U.S. Market Concentration and Import Competition*

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April 5, 2021

Abstract

A rapidly growing literature has shown that market concentration has increased in the U.S. over the last decades. Using confidential Census data for the manufacturing sector, we show that typical measures of concentration, once adjusted for competition by foreign exporters, actually stayed constant between 1992 and 2012. We reconcile these findings by linking part of the increase in domestic concentration to import competition. Although concentration among U.S.-based firms rose, the growth of foreign firms, mostly at the bottom of the sales distribution, counteracted this increase. We find that higher import competition caused a decline in the trade-adjusted market shares of the top-20 U.S. firms.

Key Words: market concentration, markups, import competition, international trade

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1 Introduction

A growing literature has documented that U.S market concentration has increased over the last decades (e.g., Van Reenen (2018), Grullon, Larkin, and Michaely (2019), Autor et al. (2020)). This literature has largely focused on concentration among domestic U.S. firms. However, given that import penetration has more than doubled since the early 1990s, taking account of foreign firms may be critical in understanding the evolution of market concentration.

In this paper, we analyze the evolution of U.S. market concentration taking into account the full distribution of firms' sales in the U.S. manufacturing sector, comprising all foreign and domestic firms. We show that once the market shares of foreign firms are taken into account, market concentration did not rise, but instead remained flat between 1992 and 2012. We reconcile this finding with the previously documented rise in domestic concentration by showing that the growth of foreign firms, mostly at the bottom of the sales distribution, counteracted the increase in concentration among U.S.-based firms. Moreover, we show that higher import competition caused a decline in the trade-adjusted market shares of the top-20 U.S. firms.

Our findings draw on comprehensive micro data from the U.S. Census Bureau, which enable us to uncover a number of new stylized facts underpinning market concentration patterns. The data comprise the universe of firm sales, both domestic and foreign, in the manufacturing sector in the U.S. for the census years (every 5 years) between 1992 to 2012. Importantly, these data provide the sales of foreign firms with firm identifiers instead of import values at a more aggregated level, which are typically used. We remove within-firm import transactions using related-party trade flags provided by the Census, and define a market at the 5-digit NAICS industry level spanning across all of the U.S. national market.[1] Each firm can operate in more than one industry, and we construct a firm's market shares for each industry in which it is active.

Our first new stylized fact is that market concentration in the U.S. manufacturing sector has been stable between 1992 and 2012 when we adjust the conventional market share measures for trade. This result is nearly entirely driven by the increased market share of foreign firms (i.e., U.S. imports). We find that adjusting the conventional concentration measures by netting out U.S. firms' exports from their total sales makes little difference to the conventional market concentration trend.

Second, these new results are not driven by just a handful of industries. The trade adjustment reduces the rise in concentration in a broad range of industries with increasing concentration and amplifies the fall in concentration in a number of industries with declining concentration. Focusing on the market share of the top 20 firms as our preferred concentration measure, we find that only 91 out of 169 industries showed a rise in trade-adjusted concentration compared to 119 industries with the conventional measure.

Third, foreign entrants have mostly increased their market share in the lower part of the market

1. Whether one focuses on the U.S. national market or more local markets should depend on how tradeable the sector is. As our analysis focuses only on the manufacturing sector, we define the market at the national level. We also experiment with more aggregate industry definition at the 4-digit level and find the same conclusions.

share distribution, with only a few firms entering among the top 20. In principle, a larger import share would be consistent with either rising or falling concentration, dependent on where in the market share distribution foreign firms enter. We find that the entry of foreign firms with small market shares is responsible for the flat trend in the trade-adjusted market concentration measure.

Our fourth stylized fact shows that trade-adjusted market concentration rose mostly in those industries with a relatively low import penetration in 1992, which are also those industries that experienced the slowest growth in import competition over the following 20 years. In contrast, concentration actually fell in most industries with high growth in import penetration. Effectively, the adjustment to market concentration measures matters the most where foreign firms play a significant role.

Did tougher import competition cause a decline in trade-adjusted market concentration? In order to establish a causal relationship between import competition and concentration, we need exogenous shocks that shift the world supply of goods to the U.S. To this end, we construct time-varying industry instruments for U.S. importing, using a novel methodology developed by Amiti and Weinstein (2018). This methodology was previously applied in a different context (in banking). We then perform an industry-level regression of the 5-year change in top-20 market concentration on the change in import penetration, using two-stage least squares. Our results show that a one standard deviation increase in import penetration reduced the trade-adjusted market shares of the top-20 U.S. firms by 3 percentage points. In contrast, when we compute market shares in the conventional way, we find that import competition actually increased concentration. These contrasting results highlight the importance of the definition of a market in understanding the relationship between import competition and concentration. If we only consider the sales of the top U.S. firms relative to the sales of other U.S. firms, then we see that larger firms are gaining market share in industries with tougher import competition, and hence concentration appears to rise. However, comparing the market share of the top U.S. firms to all sales in the U.S. market, inclusive of foreign firms' sales, we find that large U.S. firms' sales share is actually shrinking. In support of these results, we find that the number of U.S. firms fell as a result of higher import competition, a finding consistent with Feenstra and Weinstein (2017).

Our paper relates to a growing literature on market concentration. Autor et al. (2020) focus on the link between the rising labor share and market concentration, which they attribute to the rise of superstar firms, also using confidential Census data. They make an attempt to adjust market concentration measures for imports, but only do this at the industry-level with six country groups each representing one firm. Even with this adjusted concentration measure they still find a negative correlation between industry level labor share measures and concentration measures. Our approach differs in that we use firm-level data of individual exporters to individual U.S. importers. Gutiérrez and Philippon (2017) and Bonfiglioli, Crinò, and Gancia (forthcoming) adjust their concentration measures with commercially available foreign firm-level data from PIERS. However, these data only include seaborne data, which accounts for half of total trade, and the trade values and product codes

are imputed. In addition, the domestic firm component only includes publicly listed U.S. firms' total sales. The advantage of our data is that it comprises the entire distribution of domestic and foreign firms selling to the U.S. in manufacturing, which is necessary to get an accurate picture of the trend in market concentration. Benkard, Yurukoglu, and Zhang (2021) define product markets based on consumption and show that under this alternative definition concentration has actually declined since 1994. Our paper also modifies the standard definition of a market by incorporating foreign firms, and shows that under this definition concentration has remained virtually unchanged.

Our paper also contributes to the literature studying the consequences of rising concentration for aggregate markups. While markups are generally not observed, a large class of models implies that a firm's market share is a sufficient statistic for markups (Mrázová and Neary (2017), Amiti, Itskhoki, and Konings (2019)). Our work indicates that once foreign firms are taken into account competition may not have declined, and hence markups may not have risen as much as implied by conventional concentration measures.

The rest of the paper is organized as follows. Section 2 describes the confidential Census data. Section 3 describes the stylized facts, section 4 presents the results from the regression analysis, and Section 5 concludes.

