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Does Foreign Direct Investment Catalyze Local Structural Transformation and Human Capital Accumulation?

Evidence from China

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Abstract

This paper examines the effect of foreign direct investment on local structural transformation and human capital accumulation in China, exploiting variations in foreign direct investment inflows across manufacturing sub-sectors caused by China's foreign direct investment deregulation and initial sectoral composition patterns across China's cities and provinces. Using a panel of city-level data from 1990 to 2005, the paper shows that manufacturing foreign direct investment inflows greatly accelerated city-level structural transformation and human capital accumulation. By expanding access to the global market, foreign direct investment created a huge pull factor that drew excess labor away from farms into factories and services. Foreign direct investment has promoted high school and university enrollment by paying a higher wage premium for skilled workers and pushing up the skill premium. The positive effect on structural transformation is largely driven by export-oriented foreign direct investment, while market-seeking foreign direct investment has a much larger effect on college enrollment. High-skill foreign direct investment has a larger effect on college enrollment than low-skill foreign direct investment.

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JEL classification: F66, F61, I25, J24, L16

1. Introduction

Structural transformation and human capital accumulation are two key underpinnings of modern economic growth. Structural transformation – usually defined as the secular reallocation of economic activity across the broad sectors agriculture, manufacturing, and services – is a crucial driver of aggregate productivity growth. The process of structural transformation is often accompanied by human capital accumulation, as individuals increase their years of schooling, obtain on-the-job training, and accumulate industry-specific experience and know-how.

As a key vehicle of globalization and technology diffusion, FDI can play an instrumental role in catalyzing structural transformation and human capital accumulation. FDI can redefine a country's comparative advantage and shape its development trajectory by creating demand in more productive segments and sectors, bringing countries into global production networks, and diffusing frontier production technologies and managerial practices. It is critical for academics and policymakers to understand the interactions among international production, local comparative advantages, structural transformation, and human capital accumulation to craft policies that promote sustainable and inclusive growth.

While a growing body of literature examines the impact of international trade on structural transformation and human capital accumulation, the role of FDI is largely underexplored. Despite abundant literature on the productivity spillovers of FDI, less attention is paid to the broader development impact of FDI through structural transformation and human capital accumulation. In addition, most existing papers on structural transformation study the phenomenon at the national level. As economic activities increasingly concentrate in specific localities within countries and spatial inequality rises in many countries, how FDI affects structural transformation and human capital development at the subnational level is highly relevant for academics and policymakers. This paper investigates the effect of manufacturing FDI inflows on local structural transformation and school enrollment during 1990-2005.

This paper builds on and contributes to several strands of literature. It benefits from recent multi-sector growth models (Ngai and Pissarides 2007; Matsuyama 2009, 2019; Acemoglu and Guerrieri 2008; Boppart 2014; Comin et al. 2021; Herrendorf el al. 2021) that deliver sharper insights for understanding economic development, regional income convergence, aggregate productivity trends, business cycles, and wage inequality (Herrendorf et al. 2014). It also contributes to the empirical literature on the effect of globalization on structural transformation and human capital accumulation (Rodrik 2016; Teignier 2018; Erten and Leight 2021; Li 2018; Li et al. 2019). More broadly, this paper is closely related to a growing body of literature studying local labor market effects of globalization (Dix-Carneiro and Kovak, 2017;

Atkin 2016; David et al. 2013; Autor et al. 2016), as well as the effect of trade and FDI on agglomeration (Henderson et al. 2018; Jacobs et al. 2014; Helm, 2020).

The main supply side force for structural transformation is heterogeneity in sectoral rates of technical growth. Empirical estimates for the rates of productivity growth significantly vary across sectors (Martin and Mitra 2001; Nordhaus 2008; Duarte and Restuccia 2010; Lawrence and Edwards, 2013). Faster productivity growth will lower prices and reduce the share of spending and employment in that sector if demand is inelastic. Historically, productivity growth in agriculture and manufacturing have been much higher than that in services, explaining the declining share of agriculture and manufacturing in rich countries (Ngai and Pissarides, 2007). Acemoglu and Guerrieri (2008) stress another supply-side factor: cross-sectoral factor intensity differences together with capital deepening as a cause of structural transformation. Sectoral differences in the degree of capital-labor substitutability constitutes another supply-side force (Alvarez‐Cuadrado et al. 2017)

The demand side drivers of structural transformation stem from varying income elasticities across sectors. Income elasticity of demand measures how responsive the quantity demand for a good or service is to a change in consumer income. Economists have long realized the systemic variations in the sectoral income elasticities through the concept of Engel curves. As people become richer, the demand for food only increases modestly, while the demand for manufactured goods increases more and the demand for services rises the most. Even in the absence of different sectoral productivity growth, variations in sectoral income elasticities will shift economic activity from agriculture to manufacturing and from manufacturing to services. This is observed in both real and nominal terms (Kongsamut et al. 2001; Foellmi and Zweimüller 2008; Boppart 2014; Comin, et al. 2021).

Rapid globalization during the past few decades has further affected the dynamics of employment and output shares through international specialization. Theory suggests that by disentangling domestic technical growth from domestic demand, international trade can create patterns of structural change distinct from the ones already discussed (Ventura 2005; Matsuyama 2009, 2019). Matsuyama (2019) propounds a unifying perspective on how economic growth and globalization affect the patterns of structural transformation, innovation, and trade across countries and sectors in the presence of Engel's Law. It demonstrates that globalization amplifies the power of endogenous domestic demand composition differences as a driver of structural change.

Many empirical studies have investigated the role of trade in structural transformation, particularly on premature deindustrialization in developing countries. Rodrik (2016) documents significant deindustrialization trend in low and middle-income countries and suggests that both globalization and laborsaving technological progress in manufacturing have been behind these developments. Erten and Leight (2021) also evaluate the effects of an exogenous pull factor - trade shock - on local structural transformation in China. Exploiting cross-sectional variation in tariff uncertainty faced by county economies before China's WTO accession in 2001, the paper finds that counties more exposed to the reduction in tariff uncertainty post-accession are characterized by increased exports and FDI, shrinking agricultural sectors, expanding secondary sectors, and higher total and per capita GDP.

FDI can influence both supply and demand forces of structural transformation. From the supply side, FDI often brings advanced technology to the host location, thus affecting structural transformation by improving productivity differently in the three sectors (agriculture, manufacturing, and services). FDI may also alter relative factor intensity and capital-labor substitutability in the three sectors by introducing new production techniques. From the demand side, FDI can directly expand demand in the sector it operates in and raise demand in upstream and downstream industries indirectly and induce higher demand across sectors through an income effect. However, positive effect on structural transformation is not guaranteed -- ultimately the net impact of FDI depends on the characteristics of FDI and the host location.

Relatively few papers have examined the role of FDI as a catalyst of structural transformation (Mühlen and Escobar, 2020). This is partly attributable to the lack of quality data. As structural transformation is a long-term phenomenon, it usually requires time-series data on sectoral employment, output, and FDI data over a sufficiently long period. Cross-country studies are often hindered by incomparability of sectoral classification across countries. Within-country studies struggle to collect data at a more granular geographical level that would allow researchers to exploit a source of cross-sectoral variation.

Among existing papers, most within-country studies suggest a positive impact of FDI on structural transformation in the host country (Mühlen and Escobar, 2020; Elekes et al., 2019; Ascani and Iammarino, 2018; Alviarez et al., 2021). Pineli et al. (2019) estimate the relationship between FDI and structural change using a cross-country sample from 1980-2010. The results suggest that the FDI-development nexus is highly country-specific. The interaction between the sectoral concentration of FDI and the development stage of the country plays a role in determining the impact of FDI.

Economists are also increasingly interested in the labor market impact of globalization, including the impact on human capital. Still, most extant studies focus on trade shocks, primarily in the form of tariff reductions (Edmonds and Pavcnik 2005; Edmonds et al. 2010; Greenland and Lopresti 2016; Blanchard and Olney 2017; Li 2018; Autor et al. 2014, 2016; Dix-Carneiro and Kovak, 2017). Several papers have documented the negative impact of import competition from China on manufacturing employment, wages, and high school graduation rates in developed countries (Ebenstein et al. 2014; David et al. 2013; Autor et al. 2014; Pierce and Schott 2016; Greenland and Lopresti 2016). Helm (2020) found considerable employment spillovers from positive trade shocks in Germany due to trade integration of Eastern Europe and China's WTO accession. Spillovers are larger for industries that share common worker requirements and are triggered predominantly by shocks to high-technology industries.

Trade liberalization can generate positive labor market effect in developing countries. Sheng and Yang (2017) build a global production sharing model that integrates the organizational choices of offshoring into the determination of relative wages in developing countries. The model shows that offshoring through FDI contributes more prominently than arm's length outsourcing to the demand for skills in developing countries, thereby increasing the relative wage of skilled workers. Empirical evidence from China supported predictions of the theory. Kis-Katos et al. (2018) show that female work participation increased and participation in domestic duties declined in Indonesian regions that were more exposed to input tariff reductions. Trade liberalization also led to delayed marriage among both sexes and reduced fertility rates among less educated women.

In the meantime, several studies have documented the negative impact of trade liberalization on employment, wage rates and human capital in developing countries. Tariff reductions in Brazil in the early 1990s resulted in deteriorating formal labor market outcomes in regions that faced larger tariff declines (Dix-Carneiro and Kovak, 2017). Atkin (2016) found that trade liberalization in Mexico during 1986-2000 altered the distribution of education. School drop-out increased with local expansions in export-manufacturing industries. Li et al. (2019) found that trade liberalization in China has led to decreased completed years of schooling, cognitive abilities, wages, and noncognitive outcomes. Leight and Pan (2020) found that Chinese youth from counties experiencing a larger export shock after 2002 show a lower probability of enrolling in high school. Erten et al. (2019) demonstrated a negative impact of tariff reductions in South Africa on both formal and informal manufacturing employment. The effect of trade liberalization on educational attainment depends on the skill intensity of such shocks and often exacerbates initial differences in factor endowments across localities. Locations with a higher share of skilled labor prior to trade liberalization tend to experience skill-intensive trade shock and vice versa. Using a panel of 102 countries over 45 years, Blanchard and Olney (2017) find that growth in less skill-intensive exports depresses average educational attainment while growth in skill-intensive exports increases schooling. Li (2018) shows that high-skill export shocks raise both high school and college enrollments in China, while low-skill export shocks depress both in China.

Many papers study the relationship between FDI and human capital in the context of aggregate economic growth, and sufficient human capital is often found to be a necessary condition for FDI to promote growth (Noorbakhsh et al. 2001). Empirical studies on the effect of FDI on human capital is relatively scant.

Mughal and Vechiu (2009) document negative effect of FDI on tertiary school enrollment. Using data from 80 developing countries over 1980-2014, Wang and Zhuang (2021) show that inward FDI promotes primary school enrollment and completion rates for both boys and girls, has no significant impact on male secondary and tertiary enrollment, but a significantly negative effect on female secondary and tertiary enrollment. FDI from OECD countries promotes secondary and tertiary enrollment rates while non-OECD FDI does not. Rong et al. (2020) documented a positive effect of FDI on employment and human capital in China, with labor market flexibility playing a significant positive moderating role.

