The Chins Syndrome : local labor market effects of import competition in the United States

Abstract

We analyze the effect of rising Chinese import competition between 1990 and 2007 on local U.S. labor markets, exploiting cross-market variation in import exposure stemming from initial differences in industry specialization while instrumenting for imports using changes in Chinese imports by industry to other high-income countries. Rising exposure increases unemployment, lowers labor force participation, and reduces wages in local labor markets. Conservatively, it explains one-quarter of the contemporaneous aggregate decline in U.S. manufacturing employment. Transfer benefits payments for unemployment, disability, retirement, and healthcare also rise sharply in exposed labor markets.

我们分析了 1990 年至 2007 年间中国进口竞争的加剧对美国当地劳动力市场的影响，利用行业专业化最初差异导致的进口敞口的跨市场差异，同时利用中国对其他高收入国家按行业进口的变化为进口工具。敞口的增加会增加失业率，降低劳动力参与率，并降低当地劳动力市场的工资。保守地说，它解释了同期美国制造业就业总量下降的四分之一。针对失业、残疾、退休和医疗保健的转移补贴也在暴露的劳动力市场大幅上升。

unemployment . exposure

1 Introduction

The past two decades have seen a fruitful debate on the impact of international trade on U.S. labor markets (Feenstra, 2010). Beginning in the 1990s, the literature developed rapidly as economists sought to understand the forces behind rising U.S. wage inequality. While in the 1980s, trade in the form of foreign outsourcing was associated with modest increases in the wage premium for skilled manufacturing labor (Feenstra and Hanson, 1999), the evidence suggests that other shocks, including skill biased technical change, played a more important role in the evolution of the U.S. wage structure in that decade (Katz and Autor, 1999).

在过去的二十年里，关于国际贸易对美国劳动力市场的影响的辩论取得了丰硕的成果(Feenstra, 2010)。从 20 世纪 90 年代开始，随着经济学家试图理解美国工资不平等加剧背后的力量，相关文献迅速发展。虽然在 20 世纪 80 年代，以外国外包形式进行的贸易与熟练制造业劳动力工资溢价的适度增长有关(Feenstra and Hanson, 1999)，但证据表明，其他冲击，包括技能偏向的技术变化，在那十年美国工资结构的演变中扮演了更重要的角色(Katz 和 Autor, 1999)。

One factor limiting trade's impact on U.S. labor is that historically, imports from low-wage countries have been small (Krugman, 2000). Though freer trade with countries at any income level may affect wages and employment, trade theory identifies low-wage countries as a likely source of disruption to high-wage labor markets (Krugman, 2008). In 1991, low-income countries accounted for just 2.9% of U.S. manufacturing imports (Table 1). However, owing largely to China's spectacular economic growth, the situation has changed markedly. In 2000, the low-income-country share of U.S. imports reached 5.9% and climbed to 11.7% by 2007, with China accounting for 91.5% of this growth. The share of total U.S. spending on Chinese goods rose from 0.6% in 1991 to 4.6% in 2007 (Figure 1), with an inflection point in 2001 when China joined the World Trade Organization. Over the same period, the fraction of U.S. working age population employed in manufacturing fell by a third, from 12.6% to 8.4% (Figure 1). Amplifying China's potential impact on the U.S. labor market are sizable current-account imbalances in the two countries. In the 2000s, China's average current-account surplus was 5% of GDP, a figure equal to the contemporaneous average U.S. current-account deficit. U.S. industries have thus faced a major increase in import competition from China without an o setting increase in demand for U.S. exports.

限制贸易对美国劳动力影响的一个因素是，从历史上看，从低工资国家的进口一直很小(克鲁格曼，2000)。尽管与任何收入水平的国家自由贸易可能会影响工资和就业，但贸易理论认为，低工资国家可能是高工资劳动力市场中断的来源(克鲁格曼，2008 年)。1991 年，低收入国家仅占美国制造业进口的 2.9%(表 1)。然而，在很大程度上由于中国惊人的经济增长，情况发生了显著变化。2000 年，低收入国家在美国进口产品中所占份额达到 5.9%，到 2007 年升至 11.7%，其中中国占 91.5%。从 1991 年到 2007 年，美国对中国商品的总支出从 0.6%上升到 4.6%(图 1)，拐点出现在 2001 年中国加入世界贸易组织(World Trade Organization)时。同期，美国适龄劳动人口中从事制造业的比例下降了三分之一，从 12.6%降至 8.4%(图 1)。两国严重的经常项目失衡加剧了中国对美国劳动力市场的潜在影响。在本世纪头十年，中国的平均经常项目盈余占 GDP 的 5%，与同期美国的平均经常项目赤字相当。因此，在对美国出口产品的需求没有明显增加的情况下，美国工业面临着来自中国的进口竞争的大幅增加。

Table 1. Value of Trade with China for the U.S. and Other Selected High-Income Countries and Value of Imports from all other Source Countries, 1991/1992-2007.

	I. Trade with China (in BN 2007 US$)		II. Imports from Other Countries (in BN 2007 US$)		
	Imports from China (1)	Exports to China (2)	Imports from Other Low-Inc. (3)	Imports from Mexico/Cafta (4)	Imports from Rest of World (5)
			A. United States		
1991/92	26.3	10.3	7.7	38.5	905.8
2000	121.6	23.0	22.8	151.6	1865.5
2007	330.0	57.4	45.4	183.0	2365.9
Growth 1991-07	1156%	456%	491%	375%	161%
			B. 8 Other Developed Countries		
1991/92	28.2	26.6	9.2	2.8	1708.8
2000	94.3	68.2	13.7	5.3	1979.8
2007	262.8	196.9	31.0	11.6	3339.3
Growth 1991-07	832%	639%	236%	316%	95%

Notes: Trade data is reported for the years 1991, 2000, and 2007, except for exports to China which are first available in 1992. The set of "Other Developed Countries" in Panel B comprises Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. Column 3 covers imports from all countries that have been classified as low-income by the World Bank in 1989, except for China. Column 4 covers imports from Mexico and the Central American and Carribean countries covered by the CAFTA-DR free trade agreement. Column 5 covers imports from all other countries (primarily from developed countries).

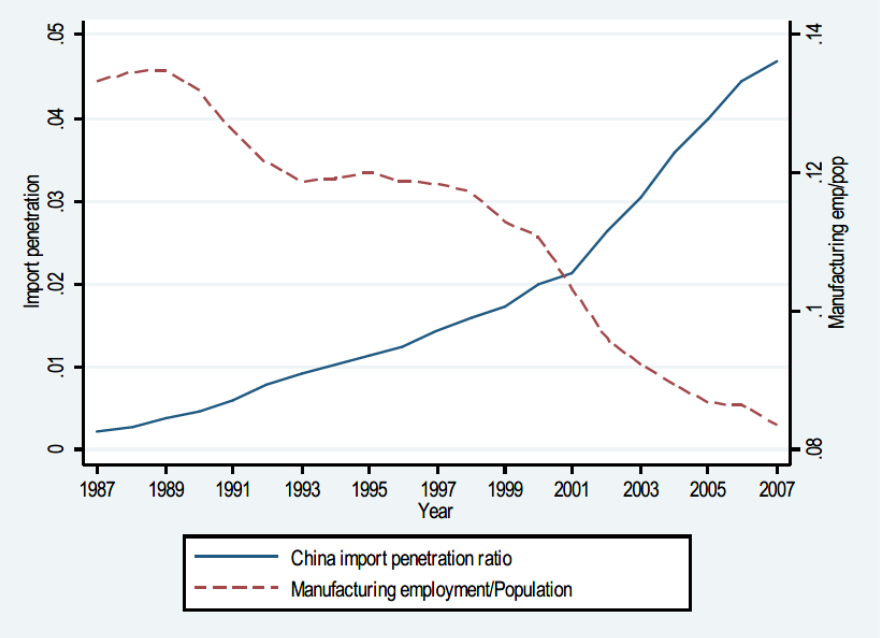

Figure 1.
Import Penetration Ratio for U.S. Imports from China (left scale), and Share of U.S. Working-Age Population Employed in Manufacturing (right scale).

In this paper, we relate changes in labor-market outcomes from 1990 to 2007 across U.S. local labor markets to changes in exposure to Chinese import competition. We treat local labor markets as sub-economies subject to differential trade shocks according to initial patterns of industry specialization. Commuting zones (CZs), which encompass all metropolitan and non-metropolitan areas in the United States, are logical geographic units for defining local labor markets (Tolbert and Sizer, 1996; Autor and Dorn, 2011). They differ in their exposure to import competition as a result of regional variation in the importance of different manufacturing industries for local employment. In 1990, the share of regional employment hours worked in manufacturing ranged from 12% for CZs in the bottom tercile to 27% for CZs in the top tercile. Variation in the overall employment share of manufacturing, however, only explains about a quarter of the variation in the measure of local-labor-market import exposure that we will define below. The main source of variation in exposure is within-manufacturing specialization in industries subject to different degrees of import competition. In particular, there is

differentiation according to local-labor-market reliance on labor-intensive industries, in which China's comparative advantage is pronounced (Amiti and Freund, 2010). By 2007, China accounted for over 40% of U.S. imports in four four-digit SIC industries (luggage, rubber and plastic footwear, games and toys, and die-cut paperboard) and over 30% in 28 other industries, including apparel, textiles, furniture, leather goods, electrical appliances, and jewelry.
在本文中，我们将 1990 年至 2007 年美国本地劳动力市场的劳动力市场结果的变化与中国进口竞争的影响联系起来。根据行业专业化的初始模式，我们将当地劳动力市场视为受差异贸易冲击影响的次级经济体。通勤区(cz)包括美国所有的大都市和非大都市地区，是定义当地劳动力市场的逻辑地理单位(Tolbert 和 Sizer, 1996;奥托和多恩，2011)。由于不同地区制造业对当地就业的重要性不同，它们受到进口竞争的影响也不同。1990 年，在制造业工作的地区就业小时数的份额范围从 12%的最低三位数到 27%的最高三位数。然而，制造业整体就业份额的变化，只能解释我们将在下文中定义的本地劳动力市场进口敞口测量的变化的大约四分之一。敞口变化的主要来源是受不同程度进口竞争影响的行业的制造业专业化。特别是，本地劳动力市场对劳动密集型产业的依赖程度存在差异，其中中国的比较优势明显(Amiti and Freund, 2010)。截至 2007 年，在四个四位数 SIC 行业(箱包、橡胶和塑料鞋类、游戏和玩具、模切纸板)中，中国进口占美国进口的 40%以上，在服装、纺织品、家具、皮革制品、电器和珠宝等 28 个其他行业中占 30%以上。

The growth in low-income country exports over the time period we examine is driven largely by China's transition to a market-oriented economy, which has involved rural-to-urban migration of over 150 million workers (Chen, Jin, and Yue, 2010), Chinese industries gaining access to long banned foreign technologies, capital goods, and intermediate inputs (Hsieh and Klenow, 2009), and multinational enterprises being permitted to operate in the country (Naughton, 2007). Compounding the positive effects of internal reforms on China's trade is the country's accession to the WTO, which gives it most-favored nation status among the 153 WTO members (Branstetter and Lardy, 2006). In light of the internal and global external factors driving China's exports, we instrument for the growth in U.S. imports from China using Chinese import growth in other high-income markets. We also adopt several alternative estimation strategies, including measuring CZ exposure to import competition using the gravity model of trade. All approaches yield substantially similar results.
在低收入国家出口增长时期我们检查的主要驱动因素是中国向市场经济过渡,已涉及城乡移民的 1.5 亿名工人(陈、金和曰,2010),中国行业获得长期禁止外国技术,资本货物,和中间投入(Hsieh 和 Klenow, 2009)，以及跨国企业被允许在该国经营(Naughton, 2007)。内部改革对中国贸易的积极影响是中国加入世贸组织，这使它在 153 个世贸组织成员中享有最惠国地位(Branstetter 和 Lardy, 2006)。鉴于推动中国出口的内部和全球外部因素，我们利用中国在其他高收入市场的进口增长来促进美国从中国进口的增长。我们还采用了几种可供选择的估计策略，包括使用贸易引力模型测量 CZ 在进口竞争中的风险。所有的方法都产生大致相似的结果。

Because trade shocks play out in general equilibrium, one needs empirically to map many industry-specific shocks into a small number of aggregate outcomes. For national labor markets at annual frequencies, one is left with few observations and many confounding factors. One solution to the degrees-of-freedom problem is to exploit the general equilibrium relationship between changes in product prices and changes in factor prices, which allows one to estimate changes in wages for skilled and unskilled labor mandated by industry trade shocks (e.g., Leamer, 1993; Feenstra and Hanson, 1999; Harrigan, 2000). This approach is well-grounded in trade theory but is silent on non-wage outcomes, such as employment status or receipt of government transfers.
由于贸易冲击在一般均衡中发挥作用，人们需要根据经验将许多特定行业的冲击映射为少量的总体结果。对于国家劳动力市场的年度频率，一个是留下了很少的观察和许多混杂因素。自由度问题的一种解决办法是利用产品价格变动和要素价格变动之间的一般均衡关系，这使人们能够估计工业贸易冲击下熟练和非熟练劳工的工资变动(例如，Leamer, 1993;Feenstra 和 Hanson, 1999 年;Harrigan, 2000)。这种方法在贸易理论中有充分的依据，但在非工资结果方面却保持沉默，比如就业状况或接受政府转移。

By taking regional economies as the unit of analysis, we circumvent the degrees-of-freedom problem endemic to estimating the labor-market consequences of trade. We relate changes in exposure to low-income-country imports to changes in CZ wages, employment levels, industry employment shares, unemployment and labor-force participation rates, and take-up of unemployment, disability, welfare, and other publicly funded benefits, where we allow impacts to vary by age, gender, and education. Our local-labor-market approach to analyzing the impacts of trade exposure follows important early work by Borjas and Ramey (1995), who also emphasize the role of trade imbalances in mapping trade shocks to labor-market outcomes, as well as more recent work by Chiquiar (2008), Topalova (2005, 2010) and Kovak

(2011), who study the effects of trade liberalizations on wages, poverty, and migration in local and regional labor markets in Mexico, India and Brazil, respectively.
通过将区域经济作为分析单元，我们规避了在估计贸易的劳动力市场后果时所特有的自由度问题。我们将低收入国家进口敞口的变化与 CZ 的工资、就业水平、行业就业份额、失业和劳动力参与率以及失业、残疾、福利和其他公共资助福利的接受情况联系起来，在这些方面，我们允许影响因年龄、性别和教育而有所不同。我们本地劳动力市场的方法来分析贸易风险的影响是重要的早期作品由佳和 Ramey(1995),他也强调贸易失衡的角色映射贸易冲击劳动力市场的结果,以及最近工作 Chiquiar (2008), Topalova(2005、2010)和 Kovak (2011),他们分别在墨西哥、印度和巴西研究贸易自由化对当地和区域劳动力市场的工资、贫困和移民的影响。

An alternative solution to the degrees-of-freedom problem in estimating the effects of trade shocks is to treat the industry or occupation as the unit of analysis. This approach is taken in recent work focusing on U.S. imports from low-income countries, including Bernard, Jensen, and Schott (2006), who find that over 1977-1997, manufacturing plants more exposed to low-wage-country imports grew more slowly and were more likely to exit, and Liu and Trefler (2008), who estimate that over 1996-2006, U.S. outsourcing of services to China and India had minimal effects on changes in occupation, employment, or earnings for U.S. workers. Ebenstein, Harrison, McMillan, and Phillips (2010), who like Liu and Trefler (2008) use data from the CPS, find larger effects of trade on wages, with wages growing more slowly in occupations more exposed to import penetration and to U.S. multinationals moving production offshore. Our approach is complementary to this strand of literature. In examining economic outcomes at the level of local labor markets, we are able to capture both the direct effect of trade shocks on employment and earnings at import-competing employers as well as net effects on employment, earnings, labor force participation, geographic mobility and take-up of public transfer benefits in the surrounding geographic area.
在估计贸易冲击的影响时，自由度问题的另一种解决办法是将行业或职业作为分析单位。这种方法是在最近的工作专注于美国从低收入国家进口,包括伯纳德,Jensen 和 Schott(2006),他们发现在 1977 - 1997 年,制造工厂更容易受到 low-wage-country 进口增长更慢,更有可能退出,和刘 Trefler(2008),世卫组织估计,在 1996 - 2006 年,美国将服务外包给中国和印度，对美国工人的职业、就业或收入的变化影响很小。与 Liu 和 Trefler(2008)一样，Ebenstein、Harrison、McMillan 和 Phillips(2010)使用了来自 CPS 的数据，发现了贸易对工资的更大影响，那些受进口渗透影响更大的职业和将生产转移到海外的美国跨国公司的工资增长更慢。我们的研究方法是对这类文献的补充。在考察当地劳动力市场层面的经济结果时，我们能够捕捉到贸易冲击对进口竞争雇主的就业和收入的直接影响，以及对就业、收入和劳动力参与的净影响，周边地理区域的地理流动性和公共交通利益的利用。

If labor is highly mobile across regions, trade may affect workers without its consequences being identifiable at the regional level. The literature on regional adjustment to labor-market shocks suggests that mobility responses to labor demand shocks across U.S. cities and states are slow and incomplete (Topel, 1986; Blanchard and Katz, 1992; Glaeser and Gyourko, 2005). Mobility is lowest for non-college workers, who are over-represented in manufacturing (Bound and Holzer, 2000; Notowidigdo, 2010). It is therefore plausible that the effects of trade shocks on regional labor markets will be evident over the medium term; indeed, our analysis does not find significant population adjustments for local labor markets with substantial exposure to imports. The sluggish response of regional labor supply to import exposure may be related to the costly mobility of labor between sectors, as documented by Artuc, Chaudhuri, and McLaren (2010) in the United States and Dix-Carneiro (2011) in Brazil, also in the context of adjustment to trade shocks.
如果劳动力在区域间高度流动，贸易可能会对工人造成影响，而其后果在区域层面上无法识别。关于劳动力市场冲击的区域调整的文献表明，美国城市和州的流动性对劳动力需求冲击的反应是缓慢和不完整的(Topel, 1986;Blanchard and Katz, 1992;Glaeser 和 Gyourko, 2005)。非大学毕业生的流动性最低，他们在制造业的比例过高(Bound 和 Holzer, 2000;Notowidigdo, 2010)。因此，贸易冲击对区域劳动力市场的影响在中期内将是明显的，这是有道理的;事实上，我们的分析并没有发现大量进口商品的当地劳动力市场有显著的人口调整。正如美国的 Artuc、Chaudhuri 和 McLaren(2010)以及巴西的 Dix-Carneiro(2011)所记录的那样，区域劳动力供应对进口敞口的缓慢反应可能与行业间劳动力流动的成本高昂有关，这也是在贸易冲击调整的背景下进行的。

Our results suggest that the predominant focus of the previous literature on wages misses important aspects of labor market adjustments to trade. We find that increased exposure to low-income-country imports is associated with rising unemployment, decreased labor-force participation, and increased use of disability and other transfer benefits, as well as

with lower wages, in affected local labor markets. Comparing two CZs over the period of 2000 through 2007, one at the 25th percentile and the other at the 75th percentile of exposure to Chinese import growth, the CZ at the 75th percentile would be expected to experience a differential 4.5 percent fall in the number of manufacturing employees, a 0.8 percentage point fall in the employment to population rate, a 0.8 percent fall in mean log weekly earnings, and increases in per capita unemployment, disability, and income assistance transfer benefits on the order of 2 to 3.5 percent. These results indicate that federally funded transfer programs, such as Social Security Disability Insurance (SSDI), implicitly insure U.S. workers against trade-related employment shocks. Import exposure also predicts a large but imprecisely measured increase in benefits from Trade Adjustment Assistance (TAA), which is the primary federal program that provides financial support to workers who lose their jobs as a result of foreign trade. TAA grants are however temporary, whereas most workers who take-up disability receive SSDI benefits until retirement or death (Autor and Duggan, 2006). For regions affected by Chinese imports, the estimated dollar increase in per capita SSDI payments is more than thirty times as large as the estimated dollar increase in TAA payments.
我们的结果表明，以前的文献对工资的主要关注忽略了劳动力市场对贸易的调整的重要方面。我们发现，在受影响的当地劳动力市场，对低收入国家进口的敞口增加与失业率上升、劳动力参与率下降、残疾和其他转移福利的使用增加以及工资降低有关。比较 2000 年到 2007 年期间的两个 CZ，一个在受中国进口增长影响的第 25 百分位，另一个在受中国进口增长影响的第 75 百分位，位于第 75 百分位的 CZ 预计将在制造业雇员数量上经历 4.5%的差异下降，就业率对人口比率下降 0.8 个百分点，平均周收入下降 0.8 个百分点，人均失业、残疾和收入援助转移福利增加 2 - 3.5%。这些结果表明，联邦政府资助的转移项目，如社会保障残疾保险(SSDI)，暗中保障了美国工人免受与贸易相关的就业冲击。进口敞口也预示着贸易调整援助(TAA)的受益将大幅增加，但测量不准确。TAA 是联邦政府主要的项目，为因对外贸易而失业的工人提供财政支持。然而，TAA 赠款是临时性的，而大多数接受残疾的工人在退休或死亡之前都能领取 SSDI 津贴(Autor 和 Duggan, 2006 年)。对于受中国进口影响的地区，估计人均 SSDI 支付的美元增量是估计的 TAA 支付的美元增量的 30 倍以上。