2 Data and Measurement

Our analysis relies on three highly disaggregated datasets from the U.S. Census Bureau. The first dataset is the Census of Manufacturing for 1992-2012, which provides, among other things, the total sales for each manufacturing establishment in the U.S. every five years. We merge into this dataset each establishment's time-consistent 6-digit North American Industrial Classification (NAICS) 2007 industry code constructed by Fort and Klimek (2018), and define an industry at the more aggregated 5-digit NAICS level so that we can accommodate the mapping to international trade data below. Our unit of analysis will therefore be the 5-digit NAICS-firm level, where each of a firm's major outputs is counted in its corresponding industry. Our analysis covers 169 time-consistent NAICS industries for the manufacturing sector.

The new data we bring to the analysis of U.S. market concentration is transaction-level import data from the Longitudinal Firm Trade Transactions Database (LFTTD) of the Census Bureau. This dataset contains transaction-level data from U.S. customs forms, covering the universe of U.S. imports since 1992. Critically, these data contain an identifier for the foreign exporter, which enables us to construct the market shares of the foreign sellers in the U.S.[2] Each transaction contains a ten-digit Harmonized Tariff System (HTS10) code for the product traded (comprising around 21,000 product codes), which we map to the 5-digit NAICS industry in which the product is most likely sold using the import concordance by Pierce and Schott (2012) in each year. We adjust these concordances to take account of revisions over time in the NAICS and HTS10 codes and adjust inconsistent map-

2. We clean the foreign exporter identifiers to obtain unique foreign firm names following Kamal and Monarch (2018). These data have been used in other contexts, see, e.g., Heise (2019).

pings from HTS10 to 5-digit NAICS. We show the robustness of our results to more aggregate 4-digit industry definitions in the online appendix.

An important feature of the LFTTD is that it contains an indicator for whether a transaction is conducted between related parties, as documented in Bernard, Jensen, and Schott (2009).[3] For each U.S. firm, we use this information to omit related-party imports that fall within an industry in which the firm is active. This approach aims to avoid double counting the imports of final goods obtained from a U.S. firm's plants abroad and sold in the U.S. market, since these will already be counted in the firm's domestic sales. However, we do keep the related-party imports that fall into an industry in which the U.S. firm is not selling. These imports are counted as the foreign firm's sales in that industry.

The final dataset we use is firm-level export data, also recorded in the LFTTD. As in the import data, we map the HTS10 code of the product traded to its corresponding NAICS industry code. We construct the domestic sales of U.S. firms in each industry by subtracting the firms' exports from their total sales. We net out both related-party and arm's-length exports, since both are likely to be counted in a firm's total sales.

Market concentration We construct market concentration measures using each firm f's market share, S^i_{ft}, within each 5-digit NAICS industry i in each census year t,

$$S^i_{ft} = \frac{sales^i_{ft}}{\sum_f sales^i_{ft}}. \tag{1}$$

These sales shares are usually constructed using U.S. firms' total shipments, i.e., domestic sales plus their exports. We adjust the conventional market share measure as follows: (i) we subtract exports from U.S. firms' total sales to get to their domestic sales; and (ii) we include sales to the U.S. market by all foreign firms. Critically, this means that the sales in the U.S. market in the denominator are summed across all firms, both foreign and U.S. firms, rather than just U.S. firms. We show below that the trade-adjusted market shares differ significantly from those constructed using total shipments.

Armed with these trade-adjusted market share measures, we can construct concentration measures by industry-year as the sum of the market shares of the top X firms active within the industry, where X is typically 4 or 20, or sum across the squared market shares of the whole distribution to construct the Herfindahl-Hirschman Index (HHI). We will focus on the top-20 measure of concentration throughout the paper, and report robustness to the other two measures in the online appendix.

3 Stylized Facts

In this section, we present a number of new stylized facts about market concentration in the U.S.

3. Based on Section 402(e) of the Tariff Act of 1930, related party trade consists of import transactions between parties with "any person directly or indirectly, owning, controlling, or holding power to vote, [at least] 6 percent of the outstanding voting stock or shares of any organization."

Fact 1. *Market concentration in U.S. manufacturing, adjusted for foreign firms, has remained stable between 1992 and 2012.*

Figure 1 plots the top-20 concentration measures, averaged across all manufacturing 5-digit NAICS industries, between 1992 and 2012. The conventional market concentration measure, depicted by the solid red line, shows an upward trend in concentration in the last two decades. This upward trend is consistent with a large literature (see for example Van Reenen (2018)) which constructs concentration measures using total sales data for all firms located in the U.S. In contrast, when we adjust the market concentration measure for trade, we find that the trend is flat between 1992 and 2012, depicted by the solid blue line in Figure 1. Interestingly, it turns out that subtracting U.S. firms' exports from their total shipments makes little difference to the trend in concentration, as shown by the dashed blue line, and so it is the inclusion of the foreign firms' sales that is responsible for this new finding.[4]

It is important to note that our trade adjustment could go in either direction as it affects both the numerator and the denominator of firms' market shares in equation 1, and hence concentration. The denominator is likely to have increased over the sample period as imports have grown dramatically over this time. Adjusting the denominator for total imports could in principle be done using publicly available industry level data, however, in practice it requires the micro data to assign establishments to time-consistent NAICS industries. Moreover, for the trade-adjusted measure, the micro data are needed to remove related party trade and to net out exports for the manufacturing firms in our sample, excluding for example exports of wholesalers. For a complete picture it is necessary to also make the appropriate adjustment to the numerator, which requires U.S. firm-level export data to convert U.S. firms' total sales to domestic sales, as well as knowledge of foreign firms' sales in the U.S. to determine the market shares of all firms within each industry.

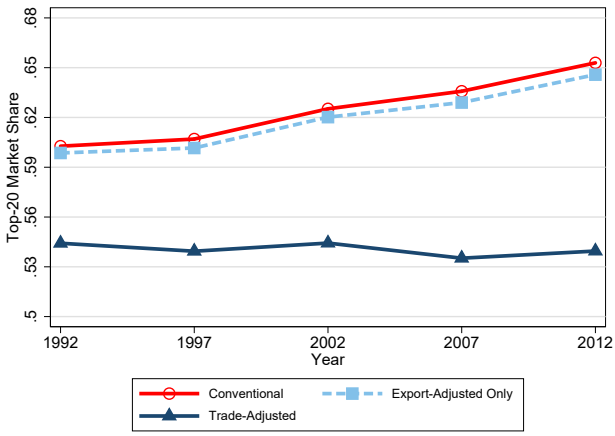
Fact 2. *Adjusting for trade affects market concentration in a broad cross-section of industries. In industries with increasing concentration the adjustment attenuates the rise and in industries with decreasing concentration it magnifies the decline.*

Is the lack of a rise in market concentration once we account for trade driven by a few large industries or does adjusting for trade reduce concentration more broadly? To explore this question, Figure 2 plots the change between 1992 and 2012 in the conventional top-20 concentration measure on the x-axis against the change in the trade-adjusted top-20 concentration on the y-axis as a bin scatter. We bin the industries by ranking them by the change in their conventional concentration measure, and then combine them into 20 groups of 8-9 industries each.[5] Each bubble depicts one of these groups, with the size of the bubble proportional to the industry group's total *absorption*, defined as total sales (or shipments) by U.S. firms minus exports plus total imports. The figure shows that nearly all of the bubbles are below the 45-degree line, indicating that the adjustment for trade resulted in a smaller increase in concentration in almost all industry groups. However,

4. We show in the online appendix that these patterns are robust to aggregating across industries using sales weights and to defining the market concentration measures as top 4 or HHI.