While structural transformation and human capital accumulation are largely studied in two separate strands of literature, they happen concomitantly with economic growth and are mutually reinforcing. Economists are increasingly interested in the intersection between structural transformation and human capital accumulation. Buera et al. (2021) found that increases in GDP per capita are associated with a systematic shift in the composition of value added to sectors that are intensive in high-skill labor, a process they labeled as skill-biased structural change. Given the interconnection of the two topics and the same underlying dataset and methodology, this paper assesses the effect of FDI on structural transformation and human capital accumulation in China together.

This paper contributes to the literature on globalization, growth, and the labor market in three ways. First, to the best of our knowledge, this paper is the first to estimate the causal effects of FDI on city level transformation and human capital accumulation in China, while previous papers mostly study the two outcomes on the national or provincial level. Second, the paper exploits China's FDI liberalization policies and the differences in initial industry composition across regions to establish causal links between FDI inflows, structural transformation and school enrollment. While there is a growing body of literature adopting this method (Edmonds et al. 2010; Topalova 2010; Dix-Carneiro and Kovak 2017; McCaig 2011; Costa et al. 2016; Erten and Leight 2021; Kis-Katos et al. 2018; Li et al. 2019; Erten et al. 2019), almost all these studies focus on trade shocks, very limited attention has been devoted to FDI. By combining China's population censuses, city statistical yearbooks 1990-2005, and the industrial firm censuses, the present paper assesses broader developmental impacts of FDI in Chinese local economies. Third, previous FDI-related studies often use aggregate FDI measures and are thus unable to differentiate between different types of FDI. The rich micro-level datasets in this paper allows us to shed light on the heterogenous effects of FDI by their export intensity and skill intensity, which could provide novel insights and better inform policymakers' FDI strategies.

China offers an ideal case for this analysis: First, China experienced two waves of dramatic FDI liberalization in 1992 and 2002, with FDI inflows to China surging more than 20-fold during the study period 1990-2005. Second, since China is among the largest countries by land area and the largest country by population, its geographical diversity is associated with huge variations in FDI presence, skill composition and industry specialization across regions. Third, China's Hukou registration system has greatly restricted inter-regional migration, thus allowing us to study local labor market effects of FDI. during our study period, cross city migration is very rare and each city functions as a local labor market, which greatly mitigates confounding effects from migration.

The rest of the paper is organized as follows: Section 2 provides the background on China's FDI liberalization, and introduces the data and identification strategy; Section 3 presents baseline results on FDI's effect on local structural transformation and school enrollment; Section 4 conducts various robustness checks to rule out the confounding factors that might contaminate our results; Section 5 tests mechanisms for FDI to affect structural transformation and school enrollment; Section 6 shows heterogenous effects by the export intensity and skill intensity of FDI and individual age group and gender. Finally, Section 7 concludes and discusses some policy implications.

2. Background, identification strategy and data

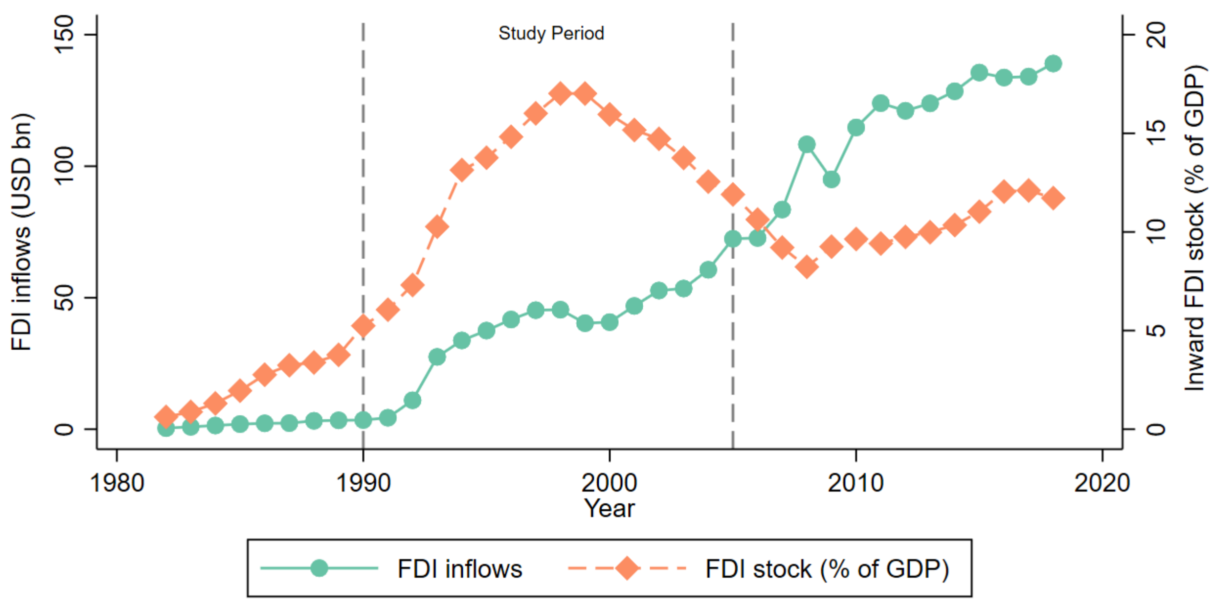
2.1 FDI liberalization in China

China was largely closed to FDI before 1990. Before 1978, the Chinese government maintained a cautious attitude toward foreign investment, foreign-funded enterprises were very rare and played a negligible role in China's economy. China embarked on its reform and opening-up policy in 1978. However, FDI was only allowed in four designated Special Economic Zones (SEZs) in the early 1980s, and foreign investors were required to have local partners. The Chinese government first allowed wholly foreign owned enterprises in 1986 and offered tax incentives to export-oriented joint ventures and foreign enterprises with advanced technologies. Despite these early policy encouragements, FDI inflows remained exiguous, the number only increased from 0.9 billion US dollars in 1983 to 3.5 billion US dollars in 1990.

China experienced two waves of FDI liberalization during our study period 1990-2005. The first wave happened in 1992, when Deng Xiaoping delivered his speech on deepening reform and opening-up by attracting foreign investment. The Chinese government subsequently made a series of major policy reforms to improve the investment climate, with a focus on attracting FDI in infrastructure and manufacturing industries to boost exports. Encouraged by policy support, more than 48,000 new foreign enterprises were established in 1992, and the utilization of foreign capital reached 11 billion US dollars, a 150 percent jump from 1991. FDI continued to soar in the following years, as more and more multinational corporations (MNCs) accelerated their investment in China. As of 2001, about 400 of the world's top 500 MNCs had entered China. Most of them were in capital and technology-intensive industries, including Motorola, Nokia, Ericsson, Siemens, Volkswagen, and General Motors. By 2001, inward FDI stock in China exceeded 200 billion US dollars, a ten-fold increase compared to 20 billion US dollars in 1990. The share of inward FDI stock over GDP also climbed up steadily since 1990 and peaked at 17 percent in 1998 (Figure 1). However, during 1992 to 2001, only some cities were open to FDI (mostly coastal cities, provincial capital cities and special economic zones). FDI was also restricted or forbidden in some industries, especially services sectors such as financial services, wholesale and retail, and professional services.

Marked by China's 2001 accession to the WTO, China further relaxed FDI regulations in 2002. To meet the WTO requirements, China substantially revised many laws and regulations on trade and FDI. The average import tariff was reduced from 17.2 in 2001 to 10.6 in 2005. China also liberalized FDI in a wide range of sectors and allowed FDI in all cities instead of a few designated cities. The Chinese government further removed export performance and local content requirements to comply with the "Agreement on Trade-Related Investment Measures (TRIMS)." Financial services, telecom and communication, construction and a range of services sectors were gradually opened. As a result of these liberalization measures, FDI inflows continued to grow rapidly, from 47 billion US dollars in 2001 to 72 billion in 2005. Inward FDI stock continued to increase from 203 billion US dollars in 2001 to 272 billion in 2005, though it declined as a percentage of GDP as China's GDP growth outpaced FDI inflows (Figure 1).

Figure 1. Inward FDI flows and stock in China



Source: MOFCOM, China.

During both waves of FDI liberalization, manufacturing sector was the primary FDI recipient. Before 1990, foreign investment mainly flowed into tertiary industries such as real estate, hotels, and entertainment. In 1990, the proportion of industrial output value of foreign-invested enterprises in China's total industrial output was merely 2 percent. China introduced a series of policies and measures to encourage FDI in high-tech manufacturing industries since 1992 and began to publish the "Catalogue of Industries for Guiding Foreign Investment" since 1995. The Catalogue classified foreign investment projects into encouraged, permitted, restricted, and prohibited categories. Preferential policies were granted to encouraged industries. Most of the encouraged category belonged to the manufacturing sector, in line with China's goal to expand manufacturing employment and participate in the global production networks. China updated the catalogue in 1997, 2002 and 2004 during our study period. Industry-level FDI deregulation is highly predictive of subsequent FDI inflows. Advanced technologies, industrial know-how, and managerial practices brought by foreign firms greatly accelerated China's economic development.

2.2 Identification strategy

This paper uses Bartik approach to measure each city's exposure to FDI deregulation. The Bartik shock for FDI inflows in each city c, province p in time t is constructed as in equation (1). $\Delta\widehat{FDI}_{it}$ is the predicted change in foreign firms' employment share in industry i from period t-1 to t owing to industry level FDI policy changes. emp_share_{icpt-1} is the lagged share of employment in industry i, city c, province p.

$$FDI\_shock_{cpt} = \sum_{i \in \Omega} \Delta\widehat{FDI}_{it} \times emp\_share_{icpt-1} \quad (1)$$

As foreign firms were very scarce in 1990, this paper assumes foreign employment share in each 3-digit industry to be zero in 1990. The change in predicted national foreign employment share in each 3-digit industry from 1990 to 2000 is therefore simply the predicted foreign employment share in 2000.

This paper uses the predicted changes in foreign employment share instead of actual changes to isolate the effect of FDI deregulation from other confounding factors. A key identification assumption to Bartik IVs is that the differential effect of higher exposure of certain industries only affects the change in the outcome through the endogenous variable of interest, and not through any potential confounding channel (Goldsmith-Pinkham et al. 2020; Adao et al. 2019; Borusyak et al. 2018). In this paper's case, FDI growth across industries may reflect both domestic supply and demand factors, which could violate the validity assumption of Bartik instruments. To mitigate this concern, we use the component of industry level foreign employment share growth explained by China's FDI deregulation during 1990-2005. Specifically, we use the "Catalogue of Industries for Guiding Foreign Investment" in 1997 and 2002 to measure FDI regulatory shocks at the 3-digit industry level. The process is explained below:

(i) We first map each industry and product in the 1997 and 2002 Catalogues to the 4-digit industry level based on 1994 industry classification. In the 1997 Catalogue, FDI was encouraged or permitted in 368 out of 426 4-digit industries. As FDI was not allowed in almost all industries, we consider FDI became more encouraged in 368 4-digit manufacturing industries from 1990 to 2000. In the 2002 Catalogue, FDI was more encouraged in 112 4-digit industries compared to the 1997 Catalogue. We assign value 1 to all industries where FDI became more encouraged, and 0 to other industries. We choose to use the 2002 Catalogue instead of the 2004 Catalogue for FDI policy changes during 2000 to 2005 for two reasons: first, the deregulation in 2002 was much more significant than the 2002 to 2004 revision. Second, the 2004 Catalogue was only published at the end of 2004 and went into effect in 2005, the effect of the 2004 changes may not be reflected in our data yet.