To motivate the analysis, we begin in Section 2 by using a standard model of trade to derive product demand shocks facing local labor markets in the U.S. resulting from export growth in China. Section 3 provides a brief discussion of data sources and measurement. Section 4 provides our primary OLS and 2SLS estimates of the impact of trade shocks on regional employment in manufacturing. Section 5 analyzes the consequences of these shocks for regional labor market aggregates. Section 6 expands the inquiry to broader measures of economic adjustment. Section 7 considers alternative measures of trade exposure. In Section 8, we provide a rough estimate of the deadweight losses associated with trade-induced changes in transfer benefits and unemployment. Section 9 concludes.
为了激励分析，我们在第 2 节中首先使用一个标准的贸易模型来推导中国出口增长导致的美国当地劳动力市场面临的产品需求冲击。第 3 节简要讨论了数据来源和测量方法。第 4 节提供了我们关于贸易冲击对区域制造业就业影响的主要 OLS 和 2SLS 估计。第 5 节分析了这些冲击对区域劳动力市场总量的影响。第 6 节将调查扩展到更广泛的经济调整措施。第 7 节考虑贸易暴露的替代措施。在第 8 节中，我们提供了与贸易引起的转移福利和失业变化相关的无谓损失的粗略估计。9 节总结道。

2 Theoretical motivation and empirical approach

In this section, we consider theoretically how growth in U.S. imports from China affects the demand for goods produced by U.S. regional economies. These product demand shocks motivate our empirical measure of exposure to import competition as well as our identification strategy.
在本节中，我们将从理论上考虑美国从中国进口的增长如何影响对美国区域经济体生产的商品的需求。这些产品需求冲击激发了我们对进口竞争暴露的实证测量，以及我们的识别策略。

2.1 Shocks to regional markets

Suppose China experiences productivity growth due to its transition from central planning to a market economy or a reduction in its trade costs as a result of its accession to the WTO. How would such shocks affect the labor market of U.S. region i? In an Online Theory Appendix, we develop a simple model of trade based on monopolistic competition (Helpman and Krugman, 1985) and variation in industry labor productivities across countries. We treat region i as a small open economy and derive how shocks in China affect region i's employment and wages. In applying the monopolistic

competition model, we assume that trade has a “gravity” structure (as in Arkolakis, Costinot, and Rodriguez-Clare, 2012), in which case one can map changes in trade quantities into labor-market outcomes. An alternative approach would be to use a Heckscher-Ohlin or a specific factors model, as in Topalova (2005, 2010) or Kovak (2011), in which the mapping is strictly from trade prices to wages and employment. Given the absence of suitable U.S. industry import price data, the quantity-based approach is logical for our setting.
假设中国经历了生产力增长，因为它从中央计划经济过渡到市场经济，或其贸易成本降低，因为它加入世贸组织。这些冲击将如何影响美国 i 地区的劳动力市场?在在线理论附录中，我们发展了一个基于垄断竞争(Helpman 和 Krugman, 1985)和国家间产业劳动生产率变化的简单贸易模型。我们将区域 i 视为一个小型开放经济体，并推导出中国的冲击如何影响区域 i 的就业和工资。在应用垄断竞争模型时，我们假设贸易具有“重力”结构(如 Arkolakis, Costinot 和 Rodriguez-Clare, 2012)，在这种情况下，人们可以将贸易量的变化映射到劳动力市场的结果中。另一种方法是使用 Heckscher-Ohlin 或特定因素模型，如 Topalova(2005, 2010)或 Kovak(2011)，其中映射严格从贸易价格到工资和就业。由于缺乏合适的美国工业进口价格数据，基于数量的方法对我们的设置是合理的。

We assume that region i produces both traded goods and a homogeneous non-traded good, which could alternatively represent consumption of leisure. Traded goods are produced in sectors that each contain a large number of monopolistically competitive firms that manufacture differentiated product varieties. For simplicity, we ignore migration in or out of region i , though in the empirical analysis we test for regional population shifts in response to trade shocks. The labor-market outcomes of interest for region i are the change in the wage (Wi), the change in employment in traded goods(LT i), and the change in employment in non-traded goods (LNi), where hats over variables denote log changes (^ x d ln x).Productivity growth or falling trade costs in China affect region i through two channels: (i) increased competition in the markets in which region i sells its output, captured by the change in China’s export-supply capability in each industry j (ACj), which we treat as exogenous and which is a function of changes in labor costs, trade costs, and the number of product varieties made in China, and (ii) increased demand for goods in China, captured by the change in expenditure in China on each industry j (ECj), which we also treat as exogenous.
我们假设区域 i 既生产贸易商品，也生产同质非贸易商品，这也可能代表休闲消费。贸易商品的生产部门都包含大量垄断竞争企业，这些企业生产不同的产品品种。为简单起见，我们忽略了进入或离开地区 i 的人口迁移，尽管在实证分析中，我们检验了区域人口迁移对贸易冲击的反应。劳动力市场的结果感兴趣的地区我工资的变化(Wi),就业的变化在贸易商品(LT),和就业的变化在非贸易商品(LNi),帽子/变量表示日志变化(^ x d ln x) .Productivity 增长或下降贸易成本在中国影响区域我通过两个渠道:(我)在市场竞争加剧的地区我出售它的输出,被中国 export-supply 能力在每个行业的变化 j (ACj),我们视为外生,劳动力成本变化的函数,贸易成本,和中国制造,产品品种的数量(ii)中国对商品的需求增加，由中国对每个行业 j (ECj)的支出变化捕获，我们也将其视为外生的。

The impacts of export-supply and import-demand shocks in China on region i’s wages and employment are as follows,
中国的出口供给和进口需求冲击对区域 i 的工资和就业的影响如下:

$$\begin{aligned}
\hat{W}_i &= \sum_j c_{ij}\frac{L_{ij}}{L_{Ni}}\left[\theta_{ijC}\hat{E}_{Cj} - \sum_k \theta_{ijk}\phi_{Cjk}\hat{A}_{Cj}\right], \\
\hat{L}_{Ti} &= \rho_i \sum_j c_{ij}\frac{L_{ij}}{L_{Ti}}\left[\theta_{ijC}\hat{E}_{Cj} - \sum_k \theta_{ijk}\phi_{Cjk}\hat{A}_{Cj}\right], \\
\hat{L}_{Ni} &= \rho_i \sum_j c_{ij}\frac{L_{ij}}{L_{Ni}}\left[-\theta_{ijC}\hat{E}_{Cj} + \sum_k \theta_{ijk}\phi_{Cjk}\hat{A}_{Cj}\right].
\end{aligned} \tag{1}$$

Wage and employment outcomes are the sum of the increase in demand for region i’s exports to China, given by the change in expenditure in China (ECj) times the initial share of output by region i that is shipped to China$(\theta_{ijC} \equiv X_{ijC}/X_{ij})$ and the decrease in demand for region i’s shipments to all markets in which it competes with China. The latter is given by the growth in China’s export-supply capability (ACj) times the initial share of output by region i that is shipped to each market k $(\theta_{ijk} \equiv X_{ijk}/X_{ij})$ and the initial share of imports from China in total purchases by each market k (ΦCjk MkjC=Ekj). These shocks are summed across sectors, weighted by the initial ratio of employment in industry j to total employment in non-traded or traded industries (Lij=LMi; M = N; T) and a general-equilibrium scaling factor (cij > 0). The employment

equations are scaled further by ρi, the share of the current-account deficit in total expenditure in region i.
工资和就业结果的总和地区需求的增加我对中国的出口,由支出的变化在中国(ECj)倍的初始共享产出的区域我运往中国和地区需求的减少我的出口市场中与中国竞争。后者由中国出口供应能力(ACj)的增长乘以地区 i 运往每个市场 k 的产出的初始份额和每个市场 k 从中国进口的总采购的初始份额得出(ΦCjk MkjC=Ekj)。这些冲击是跨部门相加的，按行业 j 的初始就业人数与非贸易或贸易行业的总就业人数的比例加权(Lij=LMi;M = N;(T)和一般均衡比例因子(cij > 0)。就业方程由 i 的 ρi 进一步缩放，i 是地区 i 的经常项目赤字占总开支的份额。

In (1) positive shocks to China's export supply decrease region i's wage and employment in traded goods and increase its employment in non-traded goods. Similarly, positive shocks to China's import demand increase region i's wage and employment in traded goods and decrease its employment in non-traded goods. In the context of balanced trade, reduced labor demand in U.S. regions relatively exposed to import competition from China would be o set by labor demand growth in U.S. regions enjoying expanded export production for China, such that for the aggregate U.S. economy labor demand may be unchanged. However, with imbalanced trade this need not be the case. The import demand shock in China is a function of growth in its expenditure, not income. Because over the time period we examine China's income exceeds its expenditure, productivity growth in China need not result in commensurate increases in import demand and export supply. In (1) the impact of trade shocks on the division of employment between traded and non-traded sectors depends on ρi≠0, or trade imbalance. With balanced trade, reduced traded-sector labor demand from greater import competition is o set by increased traded-sector labor demand from greater export production. Trade shocks may cause wages in region i to change, and labor may shift between different traded-sector industries but will not reallocate employment between the traded and non-traded sectors. Imbalanced trade breaks this symmetry, allowing shocks to affect the size of the traded sector.
在(1)对中国出口供给的正向冲击中，区域 i 贸易商品的工资和就业减少，非贸易商品的就业增加。同样，对中国进口需求的正向冲击增加了区域 i 贸易商品的工资和就业，减少了区域 i 非贸易商品的就业。在贸易平衡的背景下，相对受中国进口竞争影响的美国地区的劳动力需求减少，将由美国对中国出口生产扩大地区的劳动力需求增长所决定，因此美国经济的总劳动力需求可能保持不变。然而，在贸易不平衡的情况下，情况不一定如此。中国的进口需求冲击是支出增长的函数，而不是收入增长的函数。因为在我们考察中国收入超过支出的时期内，中国的生产率增长并不会导致进口需求和出口供应的相应增加。(1)贸易冲击对贸易部门与非贸易部门间就业分工的影响取决于 ρi≠0，即贸易不平衡。在贸易平衡的情况下，进口竞争加剧导致的贸易部门劳动力需求减少是由出口生产增加导致的贸易部门劳动力需求增加造成的。贸易冲击可能导致地区 i 的工资发生变化，劳动力可能在不同的贸易部门之间转移，但不会在贸易部门和非贸易部门之间重新分配就业。贸易不平衡打破了这种对称性，使得冲击能够影响贸易部门的规模。

To use (1) for empirical analysis, we assume that the share of the trade imbalance in total expenditure (ρi) and the general equilibrium scaling factor (cij) are the same across U.S. regions (such that ρicij =α). Further, we begin by focusing on a single channel through which trade with China affects region i: greater import competition in the U.S. market, thus ignoring (temporarily) the effects of greater U.S. exports to China or greater import competition in the foreign markets that U.S. regions serve. We impose these restrictions for our base specifications because U.S. imports from China vastly exceed U.S. exports to China (suggesting the export channel is relatively small) and because the U.S. market accounts for the large majority of demand for most U.S. industries. With these restrictions in place, the change in employment for traded goods in region i becomes with the change in the wage and the change in non-traded employment defined analogously. In(2), traded-sector employment in region i depends on growth in U.S. imports from China mandated by growth in China's export-supply capability (MCjUACj), scaled by region i's labor force (LT i),and weighted by the share of region i in U.S. employment in industry j (Lij=LUj).
为了使用(1)的实证分析，我们假设贸易不平衡占总支出的份额(ρi)和一般均衡比例因子(cij)在美国地区是相同的(这样ρicij =α)。此外，我们首先关注与中国的贸易影响区域 i 的单一渠道:美国市场上的进口竞争加剧，从而(暂时)忽略了美国对中国出口增加或美国区域所服务的外国市场上进口竞争加剧的影响。我们对我们的基本规格施加这些限制，是因为美国从中国的进口远远超过美国对中国的出口(这意味着出口渠道相对较小)，而且美国市场占美国大多数行业的绝大多数需求。有了这些限制，区域 i 的贸易商品就业的变化就变成了工资的变化和非贸易就业的变化的定义类似。在(2)中，地区 i 的贸易部门就业取决于由中国出口供应能力(MCjUACj)推动的美国从中国进口的增长，以地区 i 的劳动力(LT i)为尺度，并以地区 i 在美国工业 j 中的就业份额为权重(Lij=LUj)。

$$\hat{L}_{Ti} = -\alpha \sum_j \frac{L_{ij}}{L_{Ti}} \frac{X_{ijU}}{X_{ij}} \frac{M_{CjU}}{E_{Uj}} \hat{A}_{Cj} \approx -\tilde{\alpha} \sum_j \frac{L_{ij}}{L_{Uj}} \frac{M_{CjU} \hat{A}_{Cj}}{L_{Ti}}, \tag{2}$$

2.2 Empirical approach

Following (2), our main measure of local-labor-market exposure to import competition is the change in Chinese import exposure per worker in a region, where imports are apportioned to the region according to its share of national industry employment:
以下(2)，我们对本地劳动力市场进口竞争敞口的主要衡量指标是一个地区每个工人的中国进口敞口的变化，该地区的进口是根据该地区在全国工业就业中的份额分配的:

$$\Delta IPW_{uit} = \sum_j \frac{L_{ijt}}{L_{ujt}} \frac{\Delta M_{ucjt}}{L_{it}}. \tag{3}$$

In this expression, Lit is the start of period employment (year t) in region i and ΔMucjt is the observed change in U.S. imports from China in industry j between the start and end of the period.
在式中，Lit 是地区 i 期间就业(t 年)的开始，ΔMucjt 是在期间开始和结束之间观察到的 j 行业美国从中国进口的变化。

A concern for our subsequent estimation is that realized U.S. imports from China in (3) may be correlated with industry labor demand shocks. To identify the causal effect of rising Chinese import exposure (stemming from Chinese productivity gains and falling trade barriers) on U.S. manufacturing employment and other local labor market outcomes, we employ an instrumental variables strategy that accounts for the potential endogeneity of U.S. trade exposure. We exploit the exogenous component of Chinese imports that stems from the rising competitiveness of Chinese manufacturers (a supply shock from the U.S. producer perspective) spurred by China's lowering of trade barriers, dismantling of central planning, and accession to the World Trade Organization.
我们随后的估计值得关注的是(3)中已实现的美国从中国进口可能与行业劳动力需求冲击相关。为了确定中国进口敞口的增加(源于中国生产率的提高和贸易壁垒的下降)对美国制造业就业和其他当地劳动力市场结果的因果效应，我们采用了工具变量策略来解释美国贸易敞口的潜在内生性。我们利用了中国进口产品的外生成分，这种外生成分源于中国降低贸易壁垒、取消中央计划以及加入世界贸易组织(World trade Organization)所带来的中国制造商日益增强的竞争力(从美国生产商的角度来看，这是一种供应冲击)。

To identify this supply-driven component of Chinese imports, we instrument for growth in Chinese imports to the U.S. using the contemporaneous composition and growth of Chinese imports in eight other developed countries. Specifically, we instrument the measured import exposure variable ΔIPWuit with a non-U.S. exposure variable ΔIPWoit that is constructed using data on contemporaneous industry-level growth of Chinese exports to other high-income markets:
为了确定中国进口的这一供应驱动的组成部分，我们利用中国在其他八个发达国家进口的同期构成和增长来衡量中国对美国进口的增长。具体来说，我们用非美国的进口风险变量ΔIPWuit 来测量进口风险。使用中国对其他高收入市场同期行业级增长数据构建的风险变量 ΔIPWoit:

$$\Delta IPW_{oit} = \sum_j \frac{L_{ijt-1}}{L_{ujt-1}} \cdot \frac{\Delta M_{ocjt}}{L_{it-1}}. \tag{4}$$

This expression for non-U.S. exposure to Chinese imports differs from the expression in equation (3) in two respects. First, in place of realized U.S. imports by industry (ΔMucjt), it uses realized imports from China to other high-income markets (ΔMocjt). Second, in place of start-of-period employment levels by industry and region, this expression uses employment levels from the prior decade. We use 10-year-lagged employment levels because, to the degree that contemporaneous employment by region is affected by anticipated China trade, the use of lagged employment to apportion predicted Chinese imports to regions will mitigate this simultaneity bias.
这个表达是非美国的。中国进口敞口与式(3)中的表达式有两个不同之处。首先，它使用从中国进口到其他高收入市场

的已实现进口(ΔMocjt)，而不是按行业划分的美国已实现进口(ΔMucjt)。第二，该表达式使用了前十年的就业水平，而不是按行业和地区划分的初期就业水平。我们使用 10 年的滞后就业水平，因为在某种程度上，地区同期就业受到预期中国贸易的影响，使用滞后就业来分配预计的中国进口到地区将缓解这种同时性偏差。

This instrumental variable strategy will identify the Chinese productivity and trade-shock component of U.S. import growth if, plausibly, the common within-industry component of rising Chinese imports to the U.S. and other high-income countries stems from China's rising comparative advantage and (or) falling trade costs in these sectors. Changes in U.S. labor demand may arise in part from internal shocks to product demand or technology. If these shocks are correlated across countries, internal labor demand factors may not be fully purged by the instrument. Correlated product demand shocks are likely to bias our estimates against finding an adverse effect of Chinese import exposure on U.S. manufacturing. This attenuation bias would arise because positive domestic demand shifts for specific goods will typically contribute to both rising Chinese imports and rising U.S. employment in the relevant sectors. The effects of correlated technology shocks are more difficult to gauge. However, our alternative gravity-based estimation approach, described below, implicitly controls for changes in U.S. industry productivity.
如果中国对美国和其他高收入国家的进口不断增加的行业内共同组成部分源于中国不断上升的比较优势和(或)这些行业的贸易成本下降，那么这种工具变量策略将确定中国的生产率和美国进口增长的贸易冲击组成部分。美国劳动力需求的变化可能部分源于产品需求或技术的内部冲击。如果这些冲击在各国之间是相互关联的，那么内部劳动力需求因素可能不会被该工具完全清除。相关产品需求冲击可能会使我们的估计偏离中国进口对美国制造业的不利影响。这种衰减偏差之所以会出现，是因为对特定商品的国内需求的正向转移，通常会促进中国进口的增加和美国相关行业就业的增加。相关技术冲击的影响更难以衡量。然而，下面介绍的另一种基于重力的估算方法，隐含地控制了美国工业生产率的变化。

Equation (3) makes clear that the difference in ΔIPWuit across local labor markets stems entirely from variation in local industry employment structure at the start of period t. This variation arises from two sources: differential concentration of employment in manufacturing versus non-manufacturing activities and specialization in import-intensive industries within local manufacturing. Differences in manufacturing employment shares are not the primary source of variation, however; in a bivariate regression, the start-of-period manufacturing employment share explains less than 25% of the variation in lΔPWuit. In our main specifications, we will control for the start-of-period manufacturing share within CZs so as to focus on variation in exposure to Chinese imports stemming from differences in industry mix within local manufacturing sectors.
由式(3)可知，ΔIPWuit 在当地劳动力市场上的差异完全源于 t 期开始时当地产业就业结构的变化。这种变化有两个来源:制造业与非制造业活动的就业集中度不同，当地制造业的进口密集型产业专业化程度不同。然而，制造业就业份额的差异并不是造成差异的主要原因;在双变量回归分析中，在 lΔPWuit 数据中，制造业就业份额的起始期解释了不到 25%的变化。在我们的主要规范中，我们将控制 cz 内的初期制造份额，以便关注由于当地制造业部门内的行业组合差异而引起的中国进口敞口的变化。

In the Theory Appendix, we describe a second approach to measuring supply-driven growth in U.S. imports from China, MCjUACj. Using bilateral trade data at the industry level, we estimate a modified gravity model of trade for the period 1990 through 2007 that includes fixed effects at the importer and product level. We show that the residuals from this regression approximate the percentage growth in imports from China due to changes in China's productivity and foreign trade costs relative to the United States. Thus, in this alternative approach we estimate changes in China's comparative advantage vis-a-vis the U.S using changes in Chinese versus U.S. exports to third-party countries with which both countries trade. In the empirical estimation in section 7, we obtain qualitatively similar results using either imports per worker from equation (3), with the instrument defined as in equation (4), or using the gravity-based approach.
在理论附录中，我们描述了衡量美国从中国进口的供应驱动增长的第二种方法，MCjUACj。利用行业层面的双边贸易数据，我们估计了 1990 年至 2007 年期间的修正贸易引力模型，其中包括进口国和产品层面的固定效应。我们表明，由于中国生产率和对外贸易成本相对于美国的变化，这种回归的残差近似于从中国进口的增长百分比。因此，在这种替代方法中，我们利用中美两国对第三方国家贸易的中国对美国出口的变化来估计中国相对于美国的比较优势的变化。在第 7 节的实证估计中，我们使用公式(3)中的人均进口，使用公式(4)中定义的工具，或使用基于重力的方法，获得了定性相似的结果。