5. Census disclosure rules prevent us from disclosing top-20 market shares for individual industries.

Figure 1: Top-20 Market Concentration



Notes: Data is for census years: 1992, 1997, 2002, 2007, and 2012. The "Conventional" line is a conventional market concentration measure of the top 20 firms only using total sales data of firms located in the U.S. The "Export-Adjusted" line subtracts U.S. firms' exports from their total sales. The "Trade-Adjusted" line uses all firms' sales in the U.S. irrespective of where the firm is located. The top 20 market share concentration measure is the average across all NAICS 5-digit manufacturing industries.

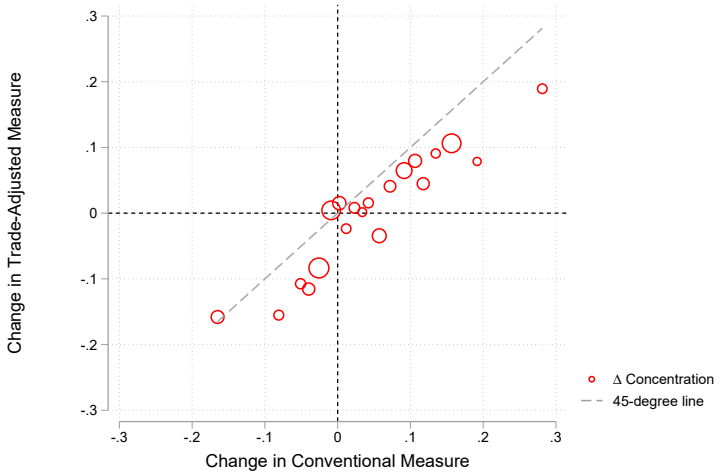
there is a wide range in the size and direction of changes in concentration, and even with the trade-adjusted measure concentration rose in a number of industries, as shown by the bubbles in the top right quadrant. We find that between 1992 and 2012, the unadjusted concentration measure rose in 119 industries, accounting for 62% of total absorption in 1992. In comparison, once we account for trade, concentration rose in only 91 industries, accounting for 59% of absorption. Moreover, these industries experienced a much smaller increase in concentration than under the conventional measure, as shown in the figure.

Fact 3. *Foreign firms have increased their presence among the top 20 firms, but their share in the top 20 remains low. Foreign firms' largest growth has been in the bottom part of the sales distribution.*

How foreign firms affect U.S. market concentration depends on how they change the distribution of firms' market shares, which we explore in Figure 3.

First, Figure 3a shows that foreign firms have increased their presence in the top 20 firms, but their average share in the top 20 remains low. We take the top 20 firms based on our trade-adjusted measure in each industry and split them into two groups, foreign and domestic. We then compute the total market share of each group, and plot the kernel density of these market shares across industries. The figure shows that the market share of foreign firms in the top 20 is relatively small, and below 10% in the vast majority of industries (red lines). However, there has been a shift in the density to the right, indicating that in the average industry the market share of foreign firms in the top 20 has grown. We omit from the graph the cases where the foreign market share in the top 20 was zero. The number of such industries falls from 108 industries in 1992 to 76 industries in 2012, consistent with the trend of a growing foreign presence. In contrast to the foreign firms, the distribution of market shares of domestic firms in the top 20 has shifted to the left (blue lines), indicating that the average

Figure 2: Change in Top-20 Market Concentration across Industries, 1992-2012



Notes: The figure plots the change in the market share of the top-20 firms between 1992 and 2012 under the conventional measure (x-axis) against the change in the top-20 share with trade adjustment (y-axis). Each bubble is a group of 8 or 9 industries, where industries are grouped by their change in the conventional top-20 share between 1992 and 2012. The size of each bubble is proportional to the total absorption of the industry in 1992, defined as total shipments less exports plus imports.

market share of domestic firms in the top 20 has fallen. However, in the median industry domestic firms in the top 20 still account for about 40%-50% of the market.

Second, Figure 3b shows that foreign firms entered the U.S. market mostly at the bottom of the sales distribution. We slice the data by each firm's ranking in the trade-adjusted market share distribution within an industry. The height of each bar gives a weighted average across industries of the market shares of firms with a given rank. We aggregate across industries using each industry's absorption in 1992. Summing over the bars of firms with rank 1 to 20 gives a weighted average analogue to the solid blue in Figure 1 in 1992 and 2012.[6] Consistent with the earlier figure, we see that the trade-adjusted market shares of the top 20 firms barely changed between 1992 and 2012.

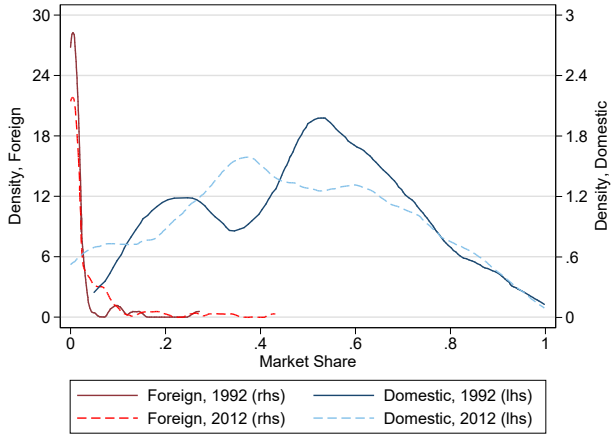
To see which part of the distribution is affected most by the foreign firms, we depict the average market share of only the foreign firms within each bin with diamonds, where we set foreign firms' market share to zero if there are no foreign firms of that rank in a given industry. Thus, the diamonds give the percentage point contribution of foreign firms to the total share of manufacturing sales accounted for by firms of a given rank. A clear pattern emerges, showing that the largest growth in foreign shares is in the bottom part of the distribution. Foreign firms with rank a rank higher than fifty more than doubled their market share from 6.9 percent to 14.4 percent. The foreign shares of the top ranked firms remained low on average, below 3 percent for each of the top seven bins.