(ii) We then generate a FDI deregulation variable ΔFDI_policy_{it} for all 3-digit industries in 2000 and 2005 by calculating the share of 4-digit industries that became more encouraged relative to the previous period over all 4-digit industries in each 3-digit industry. There are 162 3-digit manufacturing industries in our sample, FDI became more encouraged with varying degrees in 154 industries from 1990-2000, and in 63 industries from 2000-2005.

(iii) Next, we predict changes in foreign firms' employment share $\Delta\widehat{FDI}_{it}$ at the 3-digit industry level using FDI deregulation variable ΔFDI_policy_{it} based on the simple regression below:

$$\Delta\widehat{FDI}_{it} = \beta\Delta FDI\_policy_{it} + \epsilon_{it} \qquad (2)$$

We use the predicted FDI employment share growth $\Delta\widehat{FDI}_{it}$ to calculate city level FDI shock, FDI_shock_{cpt} based on equation (1).

In our baseline regression, we evaluate the effects of a positive FDI shock on city level structural transformation and school enrollment based on the reduced form regression below:

$$\Delta Y_{cpt} = \gamma FDI\_shock_{cpt} + \theta FDI\_empshare_{cpt-1} + \vartheta Y_{cpt-1} + X'_{cpt-1}\beta + \alpha_{pt} + \varepsilon_{cpt} \quad (3)$$

ΔY_{cpt} is the change in dependent variable, which can be the change in sectoral employment share, sectoral GDP share, high school enrollment or college enrollment in city c, province p and time t. The key variable of interest is ΔFDI_shock_{pct} , the city level FDI inflow shock. $FDI\_empshare_{cpt-1}$ is foreign firms' manufacturing employment share in t-1. We also control the initial level of FDI $FDI\_empshare_{cpt-1}$, initial city characteristics X'_{pct-1} and initial level of the dependent variable Y_{cpt-1}. Adding Y_{cpt-1} could induce endogeneity, but higher Y_{cpt-1} strongly predicts lower ΔY_{cpt}. As our dataset only has three periods, using the Arellano and Bond's GMM technique to alleviate the endogeneity from controlling lagged dependent variable is not feasible. However, Monte Carlo simulation shows that while the bias of the coefficient on Y_{cpt-1} can be significant, the bias for the coefficients on other independent variables tend to be very minor (Judson and Owen 1996). Given that the key coefficient of interest γ is not significantly affected, we include lagged dependent variable in all regressions in the main text. Appendix 1 shows that our results are robust to the exclusion of Y_{cpt-1} . α_{pt} are province-year fixed effects. City characteristics include average years of schooling, population, average age, population share of Han ethnicity in the structural transformation regression. We drop average years of schooling when the dependent variable is school enrollment rate. We add additional city characteristics, including GDP per capita and rural population share in robustness checks. These variables are not included in the baseline regression because controlling these variables will reduce our already small sample size.

As our dependent variable is either change in structural transformation variables or change in school enrollment, it automatically removes all time-invariant factors that affect structural transformation and educational outcomes at the city level. We further control province-year fixed effects to account for province-specific time trends. Essentially, we examine how increased local FDI presence affects the pace of structural transformation and school enrollment among cities in the same province. In all regressions, standard errors are clustered at the city level. Observations are weighted by initial population in each city.

A natural concern in Bartik IVs is that city-specific pre-trends are correlated with initial industry composition. As FDI deregulation is not assigned randomly across industries, it can introduce omitted variable bias if they are correlated with underlying trends that are not controlled for in the econometric model. McCaig (2011) discussed options to control for such underlying trends, one option is to include relevant initial conditions at the observation level. Therefore, we include initial sectoral employment share, school enrollment rate, foreign firms' employment share, average years of schooling, population, average age, population share of Han ethnicity, GDP per capita so any underlying trends associated with these variables are controlled for, and different trajectories across cities are allowed.

2.3 Data

This paper combines various data sources to explore whether FDI catalyzes local structural transformation and human capital accumulation.

Population census

This paper uses population census data in 1990, 2000 and mini-census data in 2005 to estimate city level employment share in the three broad economic sectors and high school/college enrollment rate. The population census data also provides rich information on individuals' age, gender, migration history, employment status, industry, and ethnicity. We aggregate such information at the city level as control variables. In addition, the paper uses the initial industry employment composition from population census to construct the Bartik shock IV for city level FDI inflows.

City statistical yearbooks

This paper compiled sectoral value-added, foreign industrial firms' total output and output share at the city level in 1990, 2000 and 2005 from city statistical yearbooks. Foreign firms' output share is the key variable of interest in this paper. City statistical yearbooks also contain information on GDP per capita, share of rural population, output share of state-owned enterprises (SOEs) across cities used in the robustness checks section.

Annual Survey of Industrial Firms (ASIF)

The ASIF database is a nationwide mandatory survey administered annually by the National Bureau of Statistics (NBS) in China to firms in mining industries, manufacturing industries and utilities industries. NBS uses the ASIF database to compute China's GDP, and the aggregate information is published in the official China Statistics Yearbooks. It contains many firms distributed across more than 600 four-digit industries and throughout China's 31 provinces, autonomous regions, and municipalities. Firms in the sample account for 95 percent of total Chinese industrial output and 98 percent of total Chinese industrial exports (Eberhardt et al. 2011). The sample covers all SOEs and private companies with annual sales above 5 million RMB (about 600,000-660,000 US dollars based on exchange rate during that period). The number of firms covered in the sample increased steadily from around 165,000 in 1998 to 336,000 in 2007.

The database contains more than 100 variables covering firms' basic information, financial and operational information. Basic information includes the unique identifier, firm name, legal representative, detailed address, year of incorporation, main product, industry affiliation, and ownership structure. Financial and operational information cover most items in firms' balance sheet, profit and loss statement, as well as cash flow statement. We use the ASIF database in 2000 and 2005 to complement city statistical yearbooks in calculating foreign firms' employment and output share at the industry and city level.

Tariff data

We obtained China's export and import tariff at 4-digit ISIC level for years 1992, 2000, and 2005 from the TRAINS database. Sector level tariff is based on weighted average of tariff from all import sources and export destinations. The weights are constructed using the trade flow data from three years earlier. Following Li (2018), we concord all 4-digit ISIC sectors into 3-digit Chinese Standard Industry Classification (CSIC) code, then calculate city level tariff shocks by interacting initial industry employment share with changes in import and export tariffs.

Summary statistics

Table 1 reports the summary statistics of key variables in three periods. The agriculture sector includes agriculture, forestry, fishing, and hunting. The industry sector includes mining, manufacturing, construction, and utilities. The services sector includes all the rest of the industries.

China experienced rapid structural transformation during the study period. Nearly 70% of employment was in agriculture in 1990 on average. The share declined to 64% in 2000 and 60% in 2005. Average employment share in industry and services remained stable, though the simple average masks huge variations across locations. Moving out of agriculture is also manifested in the sharp decline of agricultural GDP share, which fell from 27% in 1990 to 16% in 2005. Average industry GDP share dropped from 45% in 2000 to 41% in 2000, then increased to 47% in 2005. Services continue to account for a larger share of GDP.

Table 1. Summary statistics

	Year = 1990		Year = 2000		Year = 2005	
Variable	Obs	Mean	Obs	Mean	Obs	Mean
Panel A: Structural transformation						
Agri_emps	329	69.22%	345	64.05%	344	60.42%
Indu_emps	329	16.03%	345	15.92%	344	16.64%
Serv_emps	329	10.72%	345	10.85%	344	10.77%
Agri_gdps	298	26.55%	320	23.59%	262	16.42%
Indu_gdps	298	45.02%	320	41.35%	262	47.05%
Serv_gdps	298	28.43%	320	35.07%	262	36.53%
Panel B: School enrollment						
High school enrollment	329	8.15%	345	22.41%	344	24.82%
College enrollment	329	1.85%	345	5.30%	344	7.16%
Panel C: City characteristics						
Population	329	3391397	345	3598137	344	3693000
Years of schooling	344	6.75	344	8.28	344	8.56
Age	344	31.00	344	33.42	344	34.52
Han ethnicity	344	85%	344	85%	344	84%
GDP per capita	337	2071.81	322	8460.51	318	14886.54
Rural population share	301	66%	322	62%	324	66%
Panel D: FDI variables						
FDI emp share	341	0	341	9.52%	339	13.16%
ΔFDI_emp share	341	0	341	9.52%	337	3.52%
FDI output share	341	1.66%	341	11.89%	341	13.79%
ΔFDI_output share	341	0.94%	341	10.23%	341	1.91%

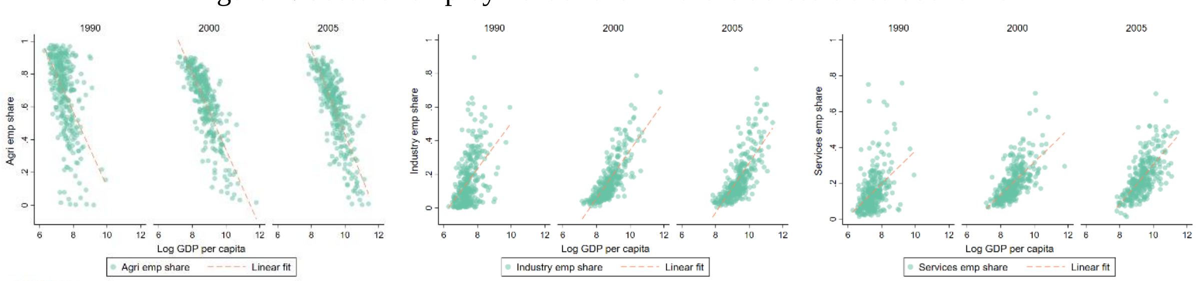
Note: This table reports summary statistics at the city level in three periods.

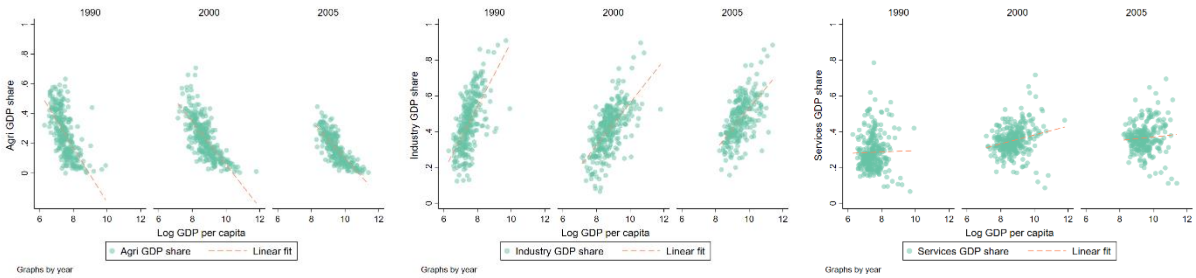
China's high school enrollment and college enrollment rate grew dramatically during 1990-2005. Average high school enrollment nearly tripled from 8% in 1990 to 22% in 2000 and increased to 25% in 2005. College enrollment was less than 2% in 1990, the number more than doubled to 5% in 2000 and to 7% in 2005.