As additional approaches in section 7, we replace the change in imports per worker as defined in equation (3) with (i) the change in net imports (imports - exports) per worker (following equation (1)), (ii) the change in imports per worker incorporating imports in non-U.S. markets (also following (1)), (iii) the change in the imputed labor content of U.S. net imports from China, an approach motivated by analyses of the labor-market consequences of trade based on the Heckscher-Ohlin model (Deardor and Staiger, 1988; Borjas, Freeman, and Katz, 1997; Burstein and Vogel, 2011), and (iv) the change in imports per worker net of imported intermediate inputs, the latter of which may have productivity enhancing effects on U.S. industries (Goldberg, Khandelwal, Pavcnik, and Topalova, 2010). These strategies again yield results that are comparable to our benchmark estimates.
作为第 7 节的附加方法，我们用(i)每个工人净进口(进口-出口)的变化(以下的方程(1))代替了(3)方程中定义的每个工人进口的变化，(ii)每个工人进口的变化包括非美国进口。(3)美国从中国净进口的归因劳动力含量的变化，这是一种基于 Heckscher-Ohlin 模型分析贸易的劳动力市场后果的方法(Deardor 和 Staiger, 1988;Borjas, Freeman 和 Katz, 1997 年;Burstein 和 Vogel, 2011)，以及(iv)进口中间投入的每工人净进口的变化，后者可能会对美国工业产生生产率提升效应(Goldberg, Khandelwal, Pavcnik，和 Topalova, 2010)。这些策略的结果与我们的基准估计相当。

3 Data sources and measurement

This section provides summary information on our data construction and measurement, with further details given in the online Data Appendix.
本节提供了关于我们的数据构建和测量的概要信息，更多的细节在在线数据附录中给出。

We use data from the UN Comrade Database on U.S. imports at the six-digit HS product level. Due to lags in countries adopting the HS classification, 1991 is the first year for which we can obtain data across many high-income economies. The first column in Panel A of Table 1 shows the value of annual U.S. imports from China for the years 1991, 2000, and 2007 (with all values in 2007 USD). During the sixteen year period from 1991 to 2007, this import value increased by a factor of 11.5, from 26 billion dollars to 330 billion dollars. For comparison, the second column of Panel A provides the value of annual U.S. exports to China in 1992, 2000, and 2007. The volume of U.S. exports was substantially smaller than the volume of imports throughout these years, and the growth of imports outpaced the growth of exports. The primary change in U.S.-China trade during our sample period is thus the dramatic increase of U.S. imports.
我们使用来自联合国同志数据库的六位数 HS 产品水平的美国进口数据。由于采用 HS 分类的国家滞后，1991 年是我们可以获得许多高收入经济体数据的第一年。表 1 中 Panel A 的第一列显示了 1991 年、2000 年和 2007 年美国每年从中国进口的价值(所有价值以 2007 年的美元为单位)。从 1991 年到 2007 年的 16 年间，这一进口额增长了 115 倍，从 260 亿美元增长到 3300 亿美元。为了比较，Panel A 的第二列提供了 1992 年、2000 年和 2007 年美国对中国的年度出口价值。这些年来，美国的出口额大大低于进口额，而且进口的增长超过了出口的增长。因此，在我们的样本期间，美中贸易的主要变化是美国进口的急剧增加。

Table 1. Value of Trade with China for the U.S. and Other Selected High-Income Countries and Value of Imports from all other Source Countries, 1991/1992-2007.

	I. Trade with China (in BN 2007 US$)		II. Imports from Other Countries (in BN 2007 US$)		
	Imports from China (1)	Exports to China (2)	Imports from Other Low-Inc. (3)	Imports from Mexico/Cafta (4)	Imports from Rest of World (5)
			A. United States		
1991/92	26.3	10.3	7.7	38.5	905.8
2000	121.6	23.0	22.8	151.6	1865.5
2007	330.0	57.4	45.4	183.0	2365.9
Growth 1991-07	1156%	456%	491%	375%	161%
			B. 8 Other Developed Countries		
1991/92	28.2	26.6	9.2	2.8	1708.8
2000	94.3	68.2	13.7	5.3	1979.8
2007	262.8	196.9	31.0	11.6	3339.3
Growth 1991-07	832%	639%	236%	316%	95%

Notes: Trade data is reported for the years 1991, 2000, and 2007, except for exports to China which are first available in 1992. The set of "Other Developed Countries" in Panel B comprises Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. Column 3 covers imports from all countries that have been classified as low-income by the World Bank in 1989, except for China. Column 4 covers imports from Mexico and the Central American and Carribean countries covered by the CAFTA-DR free trade agreement. Column 5 covers imports from all other countries (primarily from developed countries).

The third and fourth columns of Panel A summarize the value of imports from Mexico and Central America, and from a set of 51 low income countries that are mostly located in Africa and Asia. While imports from these countries grew considerably over time, the expansion was much less dramatic than in the case of Chinese imports. Panel B summarizes trade flows from the same exporters to a group of eight high-income countries located in Europe, Asia, and the Pacific (Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland). Like the U.S., these countries experienced a dramatic increase in imports from China between 1991 and 2007, and a more modest growth of imports from Mexico and Central America, and from other low-income countries. We focus on these high-income countries as they are the rich nations for which disaggregated HS trade data are available back to 1991.
Panel A 的第三和第四列总结了从墨西哥和中美洲以及一组 51 个低收入国家的进口价值，这些国家大多位于非洲和亚洲。尽管从这些国家的进口随着时间的推移大幅增长，但增幅远低于从中国进口的增幅。面板 B 总结了同一出口商对位于欧洲、亚洲和太平洋地区的八个高收入国家(澳大利亚、丹麦、芬兰、德国、日本、新西兰、西班牙和瑞士)的贸易流量。与美国一样，这些国家在 1991 年至 2007 年间从中国的进口大幅增加，而从墨西哥、中美洲以及其他低收入国家的进口增长则较为温和。我们将重点放在这些高收入国家，因为它们是可以追溯到 1991 年的分类 HS 贸易数据的富裕国家。

To assess the effect of imports of Chinese goods on local labor markets, we need to define regional economies in the U.S. Our concept for local labor markets is Commuting Zones (CZs) developed by Tolbert and Sizer (1996), who used county-level commuting data from the 1990 Census data to create 741 clusters of counties that are characterized by strong commuting ties within CZs, and weak commuting ties across CZs. Our analysis includes the 722 CZs that cover the entire mainland United States (both metropolitan and rural areas).
为了评估中国商品进口对当地劳动力市场的影响，我们需要定义美国的区域经济。我们对当地劳动力市场的概念是 Tolbert 和 Sizer(1996)提出的通勤区(CZs)。他们使用了 1990 年人口普查数据中的县级通勤数据，创建了 741 个县群，这些县群的特征是在长城区内的通勤关系强，而在长城区之间的通勤关系弱。我们的分析包括了覆盖整个美国大陆(包括大都市和农村地区)的 722 个 CZs。

It is plausible that the e ects of Chinese imports will vary across local labor markets in the U.S. because there is substantial geographic variation in industry specialization. Local economies that are specialized in industries whose outputs compete with Chinese imports should react more strongly to the growth of these imports. Our measure for the exposure of local labor markets to Chinese imports in equation (3) combines trade data with data on local industry employment. Information on industry employment structure by CZs, including employment in 397 manufacturing industries, is derived from the County Business Patterns data (see the Online Data Appendix).
为了评估中国商品进口对当地劳动力市场的影响，我们需要定义美国的区域经济。我们对当地劳动力市场的概念是 Tolbert 和 Sizer(1996)提出的通勤区(CZs)。从中国进口的产品在美国当地劳动力市场的影响可能会有所不同，因为在行业专业化方面存在巨大的地理差异。那些专门从事与中国进口产品竞争的行业的地方经济体，应该对这些进口产品的增长做出更强烈的反应。在公式(3)中，我们对当地劳动力市场受中国进口影响的程度的衡量，结合了贸易数据和当地工业就业数据。国家统计局关于产业就业结构的信息，包括 397 个制造业的就业，来自县商业模式数据(见在线数据附录)。根据 1990 年人口普查的数据，建立了 741 个县群，这些县群的特征是在长城区内部的通勤关系较强，而在长城区之间的通勤关系较弱。我们的分析包括了覆盖整个美国大陆(包括大都市和农村地区)的 722 个 CZs。

Panel A of Appendix Table 1 shows descriptive statistics for ΔIPW_{ujt} by time period. In the median commuting zone, the 10-year equivalent growth of Chinese imports amounted to $890 dollars per worker during 1990 through 2000, and to $2,110 dollars per worker during 2000 through 2007, reflecting an acceleration of import growth over time. Appendix Table 1 also documents the considerable geographic variation in the exposure of local labor markets to Chinese import shocks. In both time periods, CZs at the 75th percentile of import exposure experienced an increase in import exposure per worker that was roughly twice as large as that faced by CZs at the 25^{th} percentile. Panel B of the table summarizes changes in import exposure per worker among the 40 most populous CZs in the United States. These rankings provide evidence for considerable variation of trade exposure within U.S. regions. For instance, the state of California contained three CZs in the top quartile of exposure in the 1990s (San Jose, San Diego, and Los Angeles) but also two CZs in the bottom quartile (Sacramento and Fresno). Relative trade exposure is generally persistent across the two time periods, with San Jose and Providence being the most exposed and Washington DC, New Orleans, and Orlando being the least

exposed large CZs in both periods.

附录表 1 的面板 A 显示了 ΔIPWujt 按时间段的描述性统计。在平均通勤地区，1990 年至 2000 年，中国人均进口额增长了 890 美元，2000 年至 2007 年，人均进口额增长了 2110 美元，反映了进口增长的加速。附录表 1 也记录了当地劳动力市场受中国进口冲击影响的相当大的地理差异。在这两个时间段内，处于进口接触第 75 百分位的捷克斯洛伐克工人的进口接触增加，大约是处于第 25 百分位的捷克斯洛伐克工人的两倍。表 B 部分总结了美国人口最多的 40 个 CZs 中每个工人的进口接触变化。这些排名为美国各地区贸易敞口的相当大的差异提供了证据。例如，在上世纪 90 年代，加州有三个 CZs 位于前四分位数(圣何塞、圣地亚哥和洛杉矶)，但也有两个 CZs 位于后四分位数(萨克拉门托和弗雷斯诺)。在这两个时期内，相对贸易敞口通常持续存在，其中圣何塞和普罗维登斯受到的敞口最大，而华盛顿特区、新奥尔良和奥兰多受到的敞口最小。

Appendix Table 1. Descriptive Statistics for Growth of Imports Exposure per Worker across C'Zones

	I. 1990-2000		II. 2000-2007	
	A. Percentiles			
	90th percentile	2.05	90th percentile	4.30
	75th percentile	1.32	75th percentile	3.11
	50th percentile	0.89	50th percentile	2.11
	25th percentile	0.62	25th percentile	1.60
	10th percentile	0.38	10th percentile	1.03
Rank	B. Largest and Smallest Values among the 40 Largest C'Zones			
1	San Jose, CA	3.15	San Jose, CA	7.32
2	Providence, RI	2.59	Providence, RI	4.99
3	Buffalo, NY	2.24	Los Angeles, CA	3.59
4	Boston, MA	1.55	San Diego, CA	3.08
5	Portland, OR	1.53	Portland, OR	2.96
6	San Diego, CA	1.52	Pittsburgh, PA	2.95
7	Newark, NJ	1.32	Chicago, IL	2.93
8	Los Angeles, CA	1.28	Milwaukee, WI	2.93
9	Bridgeport, CT	1.27	Boston, MA	2.79
10	Denver, CO	1.23	Dallas, TX	2.77
20	Forth Worth, TX	0.83	Columbus, OH	1.90
21	Phoenix, AZ	0.83	Phoenix, AZ	1.90
31	Atlanta, GA	0.61	Fresno, CA	1.56
32	Pittsburgh, PA	0.56	St. Louis, MO	1.53
33	Sacramento, CA	0.53	Tampa, FL	1.49
34	Kansas City, MO	0.51	Atlanta, GA	1.31
35	West Palm Beach, FL	0.48	Baltimore, MD	1.25
36	Fresno, CA	0.47	West Palm Beach, FL	1.22
37	Orlando, FL	0.46	Kansas City, MO	1.13
38	Houston, TX	0.45	Washington, DC	0.86
39	Washington, DC	0.21	New Orleans, LA	0.70
40	New Orleans, LA	0.19	Orlando, FL	0.59

Notes: The table reports 10-year equivalent values of (Δ Imports from China to US)/Worker in kUS$. The statistics in panel A are based on 722 commuting zones and weighted by start-of-period population size. The ranking in panel B is based on the 40 commuting zones with largest population in 1990, and indicates the largest city of each ranked commuting zone.

Most of the empirical analysis studies changes in CZs' population, employment and wage structure by education, age, and gender. These variables are constructed from the Census Integrated Public Use Micro Samples (Ruggles, et al. 2004) for the years 1970, 1980, 1990 and 2000, and the American Community Survey (ACS) for 2006 through 2008.21 We map these data to CZs using the matching strategy detailed in Dorn (2009). This approach has previously been applied by Autor and Dorn (2009, 2011) and Smith (2010). We also use data on federal and state transfer payments to CZ residents. These data were obtained from the Bureau of Economic Analysis and the Social Security Administration (see the online Data Appendix for details). Appendix Table 2 provides means and standard deviations for the main variables.

实证分析主要从受教育程度、年龄和性别三个方面研究长江市人口、就业和工资结构的变化。这些变量是由 1970 年、1980 年、1990 年和 2000 年的人口普查综合公共使用微观样本(Ruggles, et al. 2004)和 2006 年至 2008 年的美国社区调查(ACS)构建的。我们使用 Dorn(2009)详细介绍的匹配策略将这些数据映射到 CZs。Autor 和 Dorn(2009, 2011)和 Smith(2010)曾应用过这种方法。我们也使用联邦和州对 CZ 居民的转移支付的数据。这些数据来自经济分析局和社会保障局(详情见在线数据附录)。附录表 2 给出了主要变量的均值和标准差。

Appendix Table 2. Means and Standard Deviations of Commuting Zone Variables.

	I. Levels			II. 10-Year Equivalent Chg	
	1990/1991	2000	2007	1990-2000	2000-2007
	(1)	(2)	(3)	(4)	(5)
(Imports from China to US)/(Workers in 1990) (in kUS$)	0.29 (0.32)	1.32 (1.18)	3.58 (2.84)	1.14 (0.99)	n/a
(Imports from China to US)/(Workers in 2000) (in kUS$)	0.25 (0.27)	1.08 (0.90)	2.92 (2.13)	n/a	2.63 (2.01)
Percentage of working age pop employed in manufacturing	12.69 (4.80)	10.51 (4.45)	8.51 (3.60)	-2.07 (1.63)	-2.73 (1.80)
Percentage of working age pop employed in non-manufacturing	57.75 (5.91)	59.16 (5.24)	61.87 (4.95)	1.29 (2.38)	3.70 (2.71)
Percentage of working age pop unemployed	4.80 (0.99)	4.28 (0.93)	4.87 (0.90)	-0.51 (0.73)	0.85 (1.39)
Percentage of working age pop not in the labor force	24.76 (4.34)	26.05 (4.39)	24.75 (3.70)	1.29 (2.56)	-1.82 (2.57)
Percentage of working age pop receiving disability benefits	1.86 (0.63)	2.75 (1.04)	3.57 (1.41)	0.91 (6.38)	1.23 (0.71)
Average log weekly wage, manufacturing sector (in log pts)	655 (17)	666 (17)	671 (19)	11.4 (6.4)	7.8 (7.7)
Average log weekly wage, non-manufacturing sectors (in log pts)	637 (16)	650 (15)	653 (16)	12.5 (4.1)	3.5 (4.3)

Appendix Table 2. Means and Standard Deviations of Commuting Zone Variables.

	I. Levels			II. 10-Year Equivalent Chg	
	1990/1991	2000	2007	1990-2000	2000-2007
	(1)	(2)	(3)	(4)	(5)
Average individual transfers per capita (in US$)	3338 (692)	4297 (908)	5544 (1091)	1004.4 (334.0)	1844.0 (437.6)
Average retirement benefits per capita (in US$)	1121 (284)	1262 (310)	1398 (338)	150.5 (79.3)	206.2 (120.4)
Average disability benefits per capita (in US$)	136 (46)	213 (77)	300 (112)	78.2 (39.8)	128.3 (61.5)
Average medical benefits per capita (in US$)	1115 (371)	1789 (552)	2564 (679)	698.3 (231.9)	1142.8 (288.5)
Average federal income assistance per capita (in US$)	298 (136)	270 (134)	303 (129)	-24.8 (43.6)	52.2 (46.0)
Average unemployment benefits per capita (in US$)	106 (52)	86 (43)	108 (55)	-19.1 (29.4)	34.1 (41.0)
Average TAA benefits per capita (in US$)	0.6 (0.6)	1.1 (1.0)	2.2 (2.7)	0.5 (0.9)	1.6 (3.3)
Avg household income per working age adult (in US$)	32122 (6544)	38126 (7743)	37909 (7501)	5964 (2358)	-367 (2646)
Avg household wage and salary income per w. age adult (in US$)	23496 (4700)	27655 (5449)	28872 (6304)	4152 (1569)	1703 (2623)

Notes: N=722 commuting zones. Statistics in columns (1) and (3) are weighted by 1990 population, statistics in columns (2) and (4) are weighted by 2000 population, and statistics in column (5) are weighted by 2007 population. The first two rows of column (3) report import volumes for the year 1991, all other variables in column (3) are based on 1990 data. Information on employment composition, wages, and income in column (5) is derived from pooled 2006-2008 ACS data.

