

Offshoring and labor market outcomes

by

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Abstract

This report focuses mainly on the impact of offshoring activities on labor market. An in-depth review of economists' empirical work indicates that the effect of increasing offshoring depends on the locations, tasks, and industries of the offshoring activity. In particular, increasing offshoring activities to low-income countries negatively affects most-routine workers' wages and positively affects intermediate-routine workers' wages. However, increasing offshoring to high-income countries hurts intermediate-routine workers' wages and benefits most-routine workers' wages on average. Moreover, we find a net positive effect of increasing offshoring activities on domestic employment despite substantial job loss; however, the magnitude depends on the industry revenue level of the offshoring firm.

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Chapter 1: Introduction

Offshoring is an innovative form of international trade that involves relocating domestic jobs abroad as production facilities and tasks move to foreign locations. Economists have established an overall benefit of offshoring using the concept of comparative advantage. Comparative advantage explains that, when two countries have the same resources the country that produces a higher quantity of the particular good at a lower cost should specialize in producing that good and trade freely. Therefore, offshoring increases productivity within an industry and reduces final goods' prices for consumers globally.

Despite these benefits, there are instances where offshoring could significantly affect the income distribution of a country's labor force. Some politicians, especially in developed countries, argue against the practice based on its negative effect on domestic workers. Politicians claim that offshoring is not a nationalist practice as foreigners receive jobs intended for nationals. For instance, in 2004, John Kerry's presidential campaign centered on offshoring. Kerry promised a tax code to discourage firms from building production plants abroad (Mankiw and Swagel, 2006). More recently, Donald Trump's 2016 presidential campaign, launched in 2015, touches on offshoring. Trump promised to regain manufacturing jobs in the United States by increasing tariffs on China to discourage multinational firms from offshoring activities (UC Santa Barbara, 2015).

Given the economic and political importance of offshoring, this report discusses different papers that evaluate the impact of offshoring on the domestic labor market with special attention to employment and wages. Essentially, this report reviews economists' empirical papers in top journals to shed light on this issue and debunk fallacies about the offshoring debate. Based on

empirical studies of trade literature, the report finds that offshoring has different effects across different groups of workers depending on the offshoring locations, skills, and industries.

The report follows this order: Chapter 1 introduces the report. Chapter 2 describes offshoring and its trends using the Foreign Direct Investment measure. Chapter 2 uses offshoring incentives to explain offshoring trends and introduces firm heterogeneity to clarify that firm's productivity is significant in determining a firm's ability to become multinational. Chapter 3 discusses economists' approach and empirical findings in their studies on the domestic labor market effect of offshoring. Chapter 4 concludes the report with findings from reviewing economists' empirical works.

Chapter 2: Offshoring and Firm Motive to Offshore

Contextual information on offshoring is relevant to understanding why firms decide to offshore production activities abroad. Therefore, this chapter will first briefly define offshoring and observe its trend and growth using data on Foreign Direct Investment (FDI) flows. Moreover, the chapter will further discuss offshoring in the service industry as a significant driver in the growth of FDI flows, a measure of offshoring. Thirdly, the chapter clarifies that minimizing trade or transportation costs (horizontal FDI) and production costs (vertical FDI) motivates multinational firms to move production processes abroad. Lastly, the chapter argues that firms' productivity is significant in determining a firm's ability to become multinational.

2.1 Contextual Information on Offshoring

2.1.1 Offshoring and Foreign Direct Investment (FDI)

Offshoring is a business practice that involves firms relocating part of production process to foreign countries by foreign outsourcing and FDI flows. Foreign outsourcing describes a parent firm contacting an independent firm in a foreign country to produce a component needed for final production. FDI flows record, for instance, firms building production facilities in foreign countries- the flow of FDI out of parent firms' country refers to FDI outflows. In contrast, the flow of Foreign Direct Investment into a foreign nation refers to FDI inflows (Krugman, Obstfeld, & Melitz, 2017).

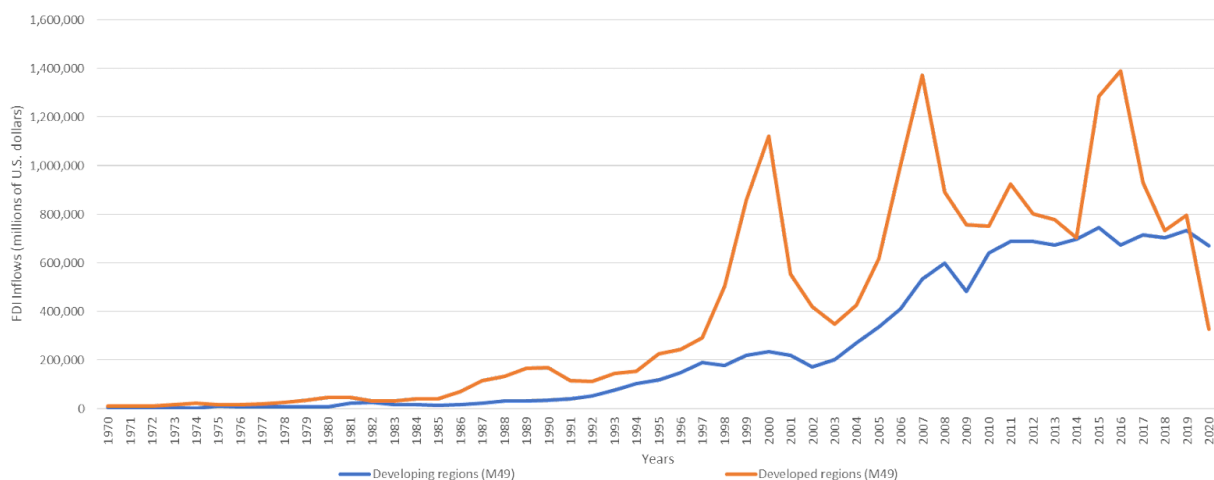
Offshoring is mostly prevalent among firms with enormous profits, sales, and capital/worker ratios (Hummels, Jørgensen, Munch, & Xiang, 2014). According to U.S statistics, a firm is categorized as multinational if it holds ownership of at least 10 percent of a foreign firm because Central banks believe that 10% is enough to have effective control over business operations (Krugman, Obstfeld, & Melitz, 2017). Apple Inc. is an example of a U.S.-based

multinational firm that heavily depends on offshoring, as 98% of its product components are manufactured and assembled worldwide, mainly in Asia (Apple Supplier List for 2020 Fiscal Year, 2021).

2.1.2 Global Offshoring Trend Using FDI Measure

The rate at which firms engage in offshoring activities has increased. As explained above, offshoring may involve FDI flows, thus, making it a good measure of offshoring activities. Figure 2.1 visually represents worldwide FDI flows by regions (developed and developing) using 1970 to 2020 data obtained from United Nations Conference on Trade and Development Statistics (UNCTDSTAT). Usually, developed nations are referred to as high-income countries, while developing countries are low- and middle-income countries. With this definition, developing regions include Africa, Latin America, the Caribbean, Asia, and Oceania, excluding Israel, Japan, and the Republic of Korea in Asia, and Australia and New Zealand in Oceania. In contrast, the developed region includes Northern America, Europe, and includes nations excluded from the developing region which are Israel, Japan, the Republic of Korea, Australia, and New Zealand.

Figure 2.1 Global FDI Inflows by Regions

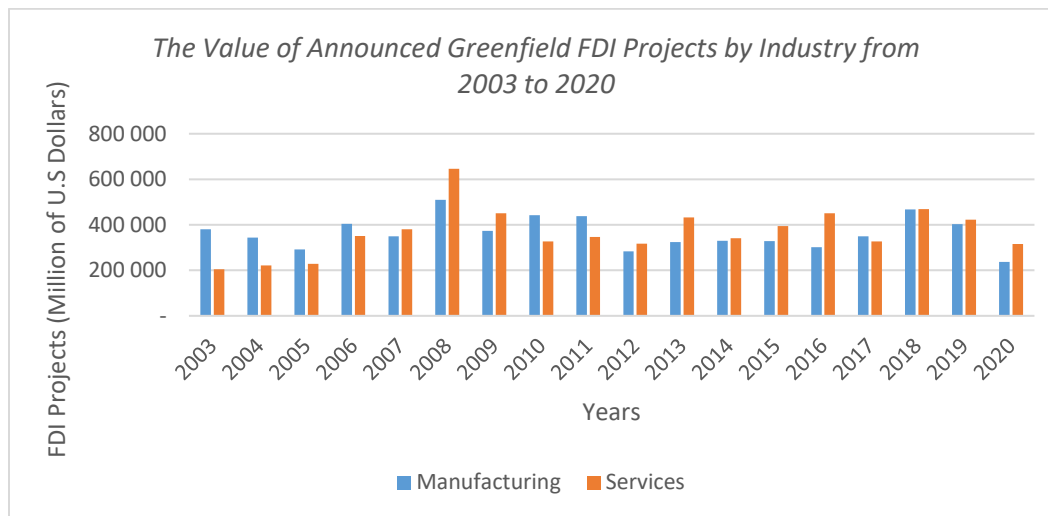


Source: UNCTADstat

Since the 1970s, developed nations received FDI inflows, while developing nations began to receive FDI inflows after the early 1990s. Both developed and developing regions have experienced growth in FDI inflows over the years, with developed regions dominating the inflows of FDI until the great recession of 2008. In 2020, we observed a reverse trend. Despite the decline in developing regions' FDI inflows (9%), the region dominated FDI flows because of the significant decline in developed region FDI inflows (59%). The decline in developed and developing nations' FDI inflows can be associated with the COVID-19 pandemic. Studies by (OECD, Foreign Direct Investment Flows in the Time of COVID-19, 2020; UNCTAD, 2022) indicated that the pandemic discouraged foreign investment because of the negative demand shock that significantly affected businesses of top Multinational Firms.

Although the pandemic negatively affected FDI inflows, it is worth noting that the disparities in the decline in FDI inflows by regions can be related to China receiving substantial FDI inflows vis-à-vis the rest of the world. In 2020, China was ranked as the largest recipient of FDI worldwide, followed by the United States and the United Kingdom (OECD, FDI in Figures, 2021). The 2020 growth in China's FDI inflows is associated with the expansion of FDI inflows into the Chinese technology and service industries (UNCTAD, Investment Flows to Developing Asia Defy COVID-19, Grow by 4%, 2021).

Figure 2.2 The Global Value of Greenfield FDI Projects by Industries



Source: UNCTAD, using information from the Financial Times Ltd, fDi Markets (www.fDimarkets.com).