The influx of FDI since 1992 increased industry output and employment share contributed by foreign firms remarkably from 1990 to 2000. In 1990, foreign firms were very scarce and only accounted for less than 2% of industrial output. There was no official statistics on industrial employment in foreign firms in 1990, but all privately-owned industrial firms combine only represented 2% of industrial employment in 1990 based on city statistical yearbook 1990. Foreign firms' industrial output share climbed up to 12% in 2000 and grew to 14% in 2005, while foreign firms' industrial employment share grew to 16% in 2000 and 26% in 2005. The presence of FDI is highly unequal across provinces and cities. Many foreign firms are in coastal cities in Southern and Eastern China. These coastal cities have been leading China's growth over the past four decades due to advantageous initial conditions as well as policy supports, especially the establishment of Special Economic Zones (SEZs) since 1980 that attracted large amounts of FDI. The coastal cities also received a disproportionate share of public investment. In addition to these coastal cities, some inland cities from Northeast, Central and West China also received a fair share of FDI.

Figure 2 plots the correlation between sectoral employment/GDP share and GDP per capita across cities in three periods. Employment shares are calculated using population census, and GDP shares are from city statistical yearbooks. The figure reveals vast differences in city level industry structure. Agricultural employment share ranges between 0 and 1 in the three periods, while on average the share declined, agriculture still employed almost the entire work force in some cities in 2005. The number of cities that had an industrial employment share greater than 30% declined from 58 to 47 during 1990-2005, whereas the number of cities that had a services employment share above 30% increased from 24 to 76. There is a very strong correlation between employment structure and GDP per capita. The correlation between services GDP share and GDP per capita is relatively weak, as services can be highly heterogenous in terms of value added per capita. Overall, while Chinese economy shifted from agriculture to industry and services during 1990-2005, the pace and degree differ considerably across cities, providing enough variance for us to test how FDI inflows contributed to such differences.

Figure 2. Sectoral employment and GDP share across cities over time

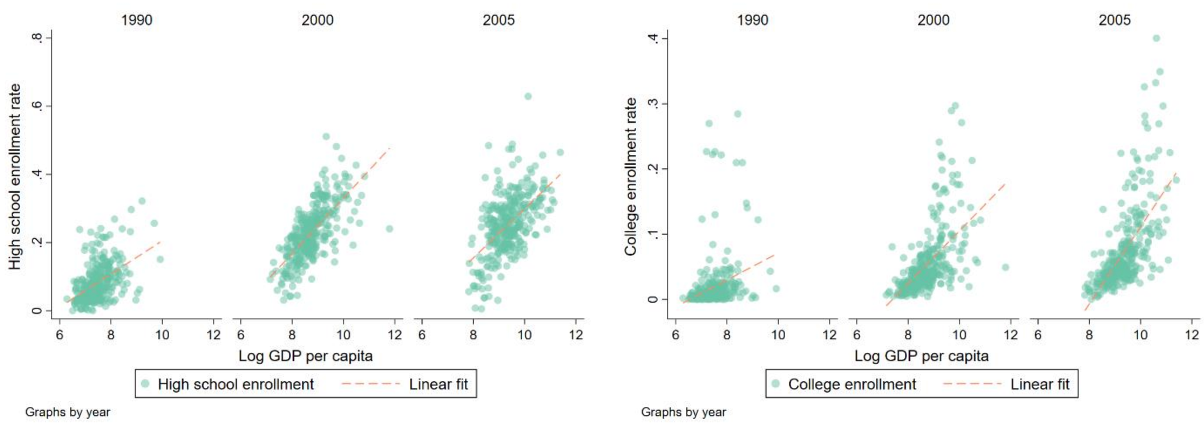




Note: The upper panel plots the correlation between sectoral employment share and GDP per capita across cities in the three periods. The bottom panel shows the correlation between sectoral GDP share and GDP per capita across cities in the three periods.

Figure 3 shows the correlation between school enrollment rates and GDP per capita across cities. Both high school and college enrollment rates improved remarkably over time. The correlation between school enrollment and GDP per capital also strengthened. Just like industry structure, school enrollment rates vary hugely across cities. In the poorest cities, high school and college enrollment rates remained nearly zero throughout the study period, while in rich cities high school enrollment was as high as 63% and college enrollment exceeded 40%.

Figure 3. School enrollment rate across cities over time



Note: The figure plots the correlation between school enrollment and GDP per capita across cities in three periods. School enrollment is calculated for individuals aged between 15-25 using the population censuses.

3. Empirical results

3.1 Local structural transformation

Table 2 reports the effect of manufacturing FDI inflows on local structural transformation. Panel A shows the results on sectoral employment share, and Panel B shows the results on sectoral GDP share. As this paper focuses on the labor market effects of FDI, we primarily use foreign firms' industrial employment share to measure FDI presence. Appendix 2 reports results using output share to measure FDI presence. Only coefficients on FDI shock and initial foreign employment share are reported. FDI inflow shock has large and significant impact on local structural transformation. A one percentage point increase in FDI shock reduces change in agricultural employment share by 1.8 percentage points and increases changes in industrial and services employment share by 1.1 percentage points. Considering that average employment share in agriculture only declined by 9 percentage points from 1990 to 2005, a one percentage point increase in FDI shock accelerates a city's pace of moving out of agriculture by around 3 years. The effect on industry employment share is insignificant, but manufacturing FDI significantly accelerates labor movement into services. Sectoral GDP shares reveal a similar impact. Cities that experienced larger FDI inflow shocks saw a faster decline in agricultural GDP share, and higher growth in industry and services GDP share.

Table 2. FDI inflows and local structural transformation

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Employment			Panel B: GDP		
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	Δagri_gdps	Δindu_gdps	Δserv_gdps
FDI_shock	-1.849**	1.098	1.050***	-2.379***	0.959***	0.863***
	(0.826)	(0.675)	(0.334)	(0.390)	(0.329)	(0.239)
L.FDI_empshare	-0.156***	0.152***	0.0174	-0.0505	0.0322	0.00247
	(0.0374)	(0.0341)	(0.0340)	(0.0328)	(0.0422)	(0.0336)
Observations	665	665	665	531	531	531
R-squared	0.463	0.504	0.368	0.772	0.659	0.720
Prov-Year FE	Y	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y	Y

Note: This table reports the effect of FDI inflows on city level structural transformation. Dependent variables are changes in city level agriculture, industry, and services employment share in Panel A and sectoral GDP share in Panel B. FDI_shock is FDI inflow shock calculated as the interaction of initial industry composition across cities and industry FDI growth explained by policy changes. Lagged city characteristics include average years of schooling, population, average age, share of Han ethnicity. The regressions also control lagged sectoral employment or GDP share. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

3.2 Local human capital accumulation

FDI inflows also induce positive effect on school enrollment. Column (1) of Table 3 reports the effect of FDI shock on change in high school enrollment, and column (2) reports the effect on change in college enrollment. A one percentage point increase in FDI shock raises a city's change in high school enrollment by 1.2 percentage points, and the change in college enrollment by 1.5 percentage points. The coefficients on FDI shock are highly significant in both columns.

Table 3. FDI inflows and local school enrollment

	(1)	(2)
Panel A: School enrollment		
Dependent var	ΔHighschool	ΔCollege
FDI_shock	1.162***	1.465***
	(0.187)	(0.222)
L.FDI_empshare	-0.0731***	0.0470*
	(0.0279)	(0.0269)

Observations	665	665
R-squared	0.797	0.413
Prov-Year FE	Y	Y
Lagged city characteristics	Y	Y

Note: This table reports the effect of FDI inflow shock on city level school enrollment. FDI_shock is FDI inflow shock calculated as the interaction of initial industry composition across cities and industry FDI growth explained by policy changes. Lagged city characteristics include population, average age, share of Han ethnicity. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

4. Robustness checks

4.1 Additional control variables

The baseline regressions in Section 3 did not control for GDP per capita and the share of rural population because these two variables contain many missing values. GDP per capita and rural population share are gleaned from city statistical yearbooks. When rural population share is unavailable from city statistical yearbooks, we use population census data to calculate the share of population with rural Hukou. There is a difference between the share of population residing in rural areas and the share of population with rural Hukou, so we do not control rural population share in other robustness checks due to this caveat.

Table 4 presents the results on structural transformation and school enrollment with additional controls. We only report results on sectoral employment share as employment is the primary indicator to measure structural transformation, and we have many more observations on sectoral employment than sectoral GDP. We include initial city level GDP per capita in natural logarithm and initial rural population share as additional controls. As expected, cities with higher initial income level experience a faster structural transformation and college enrollment growth. Cities that have a higher share of rural population at the start of the period are slower to move into services and experience lower growth in college enrollment rate. The coefficients on FDI shock are very close to baseline results in column (1) to (4). The coefficient on FDI shock becomes smaller in column (5) as lagged GDP per capita and rural population share explain a proportion of changes in college enrollment rate. Overall, controlling GDP per capita and rural population share does not affect our estimates significantly.

Table 4. Robustness check: additional controls

	(1)	(2)	(3)	(4)	(5)
	Panel A: structural transformation			Panel B: school enrollment	
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	ΔHighschool	ΔCollege
FDI_shock	-1.855**	1.175*	0.728**	1.073***	1.110***
	(0.763)	(0.636)	(0.313)	(0.198)	(0.218)
L.FDI_empshare	-0.105***	0.119***	-0.0109	-0.0867***	0.0238
	(0.0363)	(0.0334)	(0.0343)	(0.0282)	(0.0258)
L.GDP per capita	-0.0498***	0.0316***	0.0199***	0.00711	0.0175***
	(0.0111)	(0.00729)	(0.00750)	(0.00638)	(0.00528)

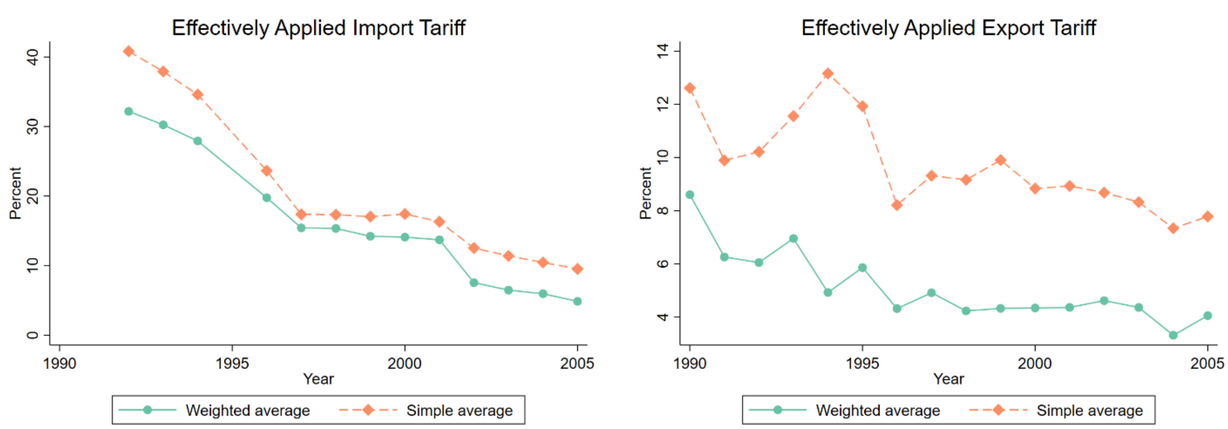
L.Rural popshare	0.0221	0.0314**	-0.0574***	0.0227*	-0.0219**
	(0.0213)	(0.0140)	(0.0166)	(0.0123)	(0.0111)
Observations	612	612	612	612	612
R-squared	0.513	0.527	0.443	0.808	0.456
Prov-Year FE	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on city level structural transformation and school enrollment. Lagged city characteristics include population, average age, share of Han ethnicity in both panels and average years of schooling in panel A. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