4 The impact of trade shocks on manufacturing employment

Our instrumental variable strategy, outlined in section 2.2, identifies the component of U.S. import growth that is due to Chinese productivity and trade costs. The identifying assumption underlying this strategy is that the common within-industry component of rising Chinese imports to the U.S. and other high-income countries is China's rising comparative

advantage and falling trade costs.
我们的工具变量战略，在第 2.2 节概述，确定了美国进口增长的组成部分，这是由于中国的生产率和贸易成本。这一战略背后的明确假设是，中国对美国和其他高收入国家进口增加的行业内共同组成部分是中国不断上升的比较优势和不断下降的贸易成本。

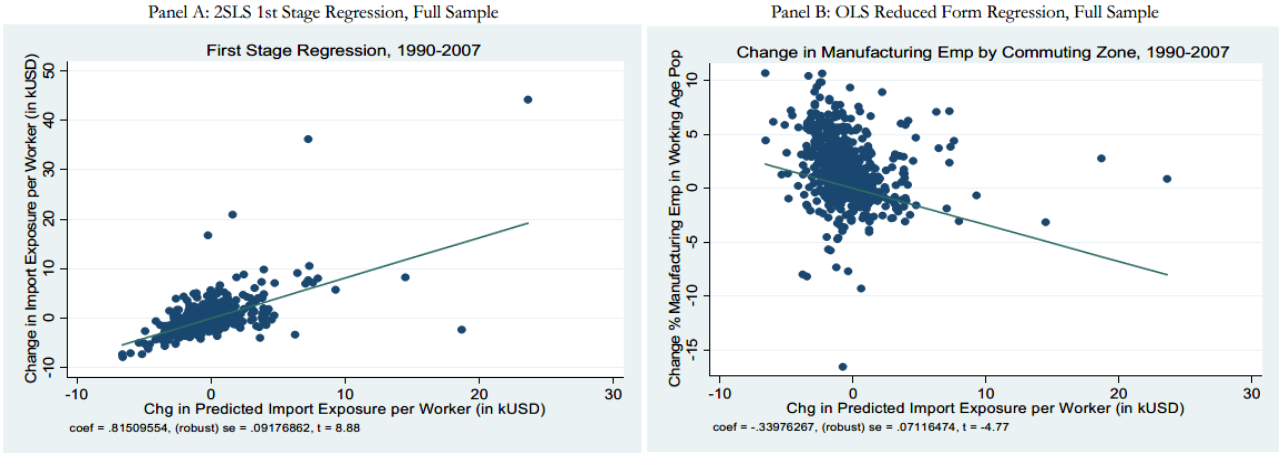

Figure 2.Change in Import Exposure per Worker and Decline of Manufacturing Employment: Added Variable Plots 2SLS and Reduced Form Estimates

Figure 2 sketches the estimation strategy. Panel A reveals the substantial predictive power of the high-income country instrument for changes in U.S. import exposure. A $1,000 predicted increase in import exposure per CZ worker corresponds to a $815 increase in measured exposure per CZ worker. Panel B of Figure 2 plots a reduced form (OLS) regression of the change in manufacturing employment on the instrument. This figure shows a substantial reduction in manufacturing employment in the CZs facing large increases in Chinese import exposure. We explore the robustness and interpretation of this result in subsequent tables.
图 2 概述了评估策略。面板 A 揭示了高收入国家工具对美国进口敞口变化的实质性预测能力。每名 CZ 工人的进口接触预计增加 1,000 美元，对应于每名 CZ 工人的测量接触增加 815 美元。图 2 的面板 B 绘制了工具上制造业就业变化的简化形式(OLS)回归图。这一数字表明，在面临中国进口敞口大幅增加的中港地区，制造业就业人数大幅减少。我们将在后面的表格中探讨这一结果的稳健性和解释。

4.1 2SLS estimates

Table 2 presents initial estimates of the relationship between Chinese import exposure and U.S. manufacturing employment. Using the full sample of 722 CZs and weighting each observation by start of period CZ population, we fit models of the following form:
表 2 给出了中国进口敞口与美国制造业就业之间关系的初步估计。使用 722 个 CZ 的完整样本，并以周期 CZ 总体的开始来加权每个观测值，我们拟合如下形式的模型:

$$\Delta L_{it}^{m} = \gamma_t + \beta_1 \Delta IPW_{uit} + X_{it}'\beta_2 + e_{ct}, \qquad (5)$$

where ΔImit is the decadal change in the manufacturing employment share of the working age population in commuting zone i. When estimating this model for the long interval between 1990 and 2007, we stack the 10-year equivalent first differences for the two periods, 1990 to 2000 and 2000 to 2007, and include separate time dummies for each decade (in the vector γt). The change in import exposure ΔIPWuit is instrumented by the variable ΔIPWoit as described above. Because the model is estimated in first differences, the decade-specific models are equivalent to fixed effects regressions, while the stacked first difference models are similar to a three-period fixed effects model with slightly less restrictive assumptions made on the error term. Additionally, the vector Xit contains (in most specifications) a rich set of controls for CZs' start-of-decade labor force and demographic composition that might independently affect manufacturing employment. Standard errors are clustered at the state level to account for spatial correlations across CZs.
其中ΔImit 是工作年龄人口在通勤区制造业就业份额的年代际变化。在估算 1990 年至 2007 年的长期区间时，我们将

1990 年至 2000 年和 2000 年至 2007 年这两个时期的 10 年等效第一差进行叠加，并包括每十年的独立时间假人(在向量 γt 中)。如上所述，导入敞口 ΔIPWuit 的变化由变量 ΔIPWoit 表示。由于模型是在一阶差分中估计的，十年特定的模型相当于固定效应回归，而堆叠的一阶差分模型类似于三期固定效应模型，对误差项的限制稍少。此外，向量出口(在大多数规范中)包含了一套丰富的控制 cz 十年之初的劳动力和人口构成的控制，这些控制可能独立地影响制造业就业。标准误差聚集在州一级，以解释跨 cz 的空间相关性。

Table 2. Imports from China and Change of Manufacturing Employment in Commuting Zones, 1970-2007: 2SLS Estimates.
Dependent Variable: 10 x Annual Change in Manufacturing Emp/Working Age Pop (in %pts)

	I. 1990-2007			II. 1970-1990 (Pre-Exposure)		
	1990-2000	2000-2007	1990-2007	1970-1980	1980-1990	1970-1990
	(1)	(2)	(3)	(4)	(5)	(6)
(Δ Current Period Imports from China to US)/Worker	-0.89 **	-0.72 **	-0.75 **			
	(0.18)	(0.06)	(0.07)			
(Δ Future Period Imports from China to US)/Worker				0.43 **	-0.13	0.15
				(0.15)	(0.13)	(0.09)

Notes: N=722, except N=1444 in stacked first difference models of columns 3 and 6. The variable 'future period imports' is defined as the average of the growth of a CZ's import exposure during the periods 1990-2000 and 2000-2007. All regressions include a constant and the models in columns 3 and 6 include a time dummy. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

The first two columns of Table 2 estimate equation (5) separately for the 1990-2000 and 2000-2007 periods, and the third column provides stacked first differences estimates. The coefficient of .0:75 in column 3 indicates that a one-thousand dollar exogenous decadal rise in a CZ's import exposure per worker is predicted to reduce its manufacturing employment per working age population by three-quarters of a percentage point. That the estimated coefficient is of a similar in magnitude in both time periods and all three models underscores the stability of the statistical relationships.
表 2 的前两列分别是 1990-2000 年和 2000-2007 年期间的估计方程(5)，第三列是堆叠的第一次差值估计。第三列中。0:75 的系数表明，一个 CZ 的每个工人的进口敞口的 1000 美元的外生十年增长，预计将减少其每个工作年龄人口的制造业就业 0.75 个百分点。估计的系数在两个时间段和所有三种模型的大小上都相似，这强调了统计关系的稳定性。

Over the time period that we examine, U.S. manufacturing experienced a secular decline. A concern for our analysis is that increased imports from China could be a symptom of this decline rather than a cause. To verify that our results capture the period-specific effects of exposure to China trade, and not some long-run common causal factor behind both the fall in manufacturing employment and the rise in Chinese imports, we conduct a falsification exercise by regressing past changes in the manufacturing employment share on future changes in import exposure. Column 4 shows the correlation between changes in manufacturing employment in the 1970s and the change in future import exposure averaged over the 1990s and 2000s while column 5 shows the corresponding correlation for the 1980s and column 6 provides the results of the stacked first differences model. These correlations provide little evidence suggesting reverse causality. There is a weak negative relationship between the change in manufacturing employment and future import exposure in the 1980s; in the prior decade, this relationship is positive. While this exercise does not rule out the possibility that other factors contribute to the contemporaneous CZ-level relationship between rising China trade exposure and declining manufacturing employment, the Table 2 estimates demonstrate that this relationship was absent in the decades immediately prior to China's rise.
在我们研究的这段时间里，美国制造业经历了长期的衰退。我们分析的一个担忧是，从中国进口的增加可能是这种下降的症状，而不是原因。为了验证我们的结果捕捉的是受中国贸易影响的特定时期的影响，而不是制造业就业下降和中国进口上升背后的长期共同因果因素，我们通过回归制造业就业份额的过去变化和未来进口敞口的变化进行了伪造练习。第 4 列显示了 20 世纪 70 年代制造业就业的变化与 90 年代和 2000 年代平均未来进口敞口的变化之间的相关性，第 5 列显示了 80 年代的相应相关性，第 6 列提供了堆叠第一差异模型的结果。这些相关性几乎没有证据表明反向因果关系。20 世纪 80 年代制造业就业变化与未来进口敞口之间存在弱负相关关系;在过去的十年里，这种关系是积极的。虽然这项工作不排除其他因素导致中国贸易敞口上升和制造业就业下降之间同时存在 czr 水平关系的可能性，但表 2 的估计表明，在中国崛起之前的几十年里，这种关系是不存在的。

In Table 3, we augment the first difference model for the period 1990-2007 with a set of demo-graphic and labor force

measures which test robustness and potentially eliminate confounds. In the second column, we add a control for the share of manufacturing in a CZ's start-of-period employment. This specification further addresses the concern that the China exposure variable may in part be picking up an overall trend decline in U.S. manufacturing rather than the component that is due to differences across manufacturing industries in their exposure to rising Chinese competition. The column 2 estimate implies that a CZ with a one percentage point higher initial manufacturing share experiences a differential manufacturing employment share decline of 0.04 percentage points over the subsequent decade. This specification finds a slightly smaller effect of import exposure on manufacturing employment than does the corresponding estimate in column 1, but the relationship remains economically large and statistically significant. Noting that the interquartile range in CZ-level import exposure growth in the time interval 2000 through 2007 was approximately one-thousand dollars per worker, the column 2 point estimate implies that the share of manufacturing employees in the working age population of a CZ at the 75th percentile of import exposure declined by -0.65 percentage points more than in a CZ at the 25th percentile between 2000 and 2007.

在表 3 中，我们对 1990-2007 年期间的第一个差分模型进行了扩充，使用了一组测试稳健性和潜在消除混杂因素的人口统计学和劳动力措施。在第二列中，我们为 CZ 的初期就业中制造业的份额添加了一个控制项。这一规范进一步解决了人们的担忧，即中国风险敞口变量可能在一定程度上加速了美国制造业的总体趋势下降，而不是由于不同制造业在面对中国日益激烈的竞争时的风险敞口存在差异。第 2 列估计表明，一个 CZ 的初始制造业份额高一个百分点，在随后的十年中，制造业就业份额的差异下降了 0.04 个百分点。该规范发现，进口敞口对制造业就业的影响略小于列 1 中相应的估计，但这种关系在经济上仍然很大，在统计上也很显著。注意到在 2000 年至 2007 年期间，cz 水平的进口敞口增长的四分位数范围约为每名工人 1000 美元，列 2 点估计表明，在进口敞口的第 75 百分位的 CZ，制造业雇员在工作年龄人口中的比例在 2000 年至 2007 年间比在第 25 百分位的 CZ 下降了-0.65 个百分点。

Table 3. Imports from China and Change of Manufacturing Employment in Commuting Zones, 1990-2007: 2SLS Estimates.
Dependent Var: 10 x Annual Change in Manufacturing Emp/Working Age Pop (in %pts)

	I. 1990-2007 Stacked First Differences					
	(1)	(2)	(3)	(4)	(5)	(6)
(Δ Imports from China to US)/Worker	-0.746 **	-0.610 **	-0.538 **	-0.508 **	-0.562 **	-0.596 **
	(0.068)	(0.094)	(0.091)	(0.081)	(0.096)	(0.099)
Percentage of employment in manufacturing$_{-1}$		-0.035	-0.052 **	-0.061 **	-0.056 **	-0.040 **
		(0.022)	(0.020)	(0.017)	(0.016)	(0.013)
Percentage of college-educated population$_{-1}$				-0.008		0.013
				(0.016)		(0.012)
Percentage of foreign-born population$_{-1}$				-0.007		0.030 **
				(0.008)		(0.011)
Percentage of employment among women$_{-1}$				-0.054 *		-0.006
				(0.025)		(0.024)
Percentage of employment in routine occupations$_{-1}$					-0.230 **	-0.245 **
					(0.063)	(0.064)
Average offshorability index of occupations$_{-1}$					0.244	-0.059
					(0.252)	(0.237)
Census division dummies	No	No	Yes	Yes	Yes	Yes
	II. 2SLS First Stage Estimates					
(Δ Imports from China to OTH)/Worker	0.792 **	0.664 **	0.652 **	0.635 **	0.638 **	0.631 **
	(0.079)	(0.086)	(0.090)	(0.090)	(0.087)	(0.087)
R^2	0.54	0.57	0.58	0.58	0.58	0.58

Column 3 augments the regression model with geographic dummies for the nine Census divisions, which absorb region-specific trends in the manufacturing employment share. These dummies modestly decrease the estimated effect of import exposure on manufacturing employment. Column 4 additionally controls for the start-of-period share of a CZ's population that has a college education, the share of population that is foreign born, and the share of working age women that are employed. These controls leave the main result unaffected.

第 3 列用 9 个人口普查部门的地理模型扩充了回归模型，这些模型吸收了制造业就业份额的地区特定趋势。这些模型适度降低了进口敞口对制造业就业的估计影响。第 4 列还控制了 CZ 人口中接受过大学教育的初期人口比例、外国出生

人口比例以及就业的工作年龄妇女比例。这些控制使主要结果不受影响。

Column 5 introduces two variables that capture the susceptibility of a CZ's occupations to substitution by technology or task offshoring. Both variables are based on occupational task data, which are described in detail in Autor and Dorn (2011). Routine-intensive occupations are a set of jobs whose primary activities follow a set of precisely prescribed rules and procedures that make them readily codifiable. This category includes white collar positions whose primary job tasks involve routine information processing (e.g., accountants and secretaries) and blue collar production occupations that primarily involve repetitive motion and monitoring tasks. If CZs that have a large start-of-period employment share in routine occupations experience strong displacement of manufacturing jobs due to automation, one would expect a negative relationship between the routine share variable and the change in manufacturing share. Indeed, the estimates in column 5 suggest that the population share in manufacturing falls by about 0.23 percentage points for each additional percentage point of initial employment in routine occupations.
第 5 列介绍了两个变量，它们捕获了 CZ 的职业对技术或外包任务替代的敏感性。这两个变量都是基于职业任务数据，在 Autor 和 Dorn(2011)中有详细的描述。常规密集型职业是指其主要活动遵循一套精确规定的规则和程序的一组工作，这些规则和程序很容易被编纂成法典。这一类包括主要工作任务涉及日常信息处理的白领职位(例如，会计和秘书)和主要涉及重复性动作和监控任务的蓝领生产职业。如果在常规职业中具有较大的初期就业份额的 cz 经历了自动化导致的制造业工作的强烈取代，那么可以预期在常规份额变量和制造业份额变化之间存在负相关关系。事实上，第 5 栏的估计数字表明，在常规职业中，初次就业每增加一个百分点，制造业中人口所占比例就下降约 0.23 个百分点。

The offshorability index used in column 5 measures the average degree to which the occupations in a commuting zone require neither proximity to a specific work-site nor face-to-face contact with U.S. based workers. If o shoring of occupations were a major driver for the decline in manufacturing within CZs, one would expect a negative relationship between the offshorability index and the change of the manufacturing employment share. The estimate in column 5 does not however find a negative or statistically significant coefficient for occupational offshorability. The fully augmented model in column 6 indicates a sizable, robust negative impact of increasing import exposure on manufacturing employment. The decline in manufacturing is also larger in CZs with a greater initial manufacturing employment share and in local labor markets where employment is concentrated in routine-task intensive occupations. It is smaller where there is a larger initial foreign born population.
第 5 栏中使用的离岸能力指数衡量了通勤区域内的职业既不需要接近特定工作地点，也不需要与美国员工面对面接触的平均程度。如果职业的支持是 CZs 内制造业下降的主要驱动因素，人们可以预期离岸性指数和制造业就业份额的变化之间存在负相关关系。但是，第 5 栏的估计没有发现职业离岸性的负的或统计上显著的系数。第 6 栏中完全扩充的模型表明，进口敞口的增加对制造业就业产生了相当大的负面影响。在具有更大的初始制造业就业份额和就业集中在常规任务密集型职业的当地劳动力市场，制造业的下降也更大。在最初外国出生的人口较多的地方，移民人数较少。

A concern for our 2SLS estimates is that in some sectors, import demand shocks may be correlated across countries. This would run counter to our instrumental variables strategy, which seeks to isolate supply shocks affecting U.S. producers, and would likely bias our results towards zero. To address this concern, in untabulated results we have experimented with dropping industries that one may consider suspect. During the 2000s, many rich countries experienced housing booms, associated with easy credit, which may have contributed to similar increases in the demand for construction materials. Using the specification in column 6 of Table 3 while dropping the steel, flat glass, and cement industries—inputs in relatively high demand by construction industries—has minimal effect on the coefficient estimate for import exposure, reducing it from -0.60 to -0.57. Computers are another sector in which demand shocks may be correlated, owing to common innovations in the use of information technology. Dropping computers raises the coefficient estimate on import exposure to -0.68. Finally, one may worry that the results are being driven by a handful of consumer goods industries in which China has assumed a commanding role. Dropping apparel, footwear, and textiles, for which China is by far and away the world's dominate exporter, reduces the import exposure coefficient modestly to -0.51. In all cases, coefficient estimates remain highly significant.
我们 2SLS 估计的一个担忧是，在某些行业，进口需求冲击可能在各国之间相互关联。这将与我们的工具变量策略背道而驰，该策略旨在隔离影响美国生产商的供应冲击，并可能使我们的结果偏向于零。为了解决这一问题，在未列表的结果中，我们尝试了一些人们可能认为可疑的行业。在 21 世纪头十年，许多富裕国家经历了房地产繁荣，伴随着宽松的

信贷，这可能导致了对建筑材料需求的类似增长。使用表 3 第 6 列中的规范，同时降低钢铁、平板玻璃和水泥行业(建筑业需求相对较高的投入)对进口敞口系数估计的影响最小，将其从-0.60 降低到-0.57。由于在使用信息技术方面的共同创新，计算机是另一个需求冲击可能相互关联的部门。下降的电脑将进口敞口的估计系数提高到-0.68。最后，人们可能会担心，这些结果是由中国占据主导地位的少数几个消费品行业推动的。服装、鞋类和纺织品(中国是世界上遥遥领先的主要出口国)的下降，将进口敞口系数略微降低到-0.51。在所有情况下，系数估计仍然非常重要。

How do OLS and 2SLS estimates compare for our preferred specification in column 6 of Table 3? The OLS estimate for this specification, as seen in column 1 of panel A in Appendix Table 3, is -0.171. OLS is subject to both measurement error in CZ employment levels and simultaneity associated with U.S. industry import demand shocks. It is possible to partially separate the importance of these two sources of bias, both of which tend to attenuate the point estimate of interest towards zero. If we measure the change in import exposure per worker using lagged employment levels (as we do in constructing the instrument in equation (4)) instead of beginning of period employment (as we do in equation (3)), the OLS coefficient estimate increases in magnitude from -0.171 to -0.273. It thus appears that addressing measurement concerns regarding CZ employment may account for one-quarter of the difference between OLS and 2SLS estimates, with the remaining difference (from -0.273 versus -0.596) associated with the correction for endogeneity.
在表 3 的第 6 列中，OLS 和 2SLS 估计与我们的首选规格相比如何?如附录表 3 中面板 A 第一列所示，此规范的 OLS 估计值为-0.171。OLS 在 CZ 就业水平和与美国工业进口需求冲击相关的同时性方面都存在测量误差。可以部分分离这两个偏倚源的重要性，这两个偏倚都倾向于使感兴趣的点估计趋于零。如果我们使用滞后的就业水平(正如我们在方程(4)中构建工具时所做的那样)来衡量每个工人进口敞口的变化，而不是使用一段时期就业的开始(正如我们在方程(3)中所做的那样)，OLS 系数估计的幅度从-0.171 增加到-0.273。因此，解决关于 CZ 就业的测量问题可能可以解释 OLS 和 2SLS 估计值之间的四分之一的差异，其余的差异(从-0.273 到-0.596)与内质性校正相关。

Appendix Table 3. Imports from Different Exporting Countries and Change of Manufacturing Employment in Commuting Zones, 1990-2007.
Dependent Variable: 10 x Annual Change in Share of Employment in Manufacturing (in %pts)

	Exporters									
	China		China+ other Low-Inc		China+ Mexico/Cafta		Mexico/ Cafta		All Other Exporters	
	(1)		(2)		(3)		(4)		(5)	
A. OLS Estimates										
(Δ Imports from specified exporter to U.S.)/Worker	-0.171	**	-0.182	**	-0.034		0.297	**	0.021	**
	(0.028)		(0.026)		(0.031)		(0.050)		(0.005)	
B. 2SLS Estimates										
second stage estimates										
(Δ Imports from specified exporter to U.S.)/Worker	-0.596	**	-0.587	**	-0.602	**	-1.870	**	-0.031	~
	(0.099)		(0.096)		(0.110)		(0.682)		(0.018)	
first stage estimates										
(Δ Imports from specified exporter to OTH)/Worker	0.631	**	0.621	**	0.632	**	1.146	*	0.420	**
	(0.087)		(0.078)		(0.093)		(0.514)		(0.047)	
T-statistic	7.3		7.9		6.8		2.2		8.9	
C. Descriptive Statistics										
Mean and SD of (Δ Imports to U.S.)/Worker	1.88		2.13		2.76		0.88		9.04	
	(1.75)		(1.89)		(2.08)		(1.12)		(9.30)	

Notes: N=1444. The other ('OTH') countries that were used to construct the instrument include Australia, Denmark, Finland, Germany, Japan, New Zealand, Spain, and Switzerland. "Low-Income" countries are defined according to the 1990 Worldbank classification (see Data Appendix); the exporters countries in column 5 comprise all countries except low-income countries and Mexico/Cafta. All regressions contain the full vector of control variables from column 6 of Table 3. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Having established the robustness of the basic setup, we build the remainder of the empirical analysis on the more detailed specification in column 6 that exploits geographic variation in import exposure conditional on initial manufacturing share, and which includes Census division dummies and measures of population demographics and labor force composition.
在建立了基本设置的稳健性之后，我们对第 6 列中更详细的规范构建了实证分析的其余部分，该规范利用了初始制造份额条件下进口敞口的地理差异，其中包括人口普查局的假人以及人口统计数据和劳动力组成。