Offshoring is not unique to the manufacturing industry as it is a common practice in other industries such as services. In the service industry, offshoring involves relocating services to foreign locations. An example of service offshoring is when a multinational firm decides to open a call center or restaurant in a foreign country and employ foreigners for the task. In the last decade, the growth in offshoring activities has been driven by service offshoring (Krugman et al., 2017). This trend can be observed in Figure 2.2. Historically, greenfield FDI projects were prominent in the manufacturing industry. However, since 2008 the service industry has experienced growth that surpasses the manufacturing sector FDI and therefore contributes to the growth in offshoring activities. Understanding that offshoring occurs across industries is crucial in empirically estimating the labor market effect of offshoring.

2.2 Firms Motive to Offshore

2.2.1 Horizontal FDI

Multinational firms participate in offshoring activities because of the economic incentives that minimize trade and transportation costs through horizontal FDI. Horizontal FDI occurs

because multinational firms with high demand for products in foreign locations usually face additional transportation and trade expenses to get products to consumers. Given this challenge, multinational firms relocate their entire production process to foreign locations to meet the local market's demand, mainly in developed economies (Markusen & Maskus, 2001). Firms usually compare per-unit export cost and fixed cost of building a new production facility when demand in the foreign market is high. If the latter is lower, then firms' optimal decision is to participate in horizontal FDI.

2.2.2 Vertical FDI

Apart from reducing trade and transportation cost, another economic incentive is that offshoring reduces production cost through vertical FDI. In this case, vertical FDI decision happens because multinational firms can cut production costs by breaking up the production process and moving parts of the process to a foreign affiliate in developed and developing countries. Thus, vertical FDI flows are related to factors of production costs that are lower in other regions due to comparative advantage (Krugman, Obstfeld, & Melitz, 2017).

In most cases, comparative advantage in the vertical FDI model is driven by differences in nations factor abundance related to Heckscher-Ohlin theory of trade. Thus, firms' offshore task and services to countries that have abundance factors. In this case, vertical FDI is cost-saving if the production process is divided by high-skilled labor-intensive activities and low-skilled labor-intensive production activities, and activities are offshored to regions that are abundant in high-skilled labor and low-skilled labor respectively (Helpman, 1984).

Research has shown that developing countries (low-income and middle-income) tend to attract FDI and foreign outsourced activities that are intensive in unskilled labor such as assembly of typical consumer electronic products (Ebenstein, Harrison, McMillan, & Phillips, 2014). This

is because developing nations are abundant in unskilled labor and developed nations are abundant in skilled labor. Therefore, relative factor abundance across regions can explain offshoring trends by region.

2.3 Firms Heterogeneity in Offshoring Decision

Previously, we established that one economic incentive of firms to participate in offshoring is to reduce trade cost that comes from exporting products to consumers in foreign nations. Thus, firms invest in foreign nations by building production facilities to replicate production processes and make them easily available to foreign consumers. However, there are instances where firms do not have the ability to expand production facilities of final and intermediate goods overseas.

Since firms have different productivity levels, only a few firms become multinationals. This can be explained by Firms heterogeneity. The theory explains that firms are not identical as each firm has its unique productivity level, which determines its ability to survive and expand into the global economy. Relating the theory to offshoring implies; firms that experience a lower marginal cost of production are better-performing firms and have a large volume of sales, thereby enabling them to expand production facilities abroad. On the contrary, the least performing firms have smaller sales and primarily sell in the domestic market or export smaller quantities. So, it would be an economic loss for the least performing firm to expand FDI into the foreign market.

An empirical study by (Helpman, Melitz, & Yeaple, Export Versus FDI with Heterogeneous Firms, 2004) demonstrates the firm heterogeneity theory in offshoring. The study uses U.S data on FDI sales and exports across 3,202 firms and finds that offshoring firms, i.e., firms that relocated production plants to foreign locations, were 15 percent more productive than exporters. At the same time, the exporters that serve local and foreign markets were more productive than firms that were forced to exit the industry because of potential negative operating

profit. Thus, firms' productivity is significant in differentiating multinationals from other firms because multinational firms are amongst the most productive firms.

Chapter 3: The Effect of Offshoring on Domestic Labor Market

After a solid background on offshoring, chapter 3 addresses its effect on domestic workers of the offshoring economy. As previously stated, some politicians argue that the domestic workers of the offshoring countries are negatively affected because jobs are relocated overseas. This narrative is logical but flawed as there are instances where domestic workers of offshoring countries experience increased employment and wages. Economist empirical studies find that the effect of offshoring on domestic workers differs across different groups of workers depending on the offshoring locations, tasks, and industries. Therefore, this chapter discusses two primary approaches economists use to draw their conclusions on labor market effect of offshoring. One is a single industry approach, which observes labor outcomes in only the manufacturing industry. While the other is a multi-industry approach, which observes labor outcomes across industries.

3.1 Single Industry Approach Analysis

3.1.1 U.S. Domestic Wages in the Manufacturing Industry

In (Feenstra & Hanson, 1999) paper, workers' wages in the manufacturing industry were observed as offshoring activities increased. Using the large country assumption, the authors use data on the U.S manufacturing industries between 1979 and 1990 to estimate the impact of offshoring and technological changes on wages. The authors use a two-stage estimation process. Firstly, the authors consider foreign outsourcing and high technological capital as the structural variables and determine how their changes affect endogenous variables (industry prices and productivity).

After isolating price changes due to industry productivity, the authors estimate the proportion of changes in primary factor prices associated with foreign outsourcing and high technological capital. The authors find that foreign outsourcing and high technological capital affect workers' wages depending on whether workers perform production or nonproduction tasks. The paper shows that the increase in foreign outsourcing activities is associated with a decline in wages for production workers; however, nonproduction workers' wages tend to increase due to offshoring. Thus, this shows a positive and negative wage effect of offshoring depending on workers' task.

3.1.2 U.S. Domestic Employment in the Manufacturing Industry

(Harrison & McMillan, 2011) paper investigate how offshoring activities between 1982 and 1999 reduced employment in the manufacturing industry in the United States. The authors model the U.S (United States) parent firm employment by observing changes in factor inputs and final goods prices at foreign affiliates' locations. In addition, the authors control for technological changes and fixed time effects. The authors observe that magnitude of change in domestic employment depends on offshoring destinations (low and high-income countries) and the motive of foreign direct investments (FDI). The authors notice a downward pressure on domestic employment when there is a fall in foreign wages at low-income affiliate locations since foreign affiliates and domestic firms perform the same task. However, when foreign affiliates and parent firm perform significantly different tasks, then U.S domestic employment increases. Thus, the magnitude of the effect of offshoring on domestic employment is mixed, and in this case, it depends on the offshoring locations and tasks.

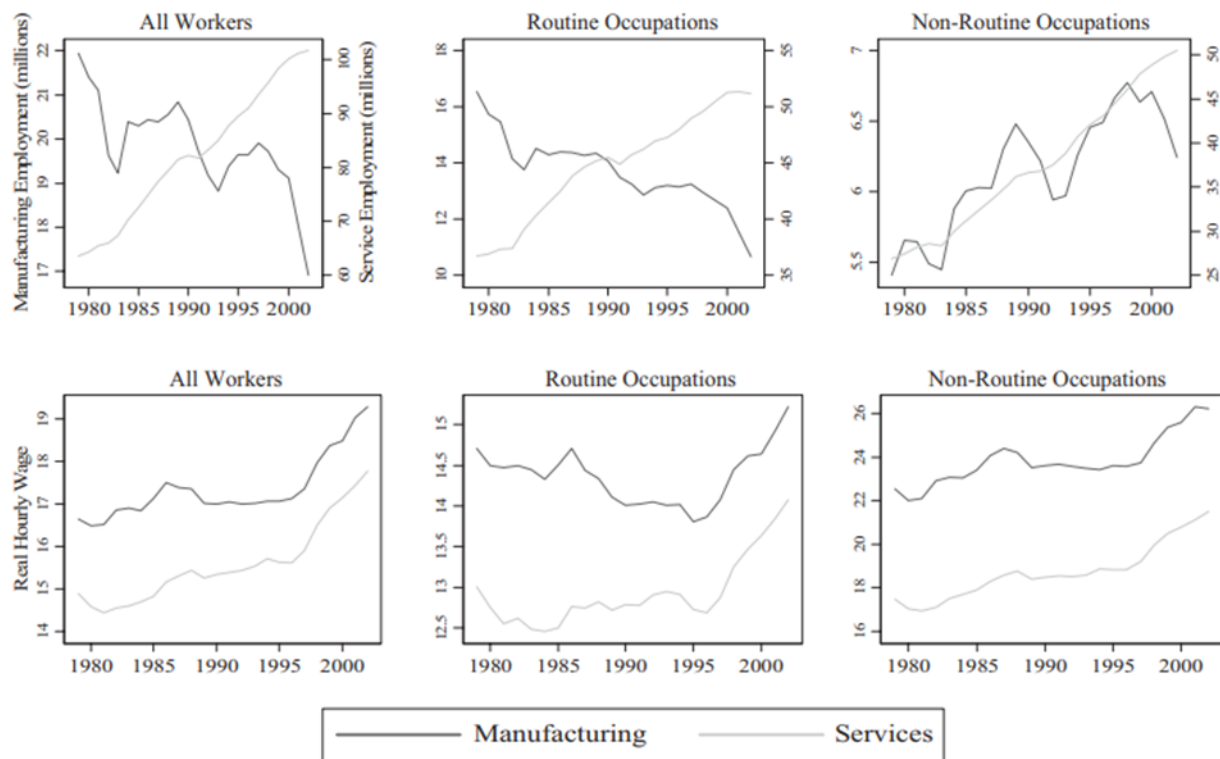
3.2 Multi-Industry Approach Analysis

Although the two papers briefly discussed above have gained popularity in international trade. Nevertheless, the empirical approach has limitations as papers' approach do not capture the net effect of offshoring across industries as labor is mobile and workers can find opportunities in other sectors at a cost (Mitra & Ranjan, 2010). (Ebenstein, Harrison, McMillan, & Phillips, 2014; Hummels, Jørgensen, Munch, & Xiang, 2014; Kovak, Oldenski, & Sly, 2021) are empirical papers that use multi-industry approach that capture the effect of offshoring across sectors.