4.2 Change in tariffs

China's FDI deregulation happened alongside trade liberalization. In the early 1990s, China's trade regime simultaneously promoted exports via incentives while offering significant domestic protection. In 1992, China's unweighted average nominal effectively applied tariff rate was about 47 percent, among the highest in the world. China's trade liberalization accelerated since 1992 as the government affirmed the core rule of market mechanisms in resource allocation. From 1992 to 1997, China cut its average import tariffs dramatically from 47 percent to 19 percent. After China's accession to WTO in 2001, average import tariff was further cut to 11 percent in 2005. Weighted import tariff imposed by China dropped from 32 percent in 1992 to less than 5 percent in 2005. Export tariffs faced by Chinese exporters were lowered too, albeit less aggressively. Simple average export tariff declined from 13 percent in 1990 to 8 percent in 2005, and weighted average export tariff from 9 percent to 4 percent (Figure 4). China's trade liberalization and integration into the world economy during the study period poses challenges to our identification. As Li (2018) demonstrates, changes in import and export tariffs do affect city level school enrollment. Erten and Leight (2021) also show that trade shocks due to China's WTO accession affect county-level structural transformation. To control the effect from trade shocks, we construct city level import and export tariff shocks by interacting initial industry employment with industry level tariff changes.

Figure 4. Tariff changes in China, 1990-2005



Note: The left panel plots average effectively applied import tariff imposed by China during 1992-2005. The right panel plots average effectively applied export tariff faced by China during 1990-2005. Data based on WITS-TRAINS database.

Table 5 reports the findings when tariff shocks are controlled for. Panel A shows the effect of FDI inflows on structural transformation, and Panel B the effect on school enrollment. Increased FDI presence has an even larger impact on structural transformation: a one percentage point increase in FDI shock now reduces change in agricultural employment share by 3.1 percentage points, and raises the change in industry and services employment share by 1.8 and 1 percentage points respectively. Import and export tariff shocks do not seem to have significant impact on the pace of structural transformation. They do affect school enrollment strongly, lower export tariff and higher import tariff lead to higher growth in college enrollment. FDI inflow shock still promotes high school and college enrollment. These results suggest that the effect of FDI entry on local structural transformation and school enrollment is not driven by China's concomitant trade liberalization.

Table 5. Robustness check: control tariff shocks

	(1)	(2)	(3)	(4)	(5)
	Panel A: structural transformation			Panel B: school enrollment	
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	ΔHighschool	ΔCollege
FDI_shock	-3.105***	1.825***	1.036**	0.754**	0.523*
	(0.930)	(0.678)	(0.416)	(0.304)	(0.306)
L.FDI_empshare	-0.0480	0.106***	-0.0637	-0.0508*	0.00758
	(0.0382)	(0.0329)	(0.0415)	(0.0283)	(0.0265)
Observations	637	637	637	637	637
R-squared	0.532	0.532	0.442	0.810	0.475
Prov-Year FE	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y

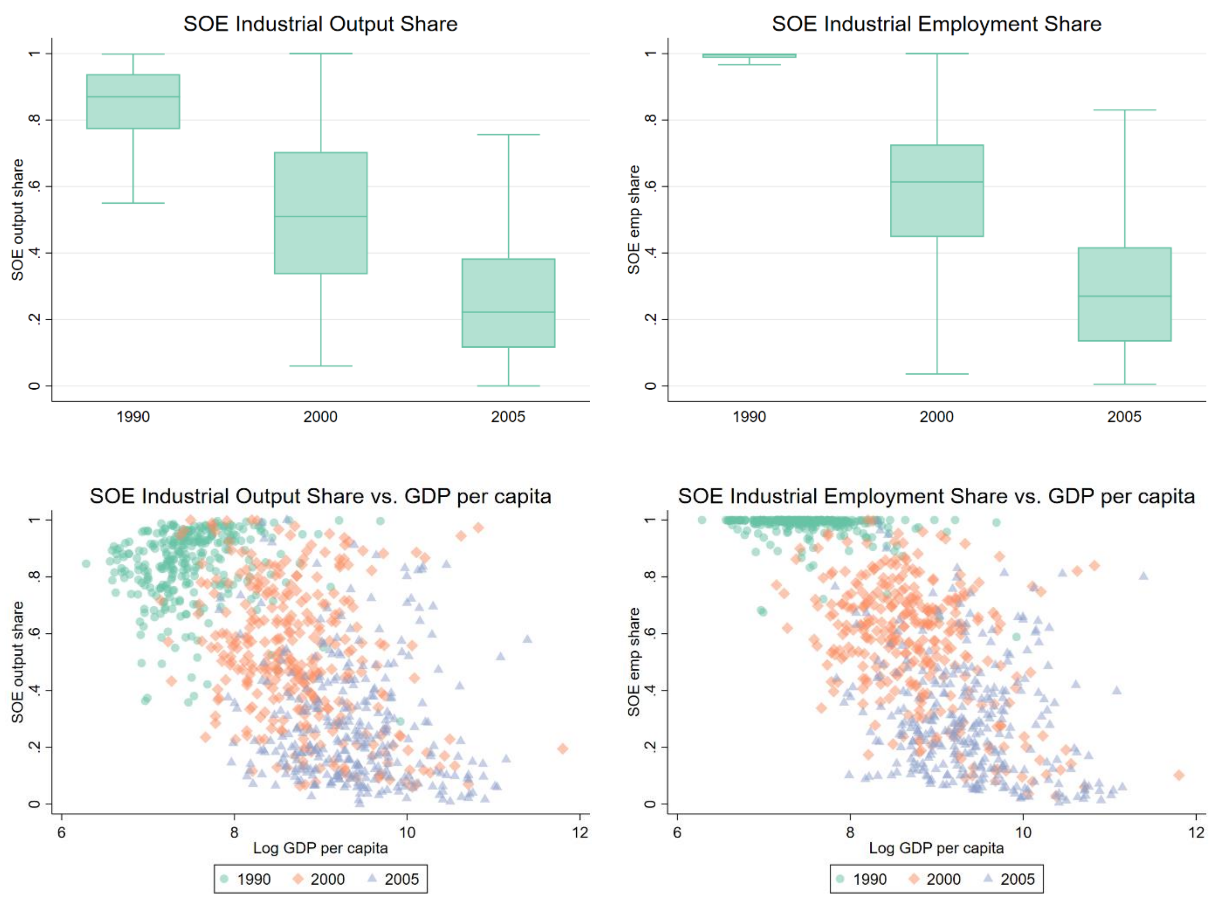
Note: This table reports the effect of FDI shock on city level structural transformation and school enrollment when export and import tariff shocks are controlled for. Lagged city characteristics include population, average age, share of Han ethnicity, log GDP per capita in both panels and average years of schooling in panel A. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

4.3 SOE reform

Another major event – the state-owned enterprise (SOE) reform – may have affected structural transformation and school enrollment during our study period. China gradually transformed its economy from a state-dominated one to a market-driven system. The process culminated in a huge economic restructuring of SOEs in the mid-1990s. Following China's FDI liberalization in 1992, SOEs faced increasing competition from domestic private enterprises and foreign enterprises. As SOE workers were guaranteed lifetime employment, SOEs could not shed staff to improve efficiency. Moreover, SOEs were encumbered by hefty welfare expenditure, ranging from staff dormitories, child education, health care, and retirement benefits (Meng 2000). By 1994, 40 percent of SOEs were making losses. To improve the competitiveness of SOEs, a national SOE reform was implemented since September 1997. The progressive SOE reform resulted in mass layoffs of around 43 million workers in SOEs and collectively owned enterprises from 1990 to 2000, and another 23 million from 2000 to 2005.

Median industrial output share by SOEs declined from 87 percent in 1990 to 22 percent in 2005 (Figure 5). Median industrial employment share by SOEs also shrank from almost 100 percent in 1990 to 27 percent in 2005. There is no clear correlation between SOEs' output or employment share and city level GDP per capita in 1990, but a strong negative correlation emerges in 2000 and 2005.

Figure 5. SOE share of industrial output over time across cities



Note: The upper panel plots the distribution of SOE output and employment share in the industry sector in 1990, 2000 and 2005. The bottom panel plots the correlation between SOE industrial output/employment share and GDP per capita in the three years. Data from city statistical yearbooks.

The massive layoffs resulted in a spike in urban unemployment rate and lower household income level (Ge 2016), which could have a negative effect on local school enrollment. On the other hand, SOE reform could lower the opportunity cost of schooling in affected cities, encouraging individuals to continue with their education (Hu 2019). To separate out the effect of SOE reform, we add lagged SOE industrial output share and change in SOE industrial output share into control variables. The results are displayed in Table

6. Cities that were less exposed to SOE reform experienced higher increase in services employment share and higher growth in college enrollment. The effect of FDI inflow shock on structural transformation and college enrollment remains significant in all columns but column (5). The effect of FDI shock on city level structural transformation and school enrollment remains robust.

Table 6. Robustness check: control SOE reform

	(1)	(2)	(3)	(4)	(5)
	Panel A: structural transformation			Panel B: school enrollment	
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	ΔHighschool	ΔCollege
FDI_shock	-2.751***	1.498**	1.151**	0.735**	0.507
	(0.985)	(0.686)	(0.481)	(0.333)	(0.338)
L.FDI_empshare	0.00250	0.0508	-0.0546	-0.0485	0.0188
	(0.0439)	(0.0369)	(0.0409)	(0.0307)	(0.0281)
Observations	607	607	607	607	607
R-squared	0.542	0.554	0.452	0.813	0.482
Prov-Year FE	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on city level structural transformation and school enrollment when SOE reform is controlled for. Lagged city characteristics include population, average age, share of Han ethnicity, log GDP per capita in both panels and average years of schooling in panel A. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

4.4 Migration

Migration creates another major threat to the validity of our findings. FDI constitutes a local labor market shock and workers can respond to such shocks by moving across cities. When a city receives huge manufacturing FDI inflows, labor demand in industry and related services sectors will rise, lifting wage rates in the city and attracting workers from other places. More and better work opportunities also attract students to this city for college education. Migration thus magnifies the effect of FDI on local structural transformation and school enrollment. On the other hand, migration could reduce school enrollment in poorer areas as youths drop out of school to work in richer cities (De Brauw and Giles 2017). Fortunately, migration should not affect our results too much because China adopts a strict Hukou system that limits the free movement of people across locations, and the share of migrants indeed remained relatively low during our study period. The population census records individual's Hukou address, current residence address and where the individual lived 5 years before the census date. We can therefore identify individuals that migrated to the current location within five years. While the number of cross-county migrants increased dramatically from 18 million to 76 million during 1990-2005, these migrants only accounted for a fraction of total working-age population (Colas and Ge 2019). The number of cross-township migrants are larger, estimated at nearly 50 million in 1995 and 153 million in 2005, primarily involving rural labor moving to nearby urban areas (Chan 2013). However, as the unit of analysis is city in this paper, only migration across cities affect our results. In 1990, only 3 percent of the population lived in a different city five years before. The share grew to 6 percent in 2000 and remained at around 6 percent in 2005. To see whether our previous results still hold when cross city migration is taken into consideration, we calculate the sectoral employment share and school enrollment using a subsample that excludes all persons that migrated to the current city within five years.