4.2 Benchmarking the impact of China trade exposure on U.S. manufacturing

One way to gauge the economic magnitude of these effects is to compare the estimated trade-induced reduction in manufacturing employment with the observed decline during 1990 to 2007. Such an exercises supposes that increased exposure to Chinese imports affects the absolute level of manufacturing employment in the United States, and not just relative employment across U.S. commuting zones. Given the magnitudes of the U.S. trade deficit and China trade surplus (and the much larger increase in U.S. imports from China than in U.S. exports to China, as seen in Table 1), the possibility seems real that import competition from China has an absolute impact on U.S. manufacturing (at least as long as trade imbalances persist).
衡量这些影响的经济规模的一种方法是将 1990 年至 2007 年期间估计的贸易导致的制造业就业减少与观察到的下降进行比较。这种研究假设，对中国进口商品的敞口增加会影响美国制造业就业的绝对水平，而不仅仅是美国通勤地区的相对就业水平。鉴于美国贸易逆差和中国贸易顺差的大小(和更大的美国从中国进口的增加比美国对中国的出口,见表 1),从中国进口竞争的可能性似乎真正的绝对影响美国制造业(至少,只要存在贸易不平衡)。

Our most conservative specification in Table 3 (column 6) implies that a $1,000 per worker increase in import exposure over a decade reduces manufacturing employment per working age population by 0.596 percentage points. Appendix Table 2 shows that Chinese import exposure rose by $1,140 per worker between 1990 and 2000 and by an additional $1,839 per worker in the seven years between 2000 and 2007. Applying these values to the Table 3 estimates, we calculate that rising Chinese import exposure reduced U.S. manufacturing employment per population by 0.68 percentage points in the first decade of our sample and 1.10 percentage points in the second decade of our sample. In comparison, U.S. manufacturing employment per population fell by 2.07 percentage points between 1990 and 2000 and by 2.00 percentage points between 2000 and 2007 (Appendix Table 2). Hence, we estimate that rising exposure to Chinese import competition explains 33 percent of the U.S. manufacturing employment decline between 1990 and 2000, 55 percent of the decline between 2000 and 2007, and 44 percent of the decline for the full 1990 through 2007 period.
我们在表 3(第 6 栏)中最保守的说明表明，每名工人进口敞口在 10 年内增加 1,000 美元，将使每工作年龄人口的制造业就业减少 0.596 个百分点。附录表 2 显示，中国进口敞口在 1990 年至 2000 年期间每名工人增加了 1,140 美元，在 2000 年至 2007 年的 7 年期间每名工人增加了 1,839 美元。将这些值应用到表 3 的估计中，我们计算出，在我们的样本的前十年中，中国进口敞口的增加使美国人均制造业就业减少了 0.68 个百分点，在我们的样本的第二个十年中减少了 1.10 个百分点。相比,美国制造业就业人口在 1990 年到 2000 年之间下降了 2.07 和 2.00 在 2000 年和 2007 年之间(附录表 2)。因此,我们估计上升接触中国进口竞争解释了 33%的美国制造业就业下降在 1990 年至 2000 年之间,在 2000 年到 2007 年的下降中占了 55%，在 1990 年到 2007 年期间下降了 44%。

One sense in which this benchmark may overstate the contribution of rising Chinese imports to declining U.S. manufacturing employment is that our 2SLS estimates measure the causal effect of the Chinese supply shock on U.S. manufacturing whereas the import per worker measure that we employ refers to the total change in Chinese imports per worker, which combines both supply and demand forces. If the demand-driven component of Chinese imports has a less negative effect on manufacturing than the supply-driven component, our benchmark may overstate the cumulative adverse effect of rising Chinese import competition on U.S. manufacturing employment.
某种意义上讲,这一基准可能夸大的贡献增加中国进口下降,美国制造业就业是我们 2 sls 估计测量因果中国供给冲击对美国制造业的影响而人均进口措施,我们采用人均指中国进口总量的变化,它结合了供给和需求的力量。如果中国进口的需求驱动部分对制造业的负面影响小于供应驱动部分，我们的基准可能会夸大中国进口竞争加剧对美国制造业就业的累积负面影响。

To isolate the share of variation in the China import measure that is driven by supply shocks, we perform in the Theory Appendix a simple decomposition that uses the relationship between OLS and 2SLS estimates to calculate the share of the variance in imports per worker that stems from the exogenous supply-driven component, with the remainder attributed to demand forces. This calculation implies that close to half (48%) of the observed variation in rising Chinese import exposure can be attributed to the supply-driven component. We more conservatively estimate that Chinese import competition explains 16 percent of the U.S. manufacturing employment decline between 1990 and 2000, 26 percent of the decline between 2000 and 2007, and 21 percent of the decline over the full period. For the mainland U.S. working-

age population, these estimates imply a supply-shock driven net reduction in U.S. manufacturing employment of 548 thousand workers between 1990 and 2000 and a further reduction of 982 thousand workers between 2000 and 2007.
孤立的比例变化在中国进口措施,是由供应冲击,我们执行理论附录一个简单分解,使用 OLS 和 2 sls 估计之间的关系计算人均进口份额的方差,源于外生供应驱动的组件,其余的归因于需求力量。这一计算表明，在观察到的中国进口敞口增加的变化中，近一半(48%)可归因于供应驱动的成分。我们更保守地估计，1990 年至 2000 年期间，16%的美国制造业就业岗位下降，2000 年至 2007 年期间 26%的下降，以及整个期间 21%的下降，都是由中国进口竞争造成的。对于美国大陆的工作年龄人口，这些估计意味着供应冲击导致美国制造业就业人数在 1990 年至 2000 年期间净减少 54.8 万人，在 2000 年至 2007 年期间进一步减少 98.2 万人。

4.3 The importance of non-China trade

The focus of our study on Chinese imports is motivated by the observation that China accounts for a very large portion of the dramatic recent increase in U.S. imports from low-income countries (Table 1). Moreover, it is plausible that much of China's recent trade expansion has been driven by internal productivity growth and reductions in trade barriers rather than by labor demand shocks in the U.S. To consider Chinese imports alongside those of other countries, Appendix Table 3 compares the impact of growing exposure to Chinese imports to the effect of exposure to imports from other source countries. The first column repeats our baseline estimates from Tables 2 and 3. The second column shows that the effect of imports from all low-income countries (China included) is nearly identical to the effect of imports from China, suggesting that imports from other low-income countries may have a similar impact on U.S. manufacturing as Chinese imports. Because the real dollar growth in imports from other low-income countries is an order of magnitude smaller than the growth in imports from China, their inclusion leaves our substantive conclusions regarding economic magnitudes unaffected.
我们之所以将研究重点放在中国进口上，是因为观察到最近美国从低收入国家进口的急剧增长中，中国占了很大一部分(表 1)。此外，中国最近的贸易扩张在很大程度上是受到国内生产率增长和贸易壁垒减少的推动，而不是受到美国劳动力需求冲击的推动，这似乎是有道理的。附录表 3 比较了对中国进口敞口的增加和对其他来源国进口敞口的影响。第一列重复了我们从表 2 和表 3 中得到的基线估计。第二列显示，从所有低收入国家(包括中国)进口的影响几乎与从中国进口的影响相同，这表明从其他低收入国家进口对美国制造业的影响可能与从中国进口类似。由于以美元计算，从其他低收入国家进口的实际增长比从中国进口的增长要小一个数量级，因此，将这些数字包括在内，我们就经济规模得出的实质性结论不会受到影响。

Columns 3 and 4 of the table contain estimates of the impact on U.S. manufacturing employment of imports from Mexico and Central America. Column 3, which calculates import exposure by adding imports from Mexico and Central America to those of China, produces nearly identical 2SLS estimates to China's imports alone, reinforcing the idea that trade with China is the driving force behind supply-driven U.S. imports from lower wage countries. Column 4, which considers imports from Mexico and Central America separately from China, produces coefficient estimates that are more erratic. The OLS estimates in panel A show a positive relationship between increasing exposure to imports from Mexico and Central America and growth of manufacturing employment in the U.S., consistent with the interpretation that growth in Mexican exports is largely driven by rising U.S. product demand rather than changing conditions in Mexico. The 2SLS estimate of this coefficient, by contrast, is negative and significant. A likely explanation for this latter result is that our measure of predicted CZ-level exposure to Mexican imports is highly correlated with the corresponding exposure measure for Chinese imports. Confirming this intuition, we find that the correlation between the predicted values of CZ-level exposure to Mexican imports and the predicted values for Chinese imports from the first stage models in columns 4 and 1, respectively, exceeds 0.70, implying that we cannot separately identify the Mexico/CAFTA versus China trade effect. Reassuringly, combining Mexico/CAFTA imports with Chinese imports has almost no effect on the point estimates, as was shown in column 3. The final 2SLS estimates in column 5, analyzing the impact of all other middle-income and high-income country imports on U.S. manufacturing, find small and inconsistently signed effects.
表格的第 3 和第 4 列包含了从墨西哥和中美洲进口对美国制造业就业的影响的估计。第三列是通过将来自墨西哥和中美洲的进口与中国的进口相加来计算进口风险的，它得出的 2SLS 估计数据与中国的进口几乎完全相同，这强化了一个观点，即对华贸易是美国从低工资国家进口供应驱动型产品背后的驱动力。第四列将从墨西哥和中美洲的进口与中国分开考虑，得出的系数估计更不稳定。OLS 估计在面板上显示一个积极的关系增加接触进口来自墨西哥和中美洲和制

造业就业的增长在美国,符合解释,墨西哥出口的增长很大程度上是由美国产品需求上升而不是在墨西哥不断变化的环境。相比之下，这个系数的 2SLS 估计是负的和显著的。对后一种结果的一种可能的解释是，我们对墨西哥进口的预测 cz 水平暴露的测量与对中国进口的相应暴露测量高度相关。为了证实这一直觉，我们发现，第 4 和第 1 列的第一阶段模型中对墨西哥进口的 cz 水平暴露的预测值与中国进口的预测值之间的相关性分别超过了 0.70，这意味着我们不能单独确定墨西哥/CAFTA 与中国的贸易效应。令人放心的是，将墨西哥/CAFTA 进口与中国进口相结合，对点估计几乎没有影响，如第 3 栏所示。第 5 栏中最后的 2SLS 估计，分析了所有其他中等收入和高收入国家进口对美国制造业的影响，发现了小的和不一致的签名效应。

The results of sections 4.1 to 4.3 suggest that the exposure of CZs to growing imports from China is a quantitatively important determinant of the decline in the share of manufacturing employment in the working age population. We now expand our focus beyond manufacturing to study the impacts of China trade shocks on broader labor market outcomes.
第 4.1 至 4.3 节的结果表明，从中国进口的增长对长三角地区的影响在数量上是制造业就业在工作年龄人口中所占比例下降的重要决定因素。我们现在将研究重点从制造业扩展到中国贸易冲击对更广泛的劳动力市场结果的影响。

5 Beyond manufacturing: Trade shocks and local labor markets

Prior research on the labor market impacts of international trade has primarily focused on employment and wage effects in manufacturing industries or occupations. This approach is satisfactory if labor markets are geographically integrated, fully competitive, and in continuous equilibrium such that a shock to any one manufacturing sector affects the aggregate labor market through only two channels: directly, via a change in employment in the affected sector; and indirectly, to the degree that the sector affects aggregate labor demand. This latter channel will in turn move the competitive wage rate faced by all other sectors, spurring further employment adjustments economy-wide. If these rather stringent conditions are not satisfied, shocks to local manufacturing employment may also differentially affect employment, unemployment, and wages in the surrounding local labor market. We explore the relevance of these local labor market effects in this section, focusing on impacts in the aggregate labor market and in non-manufacturing specifically.
先前关于国际贸易对劳动力市场影响的研究主要集中在制造业或职业的就业和工资影响。这种方法是令人满意的，如果劳动力市场在地理上是一体化的，充分竞争，并在持续的均衡中，这样，对任何一个制造业部门的冲击只会通过两个渠道影响总劳动力市场:直接，通过受影响部门的就业变化;并且间接地，到该部门影响总劳动力需求的程度。后一个渠道将反过来推动所有其他部门面临的有竞争力的工资率，刺激经济范围内的进一步就业调整。如果这些相当严格的条件得不到满足，对当地制造业就业的冲击也可能会对周围当地劳动力市场的就业、失业和工资产生不同的影响。在本节中，我们探讨了这些本地劳动力市场效应的相关性，重点关注总劳动力市场和非制造业的影响。

5.1 Population and employment effects in local labor markets

We begin in Table 4 by assessing the degree to which import shocks to local manufacturing cause reallocation of workers across CZs. If this mobility response is large, this would suggest that we are unlikely to find indirect effects of trade on local labor markets since initial local impacts will rapidly diffuse across regions. We find no robust evidence, however, that shocks to local manufacturing lead to substantial changes in population. The regressions in Table 4 are analogous to our earlier models for the manufacturing employment share except that our dependent variable is the log of the working age population ages 16 through 64 in the CZ, calculated using Census IPUMS data for 1990 and 2000 and American Community Survey for 2006 through 2008.
在表 4 中，我们首先评估了进口冲击对当地制造业造成跨中国大陆工人重新分配的程度。如果这种流动性反应很大，这意味着我们不太可能发现贸易对当地劳动力市场的间接影响，因为最初的当地影响将迅速扩散到各个地区。然而，我们没有发现有力的证据表明，对当地制造业的冲击会导致人口的实质性变化。表 4 的回归是类似于我们先前模型制造业就业份额,除了我们的因变量是日志的工作年龄人口年龄在 16 到 64 年 CZ,计算 1990 年和 2000 年使用人口普查 IPUMS 数据和美国社区调查 2006 年到 2008 年。

The specifications in panel A, which includes no controls except a constant and a time dummy for the 2000-2007 time period, finds a significant negative relationship between exogenous increases in Chinese import exposure and CZ-level population growth. A $1,000 per worker increase in trade exposure predicts a decline of 1.03 log points in a CZ's working-age population. In specifications that add Census division dummies (panel B)—which are equivalent to trends in our first-

difference model—and in specifications that further include the full set of controls from Table 3, we find no significant effect of import shocks on local population size. This null is found for the overall working age population (column 1), for college and non-college adults (columns 2 and 3), and for age groups 16 through 34, 35 through 49, and 50 through 64 (columns 4 through 6). In moving from panel A to C, the point estimates on import exposure fall while the standard errors rise. These estimates suggest that the effect of trade exposure shocks on population flows is small, though the imprecision of these estimates does not preclude more substantial responses.
面板 A 中的规范，除了 2000-2007 年期间的一个常数和一个时间虚拟变量外，不包括任何控制，发现中国进口敞口的外源性增长与 cz 水平的人口增长之间存在显著的负相关关系。每增加 1,000 美元的贸易敞口，就意味着捷克的劳动年龄人口将下降 1.03 log points。在添加了人口普查局假人(面板 B)的规范中(这相当于我们的一阶差分模型中的趋势)，以及进一步包括了表 3 中的全部控制的规范中，我们发现进口冲击对当地人口规模没有显著影响。这个发现为 null 的整体工作年龄人口(第 1 列),大学,而成年人(第 2 列和第 3 列),并通过 34 岁年龄组 16 35 通过 49 岁和 50 到 64 年(列 4 到 6),在面板从 A 到 C 点估计进口下降而标准的错误继续上升。这些估计表明，贸易敞口冲击对人口流动的影响很小，尽管这些估计的不精确性并不排除更大的反应。

Table 4. Imports from China and Change of Working Age Population in Commuting Zones, 1990-2007: 2SLS Estimates.
Dependent Variables: 10-Year Equivalent Log Changes in Headcounts (in log pts)

	I. By Education Level			II. By Age Group		
	All	College	Non-College	Age 16-34	Age 35-49	Age 50-64
	(1)	(2)	(3)	(4)	(5)	(6)
A. No Census Division Dummies or Other Controls						
(Δ Imports from China to US)/Worker	-1.031 *	-0.360	-1.097 *	-1.299	-0.615	-1.127 **
	(0.503)	(0.660)	(0.488)	(0.826)	(0.572)	(0.422)
R^2	.	0.03	0.00	0.17	0.59	0.22
B. Controlling for Census Division Dummies						
(Δ Imports from China to US)/Worker	-0.355	0.147	-0.240	-0.408	-0.045	-0.549
	(0.513)	(0.619)	(0.519)	(0.953)	(0.474)	(0.450)
R^2	0.36	0.29	0.45	0.42	0.68	0.46
C. Full Controls						
(Δ Imports from China to US)/Worker	-0.050	-0.026	-0.047	-0.138	0.367	-0.138
	(0.746)	(0.685)	(0.823)	(1.190)	(0.560)	(0.651)
R^2	0.42	0.35	0.52	0.44	0.75	0.60

Notes: N=1444 (722 commuting zones x 2 time periods). All regression include a constant and a dummy for the 2000-2007 period. Models in Panel B and C also include Census Division dummies while Panel C adds the full vector of control variables from column 6 of Table 3. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ p ≤ 0.10, * p ≤ 0.05, ** p ≤ 0.01.

The lack of a significant effect of trade exposure on population flows is consistent with several hypotheses. One is that shocks to manufacturing from China trade are too small to affect outcomes in the broader CZ. A second is that goods markets are sufficiently well integrated nationally that local labor markets adjust to adverse shocks without a mobility response. This would occur, for example, in a Heckscher-Ohlin setting if local labor markets operated within a single cone of diversification, such that factor price equalization pins down the wage in all markets, making local factor prices independent of local factor demands and supplies. A third possibility is that population adjustments to local economic shocks are sluggish because mobility is costly or because factors other than labor (including government transfer benefits or house prices) bear part of the incidence of labor demand shocks (Katz and Blanchard, 1991; Glaeser and Gyourko, 2005; Notowidigdo, 2010). Costs to labor of moving between sectors (as in Artuc, Chaudhuri, and McLaren, 2010, and Dix-Carneiro, 2011) may contribute to costs of moving between regions. In this third case, we would expect to see local labor markets adjust along margins other than inter-sectoral or geographic mobility. Our evidence below is most consistent with the third interpretation.
贸易敞口对人口流动没有显著影响，这与几个假设是一致的。一是中国贸易对制造业的冲击太小，不足以影响更广泛的区域的结果。第二，商品市场在全国范围内已经充分整合，使得当地劳动力市场能够在没有流动性反应的情况下适应不利的冲击。例如，在赫克舍尔-奥林环境中，如果当地劳动力市场在单一的多样化锥内运行，那么这种情况就会发生，例如要素价格均等化将限制所有市场的工资，使当地要素价格独立于当地要素的需求和供应。第三种可能是，人口对当地经济冲击的调整缓慢，因为流动性成本高，或者因为劳动力以外的因素(包括政府转移福利或房价)承担了劳动力需求冲击的部分影响(Katz 和 Blanchard, 1991;Glaeser 和 Gyourko, 2005 年;Notowidigdo, 2010)。在不同部门之间迁移的劳动力成本(如在 Artuc、Chaudhuri 和 McLaren, 2010 年，和 Dix-Carneiro, 2011 年)可能会导致地区之间的迁移成本。在第

三种情况下，我们预计当地劳动力市场会沿着边际而不是跨部门或地理流动性进行调整。我们下面的证据与第三种解释是一致的。

If working age adults do not depart from CZs facing adverse trade shocks, then the trade-induced decline in manufacturing employment must yield a corresponding rise in either non-manufacturing employment, unemployment, labor force exit or some combination of the three. In the first panel of Table 5, we study the impact of import shocks on the log change in the number of non-elderly adults in four exhaustive and mutually exclusive categories: employment in manufacturing, employment in non-manufacturing, unemployment and labor force non-participation. We find that a $1; 000 per worker increase in import exposure reduces the number of workers in manufacturing employment by 4.2 log points (4:2 percent, t = 4:04). Perhaps surprisingly, this effect is not offset by a rise in non-manufacturing employment in the affected CZ; rather, there is a modest decline in local non-manufacturing employment on the order of 0.27 log points. This point estimate is not statistically significant, though we show below that there is a significant reduction in non-college employment in non-manufacturing. These net declines in manufacturing and non-manufacturing employment are echoed by sharp rises in the number of unemployed workers and labor force non-participants: a $1,000 per worker import shock increases the number of unemployed and non-participating individuals by 4.9 and 2.1 percent, respectively. In concert with the results in Table 4, these results indicate that trade-induced declines in manufacturing employment accrue essentially one-for-one to rising unemployment and non-employment within affected CZs. These point estimates also underscore that the null results for population flows found in Table 4 are reliable. If trade-induced population flows between CZs were as large as trade-induced flows within CZs, these population flows would be detectable in our sample at available levels of precision.
如果处于工作年龄的成年人不离开面临不利贸易冲击的 CZs，那么贸易导致的制造业就业的下降必然导致相应的非制造业就业、失业、劳动力退出或三者的某种组合的上升。在表 5 的第一个面板中，我们在四个详尽且相互排斥的类别中研究了进口冲击对非老年人数量对数变化的影响:制造业就业、非制造业就业、失业和劳动力不参与。我们发现$1;进口敞口每增加 000 个工人，制造业就业工人人数减少 4.2 log points (4:2%， t = 4:04)。也许令人惊讶的是，这种影响并没有被受影响的 CZ 的非制造业就业的增加所抵消;相反，当地非制造业就业略有下降，约为 0.27 log points。这一点估计在统计上并不显著，尽管我们在下面显示，在非制造业中，非大学毕业生的就业有显著减少。制造业和非制造业就业的净下降与失业工人和劳动力非参与方人数的急剧上升相呼应:每名工人进口 1000 美元，失业和非参与方人数分别增加 4.9%和 2.1%。与表 4 的结果相一致，这些结果表明，贸易导致的制造业就业下降基本上是与受影响的中国经济区内失业率和失业人数的上升一一对应的。这些点估计还强调表 4 中关于人口流动的空结果是可靠的。如果长江流域之间的贸易引起的人口流动与长江流域内部的贸易引起的人口流动一样大，那么这些人口流动将在我们的样本中以可用的精度水平被检测出来。