3.2.1 Occupational Exposure and U.S. Domestic Wages

The paper, (Ebenstein, Harrison, McMillan, & Phillips, 2014), posit that focusing on industry-level exposure may not capture the possibility that workers may move to another industry within their occupation, which minimizes the consequences of exposure on wages. Instead, a worker may be forced to leave their occupation and move, for instance, into service activities; this may then lead to more severe consequences of exposure to globalization forces. Thus, they focus on occupational exposure (rather than industry exposure) to globalization (offshoring).

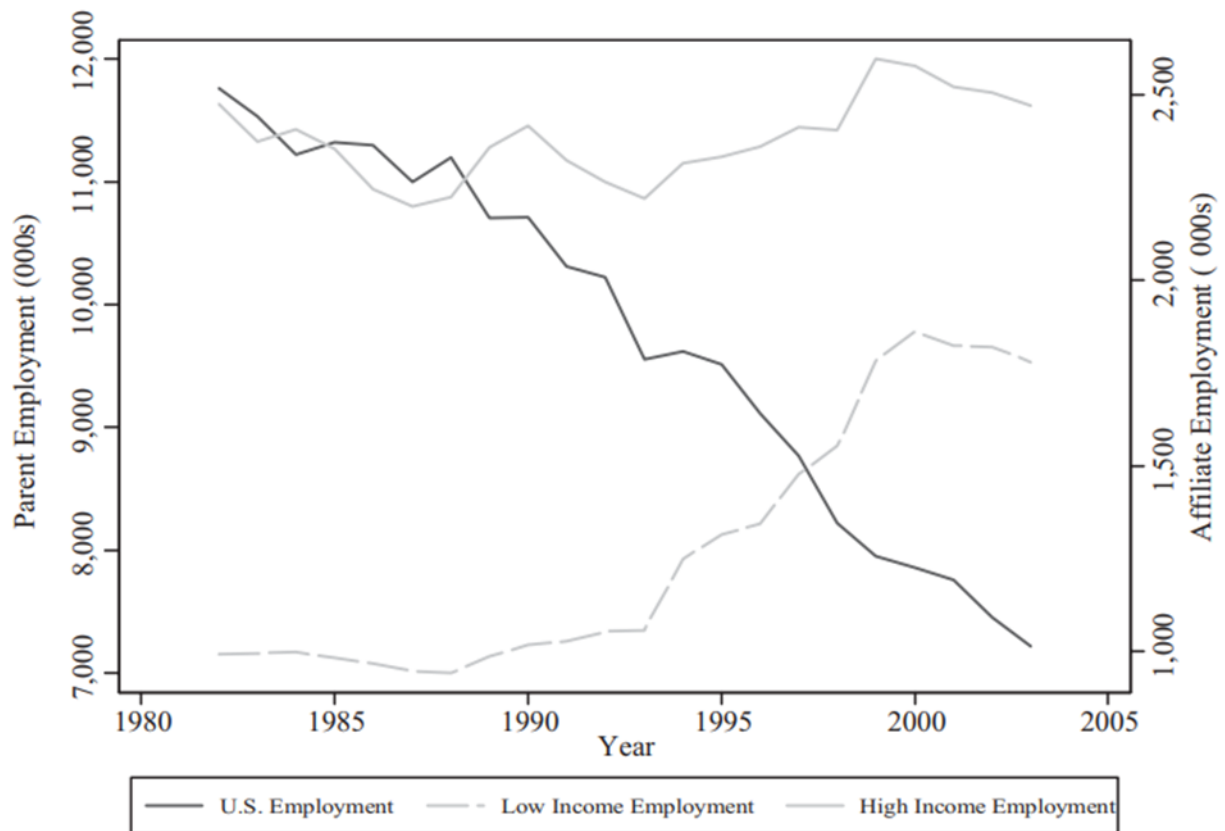
Figure 3.1 Employment and Wages Trends in Manufacturing and Service Industry



Note: Figure is obtained from figure 1 in (Ebenstein, Harrison, McMillan, & Phillips, 2014).

The above figure compares change in U.S. employment alongside changes in real wages of workers employed in both manufacturing and services between 1980 to 2000 using real data obtained from Current Population Surveys (CPS) employment numbers. In this comparison the authors further classify workers in routine and non-routine in each sector. The figure shows that over this period employment in manufacturing declined while employment in services increased. Among routine workers the trend is similar to that of all workers. However, for non-routine workers, employment in both manufacturing and services increased. Importantly, they note that most U.S. expansion of imports originated in their trade with developing countries. As such, they argue that more routine occupations have fared worse from exposure to globalization forces than less routine occupations.

Figure 3.2 Changes in U.S. Multinational Firms' Employment



Note: Figure is obtained from figure 2 in (Ebenstein, Harrison, McMillan, & Phillips, 2014). The sample includes all part-time and full-time workers. Wages are in 2005 dollars.

Figure 3.2 uses data obtained from the Bureau of Economic Analysis to compare simultaneous change in U.S multinational firms' employment in three categories: Domestic, low-income countries, and high-income countries, between 1980 to 2005. Low-income countries affiliate employments increased, while the U.S. affiliate's domestic employment declined. Instead, employment in high-income countries was roughly constant. Thus, Figure 3.2 suggests that exposure to offshoring activities in low-income/developing countries could have a stronger affect to most U.S. routine workers since these countries have comparative advantage in occupations performing mostly routine tasks. Therefore, it suggests that the authors should investigate a

possible substitution effect on wages, in particular, earned by routine workers, as multinational firms increase employment levels in low-income countries.

3.2.1.1 Empirical Strategy of (Ebenstein, Harrison, McMillan, & Phillips, 2014)

The authors use a panel dataset with over 3.4 million U.S. workers and it has information on their industry and occupation from the period 1983 to 2002. This large sample of workers was obtained from the Current Population Survey (CPS) Merged Outgoing Rotation Group. The authors use offshoring activity and trade flows as proxies for globalization forces. Offshoring activities are measured as U.S multinational firms' employment affiliated in low-income countries and high-income countries. This information is retrieved from the Bureau of Economic Analysis (BEA). Trade data consist on import penetration ratios and export shares obtained from (Bernard , Jensen, & Schott, 2006). As explained below, they construct exposure measure at the occupation level using these measures at the industry level.

The productivity control variables data that account for technological changes could confound with offshoring and trade activities. Thus, they control for productivity using Wayne Gray NBER's total factor productivity. As usual, they control for industry-level specific factors that vary by industry and year such as the price of investment goods, capital-to-labor ratios, and the real price of shipping transportation cost. Data on computer usage by industry and occupation is obtained from the CPS computer supplement conducted during the sample period.

This study uses Autor et al. (2003) approach of differentiating occupations according to most, intermediate, and least routine levels. Routine occupations rely heavily on cognitive and manual tasks. Ebenstein et al. (2014) provide some examples. For instance, attaching hands to the face of a watch or answering the phone represent routine tasks. These jobs require commands that do not rely on intense cognitive skills, and, therefore, can easily be offshored or replaced with

goods imported from developing countries. Below expression (1.1) shows the formula for the degree of routineness of occupation k and it ranges from 0 to 1.

$$Routine_k = \frac{Routine\ Cognitive_k + Routine\ Manual_k}{Routine\ Cognitive_k + Routine\ Manual_k + DCP_k + EFH_k + Math_k} \quad (1.1)$$

Where ***Routine Cognitive_k*** and ***Routine Manual_k*** measure the degree of task routine level from 1 to 10 by occupation k , where 1 means not routine and 10 means fully routine task. And $DCP_k + EFH_k + Math_k$ respectively denotes Direct Control Planning of Activities, Eye Foot, and Hand Coordination Activities, and Math indicator for each occupation. Therefore, when DCP_k , EFH_k and $Math_k$ are relatively large, it makes $Routine_k$ smaller and closer to zero. This case would represent an occupation with low-routine level. In this case, occupation tasks require non-routine cognitive skills, therefore discouraging U.S firms from offshoring tasks to developing countries.

For comparison purposes, the industry-level specification used in Ebenstein et al. (2014) is described by the following expression:

$$W_{ijt} = \beta_0 Z_{ijt} + \beta_1 G_{jt-1} + \beta_2 TFP_{jt-1} + \beta_3 PINV_{jt-1} + \beta_4 KLRATIO_{jt-1} + \beta_5 COMP_{jt} + \beta_6 d_t + \beta_7 I_j + \varepsilon_{ijt} \quad (1.2)$$

In expression (1.2), subscripts i and j denote workers and industries, respectively. Other variables are described below:

- Dependent Variable
 - W_{ijt} is the log wage of U.S worker i in industry j at time t
- Explanatory Variables
 - Z_{ijt} is a vector of individual characteristics such as education, age, sex, race, experience, and state/county worked.

- G_{jt-1} is a vector with lagged measures of exposure to offshoring and international trade in industry j at time $t-1$,
- I_j represents the industry fixed effect,
- d_t represents the time fixed effect,
- TFP_{jt-1} denotes productivity in industry j at time $t-1$,
- $PINV_{jt-1}$ represents the price of investment goods in industry j at time $t-1$,
- $KLRATIO_{jt-1}$ represents the factor intensity in industry j at time $t-1$,
- $COMP_{jt}$ denotes computer usage in industry j at time $t-1$.
- β_a represents a vector with the coefficients of interest and other explanatory variables,
- ε_{ijt} represents other factors that are not included in this model.

As seen above, expression (1.2) estimates a causal relationship between industry-level globalization (offshoring activities and international trade) forces and workers' wages while controlling for important variables that confound with globalization. Ebenstein et al. (2014) create a multiple linear regression model that uses Ordinary Least Squares to estimate the industry-level wage effects of globalization. It is important to note that, in this model, the outcome variable is W_{ijt} , the log wage of U.S. workers, and the vector with the variables of interest is G_{jt-1} , which measures the exposure to offshoring activities and international trade. The time fixed effects d_t accounts for business cycle and fluctuation in the exchange rate that could affect the demand of labor and wages.

Lastly, the authors include variables that control for industry-level time-varying shocks that confound with globalization forces. For instance, TFP_{jt-1} accounts for productivity changes

that could affect industry-level demand for labor and wages. Variables $PINV_{jt-1}$, $COMP_{jt}$, and $KLRATIO_{jt-1}$ represent additional controls for productivity differences across industries. Specifically, $PINV_{jt-1}$ captures changes in industrial wages due to falling computer prices. $COMP_{jt}$ and $KLRATIO_{jt-1}$ capture the industry-level impact of replacing labor with computers on wages. Lastly, ϵ_{ijt} control for factors outside the model that could affect U.S. wages.