Table 7 presents the results based on a non-migrant subsample. As expected, FDI's impact on sectoral employment share becomes slightly smaller. The effect on school enrollment becomes larger and more significant than in Table 6. This suggests that FDI shock encourages local youth to obtain higher educational attainment while attracting more unskilled migrant workers into the city. Rising income level spurred by FDI also enables local parents to enroll their children in high schools and colleges.

Table 7. Robustness check: exclude cross-city migrants

	(1)	(2)	(3)	(4)	(5)
	Panel A: structural transformation			Panel B: school enrollment	
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	ΔHighschool	ΔCollege
FDI_shock	-2.468***	1.095*	1.077**	1.319***	0.519***
	(0.950)	(0.640)	(0.450)	(0.352)	(0.169)
L.FDI_empshare	0.0111	0.0457	-0.0544	-0.0615**	0.0341
	(0.0409)	(0.0416)	(0.0411)	(0.0311)	(0.0293)
Observations	607	607	607	607	607
R-squared	0.552	0.573	0.494	0.819	0.736
Prov-Year FE	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y

Note: This table tests whether the effects of FDI shock on city level structural transformation and school enrollment are driven by migrants. We excluded people that migrated from other cities within the last 5 years when calculating sectoral employment share and school enrollment. Lagged city characteristics include population, average age, share of Han ethnicity, log GDP per capita in both panels and average years of schooling in panel A. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Nevertheless, internal migration played an important role in China's urbanization and structural transformation. After China's WTO accession in 2002, demand for migrant workers in manufacturing, construction, and labor-intensive services increased greatly. Many provinces, especially coastal provinces reduced regulatory barriers for migrant workers in 2003. The number of migrant workers grew more rapidly during 2003-2008. Richer provinces in coastal regions tend to have higher migrant worker shares than poorer interior provinces (Tombe and Zhu 2019). As the population census data only tracks migrant workers who have lived in the current address for at least half a year, this paper could not exclude short-term migrants in the sample. Internal migration could have a bigger effect on our estimation.

5. Mechanism

5.1 Mechanism for structural transformation

Previous results show that manufacturing FDI inflows accelerated structural transformation in receiving cities. What are the main channels for this positive effect? Manufacturing FDI inflows could speed up local structural transformation through both demand and supply channels.

(1) Demand side:

a. FDI expands exports and raises labor demand in the industry sectors directly.

b. FDI affects labor demand in all three broad sectors indirectly through upstream and downstream linkages, spillovers, competition, and agglomeration.

c. FDI increases local income levels through higher wages, thus raising consumer purchasing power and demand for all three broad sectors.

(2) Supply side:

a. FDI boosts productivity in agriculture sector by providing better agricultural production inputs (such as fertilizer, pesticides, and machinery), reducing labor demand for agricultural activities.

b. FDI stimulates productivity in manufacturing and services. If productivity growth spurred by manufacturing FDI is larger in industry than in services, FDI will accelerate the movement of labor from industry to services.

c. FDI changes factor intensity and elasticity of substitution between capital and labor. FDI introduces advanced production techniques that alter the factor intensity and elasticity of substitution between factors, inducing changes in sectoral employment share.

Demand side channels tend to increase GDP and employment growth in manufacturing and services. Supply side channels will boost labor productivity in all three sectors, while reducing employment in agriculture and manufacturing if productivity growth is the slowest in services. To test which channels are at play, we regress the FDI variables on local sectoral GDP growth, sectoral employment growth, sectoral labor productivity growth and growth in GDP per capita.

Table 8 reports how FDI shock affects sectoral employment and GDP growth. Intensifying FDI presence results in a faster decline in agricultural employment and more rapid growth in industry and services employment. Interestingly, industrial GDP growth does not change significantly due to FDI despite more people working in the sector, implying limited productivity improvement in the industrial sector. A one percentage point increase in FDI shock causes a 11 percent increase in industrial employment growth, this indicates that positive demand effect far outweighs negative worker displacement effect due to supply side technology advancement during the study period.

Table 8. FDI inflows and local structural transformation: demand side channels

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: employment growth			Panel B: GDP growth		
Dependent var	Δlnagri_emp	Δlnindu_emp	Δlnserv_emp	Δlnagri_gdp	Δlnindu_gdp	Δlnserv_gdp
FDI_shock	-11.29***	10.93***	4.018*	-10.55***	3.063	3.732**
	(2.283)	(2.793)	(2.183)	(2.012)	(1.931)	(1.776)
L.FDI_empshare	-0.708**	0.624**	-0.0650	-0.390*	0.122	0.152
	(0.316)	(0.266)	(0.264)	(0.235)	(0.192)	(0.154)
Observations	637	637	637	591	591	531
R-squared	0.718	0.699	0.723	0.927	0.867	0.922
Prov-Year FE	Y	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on employment and GDP growth in the three broad sectors. Lagged city characteristics include population, average age, share of Han ethnicity, log GDP per capita and average years of schooling. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Results in Table 9 confirm that manufacturing FDI inflows raise labor productivity in agriculture and services. A one percentage point increase in FDI shock contributes to 0.1 percent higher labor productivity growth in agriculture and 0.25 percent higher labor productivity growth in services. The positive effect of FDI on labor productivity in agriculture and services does not necessarily mean improved efficiency. Increased agricultural labor productivity is likely driven by a decline in excess labor, while higher labor productivity in services reflects the emergence of modern, high value-added services in FDI-receiving cities. Surprisingly, the effect of manufacturing FDI inflows on labor productivity growth in industry is insignificant. This could be due to a range of factors: given abundant labor, foreign firms entering China may choose to adopt technologies that use labor intensively, with limited improvement in overall labor productivity; the industry sector lumps together mining, manufacturing, utilities and construction, potential measurement errors could also contaminate the results. In Panel B, the results show that a one percentage point increase in FDI shock results in a 10 percent higher growth in GDP per capita. Higher income growth spurred by FDI inflows will further drive local structural transformation away from agriculture towards industry and services.

Table 9. FDI inflows and local structural transformation: supply side channels

	(1)	(2)	(3)	(4)
	Panel A: Labor productivity			Panel B: Income
Dependent var	Δagri_lp	Δindu_lp	Δserv_lp	ΔlnGDP per capita
FDI_shock	0.106***	-0.114	0.246***	10.43***
	(0.0385)	(0.104)	(0.0931)	(1.645)
L.FDI_empshare	0.0203***	-0.0107	0.0374*	0.211
	(0.00731)	(0.0178)	(0.0202)	(0.158)
Observations	590	590	531	620
R-squared	0.799	0.676	0.693	0.789
Prov-Year FE	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on labor productivity growth in three broad sectors and GDP per capita growth. Lagged city characteristics include population, average age, share of Han ethnicity, log GDP per capita and average years of schooling. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

The above results suggest that manufacturing FDI inflows in China propelled local structural transformation primarily through demand-side effects during the study period. This is consistent with the "Vent for surplus" theory, which argues that trade and FDI liberalization will provide a vent for the output of surplus resources, which is labor in China's case (Fu and Balasubramanyam, 2005). Many foreign firms that entered China during the study period (1990-2005) were export-oriented, booming exports raised labor demand tremendously in the industrial sectors and absorbed excess labor from the agriculture sector. Rising income levels and business linkages boosted demand for services as well, services GDP and employment grew rapidly consequently. Supply-side effect through enhancing productivity is not apparent in the industry sector.

5.2 Mechanism for school enrollment

Many previous studies document that foreign firms often pay a wage premium relative to domestic firms, and the wage premium is particularly high for skilled workers (Aitken et al 1996; Bandick 2011; Lipsey and Sjöholm 2004; Sjöholm and Lipsey 2006; Heyman et al. 2007). There are multiple reasons why foreign companies tend to pay a wage premium: first, foreign firms might try to prevent technological spillovers through labor turnover by paying higher wages (Fosfuri et al. 2001); second, foreign firms are more productive and can benefit from rent-sharing with their global headquarters (Budd et al. 2005); thirdly, the wage premium can be a compensation for higher labor demand volatility and lower job security (Fabbri et al. 2003, Bernard and Sjöholm 2003).

Individuals might be motivated to improve their educational credentials to join foreign firms. Foreign firms indeed are more likely to hire individuals with higher educational attainment. After controlling for gender, age and age squared, marital status, ethnic minority dummy, industry and city fixed effects, the probability of being employed by a foreign firm is 2.6 percentage points higher for college graduates, and 5.1 percentage points higher for people with at least a high school diploma.

To see whether there is a foreign wage premium in China and whether it is higher for skilled workers, we use the 2005 mini census data to run a simple cross-section regression below:

$$\ln income_{pic} = \alpha Foreign_{pic} + \beta Skilled_{pic} + \gamma Foreign \times Skilled_{pic} + X'_{pic}\rho + \mu_i + \theta_c + \epsilon_{pic} \quad (4)$$

$\ln income_{pic}$ represents monthly income in RMB yuan of person p in industry i, city c in natural logarithm. Foreign is a dummy variable that takes the value of 1 if the person is employed in a foreign-owned firm. Skilled is also a dummy variable, measured as whether a person at least attended high school or college. $Foreign \times Skilled$ is the interaction term. X'_{pic} includes individual characteristics that can affect one's income, including gender, marital status, age and age squared, ethnic minority dummy. μ_i is industry fixed effect, and θ_c is city fixed effect.

The results are reported in Table 10. City fixed effects are not included in column (1) and (3), column (2) and (4) add city fixed effects. Foreign firms pay a significant wage premium that ranges from 3 percent to 16 percent depending on whether city fixed effects are controlled for. Skilled workers also earn a much higher monthly income than unskilled worker, individuals who at least went to high school on average make 30 percent more than those who failed to attend high school. The gap is even larger between those who went to college and those who do not, the college premium can be as high as 50 percent. Both interaction terms are also large and highly significant, foreign firm wage premium is 10 percent and 24 percent higher for those who went to high school and college respectively. This provides strong incentives for people to go to college where the presence of foreign firms increased substantially. Anecdotal evidence also abounds in the attractiveness of foreign firms to college students in 1990s and early 2000s. Being employed in a foreign firm is associated with success during that time, more than half of the top ten most attractive employers for college graduates in engineering major are foreign companies in 2008, foreign firms even make up 8 out of the 10 best employers for students in business major.[1] Foreign language and international trade related majors were also the most popular college major in early 2000s.