Panel B of Table 5 presents a corresponding set of models for employment, unemployment and non-employment using as a dependent variable the share of the non-elderly adult population in each category: declines in the population share in one category (e.g., manufacturing employment) must yield equivalent gains in other categories. Since population—the denominator of the share variable—is not systematically affected by the shock, normalizing by this measure is not problematic. The sum of the first two coefficients in panel B indicates that a $1,000 per worker increase in a CZ's import exposure reduces its employment to population rate by 0.77 percentage points. About three-quarters of that decline is due to the loss in manufacturing employment, with the remainder due a (not significant) decline in non-manufacturing employment. The next two columns show that one-quarter of the reduction in the employment to population ratio is accounted for by a rise in the unemployment to population rate (0.22 percentage points) while the remaining three-quarters accrue to labor force non-participation (0.55 percentage points). Thus, the shock to manufacturing employment leads to a more than one-for-one rise in non-employment.
表 5 的 B 组提出了一套相应的就业、失业和非就业模型，将每一类中的非老年人人口份额作为因变量:某一类(例如制造业就业)中人口份额的下降必须在其他类别中产生同等的收益。由于人口(份额变量的分母)没有系统地受到冲击的影响，用这种方法进行正常化并不成问题。面板 B 中前两个系数的总和表明，CZ 的进口敞口每增加 1,000 美元，就会减少其就业对人口比率 0.77 个百分点。大约四分之三的下降是由于制造业就业的损失，其余的是由于非制造业就业的(不显著的)下降。下两列显示，就业人口比下降的四分之一是由于失业率人口比上升(0.22 个百分点)，而其余四分之三是由于劳动力不参与(0.55 个百分点)。因此，对制造业就业的冲击导致非就业人数的增幅超过一比一。

Table 5. Imports from China and Employment Status of Working Age Population within Commuting Zones, 1990-2007: 2SLS Estimates.
Dep Vars: 10-Year Equivalent Changes in Population Log Population Counts and Population Shares by Employment Status

	Mfg Emp (1)		Non-Mfg Emp (2)		Unemp (3)		NILF (4)		SSDI Receipt (5)	
A. 100 × Log Change in Population Counts										
(Δ Imports from China to US)/Worker	-4.231	**	-0.274		4.921	**	2.058	~	1.466	**
	(1.047)		(0.651)		(1.128)		(1.080)		(0.557)	
B. Change in Population Shares										
All Education Levels										
(Δ Imports from China to US)/Worker	-0.596	**	-0.178		0.221	**	0.553	**	0.076	**
	(0.099)		(0.137)		(0.058)		(0.150)		(0.028)	
College Education										
(Δ Imports from China to US)/Worker	-0.592	**	0.168		0.119	**	0.304	**	.	
	(0.125)		(0.122)		(0.039)		(0.113)			
No College Education										
(Δ Imports from China to US)/Worker	-0.581	**	-0.531	**	0.282	**	0.831	**	.	
	(0.095)		(0.203)		(0.085)		(0.211)			

Notes: N=1444 (722 commuting zones x 2 time periods). All statistics are based on working age individuals (age 16 to 64). The effect of import exposure on the overall employment/population ratio can be computed as the sum of the coefficients for manufacturing and non-manufacturing employment; this effect is highly statistically significant ($p \leq 0.01$) in the full sample and in all reported subsamples. All regressions include the full vector of control variables from column 6 of Table 3. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

While import shocks reduce employment and raise unemployment and non-participation among both college and non-college adults, these effects are much more pronounced for non-college adults. The next two rows of panel B show that a $1,000 import shock reduces both college and non-college manufacturing employment per population by equivalent amounts, but have distinct effects on college versus non-college employment in non-manufacturing employment, unemployment and non-employment. Specifically, a $1,000 import exposure shock reduces non-college employment in non-manufacturing by a highly significant 0:53 percentage points, which is comparable to its effect on non-college manufacturing employment. By contrast, college employment in non-manufacturing increases modestly by 0:17 percentage points (t = 1:37). A potential explanation for this pattern is that the decline of manufacturing industries decreases the demand for non-traded services that are typically provided by low-skilled workers, such as transportation, construction, or retail trade. On net, a $1,000 import exposure shock reduces the employment to population rate of college adults by 0.42 percentage points and of non-college adults by 1.11 percentage points—which is nearly three times as large. For both groups, only about one-fourth of the net employment reduction is accounted for by rising unemployment, with the remainder accruing to labor force non-participation.
虽然进口冲击减少了就业，提高了大学生和非大学生的失业率和不参与，但这些影响在非大学生中更为显著。面板 B 的下两行显示，1000 美元的进口冲击减少了大学和非大学制造业就业人均等量，但有明显的影响大学和非大学就业在非制造业就业，失业和非就业。具体来说，1000 美元的进口敞口冲击将非大学毕业生在非制造业中的就业减少了非常显著的 0:53 个百分点，这与它对非大学毕业生制造业就业的影响相当。相比之下，非制造业的大学毕业生就业率小幅增长 0:17 个百分点(t = 1:37)。对这种模式的一个可能的解释是，制造业的衰退减少了对非贸易服务的需求，这些服务通常是由低技能工人提供的，如运输、建筑或零售贸易。从净额上看，1000 美元的进口风险冲击将大学生的就业率降低 0.42 个百分点，而非大学生的就业率降低 1.11 个百分点——这几乎是前者的三倍。对于这两个群体来说，只有大约四分之一的净就业减少是由上升的失业率造成的，其余的是由于劳动力的不参与。

As detailed in Appendix Table 4, declining employment and increasing unemployment and non- participation are similar for males and females in percentage-point terms, though relative employment declines are larger among females because the initial share of manufacturing employment among women (8.3% in 1990) is considerably smaller than among men (17.3%). Employment-to-population reductions are equally concentrated among young, mid-career and older workers (ages 16-34, 35-49, and 50-64), though the employment losses are relatively more concentrated in manufacturing among the young and in non-manufacturing among the old. For the oldest group, fully 84% of the decline in employment is accounted for by a rise in non-participation, relative to 71% among the prime-age group and 68% among the younger group.

如附录表 4 所示，以百分比计算，男性和女性的就业率下降、失业率上升和不参加就业的情况相似。虽然妇女的相对就业下降较大，因为妇女在制造业就业中最初的份额(1990 年为 8.3%)比男子(17.3%)小得多。就业人口比的下降同样集中在年轻、职业中期和年长的工人(16-34 岁、35-49 岁和 50-64 岁)，尽管就业损失相对更集中在制造业的年轻人和非制造业的老年人。在最年长的群体中，就业率下降的整整 84%是由于不参与就业的上升造成的，而这一比例在壮年群体中为 71%，在较年轻的群体中为 68%。

Appendix Table 4. Imports from China and Employment Status of Working Age Population within CZs, 1990-2007: 2SLS Estimates.
Dep Vars: 10-Year Equivalent Changes in Population Shares by Employment Status (in %pts)

	I. Overall and by Sex				II. By Age Group			
	Mfg Emp/ Pop	Non-Mfg Emp/ Pop	Unemp/ Pop	NILF/ Pop	Mfg Emp/ Pop	Non-Mfg Emp/ Pop	Unemp/ Pop	NILF/ Pop
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	A. Entire Working Age Population				C. Age 16-34			
(Δ Imports from China to US)/Worker	-0.596 **	-0.178	0.221 **	0.553 **	-0.686 **	-0.155	0.271 **	0.569 **
	(0.099)	(0.137)	(0.058)	(0.150)	(0.129)	(0.145)	(0.074)	(0.128)
	B. Males				D. Age 35-49			
(Δ Imports from China to US)/Worker	-0.625 **	-0.140	0.224 **	0.541 **	-0.637 **	-0.162	0.236 **	0.563 **
	(0.124)	(0.151)	(0.062)	(0.159)	(0.119)	(0.119)	(0.076)	(0.157)
	C. Females				E. Age 50-64			
(Δ Imports from China to US)/Worker	-0.555 **	-0.218	0.217 **	0.556 **	-0.353 **	-0.295	0.105 **	0.542 **
	(0.088)	(0.133)	(0.060)	(0.149)	(0.079)	(0.195)	(0.035)	(0.199)

Notes: N=1444 (722 commuting zones x 2 time periods). All statistics are based on working age individuals (age 16 to 64). The effect of import exposure on the overall employment/population ratio can be computed as the sum of the coefficients for manufacturing and non-manufacturing employment; this effect is highly statistically significant ($p \leq 0.01$) in the full sample and in all reported subsamples. All regressions include the full vector of control variables from column 6 of Table 3. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

One mechanism that accommodates the rise in labor force non-participation following a rise in import exposure is enrollment in the Social Security Disability Insurance (SSDI) program, which provides transfer benefits and Medicare coverage to working-age adults who are able to establish that their disabilities preclude gainful employment. The estimates in Panel B of Table 5 suggests that 9.9% (0.076/0.77) of those who lose employment following an import shock obtain federal disability insurance benefits. While this is a large fraction, it is not implausible. As of 2010, 4.6% of adults age 25 to 64 receive SSDI benefits, and SSDI applications and awards are elastic to adverse labor market shocks (Autor and Duggan, 2003 and 2011). It is likely that the increase in disability rolls is strongly concentrated among older workers and workers without a college education, though we cannot directly test this assumption since the SSDI data are not available to us separately by age or education group at the detailed geographic level.
在进口敞口增加后，适应劳动力不参与增加的一种机制是参加社会保障残疾保险(SSDI)计划，该计划向能够确定其残疾妨碍了有收入的就业的工作年龄成年人提供转移福利和医疗保险覆盖。表 5 Panel B 中的估计表明，9.9%(0.076/0.77)在进口冲击后失业的人获得联邦残疾保险福利。虽然这是一个很大的比例，但并非不可信。截至 2010 年，25 岁至 64 岁的成年人中，有 4.6%的人获得了 SSDI 福利，SSDI 申请和奖励对不利的劳动力市场冲击具有弹性(Autor 和 Duggan, 2003 年和 2011 年)。残疾人数的增加很可能主要集中在年龄较大的工人和没有受过大学教育的工人中，尽管我们无法直接检验这一假设，因为我们无法在详细的地理水平上获得按年龄或教育群体分列的 SSDI 数据。

5.2 Wage effects

In Table 6, we analyze effects of import exposure shocks on CZ wage levels. Our estimation approach follows the models above except that our dependent variable is the mean log weekly earnings in a CZ. Because the outcome is only available for the employed, and bearing in mind that we have already established that import exposure shocks reduce employment, the wage estimates must be interpreted with caution. If, plausibly, workers with lower ability and earnings are more likely to lose employment in the face of an adverse shock, the observed change in wages in a CZ will understate the composition-constant change in wages. This is likely to be relevant for workers with lower education levels, among whom job losses are concentrated.

在表 6 中，我们分析了进口敞口冲击对 CZ 工资水平的影响。我们的估计方法遵循上述模型，除了我们的因变量是 CZ 的平均日志每周收入。由于该结果仅适用于受雇者，且我们已确定进口敞口冲击会减少就业，因此必须谨慎地解释工资估计。如果，能力和收入较低的工人在面对不利冲击时更有可能失去工作，那么 CZ 中观察到的工资变化将低估工资的组成-持续变化。这可能与受教育程度较低的工人有关，因为失业集中在这些人身上。

Table 6. Imports from China and Wage Changes within Commuting Zones, 1990-2007: 2SLS Estimates.
Dep Var: 10-Year Equivalent Change in Avg Log Weekly Wage (in log pts)

	All Workers (1)		Males (2)		Females (3)	
			A. All Education Levels			
(Δ Imports from China to US)/Worker	-0.759	**	-0.892	**	-0.614	**
	(0.253)		(0.294)		(0.237)	
R^2	0.56		0.44		0.69	
			B. College Education			
(Δ Imports from China to US)/Worker	-0.757	*	-0.991	**	-0.525	~
	(0.308)		(0.374)		(0.279)	
R^2	0.52		0.39		0.63	
			C. No College Education			
(Δ Imports from China to US)/Worker	-0.814	**	-0.703	**	-1.116	**
	(0.236)		(0.250)		(0.278)	
R^2	0.52		0.45		0.59	

Notes: N=1444 (722 commuting zones x 2 time periods). All regressions include the full vector of control variables from column 6 of Table 3. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Despite the potential for upward bias, Table 6 finds a significant negative effect of import exposure on average weekly earnings within CZs. A $1,000 per worker increase in a CZ's exposure to Chinese imports during a decade is estimated to reduce mean weekly earnings by -0.76 log points. Point estimates for wage impacts are largely comparable across gender and education groups. While they are somewhat larger overall for males than for females, with the largest declines found among college males and non-college females, we do not have sufficient precision to reject the null hypothesis that impacts are uniform across demographic groups.
尽管存在潜在的向上偏差，表 6 发现进口敞口对 zs 内的平均周收入有显著的负面影响。据估计，在未来 10 年里，每个工人对中国进口商品的敞口每增加 1000 美元，每周平均收入就会减少-0.76 log points。对工资影响的点估计在性别和教育群体中具有很大可比性。虽然总体而言，男性比女性的影响更大，在大学男性和非大学女性中发现的降幅最大，但我们没有足够的精确度来拒绝零假设，即影响在人口统计学群体中是一致的。

In Table 7, we explore wage effects separately for workers employed in manufacturing and non-manufacturing. To aid interpretation, the upper panel of the table presents estimates of the effect of import exposure on log employment counts in both sectors. Consistent with the estimates above, Table 7 confirms that import exposure reduces head-counts in manufacturing but has little employment effects outside of manufacturing, particularly for college workers.
在表 7 中，我们分别探讨了制造业和非制造业工人的工资影响。为便于解释，表上的面板列出了进口敞口对这两个部门原木就业人数影响的估计。与上述估计一致，表 7 证实，进口敞口减少了制造业的人数，但对制造业以外的就业几乎没有影响，特别是对大学工人。

Table 7. Comparing Employment and Wage Changes in Manufacturing and outside Manufacturing, 1990-2007: 2SLS Estimates.
Dep Vars: 10-Year Equiv. Changes in Log Workers (in Log Pts) and Avg Log Weekly Wages (in %)

	I. Manufacturing Sector			II. Non-Manufacturing		
	All Workers (1)	College (2)	Non-College (3)	All Workers (4)	College (5)	Non-College (6)
A. Log Change in Number of Workers						
(Δ Imports from China to US)/Worker	-4.231 **	-3.992 **	-4.493 **	-0.274	0.291	-1.037
	(1.047)	(1.181)	(1.243)	(0.651)	(0.590)	(0.764)
R^2	0.31	0.30	0.34	0.35	0.29	0.53
B. Change in Average Log Wage						
(Δ Imports from China to US)/Worker	0.150	0.458	-0.101	-0.761 **	-0.743 *	-0.822 **
	(0.482)	(0.340)	(0.369)	(0.260)	(0.297)	(0.246)
R^2	0.22	0.21	0.33	0.60	0.54	0.51

Notes: N=1444 (722 commuting zones x 2 time periods). All regressions include the full vector of control variables from column 6 of Table 3. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

The effect of import exposure on mean wages found in panel B of Table 7 is the complement of the employment effects estimated in panel A. Although import exposure reduces manufacturing employment, it appears to have no significant effects on mean manufacturing wages in CZs. This finding mirrors the outcomes of industry-level studies such as Edwards and Lawrence (2010) or Ebenstein et al. (2010), which observe no negative wage effects of imports on U.S. workers in import-competing manufacturing industries. One explanation for this pattern is that the most productive workers retain their jobs in manufacturing, thus biasing the estimates against finding a reduction in manufacturing wages. An alternative possibility, suggested by Bloom, Draca and van Reenen (2009), is that manufacturing plants react to import competition by accelerating technological and organizational innovations that increase productivity and may raise wages.
表 7 面板 B 中发现的进口敞口对平均工资的影响是面板 a 中估计的就业影响的补充。尽管进口敞口减少了制造业就业，但它似乎对 CZs 的平均制造业工资没有显著影响。这一发现反映了行业层面的研究结果，如 Edwards 和 Lawrence(2010)或 Ebenstein 等人(2010)，他们没有观察到进口对与进口竞争的制造业的美国工人的工资产生负面影响。对这种模式的一种解释是，生产力最高的工人保留了他们在制造业的工作，因此，对制造业工资减少的估计存在偏差。Bloom、Draca 和 van Reenen(2009)提出的另一种可能性是，制造工厂通过加速技术和组织创新来应对进口竞争，从而提高生产率和工资。

By contrast, Chinese import exposure significantly reduces earnings in sectors outside manufacturing. Non-manufacturing wages fall by 0.76 log points for a $1,000 increase in Chinese import exposure per worker, an effect that is similar for college and non-college workers. This result suggests that a negative shock to local manufacturing reduces the demand for local non-traded services while increasing the available supply of workers, creating downward pressure on wages in the sector.
相比之下，中国的进口敞口显著降低了制造业以外行业的收益。每名工人的中国进口敞口增加 1,000 美元，非制造业工资就会下降 0.76 个原木点，对大学生和非大学生的影响类似。这一结果表明，对当地制造业的负面冲击降低了对当地非贸易服务的需求，同时增加了劳动力的可用供应，对该行业的工资造成了下行压力。

The results of this section demonstrate that an increase in the exposure of local U.S. labor markets to Chinese imports stemming from rising Chinese comparative advantage leads to a significant decline in employment and wages in local markets. These findings suggest that a variety of partial and incomplete labor market adjustments are operative. Because total CZ employment falls following a shock to local manufacturing, we conclude that labor and product markets are not sufficiently integrated to di use the shock across the broader regional or national labor market. The fact that manufacturing wages do not fall along with employment may indicate that manufacturing wages are downwardly rigid or that any wage effects are masked by shifts in employment composition. That wages fall in non-manufacturing, however, suggests that this sector is subject to a combination of negative demand shocks—working through reduced demand for non-traded services—and positive shocks to sectoral labor supply, as workers leaving manufacturing seek jobs outside of the sector. Overall, the findings suggest that general equilibrium effects operate within but not across local labor markets: an adverse demand shock to manufacturing reduces wages in other sectors locally and is not dissipated either

within or across sectors in the broader(non-local) labor market.
本节的结果表明，由于中国相对优势的上升，美国当地劳动力市场对中国进口产品的敞口增加，导致当地市场就业和工资显著下降。这些发现表明，各种局部和不完全的劳动力市场调整是可行的。由于 CZ 总就业人数在当地制造业受到冲击后下降，我们得出结论，劳动力和产品市场没有充分整合，无法在更广泛的地区或国家劳动力市场上消除冲击。制造业工资不随就业而下降这一事实可能表明制造业工资是刚性下降的，或者任何工资影响被就业构成的变化所掩盖。然而，非制造业的工资下降表明，这一行业受到双重负面需求冲击(通过减少非贸易服务的需求来实现)和行业劳动力供应的正面冲击(因为离开制造业的工人在该行业以外寻找工作)的影响。总体而言，研究结果表明，一般均衡效应在本地劳动力市场内部发挥作用，而不是在整个劳动力市场:对制造业的不利需求冲击降低了当地其他部门的工资，而且在更广泛的(非本地)劳动力市场的部门内部或部门之间都不会消散。

6 Public transfer payments and household incomes

The decline in employment and wages in CZs facing growing import exposure is likely to generate an increase in residents' demand for public transfer payments. This conjecture is reinforced by the finding in Table 5 above that CZs facing increased import exposure experience a rise in federal disability program (SSDI) recipients. Table 8 studies how a variety of public transfer benefits respond to changes in import exposure. We use data from the BEA Regional Economic Accounts and from the Social Security Administration's Annual Statistical Supplement to measure transfer payments per capita. Table 8 reports the estimated effect of changes in import exposure on both the dollar and log change in individual transfers per capita for total transfers and for major subcategories.
面临进口敞口不断增加的长城县的就业和工资下降，很可能会增加居民对公共转移支付的需求。上述表 5 的发现进一步证实了这一猜想，即面临进口敞口增加的 cz 的联邦残疾计划(SSDI)受助人增加。表 8 研究了各种公共转移利益如何应对进口敞口的变化。我们使用来自东亚银行区域经济核算和社会保障局年度统计增补的数据来衡量人均转移支付。表 8 报告了进口敞口变化对总转让和主要子类别的人均个别转让的美元和对数变化的估计影响。

Table 8. Imports from China and Change of Government Transfer Receipts in Commuting Zones, 1990-2007: 2SLS Estimates.
Dep Vars: 10-Year Equivalent Log and Dollar Change of Annual Transfer Receipts per Capita (in log pts and US$)

