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The Empirics of the China Trade Shock: A Summary of Estimation Methods and A Literature Review

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1 Introduction

Since the 2010s, a growing number of empirical studies have been conducted to understand the impact of international trade on the economy. I believe that there are two reasons behind the increasing focus on this topic. The first is the rise of the Chinese economy. Its rapid economic growth and accession to the WTO has led to a drastic increase in Chinese exports. This phenomenon is called the "China shock" in extant literature.[1] To what extent the economy has been affected by this shock, is one of the most important research questions for trade economists today.

The second reason for the increasing focus on this topic, in my view, is innovations in estimation methods. Empirical investigations on the effect of trade on the economy, especially labor markets, were not popular in academia prior to the 1990s. This may be due to the difficulty in identifying the causal relationship from imports to employment, which has drawn interest from economists. Typically, observed data reflect on the reverse causality from employment to imports. As a result, it is difficult to extract the effect of imports per se on employment. For example, when the economy is booming, employment increases, raising the purchasing power of consumers. As a result, imports also increase. Other potential issues include measurement errors of variables and omitted variable bias. However, since the mid-2000s, there were two important innovations that changed these perceptions.

The first innovation was the introduction of "local labor markets." Most studies in the early 2000s employed industry-level or plant-level data (Tomiura, 2003; Bernard et al., 2006). However, economists introduced a notion of local labor markets, converting a national-level trade policy variable (such as tariffs) into a variable that differs across domestic regions by exploiting regional employment (Topalova, 2007). This local labor market level variable provided economists with the ability to consider geographical aspects of a trade shock.

The second innovation was the usage of shift-share instruments (or Bartik instruments) in the context of international trade. Autor, Dorn, and Hanson (2013) (hereafter ADH) utilized this approach to examine the effect of imports from China, caused by China's supply shock, on U.S. labor markets. Although there are critics, most economists today believe that this approach is one of the best ways to identify the causal effect of imports on the economy. These two innovations have prompted a number of economists to carry out empirical studies on the effect of trade.

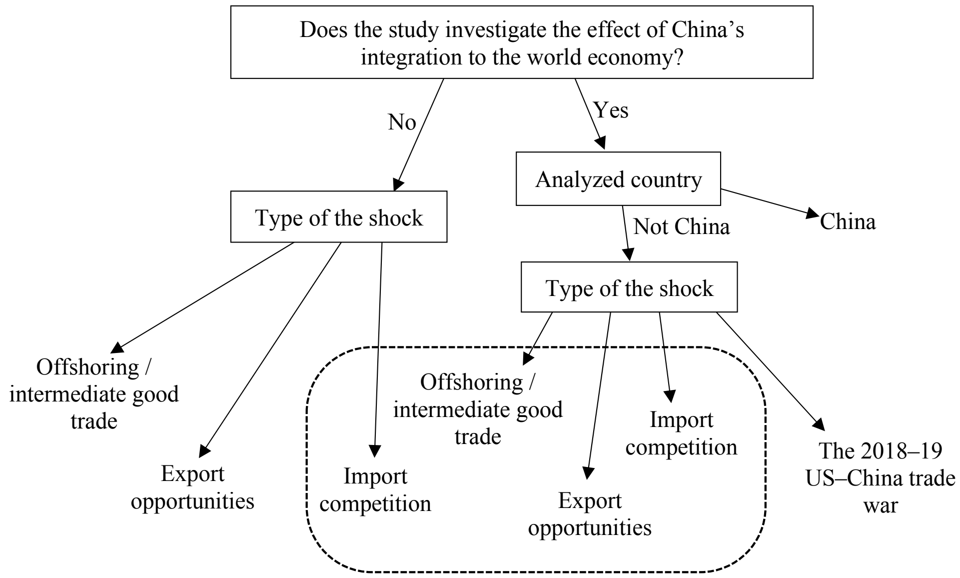
This paper summarizes empirical studies that are related to at least one of the following keywords: (1) the China shock, (2) local labor markets, and (3) shift-share instruments.[2] The first key term, the China

[1] Autor (2018) defines the "China shock" as "denoting China's rapid market integration in the 1990s and its accession to the World Trade Organization in 2001." To clarify that it is a shock in international trade, it is also referred to as the "China shock in trade" (Feenstra, Ma, Sasahara, et al., 2018) and the "China trade shock" (Caliendo, Dvorkin, et al., 2019). Sometimes, it is referred to as the "China syndrome" (Autor, Dorn, and Hanson, 2013; Choi and Xu, 2020). Throughout this paper, it is referred to as the "China shock."

[2] Autor, Dorn, and Hanson (2016) also summarize existing studies on the China shock and Pavcnik (2017) provides a survey on the effect of import competition in developing countries. This paper covers more articles and provides a comprehensive survey. Survey articles (or columns) written in Japanese include Tomiura (2012), Tanaka (2016), Matsuura (2018), and Sato (2019).

shock, is commonly used to refer to import competition from China. Therefore, this paper discusses studies on import competition, not necessarily with China but with other countries as well. We also look at studies investigating the effect of exports to China and offshoring (i.e., trade in intermediate goods).[3] Studies on the impact of trade on China's economy and the effect of the 2018–2019 U.S.–China trade war are not discussed in this paper.[4] The area inside of the dashed line in Figure 1 summarizes the specific topics covered in this study. Primarily, this paper discusses existing studies on the effect of imports from China from the 1990s to 2000s through the intensified competition in the goods market and on import competition in general. It especially focuses on studies using local labor markets and shift-share instruments.

FIGURE 1: Topic coverage of this study



Note: The topics inside of the dashed line are covered in this study.

The remainder of this paper is organized as follows: Section 2 discusses the methodological development in estimation techniques. Section 3 summarizes existing studies by country. Section 4 summarizes studies extending the import competition variable of ADH. Section 5 summarizes existing studies by topic. Section 6 provides future directions for research.

2 Development of Estimation Methods

This section summarizes empirical approaches estimating the effects of import competition. First, I explain notations used throughout this section. The Greek letter β is used to denote parameters in all regression equations to avoid running out of Greek letters. Bold notations indicate that the parameter

[3] Feenstra and Hanson (2003) and Kurokawa (2014) provide surveys on the effects of offshoring on wage inequality

[4] As an example regarding the effect of trade on China's economy, see Feng et al. (2017). Regarding the effect of the 2018–2019 U.S.–China trade war, see, for example, Caliendo and Parro (2021).

(or the variable) is a vector rather than a scalar. Δ indicates a change. Whether it is lag or forward and the number of lagged (or forwarded) years are defined in each equation. The term $\ln A$ indicates a natural log of variable A. As a result, $\Delta \ln A$ is a continuous-time compounded rate of change of A. Subscript i indicates industry, p indicates plant, r indicates region (e.g., commuting zones, metropolitan areas, counties, prefectures), c indicates country, and t indicates year. $\mathbf{X}$ is a vector of control variables including a constant term. δ and ε with appropriate subscript(s) indicate fixed effects and the error term, respectively.

2.1 Analysis with Import Prices

In traditional trade models such as the Ricardian model, trade shocks are modelled as a change in relative prices. Following this idea gives us a regression equation with import prices on the right-hand-side. For example, using Japanese industry-level data, Tomiura (2003) estimates the following regression equation:

$$\Delta \ln L_{it} = \beta_1 \Delta \ln P_{it} + \beta_2 \left[MS_{it} \times \ln P_{it} \right] + \mathbf{X}'_{it} \boldsymbol{\beta}_3 + \varepsilon_{it},$$

where L_{it} is industry i's employment in year t. Equation $\Delta L_{it} = \ln L_{it} - \ln L_{it-1}$ is the employment growth rate. Variable ΔP_{it} is the rate of change in the import price. In addition, an interaction term between ΔP_{it} and MS_{it} is introduced. As a decline of import prices is expected to reduce employment, the expected sign of β_1 is positive. Furthermore, the negative effect of imports on employment is expected to be greater in industries with higher import shares. Therefore, the expected sign of β_2 is also positive. Variable $\mathbf{X}_{it}$ includes control variables such as a lagged dependent variable ΔL_{it-1} and input costs.

If the Japanese economy is considered a small open economy, ΔP_{it} can be seen as an exogenous variable. However, MS_{it} is an endogenous variable and is expected to correlate with the error term. Therefore, Tomiura (2003) employs a lagged import share MS_{it-1} and input costs as instruments. He finds that $\beta_1 > 0$ and $\beta_2 > 0$ during the 1993–1995 period where the Japanese economy was experiencing a recession and the yen was appreciating. Other studies employing the same approach include Tomiura (2004) and Sasaki (2007).

2.2 Analysis with Import Penetration at the Industry-level

Import competition can also be measured by import values as a share of domestic absorption, which we call "import penetration." Bernard et al. (2006) define import penetration as follows:

$$IP_{it} = M^L_{it} / (M_{it} + Q_{it} - X_{it}),$$

where M^L_{it} denotes industry i's imports from low-income countries in year t; M_{it} denotes such imports from all countries; Q_{it} is domestic production, and X_{it} is exports. As a result, the denominator measures the domestic absorption. They estimate the following equation:

$$\Delta \ln L_{pt} = \beta_1 IP_{it} + \mathbf{X}'_{ipt}\boldsymbol{\beta}_2 + \delta_t + \delta_p + \varepsilon_{pt}, \tag{1}$$

where $\Delta \ln L_{pt}$ denotes the employment growth rate of plant p from year t to year t+5. Similar approaches are employed by Ito (2005), Inui et al. (2011), Auer and Fischer (2010), Khandelwal (2010), Kneller et al. (2012a), Kneller et al. (2012b), Federico (2014), and Acemoglu et al. (2016).