Notice that Ebenstein et al. (2014) focus on the occupation-level effect of globalization forces on U.S. wages. As such, their baseline specification is described by the following expression:

$$W_{ijtk} = \beta_0 Z_{ijkt} + \beta_1 G_{kt-1} + \beta_2 TFP_{jt-1} + \beta_3 PINV_{jt-1} + \beta_4 KLRATIO_{jt-1} + \beta_5 COMP_{kt} + \beta_6 d_t + \beta_7 I_j + \beta_8 Occupation_k + \epsilon_{ijkt} \quad (1.3)$$

In expression (1.3), subscript k denotes a worker's occupation. To capture occupational exposure, the authors modify the vector with variables of interest to G_{kt-1} . For instance, they represent the occupation specific import penetration by the following expression:

$$\sum_{j=1}^J \alpha_{kj83} IMP_{jt} \quad (1.4)$$

Where the weights α_{kj83} are calculated using

$$\alpha_{kj83} = \frac{L_{kj83}}{L_{k83}} \quad (1.5)$$

Where L_{kj83} is the total number of workers in occupation k and industry j in 1983, which decreases endogeneity concerns since their analysis focuses on information between 1983 and 2002. Notice that L_{k83} is the total number of workers in occupation k across all industries. α_{kj83} denotes share of occupation k 's workers in industry j and it interacts with the vector G_{jt-1} . In this

case, it is the import penetration ratio IMP_{jt} . Notice that expression (1.3) introduces a new control variable $Occupation_k$, which denotes the occupation fixed effect.

3.2.1.2 Main Finding of (Ebenstein, Harrison, McMillan, & Phillips, 2014)

Recall from the empirical section that the degree of occupations' routineness may be crucial in estimating the offshoring and trade effect on U.S. wages. Table 3.1 provides a preliminary examination of the relationship between the industry share of routine jobs and changes in employment offshored and import penetration ratio between 1983 and 2002. The results shown in columns 1 and 2 suggest that a one percentage point increase in industry routine job is associated with a 5.1 and 5.5 percentage point increase in employment offshored to low-income countries, respectively. Instead, the specifications used in columns 3 and 4 suggest that an increase in the share of routine jobs in 1983 does not significantly affect offshoring to high-income countries in future years. Furthermore, the specifications shown in Columns 5 and 6 imply that a one-percentage-point increase in the share of routine jobs in 1983 tends to increase the industry-level import penetration ratio in future years by 1.2 percentage points

Table 3.1 Industry Routine Job and Offshoring to Low- and High-Income Countries

	Dependent Variable: Log Difference in Employment Offshored (1983 -2002)				Dependent Variable: Import Penetration Difference (1983 – 2002)	
	Low–Income Countries		High–Income Countries			
	(1)	(2)	(3)	(4)	(5)	(6)
Industry share of routine jobs, 1983	5.132*** (2.40)	5.501** (2.59)	-0.980 (2.03)	-0.053 (2.26)	1.217*** (0.34)	1.237*** (0.33)
Difference in log of price of investment between 1983 and 2022		-0.262 (0.45)		0.234 (0.40)		-0.079 (0.06)
Difference in total factor productivity level between 1983 and 2022		0.084 (0.07)		-0.056 (0.06)		0.0242** (0.01)
Difference in capital to labor ratio between 1983 and 2022		-0.230 (1.21)		-1.218 (1.06)		-0.249 (0.16)
Difference in computer use rates between 1983 and 2022		0.441 (0.68)		-0.391 (0.59)		0.028 (0.09)
Number of observations	66	59	66	59	66	61
R^2	0.07	0.12	0.00	0.17	0.17	0.35

Note: Table 3.1 is obtained form Table 1 in (Ebenstein, Harrison, McMillan, & Phillips, 2014). Robust Standard Errors are in parentheses below the coefficient estimates.

Table 3.2 describes the baseline results of the paper using data from 1984 to 2002. In this case, the specifications used in columns 1-4 focus on industry-level exposure, and are based on expression (1.2), while the specifications used in columns 5-8 examine the effects of occupation specific exposure, which rely on the estimation of expression (1.3). In each group, the table presents the estimation using all sample of workers (columns 1 and 5), workers in most routine occupations (columns 2 and 6), workers involved with intermediate routine occupations (columns

3 and 7), and workers with least routine occupations (columns 4 and 8). The results shown in columns 1-4 suggest that industry-level globalization forces do not affect U.S. wages.

Instead, the results shown in columns 5-8 suggest that an increase in occupational exposure leads to an average decrease in U.S. wages and this result is driven by workers involved in occupations with high degrees of routineness. The result shown in the first row of column 6 implies that a 1 percent increase in occupational-specific offshoring activities to low-income country for most routine workers is associated with a 0.07 percent decline in U.S. domestic wages. Instead, the result shown in the second row of column 6 suggests that a 1 percent increase in occupational-specific offshoring activities to high-income countries for most routine workers tend to increase U.S. domestic wages by 0.05 percent. These results are in line with the results in Table 3.1, which suggest that occupations with high level of routineness led to more offshoring activities in low-income countries and greater level of imports. Besides, the results emphasize the importance of controlling for workers' occupational exposure rather than industry specific exposure.

Table 3.2 Comparing Industry-Specific Exposure and Occupational-Specific Exposure

Variables	Dependent Variable: Log Wage							
	Offshoring and Trade Measured by Industry-Specific Exposure, Manufacturing Only				Offshoring and Trade Measured by Occupational-Specific Exposure, All Sectors			
	All Occupations	Most Routine	Intermediate Routine	Least Routine	All Occupations	Most Routine	Intermediate Routine	Least Routine
Lagged log of low-income affiliate employment	0.001 (0.002)	0.002 (0.002)	0.000 (0.003)	0.002 (0.003)	-0.040** (0.016)	-0.070*** (0.016)	0.018 (0.029)	0.072 (0.056)
Lagged log of high-income affiliate employment	0.014*** (0.005)	0.008* (0.005)	0.011 (0.007)	0.024*** (0.008)	0.034** (0.015)	0.050*** (0.014)	-0.003 (0.026)	-0.045 (0.048)
Lagged export share	0.022 (0.043)	-0.021 (0.058)	0.002 (0.048)	0.047 (0.045)	0.255** (0.121)	0.677*** (0.157)	0.232 (0.184)	-0.815* (0.420)
Lagged import penetration	0.077 (0.050)	0.090 (0.061)	0.042 (0.057)	-0.050 (0.074)	-0.290*** (0.091)	-0.296*** (0.099)	-0.761 (0.466)	1.083 (0.750)
Number of Observation	551,528	316,048	150,319	85,161	3,068,095	1,109,835	1,156,208	802,02
R^2	0.46	0.39	0.41	0.38	0.50	0.42	0.54	0.40

Note: Table 3.2 is obtained from Table 2 in (Ebenstein, Harrison, McMillan, & Phillips, 2014). Robust Standard Errors are in parentheses below the coefficient estimates. Estimates have been rounded up to 3 decimal places.

Table 3.3 considers the same specifications used in Table 3.2 while using data between 1997 and 2002. This timeframe coincides with higher levels of globalization relative to the mid-1980s, for instance. It is noticeable from column 1 to 4 that industry-level globalization forces do not affect U.S. wages. Again, however, exposure to imports and offshoring to low-income countries at the occupation level tends to affect negatively the workers in most-routine occupations. Specifically, a one percent increase in offshoring to low-income countries decrease wages by 0.198 percent. These results are found in column 5 of Table 3. Likewise, these workers are negatively affected by competition from imports. In this case, an increase of 1 percentage point

increase in exposure to imports leads to a decline of 0.3 percent in wages. The latter effect is not present for least-routine workers, for instance.

Table 3.3: Comparing Industry-Specific Exposure and Occupational-Specific Exposure 1997-2002

Variables	Dependent Variable: Log Wage							
	Offshoring and Trade Measured by Industry-Specific Exposure, Manufacturing Only				Offshoring and Trade Measured by Occupational-Specific Exposure, All Sectors			
	All Occupations (1)	Most Routine (2)	Intermediate Routine (3)	Least Routine (4)	All Occupations (5)	Most Routine (6)	Intermediate Routine (7)	Least Routine (8)
Lagged log of low-income affiliate employment	-0.009 (0.006)	-0.005 (0.008)	-0.022*** (0.008)	0.002 (0.013)	-0.107*** (0.040)	-.198*** (0.038)	0.147*** (0.050)	0.330* (0.165)
Lagged log of high-income affiliate employment	-0.002 (0.009)	-0.014 (0.010)	0.004 (0.013)	0.016 (0.022)	0.095** (0.037)	0.169*** (0.035)	-0.140*** (0.042)	-0.299** (0.143)
Lagged export share	-0.021 (0.072)	-0.111 (0.078)	0.039 (0.092)	0.049 (0.075)	0.478*** (0.178)	0.999*** (0.240)	0.292 (0.271)	-0.808 (0.948)
Lagged import penetration	0.119 (0.073)	0.196** (0.094)	-0.067 (0.150)	-0.094 (0.176)	-0.306** (0.146)	-0.437** (0.160)	-0.035 (0.587)	1.668 (1.419)
Number of Observation	132,104	71,985	36,982	23,137	886,984	291,894	337,057	258,033
R^2	0.44	0.35	0.40	0.38	0.48	0.39	0.51	0.37

Note: Table 3.3 is obtained from Table 4 in (Ebenstein, Harrison, McMillan, & Phillips, 2014). Robust errors are in parentheses.

In general, the authors give evidence that estimating the effect of offshoring by only observing industry exposure minimizes the effect of offshoring on domestic wages. To accurately estimate the effect of offshoring on a country's labor market, one should look at occupational exposure as workers might move across industry. More importantly, by observing occupation exposure, its effect on wage is conditional on the country that receives offshoring job. When firm offshore job to low-income countries, we observe that most routine workers experience a

significant negative impact on their wages. Whereas least routine workers' wages are positively impacted. On the other hand, when high income country receives the offshoring task, most routine worker wages at home experience increase in wages. Whereas wages of least routine workers in domestic countries tend to decrease. Next, we will discuss (Hummels, Jørgensen, Munch, & Xiang, 2014) empirical findings in estimating the effect of offshoring on Dutch workers across various industries while observing firms' offshoring and trade activities.