	Total Individ Transfers (1)		TAA Benefits (2)		Unemp-loyment Benefits (3)		SSA Re-tirement Benefits (4)		SSA Disability Benefits (5)		Medical Benefits (6)		Federal Income Assist (7)		Other Income Assist (8)		Educ/ Training Assist (9)	
						A. Log Change of Transfer Receipts per Capita												
(Δ Imports from China to US)/Worker	1.01	**	14.41	~	3.46	~	0.72	~	1.96	**	0.54		3.04	**	1.08		2.78	*
	(0.33)		(7.59)		(1.87)		(0.38)		(0.69)		(0.49)		(0.96)		(2.20)		(1.32)	
R^2	0.57		0.28		0.48		0.36		0.32		0.27		0.54		0.37		0.33	
						B. Dollar Change of Transfer Receipts per Capita												
(Δ Imports from China to US)/Worker	57.73	**	0.23		3.42		10.00	~	8.40	**	18.27		7.20	**	4.13		3.71	**
	(18.41)		(0.17)		(2.26)		(5.45)		(2.21)		(11.84)		(2.35)		(4.44)		(1.44)	
R^2	0.75		0.28		0.41		0.47		0.63		0.66		0.53		0.30		0.37	

Notes: N=1444 (722 commuting zones x 2 time periods), except N=1436 in column 2, panel A. Results for TAA benefits in column 2 are based on state-level data that is allocated to commuting zones in proportion to unemployment benefits. Unemployment benefits in column 3 include state benefits and federal unemployment benefits for civilian federal employees, railroad employees, and veterans. Medical benefits in column 6 consist mainly of Medicare and Medicaid. Federal income assistance in column 7 comprises the SSI, AFDC/TANF, and SNAP programs while other income assistance in column 8 consists mainly of general assistance. Education and training assistance in column 9 includes such benefits as interest payments on guaranteed student loans, Pell grants, and Job Corps benefits. The transfer categories displayed in colums 2 to 9 account for 96% of total individual transfer receipts. All regressions include the full vector of control variables from column 6 of Table 3. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

The effect of import exposure on transfer payments to CZs is sizable. We estimate that a $1,000 increase in Chinese import exposure leads to a rise in transfer payments of $58 per capita (1.01 log points in the logarithmic specification). Logically, the largest proportionate increase is found for Trade Adjustment Assistance (TAA), which is targeted specifically at individuals who lose employment due to foreign competition. Other transfers that are elastic to import exposure are Unemployment Insurance benefits, Social Security Disability Insurance (SSDI) benefits, federal income assistance benefits from SSI (Supplemental Security Income), TANF (Temporary Assistance for Needy Families), and SNAP (Supplemental Nutrition Assistance), which are summed in column 7, and education and training assistance, which comprises means-tested education subsidies.
进口敞口对中国出口企业转移支付的影响是相当大的。我们估计，中国进口敞口增加 1,000 美元，将导致人均转移支付

增加 58 美元(对数规范中为 1.01 对数点)。从逻辑上讲，增加比例最大的是贸易调整援助(TAA)，它专门针对因外国竞争而失业的个人。其他对进口有弹性的转移支付包括失业保险津贴、社会保障伤残保险(SSDI)津贴、联邦收入援助津贴(SSI)(补充保障收入)、TANF(贫困家庭临时援助)和 SNAP(补充营养援助)，它们的总和在第 7 栏。以及教育和培训援助，其中包括经经济状况调查的教育补贴。

These transfer programs di er substantially in expenditure levels per capita (Appendix Table 2). In-kind medical transfer benefit programs, which include Medicare and Medicaid, spent about $2,500 per adult in 2007, whereas the Social Security retirement and disability insurance programs transferred about $1,400 and $300 per adult, respectively. Meanwhile, federal income assistance (SSI, TANF, and SNAP) transferred about as much income as SSDI. By contrast, average TAA payments amounted to a mere $2 per adult which is less than 0.05 percentage points of total transfers from governments to individuals. The substantial relative growth of TAA payments in CZs with growing import exposure thus translates to just a small increase of $0.23 in per adult in benefits for every $1,000 of growth in a CZ's per-worker exposure to Chinese imports. Unemployment benefits also contribute only modestly to the overall increase in transfers. In contrast, the increase in federal transfer spending on SSDI payments is large and significant, equal to about $8 per $1,000 growth of export exposure. In-kind medical benefits rise by $18 per capita, while federal and other income assistance and retirement benefits account for an additional $11 and $10 in per-adult transfer spending. Not all of these effects are precisely measured, however.
这些转移支付计划大大降低了人均支出水平(附录表 2)。在 2007 年，包括医疗保险(Medicare)和医疗补助(Medicaid)在内的实物医疗转移福利计划为每位成年人支付了约 2,500 美元，而社会保障(Social Security)退休和残疾保险计划分别为每位成年人支付了约 1,400 美元和 300 美元。与此同时，联邦收入援助(SSI、TANF 和 SNAP)转移的收入与 SSDI 相当。相比之下，TAA 的平均支付金额仅为每位成年人 2 美元，这还不到政府向个人支付的总金额的 0.05 个百分点。因此，随着进口敞口的增加，捷克共和国的 TAA 支付大幅相对增长，意味着捷克共和国的每个工人对中国进口敞口每增加 1000 美元，每个成年人的福利只会增加 0.23 美元。失业救济金对转移支付的整体增长也贡献甚微。相比之下，用于 SSDI 支付的联邦转移支出的增长是巨大而显著的，相当于出口敞口每增长 1000 美元约 8 美元。实物医疗福利人均增加了 18 美元，而联邦及其他收入援助和退休福利在每个成年人的转移支出中分别增加了 11 美元和 10 美元。然而，并不是所有这些影响都能被精确测量。

Overall, Table 8 suggests that through its effects on employment and earnings, rising import exposure spurs a substantial increase in government transfer payments to citizens in the form of increased disability, medical, income assistance, and unemployment benefit payments. These transfer payments vastly exceed the expenses of the TAA program, which specifically targets workers who lose employment due to import competition. The transfers should not for the most part be counted as economic losses, of course, since they primarily reflect income redistribution among citizens via taxation and transfers. However, applying a typical estimate of the deadweight loss of taxation of around 40 cents on the dollar (Gruber, 2010), the real cost of the transfers spurred by rising import exposure is non-trivial. In addition, the trade-induced rise in labor force non-participation documented above should also be counted as a deadweight loss to the degree that workers' market wage (prior to the shock) exceeds their value of leisure, a point we return to below.
总的来说，表 8 表明，通过对就业和收入的影响，进口敞口的增加促使政府以增加残疾、医疗、收入援助和失业福利金的形式大幅增加向公民支付的转移支付。这些转移支付远远超过了专门针对因进口竞争而失业的工人的贸易适应援助计划的支出。当然，这些转移在很大程度上不应算作经济损失，因为它们主要反映了通过税收和转移在公民中进行的收入再分配。然而，应用一美元约 40 美分的税负损失的典型估计(Gruber, 2010)，进口敞口增加所刺激的转移的实际成本是不小的。此外，上面记录的由贸易引起的劳动力不参与的上升也应该被视为无谓损失，因为工人的市场工资(在冲击之前)超过了他们的休闲价值，我们回到下面的一个点。

Import exposure shocks may also cause reductions in household income and therefore consumption. Table 9 shows that the combination of falling employment, declining wage levels, and growing transfer payments has measurable impacts on the level and composition of household income in local labor markets exposed to growing import competition. The models in Table 9, which are estimated using data from the Census and American Community Survey (rather than the BEA transfer data above), find that a $1,000 increase in a CZ's import exposure leads to a fall in CZ average household wage and salary income per working age adult of 2.14 log points (column 2 of panel A) or about $549 per working age adult and year (panel B).

进口敞口冲击也可能导致家庭收入减少，进而导致消费减少。表 9 显示，就业下降、工资水平下降和转移支付增加等因素结合在一起，对面临日益激烈的进口竞争的当地劳动力市场的家庭收入水平和构成产生了可衡量的影响。表 9 中的模型是使用人口普查和美国社区调查(而不是上面的 BEA 转移数据)的数据估计的，发现 CZ 的进口敞口增加$1,000 会导致 CZ 的平均家庭工资和每个工作年龄成人的工资收入下降 2.14 log points (panel a 的第 2 列)或大约$549 每个工作年龄成人和年(panel B)。

The effect of import competition on household incomes is statistically significant and economically large. To confirm its plausibility, we benchmarked it against our earlier estimates of the effect of import exposure on employment and earnings among the employed. The estimates in the first two columns of Table 5 (panel B) indicate that a $1,000 per worker increase in a CZ's import exposure reduces manufacturing and non-manufacturing employment per population by 0.60 and 0.18 per- centage points, respectively. Average annual earnings in these sectors at the mid-point of our sample was $44,233 and $36,142 (in 2007 USD), implying that a $1,000 increase in trade exposure lowered labor income per capita among adults by $331 through reduced employment, with four-fifths of the fall due to reduced manufacturing employment. Turning to wages, the estimates in Table 7 imply that a $1,000 per worker rise in trade exposure reduced weekly earnings by -0.76 log points among workers employed in non-manufacturing and increased weekly earnings by 0.15 log points among workers in manufacturing. The average employment-to-population ratio in the manufacturing and non-manufacturing sectors was 10.5 percent and 59.2 percent at the mid-point of our sample. We thus calculate a further reduction in labor earnings of $156 per adult accruing from reduced weekly earnings among the employed. Combining the employment and earnings margins yields an estimated per adult reduction of $487 per $1,000 increase in trade exposure, which is similar to the per adult wage/salary impact estimate of $549 obtained in Table 9.
进口竞争对家庭收入的影响在统计上是显著的，在经济上是巨大的。为了证实其合理性，我们将其与我们早先估计的进口敞口对就业和就业人员收入的影响进行了对比。表 5(面板 B)的前两列估计表明，CZ 的进口敞口每增加 1,000 美元，制造业和非制造业就业人口分别减少 0.60 和 0.18 个百分点。在我们样本的中间点，这些行业的平均年收入分别为 44,233 美元和 36,142 美元(以 2007 年的美元计算)，这意味着 1000 美元的贸易敞口增加会导致成年人的人均劳动收入减少 331 美元，其中五分之四的下降是由于制造业就业减少。关于工资，表 7 中的估计表明，每名工人的贸易敞口增加 1000 美元，非制造业工人的周收入减少-0.76 对数点，制造业工人的周收入增加 0.15 对数点。制造业和非制造业的平均就业人口比分别为 10.5%和 59.2%。因此，我们计算出，由于受雇者每周收入的减少，每个成年人的劳动收入进一步减少了 156 美元。结合就业和收入差额，贸易敞口每增加 1 000 美元，估计每成年人减少 487 美元，这与表 9 中得出的每成年人工资/薪金影响估计数 549 美元相似。

Table 9. Imports from China and Change in Household Income, 1990-2007: 2SLS Estimates.
Dependent Variable: 10-Year Equivalent Relative Growth and Absolute Dollar Change of Average and Median Annual Household Income per Working-Age Adult (in %pts and US$)

	Average HH Income/Adult by Source				Median HH Inc./Ad.	
	Total	Wage-Salary	Business Invest	SocSec +AFDC	Total	Wage-Salary
	(1)	(2)	(3)	(4)	(5)	(6)
	A. Relative Growth (%pts)					
(Δ Imports from China to US)/Worker	-1.48 **	-2.14 **	-0.51	2.12 **	-1.73 **	-2.32 **
	(0.36)	(0.59)	(0.74)	(0.58)	(0.38)	(0.51)
R^2	0.69	0.43	0.76	0.52	0.53	0.52
	B. Dollar Change					
(Δ Imports from China to US)/Worker	-492.6 **	-549.3 **	40.1	17.3 **	-439.9 **	-476.5 **
	(160.4)	(169.4)	(116.7)	(4.3)	(112.7)	(122.2)
R^2	0.63	0.40	0.72	0.51	0.49	0.48

Notes: N=1444 (722 commuting zones x 2 time periods). Per capita household income is defined as the sum of individual incomes of all working age household members (age 16-64), divided by the number of household members of that age group. Total income comprises wage and salary income; self-employment, business and investment income; social security and welfare income; and income from other non-specified sources. Social security and welfare income in column 4 includes social security retirement, disability, and supplementary income, aid to families with dependent children (AFDC), and general assistance. All regressions include the full vector of control variables from column 6 of Table 3. Robust standard errors in parentheses are clustered on state. Models are weighted by start of period commuting zone share of national population. ~ $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Also consistent with the estimates in Table 8, we find that rising transfer income offsets only a small part of the decline in household earnings. The estimates in column 4 show that a $1,000 increase in a CZ's import exposure generates a $17 increase in average household transfer income per working age adult from Social Security and AFDC. Other sources of

transfer income, notably those that do not take the form of unrestricted cash benefits, cannot be observed in the Census data. However, given an increase in total government transfers of about $58 per person for a $1,000 increase in import exposure according to Table 8, it appears unlikely that the increase in households' transfer benefits comes anywhere close to offsetting the substantial decline in earnings.
同样与表 8 中的估计一致的是，我们发现，转移收入的增加只抵消了家庭收入下降的一小部分。第 4 列的估计显示，CZ 的进口敞口每增加 1,000 美元，就会从社会保障和 AFDC 中产生平均每个工作年龄成人的家庭转移收入增加 17 美元。其他转移收入来源，特别是不采取无限制现金福利形式的转移收入来源，在人口普查数据中看不到。但是，根据表 8，进口风险增加 1 000 美元，政府转让总额每人增加约 58 美元，因此，家庭转让收益的增加似乎不太可能抵销收入的大幅下降。

7 Exports and the factor content of trade

In this section, we consider alternative measures of trade exposure for U.S. commuting zones in order to gauge the robustness of our results.
在本节中，我们考虑美国通勤地区贸易敞口的替代措施，以衡量我们的结果的稳健性。

First, we modify our definition of import exposure to include competition in other foreign markets. China's growth not only displaces U.S. producers in the U.S. market but may also affect U.S. sales in the foreign markets that U.S. industries serve. We measure global U.S. industry exposure to import competition from China using initial U.S. exports to each market divided by the market's imputed spending on industry output (calculated under the assumptions that preferences are Cobb-Douglas and that foreign industry expenditure shares equal those in the U.S.). Following equations (1) and (3), the total exposure of U.S. region i to imports from China is,
首先，我们修改了对进口敞口的定义，将其他外国市场的竞争纳入其中。中国的增长不仅会取代美国生产商在美国市场的地位，还可能影响美国在美国工业服务的外国市场的销售。我们用美国对每个市场的初始出口除以市场对工业产出的估算支出来衡量全球美国工业在中国进口竞争中的敞口(计算的假设是，美国的偏好是柯布-道格拉斯(Cobb-Douglas)，且外国工业支出占美国的份额相等)。根据式(1)(3)，美国地区 i 对中国进口的总风险敞口为:

$$\sum_j \frac{E_{ijt}}{E_{ujt}} \frac{\Delta M_{ucjt} + \sum_{o \neq c} \frac{X_{oujt}}{X_{ojt}} \Delta M_{ocjt}}{E_{it}}.$$

This expression differs from equation (3) due to the second summation term, which captures growth in third markets' imports from China (ΔMocjt) weighted by the initial share of spending in these markets on U.S. produced goods (Xoujt=Xojt). The large share of spending most countries devote to domestic goods means that the imputed share of expenditures directed towards U.S. products is small. Allowing for U.S. exposure to China through third markets increases the mean change in China import exposure for CZs by only 21 percent.
这个表达式与方程(3)的不同之处是由于第二个累加项，它反映了第三市场从中国进口(ΔMocjt)的增长，并以这些市场对美国产品的初始支出份额(Xoujt=Xojt)加权。大多数国家的大部分支出都用于国内产品，这意味着直接用于美国产品的估算支出份额很小。允许美国通过第三方市场对中国进行敞口，只会使中国企业在中国进口敞口的平均变化增加 21%。

Panel B of Table 10 reports regression results in which we replace the import exposure measure in equation (3) with domestic plus international import exposure to Chinese trade. We adjust the instrument for import exposure in equation (4) in an analogous manner. The results are qualitatively similar to the baseline regressions in panel A and show similar patterns of statistical significance. The coefficients are smaller in absolute value, consistent with the scaling up of import exposure in the new measure. In column (1), the impact of a $1,000 increase in import competition from China on the manufacturing employment to population share falls to -0.42.
表 10 的 Panel B 报告了回归结果，其中我们用对中国贸易的国内+国际进口敞口取代方程(3)中的进口敞口测度。我们以类似的方式调整式(4)中的进口敞口仪器。结果在定性上与面板 A 中的基线回归相似，并显示类似的统计显著性模式。这些系数的绝对值更小，与新衡量方法中进口敞口的扩大一致。在列(1)中，来自中国的进口竞争增加 1000 美元对制造业就业人口份额的影响下降到-0.42。

Table 10. Adding Exposure to Indirect Import Competition or Exposure to Net Imports, 1990-2007: 2SLS and OLS Estimates.
Dependent Variables: 10-Year Equivalent Changes of Indicated Variables

	I. Employment/Pop		II. Log Wages		III. Transfers, Wage Inc	
	Mfg (1)	Non-Mfg (2)	Mfg (3)	Non-Mfg (4)	Log Transfers (5)	Avg Log HH Wage Inc (6)
A. Baseline Results: Gross Chinese Imports per Worker (2SLS)						
(Δ Imports from China to US)/Worker	-0.60 **	-0.18	0.15	-0.76 **	1.01 **	-2.14 **
	(0.10)	(0.14)	(0.48)	(0.26)	(0.33)	(0.59)
B. Domestic Plus International Exposure to Chinese Exports (2SLS)						
(Δ Domestic + Intn'l Exposure to Chinese Imports)/Worker	-0.42 **	-0.10	0.11	-0.47 **	0.87 **	-1.75 **
	(0.05)	(0.10)	(0.33)	(0.18)	(0.22)	(0.43)
C. Exposure to Final Goods and Intermediate Inputs (2SLS)						
(Δ Imports from China to US net of I'med Inputs)/Worker	-0.49 **	-0.01	0.71	-0.41	0.84 *	-1.47 ~
	(0.12)	(0.20)	(0.52)	(0.37)	(0.36)	(0.88)
D. Net Chinese Imports per Worker (2SLS)						
(Δ Net Imports of US from China)/Worker	-0.45 **	-0.09	0.45	-0.47 ~	0.73 *	-1.64 *
	(0.10)	(0.15)	(0.42)	(0.27)	(0.35)	(0.65)
E. Change in China-US Productivity Differential (OLS Gravity Residual)						
Δ Comparative Advantage China (Gravity Residual)	-0.29 **	-0.03	0.04	-0.26 ~	0.53 **	-0.93 **
	(0.04)	(0.08)	(0.28)	(0.15)	(0.14)	(0.28)
F. Factor Content of Net Chinese Imports per Worker (2SLS)						
(Δ Factor Content of Net Imports from China)/Worker	-0.57 **	-0.12	0.59	-0.66 *	0.81 *	-1.90 **
	(0.10)	(0.15)	(0.50)	(0.26)	(0.36)	(0.60)

A second issue with measuring trade exposure is that imports from China include both final goods purchased by U.S. consumers and intermediate inputs purchased by U.S. firms. If trade with China increases the variety of inputs to which U.S. producers have access, it may raise their productivity (e.g., Goldberg, Khandelwal, Pavcnik, and Topalova, 2010), increasing their demand for labor and partially offsetting the impact of import competition in final goods. Panel C of Table 10 reports results in which we measure industry import exposure using total China imports per worker less China imports of intermediate inputs per worker, in which we calculate industry imported inputs by combining U.S. trade data with the 1992 U.S. input-output table (assuming that industry patterns of input usage are the same for imports as for U.S. domestic goods). We construct the instrument for input-adjusted import exposure analogously. In column (1), the coefficient on import exposure is -0.49, 18% smaller than in panel A, and still very precisely estimated.
衡量贸易敞口的第二个问题是，从中国进口的商品既包括美国消费者购买的最终产品，也包括美国企业购买的中间投入。如果与中国的贸易增加了美国生产商能够获得的各种投入，这可能会提高他们的生产率(例如 Goldberg, Khandelwal, Pavcnik，和 Topalova, 2010)，增加他们对劳动力的需求，并部分抵消最终产品进口竞争的影响。表 10 的面板 C 报告的结果中，我们使用每个工人的中国总进口减去每个工人的中间投入的中国进口来衡量工业进口风险，其中，我们通过结合美国贸易数据和 1992 年美国投入产出表来计算工业进口投入(假设工业投入使用模式对进口产品和美国国内产品的投入使用相同)。我们以类似的方法构造输入调整进口曝光的仪器。在列(1)中，进口敞口的系数为-0.49，比 panel A 小 18%，但仍然是非常精确的估计。

Another feature missing in our analysis is U.S. exports to China. Because U.S. imports from China are much larger than U.S. exports to China, excluding exports may not greatly affect our measure of trade exposure. Incorporating exports is complicated by China and the U.S. occupying different positions in global production chains. Whereas the model we outline in section 2 treats all products as final goods, in practice firms may produce inputs in one country, export the goods to a second country for further processing, and so on until the final product is delivered to consumers (Hummels, Ishii, and Yi, 2001). China is often the final link in the supply chain owing to its comparative advantage in labor-intensive assembly, which tends to be the last stage of production (Feenstra and Hanson, 2005), meaning that goods leaving China tend to be on their way to consumers. China's place in global production suggests that although we do not explicitly account for supply chains, our approach still captures how imports from China (and from other countries whose value added is embodied in U.S. imports from China) affect the demand for U.S. goods.

