import Tariffs	-0.044	-0.046	0.038	0.303***	-0.386**	0.046
	(0.038)	(0.028)	(0.096)	(0.067)	(0.125)	(0.028)
CN Import Tariffs	-0.008	-0.001	0.027	-0.000	-0.028	0.001
	(0.007)	(0.004)	(0.017)	(0.011)	(0.024)	(0.004)
Size FE	Yes	Yes	Yes	Yes	Yes	Yes
Control mean in 2007	0.922	6.365	4.777	0.489	1.099	0.635
Observations	174,242	174,242	174,242	174,242	174,242	174,242

(b) Normalized wages by destination

	Wages earned			
	Overall	Initial firm	Initial industry	Other industries
Treated	-0.078	-0.441**	0.091	0.272
	(0.187)	(0.155)	(0.138)	(0.170)
US NNTR Gap	-0.003	0.020**	0.019**	-0.042**
	(0.009)	(0.007)	(0.007)	(0.012)
US Import Tariffs	-0.035	0.107	0.389***	-0.531**
	(0.117)	(0.138)	(0.094)	(0.165)
CN Import Tariffs	-0.007	0.030	0.000	-0.037
	(0.017)	(0.018)	(0.015)	(0.033)
Size FE	Yes	Yes	Yes	Yes
Control mean in 2007	7.179	5.333	0.616	1.230
Observations	174,242	174,242	174,242	174,242

Note: This table presents the regression estimates of the average effects of the liberalization policy on workers' cumulative outcomes. Job transitions, years employed, years unemployed, and wages earned are cumulative outcomes from 2001 to 2007. Self-employed individuals are treated as unemployed. The cumulative wages are normalized by wages in 2001. Control variables include worker age, age squared, gender, and marital status, their initial employer's average yearly Chinese import tariffs (on exports from Taiwan), US import tariffs (on exports from China), the gaps between US NTR and NNTR tariffs, and firm-size decile group. Standard errors are clustered at the SIC four-digit industry level. The control mean is the mean outcome for untreated workers. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 19: Robustness check: Worker heterogeneity by initial wage (kernel-matching sample)

(a) Job transitions and years employed by destination

	Job transitions	Years employed				Years unemployed
		Overall	Initial firm	Initial industry	Other industries	
Treated*<p25	0.172**	-0.141	-0.490***	0.129	0.220	0.141
	(0.060)	(0.080)	(0.129)	(0.065)	(0.121)	(0.080)
Treated*p25-p50	0.242**	-0.324***	-0.624**	0.134	0.165	0.324***
	(0.088)	(0.080)	(0.189)	(0.073)	(0.139)	(0.080)
Treated*p50-p75	0.183**	-0.310***	-0.448***	0.049	0.089	0.310***
	(0.053)	(0.076)	(0.122)	(0.040)	(0.088)	(0.076)
Treated*p75-p90	0.019	-0.123***	-0.004	-0.083	-0.036	0.123***
	(0.068)	(0.032)	(0.141)	(0.043)	(0.104)	(0.032)
Treated	0.094	0.131*	-0.076	0.007	0.200	-0.131*
	(0.050)	(0.054)	(0.115)	(0.056)	(0.146)	(0.054)
Size FE	Yes	Yes	Yes	Yes	Yes	Yes
Control mean in 2007	0.922	6.365	4.777	0.489	1.099	0.635
Observations	174,242	174,242	174,242	174,242	174,242	174,242

(b) Normalized wages by destination

	Wages earned			
	Overall	Initial firm	Initial industry	Other industries
Treated*<p25	-0.449	-0.846**	0.052	0.345*
	(0.384)	(0.252)	(0.163)	(0.135)
Treated*p25-p50	-0.849**	-1.066***	0.081	0.136
	(0.279)	(0.264)	(0.114)	(0.139)
Treated*p50-p75	-1.005***	-0.964***	-0.046	0.005
	(0.226)	(0.220)	(0.070)	(0.097)
Treated*p75-p90	-0.833***	-0.530**	-0.184*	-0.118
	(0.122)	(0.178)	(0.075)	(0.122)
Treated	0.629*	0.335	0.103	0.191
	(0.247)	(0.226)	(0.083)	(0.172)
Size FE	Yes	Yes	Yes	Yes
Control mean in 2007	7.179	5.333	0.616	1.230
Observations	174,242	174,242	174,242	174,242

Note: This table presents the regression estimates of the heterogeneous effects of the liberalization policy on workers' cumulative outcomes by worker's initial wage. Control variables include worker age, age squared, gender, and marital 's average yearly Chinese import tariffs (on exports from Taiwan), US import tariffs (on exports from China), the gaps between US NTR and NNTR tariffs, and firm-size decile group. Standard errors are clustered at the SIC four-digit industry level. The control mean is the mean outcome for untreated workers. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 20: Robustness check: Worker heterogeneity by gender (kernel-matching sample)

(a) Job transitions and years employed by destination

	Job transitions	Years employed				Years unemployed
		Overall	Initial firm	Initial industry	Other industries	
Treated*Male	-0.226***	0.164***	0.619***	-0.188*	-0.267***	-0.164***
	(0.032)	(0.041)	(0.079)	(0.080)	(0.073)	(0.041)
Treated	0.356***	-0.154*	-0.767***	0.172*	0.441***	0.154*
	(0.048)	(0.064)	(0.118)	(0.084)	(0.105)	(0.064)
Size FE	Yes	Yes	Yes	Yes	Yes	Yes
Control mean in 2007	0.922	6.365	4.777	0.489	1.099	0.635
Observations	174,242	174,242	174,242	174,242	174,242	174,242

(b) Normalized wages by destination

	Wages earned			
	Overall	Initial firm	Initial industry	Other industries
Treated*Male	0.134	0.588***	-0.234	-0.220*
	(0.179)	(0.137)	(0.141)	(0.094)
Treated	-0.150	-0.754***	0.215	0.389**
	(0.176)	(0.140)	(0.117)	(0.135)
Size FE	Yes	Yes	Yes	Yes
Control mean in 2007	7.179	5.333	0.616	1.230
Observations	174,242	174,242	174,242	174,242

Note: This table presents the regression estimates of the heterogeneous effects of the liberalization policy on workers' cumulative outcomes by worker gender. Control variables include worker age, age squared, gender, and marital 's average yearly Chinese import tariffs (on exports from Taiwan), US import tariffs (on exports from China), the gaps between US NTR and NNTR tariffs, and firm-size decile group. Standard errors are clustered at the SIC four-digit industry level. We set gender = 1 for males and gender = 0 for females. The control mean is the mean outcome for untreated workers. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.