3.2.2 Occupation and Skill Exposure, Trade Pattern, and Dutch Wages

The motive behind Hummels et al. (2014) is that offshoring could potentially affect wages depending on the worker's skill level and whether the firm primarily imports or focuses mainly on exports. For instance, firms that have increased offshoring activities without increasing their export activity over time might force their employees to leave because their jobs have relocated to another location. In estimating offshoring activities on wages, the authors focus on a more recent approach of matching workers and firm data. The authors use Denmark for this study because of the flexibility of its labor market, which makes it a viable candidate for this study.

The authors use retail share to distinguish the service industry from manufacturing. The retail share is a fraction that captures firms that resell a substantial fraction of imported products with no value-added. On average, the retail share for a manufacturing firm is 2.9 percent, while service firms have a retail share of 35.5 percent. The manufacturing retail share proves that manufacturing firms import intermediate goods used for production rather than final goods. Then, the authors hypothesize that offshoring activities result in the firm substituting labor with imported materials (intermediate goods) as employees could have produced the imported goods. Further, the authors account for domestic production replaced by imported intermediate inputs using

narrow offshoring, i.e., the value of imports that fall under the same categories as goods sold by firms.

Notably, the authors note that Danish offshoring firms are large exporters, an observation in line with studies about the distribution of firms across countries. On the other hand, firms that import more likely tend to export, which they control for and can then investigate the net effect of offshoring. Essentially, workers are affected depending on their skill levels and the net trade position of the firm in which they work. Table 3.4 establishes some priors Hummels et al. (2014) used to determine their main hypotheses.

Table 3.4 Firm Trade Pattern and Offshoring Decision

	OLS	Firm FE	Firm FE predicted offshoring	Firm FE predicted offshoring and exports	
	Offshoring Dummy (1)	log(offshoring) (2)	log(offshoring) (3)	Log(offshoring) (4)	Log(exports) (5)
Log employment	0.681***	0.044***	-0.106***	-0.205***	0.374***
Log gross output	0.958***	0.082***	0.394***	0.143**	0.511***
Log accounting profits	0.953***	0.066***	0.506***	0.001	0.908***
Log (Capital per worker)	0.161*	0.005	0.245***	0.119***	0.243**
Log(wage bill per worker)	0.040**	0.014***	0.224***	0.131***	0.113***
Log material inputs	1.162***	0.083***	0.195**	-0.140*	0.725***
Log domestic material inputs	0.668	0.037***	0.355***	-0.082	0.847***
Share of high-skilled workers	-0.007	0.002*	0.091***	0.053***	0.055**
Materials/output	0.093***	0.005**	-0.049*	-0.063**	0.057*
Domestic materials/output	-0.043**	-0.011***	0.012	-0.026	0.073**

Note: Table 3.4 is obtained from Table 3 in (Hummels, Jørgensen, Munch, & Xiang, 2014).

The authors regress several firm characteristics on offshoring status and volume. These characteristics include employment, capital-labor ratio, and the importance of inputs in production. Importantly, column 3 estimates the effects of offshoring activities using predicted imports. In this case, results suggest a one percent increase in predicted offshoring leads to a 0.1 percent decline in employment. This result is essential for showing potential endogeneity concerns relating to firm size and offshoring activities.

Moreover, it shows that offshoring may have deleterious effects on employment. Besides, the results in column 3 also show that offshoring may increase the employment of skilled workers relative to unskilled workers, an essential feature of their analysis. Finally, the results in column 5 show that exports tend to boost employment levels and profits, alongside a relative increase in the employment of skilled workers.

3.2.2.1 Empirical Strategy of (Hummels, Jørgensen, Munch, & Xiang, 2014)

The study uses 1.95 million worker-firm-year and 9,800 firm-year observations. The authors obtained firm data from Firm Statistics Register (FirmStat) for 1995-2006. Data on workers' characteristics and employment information came from the Integrated Database for Labor Market Research or IDA. Data include workers' hourly wages, education, occupation, and skill level (International Standard Classification of Educations). In addition, information on firm-level trade flows, including country of origin and destination, was acquired from the Danish Foreign Trade Statistics Register for the same period. Firm-Integrated Database for Labor Market Research (FIDA) combined firms, workers, and trade flows data. Matching three levels of data helps to control for job-spell fixed effects. The private firms included in the sample must be large enough, implying a minimum of 50 employees and 0.6 million DKK imports.

It is important to note that this paper differentiates between narrow and broad offshoring to capture inputs that substitute domestic jobs within a firm. The authors adapt Feenstra and Hanson's (1999) idea of narrow offshoring, the total number of imports categorized in the same group as goods produced and sold by manufacturing firms either abroad or at home. Specifically, individual firms' total imports in the same 6-digit of the HS category are goods sold by the firm domestically or globally. The following expression describes the worker-firm-year level specification used in Hummels et al. (2014):

$$\ln w_{ijt} = b_{L,M} \ln M_{jt} + b_{M1} S_i \ln M_{jt} + b_{L,X} \ln X_{jt} + b_{X1} S_i \ln X_{jt} + x_{it} \beta_1 + z_{it} \beta_2 + \alpha_{ij} + \varphi_{IND,t} + \varphi_R + \varepsilon_{ijt}, \quad (2.1)$$

In expression (2.1) subscripts j , t and i denote firm, time, and worker respectively. Other variables are described below:

- w_{ijt} is the independent variable that represents wages of workers i employed by firm j in year t ,
- M_{jt} denotes imported inputs at firm j at time t ,
- X_{jt} denotes the value of firm j 's export in year t ,
- S_i represent a dummy variable for worker i that is high skilled,
- β_1 is a vector of individual characteristics of worker i such as experience, union status, and marital status,
- β_2 is a vector of individual characteristics of firm j such as output, employment, capital, and skilled worker share of employment,
- α_{ij} represents worker-by-firm fixed effects,
- $\varphi_{IND,t}$ represents year-by-industry fixed effect,

- φ_R represents region fixed effect,
- ε_{ijt} represents other factors that are not included in this model,

The coefficients denote:

- $b_{L,M}$ estimates the coefficient of imported inputs at firm j at time t ,
- b_{M1} estimates the coefficient of the interaction between skilled-worker i indicator with imported inputs at firm j at time t ,
- $b_{L,X}$ estimates the coefficient of firm j 's export in year t ,
- b_{X1} estimates the coefficient of the interaction between skilled-worker i indicator interacted with firm j 's exports in year t ,
- x_{it} represents a vector with the coefficients of individual characteristics of worker i ,
- z_{it} represents a vector with the coefficients of individual characteristics of firm j ,

Hummels et al. (2014) uses an OLS and IV regression models to estimate the worker-firm-level wage effects of offshoring while controlling for variables that confound with offshoring. It is important to note that in equation (2.1), a shock to output demand is controlled by using firm-level exports, and it is allowed to have different effects across skilled and unskilled workers. Further, the authors included year-by-industry and region-fixed effects ($\varphi_{IND,t}$ and φ_R) to control for changes in industry-level demand shocks, for instance. To capture time-varying shock to workers' productivity, the authors include vector x_{it} to control for individual characteristic of workers such as experience, union status, and marital status. Lastly, vector z_{it} is incorporated to control for firms' variables such as output, unemployment, capital, and skilled worker share of employment.

For comparison purposes, a modified specification that does not control for firms' characteristics is expressed as:

$$\ln w_{ijt} = b_{L,M}^* \ln M_{jt} + b_{M1}^* S_i \ln M_{jt} + b_{L,X}^* \ln X_{jt} + b_{X1}^* S_i \ln X_{jt} + x_{it} \beta_1 + \alpha_{ij} + \varphi_{IND,t} + \varphi_R + \varepsilon_{ijt}, \quad (2.2)$$

Comparing equations (2.1) and (2.2) determine how firms' productivity affects wages. Previous trade literature suggests that offshoring can indirectly increase a firm's output through raises in productivity or lower production costs. Therefore, the authors eliminate vector z_{jt} that holds firms' output constant because offshoring could confound with it.

Furthermore, the authors estimate the overall effect (wage and displacement) of offshoring by including all firm employees prior to offshoring and tracking workers over five years. Notably, the authors classify workers into a cohort of high-skilled and low-skilled workers to understand how offshoring affects workers' wages across the two groups. The authors construct a new model to estimate the overall wage effect for each cohort using the expression:

$$\Delta \log y_{vt}^j = \alpha_v + \alpha_t + (\Delta x_{vt}^j) \beta + \sum_{k=1}^5 \delta_k (\Delta \log \text{OFF}_{v+1}^j) D_{k+v} + \varepsilon_{vt}, \quad (2.3)$$

In the above equation, v , j , k , and t denote base year, firm, period after shock, and year, respectively.

- y_{vt}^j denotes the cohort outcome variables wages, earnings, and gross earnings from firm j with base year v at time t ,
- α_v denotes cohort fixed effects,
- α_t denotes year fixed effects,

- x_{vt}^j represents vector of control variables such as cohort average experience and firm's j percentage change in predicted exports,
- OFF_{v+1}^j denotes offshoring shock post base year v ,
- D_{k+v} is dummy variable for the k th year after base year v ,
- δ_k is the coefficient vector of the post offshoring shock,

The cohort outcome variables are wages, earnings, and gross earnings. Since years of experience and other factors can affect workers' earnings or wages, the authors included x_{vt}^j to control for average cohort experience and other factors. In addition, the authors observe workers in each cohort that exit firms because of offshoring shock.

3.2.2.2 Main Findings of (Hummels, Jørgensen, Munch, & Xiang, 2014)

As indicated above, equations (2.1) and (2.2) estimate changes in workers' wages because of exogenous changes to firms importing activity, a proxy for narrow offshoring, while controlling firms' exporting activities and worker-firm and firm-year fixed effect. Since time-varying firm productivity can affect offshoring and wages paid to the firm's workers, the authors use instrumental variables to control this important missing variable. A critical instrument used to control for the endogeneity of offshoring is the weighted average of world export supply and transport costs. Instead, firm-level exports are instrumented using the weighted averages of world import demand and export transport costs. The dependent variables used in table 3.5 are workers' hourly wages and labor income. Columns 3 and 4 use offshoring and exporting instruments to estimate the hourly wage effects while controlling for worker-firms and industry-years fixed effects.

For columns 1 and 2, the authors do not use instrumental variables, thus, ignoring the possibility of the simultaneity problem - that productivity drives both wages and offshoring. From columns 3 and 4, we observe that offshoring is associated with a decline in unskilled workers' wages. In contrast, offshoring tends to increase the wages of skilled workers. This result aligns with Hummels et al.'s (2014) hypothesis that offshoring substitutes unskilled domestic labor, thus, putting downward pressure on domestic wages for unskilled workers.