It is difficult to estimate equation (1) owing to the endogeneity of the import penetration variable IP_{it}. To overcome this issue, Bernard et al. (2006) use variables, such as tariffs, as instruments. To be a valid instrument, two conditions need to be satisfied: the relevance condition and the exclusion restriction.[5] The relevance condition appears to be satisfied as tariffs influence imports. However, the exclusion restriction, which requires that tariffs do not affect employment directly, does not appear to be satisfied. Because tariffs are an endogenous policy instrument of a country, policymakers may change tariffs by reflecting changes in domestic employment levels, leading to an endogeneity issue. However, as we will discuss in the next section, a drastic tariff cut caused by political reasons may be an exogenous shock (e.g., India, Indonesia, and Brazil in the 1990s and China's accession to the WTO).

2.3 Analysis with Local Labor Markets

The previous sections have discussed studies employing industry-level data. However, newer studies since the mid-2000s employ data from local labor markets, making it possible to examine geographical aspects of a trade shock. For example, Petia Topalova estimates the following equation

$$y_{rt} = \beta_0 + \beta_1 \tau_{rt} + Post_t + \delta_r + \varepsilon_{rt},$$

where y_{rt} denotes the dependent variable (the poverty level and the consumption level in Topalova, 2007, and Topalova, 2010, respectively) of region r in year t. $Post_t$ indicates the dummy variable taking unity after trade liberalization (after the year 1991). The variable τ_{rt} denotes the weighted-average tariff of region r, defined as follows:

$$\tau_{rt} = \frac{\sum_{i \in N} L_{r,i,1991} \times Tariff_{it}}{\sum_{i \in N} L_{r,i,1991}}, \tag{2}$$

where $L_{r,i,1991}$ denotes industry i's employment in region r in the year 1991. The variable $Tariff_{it}$ denotes industry i's import tariffs in year t, and N indicates the set of all industries. Although the trade shock variable $Tariff_{i,t}$ varies only across industries, it is converted to a variable that varies across regions within a country based on regional employment levels.

Topalova sets $Tariff_{it} = 0$ for non-tradable industry i. As a result, regions that specialize in tradable

[5] For example, Felbermayr and Gröschl (2013) show that these two conditions are satisfied in the context of estimating the effects of trade on income levels.

industries may have systematically greater reductions in τ_{rt} because $Tariff_{it}$ does not decrease by construction. Therefore, the effect of tariffs on employment may be overestimated. To deal with this issue, Topalova employs an instrument variable of the weighted-average tariff based on tradable industries only:

$$\tau_{rt}^{T} = \frac{\sum_{i \in N^T} L_{r,i,1991} \times Tariff_{it}}{\sum_{i \in N^T} L_{r,i,1991}},$$

where N^T indicates the set of tradable industries. Similar approaches are employed by Edmonds et al. (2010), Gaddis and Pieters (2012), Law (2019), and Anukriti and Kumler (2019).

However, it is controversial to include non-tradable industries in τ_{rt} in the first place.[6] Kovak (2013) and Dix-Carneiro, Soares, et al. (2018) propose a variable based on tradable industries. They call it the regional tariff change (RTC) and define it as follows:

$$RTC_r = \frac{\sum_{i \in T} (\lambda_{rt}/\varphi_i) \times \Delta \ln(1 + Tariff_i)}{\sum_{i \in T} (\lambda_{rt}/\varphi_i)}, \tag{3}$$

where $Tariff_i$ denotes industry i's tariff rate, λ_{ri} denotes the employment share of industry i in region r, φ_i denotes one minus the wage payment share of industry i, and T denotes the set of tradable industries. Differing from equation (2), equation (3) reflects wages to measure the size of each industry. In addition, there is a theoretical foundation as this equation is derived from the specific-factors model. Studies on the Brazilian economy use equation (3) to show that, in import-competing regions, wages declined (Kovak, 2013), employment levels and incomes declined (Dix-Carneiro and Kovak, 2017), and the crime rate increased (Dix-Carneiro, Soares, et al., 2018).

Hakobyan and McLaren (2016) also employ data from local labor markets to examine the effect of U.S. imports from Mexico on the U.S. economy. Their import-competition variable is as follows:

$$\Delta\tau_r = \frac{\sum_i L_{r,i,1991} \times RCA_i \times \Delta Tariff_i}{\sum_i L_{r,i,1991} \times RCA_i}, \quad \text{with} \quad RCA_i = \frac{X_{i,1990}^{MEX} / \sum_i X_{i,1990}^{MEX}}{X_{i,1990}^{ROW} / \sum_i X_{i,1990}^{ROW}}$$

where $L_{r,i,1990}$ denotes industry i's employment in region r in the year 1990. The variable $Tariff_i$ denotes the change in industry i's tariff rate imposed by the U.S. on Mexican exports during the 1990–2000 period. The main difference from equation (2) is that the term "revealed comparative advantage," RCA_i, is used. The variable $X_{i,1990}^{MEX}$ denotes Mexican exports from industry i to countries other than the U.S. The variable $X_{i,1990}^{ROW}$ denotes exports from countries other than Mexico and the U.S. (Rest Of World) from industry i to countries other than the U.S.[7] If $RCA_i > 1$, Mexican exports from industry i are greater than other countries' exports from industry i. Therefore, Mexico has a comparative advantage in industry i.

[6] Gaddis and Pieters (2017), which is the published version of Gaddis and Pieters (2012), treat τ_{rt}^{T} as an exogenous shock and employ the fixed effects model, instead of estimating an IV model. Kis-Katos and Sparrow (2011) raise a concern regarding τ_{rt}, by citing a critique by Hasan et al. (2007). They employ τ_{rt}^{T} as an explanatory variable instead of using τ_{rt}.

[7] Exports to the U.S. are excluded from the calculation presumably because they attempt to exclude demand shocks in the U.S.

Hakobyan and McLaren (2016) utilize this variable to show that import competition reduced wages of low-skilled workers in the U.S.

Thus, seminal work by Topalova, Kovak, Dix-Carneiro, Hakobyan, McLaren and others have introduced the concept of "local labor market" in the context of international trade.[8] This innovation made it possible to capture the geographical differences in the degree of trade liberalization. This idea is also employed by ADH.

2.4 Analysis with Shift-share Instruments

The change in the degree of import competition faced by each firm or industry can be decomposed into changes caused by macroeconomic factors and changes caused by other factors. As macro factors are exogenous for individual firms or individual industries, macro components can be utilized as an instrument. Specifically, we construct a variable equal to the "initial exposure to import competition" multiplied by the "economy-wide change in imports." This variable can be seen as a change in the exposure to import competition caused by an economy-wide shock, plausibly exogenous. It is called a shift-share instrument or a Bartik instrument, after Timothy J. Bartik (1991).[9]

For example, to examine the effect of imports from China on firms' innovations, Bloom et al. (2016) estimate the following equation:

$$\Delta \ln TECH_{pict} = \beta_1 \Delta IMP_{it}^{CH} + \delta_{ct} + \varepsilon_{pict},$$

where $\Delta \ln TECH_{pict}$ denotes the rate of change of an innovation variable (such as the number of patents) of plant p in industry i in country c. The variable ΔIMP_{it}^{CH} is a change in $IMP_{it}^{CH} = M_{it}^{CH}/M_{it}^{World}$, where M_{it}^{CH} denotes country c's imports from China's industry i and M_{it}^{World} denotes country c's imports from all countries' industry i. To deal with the endogeneity of ΔIMP_{it}^{CH}, Bloom et al. (2016) utilize the initial exposure to imports from China $IMP_{it-1}^{CH} = M_{it-1}^{CH}/M_{it-1}^{World}$ multiplied by the increase in the EU's overall imports from China ΔM_t^{CH} as an instrument in Section 5.2 of their study.

As both the initial exposure IMP_{it-1}^{CH} and the overall increase in imports ΔM_t^{CH} are exogenous, the product of the two, $IMP_{it-1}^{CH} \times \Delta M_t^{CH}$, is also exogenous for individual industries. Bloom et al. (2016) utilize variations in the shift-share variable as an exogenous shock to examine the effect of import competition from China. They show that import competition led to firm innovations and reallocation of workers from low-tech to high-tech firms. Other studies employing similar ideas include Majlesi (2016) and Dell et al. (2019). See Section 3.3.1 for their findings.

[8] Ebenstein et al. (2014) construct a region-level import penetration variable using a sectoral import penetration variable and employment data. To measure region-level export opportunities in Vietnam, McCaig (2011) converts the sectoral tariff rates imposed by the U.S. to Vietnam to a region-level variable using employment data. To examine the effects of trade liberalization in Mexico, Hanson (1998) classifies his sample into a pre-liberalization sample (1980-1984) and a post-liberalization sample (1985-1993). To examine the effects of trade on wages in China, Han et al. (2012) define liberalizing and non-liberalizing areas based on distance from the coast.

[9] Jaeger et al. (2018) summarize existing studies using shift-share instruments in immigration research.

2.5 Analysis with Local Labor Markets and Shift-share Instruments

2.5.1 Import Penetration at the Local Labor Market Level

This section discusses the method employed by ADH, a workhorse approach in the field of international trade today. I would like to emphasize that even their seminal approach is a combination of previous approaches, suggesting the importance of considering previous studies in drafting a creative and influential paper. First, their approach utilizes the concept of "import penetration," similar to Bernard et al. (2006). Second, it uses data from "local labor markets" as Topalova and Kovak. Third, they use the data on (lagged) initial employment levels to construct their instrument as in Bartik (1991).