The difference between the top of each bar and the diamond gives the market share of the domestic firms in the top 20. The figure indicates that the concentration of domestic firms has increased,

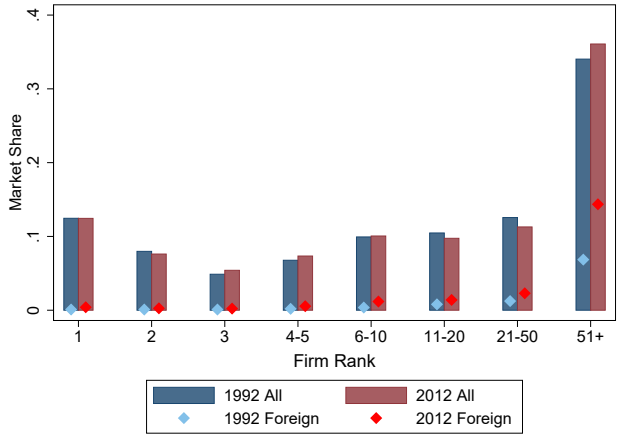
6. In the online appendix, we show Figure 1 using sales weights. Trade-adjusted concentration in that figure is exactly corresponds to the bars of firms with rank 1 to 20.

Figure 3: Market Share Heterogeneity

(a) Density of Top-20 Market Shares



(b) Average Share by Rank



Notes: The left panel, a, plots the kernel densities of the summed market shares of domestic firms in the top 20 (blue lines) and of foreign firms in the top 20 (red lines) across industries. For foreign firms, we omit from the density industries in which no foreign firms are in the top 20, and hence the density includes only non-zero values. In the right panel, b, each set of bars plots the weighted average trade-adjusted market share across industries of the firms with the rank noted on the x-axis, where we weight the market shares by each industry's absorption in 1992. The diamonds depict the percentage point contribution of the foreign firms within each ranking.

consistent with the red line in Figure 1. Specifically, we see that the market share of domestic firms declined at in all the bins with ranks above 10, while their market share at the top ranks remained approximately unchanged, consistent with a rise in domestic concentration.

Overall, these patterns shed light on the evolution of aggregate market concentration in the U.S. manufacturing sector. Although U.S. firms have become more concentrated among themselves, their share has fallen once we take account of the large influx of foreign firms. Most of the foreign growth share has been in the lower tail of the distribution, but also some growth in the 6 to 50 ranked firms. If this growth moves to the upper part of the distribution, we would then see higher imports coincide with higher market concentration. We next directly relate the change in concentration to a change in imports.

Fact 4. *Market concentration fell the most in industries with high import penetration.*

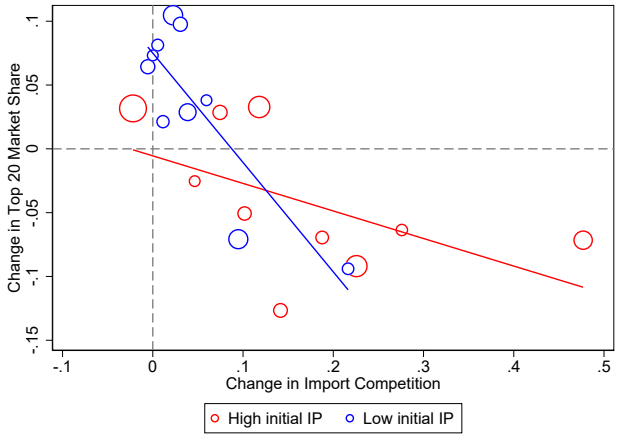
We proxy for import competition with import penetration for each industry i in year t, as follows:

$$IP_t^i = \frac{Imports_t^i}{Absorption_t^i}, \tag{2}$$

where absorption is equal to sales less exports plus imports, as defined above. Based on our import measure which excludes some related party trade, aggregate import penetration has increased by nearly 9 percentage points over our sample period, from 10.7 percent to 19.2 percent.

Figure 4 illustrates that the industries with the largest increase in import competition showed the slowest growth in trade-adjusted market concentration. The figure plots an industry's change in

Figure 4: Change in Market Concentration and Import Penetration



Notes: The figure presents a bin scatter plot of the change in the top 20 trade-adjusted market concentration between 1992 and 2012 on the y axis against the change in import penetration, defined as the change in imports between 1992 and 2012, divided by inital absorption in each industry. The size of each dot is proportional to industry absorption in 1992.

import penetration between 1992 and 2012 against the change in trade-adjusted concentration over the same period. We distinguish industries with a below-median level of import competition in 1992 (blue dots) from those with above-median import competition (red dots), and sort industries within each of these two groups into ten deciles based on their change in import competition between 1992 and 2012. We take a weighted average of the change in import penetration and the change in the top-20 market share across the industries in each decile, using the absorption of each industry in 1992 as weight. The figure shows that the behavior of concentration is strikingly different for the industries with low import competition in 1992 compared to those with high initial import competition. Most industries with above-median import penetration in 1992 experienced further increases in foreign competition in subsequent years and almost no change or even a decline in concentration. Examples include audio and video equipment manufacutring, semi-conductor and electronic components, sand curtain and linen mills.[7] In contrast, the industries with low initial import penetration continued to have a low share of foreign firms, and showed the largest growth in market concentration. For example, concrete industries. Effectively, the adjustment to the market concentration measure matters the most where foreign firms play a significant role. How this growth in foreign entry causally affects market concentration is a question we turn to next.

4 Market Concentration and Import Competition

We analyze whether increased import competition caused a decline in market concentration. Since changes in imports will partially be due to changes in U.S. demand, to isolate the causal effect of import competition on U.S. firms we need exogenous shocks that shift the world supply of goods to the U.S. To this end, we construct time-varying instruments for U.S. imports using a methodol-

7. These examples are based on publicly available Census data for 1997 to 2012.

ogy developed in Amiti and Weinstein (2018), which was applied in a different context (in banking). This approach builds on the methodology developed by Autor, Dorn, and Hanson (2013), with adjustments to further address the possibility that rest-of-the-world supply shocks are correlated with the demand shocks in the U.S. Our instrument has the desirable property that it strips out any U.S.-specific factors.

To provide intuition for this methodology, we start with a standard fixed effects regression model, with

$$\triangle M^i_{jkt} = \alpha^i_{kt} + \beta^i_{jt} + \epsilon^i_{jkt}, \tag{3}$$

where $\triangle M^i_{jkt}$ is the percentage change in imports from country j to country k in a 5-digit NAICS industry i over the 5-year period up to time t. The dependent variable is regressed on importer country-industry-time fixed effects, α^i_{kt}, and exporter country-industry-time fixed effects, β^i_{jt}. The coefficients on these fixed effects isolate the change in imports due to conditions in the importer country and the exporter country, respectively, holding fixed the other component.