Notice that in columns 1 and 2, the estimates for the effects of offshoring are much smaller than the estimates shown in columns 3 and 4; this results from not controlling for productivity that captures technological changes that have significantly affected workers' wages. The result in column 3 implies that a 1 percent increase in offshoring activities leads to approximately 0.022 percent decline in unskilled workers' hourly wages. For skilled workers, a 1 percent increase in offshoring activities is associated with approximately 0.029 percent increase in skilled workers' hourly wages. The relationship between offshoring and wages is consistent with Ebenstein et al. (2014) finding in the previous subsection.

Table 3.5 Worker-level Analysis using Narrow Offshoring

	log hourly wage				log labor income	
	FE		FE-IV		FE-IV	
	(1)	(2)	(3)	(4)	(5)	(6)
log offshoring	-0.003** [-2.43]	-0.001 [-1.41]	-0.022** [-2.56]	-0.023*** [-3.70]	-0.015* [-2.06]	-0.010* [-1.94]
log offshoring x high skilled	0.006*** [5.59]	0.006*** [5.57]	0.051*** [7.71]	0.052*** [7.78]	0.022*** [3.59]	0.024*** [3.84]
log exports	0.004** [2.02]	0.006*** [2.82]	0.049*** [4.48]	0.053*** [7.63]	0.039*** [3.59]	0.054*** [6.47]
log exports x high skilled	-0.001 [-0.25]	0.000 [0.02]	0.001 [0.08]	0.002 [0.18]	0.036*** [3.62]	0.040*** [3.83]
log output	0.014*** [4.56]		0.006 [0.88]		0.025** [2.51]	
log employment	0.016*** [4.62]		-0.004 [-0.39]		0.001 [0.73]	
Log capital-labor ratio	0.004*** [5.07]		0.005*** [4.15]		0.001 [0.73]	
Share, high-skilled workers	0.088*** [5.07]		0.144*** [6.66]		0.136*** [5.14]	
Experience	0.017*** [13.27]	0.018*** [14.00]	0.016*** [11.58]	0.016*** [11.42]	0.219*** [34.43]	0.219*** [34.33]
Experience² x 100	-0.05*** [-84.53]	-0.05*** [-84.77]	-0.05*** [-80.68]	-0.05*** [-77.89]	-0.11*** [-95.33]	-0.11*** [-94.18]
Union	0.014*** [13.38]	0.014*** [13.29]	0.016*** [14.29]	0.015*** [14.49]	0.030*** [21.34]	0.030*** [21.59]
Married x 100	0.34*** [6.42]	0.35*** [6.59]	0.29*** [5.43]	0.29*** [5.39]	-0.80*** [-8.92]	-0.81*** [-8.96]
Observations	1,928,599	1,928,599	1,928,599	1,928,599	1,928,428	1,928,428
Number of job- spell fixed effects	383,035	383,035	383,035	383,035	383,033	383,033
R²	0.155	0.153	0.155	0.153	0.103	0.101

Note: Table 3.5 is obtained from Table 5 in (Hummels, Jørgensen, Munch, & Xiang, 2014). Robust t-statistics in brackets below the coefficient estimates. Estimates are rounded up 3 decimal places except for controls: Experience² x 100 and Married x 100.

In table 3.6, the authors implement additional workers-level regressions using data on broad offshoring (total value of firm import purchased) as a robustness check. The results in table 3.6 are very similar to the result in table 5 and are also significant in explaining changes in domestic wages. With broad offshoring, a 1 percent increase in offshoring is associated with an approximately 0.016 percent decline in hourly wages of low-skilled workers that have worked at the firm for more than seven years. In the case of high-skilled workers, a 1 percent increase in offshoring is associated with approximately 0.038 increase in hourly wages of skilled workers. Notice that the hourly wage effect estimate is more prominent in table 3.6. This is because broad offshoring includes intermediate and final goods, such as technological products. Thus, capturing changes in hourly wages due to import competition and technology.

Table 3.6 Worker-level Analysis using Broad Offshoring

Robustness check:	Log hourly Wage							
	I. 7 + year job spells		II. High-income countries		III. 3-year MAS (WID/WES)		V. Drop computers and building supplies	
	FE-IV		FE-IV		FE-IV		FE-IV	
Log(offshoring)	-0.0105 [-1.64]	-0.0155*** [-2.83]	-0.0168** [-2.53]	-0.0190*** [-3.67]	-0.0177** [-2.14]	-0.0181*** [-3.01]	-0.0354*** [-3.44]	-0.0317*** [-4.53]
Log(offshoring) X high-skilled	0.0510*** [7.06]	0.0536*** [7.24]	0.0271*** [4.94]	0.0269*** [4.88]	0.0519*** [7.49]	0.0530*** [7.47]	0.0833*** [9.57]	0.0833*** [9.92]
Log(exports)	0.0665*** [6.21]	0.0621*** [7.46]	0.0464*** [4.52]	0.0492*** [7.14]	0.0478*** [4.77]	0.0503*** [6.87]	0.0488** [2.50]	0.0656*** [7.18]
	0.0055 [0.48]	0.0026 [0.22]	0.0344*** [3.87]	0.0370*** [4.28]	0.0057 [0.54]	0.0060 [0.57]	- 0.0436*** [-3.20]	-0.0461*** [-3.25]
First Stage IV F-statistics:								
Log(offshoring)	7.21	13.42	6.25	11.62	4.46	9.13	4.76	8.33
Log(offshoring) X high skill	28.49	24.10	22.41	17.53	22.56	21.05	26.21	18.97
Log(exports)	5.79	14.92	5.35	10.43	4.98	10.30	3.80	7.92
Log(exports)x high-skilled	17.54	16.11	18.45	15.36	16.60	16.52	18.90	14.70
Other firm-level controls	Yes	No	Yes	No	Yes	No	Yes	No
Observations	967,053	967,053	1,917,625	1,917,625	1,928,599	1,928,599	1,692,736	1,692,736
Number of Observation	103,989	103,989	380,781	380,781	383,035	383,035	338,922	338,922
R ²	0.186	0.183	0.155	0.153	0.155	0.153	0.156	0.155

Note: Table 3.6 is obtained from Table 7 in (Hummels, Jørgensen, Munch, & Xiang, 2014). Robust t-statistics in brackets below the coefficient estimates

As previously mentioned, Ebenstein et al. (2014) established that occupation routine level was crucial in understanding the domestic wage effect; Hummel et al. (2014) paper uses a similar idea. Table 3.7 arrange workers in the sample by task characteristics to investigate wage effect and introduces an interaction Z, the routine score of worker task. In columns 1 and 2, wages significantly decline when offshoring interacts with a high routine score. Whereas non-routine workers' wages substantially increase. The result proves that Hummel et al. (2014) hypothesize that offshoring tasks replace jobs at the domestic firm for routine and unskilled workers. The result is consistent with Ebenstein et al.'s (2014) finding.

Table 3.7 IV Estimates of Wage Effects by Occupation

Interaction term (Z)	Routine	Non-Routine	Non-routine (Other than Math)	Social Sciences	Natural sciences	Communication	Industry-Specific Experience
Log (offshoring)	0.008 [0.83]	-0.003 [-0.40]	-0.005 [-0.66]	-0.005 [-0.54]	-0.016* [-1.70]	0.003 [0.34]	-0.025*** [-2.85]
Log (offshoring) x high-skilled	-0.008 [-1.20]	-0.026*** [-3.89]	-0.023*** [-3.37]	0.015** [2.40]	0.047*** [6.88]	-0.008 [-1.28]	0.051*** [8.53]
Log (offshoring) x Z	-0.042*** [-17.36]	0.050*** [14.10]	-0.044*** [-13.56]	0.038*** [16.09]	-0.000 [-0.44]	0.045*** [17.23]	-0.000 [-1.12]
Log (exports)	0.059*** [5.25]	0.024** [2.04]	0.015 [1.25]	0.056*** [4.96]	0.047*** [4.21]	0.042** [3.78]	0.037*** [3.37]
Log (exports) x high-skilled	-0.000 [-0.02]	0.014 [1.41]	0.020** [2.04]	0.000 [0.03]	0.008 [0.78]	0.007 [0.73]	-0.003 [-0.30]
Other firm-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,570,088	1,570,088	1,570,088	1,570,088	1,570,088	1,570,088	1,906,704
Number of job spells	376,590	376,590	376,590	376,590	376,590	376,590	378,474
R^2	0,142	0,143	0,143	0,142	0,141	0,143	0,155

Note: Table 3.7 is obtained from Table 8 in (Hummels, Jørgensen, Munch, & Xiang, 2014). Robust t-statistics in brackets below the coefficient estimates

Lastly, table 3.8 reports the overall effect of offshoring using equation 2.3. This result is similar to previous tables. In columns 2, 4, 6, and 8, offshoring is associated with a decline in low-skilled workers. The wage effect over five years using present discount value (PDV) suggests that an average low-skilled worker of a firm can expect their pre-offshoring wages to decline by 11.55 percent over five years. In contrast, low-skilled workers who exit the firm in the year of offshoring experience a much higher decline in earnings over five years, as their pre-offshoring earnings decline by 54.08 percent compared to an 11.5 percent decline for workers who were still at the firm.

Importantly, we observe across high-skilled workers that offshoring tends to increase their wages, but when high-skilled workers are forced to leave the firm due to offshoring, they experience a decline in their earnings. On average, high skilled workers of a firm can expect their pre-offshoring wages to decline by 51.47 percent when offshoring requires them to leave the firm. Thus, employees that have exited due to offshoring are hurt the most.