我们的分析中缺少的另一个特征是美国对中国的出口。由于美国从中国的进口远远大于美国对中国的出口，排除出口可能不会对我们的贸易敞口的衡量产生很大影响。由于中国和美国在全球生产链中占据不同的位置，将出口纳入统计是一件复杂的事情。尽管我们在第 2 节中概述的模型将所有产品视为最终产品，但在实践中，企业可能在一个国家生产投入，将货物出口到另一个国家进行进一步加工，等等，直到最终产品交付给消费者(Hummels, Ishii, and Yi, 2001)。由于中国在劳动密集型组装方面的比较优势，中国往往是供应链的最后一环，而组装往往是生产的最后阶段(Feenstra and Hanson, 2005)，这意味着离开中国的商品往往是在通往消费者的路上。中国在全球生产中的地位表明，尽管我们没有明确地考虑供应链，但我们的方法仍然捕捉了来自中国的进口(以及附加值体现在美国从中国进口的其他国家的进口)如何影响对美国商品的需求。

The same is unlikely to hold for U.S. exports to China. U.S. firms tend to locate early in the production chain, meaning that U.S. products destined for China may be shipped through third countries (e.g., U.S. technology is used by Korea to manufacture chips for cell phones before these chips are sent to China for assembly and testing). Thus, there may be greater disconnect between our model and actual trade for U.S. exports to China than for U.S. imports from China.
同样的情况不太可能发生在美国对中国的出口上。美国公司倾向于定位在生产链的早期，这意味着美国产品销往中国可能会通过第三国(例如，美国技术被韩国用于制造手机芯片，然后这些芯片被送往中国进行组装和测试)。因此，与美国从中国进口相比，我们的模式与美国对华出口的实际贸易之间可能存在更大的脱节。

Despite these qualms, we construct net imports from China by subtracting U.S. exports from U.S. imports by industry, which following equation (3) yields:
尽管存在这些疑虑，我们还是通过从美国工业进口中减去美国出口来计算从中国的净进口，其结果如下式(3):

$$\sum_j \frac{E_{ijt}}{E_{ujt}} \frac{\Delta M_{ucjt}}{E_{it}} - \sum_j \frac{E_{ijt}}{E_{ujt}} \frac{\Delta X_{cujt}}{E_{it}}.$$

We instrument for the net import measure using two variables: the potential import exposure index used in prior tables (equation 4) and an analogously constructed potential export exposure measure, built using observed exports to China by industry from the eight comparison countries previously used for the potential import exposure measure. Panel D of Table 10 presents estimates. A $1,000 per worker increase in Chinese net import exposure reduces the manufacturing employment to population ratio by 0.45 percentage points. This point estimate is about 25 percent smaller and similarly precisely estimated to the model in panel A that uses gross rather than net import exposure.
我们使用两个变量来测量净进口:在之前的表中使用的潜在进口暴露指数(公式 4)和一个类似构造的潜在出口暴露测度，该测度是使用以前用于潜在进口暴露测度的八个比较国家的按行业对中国的观察出口建立的。表 10 的 D 组列出概算。中国净进口敞口每增加 1000 美元，制造业就业与人口的比例就会降低 0.45 个百分点。这个估计值比面板 A 中使用总进口敞口而不是净进口敞口的模型要小 25%，而且与面板 A 中使用的模型类似精确。

An alternative to studying net import effects that circumvents the conceptual and measurement issues discussed above is to apply the gravity residual described in the Theory Appendix. The virtue of the gravity measure is that it captures changes in the productivity or transport costs of Chinese producers relative to U.S. producers. These relative changes are the force that gives rise to both Chinese imports and U.S. exports. To interpret the scale of the gravity measure, note that a one unit increase in the gravity measure corresponds to a $1,000 per worker increase in a region's Chinese import exposure stemming from a rise in China's productivity or fall in China's trade costs. This scaling is comparable to the import exposure variable in our baseline specification with two slight differences: first, because the gravity residual corresponds to a logarithmic measure of productivity, it is appropriate to exponentiate this coefficient for comparison; second, since changes in Chinese relative productivity or trade costs will affect net rather than gross imports, the gravity estimates are most comparable to the net import exposure models in Panel D.
研究净进口效应的另一种方法是采用理论附录中描述的重力残差，这种方法可以绕过上述讨论的概念和测量问题。重力测量法的优点在于，它捕捉到了中国生产商相对于美国生产商的生产率或运输成本的变化。这些相对变化是促进中国进口和美国出口的力量。为了解释重力测量的规模，请注意，重力测量每增加一个单位，对应于一个地区的中国进口敞口因中国生产率的上升或中国贸易成本的下降而增加每个工人 1,000 美元。这一比例与我们基线规范中的进口暴露变量具有两个微小的差异:首先，因为重力残差对应于生产率的对数测量，因此适当地将该系数取指数进行比较;第二，

由于中国相对生产率或贸易成本的变化将影响净进口而不是总进口，因此引力估计与 D 组中的净进口风险模型最具有可比性。

Panel E of Table 10 use the gravity-based approach to measure the exposure of CZs to Chinese trade. Column 1 finds that a $1,000 per worker increase in net import exposure to Chinese trade resulting from rising relative Chinese productivity or falling transport costs reduces local U.S. manufacturing employment by three-tenths of one percentage point. We detect a significant positive effect of increased Chinese trade exposure on receipt of transfer benefits in CZs and a significant negative effect on household wage income of CZ residents.
表 10 的面板 E 使用基于重力的方法来衡量中国对中国贸易的敞口。第一列发现，中国相对生产率上升或运输成本下降导致的中国贸易净进口对每个工人增加 1,000 美元，会使美国当地制造业就业减少 0.3 个百分点。我们发现中国贸易敞口的增加对 CZ 地区转移收益的接收有显著的正向影响，而对 CZ 地区居民的家庭工资收入有显著的负向影响。

As a final specification, we use the factor content of U.S. net imports from China to replace imports per worker. An earlier literature, based on Heckscher-Ohlin trade theory, models trade as affecting labor markets through the import of factor services embodied in goods (Deardorff and Staiger, 1988; Borjas, Freeman, and Katz, 1997). We re-estimate our core regressions using the factor content of trade to measure import exposure in CZs. Because our data at the CZ level do not permit measurement of factor content by labor type, we treat labor as a composite factor. In panel F of Table 10, we report results in which we replace the change in imports per worker with the change in the net import of effective labor services,
作为最后的规范，我们使用美国从中国净进口的要素含量来代替每个工人的进口。早期文献基于 Heckscher-Ohlin 贸易理论，将贸易模型作为通过商品中体现的要素服务的进口来影响劳动力市场的模型(Deardorff 和 Staiger, 1988;Borjas, Freeman 和 Katz, 1997)。我们使用贸易的因素含量来衡量进口敞口，重新估计了我们的核心回归。因为我们在 CZ 层面的数据不允许按劳动类型测量因子含量，所以我们将劳动视为一个复合因子。在表 10 的面板 F 中，我们报告的结果是，我们用有效劳动服务净进口的变化替换了每个工人进口的变化，

$$\sum_j \frac{E_{ijt}}{E_{ujt}} \frac{\tilde{E}_{uj0}}{V_{uj0}} \frac{\Delta M_{ucjt}}{E_{it}} - \sum_j \frac{E_{ijt}}{E_{ujt}} \frac{\tilde{E}_{uj0}}{V_{uj0}} \frac{\Delta X_{cujt}}{E_{it}}.$$

This measure of the labor content of U.S. net imports from China calculates CZ exposure to trade by imputing labor services embodied in net imports using net imports times employment per dollar of gross shipments in U.S. industries at the national level (Euj0=Vuj0), where we measure Euj0 based on the direct plus indirect employment of labor used to manufacture goods in an industry. We instrument for the labor content of net imports from China in a manner analogous to our strategy for net imports in panel D.
这一衡量美国从中国净进口的劳动力含量的方法，计算 CZ 对贸易的敞口，计算方法是将净进口中包含的劳动力服务，用净进口乘以美国工业每美元总出货量的就业人数(Euj0=Vuj0)，Euj0 是基于工业中用于制造产品的直接和间接劳动力就业。我们用类似于图 D 中净进口策略的方式，对中国净进口的劳动力含量进行了测量。

The results in column 1 of panel F show that the net import of labor services of one U.S. worker displaces 0.81 workers in manufacturing, after adjusting for differences in the scale of the net-labor-services import measure (denominated in labor services per worker in a CZ) and the manufacturing-employment-per-population outcome (denominated in manufacturing workers per working-age population in a CZ). These impact estimates are precisely estimated and are consistent with our findings for other measures of trade exposure: larger increases in the factor content of net imports yield lower wages in non-manufacturing, higher government transfers to households, and lower household wage and salary income.
panel F 中第 1 列的结果显示，一个美国工人的净劳动力服务进口取代了制造业 0.81 个工人，在调整了净劳动力服务进口衡量标准(以每名 CZ 工人的劳动服务计算)和每人口制造业就业产出(以每 CZ 工作年龄人口的制造业工人计算)的差异后。这些影响估计是精确估计的，并且与我们对其他贸易敞口衡量指标的发现一致:净进口要素含量的大幅增加会导致非制造业工资的降低，政府向家庭转移的增加，以及家庭工资和薪金收入的降低。

Taken together, the Table 10 results suggest that our focus on Chinese imports effectively utilizes the economically consequential and well-identified variation in China trade exposure without compromising the substantive interpretation of the results.
综上所述，表 10 的结果表明，我们对中国进口的关注有效地利用了中国贸易敞口中的经济后果和识别良好的变化，而不影响对结果的实质性解释。

8 Losses in efficiency from use of public benefits and involuntary labor-force non-participation

What do our results imply about U.S. gains from trade with China? In theory, such gains are positive. Trade may lower incomes for workers exposed to import competition, but gains to consumers from increased product variety (Broda and Weinstein, 2006) and gains to firms from having inputs at lower cost and in greater variety (Goldberg, Khandelwal, Pavcnik, and Topalova, 2010) should ensure that aggregate gains from trade are larger than zero. Trade may also induce firms to invest in innovation, contributing to productivity growth (Bloom, Draca, and Van Reenen, 2009). Our finding that increased exposure to import competition is associated with lower manufacturing employment and lower wages in exposed local labor markets in no way contradicts this logic. It does, however, highlight trade's distributional consequences.

One manner in which adjustment to import competition may partly offset gains from trade is through the deadweight loss associated with individual take-up of government transfers. Such a loss is not a distributional consequence of trade but a reduction in economic efficiency associated with U.S. benefit programs. The coefficient estimate in column 1 of Table 8 implies that annual per capita transfers increase by $58 for every $1,000 of additional import exposure per worker. By multiplying this coefficient by the observed growth of exposure to Chinese imports and the fraction of this growth that we attribute to supply shocks, we obtain that rising import competition from China has been associated with an increase in annual transfers receipts of $32 and $51 per capita in 1990-2000 and 2000-2007, respectively. Using Gruber's (2010) estimate that the marginal excess burden of taxation (required to fund transfers) is equal approximately to 40 cents on the dollar, the increase in transfers resulting from import exposure implies an increase in annual deadweight loss of $13 and $21 in these two periods, or $33 in total. Applying a confidence interval of plus and minus one standard error around the point estimate for induced transfers, we estimate the range of deadweight losses at $22 to $44 per capita

Another source of efficiency loss from trade adjustment is involuntary reductions in labor force participation, which will lead to deadweight losses if the market wage of involuntarily displaced workers exceeds their value of leisure. We benchmark the magnitude of this frictional cost by estimating workers' forgone value of leisure during employment and comparing this to their market wage. The gap between these values is equal to workers' surplus from employment or, in the case of involuntary unemployment, to the magnitude of the deadweight loss.

We assume that initially workers choose hours freely, so they are indifferent at the margin between supplying an additional hour of labor and consuming an additional hour of leisure. We write

$$|w_0 u_c\left(y + w h_0, h_0\right) = -u_h\left(y + w_0 h_0, h_0\right), \tag{6}$$

where the left-hand side of this expression is equal to the marginal utility of the consumption afforded by an hour of labor at the optimal hours choice h0 and wage w0, and the right-hand side is the marginal disutility of work, or equivalently, the marginal utility of leisure. Due to risk aversion, the marginal utility of consumption is globally declining in income, so a lower bound on the consumer's loss of welfare from a reduction in income (holding labor supply constant) is the initial marginal utility of consumption times the income loss u0c. We therefore conservatively assume that uc(y + w0h0; h0) = u0 c is constant at the initial wage. Applying this simplification to (6), taking logs and differentiating yields the inverse compensated hours elasticity of labor supply:

$$\frac{\partial \ln w}{\partial \ln h} = \frac{\partial \ln \left(-u_h \left(y + w_0 h_0, h_0\right)\right)}{\partial \ln h} = \frac{1}{\eta_h}.$$

To estimate worker surplus from employment, we integrate the labor supply function over the relevant range and subtract this value from labor earnings:

$$\Delta \models w_0 h_0 - \frac{w_0 h_0}{1 + 1/\eta_h} = \frac{w_0 h_0}{\eta_h + 1}. \tag{7}$$

A higher labor supply elasticity gives workers lower surplus from employment since the wage demanded for an additional hour of labor is not much above the wage paid for the prior hour.

Next consider a trade-induced shock that leads to involuntary displacement—forcing some workers to reduce hours of work to zero—and, further, reduces the market wage that displaced workers would receive were they to hypothetically regain employment. In estimating the associated dead-weight loss, we must recognize that trade-induced employment reductions are in part volitional, stemming from the effect of falling wages on labor supply. To estimate the deadweight loss from involuntary unemployment, we first net out the voluntary labor supply reductions on the extensive (participation) and intensive (hours) margins.

We estimate these voluntary responses by applying Hicksian labor force participation and hours elasticities of e 0:25 and h 0:50, respectively, drawn from Chetty (forthcoming). Our impact estimates in Tables 5 and 6 find that a $1,000 import shock reduces wages by w = .0:76 percent and reduces labor force participation by e = .0:77 percentage points. The extensive margin elasticity of 0:25 implies that a 0:76 percent wage decline will generate a decline in labor force participation of 0:19 percent, which is roughly one quarter as large as what we observe in the data. We infer that approximately three-quarters of the trade-induced fall in employment is involuntary. Lower wages will also reduce desired hours among those who remain employed. To incorporate this response, we write the new market wage as w0 0: w0 0 < w0 with associated hours choice h0 0 h0(1 + hln (w0 0 =w0)).

Substituting these adjusted wage and hours value into equation (7) yields the welfare loss from involuntary employment,

$$\Delta' = \frac{\alpha w_0 h_0 \left[1 + \eta_h \left(\alpha - 1\right)\right]}{\eta_h + 1}, \tag{8}$$

where = w0 0 =w0 and we approximate ln (w0 0 =w0) 1+ ^ w IP Wut. This equation says that the deadweight loss from involuntary unemployment is somewhat less than workers' surplus from employment since reductions in the equilibrium wage and associated reductions in hours of work reduce worker surplus even conditional on remaining employed.

Applying these estimates, we calculate that the exogenous component of rising China trade exposure increased involuntary unemployment and non-participation by 0:32 and 0:52 percentage points, respectively, in the first and second periods of our sample, with associated reductions in earnings per capita of $65 and $106. Using equation (8) to calculate the loss in worker surplus, we estimate deadweight losses from involuntary unemployment of $43 and $69 per capita. Allowing for a one standard error band for the estimated impact of trade exposure on the employment rate, we obtain a deadweight loss due to involuntary unemployment of $87 to $137 per capita during 1990 through 2007.

As affected workers retire or pass away, the trade-induced losses from either the transfers they receive or involuntary unemployment will dissipate whereas the gains from trade should persist. Nevertheless, in the medium run losses in economic efficiency from increased usage of public benefits and involuntary labor-force non-participation may offset a portion of the gains from trade from China.

9 Conclusion

The value of annual U.S. goods imports from China increased by a staggering 1,156% from 1991 to 2007, whereas U.S. exports to China grew by much less. The rapid increase in U.S. exposure to trade with China and other developing economies over this period suggests that the labor-market consequences of trade may have increased considerably relative to earlier decades. Much previous research has studied the effects of imports on manufacturing firms or employees of manufacturing industries. By analyzing local labor markets that are subject to differential trade shocks according to initial patterns of industry specialization, our paper extends the analysis of the consequences of trade beyond wage and employment changes in manufacturing. Specifically, we relate changes in manufacturing and non-manufacturing employment, earnings, and transfer payments across U.S. local labor markets to changes in market exposure to Chinese import competition. While most observed trade flows into the U.S. are the result of both supply and demand factors, the growth of Chinese exports is largely the result of reform-induced changes within China: rising productivity growth, greater investment in labor-intensive export sectors, and a lowering of trade barriers. In light of these factors, we instrument for the growth in U.S. imports from China using Chinese import growth in other high-income markets.
从 1991 年到 2007 年，美国每年从中国进口的商品价值增长了惊人的 1,156%，而美国对中国的出口增长却少得多。在此期间，美国与中国和其他发展中经济体的贸易往来迅速增加，这表明，与前几十年相比，贸易对劳动力市场的影响可能大幅增加。以往的许多研究都研究了进口对制造业企业或制造业员工的影响。通过分析根据行业专业化的初始模式而受到差异贸易冲击的当地劳动力市场，我们的论文扩展了对制造业中工资和就业变化以外的贸易后果的分析。具体来说，我们将美国当地劳动力市场制造业和非制造业就业、收入和转移支付的变化与中国进口竞争对市场的影响联系起来。虽然大多数观察到的流入美国的贸易流是供需因素共同作用的结果，但中国出口的增长在很大程度上是中国内部改革引发的变化的结果:生产率增长加快，劳动密集型出口行业投资增加，贸易壁垒降低。鉴于这些因素，我们利用中国在其他高收入市场的进口增长来衡量美国从中国进口的增长。

Our analysis finds that exposure to Chinese import competition affects local labor markets not just through manufacturing employment, which unsurprisingly is adversely affected, but also along numerous other margins. Import shocks trigger a decline in wages that is primarily observed outside of the manufacturing sector. Reductions in both employment and wage levels lead to a steep drop in the average earnings of households. These changes contribute to rising transfer payments through multiple federal and state programs, revealing an important margin of adjustment to trade that the literature has largely overlooked. Comparing two CZs at the 75th and 25th percentiles of rising Chinese trade exposure over the period of 2000 through 2007, we find a differential increase in transfer payments of about $63 per capita in the more exposed CZ. The largest transfer increases are for federal disability, retirement and in-kind medical payments. Unemployment insurance and income assistance play a significant but secondary role. By contrast, Trade Adjustment Assistance (TAA), which specifically provides benefits to workers who have been displaced by trade shocks, accounts for a negligible part of the trade-induced increase in transfers.
我们的分析发现，面对来自中国的进口竞争，不仅会影响当地劳动力市场，制造业就业也会受到不利影响(这一点并不令人意外)，而且还会影响许多其他方面的利润。进口冲击引发工资下降，这主要发生在制造业以外。就业和工资水平的下降导致家庭平均收入的急剧下降。这些变化通过多个联邦和州项目促进了转移支付的增加，揭示了一个重要的贸易调整幅度，这在很大程度上被文献忽略了。比较 2000 年至 2007 年期间中国贸易敞口上升的第 75 和 25 个百分点的两个 CZ，我们发现，在敞口更大的 CZ，转移支付的差异增长约为 63 美元。转移支付增加最多的是联邦残疾、退休和实物医疗支付。失业保险和收入援助起着重要但次要的作用。相比之下，贸易调整援助(TAA)，专门为因贸易冲击而失业的工人提供福利，在贸易导致的转移增长中只占微不足道的一部分。

Theory suggests that trade with China yields aggregate gains for the U.S. economy. Our study highlights the distributional consequences of trade and the medium-run efficiency losses associated with adjustment to trade shocks. The consequences of China trade for U.S. employment, household income, and government benefit programs may help account for the apparent public ambivalence toward globalization and specific anxiety about increasing trade with China.
理论上，与中国的贸易给美国经济带来了总体收益。我们的研究强调了贸易的分布后果和与贸易冲击调整相关的中期效率损失。对华贸易对美国就业、家庭收入和政府福利项目的影响，可能有助于解释公众对全球化明显的矛盾心理，以及对对华贸易增长的特定焦虑。