Table 10. Foreign wage premium

	(1)	(2)	(3)	(4)
	Panel A: High school		Panel B: College	
	Dependent var: log monthly income			
Foreign	0.151***	0.0306***	0.163***	0.0395***
	(0.00507)	(0.00491)	(0.00427)	(0.00415)
High school	0.313***	0.282***		
	(0.00196)	(0.00189)		
Foreign * High school	0.111***	0.0993***		
	(0.00766)	(0.00733)		
College			0.535***	0.491***
			(0.00300)	(0.00288)
Foreign * College			0.249***	0.235***
			(0.0104)	(0.00999)
Observations	1,388,158	1,388,158	1,388,159	1,388,159
Industry FE	Y	Y	Y	Y
City FE	N	Y	N	Y
Individual characteristics	Y	Y	Y	Y

Note: This table reports the estimated foreign wage premium. Individual characteristics include gender, marital status, age, age square, ethnic minority dummy, as well as skill dummy. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

[1] https://new.qq.com/omn/20190917/20190917A0KI0X00.html

More importantly, FDI can push up wage levels for skilled workers and elevate the overall returns to education in local labor market. FDI also raises household income in host locations. Table 9 already demonstrated a strong income effect. As parents' income rises, they are more likely to send their children to high school and college. Unfortunately, we are unable to test whether cities that received more manufacturing FDI inflows experienced higher increase in skill premium because we only have income data in 2005.

6. Heterogeneity

6.1 FDI shock by export intensity

A main channel for manufacturing FDI to increase labor demand is through export expansion. Better knowledge about foreign markets and established global production networks allow foreign-owned firms to account for a disproportionately high share of exports in many host locations. By supplying to the global market, export-oriented FDI raises labor demand much more than domestic market-seeking FDI does. How does the effect of FDI shock on structural transformation and human capital accumulation vary by export intensity of FDI? We first calculate foreign manufacturing firms' export intensity across 3-digit industries using 1998-2005 ASIF dataset. Export intensity of FDI is calculated as below:

$$FDI\_export\_intensity_i = \frac{\sum_{fi} export_{fi}}{\sum_{fi} sales_{fi}} \qquad (5)$$

The numerator is total exports of all foreign firms in industry i during 1998-2005. The denominator is total sales of all foreign firms in industry i during the same period. Essentially, the export intensity of FDI is the share of total foreign exports in total foreign sales in each industry. Ideally, we would use 1990-2005 firm data to calculate FDI export intensity, but ASIF data is only available from 1998. Foreign firms' export intensity in each industry remains highly stable over time, so we calculate this time-invariant indicator and divide manufacturing industries into two groups: high export intensity industries (above median export intensity) and low export intensity industries (below median export industry). Using a similar Bartik approach, we define change in high and low export intensity FDI: ΔFDI_export_H and ΔFDI_export_L as below:

$$\Delta FDI_{cpt\_export_H} = \sum_{i \in H} \Delta \widehat{FDI}_{it} \times emp\_share_{icpt-1} \qquad (6)$$

$$\Delta FDI_{cpt\_export_L} = \sum_{i \in L} \Delta \widehat{FDI}_{it} \times emp\_share_{icpt-1} \qquad (7)$$

ΔFDI_export_H is the interaction between initial industry employment share in city c, province p and predicted change in national foreign employment share for all high export intensity industries.

ΔFDI_export_L is calculated similarly for all low export intensity industries. Table 11 reports the heterogenous effects by export intensity of FDI. Quite intuitively, only export oriented FDI inflows have a significant impact on drawing labor out of agriculture into industry and services. While export oriented FDI plays a dominant role in moving people from farms to factories, domestic market-seeking FDI has a greater positive effect on college enrollment. This is also perfectly reasonable as export-oriented FDI is concentrated in labor-intensive industries including textile, apparel, leather, furniture and electronics. The primary goal of export-oriented FDI in China is to reduce cost and demand for skills is relatively low. In fact, the average share of employees with at least a college degree is 9.9 percent in domestic market-seeking sectors, significantly higher than the 6.6 percent in export-oriented sectors. Therefore, it is not surprising that domestic market-seeking FDI is more conducive to college enrollment.

Table 11. Heterogeneity: Export intensity of FDI shock

	(1)	(2)	(3)	(4)	(5)
	Panel A			Panel B	
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	ΔHighschool	ΔCollege
ΔFDI_export_H	-3.538***	2.038***	1.215*	1.342***	0.536**
	(0.993)	(0.737)	(0.647)	(0.405)	(0.254)
ΔFDI_export_L	-1.172	-0.180	0.685	1.147**	0.570**
	(1.153)	(0.819)	(0.548)	(0.544)	(0.229)
Observations	609	609	609	609	609
R-squared	0.558	0.581	0.494	0.818	0.735
Prov-Year FE	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y	Y

Note: This table shows the heterogenous effects of FDI on city level structural transformation and school enrollment by export intensity of FDI. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

6.2 FDI shock by skill intensity

Li (2018) shows that high-skill export shocks raise both high school and college enrollments, while low-skill export shocks depress both. By the same token, the effect of FDI shock could also vary by the skill intensity associated with FDI. We construct high-skill FDI shock and low-skill FDI shock in a similar way as high export intensity and low export intensity shocks. We first calculate the share of employees with at least a college degree in each 3-digit manufacturing industry based on the 2000 population census. We then divide industries into high-skill and low-skill based on whether the college employee share is above the median of all manufacturing industries. Next, we calculate high-skill and low-skill FDI shocks as the interaction between each city's initial industry employment share and predicted national FDI employment share changes at the industry level for their respective group of industries:

$$\Delta FDI_{cpt}^{skill\_H} = \sum_{i \in H} \Delta \widehat{FDI}_{it} \times emp\_share_{icpt-1} \quad (8)$$

$$\Delta FDI_{cpt}^{skill\_L} = \sum_{i \in L} \Delta \widehat{FDI}_{it} \times emp\_share_{icpt-1} \quad (9)$$

The results are reported in Table 12. Only low-skill FDI has significant effect on structural transformation. High-skill FDI is concentrated in aerospace, chemical and pharmaceutical sectors, machinery and equipment, electronics, and transportation equipment. Low-skill FDI is primarily in leather, textile and apparel, plastic products, wood and furniture, and food manufacturing. Low-skill FDI employs much more workers than high-skill FDI, thereby magnifying the pull effect of structural transformation. On the contrary, high-skill FDI promotes college enrollment much more than low-skill FDI. FDI in skill intensive services could play a bigger role in stimulating college enrollment, as documented by Xue and Han (2006). Unfortunately this paper cannot study the effect of services FDI on structural transformation and school enrollment due to lack of data.

Table 12. Heterogeneity: Skill intensity of FDI shock

	(1)	(2)	(3)	(4)	(5)
	Panel A			Panel B	
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	ΔHighschool	ΔCollege
ΔFDI_skills_H	-1.933	0.422	1.245	1.091*	0.755**
	(1.353)	(0.826)	(0.875)	(0.628)	(0.321)
ΔFDI_skills_L	-2.707***	1.430*	0.916**	1.337***	0.458**
	(1.047)	(0.811)	(0.444)	(0.429)	(0.182)
Observations	609	609	609	609	609
R-squared	0.553	0.574	0.494	0.818	0.735
Prov-Year FE	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y	Y

Note: This table shows the heterogenous effects of FDI on city level structural transformation and school enrollment by skill intensity of FDI. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

6.3 School enrollment by age group

In previous regressions, school enrollment is calculated for individuals aged between 15-25. However, in China one makes education decisions at two critical junctures: around 15-16 years old for high school enrollment and around 18-19 years old for college enrollment. The labor market shock induced by FDI could affect different age cohorts differently. Children aged between 16-18 are more likely to be affected for high school enrollment, while young people aged between 19-22 are more affected for college enrollment. To see how FDI shocks affect school enrollment of different age groups differentially, we run separate regressions for three age groups: 16-18, 19-22, and 23-25. The results are reported in Table 13. As expected, FDI shock has the largest effect on high school enrollment for teenagers between 16-18 (column

(1), 2.2). The effect on college enrollment is insignificant for age group 16-18 and highly significant for age group 19-22 and 23-25. These results lend further credit to our main finding that manufacturing FDI inflows promote local school enrollment. In Appendix 3 (Table A5 and A6), we further show that domestic market-oriented FDI and high-skill FDI have a larger effect on college enrollment, the effect is larger for age group 19-22 and 23-25.

Table 13. FDI inflows and local school enrollment: by age group

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: 16-18		Panel B: 19-22		Panel C: 23-25	
Dependent var	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege
FDI_shock	2.200***	-0.0468	1.041***	0.689**	1.131***	0.981***
	(0.551)	(0.132)	(0.369)	(0.289)	(0.317)	(0.300)
L.FDI_empshare	-0.0595	0.0209	-0.0991**	0.106*	0.0316	-0.0113
	(0.0551)	(0.0293)	(0.0402)	(0.0562)	(0.0328)	(0.0348)
Observations	607	607	607	607	607	607
R-squared	0.839	0.497	0.847	0.678	0.721	0.589
Prov-Year FE	Y	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on city level school enrollment by student age group. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

6.4 School enrollment by gender

Lastly, we test how the effect of FDI shock on school enrollment varies by gender. We calculate high school and college enrollment for boys and girls separately based on population censuses. The results are reported in Table 14. FDI shock has a positive impact on high school and college enrollment for both boys and girls. The effect on high school enrollment is larger for girls while the effect on college enrollment is higher for boys. High-skill FDI shock has a larger effect on female college enrollment than on male (Appendix 3, Table A7 and A8).

Table 14. FDI inflows and local school enrollment: by gender

	(1)	(2)	(3)	(4)
	Panel A: Female		Panel B: Male	
Dependent var	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege
FDI_shock	1.500***	0.414**	1.123***	0.613***
	(0.380)	(0.194)	(0.351)	(0.185)
L.FDI_empshare	-0.0530	0.0442	-0.0662*	0.0168
	(0.0353)	(0.0397)	(0.0348)	(0.0282)
Observations	607	607	607	607
R-squared	0.828	0.682	0.770	0.652
Prov-Year FE	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y

Tariff shocks	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on city level school enrollment by gender. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

7. Conclusion

China's prominent rise as a global manufacturing powerhouse during the past few decades has been accompanied by massive labor reallocation from agriculture to industry and services, as well as human capital accumulation. Inbound FDI has been instrumental in China's economic development and export success. China has been the largest FDI recipient among developing countries since 1992. While many studies have assessed the productivity spillovers of FDI based on firm level data, very few papers have investigated the broader developmental impact of FDI. This paper constructs a city level panel data set spanning 1990-2005 to present the first causal evidence of the effect of FDI on local structural transformation and human capital accumulation in China. The paper exploits variations in FDI inflows across manufacturing sub-sectors and initial industry specialization patterns across cities as instrumental variables for local FDI shocks.

As far as we know, this paper is the first to analyze the causal effect of FDI on structural transformation and human capital accumulation in China at the city level. It joins the very limited literature assessing the role of FDI in catalyzing structural transformation, school enrollment and other local labor market effects. The paper highlights that in addition to trade shocks, FDI plays a pivotal role in driving local structural transformation and human capital accumulation, and the effect varies by the type of FDI.

Our results show that manufacturing FDI inflows greatly accelerated city level structural transformation and human capital accumulation. Cities that received more manufacturing FDI experienced higher increases in industry and services employment and GDP shares accompanied with faster declines in agricultural employment and GDP shares. These cities also witnessed larger improvements in high school and college enrollment rates. These results are robust to a series of robustness checks, including additional controls, changes in tariffs, SOE reform, migration, and alternative measure of FDI presence.