Specifically, using the commuting zone level data, ADH estimates the following equation:

$$\Delta L_{rt} = \beta_1 \Delta IPW^C_{rt} + \mathbf{X}'_{rt}\boldsymbol{\beta}_2 + \delta_t + \varepsilon_{rt},$$

where ΔL_{rt} denotes the change in the share of the manufacturing employment in the working age population in region r in year t. The degree of import penetration from China is measured as follows:

$$\Delta IPW^C_{rt} = \frac{\sum_i L_{rit} \times \Delta m^{CU}_{it}}{\sum_i L_{rit}}, \quad \text{with} \quad \Delta m^{CU}_{it} = \frac{\Delta M^{CU}_{it}}{L_{it}}, \tag{4}$$

where L_{rit} denotes the employment level of industry i in region r. The variable ΔM^{CU}_{it} denotes the change in industry i's exports from China to the U.S. The import penetration variable can be re-written as $\Delta IPW^C_{rt} = \sum_i \left(\frac{L_{rit}}{\sum_k L_{rkt}}\right) \times \Delta m^{CU}_{it}$, which can be decomposed into two components: $\frac{L_{rit}}{\sum_k L_{rkt}}$ and Δm^{CU}_{it}. The former measures the degree of industrial specialization in region r and the latter measures the import value per worker in industry i.

2.5.2 The Shift-share Instrument of ADH

To deal with the endogeneity issue, ADH uses

$$\Delta IPW^O_{rt} = \frac{\sum_i L_{rit-1} \times \Delta m^{CO}_{it}}{\sum_i L_{rit-1}}, \quad \text{with} \quad \Delta m^{CO}_{it} = \frac{\Delta M^{CO}_{it}}{L_{it-1}}, \tag{5}$$

as an instrument. Comparing it with equation (4), notice that the subscript for the employment variable is now replaced with $t-1$ rather than t. The intention of this modification is to deal with potential endogeneity issues stemming from U.S. workers' expectation of China's rise in year t. It is possible that U.S. workers had expected the arrival of the China shock and that expectation could have reflected on the initial geographical and industrial distribution of employment levels. Using the employment data from year $t-1$ alleviates that concern.

The second modification is that ΔM^{CH}_{it} is now replaced with ΔM^{CO}_{it}, a change in U.S. imports from other developed countries.[10] Following the conventional shift-share approach, one would use a change in total U.S. imports from China, ΔM_t^{CH}, instead of ΔM_{it}^{CO}. However, ADH uses ΔM_{it}^{CO} because they assume that China's exports to the other developed countries can be seen as China's supply shock. U.S. imports from China, ΔM_{it}^{CU} (even aggregated imports; ΔM_t^{CU}) includes U.S. demand shocks, which will correlate with the error term.[11] Therefore, it does not satisfy the exclusion restriction.

As we will discuss, there are some critiques. Nevertheless, this approach is widely accepted in academia and a significant number of studies have used this approach (See Table 1 of Section 2.7). Some studies also employ a similar idea to construct their instruments. For example, to examine the effect of imports from China on demand for tasks, Lu and Ng (2013) use China's exports to the U.K. as an instrument. Choi and Xu (2020) use China's exports to Japan as an instrument for China's exports to Korea. Endoh (2018) uses Japan's imports from the rest of the world as an instrument for Japan's imports from China.

2.5.3 Validity of Shift-share Instruments

Studies have conducted rigorous research on the validity of shift-share instruments from an econometrics point of view (Adão, Kolesàr, et al., 2019; Goldsmith-Pinkham et al., 2020; Borusyak et al., 2021).[12] In order for the coefficient to be unbiased, two conditions need to be met: (1) controlling for explanatory variables and fixed effects, the error term does not correlate with the macro shock, Δm_{it}^{CO}; and (2) controlling for explanatory variables and fixed effects, the error term does not correlate with the initial employment share, $\frac{L_{rit}}{\sum_k L_{rkt}}$). If either of the two conditions are met, the coefficient will be consistent. Future studies will have to discuss if these two conditions are satisfied or not.

Kim and Vogel (2021) use a trade model with frictional labor markets to examine whether estimates obtained from a reduced-form regression with a shift-share instrument can be utilized to gauge welfare effects of a trade shock for each group of workers. They argue that the estimates can be used to find welfare effects for groups of workers classified by region, education, and gender. Adão, Arkolakis, et al. (2019) examine the link between estimating a reduced-form regression equation, such as ADH, and a general equilibrium analysis, such as Caliendo, Dvorkin, et al. (2019). They derive the optimal instrumental variable and use it to estimate the effects of the China shock. They find that (1) manufacturing and non-manufacturing employment decreased, (2) a positive welfare effect of price reductions offsets half of the employment losses, and (3) considering the regional interactions through the goods market offsets the negative effect of the China shock almost entirely.

Fischer and Saure (2018) argue that the estimation approach by ADH does not identify the causal effect of imports correctly. They argue that China's exports to other developed countries correlate with

[10] The eight developing countries in ADH are Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland.

[11] ADH argues that an increase in U.S. imports from China was mainly caused by supply-factors such as China's accession to the WTO and China's productivity growth.

[12] This explanation is based on the description in Section 2.4.2 of Lu, Sugita, et al. (2020). Section 2.3.2 of Caliendo and Parro (2021) also discusses a theoretical background of shift-share instruments.

U.S. demand factors, which makes ADH's approach less reliable. They propose a plausibly exogenous measure of import penetration using a monopolistic competition model of trade.

2.6 Analysis with PNTR as an Exogenous Shock

The U.S. Congress granted Permanent Normal Trade Relations (PNTR) status to China in 2001 (Handley and Limão, 2017). Prior to that, Chinese firms exporting to the U.S. faced uncertainty regarding U.S. tariffs subject to annual revision. Most studies consider this policy change an exogenous shock. If so, OLS estimates will be unbiased and consistent. As a result, there is no need to employ an IV approach.

2.6.1 Industry- or Firm-level Data and PNTR

Pierce and Schott (2016) use the gap between non-NTR tariffs and NTR tariffs,

$$NTR\ Gap_i = Non\ NTR\ Rate_i - NTR\ Rate_i, \tag{6}$$

to measure the size of the removal of the tariff uncertainty. A greater $NTR\ Gap_i$ indicates that industry i experienced a greater reduction in policy uncertainty. They estimate the following regression equation:

$$\ln L_{it} = \beta_1(PostPNTR_t \times NTR\ Gap_i) + \beta_2 PostPNTR_t + \mathbf{X}_i'\boldsymbol{\beta}_3 + \mathbf{X}_{it}'\boldsymbol{\beta}_4 + \delta_t + \delta_i + \varepsilon_{it},$$

where $\ln L_{it}$ indicates the natural log of industry i's employment in year t; $PostPNTR_t$ indicates the dummy variable taking unity after China was given PNTR status in 2001. The parameter for the interaction term, β_1, measures the effect of the policy shock, which shows that $\beta_1 < 0$.

2.6.2 Local Labor Markets and PNTR

Although $NTR\ Gap_i$ is an industry-level variable, Pierce and Schott (2018) convert it to a variable that changes across regions using data on regional employment in each industry. Specifically, the size of a policy shock faced by region r is measured as follows:

$$NTR\ Gap_r = \frac{\sum_i L_{r,i,1990} \times NTR\ Gap_i}{\sum_i L_{r,i,1990}}, \tag{7}$$

where $L_{r,i,1990}$ is industry i's employment in region r in 1990 and $NTR\ Gap_i$ is as defined in equation (6). Replacing Δm_{it}^{CU} with $NTR\ Gap_i$ in equation (4) leads to equation (7). Using this variable, Pierce and Schott (2020) show that import competition with China raised the mortality rate by furthering drug abuse. Similar approaches are employed by Che, Lu, et al. (2016), Greenland, Lopresti, and McHenry (2019), and Besedeš et al. (2021). Kondo (2018) uses equation (7), instead of equation (5), as an instrument for equation (4), a strategy which combines the ADH approach and the Pierce-Schott approach. McManus and Schaur (2016) and Lu, Shao, et al. (2018) use both the ADH and Pierce-Schott approach.

2.7 Other Identification Strategies

2.7.1 China's Accession to the WTO and the Removal of the MFA Quotas

Bloom et al. (2016), which we discussed in Section 2.4, use the removal of quotas following China's accession to the WTO as an instrument. Utar (2014) and Utar (2018) also consider the removal of the Multi-Fiber Arrangement (MFA) quotas and China's accession to the WTO as an exogenous shock and employs these events in a difference-in-difference estimation. It is shown that import competition has a negative effect on Danish firms' employment, value-added, and intangible assets (Utar, 2014), and that a negative effect is concentrated on workers with manufacturing industry-specific education (Utar, 2018). Sugita et al. (2021) also utilize the removal of the MFA quotas to examine the effect of trade liberalization on matching patterns between exporters and importers.

2.7.2 Exchange Rate Fluctuations and Other Strategies

Some studies use exchange rate fluctuations as an exogenous shock. Mion and Zhu (2013) use the exchange rate as an instrument for their import competition variable, showing that the China shock reduced manufacturing employment in Belgium and led to an upgrade in skilled workers. Campbell (2020) uses exchange rate fluctuations as an exogenous shock to show that an appreciation of the U.S. dollar reduces U.S. exports and employment. Yokoyama et al. (2021) also utilize exchange rate fluctuations to examine employment adjustment behavior of Japanese firms. They show that an appreciation of the Japanese yen reduced non-regular employment in industries that rely more on exports. Ebenstein et al. (2014) use the prevalence of access to the internet and education levels as instruments for offshoring. They find globalization induced labor reallocation from high-wage industries to low-wage industries, resulting in a decline of the average wage.

Table 1 summarizes the studies we have discussed so far. All of these studies estimate reduced-form regression models. Topalova (2010) and Caliendo and Parro (2021) acknowledge the need for prudence in interpreting results from such an analysis. They note that estimation results obtained from a difference-in-difference approach or a local labor markets analysis show us whether import competing regions have a significantly greater decline of employment (or other outcome variables) relative to other regions. This implies that, even if the estimated coefficient is insignificant, we cannot conclude that the overall effect on the economy is zero. To understand the overall effect on the economy, an input–output analysis or an analysis based on a quantitative trade model is more appropriate.