These coefficients could in principle be recovered using fixed effects estimation. However, the dependent variable is in percentage changes and is therefore not defined for any new importer-exporter country-industry trading relationship, which leads to biased estimates in cases where the share of new relationships is high. We overcome this problem by using the Amiti and Weinstein (2018) approach, which enables us to include these new trading relationships in the estimation of the coefficients in equation (3).[8]

We estimate α^i_{kt} and β^i_{jt} with bilateral HS 6-digit import data from UN COMTRADE[9], collapsed to the bilateral 5-digit time-consistent NAICS level, for the countries making up the top-fifty U.S. trading partners, which cover more than 90% of U.S. trade. Importantly, we also include the U.S. as an exporter j and an importer k in the estimation. By including the U.S., we can strip out any U.S.-specific effects that might be correlated with the exporter and importer shocks in other countries, and hence obtain export supply shocks that are cleaned of U.S. demand effects.

To construct export supply shocks at the industry-level, we aggregate across all countries j within each NAICS industry i:

$$Instrument \triangle IP^i_t = \sum_{j \neq US} w^i_{j,t-5} \hat{\beta}^i_{jt} \tag{4}$$

where the weights are the 5-year lagged total imports of industry i from country j as a share of total absorption of that industry i, and $\hat{\beta}^i_{jt}$ are the estimated coefficients from equation (3), relative to their industry-year median. This variable will serve as an instrument for import competition, which we proxy for with the percentage change in import penetration, following Autor, Dorn, and Hanson

8. Amiti and Weinstein (2018) show that this methodology is equivalent to a weighted least squares esitmation with lagged values as weights when there are no new trade relationships. The sum of the predicted values aggregates exactly to the country-level imports. See the online appendix for more details.

9. https://comtrade.un.org/db/default.aspx

(2013), as follows:

$$\triangle IP_t^i = \frac{Imports_t^i - Imports_{t-5}^i}{Absorption_{t-5}^i}.$$

We estimate the effect of import competition on market concentration using two-stage least squares:

$$\triangle C_{20,t}^i = \gamma \triangle IP_t^i + \delta_t + \epsilon_{i,t}, \tag{5}$$

where $\Delta C_{20,t}^i$ is the 5-year change in top-20 concentration in industry i in year t. All regressions include time fixed effects and are weighted by 5-year lagged industry shipments or absorption.

The results are presented in Table 1.[10] First, we consider the effect of import competition on the conventional market concentration measures of the top 20 U.S. firms. Using OLS estimation in column 1, we find a negative but insignificant coefficient. However, when we instrument for import competition in column 2, we find a positive significant coefficient, equal to 0.25. This result implies that a one standard deviation increase in import penetration results in a 2 percentage point increase in market concentration when we define it in the conventional way, consistent with the upward sloping red line in Figure 1.

Next, we turn to the trade-adjusted market concentration measures. We adjust firms' market shares by trade and rank them in terms of their domestic sales as a share of absorption. We study the impact of import competition on the top 20 U.S. firms under this alternative ranking. Note that these firms are potentially different than the ones used to construct the solid blue line in Figure 1, which includes both foreign and domestic firms. In column 3, we estimate equation (5) using the trade-adjusted market concentration measure with OLS, and we find a negative and significant coefficient. This finding indicates that higher import competition reduced the market share of the top-20 U.S. firms, as a share of total absorption. In column 4, we instrument for import penetration and find a significantly negative coefficient of larger magnitude than in the OLS estimation, equal to -0.32. Our estimate implies that a one standard deviation increase in import penetration results in a 3 percentage point fall in the market share of the top-20 U.S firms. Aggregating across industries and time, we predict a decline of 0.8 percentage points in the top-20 U.S. firms market concentration due to import competition between 1997 and 2012. Since over the time period considered the weighted average concentration of the top-20 U.S. firms fell by 1.6 percentage points, our predicted effect is about half as large as the actual effect.

How can we reconcile the positive coefficient in column 2 with the negative one in column 4? The key to understanding these results is to consider how to define the market in which a firm competes. If we ignore the sales of foreign firms in the U.S. market, we find that large firms are taking a larger share of U.S. firms' total sales in industries with more import competition. It is likely that the large firms are less hurt by foreign competition than small firms, if for example they adjust their markups.[11] However, once we consider the total sales in the U.S. market, inclusive of imports,

10. We show unweighted regression results and results using 1992 weights in the online appendix.

11. In many models, large firms reduce markups in response to increased competition, see for example Atkeson and Burstein (2008). See De Loecker et al. (2016) for empirical support showing that that import competition reduces markups.

Table 1: Regressions

	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	ΔC_{20}	ΔC_{20}	ΔC_{20}	ΔC_{20}	ΔNfirms	ΔNfirms
Trade adjusted	no	no	yes	yes		
ΔIP_t	-0.041	0.247**	-0.263***	-0.321***	0.254*	-2.243***
	(0.031)	(0.110)	(0.029)	(0.089)	(0.150)	(0.567)
First Stage		ΔIP_t		ΔIP_t		ΔIP_t
instrument$_{\Delta IP_t}$		0.347***		0.375***		0.375***
		(0.048)		(0.048)		(0.048)
Predicted Effects		0.004		-0.008		
Actual		0.030		-0.015		
Weighted	shipments$_{t-5}$		absorption$_{t-5}$		absorption$_{t-5}$	
N	500	500	500	500	500	500

Notes: Decimals have been rounded to four significant digits per Census Bureau disclosure guidelines. Number of observations has been rounded to hundreds. Mean of ΔIP_t is 0.052, standard deviation is 0.098. The predicted effects are calculated by first predicting the change in import penetration as the first-stage coefficient times the instrument, and then multiplying this by the second stage coefficient and aggregating across all industries using 5-year lagged absorption weights for the trade-adjusted measure and 5-year lagged U.S. shipment weights for the conventional measure.

the share of the top 20 U.S. firms is actually falling, as foreign firms take over some of their market share. Specifically, as shown in Figure 1 above, the market share of the top 20 firms inclusive of foreign firms was basically flat over this time period. We further see in column 6 that the number of U.S. firms in industries with increased import competition also falls.

5 Conclusion

In this paper, we have shown that once the increasing market shares of foreign exporters to the U.S. are taken into account, market concentration in U.S. manufacturing actually stayed constant between 1992 and 2012. Moreover, we find that tougher import competition caused a decline in U.S. firms' sales as a share of total industry sales. Our findings have important implications for the discussion of the effects of rising concentration on firm outcomes such as markups. Standard models (such as Atkeson and Burstein (2008)) link an increase in markups to an increase in market concentration. Looking through the lens of these models suggests that if concentration has not increased due to the presence of foreign firms, then aggregate markups may not have risen as much as predicted by the rise of concentration among U.S. firms alone.

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Supplemental Material

A Data Construction

Census of Manufacturing This dataset contains the universe of U.S. manufacturing establishments from the Census. We obtain from this dataset the total sales (also referred to as shipments) for each manufacturing establishment in the U.S. every five years over the period 1992-2012. We merge into this dataset each establishment's time-consistent 6-digit North American Industrial Classification (NAICS) 2007 industry code constructed by Fort and Klimek (2018).

To address measurement errors in reporting, we clean the data by dropping establishments whose industry code splits over time into more than 100 possible NAICS codes and establishments with missing NAICS codes. We also drop inactive establishments with zero employees.