The mechanism for manufacturing FDI inflows to accelerate structural transformation is primarily through the expansion of demand. By integrating China into global production networks and supplying the global market, manufacturing FDI inflows created a huge pull factor that has drawn excess labor away from farms into factories and services. Furthermore, through FDI promoting local school and college enrollment by paying a wage premium for skilled workers and pushing up the skill premium in local labor markets, FDI helped increase consumer purchasing power and aggregate demand.

The effect of FDI on structural transformation and school enrollment also hinges on the characteristics of such FDI. Only export-oriented FDI has had a significant impact of moving labor from agriculture into industry and services. While both export-oriented and domestic market-seeking FDI promote high school and college enrollment, domestic market-seeking FDI has had a much larger effect as such FDI has higher demand for skilled labor. Similarly, high-skill FDI shock has a larger effect on structural transformation and school enrollment than low-skill FDI shock.

Finally, the impact of FDI on school enrollment also varies by age group and gender. The effect on high school enrollment is the largest for teenagers between the ages of 16 and 18, and the effect on college enrollment is larger for 19- to 25-year-olds. Boys seem to benefit slightly more than girls in terms of high school and college enrollment.

The findings of this paper have important policy implications. Many low- and middle-income countries aspire to boost aggregate productivity by creating more and better jobs in the formal sector, in industry and services sectors, and by improving their human capital. Attracting manufacturing FDI, especially export-oriented FDI could catalyze the structural transformation process, while domestic market-seeking FDI and skill-intensive FDI are more beneficial for human capital accumulation. The type of FDI a country attracts is largely determined by its own endowments, development stage and policies, which in turn affect the development trajectory of the country. Policy makers in developing countries need to align their FDI policy and promotion strategies with broader development objectives to maximize the benefits brought by FDI.

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Appendices

Appendix 1. Alternative regression specifications

In the main text we used the Ordinary Least Squares (OLS) approach to estimate the reduced form equation:

$$\Delta Y_{cpt} = \gamma FDI\_shock_{cpt} + \theta FDI\_empshare_{cpt-1} + \vartheta Y_{cpt-1} + X'_{cpt-1}\beta + \alpha_{pt} + \varepsilon_{cpt}$$

While using the Bartik shock in reduced form regressions is very common (Li 2018; Erten and Leight 2021), we estimate the following equation using Two-Stage Least Squares (2SLS) regression to demonstrate that FDI deregulation indeed led to higher FDI inflows and our baseline results remain valid. $\Delta FDI\_empshare_{cpt}$ is the actual change in foreign firms' employment share in the manufacturing sector. We instrument it with FDI_shock_{cpt}.

$$\Delta Y_{cpt} = \gamma \Delta FDI\_empshare_{cpt} + \theta FDI\_empshare_{cpt-1} + \vartheta Y_{cpt-1} + X'_{cpt-1}\beta + \alpha_{pt} + \varepsilon_{cpt}$$

Table A1 and A2 reports 2SLS results on structural transformation and school enrollment respectively. In both tables, FDI shock strongly predicts actual increase in FDI employment share. Increase in FDI employment share results in a significantly faster shift of employment and GDP from agriculture to industry and services. FDI inflows also leads to higher growth in high school and college enrollment.

Table A1. FDI inflows and local structural transformation: 2SLS results

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Employment			Panel B: GDP		
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	Δagri_gdps	Δindu_gdps	Δserv_gdps
ΔFDI_empshare	-0.867**	0.426*	0.546**	-1.232***	0.470**	0.471**
	(0.394)	(0.219)	(0.230)	(0.383)	(0.192)	(0.185)
L.FDI_empshare	-0.229***	0.182***	0.0686	-0.134*	0.0643	0.0376
	(0.0628)	(0.0415)	(0.0457)	(0.0778)	(0.0450)	(0.0437)
Panel C: First stage results						
FDI_shock	2.093***	2.590***	1.927***	1.937***	2.039***	1.839***
	(0.6318)	(0.7684)	(0.5368)	(0.5871)	(0.5934)	(0.5794)
First stage F statistics	576.7	548.23	565.86	2384.93	232.09	245.94
Observations	660	660	660	532	532	532
Prov-Year FE	Y	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y	Y

Note: This table reports the effect of change in manufacturing FDI employment share on city level structural transformation. Dependent variables are changes in city level agriculture, industry, and services employment share in Panel A and GDP share in Panel B. Lagged city characteristics include average years of schooling, population, average age, share of Han ethnicity. The regressions also control lagged sectoral employment or GDP share. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Table A2. FDI inflows and local school enrollment: 2SLS results

	(1)	(2)
Panel A: School enrollment second stage results		
Dependent var	ΔHighschool	ΔCollege
ΔFDI_empshare	0.567***	0.826***
	(0.169)	(0.246)
L.FDI_empshare	-0.0255	0.127**
	(0.0437)	(0.0544)
Panel B: First stage results		
FDI_shock	2.047***	1.775***
	(0.4978)	(0.4651)
First stage F statistics	1022.45	523.26
Observations	660	660
Prov-Year FE	Y	Y
Lagged city characteristics	Y	Y

Note: This table reports the effect of changes in FDI employment share on city level school enrollment using 2SLS method. Lagged city characteristics include population, average age, share of Han ethnicity. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

The previous regression specification also controls for lagged dependent variable. While we found initial industry structure/school enrollment rate to be a very significant predictor of changes in industry structure/school enrollment, controlling Y_{cpt-1} creates further endogeneity in the regression. Below we report the results from an alternative regression specification that does not control Y_{cpt-1} to see whether and how much the coefficients deviate from the main results in Table 8. The coefficients γ and θ are similar to those in Table 8, the positive effect of FDI on structural transformation and school enrollment still holds.

Table A3. Exclude lagged dependent variables

	(1)	(2)	(3)	(4)	(5)
	Panel A: Structural transformation			Panel B: School enrollment	
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	ΔHighschool	ΔCollege
ΔFDI_empshare	-1.783**	-0.625	2.408***	1.219***	0.394*
	(0.823)	(0.544)	(0.856)	(0.375)	(0.214)
L.FDI_empshare	0.0204	0.0352	-0.0556	-0.0669**	0.0281
	(0.0426)	(0.0412)	(0.0422)	(0.0315)	(0.0331)
Observations	607	607	607	607	607
R-squared	0.542	0.536	0.397	0.811	0.685
Prov-Year FE	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y
Exclude migrants	Y	Y	Y	Y	Y

Note: This table reports results based on an alternative specification that excludes lagged dependent variable. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Appendix 2. Measuring FDI with output share

This paper primarily measures FDI presence as foreign firms' employment share in the manufacturing sector. Following the same approach, we use FDI policy changes to predict changes in industry level FDI output share, and estimate the equation below:

$$\Delta Y_{cpt} = \gamma \Delta FDI\_shock\_output_{cpt} + \theta FDI\_outputshare_{cpt-1} + \vartheta Y_{cpt-1} + X'_{cpt-1}\beta + \alpha_{pt} + \varepsilon_{cpt}$$

Results in Table A4 confirms that measuring FDI presence with output share does not affect our findings.

Table A4. Measuring FDI with output share

	(1)	(2)	(3)	(4)	(5)
	Panel A			Panel B	
Dependent var	Δagri_emps	Δindu_emps	Δserv_emps	ΔHighschool	ΔCollege
ΔFDI_shock_output	-1.929**	0.452	1.077***	0.975***	0.502***
	(0.753)	(0.499)	(0.341)	(0.293)	(0.112)
L.FDI_outputshare	-0.0510	-0.0186	0.0817**	-0.0729***	0.0796***
	(0.0326)	(0.0455)	(0.0395)	(0.0229)	(0.0223)
Observations	609	609	609	609	609
R-squared	0.554	0.567	0.513	0.821	0.752
Prov-Year FE	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y	Y

Note: This table shows the effects of FDI shock on city level structural transformation and school enrollment using alternative FDI measure. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Appendix 3. Heterogenous effects on school enrollment by FDI type, age group and gender

Table A5. FDI inflows and local school enrollment: by age group and FDI export intensity

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: 16-18		Panel B: 19-22		Panel C: 23-25	
Dependent var	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege
ΔFDI_export_H	2.315***	-0.100	0.693	0.732	0.879**	0.672*
	(0.671)	(0.182)	(0.437)	(0.457)	(0.351)	(0.361)
ΔFDI_export_L	1.918**	0.0855	1.355**	0.857**	1.567***	1.407***
	(0.837)	(0.138)	(0.587)	(0.419)	(0.458)	(0.399)
Observations	609	609	609	609	609	609
R-squared	0.838	0.495	0.846	0.674	0.721	0.589
Prov-Year FE	Y	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on city level school enrollment by student age group and FDI export intensity. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Table A6. FDI inflows and local school enrollment: by age group and FDI skills intensity

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: 16-18		Panel B: 19-22		Panel C: 23-25	
Dependent var	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege
ΔFDI_skills_H	3.197***	0.352*	0.347	1.825***	1.739***	1.480***
	(0.951)	(0.213)	(0.701)	(0.569)	(0.539)	(0.554)
ΔFDI_skills_L	1.724***	-0.186	1.206***	0.325	0.891**	0.735***
	(0.619)	(0.119)	(0.439)	(0.323)	(0.354)	(0.273)
Observations	609	609	609	609	609	609
R-squared	0.839	0.499	0.846	0.676	0.722	0.589
Prov-Year FE	Y	Y	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on city level school enrollment by student age group. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Table A7. FDI inflows and local school enrollment: by gender and FDI export intensity

	(1)	(2)	(3)	(4)
	Panel A: Female		Panel B: Male	
Dependent var	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege
ΔFDI_export_H	1.500***	0.435	1.179***	0.579**
	(0.417)	(0.284)	(0.440)	(0.286)
ΔFDI_export_L	1.382**	0.482**	0.889*	0.704**
	(0.587)	(0.245)	(0.533)	(0.282)
Observations	609	609	609	609
R-squared	0.827	0.680	0.769	0.651
Prov-Year FE	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on city level school enrollment by gender and FDI export intensity. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.

Table A8. FDI inflows and local school enrollment: by gender and FDI skill intensity

	(1)	(2)	(3)	(4)
	Panel A: Female		Panel B: Male	
Dependent var	ΔHighschool	ΔCollege	ΔHighschool	ΔCollege
ΔFDI_skills_H	1.553**	0.862**	0.591	0.754**
	(0.687)	(0.368)	(0.608)	(0.353)
ΔFDI_skills_L	1.413***	0.274	1.261***	0.572***
	(0.450)	(0.209)	(0.432)	(0.198)
Observations	609	609	609	609
R-squared	0.827	0.681	0.769	0.651
Prov-Year FE	Y	Y	Y	Y
Lagged city characteristics	Y	Y	Y	Y
SOE reform	Y	Y	Y	Y
Tariff shocks	Y	Y	Y	Y
Excluding migrants	Y	Y	Y	Y

Note: This table reports the effect of FDI shock on city level school enrollment by gender and FDI skill intensity. Standard errors are clustered at the city level. *** p<0.01, ** p<0.05, * p<0.1.