Table 1: Identification strategies to estimate the effect of import competition

Identification strategy	Industry / firm / worker level	Local labor market level
(1) Lagged dependent variable and input costs as IVs	Tomiura (2003, 2004), Bernard et al. (2006)	
(2) Tariff cuts as an exogenous shock		Topalova (2007, 2010), Kovak (2013), Dix-Carneiro and Kovak (2017), Dix-Carneiro et al. (2018), Hakobyan and McLaren (2016)
(3) Shift-share instruments with aggregate imports	Bloom et al. (2016)	Majlesi (2016), Dell et al. (2019)
(4) Shift-share instruments with China's exports to countries other than analyzed country	Acemoglu et al. (2016), Keller and Utar (2018), Endoh (2018), Choi and Xu (2020), Kiyota et al. (2021), Hayakawa et al. (2021a, 2021b),	Autor et al. (2013), Dauth et al. (2014), Mendez (2015), Malgouyres (2017), Taniguchi (2019)
(5) PNTR gap as an exogenous shock	Pierce and Schott (2016, 2018)	Che et al. (2016), Kondo (2018), Greenland et al. (2019), Pierce and Schott (2020), Besedeš et al. (2021)
(6) Both (4) and (5)	McManus and Schaur (2016)	Lu et al. (2018)
(7) China's accession to the WTO and the removal of the MFA quotas as an exogenous shock	Utar (2014, 2018), Bloom et al. (2016), Sugita et al. (2021)	
(8) Exchange fluctuations as an exogenous shock	Mion and Zhu (2013), Ebenstein et al. (2014), Campbell (2020), Yokoyama et al. (2021)	

Note: This table lists major studies only and is not comprehensive.

2.8 Analysis with Input–Output Tables

An input–output analysis provides us with an estimate of a direct effect as well as an indirect effect caused by the propagation of the direct effect. In addition, industry-by-industry effects can be easily estimated. However, observed data reflects supply-side and demand-side factors of the labor market, making it difficult to extract the effects of changes in labor demand per se. Furthermore, various assumptions are made to construct an input–output table, making an estimate less reliable.

2.8.1 Analysis with Domestic Input–Output Tables

Kiyota (2012) estimates the effect of foreign demand on domestic employment using a Japanese input–output table. It covers $n = 108$ industries during the 1975–2006 period. The size of the input coefficient matrix $\mathbf{A}$ is $n \times n$. The size of the final demand matrix $\Delta\mathbf{F}$ is $n \times 1$. Using these, the employment effect $\Delta\mathbf{L}$ is estimated as follows:

$$\mathbf{L} = \mathbf{p}\left[\mathbf{I} - (\mathbf{I} - \mathbf{m})\mathbf{A}\right]^{-1} \Delta\mathbf{F}, \tag{8}$$

where $\mathbf{p}$ is an $n \times n$ matrix with the employment divided by value-added in diagonal entries and zeros in other entries. $\mathbf{I}$ denotes an identity matrix. $\mathbf{m}$ is another n×n matrix with imports divided by domestic absorption, $m_i = M_i/(\sum_j q_{ij} + d_i)$, in diagonal entries and zeros in other entries. The variable M_i denotes the import value of industry i. The variable q_{ij} indicates the value of intermediate goods produced in industry i and used in industry j. Variable d_i denotes the value of final demand faced by industry i. Feenstra and Hong (2010) estimate the employment effects of China's exports using the same approach. Sakurai (2004) and Sakurai (2011) also estimates the employment effect of Japan's net exports.

Numerous studies have been conducted using the same approach. However, in the early 2000s, the research shifted toward simulation analyses based on more detailed economic models because input–output analyses suffered from some issues as mentioned. Nevertheless, owing to the introduction of international input–output tables which connects countries' domestic input–output tables using data on trade flows, researchers re-started using an input–output analysis in academic studies on trade.

2.8.2 Analysis with International Input-output Tables

In an international input–output table with k countries, the size of the input–output matrix, $\mathbf{A}$, and the employment-to-"value-added" share matrix, $\mathbf{p}$, is $(k \times n) \times (k \times n)$. The size of the final demand matrix, $\mathbf{F}$, and the resulting change in employment, $\Delta\mathbf{L}$, is $(k \times n) \times 1$. The employment effects of foreign demand are estimated as follows:

$$\mathbf{L} = \mathbf{p}\left[\mathbf{I} - \mathbf{A}\right]^{-1} \Delta\mathbf{F}. \tag{9}$$

The difference from equation (8) is that equation (9) does not include $(\mathbf{I} - \mathbf{m})$. In an international input–output table, international trade in intermediate goods is already reflected in $\mathbf{A}$. As a result, there is no need to adjust trade in intermediate goods using $(\mathbf{I} - \mathbf{m})$.

For example, Feenstra and Sasahara (2018) investigate the employment effects of trade using an international input–output table. They find that imports and exports created approximately 0.7 million jobs in the U.S. economy during the 1995–2011 period. Other studies conducting an analysis using an international input–output table include Los et al. (2015), Kiyota (2016), Feenstra and Sasahara (2019), and Sasahara (2019). Some studies utilize an international input–output table to estimate value-added exports, which are included in their regressions. Such studies include Wang et al. (2018), Shen and Silva (2018), and Jakubik and Stolzenburg (2021).

2.9 Quantitative Trade Models

We have discussed that estimating a reduced-form regression does accurately convey the overall effect of a trade shock and that an input–output analysis does not give us the effect of an exogenous labor demand shock. A simulation analysis based on quantitative trade models can address these issues. For example, Caliendo, Dvorkin, et al. (2019) build a quantitative trade model with internal migration costs, input–output linkages, and frictional labor markets. They find that imports from China (1) account for 16% of the employment decline during the 2000–2007 period, (2) induced labor reallocation from manufacturing to non-manufacturing, and (3) led to a 0.2% increase in U.S. welfare.

Lyon and Waugh (2019) develop a dynamic Ricardian model with incomplete markets and frictional labor markets. They find that the China shock increased the labor supply by strengthening workers' precautionary saving motive and raised GDP by 2% in a five-year span. Brussevich (2018) estimates sectoral job switching costs in a frictional labor market for women and men separately, utilizing them to estimate the effect of the China shock on welfare levels by gender.

Thus, "frictional labor market" is a keyword in this series of studies. It is essential to include a frictional labor market in a model to reflect realistic labor market conditions where changing sectors and jobs require monetary and non-monetary costs. McLaren (2017) emphasizes this point and discusses quantitative trade models from that perspective. Caliendo and Parro (2021) also review quantitative trade models with input–output linkages and local labor markets. These adverse effects of the China shock are presumably due to the fact that imports from China are less expensive and have greater pro-competitive effects.[13]

3 Impacts of the China Trade Shock

This section summarizes existing studies on the China trade shocks and other import competition by country.

3.1 Impacts on the U.S. Economy

3.1.1 Adverse Effects on Employment

ADH shows that imports from China led to a loss of the manufacturing jobs of 1.53 million people during the 1990-2007 period.[14] Acemoglu et al. (2016) find that the China shock led to a loss of manufacturing jobs of one million people during the 1999–2011 period. They also show that considering input–output linkages between manufacturing and non-manufacturing industries increases the number of lost jobs to 2 million. Pierce and Schott (2016) utilize PNTR gaps as an exogenous shock to examine the effect of the China shock. They show that adverse effects on employment are greater in the U.S. than in EU nations. Furthermore, Autor, Dorn, and Hanson (2021) show that the adverse employment effects of the China shock are persistent even in 2019. They show that 55% of the decrease in employment since 2000 can be explained by the China trade shock.

[13] For example, using establishment-level data from the U.S. manufacturing sector between 1997 and 2012, Kamal and Lovely (2017) show that imports from middle- and high-income countries are not correlated with employment changes while imports from low-income countries are associated with employment losses.

[14] See footnote 31 on page 2140 of ADH for this figure.

3.1.2 Types of Affected Workers

There are studies investigating the effect of the China shock by type of worker. For example, del Angel et al. (2019) consider several categories of workers based on wage, labor type, and education level. They show that the China shock adversely affected less educated, low-wage manual laborers the most. Ferriere et al. (2021) show that the negative shock strongly affected non-college graduates and that the college enrollment rates increased in import-competing regions.

Autor, Dorn, and Hanson (2015) examine the effect of the China shock at the task level. They show that the China shock reduced routing task jobs while increasing abstract and manual task jobs. Lu and Ng (2013) investigate the effects of import competition during the 1971–2001 period. They find that import competition affected cognitive and interpersonal skill intensive industries. Lu and Ng (2013) also find similar effects using imports from countries other than China. Based on this, they argue that their results are not driven by imports from China only.

3.1.3 Channels and Mechanisms

It is important to understand both the mechanisms through which the China shock reduced employment and the transitions of workers who lost their jobs. There are three studies which attempt to answer these questions: they find that (1) workers in the import competing industry have a higher probability of losing their jobs (Autor, Dorn, Hanson, and Song, 2014; worker-level data); (2) employment losses are caused by the closure of establishments (Asquith et al., 2019; establishment-level data); and (3) the number of new businesses declined and business closures increased in import competing industries (Aslan and Kumar, 2021; household-level data).

Magyari (2017) points out that the China shock triggered "servification," a transition of manufacturing plants to non-manufacturing plants. She shows that employment declined in the manufacturing plants producing goods, but it increased in manufacturing plants doing R&D. Furthermore, the job creation effects offset the job destruction effects, leading to an annual average increase in employment of 2% during the 1997–2012 period.