Table 3.8 The overall Effects of Offshoring

	All workers						First-year leavers	
	Wages	Earnings		Gross Earnings			Earnings	
	High-skilled	Low-skilled	High-skilled	Low skilled	High-skilled	Low-skilled	High-skilled	Low skilled
Offs. Shock year 1	-0.0097* [-1.76]	-0.0274*** [-3.61]	0.0144*** [2.89]	0.0011 [0.29]	0.0118** [2.51]	-0.0029 [-0.80]	-0.1492*** [-6.29]	-0.1621*** [-6.16]
Offs. Shock year 2	-0.0126** [-2.22]	-0.0394*** [-5.95]	0.0085 [1.56]	-0.0152*** [-3.72]	0.0082 [1.59]	-0.0133*** [-3.48]	-0.1744*** [-6.96]	-0.1677** [-6.85]
Offs. Shock year 3	-0.0047 [-0.74]	-0.0253*** [-4.85]	0.0022 [0.41]	-0.0188*** [-5.46]	0.0026 [0.52]	-0.0152*** [-5.20]	-0.1109*** [-4.68]	-0.0930*** [-4.24]
Offs. Shock year 4	-0.0012 [-0.19]	-0.0197*** [-3.49]	0.0082 [1.42]	-0.0124*** [-3.61]	0.0082 [1.51]	-0.0109*** [-3.56]	-0.0622** [-2.56]	-0.0816*** [-3.91]
Offs. Shock year 5	0.0150** [2.07]	-0.0109* [-1.86]	0.0203*** [3.06]	0.0005 [0.11]	0.0191*** [3.04]	-0.0011 [-0.32]	-0.0468* [-1.76]	-0.0689*** [-3.09]
Five year PDV	-0.0144 [0.64]	-0.1155*** [4.89]	0.0492** [2.26]	-0.0415** [2.96]	0.0457** [2.22]	-0.0404*** [3.13]	-0.5147*** [5.34]	-0.5408*** [5.81]
Observations	92,0291	4,280,135	920,303	4,280,135	920,303	4,280,135	96,366	419,415

Note: Table 3.8 is obtained from Table 10 in (Hummels, Jørgensen, Munch, & Xiang, 2014). Robust t-statistics in brackets below the coefficient estimates

The authors' approach testifies that offshoring on domestic wages depends on workers' skills and if workers have to exit the firm because of offshoring activities. Low-skilled workers experience a significant decline in wages for workers who still work in the firm, while low-skilled workers who had to exit the firm experience an even more significant decline. In the case of high-skilled workers, they enjoy higher wages. However, when a high-skilled worker must exit the firm because of offshoring, that worker experiences a significant decline in wages as well.

3.2.3 Bilateral Tax Treaties and U.S. Employment

Kovak et al. (2021) posit that offshoring activity is affected by Bilateral Tax Treaties (BTT), thereby influencing U.S. domestic employment. The intuition behind this is that most multinational firms constitute a parent firm that provides domestic headquarters services and its foreign affiliates that usually assemble manufactured parts. As a result of the integrated relationship between the parent firm and affiliates, the profits generated from sales are proportionally shared between the two units. Therefore, the tax authority at the affiliate unit usually imposes taxes on Royalties, Interests, and Dividends (RID) payments to the parent unit and additional taxes on the income earned within the affiliate unit territory.

As a result, multinational firms are subject to double taxation. However, foreign affiliates may benefit from the present of BTT, which prevents double taxation. This tax credit reduces offshoring costs at foreign affiliates. Thus, foreign affiliates might be incentivized to expand output by employing more workers at offshore production sites. Given that the profit of parent and foreign affiliates are integrated, the parent firm's profits might also increase. Therefore, the parent firm might also be motivated to expand output by employing more workers domestically. Thus, BTT could positively affect U.S. hiring decisions by reducing offshoring costs.

Notably, the authors distinguish between firms in high RID and low RID industries because BTT only affects U.S. domestic employment in high RID industries. This idea comes from Blonigen et al. (2014), which show that BTT tend to affect U.S. industries according to their revenue and markup level. High revenue U.S. industries are associated with firms that are more likely subject to double taxation. Therefore, the BTT will significantly reduce offshoring costs, increasing then the degree of offshoring operations.

On the other hand, it could also increase the domestic employment of firms in high RID industries. The positive relationship exists because reduction in offshoring cost may result to firms increasing overall activities compared to only moving activities towards cheaper affiliate unit. However, since double taxation is rare for firms with less revenue, we expect no significant effect on the domestic employment of firms in low RID industries. Table 3.9 provides empirical support to some of Kovak et al. (2021) assumptions used to conclude the hypothesis.

Table 3.9 BTT Effect on Parent Employment using Difference-in-Difference Analysis

Dependent Variable: Log Parent Employment $\ln S_{ft}$						
	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All	High RID	Low RID	All	High RID	Low RID
BTT [$\hat{\varphi}_f 1(t \geq \hat{t}_f)$]	0.027 (0.007)	0.055*** (0.014)	-0.009 (0.013)	0.012 (0.090)	0.064*** (0.023)	-0.027 (0.018)
$\ln(GDP_{us} + GDP_d)$				0.025 (0.123)	-0.076 (0.147)	0.196 (0.189)
$\ln(GDP_{us} - GDP_d)^2$				-0.054 (0.061)	-0.006 (0.072)	-0.135 (0.094)
$\ln(\text{Skill Difference})$				-0.077 (0.050)	-0.084 (0.059)	-0.066 (0.095)
$\ln(\text{Trade Costs})$				0.003 (0.015)	0.012 (0.017)	0.003 (0.030)
BIT				-0.287 (0.177)	-0.242 (0.244)	-0.259 (0.23)
FTA				-0.008 (0.062)	-0.08 (0.088)	0.02 (0.079)
Exchange Rate				-0.0001 (0.000)	-0.0001 (0.000)	0.0001 (0.000)
Parent FE	YES	YES	YES	YES	YES	YES
Industry-Year FE	YES	YES	YES	YES	YES	YES
N	43,233	29,765	13, 468	43,233	29,765	13,468
R-squared	0.0021	0.0033	0.0002	0.0573	0.0644	0.0431

Note: The results are obtained from Table 3 in Kovak et al. (2021). The standard errors are in parentheses

The above table establishes a preliminary examination of the relationship between the first Bilateral Tax Treaties received at foreign affiliates and parent multinational offshoring employment using a difference-in-difference regression model. In the difference-in-difference analysis, the authors observe changes in U.S. parent firm employment as foreign affiliates receive new BTT. Column 2 implies that U.S parent firms in High RID industries whose single foreign affiliates receive BTT significantly increase parent employment by 5.6 percent compared to foreign affiliates that did not receive BTT. While in the case of firms in low RID industries, the effect of BTT on parent employment is insignificant as it is very close to zero. Thus, it suggests

that the authors should further investigate the relationship while focusing on firms in high RID industries.

3.2.3.1 Empirical Strategy of (Kovak , Oldenski, & Sly, 2021)

Kovak et al. (2021) obtained data on multinational firms from the U.S. Direct Investment Abroad Survey conducted by the Bureau of Economic Analysis (BEA) covering the period 1987 to 2007. The data contain information on the number of employments by U.S. parent firms and their foreign affiliate employment while taking note of their three-digit Standard Industrial Classification (SIC) and International Survey Industry Classification (ISIC) codes. In addition, employment data on regional and industry employment were obtained from U.S Census Bureau's County Business Patterns (CBP). Data on trade and real GDP were obtained from Penn World Tables. At the same time, skill differences data were obtained from Barro and Lee (2010). Information on host countries' Bilateral Investment Treaty (BIT) with the United States is obtained from the United Nations Conference on Trade and Development. Free Trade Agreement (FTA) and exchange rate data were obtained from the U.S. Trade Representative and World Bank, respectively. Lastly, information on countries' Bilateral Tax Treaties with the United States is obtained from IRS United States Income Tax Treaties.

To empirically estimate the effect of offshoring on domestic workers, the authors begin with a first-stage regression to estimate the effect of the instrumental variable, BTT, on foreign affiliates' employment using the specification below:

$$\ln m_{at} = \beta^A BTT_{ct} + \Gamma X_{at} + a_a + b_{ti} + \epsilon_{at}, \quad (3.1)$$

Where c , t , a , and i denote country, year, individual affiliate, and industry.

The specification above estimates the effect of BTT on foreign affiliate employment. m_{at} denotes employment at affiliate a at time t . BTT indicates the presence of BTT between the U.S.

and host country c at time t . X_{at} is a vector of controls for affiliate a ; while a_a and b_{ti} are affiliate and industry-year fixed effects. Lastly, ϵ_{at} denotes the error term that controls for additional factors that affect affiliate employment but are excluded in the specification.

Secondly, the authors use the BTT induced variation in foreign affiliate employment obtained using equation (3.1) to estimate the domestic employment effect of offshoring activities at the U.S. firm, U.S. industry, and U.S. regional levels. The U.S. firm-level, U.S. industry-level, and U.S. regional-level specifications are a modification of expression (3.1). Below is the expression for the U.S firm-level specification:

$$\ln s_{ft} = \beta^P \ln M_{ft} + \Gamma X_{ft} + c_f + d_{ti} + \epsilon_{ft}, \quad (3.2)$$

Expression (3.2) estimates the effect of an increase in foreign affiliate employment on parent firm domestic employment while controlling for covariates. s_{ft} denotes employment at parent firm f at time t . M_{ft} refers to the predicted value of affiliate employment obtained with the estimation of (3.1) total affiliate employment for firm f . X_{ft} denotes the vector of controls for parent firm f at time t . Firms and industry-year fixed effects are c_f and d_{ti} , respectively. Importantly, β^P is the coefficient of interest. Note that M_{ft} and X_{ft} are derived by aggregating predicted employment at affiliates (m_{at}) and affiliate controls (X_{at}). In addition to parent firm-level empirical analysis, Kovak et al. (2021) include industry and regional-level analysis because changes in parent firm employment due to offshoring activity can alter U.S aggregate employment, thereby affecting U.S. industry and regional employment. The U.S. industry-level (3.3) and regional-level (3.4) specifications are expressed below:

$$\ln L_{it} = \beta^I \ln M_{it} + \Gamma X_{it} + f_i + g_t + \epsilon_{it}, \quad (3.3)$$

Where subscripts i and t denotes industry and year, respectively.

$$\ln L_{mt} = \beta^M \ln M_{mt} + h_m + k_t + \epsilon_{mt}, \quad (3.4)$$

Where subscripts m and t denotes metro area and year, respectively.