To facilitate the merge with the trade data, we aggregate across establishments to the firm - 5-digit NAICS level. Thus, a firm with establishments active in multiple industries would be recorded in each of these industries with the corresponding sales. We take account of revisions over time in the NAICS codes, resulting in a time-consistent industry aggregation of 169 NAICS at the 5-digit for the manufacturing sector. We drop outlier firms whose increase of the sales/employees ratio between year $t-5$ and year t is above the 99.5th percentile and whose sales/employee ratio in year t is above the 99.5th percentile of that industry-year.

Longitudinal Firm Trade Transactions Database (LFTTD) The LFTTD dataset provides transaction-level data for the universe of all U.S. imports. Critically, it contains an identifier for the foreign exporter in addition to the identifier for the U.S. importer for each transaction. Since the foreign firm identifier differs across establishments of the same foreign firm and we are interested in the foreign firm-level exports to the U.S., we follow the methodology by Kamal and Monarch (2018) and replace the exporter ID with a shortened identifier that contains only the country ISO code and the name portion of the ID.[12] Transactions with a missing foreign firm identifier account for 1.1% of total imports and 0.2% of total sales (imports plus domestic sales) in the U.S.. We keep imports with missing identifier for the denominator of the market shares. We drop all transactions with a negative value and imports flagged as warehouse entries.

The LFTTD also contains an indicator for whether a transaction is conducted between related parties. Based on Section 402(e) of the Tariff Act of 1930, a related party trade is an import transaction between parties with "any person directly or indirectly, owning, controlling, or holding power to vote, [at least] 6 percent of the outstanding voting stock or shares of any organization". To correct for missing or incorrect related party flags, we classify an importer-exporter pair as related if it had a related party flag for any transaction in the given year. We drop related-party imports when the

12. The overall foreign exporter ID is a combination of the exporter's country, its name, and the street address. Kamal and Monarch (2018) find that the number of the shortened identifiers is consistent with the total number of exporters to the U.S. from other countries' trade statistics.

industry code of the imports fall within the same NAICS code as the U.S. firm's shipments, as these products are unlikely to have any additional value added, and keep related-party imports that are not within the firm's output industry. This step removes about 34% of U.S. imports.

Each import transaction also contains a ten-digit Harmonized Tariff System (HTS10) code for the product traded, which we map to NAICS codes using the import concordance by Pierce and Schott (2012). We adjust this condordance to take account of revisions over time in the HTS10 and inconsistent mappings from HTS10 to NAICS. We finally aggregate across transactions to the foreign exporter - year - 5-digit NAICS level.

In addition to U.S. imports, the LFTTD also provides transaction-level data on U.S. firms' exports. We clean the export data by keeping only domestic exports, and map the HTS10 product codes to time-consistent NAICS codes analogously to the import data. We then construct the domestic sales of U.S. firms in each industry by subtracting exports from total shipments. We net out both related-party and arms'-length exports from total shipments, since both are likely to be counted in a firm's total shipments. We drop all export transactions that we cannot map to a manufacturing firm in the CMF.

B Derivation of Trade Shocks

We provide some more details on the construction of the trade shocks that we use to construct the instrument in our regressions. Start with a standard fixed effects regression model:

$$\triangle M^i_{jkt} = \alpha^i_{kt} + \beta^i_{jt} + \epsilon^i_{jkt}, \tag{6}$$

where the dependent variable is the change in imports from country j to k at time t in industry i. The right-hand side variables are source country-industry-time fixed effects and destination country-industry-time fixed effects. In order to identify these coefficients, there must be a connected set of source country and destination country trade, and the error term must satisfy $E[\epsilon^h_{jkt}] = 0$.

A major shortcoming in using standard fixed effects estimation to estimate the coefficients is that the dependent variable is undefined for new trading relationships, i.e., country-industry pairs that trade in t but not in $t-5$. So the gap between the predicted aggregate imports and actual imports is going to depend on how important new trading relationships are in explaining the variation in aggregate trade. Our methodology overcomes this problem by incorporating new trade relationships, estimating supply and demand shocks that exactly match aggregate imports. In fact, the methodology collapses to weighted least squares estimation, with lagged trade weights, and the dependent variable defined as the percentage change in trade, if there are no new trade relationships (see Amiti and Weinstein (2018) Appendix A for proof).

The percentage change in a country j's total exports of industry i, D^i_{jt}, can be obtained by summing equation (6) cross all destination countries k; and the percent change in a country k's total imports of industry i, D^i_{kt}, can be obtained by summing equation (6) across all source countries to

give us the following moment conditions:

$$D^i_{jt} \equiv \frac{\sum_j M^i_{jkt} - \sum_j M^i_{jk,t-5}}{\sum_j M^i_{jk,t-5}} = \beta^i_{jt} + \sum_j \phi^i_{jk,t-5}\alpha^i_{kt}, \text{with } \phi^i_{jk,t-5} \equiv \frac{M^i_{jk,t-5}}{\sum_k M^i_{jk,t-5}};$$

and

$$D^i_{kt} \equiv \frac{\sum_k M^i_{jkt} - \sum_k M^i_{jk,t-5}}{\sum_i M^i_{jk,t-5}} = \alpha^i_{kt} + \sum \theta^i_{jk,t-5}\beta^i_{jt}, \text{with } \theta^i_{jk,t-5} \equiv \frac{M^i_{jk,t-5}}{\sum_i M^i_{jk,t-5}}.$$

These are I+J equations in I+J unknowns, which will produce unique α^i_{kt} and β^i_{jt} up to a numeraire. These adding up constraints ensure that exporting equals importing, and the predicted values will exactly match aggregate exporting at the exporting country level, importing-level, and time-level. Note that the denominator in the above equation is country $j's$ total expors of industry i, as it is summed across imports from all the countries that imported that product at time $t-5$, so new relationships that form between these countries will still be included provided there was an export to at least one country in industry i.

C Additional Results

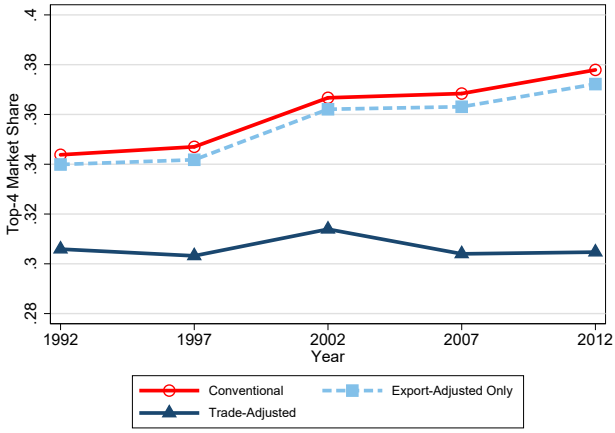
C.1 Alternative Measures of Market Concentration

We show that trade-adjusted market concentration remained virtually unchanged between 1992 and 2012 using alternative measures of concentration and using different weighting approaches.