3.1.4 Considering U.S. Exports and Non-manufacturing Industries

The U.S. manufacturing industry is considered a comparative disadvantage industry (Eriksson et al., 2021). Therefore, it is theoretically natural that import competition has a negative effect on manufacturing employment. Some studies consider the effects of U.S. exports and include non-manufacturing industries in their analyses. For example, Feenstra, Ma, and Xu (2019a) apply the ADH approach to examine the employment effects of U.S. exports. They find that overall trade (imports and exports) led to 0.4 million lost manufacturing jobs based on industry-level analysis, and that the effect of overall trade is almost zero at the commuting zone level. Liang (2021) conducts a similar analysis and finds that U.S.

exports created 1.6 million jobs during the 1991-–2007 period.

Uysal et al. (2015) examine U.S. firm-level data and show that the adverse effect of import competition on employment increases with firm productivity for non-exporters while the adverse effect decreases with firm productivity for exporters. The result suggests that exporting creates additional jobs and mitigates the job destruction effect of import competition.[15] A global input–output analysis by Feenstra and Sasahara (2018) and an analysis with a quantitative trade model by Caliendo, Dvorkin, et al. (2019) also consider non-manufacturing sectors.

3.1.5 Reasons for Sizable Impacts

The adverse effects of the China trade shock in the U.S. economy are discussed in a sensational way, not just in academia but also in policy debates. Economists have investigated why the effects of imports from China have been so enormous in the U.S.

Product cycles: Eriksson et al. (2021) investigate the long-run effects of trade on the U.S. economy from the view of product cycles. They argue that the adverse effects of the China shock have been sizable because, during the 1990–2007 period, the U.S. manufacturing industry had entered a later stage of the product cycle, had been employing less educated workers and lacked innovation. By contrast, they argue that the U.S. manufacturing industry was at an early stage of the product cycle when the Japan shock (1975–1985) and the Tiger shock[16] (1975–1988) hit the U.S. economy, which resulted in a smaller effect on manufacturing employment.[17]

Housing markets: Feenstra, Ma, and Xu (2019b) argue that the impacts of the China shock had become sizable because the U.S. economy was doubly hit by the China shock and the collapse of the housing market.[18] They show that the inclusion of housing market variables in the ADH regression equation halves the absolute value of the coefficient. In other words, if the housing market did not react at all, the decline of manufacturing employment would have been one half of the actual decline.

Limited regional labor mobility: A limited labor mobility across regions may be the cause of the concentration of adverse effects of imports on import-competing regions.[19] Greenland, Lopresti, and

[15]The effects of exports are estimated to be positive. However, it is not necessarily correct to assume that imports always have a negative effect and exports always have a positive effect on employment. For example, a boom leads to employment growth, raising the purchasing power of consumers and increasing imports, leading to a positive correlation between employment and imports (Krugman, 1994; Irwin, 2020, Chapter 4). Furthermore, Atkin (2016) finds that regions with export-oriented industries experienced a decline in the high school graduation rate by raising opportunity costs of graduating from high school in Mexico. Hummels et al. (2016) show that an increase in export opportunities raised workers' business hours, associated mental stress, and work-related injuries in Denmark. Thus, there are negative aspects of exports.

[16]The Tiger shock refers to an increase in imports from Taiwan, Korea, Singapore, Thailand, and Hong Kong.

[17]There are other studies on the effects of trade during the 1970s and 1980s. Batistich and Bond (2019) argue that the Japan shock deteriorated labor market conditions of African American workers, leading to civil rights movements. Nishioka and Olson (2020) examine the effects of the Japan shock on U.S. politics. As a result of the Japan shock, the Democratic party implemented a protectionist policy. However, the Reagan administration attempted to increase exports to Japan by utilizing Section 301. Nishioka and Olson (2020) argue that, owing to the different policies, Republican party supporters decreased in the Midwest where the Japan shock hit severely.

[18]Housing prices spiked in California and Florida during the 2000–2007 period. By contrast, housing prices did not increase much in areas that were exposed to the China shock, such as the Midwest. According to Feenstra, Ma, and Xu (2019b), housing market reactions worked to magnify the effect of the China shock. The effects on the housing market are also considered in Barrot et al. (2018) and Feler and Senses (2017).

[19]Ganong and Shoag (2017) show that a decline in regional labor mobility, caused by a sharp increase in urban housing

McHenry (2019) demonstrate that the China shock resulted in a relocation of workers from import-competing regions to elsewhere. However, such adjustments may not have been enough to absorb the entire effect of the China shock. Caliendo, Dvorkin, et al. (2019) show that, while the welfare effect of the China shock is positive when there is full regional labor mobility, it is negative when labor mobility is limited. Kondo (2018) shows that an increase in workers with Trade Adjustment Assistance leads to two additional unemployed workers, suggesting that the negative effects are concentrated within each region. He also shows that, when regional labor mobility is muted, import competition increases regional income inequality.

Measurement issues: The expanding global value chains have increased trade in intermediate goods. Some studies consider that aspect by introducing the value-added contents in trade rather than gross trade. For example, Shen and Silva (2018) show that value-added imports from China's upstream industries have smaller effects on U.S. employment. Jakubik and Stolzenburg (2021) show that an analysis with value-added imports leads to a smaller employment effect compared with ADH.

3.2 Impacts on the Japanese Economy

3.2.1 Earlier Studies

Greater attention has been paid to the effects of trade on employment in Japan due to its proximity to low-income Asian countries since the early 2000s. Using industry-level data from 1988–1995, Tomiura (2003) finds that the combination of the recession and the appreciation of the yen reduced employment. Sasaki (2007) updated the data to the 1994–2003 period. He finds that imports had a stronger negative effect on employment in the labor-intensive industries. Tomiura (2004) shows that a decline in the prices of imports reduced employment by triggering exits of manufacturing plants. Using industry-level data during the 1975–1994 period, Dekle (1998) finds that the appreciation of the yen reduced the competitiveness of Japanese exports, resulting in a decrease in employment.

Using firm-level data from the late 1990s, Ito (2005) shows that imports from low-income countries reduced the sales and employment growth rate. Using data from the 1981–2000 period, Inui et al. (2011) find that imports from low-income countries reduced the survival rate of incumbent firms and employment. However, they also show that imports have a smaller effect on more productive firms and that imports from non-low-income countries have a positive effect on the survival rate and employment. Using the 1994–2005 period data, Kneller et al. (2012a) show that there is no systematic relationship between imports from low-income countries and plants' exits and that imports have a negative effect on plant-level productivity. Kneller et al. (2012b) analyze the effects of imports on firms' organizational structures such as the number of owned plants and the exit rate. They find no significant relationship between imports and plants' exits.

prices, was one of the causes of declining income convergence across regions.

3.2.2 Recent Studies with Aggregated Data

Prefectures and commuting zones: A growing number of studies have analyzed the effects of the China shock on Japanese labor markets. Taniguchi (2019) applies the ADH approach to the Japanese prefecture-level data from the 1995–2007 period. She finds that imports from China boosted employment in Japan by 0.32 million, which is in contrast with the adverse employment effects found in the U.S. The positive employment effects are explained by the fact that China's exports to Japan include a sizable share of intermediate goods.

The cross-sectional unit in Taniguchi (2019) is "prefectures." However, Kainuma and Saito (2022) analyze "commuting zone" level data, whereas, commuting zones in Japan are defined by Adachi et al. (2021).[20] They show that imported inputs from China had a positive effect on Japan's downstream industries' employment and that there is no significant effect on upstream industries' employment.

Industries: Using the employment data from a Japanese input–output table, Hayakawa et al. (2021a) show that imports from China reduced employment and that an increase in imports caused by regional free trade agreements increased employment.

3.2.3 Recent Studies with Micro Data

Employment: A growing number of studies use micro data such as firm-level data and worker-level data. For example, Matsuura (2020) and Matsuura (2021) construct a firm-level import penetration variable to investigate the effects of imports from China on manufacturing employment. These studies find that import competition resulted in "servification," a reallocation of labor from manufacturing plants to non-manufacturing plants within the manufacturing industry. Bellone et al. (2021) examine data on multi-product firms. They find that imports from China reduced the number of products produced by each firm. Hayakawa et al. (2021b) analyze firm-level data and find that imports from China reduced downstream firms' employment and increased upstream firms' employment.

Endoh (2021a) decomposes job flows into three factors — the regional, industrial, and common components —– and analyzes their effects on imports. He finds that imports from China reduced job creation by 0.3% and increased job destruction by 5.3%. Tomiura and Suzuki (2021) show that imports from China affected job turnover of older workers and job switching of younger workers. They also show that imports from China had little effect on workers' relocation across prefectures.[21]

Wages: Endoh (2018) analyzes wages paid by large firms. He finds that import competition has almost no effect on wages paid to workers with high school diplomas and has a positive effect on workers with college degrees. Endoh (2021c) includes small- and medium-scale firms in his sample and finds the

[20] For example, the southern region of Saitama, Tokyo, the northern region of Kanagawa, and the western region of Chiba can be considered as one commuting zone. A large prefecture like Hokkaido consists of multiple commuting zones.

[21] Regarding the limited effects of the China shock on regional labor mobility, the authors argue that labor mobility across prefectures was already small. In addition, during the 1992–1997 period, global value chains between Japan and China had not yet expanded, resulting in a smaller China shock effect.

following: (1) imports from Asia had a positive effect on high-wage workers and a negative effect on low-wage workers; and (2) that these effects are small compared with overall variations in wages. Endoh (2021b) shows that offshoring has essentially no effect on skill premium and gender gaps measured by base salaries. However, it increases skill premium measured by hourly wages and expands the gender gap in annual income.

Others: Yamashita and Yamauchi (2020) report that imports from China increased Japanese firms' innovation activities and patents. However, they also find that imports from China reduced the quality of innovation measured by the number of citations. Endoh (2022) shows that upstream firms that are given to access to international markets through firm-to-firm transactions with downstream firms have higher survival rates. Ito (2021) examines the data on Japan's national elections during the 2009–2014 period. He finds that candidates in import-competing regions tend to have protectionist policies and this pattern is more strongly observed from challengers rather than incumbents.