The U.S. industry-level specification expressed in equation (3.3) estimate the effect of offshoring exposure on U.S industry employment. β^I is the coefficient of interest. L_{it} denotes total domestic employment in industry i in year t . X_{it} , f_i and g_t are vector of industry- level controls, industry fixed effects, and year fixed effects, respectively. And ϵ_{it} denotes other factors that could affect U.S. industry employment but are excluded in the industry-level specification. On the other hand, the regional level specification expressed in equation (3.4) estimates the effect of offshoring exposure on domestic employment across U.S. metropolitan labor markets. The coefficient of interest is β^M . L_{mt} denotes metro-area m employment in year t . While h_m and k_t represent metro-area and year fixed effects, respectively. M_{mt} is the metro-area's weighted average of predicted industry-level foreign affiliate employment. The expression (3.5) is the formula used to derive the industry-weighted employment that captures employment across metropolitan areas.

$$M_{mt} = \sum_i \sigma_{mi}^{1986} M_{it} \quad (3.5)$$

Where σ_{mi}^{1986} denotes each metro area exposure to predicted foreign affiliate employment and it interacts with the total foreign affiliate employment in industry i and year t .

3.2.3.2 Main Finding of (Kovak , Oldenski, & Sly, 2021)

Recall that the specifications above estimate how U.S. domestic employment changes with changes in foreign affiliate employment, which, in turn, depends on foreign affiliates reacting to the presence of BTT. Table 3.10 reports the results of the first-stage regression in equation (3.1) that estimates the effect of BTT on foreign affiliate employment. From the table, the instrument variable, BTT, is highly and positively correlated with multinational firms' affiliate employment. In column 5, where the sample is restricted to affiliates in high RID industries, we observe a

tremendous increase in offshoring employment by about 40.2 percent ($\exp(0.338) - 1 = 0.402$). The F-statistic for column 5 is 24.31, which suggests that the BTT and foreign affiliates are significantly correlated, which indicates BTT as a good instrument. Also, tables 3.11 and 3.12 include endogenous test p-values to confirm that BTT solves the endogeneity problem because the p-values are less than 0.05.

Table 3.10 The Effect of BTT on Affiliate Employment

Dependent Variable: Log Affiliate Employment $\ln M_{mt}$						
	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All	High RID	Low RID	All	High RID	Low RID
BTT	0.0232*** (0.066)	0.461*** (0.077)	-0.022 (0.086)	0.132* (0.072)	0.338*** (0.083)	-0.027 (0.088)
$\ln(GDP_{us} + GDP_d)$				7.062** (3.129)	6.658* (3.451)	7.331*** (2.800)
$\ln(GDP_{us} - GDP_d)^2$				0.480* (0.264)	0.512* (0.286)	0.416* (0.244)
$\ln(\text{Skill Difference})$				-0.185* (0.050)	-0.173* (0.102)	-0.195** (0.087)
$\ln(\text{Trade Costs})$				0.031 (0.034)	0.029 (0.036)	0.033 (0.032)
BIT				-0.548** (0.258)	-0.528* (0.279)	-0.566** (0.240)
FTA				0.016 (0.105)	0.075 (0.099)	-0.05 (0.112)
Exchange Rate				-0.00002 (0.000)	-0.00003 (0.000)	-0.0001 (0.000)
Parent-Sibling BTTs				-0.044* (0.026)	-0.046** (0.021)	-0.044 (0.033)
Affiliate-Sibling BTTs				0.133* (0.075)	0.173** (0.081)	0.083 (0.090)
Affiliate FE	YES	YES	YES	YES	YES	YES
Industry-Year FE	YES	YES	YES	YES	YES	YES
N	43,233	29,765	13,468	43,233	29,765	13,468
R-squared	0.0021	0.0033	0.0002	0.0573	0.0644	0.0431
F-Statistic	12.47	35.58	0.06	7.31	24.31	4.12

Note The results are obtained from Table 4 in Kovak et al. (2021). The standard errors are in parentheses

Given the existing relationship between BTT and offshoring employment, the following tables will estimate the effect of offshoring employment on U.S domestic employment. However,

since we have established in the previous empirical section that the industry-level specification does not accurately estimate the effect of offshoring exposure on the labor market, we will focus on the results that estimate the offshoring effect on parent firms and regional employment.

Table 3.11 reports the result of the estimation of expression (3.2) where the authors investigate the effect of offshoring employment on U.S. parent firm employment. Column 4 suggests that a 10 percent increase in foreign affiliate employment is associated with a 1.3 percent increase in parent firm employment. Considering the 40.2 percent BTT-induced change obtained from the first stage analysis, column 4 suggests that an increase in offshoring employment is associated with a 5.2 percent increase in employment at the parent firm. The positive relationship exists because reduction in offshoring cost has a positive scale effect on firms' overall activities that exceeds negative substitute effect of moving activities towards cheaper affiliate unit.

Table 3.11 The Effect of Offshoring Employment on U.S. Parent Firm Employment

	Dependent Variable: Log Parent Employment- $\ln(s_{ft})$					
	(1)	(2)	(3)	(4)	(5)	(6)
Specification	OLS	OLS	IV	IV	IV	IV
Sample	All	All	All	All	New Aff	Cont Aff
Log affiliate Employment ($\ln M_{it}$)	0.289*** (0.017)	0.263*** (0.017)	0.174*** (0.017)	0.130*** (0.015)	0.103 (0.116)	0.139*** (0.016)
$\ln(GDP_{us} + GDP_d)$		-0.039 (0.126)		0.006 (0.092)	-0.331 (0.366)	-0.004 (0.088)
$\ln(GDP_{us} - GDP_d)^2$		-0.006 (0.064)		-0.007 (0.047)	0.148 (0.189)	-0.001 (0.045)
$\ln(\text{Skill Difference})$		-0.167*** (0.057)		-0.097** (0.044)	0.093 (0.106)	-0.118** (0.047)
$\ln(\text{Trade Costs})$		0.005 (0.018)		-0.017 (0.013)	0.017 (0.035)	-0.02 (0.014)
BIT		-0.473* (0.25)		-0.432** (0.167)	-0.335 (0.208)	-0.460** (0.201)
FTA		-0.016 (0.082)		-0.004 (0.048)	0.083 (0.125)	-0.009 (0.053)
Exchange Rate		-0.000 (0.000)		-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Parent FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	29,765	29,765	29,765	29,765,	6,077	23,688
R-squared	0.1865	0.2189	0.1406	0.1581	0.3536	0.1663
First-Stage F-Statistic	-	-	508.14	413.36	117.5	402.53
Endogenous Test P-value	-	-	0.0017	0.0019	0.0022	0.0015

Note: The results are obtained from Table 5 in Kovak et al. (2021). The standard errors are in parentheses.

Despite the net increase in parent firms' employment, there might be instances where the multinational firm might be incentivized to increase vertical-oriented FDI activities due to declining offshoring costs. In cases like this, non-multinational firms' employment in the same industry as the offshoring firm is negatively affected as domestic workers could have been employed for the task.

Table 3.12 results estimate the effect of offshoring exposure on domestic employment across various industries in the United States using the metro area level specification expressed in equation 3.4. A strong positive relationship is observed using the metropolitan analysis. However, the magnitude is less positive than the parent firm-level result because regional employment is indirectly affected. Column 4 in Table 3.12 implies that a 10 percent increase in regional affiliate employment tends to increase U.S. regional employment by 0.17 percent. Taking account of the BTT-induced change in foreign affiliate employment, column 4 suggests an approximately 0.7 percent increase in regional employment. The modest positive effect suggests that industries directly affected by offshoring exposure can negatively affect other industries within the local economy. Thus, we observe a negative spillover effect.

Table 3.12 The Effect of offshore Employment on U.S. Regional Employment

	(1)	(2)	(3)	(4)
Specification	OLS	OLS	IV	IV
regional log affiliate employment ($\ln M_{mt}$)	0.035*** (0.008)	0.033*** (0.008)	0.018** (0.004)	0.017*** (0.004)
$\ln(GDP_{us} + GDP_d)$		-0.756** (0.343)		-0.326** (0.152)
$\ln(GDP_{us} - GDP_d)^2$		0.365** (0.173)		0.158** (0.077)
$\ln(\text{Skill Difference})$		0.209 (0.129)		0.094 (0.057)
$\ln(\text{Trade Costs})$		0.058 (0.060)		0.022 (0.026)
BIT		0.077 (0.289)		0.030 (0.127)
FTA		0.010 (0.091)		0.003 (0.040)
Exchange Rate		-0.0009 (0.001)		-0.0004 (0.000)
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	6,080	6,080	6,080	6,080
R-squared	0.7312	0.7377	0.7308	0.7374

First-Stage F-Statistic	-	-	165.96	171.84
Endogenous Test p-value	-	-	0.0205	0.0249

Note: The results are obtained from Table 9 in Kovak et al. (2021). The standard errors are in parentheses.

In spite of the positive relationship between regional affiliate employment and U.S. domestic employment, we observe a deleterious effect on regional-level employment when the foreign affiliate are located in developing countries. Kovak et al. (2021) measures the effect of offshoring on the labor market by observing how tax treaties at multinational firms affect offshoring hiring decisions. Although the authors empirically estimate a positive relationship between offshoring activities and U.S. domestic employment, there are instances where domestic employees are negatively affected because some multinational firm might move production process to foreign location due to reduction in offshoring cost.

Chapter 4: Conclusion

In the introduction, we observed that some politicians' perspective on the effect of offshoring on nationals is solely negative. An in-depth review of economists' empirical work on estimating the effect of offshoring on the labor market reveals a heterogeneous effect, i.e., the effect is different across different groups of workers and depend on the foreign country's level of development. Such heterogeneous effect is attributed to the complexity of offshoring activity as sometimes it involves specific locations, tasks, and industries.

When Ebenstein et al. (2014) investigated the effects of offshoring to low-income countries, the effect was negative on most routine workers' wages and positive on intermediate routine workers' wages. However, when offshoring to high-income countries was considered, the effect on intermediate routine workers' wages was negative and positive for most routine workers. Secondly, we observe a similar trend in Hummels et al. (2014). The paper reveals that increase in offshoring activity decreases the wages of low-skilled workers, who are highly correlated with routine workers and increase the wages of high-skilled workers, who are highly correlated with intermediate routine workers. In Kovak et al. (2021), offshoring in high-revenue U.S. industries has a net positive effect on U.S. domestic employment across all industries, despite employment relocation and considerable job loss.

This report provides contextual information on offshoring and its trend using data on FDI inflow. We clarified that offshoring reduces production costs (vertical FDI) and trade and transportation costs (horizontal FDI), which explains the trend of multinational firms offshoring to developing and developed countries. Also, we elucidate firm's productivity is essential in determining whether firms become multinational. Empirical papers indicate both negative and positive effects of offshoring on the labor market. Given the findings from empirical papers in

highly ranked economics journals, we argue that politicians' argument on offshoring are flawed because it fails to give a complete picture of the effect of offshoring on nationals.

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