Figure C.1 shows the evolution of the top 4 concentration measure and Figure C.2 shows the HHI. As in the main text, each figure shows the evolution of concentration under the conventional measure using the total sales of all firms located in the U.S. (red solid line), an "export-adjusted" measure that subtracts U.S. firms' exports (blue dashed line), and a trade-adjusted measure that also includes the sales of foreign firms (blue solid line). While the conventional and export-adjusted measures increase over time, the trade-adjusted measure is flat or decreasing.

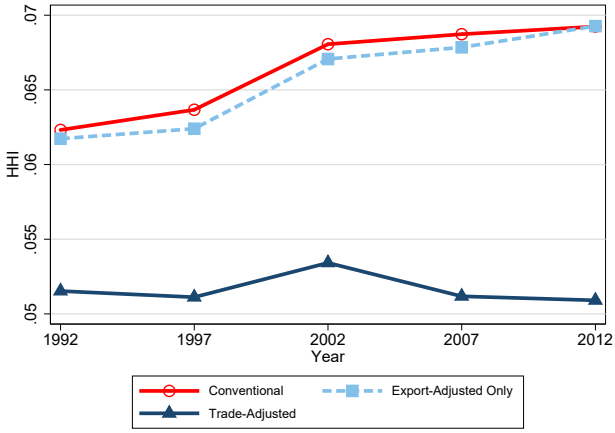
Figures C.3 to C.5 present similar measures, where we aggregate across industries using sales weights. For the "Conventional" measure we weight each industry by its U.S. firms' total shipments in 1992, for the "Export-Adjusted" measure we use shipments minus exports in 1992, and for the "Trade-Adjusted" measure we use total absorption in 1992, i.e., shipments minus exports plus imports. We find similar results to before.

Figure C.1: Top-4 Market Concentration



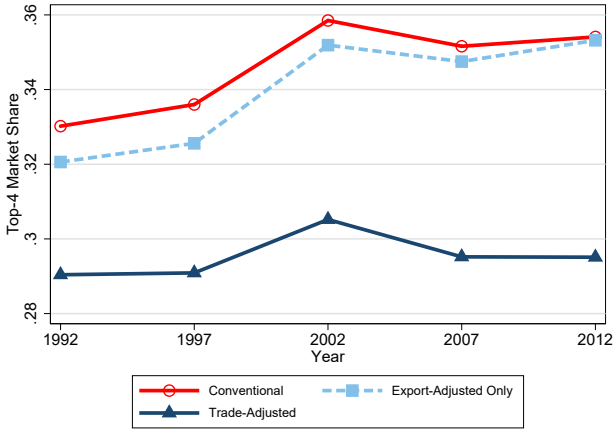
Notes: Data is for census years: 1992, 1997, 2002, 2007, and 2012. The "Conventional" line is a conventional market concentration measure of the top 4 firms only using total sales data of firms located in the U.S. The "Export-Adjusted" line subtracts U.S. firms' exports from their total sales. The "Trade-Adjusted" line uses all firms' sales in the U.S. irrespective of where the firm is located. The top 4 market share concentration measure is the average across all NAICS 5-digit manufacturing industries.

Figure C.2: Herfindahl-Hirschmann Index (HHI)



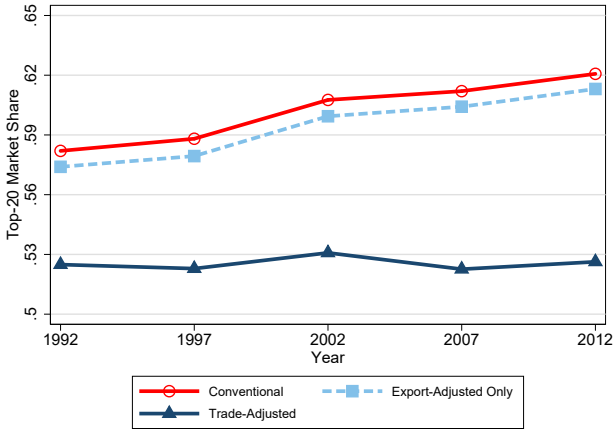
Notes: Data is for census years: 1992, 1997, 2002, 2007, and 2012. The "Conventional" line is a conventional HHI measure using total sales data of firms located in the U.S. The "Export-Adjusted" line subtracts U.S. firms' exports from their total sales. The "Trade-Adjusted" line uses all firms' sales in the U.S. irrespective of where the firm is located. The HHI measure is the average across all NAICS 5-digit manufacturing industries.

Figure C.3: Top-4 Market Concentration (Weighted)



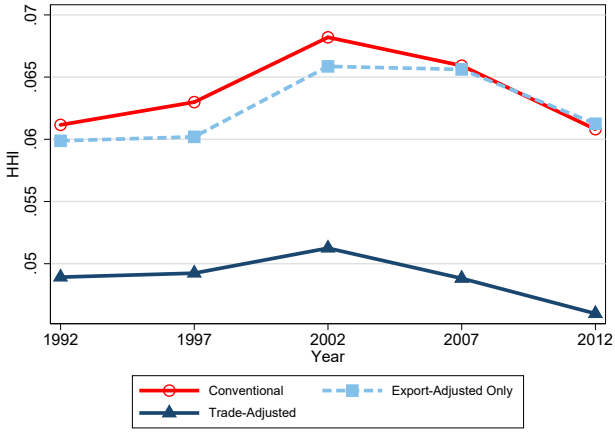
Notes: Data is for census years: 1992, 1997, 2002, 2007, and 2012. The "Conventional" line is a conventional market concentration measure of the top 4 firms only using total sales data of firms located in the U.S. The "Export-Adjusted" line subtracts U.S. firms' exports from their total sales. The "Trade-Adjusted" line uses all firms' sales in the U.S. irrespective of where the firm is located. The top 4 market share concentration measure is the weighted average across all NAICS 5-digit manufacturing industries. For the "Conventional" measure we weight each industry by its U.S. firms' total shipments in 1992, for the "Export-Adjusted" measure we use shipments minus exports in 1992, and for the "Trade-Adjusted" measure we use total absorption in 1992, i.e., shipments minus exports plus imports.

Figure C.4: Top-20 Market Concentration (Weighted)



Notes: Data is for census years: 1992, 1997, 2002, 2007, and 2012. The "Conventional" line is a conventional market concentration measure of the top 4 firms only using total sales data of firms located in the U.S. The "Export-Adjusted" line subtracts U.S. firms' exports from their total sales. The "Trade-Adjusted" line uses all firms' sales in the U.S. irrespective of where the firm is located. The top 20 market share concentration measure is the weighted average across all NAICS 5-digit manufacturing industries, using each industry's sales in 1992 as weight. For the "Conventional" measure we weight each industry by its U.S. firms' total shipments in 1992, for the "Export-Adjusted" measure we use shipments minus exports in 1992, and for the "Trade-Adjusted" measure we use total absorption in 1992, i.e., shipments minus exports plus imports.