3.2.4 Impacts of Exports

Studies have investigated the effects of exports as well. Reduced-form analyses have shown the following: (1) exports increased manufacturing workers' business hours, but it did not affect the share of non-regular employment to total employment (Tanaka, 2013); and (2) the product churning effects of the China shock are mitigated by export opportunities (Bellone et al., 2021). Input–output analyses have shown the following: (1) imports during the 1980–1990 period reduced manufacturing jobs by 0.53 million, which account for 4.7% of the initial employment level (Sakurai, 2004); (2) a decrease in net exports during the 1990–2000 period reduced jobs by 0.57 million (Sakurai, 2011, Chapter 6); (3) the export dependency is higher in the transport and wholesale industry, and the indirect effects through input–output linkages have greater impacts on employment than the direct effects of foreign demand (Kiyota, 2012); and (4) industries that export greater value-added content have larger employment effects per export (Sasahara, 2019).

3.3 Impacts on Countries Other Than the U.S. and Japan

3.3.1 Mexico

Studies have examined the effects of China's exports to Mexico on the Mexican economy. For example, Iacovone et al. (2013) examine firm-level and product-level data. They find that imports from China hastened exits of firms with lower sales but did not affect firms with higher sales as much. In addition, using municipality level data, Majlesi and Narciso (2018) show that import-competing municipalities had higher out-migration rates.

Given that Mexico is one of the major trading partners of the U.S., some studies have investigated the effects of China's exports to the U.S. on the Mexican economy through trade diversion. Dell et al. (2019)

show that, in Mexican regions with industries that faced import competition with China in the U.S. market, the unemployment rate rose and drug transactions increased, resulting in an increase in violent crimes. Utar and Ruiz (2018) show that Mexican industries that faced import competition with China in the U.S. economy had lower employment and sales growth. Majlesi (2016) finds that fiercer import competition in the U.S. increased job opportunities for women compared to men, giving women more decision-making power, and improving health conditions of children. Mendez (2015) also investigates the direct effects of China's exports to Mexico and the indirect effects of China's exports to the U.S. on Mexican manufacturing employment. He shows that a decline in Mexican exports to the U.S. caused by the rise of the Chinese economy reduced Mexican manufacturing employment.

3.3.2 Canada

Studies on the Canadian economy define each metropolitan area as a local labor market. Murray (2017) argues that imports from China account for 20% of the observed decline in manufacturing employment during the 2001–2011 period. Using the data from the 1991–2011 period, Kim (2018) shows that imports from China had a greater adverse effect on female workers than male workers. Albouy et al. (2019) show that the adverse effects of the China shock on the Canadian economy were smaller than those on the U.S. economy. They argue that the difference comes from Canada employing a larger-scale income redistribution policy than the U.S. and that Canada accepts a greater share of high-skilled immigrants. Yang et al. (2021) show that import competition increased firms' product innovation (the development of new products), but reduced process innovation (the improved efficiency of the production process).

3.3.3 Denmark

Using Danish matched firm-employee data, Keller and Utar (2018) show that imports from China increased the gender wage gap, resulting in increased family time for women. They also show that the marriage rate increased, divorce rate decreased, and birth rate increased. Utar (2018) utilizes the removal of the MFA quotas as an exogenous shock to increase imports from China. She shows that this shock reduced manufacturing employment and wages. Traiberman (2019) shows that the China shock increased workers likelihood of pursuing education, presumably because these workers are adjusting to a negative shock by acquiring human capital. He shows that import competition during the 1995–2005 period reduced workers' income by 5% and that import shocks at the occupation-level account for 60% of overall import shocks' variations.

3.3.4 Germany

Dauth et al. (2014) apply the ADH approach on the import- and export-side of the German economy. They find that exports have a positive employment effect while imports have a negative employment effect. They also show that the negative effect of imports is mainly caused by imports from China and the positive effect of exports is mainly caused by exports to Eastern Europe. Dauth et al. (2021) use worker-level data and show that income earned by workers increased in export-oriented industries and did not significantly change in import-competing industries. Surprisingly, they also show that the negative effects of import competition are concentrated in workers employed by high-wage plants.

3.3.5 France

Using French commuting zone level data during the 1995–2007 period, Malgouyres (2017) shows that import-competing regions experienced a decline of employment and wages in manufacturing and non-manufacturing industries. Furthermore, studies have shown the following: (1) imports from China reduced firms' markups but the negative effect is smaller for firms with export opportunities (Caselli and Schiavo, 2020); (2) imports from China improved firms' productivity and products' quality (Caselli, Nesta, et al., 2021); and (3) firms that compete with final goods from China reduced their employment, while firms that purchase inputs from China did not reduce employment substantially (Aghion et al., 2021).

3.3.6 Brazil

Brazil experienced a large tariff cut in the 1990s and studies have examined its effects. For example, it has been shown that import competition reduced employment and wages, and increased the crime rate (Kovak, 2013; Dix-Carneiro, 2014; Dix-Carneiro and Kovak, 2017). These studies argue that a limited labor reallocation across industries is one of the causes of these adverse effects. Costa et al. (2016) show that import competing regions have smaller wage growth rates and that export-oriented regions experienced an increase in wage and formal sector jobs. Benguira and Ederington (2021) show that import competition reduced the gender wage gap in Brazil.

3.3.7 Other Countries

Studies have examined the effects on other countries as well. They show the following: (1) in Spain, an increase in non-manufacturing employment almost entirely offset a decrease in manufacturing employment (Donoso et al., 2015); (2) in Belgium, the employment growth rate of low-tech manufacturing firms decreased and workers upgraded their skill levels (Mion and Zhu, 2013); (3) in Norway, the unemployment rate among low-skilled workers increased but the China shock accounted for only 10% of observed decline in manufacturing employment (Balsvik et al., 2015); (4) in Portugal, a decline in employment caused by import competition stemmed from adjustments in non-regular workers' employment (Branstetter et al., 2019); (5) in Italy, support for right-wing parties increased (Caselli, Francasso, et al., 2020), and employment in low-skilled labor intensive and less R&D focused manufacturing industries decreased (Federico, 2014); (6) in the U.K., workers' mental stress increased in import-competing industries (Colantone, Crino, et al., 2018b); and (7) in South Korea, imports from China reduced employment but exports to China offset the negative effect, resulting in an increase in employment of 0.52 million (Choi and Xu, 2020).

3.3.8 Cross-Country Analyses

Kiyota et al. (2021) analyze country-industry level data from the World Input–Output Tables to examine the effects of imports from China on employment in the U.S., Japan, Germany, the U.K., France, and South Korea. They show that (1) imports of final goods from China had a negative employment effect, (2) imports of intermediate goods from China and exports (of final and intermediate goods) to China had a positive employment effect, and (3) the overall employment effect in a country depends on the balance between these effects. Bloom et al. (2016) and Feenstra and Sasahara (2019), which were discussed in Section 2.4 and Section 3.1, respectively, also investigate the effects on employment in multiple countries.

4 Different Types of Import Shocks

This section summarizes existing studies using import competition variables that reflect industries' characteristics.

4.1 Upstream and Downstream

4.1.1 Industry-level Data and Domestic Input–Output Linkages

Acemoglu et al. (2016) define the "downstream→upstream" import shock on industry i as follows:

$$\Delta IP_i^{Down \to Up} = \frac{\sum_j \mu_{(i,U),(j,U)} \times \Delta m_j^{Total}}{\sum_j \mu_{(i,U),(j,U)}},$$

where Δm_j^{Total} denotes the change in imports of industry i's goods from China. The variable $\mu_{(i,U),(j,U)}$ denotes the value of intermediate goods produced in industry i in the U.S. and used in industry j in the U.S. The variable Δm_j^{Total} captures the propagation effect of an import competition shock on the importing country's downstream industry j into the same country's upstream industry i. Replacing the order of the subscripts of $\mu_{(i,U),(j,U)}$ leads to the "upstream→downstream" import shock on industry i:

$$\Delta IP_i^{Up \to Down} = \frac{\sum_j \mu_{(j,U),(i,U)} \times \Delta m_j^{Total}}{\sum_j \mu_{(j,U),(i,U)}},$$

The variable Δm_j^{Total} denotes the change in imports of upstream industry j's goods. Therefore, it captures the propagation effect from upstream industries into downstream industries in the importing country.

Acemoglu et al. (2016) show that the coefficient for $\Delta IP_i^{Down \rightarrow Up}$ is negative and statistically significant while the coefficient for $\Delta IP_i^{Up \rightarrow Down}$ is insignificant. In other words, a negative shock on downstream industries adversely influenced upstream industries. However, a negative shock on upstream industries did not affect downstream industries. This is because import competition in domestic upstream industries may cause domestic final goods producers to purchase imported inputs, escaping the negative shock on domestic upstream industries.

Federico (2014) and Hayakawa et al. (2021b) also construct similar variables. However, the labels are completely different from the ones in Acemoglu et al. (2016). Federico (2014) and Hayakawa et al. (2021b) add labels based on industries that were initially hit by import competition shock. However, Acemoglu et al. add labels based on industries to which the initial shock propagated. Although it is confusing to compare these studies owing to the different labelling rules, Federico and Hayakawa et al. also obtain similar results as Acemoglu et al. using Italian and Japanese data, respectively. A slight difference is that, although $\Delta IP_i^{Up \rightarrow Down}$ is negative in Acemoglu et al., it is positive in Federico and Hayakawa et al.

4.1.2 Commuting Zone Level Data and International Input–Output Linkages

U.S. producers purchasing imported inputs from China may benefit from the China shock because they can use less expensive inputs from China. To examine if there is such an effect, Wang et al. (2018) define their downstream shock as follows:

$$\Delta IPW_{rt}^{Down} = \frac{\sum_i L_{rit} \times \Delta IP_i^{Down}}{\sum_i L_{rit}}, \quad \text{with} \quad \Delta IP_i^{Down} = \frac{\sum_j \mu_{(j,C),(i,U)} \times \Delta m_j^{Int}}{\sum_j \mu_{(j,C),(i,U)}},$$

where $\mu_{(j,C),(i,U)}$ denotes the value of intermediate goods produced in industry j in China and used in industry i in the U.S. The variable Δm_j^{Int} denotes the change in the value of imported inputs from China's industry j. Therefore, ΔIP_i^{Down} captures the effect of imported inputs from China on U.S. downstream industry i. However, the upstream shock is defined as follows:

$$\Delta IPW_{rt}^{Up} = \frac{\sum_i L_{rit} \times \Delta IP_i^{UP}}{\sum_i L_{rit}}, \quad \text{with} \quad \Delta IP_i^{Up} = \frac{\sum_j \mu_{(i,U),(j,U)} \times \Delta m_j^{Int}}{\sum_j \mu_{(i,U),(j,U)}},$$

where $\mu_{(i,U),(j,U)}$ denotes the value of intermediate goods produced in industry i in the U.S. and used in industry j in the U.S. Therefore, ΔIP_i^{Up} measures the effect of imported inputs on U.S. upstream industry i.

There are three differences from the variables in Acemoglu et al. (2016): first, Acemoglu et al. use total imports from China, Δm^{Total}, while Wang et al. use imported inputs from China, Δm^{Int}; second, Acemoglu et al. use $\mu_{(j,U),(i,U)}$ to capture input–output linkages within U.S. industries, while Wang et al. use $\mu_{(j,C),(i,U)}$ to capture international input–output linkages between China and the U.S.; third, Acemoglu et al.'s variables are at the industry-level, while Wang et al. transform industry-level data into local labor market variables.

As U.S. downstream industries can benefit from imported inputs from China, the effect of ΔIPW_{rt}^{Up} on U.S. employment is expected to be positive. However, ΔIPW_{rt}^{Down} is expected to have a negative effect on U.S. employment because U.S. upstream industries compete with China's intermediate goods producers. Wang et al. (2018) obtain results that are consistent with these considerations.

4.1.3 Commuting Zone Level Data and Domestic Input–Output Linkages

Using Japanese commuting zone level data, Kainuma and Saito (2022) examine the effects of import competition on employment. They also introduce separate upstream and downstream variables. Their definitions are a combination of Acemoglu et al. (2016) and Wang et al. (2018). The approaches of Kainuma and Saito (2022) and Wang et al. (2018) are similar in that both convert industry-level shocks to the commuting zone level. Kainuma and Saito (2022)'s approach is similar to Acemoglu et al. (2016)'s approach in that the import penetration variables are constructed based on the importing country's domestic input–output table. Kainuma and Saito (2022) show that an import shock on Japan's upstream industries had a positive employment effect on Japan's downstream industries (i.e., $\Delta IP_i^{U \to D}$ is positive). Table 2 summarizes the upstream and downstream variables in the three studies we have discussed.

TABLE 2: Upstream and downstream variables in the three existing studies

	Variables' cross-sectional unit		Input–output table	
	Industry	Commuting zone	Domestic	International
Acemoglu et al. (2016)	✓		✓	
Wang et al. (2018)		✓		✓
Kainuma and Saito (2022)		✓	✓	

4.1.4 Considering Value-added Content in Trade

Shen and Silva (2018) examine the effects of value-added imports, rather than gross imports, from China. They define the downstream and upstream shock,

$$\Delta IPW_{rt}^{Down} = \frac{\sum_i L_{rit} \times \Delta VAX_i^C \times D_i}{\sum_i L_{rit}} \quad \text{and} \quad \Delta IPW_{rt}^{Up} = \frac{\sum_i L_{rit} \times \Delta VAX_i^C \times (1 - D_i)}{\sum_i L_{rit}},$$

respectively. The variable ΔVAX_i^C denotes value-added imports of industry i's goods from China. The variable $_i$ denotes the dummy variable taking unity if China's export industry i's downstream level is above the median. They compute the downstream level based on an international input–output table. The downstream shock ΔIPW_{rt}^{Down} is the effect of value-added imports from China's downstream industries. Therefore, it is expected to have a pro-competitive effect on the importing country's goods market, leading to a greater negative employment effect. Moreover, the upstream shock ΔIPW_{rt}^{Up} is the effect of value-added imports from China's upstream industries. Therefore, it is expected to have a limited effect on the importing country's goods market competition. Using U.S. data, they obtain expected results.

Table 3 summarizes the upstream and downstream effects we have discussed. It shows that the definition of "downstream" and "upstream" effects vary across extant literature and the expected impacts on labor markets also differ. Readers need to check the definitions carefully to understand each study's empirical results.

Table 3: Upstream and downstream variables in existing studies

	Upstream effects		Downstream effects	
	Effect	Interpretation	Effect	Interpretation
Acemoglu et al. (2016)	Negative	The propagation effect of imports in the importing country's downstream industries on upstream industries in the same country	Ambiguous	The propagation effect of imports in the importing country's upstream industries on downstream industries in the same country
Kainuma and Saito (2022)	Ambiguous		Positive	
Federico (2014), Hayakawa et al. (2021b)	Positive	The propagation effect of imports in the importing country's upstream industries on downstream industries in the same country	Negative/ Ambiguous	The propagation effect of imports in the importing country's downstream industries on upstream industries in the same country
Wang et al. (2018)	Negative	The effect of imported inputs from China on the importing country's upstream industries (pro-competitive effects of imported inputs)	Positive	The effect of imported inputs from China on the importing country's downstream industries (production complement effects of imported inputs)
Shen and Silva (2018)	Ambiguous	The effect of value-added imports from China's upstream industries on the importing country's goods market competition	Negative	The effect of value-added imports from China's downstream industries on the importing country's goods market competition

4.2 Vertical and Horizontal shocks

4.2.1 Local Labor Markets and Trade in Intermediate Goods

Taniguchi (2019) examines the effects of final goods imports and intermediate goods imports from China separately. In doing so, she uses industry i's final goods share, θ_i^F, and intermediate goods share, θ_i^I, where $\theta_i^F + \theta_i^I = 1$, to decompose the ADH import penetration variable into the final goods import shock and the intermediate goods import shock:

$$\Delta IPW_r^F = \frac{\sum_i L_{ri} \times \Delta m_i^C \theta_i^F}{\sum_i L_{ri}} \quad \text{and} \quad \Delta IPW_r^I = \frac{\sum_i L_{ri} \times \Delta m_i^C \theta_i^I}{\sum_i L_{ri}},$$

respectively. She finds that ΔIPW_r^F has a negative employment effect while ΔIPW_r^I has a positive employment effect. The negative effect of ΔIPW_r^F is consistent with the negative downstream effect of Shen and Silva (2018). The positive effect of ΔIPW_r^I is consistent with the positive downstream effect of Wang et al. (2018).

4.2.2 Firm-level Trade in Final and Intermediate Goods

Using French firm-level data, Aghion et al. (2021) consider whether firms compete with imports from China in the goods market (the horizontal relationship with imports from China) or purchase imported inputs from China (the vertical relationship with imports from China). Their variable capturing the horizontal shock is

$$\Delta IP_p^H = \frac{\sum_i x_{pi} \times \Delta M_i^C}{\sum_j x_{pi}},$$

where x_{pi} denotes firm p's exports of industry i's goods and ΔM_i^C denotes the change in imports of industry i's goods from China. Because firm p exports industry i's goods abroad, it can be argued that it competes with the same industry's goods imported from China. As a result, it is interpreted as a horizontal shock. However, the horizontal shock is

$$\Delta IP_p^V = \frac{\sum_i m_{pi} \times \Delta M_i^C}{\sum_j m_{pi}},$$

where m_{pi} denotes firm p's imports of industry i's goods. As the firm directly imports the goods from China, it can be said that the goods are used as intermediate goods, which is a vertical relationship. Using these variables, Aghion et al. (2021) examine the effects on employment, patents, and other outcomes. They show that the horizontal shock has significant negative effects while the vertical shock has either positive effects or statistically insignificant effects. The horizontal and vertical shocks in Aghion et al. (2021) are similar to the final goods and the intermediate goods shock in Taniguchi, respectively. Table 4 summarizes the shocks we have discussed.

TABLE 4: Differences in upstream and downstream variables in existing studies

	Effects of imports from China's downstream industries on the importing country's goods market (Employment effects are negative)	Effects of imports of inputs from China on the importing country's downstream industries (Employment effects are positive or ambiguous)
Wang et al. (2018)		Downstream shock
Shen and Silva (2018)	Downstream shock	
Taniguchi (2019)	Final goods import shock	Intermediate goods import shock
Aghion et al. (2021)	Horizontal shock	Vertical shock

5 Impacts by Topic

This section summarizes existing studies by topic. It includes topics that are both intensively studied and under-investigated.

5.1 Labor Market Aspects

5.1.1 Patents, Research & Development, Investment, and Productivity

Existing studies have examined the effect of import competition on firm behavior. Studies on the U.S. economy have found that, due to import competition, (1) firms' incentive for innovation and the number of patents declined (Autor, Dorn, Hanson, Pisano, et al., 2020), (2) investment declined (Pierce and Schott, 2016), and (3) firms with higher R&D capital stock suffer less from the China shock (Hombert and Matray, 2018). In addition, studies have pointed out that, while manufacturing employment declined by 25% during the 2000-2012 period, manufacturing output increased, hence labor productivity increased (Pierce and Schott, 2016; Fort et al., 2018).