Figure C.5: Herfindahl-Hirschmann Index (HHI) (Weighted)

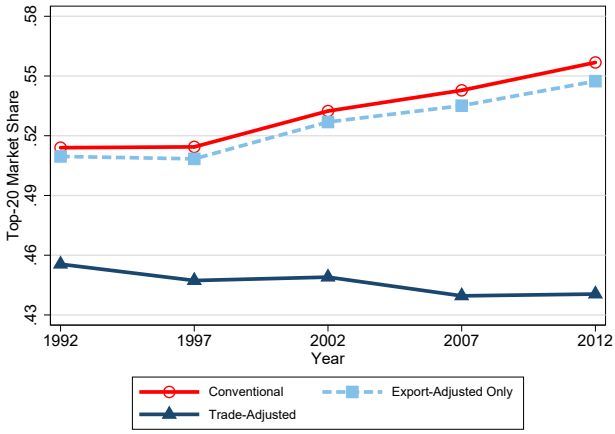


Notes: Data is for census years: 1992, 1997, 2002, 2007, and 2012. The "Conventional" line is a conventional HHI measure using total sales data of firms located in the U.S. The "Export-Adjusted" line subtracts U.S. firms' exports from their total sales. The "Trade-Adjusted" line uses all firms' sales in the U.S. irrespective of where the firm is located. The HHI measure is the weighted average across all NAICS 5-digit manufacturing industries. For the "Conventional" measure we weight each industry by its U.S. firms' total shipments in 1992, for the "Export-Adjusted" measure we use shipments minus exports in 1992, and for the "Trade-Adjusted" measure we use total absorption in 1992, i.e., shipments minus exports plus imports.

C.2 Aggregation at the 4-Digit NAICS Level

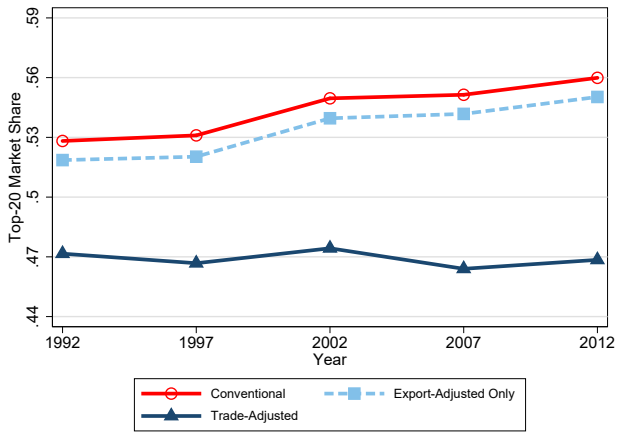
We present the top-20 concentration measure computed at the 4-digit NAICS level. Figure C.6 presents an unweighted average across industries and Figure C.7 presents a weighted average. The results are similar to the 5-digit aggregation.

Figure C.6: Top 20 Market Share, NAICS 4-Digit Aggregation



Notes: Data is for census years: 1992, 1997, 2002, 2007, and 2012. The "Conventional" line is a conventional market concentration measure only using total sales data of firms located in the U.S. The "Export-Adjusted" line subtracts U.S. firms' exports from their total sales. The "Trade-Adjusted" line uses all firms' sales in the U.S. irrespective of where the firm is located. The top 20 market share concentration measure is the average across all NAICS 4-digit manufacturing industries.

Figure C.7: Top 20 Market Share, NAICS 4-Digit Aggregation (Weighted)



Notes: Data is for census years: 1992, 1997, 2002, 2007, and 2012. The "Conventional" line is a conventional market concentration measure only using total sales data of firms located in the U.S. The "Trade-Adjusted" line uses all firms' sales in the U.S. irrespective of where the firm is located. The top 20 market share concentration measure is the average across all NAICS 4-digit manufacturing industries - solid lines are simple averages and dashed lines are sales weighted averages. The top 20 market share concentration measure is the weighted average across all NAICS 4-digit manufacturing industries, using each industry's sales in 1992 as weight. For the "Conventional" measure we weight each industry by its U.S. firms' total shipments in 1992, for the "Export-Adjusted" measure we use shipments minus exports in 1992, and for the "Trade-Adjusted" measure we use total absorption in 1992, i.e., shipments minus exports plus imports.

C.3 Alternative Regression Weightings

We present the regression results where we do not weight the regression or where we use sales weights in 1992. Table C.1 presents the unweighted regression results. Table C.2 presents the results using 1992 weights. The results are broadly similar to the main text.

Table C.1: Unweighted Regression Results

	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	ΔC_{20}	ΔC_{20}	ΔC_{20}	ΔC_{20}	ΔNfirms	ΔNfirms
Trade adjusted	no	no	yes	yes		
ΔIP_t	-0.007	0.122*	-0.184***	-0.339***	0.106*	-0.959***
	(0.023)	(0.072)	(0.026)	(0.081)	(0.098)	(0.325)
First Stage		ΔIP_t		ΔIP_t		ΔIP_t
instrument$_{\Delta IP_t}$		0.446***		0.446***		0.446***
		(0.056)		(0.056)		(0.056)
Predicted Effects		0.003		-0.009		
Actual		0.046		-0.016		
N	500	500	500	500	500	500

Notes: Decimals have been rounded to four significant digits per Census Bureau disclosure guidelines. Number of observations has been rounded to hundreds. Mean of ΔIP_t is 0.052, standard deviation is 0.098. The predicted effects are calculated by first predicting the change in import penetration as the first-stage coefficient times the instrument, and then multiplying this by the second stage coefficient and taking a simple average across all industries.

Table C.2: Regression Results with 1992 Sales Weights

	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	ΔC_{20}	ΔC_{20}	ΔC_{20}	ΔC_{20}	ΔNfirms	ΔNfirms
Trade adjusted	no	no	yes	yes		
ΔIP_t	-0.025	0.209**	-0.238***	-0.289***	0.219	-2.298***
	(0.027)	(0.089)	(0.028)	(0.083)	(0.140)	(0.539)
First Stage		ΔIP_t		ΔIP_t		ΔIP_t
instrument$_{\Delta IP_t}$		0.383***		0.390***		0.390***
		(0.050)		(0.049)		(0.049)
Predicted Effects		0.005		-0.008		
Actual		0.033		-0.016		
Weighted	shipments$_{1992}$		absorption$_{1992}$		absorption$_{1992}$	
N	500	500	500	500	500	500

Notes: Decimals have been rounded to four significant digits per Census Bureau disclosure guidelines. Number of observations has been rounded to hundreds. Mean of ΔIP_t is 0.052, standard deviation is 0.098. The predicted effects are calculated by first predicting the change in import penetration as the first-stage coefficient times the instrument, and then multiplying this by the second stage coefficient and aggregating across all industries using 1992 absorption weights for the trade-adjusted measure and 1992 U.S. shipment weights for the conventional measure.