Studies on countries other than the U.S. have found that import competition: (1) increased innovation and triggered labor reallocation from low-tech firms to high-tech firms in EU nations (Bloom et al., 2016), (2) increased firms' productivity and improved product quality in France (Caselli, Nesta, et al., 2021), (3) increased the number of patents but reduced the number of citations in Japan (Yamashita and Yamauchi, 2020), and (4) increased product innovation but reduced process innovation in Canada (Yang et al., 2021).

5.1.2 Gender

Import competition affects certain industries more strongly than others. In addition, gender compositions vary across industries. As a result, it is easy to understand that import competition affects each gender differently on average. For example, Autor, Dorn, and Hanson (2019) show that import competition reduced the marriage rate of U.S. male workers. They argue this is because imports adversely affected male-intensive manufacturing sectors, reducing the marriage opportunities for men. Besedeš et al. (2021) show that imports from China reduced the gender wage gap and the gender employment gap in the U.S. Brussevich (2018) finds that import competition raised the relative welfare level of women because women have lower job switching costs. Sasahara and Mori (2021) construct a theoretical model to quantify the role of international trade in explaining narrowing gender gaps in the U.S.

There are also studies focusing on countries other than the U.S. These studies have shown that import competition (1) increased the gender wage gap, marriage rate, and birth rate, and reduced the divorce rate in Denmark (Keller and Utar, 2018), (2) reduced the gender wage gap by increasing the number of women with high-wage occupations in Brazil (Benguira and Ederington, 2021), and (3) improved women's rights within their families by increasing job availability for women in Mexico (Majlesi, 2016).

5.1.3 Human Capital

Research has found that a negative effect caused by the China shock increased human capital by raising benefits from higher education. For example, (1) import competition reduced employment opportunities for workers who did not graduate high school, resulting in an increase in high school graduation rates in the U.S. (Greenland and Lopresti, 2016); (2) the college enrollment rates increased in import-competing regions in the U.S. (Ferriere et al., 2021); and (3) import competition raised enrollment in education of workers who were employed in import-competing industries in Denmark (Utar, 2018). On the contrary, import competition during the 1990s in India dampened enrollment in education (Edmonds et al., 2010). A study shows that workers with greater human capital have higher job switching costs, and ignoring these switching costs results in biased estimates (Traiberman, 2019).

5.1.4 Migration

Studies have found that import-competing regions experienced a reduction in in-migration and an increase in out-migration in the U.S. (Greenland, Lopresti, and McHenry, 2019) and Mexico (Mendez, 2015; Majlesi and Narciso, 2018). As discussed in Section 3.2.3, Tomiura and Suzuki (2021) examine the effects of the China shock on migration across prefectures in Japan. Faber et al. (2020) examines migration responses to two shocks–the China shock and an increase in the prevalence of robots between 1990 and 2015. They find that robots cause a greater migration response than the China shock.

5.2 Outside of the Labor Market

5.2.1 Prices

Traditional gains from trade include a reduction in consumer prices and an associated rise in consumer welfare. Indeed, Amiti et al. (2020) find that imports from China reduced manufacturing prices, raising the welfare of U.S. consumers. A study with bar-code level data shows that, during the 2004–2015 period, an increase in imports from China resulted in an annual average decline in the price index of 0.19% (Bai and Stumpner, 2019). In addition, a study with U.S. industry-level data shows that a 1% increase in imports from China reduces the producer price index by 2.4% (Auer and Fischer, 2010).

5.2.2 Fiscal Revenue

A negative effect on local labor markets caused by imports may make it difficult for municipal governments to collect taxes. This could result in a reduction in the provision of public goods. For example, Feler and Senses (2017) show that firms' sales and land prices declined in import competition regions in the U.S., which reduced government expenditure for police and education. Dix-Carneiro, Soares, et al. (2018) show that import competing regions in Brazil experienced a rise in unemployment rates and a decrease in tax revenue. They show that these changes resulted in a decrease in public expenditure and an increase in high school dropout rates.

5.2.3 Politics

A number of existing U.S studies that have investigated the political aspects of the China shock have shown that import competition: (1) increased votes for the Democratic party, a party which attempts to employ policies enhancing relief from competition and expanding benefits for unemployed workers (Che, Lu, et al., 2016); (2) caused political polarization (Autor, Dorn, Hanson, and Majlesi, 2020)[22]; (3) reduced the positive attitude toward giving the U.S. president special authority regarding free trade agreements (Che and Xiao, 2020); and (4) led to local newspapers from import-competing regions to report negative news about China (Lu, Shao, et al., 2018). Bombardini et al. (2020) examine if US politicians had expected the adverse effects of imports from China when they voted for pro-China Normal Trade Relations status between 1990 and 2001.

Studies on countries other than the U.S. show that import competition: (1) increased citizens' support for right-wing parties (Colantone and Stanig, 2018a, 15 Western European nations; Caselli, Francasso, et al., 2020, Italy; Dippel et al., 2022, Germany), (2) decreased votes for left-wing presidential candidates (Ogeda et al., 2021, Brazil), and (3) resulted in a greater share of people voting to leave the EU in import-competing regions in the U.K. (Colantone and Stanig, 2018b).

The effects on politicians' views are also analyzed. Feigenbaum and Hall (2015) examine the data on members of the House of Representatives in the U.S. during the 1990–2010 period. They find that politicians in import-competing regions tend to support protectionist policies. Ito (2021), discussed in Section 3.2.3, is also included in this category.

5.2.4 Health

A decline in income levels caused by import competition may make it difficult to pay medical bills and maintain healthy lifestyles. In the U.S., for example, import competition had the following effects: (1) deteriorated physical and mental health, and raised the mortality rate (Adda and Fawaz, 2020); (2) affected mental health more strongly than physical health (Lang et al., 2019); (3) increased opioid abuse (Charles et al., 2018); (4) raised the mortality rate by increasing drug abuse (Pierce and Schott, 2018); and (5) increased work-related injuries in import-competing industries' plants (McManus and Schaur, 2016).[23] A study also shows that workers in import competing industries in the U.K. experienced an increase in mental stress (Colantone, Crino, et al., 2018b).

[22] Autor, Dorn, Hanson, and Majlesi (2020) show that import competition increased the support for conservative Republican candidates in regions with greater shares of Caucasian Americans. By contrast, the same shock increased the support for Democratic candidates in regions with greater shares of racial minorities.

[23] As noted in footnote 15, a study with Danish data shows that export opportunities increased work hours, resulting in an increase in work-related injuries and mental stress (Hummels et al., 2016).

5.2.5 Crime

An increase in unemployment caused by import competition may lead to a surge in crime rate. Studies have shown the following: (1) the crime rate increased in import-competing regions in the U.S. (Che, Xu, et al., 2018); (2) violent crimes increased in Mexican regions with industries that faced tougher competition with China in the U.S. market (Dell et al., 2019); and (3) the crime rate increased in Brazilian regions with industries experiencing greater tariff cuts (Dix-Carneiro, Soares, et al., 2018).

Thus, existing studies have analyzed the effects of imports from China on various aspects of the economy. Research on the exact mechanisms through which the China shock resulted in these changes and the effects on new aspects of the economy will be an important contribution to the literature.

6 Summary

This paper has summarized empirical approaches, existing studies on the China trade shock, and other studies on import competition by country and topic. Numerous studies on the effects of the China shock on the U.S. economy have been conducted. However, there is still room for further studies on the impacts of the China shock on non-U.S. economies and explanations of different impacts of the China shock across countries. For example, existing studies have shown that adverse effects on EU nations and Canada were smaller than those on the U.S. economy (Pierce and Schott, 2016; Albouy et al., 2019). Additionally, positive employment effects were found for the Japanese and Korean economies (Taniguchi, 2019; Choi and Xu, 2020).

Possible explanations for the cross-country differences may come from the following: (1) labor market institutions, laws, and norms; (2) the social welfare systems such as unemployment benefits; (3) development stages of the manufacturing industry, whether it is a comparative advantage or disadvantage industry; (4) the degree of integration in global value chains (whether traded goods are final goods or intermediate goods); and (5) trade balances.

Regarding (3), Eriksson et al. (2021) have shown that the U.S. manufacturing industry since the 2000s is a comparatively disadvantaged industry. However, such an analysis has not yet been conducted to understand the effects of the China shock in Japan. Regarding (4), Taniguchi (2019) investigates the effect of imported inputs. Kiyota et al. (2021) also attempt to explain cross-country differences in the magnitude of the China shock effect by type of goods (intermediate goods or final goods) and the direction of trade (imports or exports). Regarding (5), Choi and Xu (2020) attribute the cause of the positive employment effects of trade with China to a positive trade surplus in the Korean economy. However, as noted in footnote 15, exports may not necessarily have a positive effect on the economy. Therefore, we need to carefully examine the effects of exports. There is a lack of existing studies on (1) and (2) and these require further research.

In addition, dependent variables other than employment will be an important focus of future studies. For example, U.S. manufacturing labor productivity has been drastically improved (Pierce and Schott, 2016; Fort et al., 2018). By contrast, Japan's manufacturing productivity has not grown as much as the U.S. since the 1990s (Sasahara, 2019). The association between the China trade shock and the manufacturing productivity is an interesting topic to pursue. Furthermore, in studies focusing on Japan, unique economic situations of the Japanese economy such as aging, proximity to Asian countries, and deeper integration in global value chains will be important aspects to be considered.

Lastly, I would like to point out that existing studies mainly focus on import competition with China through the good market. The effects of China's integration in the global trade system on the Chinese economy, countries' offshoring to China, and the 2018–2019 U.S.–China trade frictions are important topics to pursue. In addition, the difference between the effects of trade and those of technological progress are not yet well studied in the context of the China shock.[24] Such focus should be included in the future research agenda.

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[24] Within the traditional framework, such as the Ricardian model, if trade and technology change the relative price of exports and imports in the same way, theoretically, technological progress has the same effect as trade. However, empirical investigations are needed to examine if that is the case. See Feenstra and Hanson (1999) for an early study.

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