U.S. Market Concentration and Import Competition*

Mary Amiti
Federal Reserve Bank of New York

Sebastian Heise
Federal Reserve Bank of New York

July 14, 2023

Abstract

Many studies have documented that the sales concentration of U.S. producers has risen in recent decades. In this paper, we show that this increase was accompanied by more entry and growth of foreign competitors. Using confidential census data covering the universe of all firm sales in the U.S. manufacturing sector, we find that rising import competition increased concentration among U.S. firms by reallocating sales from smaller to larger U.S. firms and by causing firm exit. However, this increase in *production* concentration was counteracted by the expansion of foreign firms, which reduced domestic firms' share of the U.S. market inclusive of foreign firms' sales. We find that once the sales of foreign exporters are taken into account, U.S. market concentration in manufacturing was stable between 1992 and 2012.

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

JEL Classifications: F14, F60, L11

*Amiti: Federal Reserve Bank of New York. 33 Liberty Street, New York, NY 10045 (email: mary.amiti@ny.frb.org); Heise: Federal Reserve Bank of New York (email: sebastian.heise@ny.frb.org). We would like to thank George Alessandria, Costas Arkolakis, Doireann Fitzgerald, Oleg Itskhoki, Marc Melitz, Peter Neary, Brent Neiman, Andrés Rodríguez-Clare, John Van Reenen, David Weinstein, and seminar participants for insightful comments. We thank Sean Fulmer, Meghana Gaur, Karen Ni, Aidan Wang, and Julia Wu for excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily represent those of the Federal Reserve Bank of New York or the Federal Reserve System or those of the U.S. Census Bureau. The Census Bureau's Disclosure Review Board and Disclosure Avoidance Officers have reviewed this information product for unauthorized disclosure of confidential information and have approved the disclosure avoidance practices applied to this release. This research was performed at a Federal Statistical Research Data Center under FSRDC Project Number 1883 (CBDRB-FY21-P1883-R8915, CBDRB-FY21-P1883-R10633).

1 Introduction

A salient feature of the U.S. economy is the increasing dominance of large firms. Many studies have documented that sales concentration has risen among U.S. firms in recent decades (e.g., Gutiérrez and Philippon (2017), Van Reenen (2018), Covarrubias, Gutiérrez, and Philippon (2019), Grullon, Larkin, and Michaely (2019), Autor et al. (2020), and Barkai (2020)). The common approach to measuring concentration computes market shares based on where the sales originate (i.e., in the U.S.), and includes all sales irrespective of where they are destined (i.e., including sales to foreign markets). For questions relating to market power in the labor market, this conventional concentration measure, which we refer to as *production concentration*, is indeed the appropriate measure. Greater production concentration is associated with a decline in the labor share (Autor et al. (2020)) and can reduce workers' bargaining power and wages (Jarosch, Nimczik, and Sorkin (2019)).

Another reason for the close attention to concentration is that it is often interpreted as a proxy for market power in the product market. The link between market concentration and product market power derives from a large class of models where a firm's market share is a sufficient statistic for markups (e.g. Mrázová and Neary (2017), Amiti, Itskhoki, and Konings (2019)). However, this result rests on an appropriate definition of a market, which focuses on the destination of the sales. We refer to this theory-consistent measure, relevant for market power in the product market, as *market concentration.* Importantly, we cannot infer product market power from trends in production concentration, since that measure is based on where shipments are produced. For example, a car sold in the U.S. is unlikely to be competing with a car destined for Japan. Instead U.S. firms compete with other U.S. firms as well as with foreign firms selling in the U.S. market. To capture the full set of all competitors requires knowledge of the universe of all firms' sales to the U.S. market, which is rarely available.

We fill this gap by examining the full distribution of all firms' market shares in the U.S. manufacturing sector, using confidential data from the U.S. Census Bureau for the census years (every 5 years) from 1992 to 2012, providing the first comprehensive measures of market concentration. Critically, the data include the sales of all domestic firms (located in the U.S.) and all foreign firms (located abroad) selling in the U.S. market, which we can track with foreign-firm identifiers. In addition, the data also include related-party indicators, enabling us to make appropriate adjustments for U.S. firms importing from their affiliates. Having firm-level data for all foreign firms is essential because it is not only the share of imports by industry that matters for market concentration but the distribution of these firm sales. For example, an increase in imports of 10 percentage points would have very different implications for market concentration if the additional sales were from one hundred foreign firms than if they were all from one foreign firm. We define the market at the 5-digit NAICS industry level, and construct a time-consistent mapping between industries and product-level imports and exports over the entire period.

Our analysis uncovers several new stylized facts. First, once foreign firms' sales are taken into account, we find that average market concentration across U.S. manufacturing industries did not rise but instead remained flat between 1992 and 2012. This result can easily be understood from standard international trade theory, such as Melitz (2003) and Arkolakis et al. (2019) (ACDR). In these models, trade liberalization increases production concentration among domestic firms due to reallocation from small inefficient firms to large firms, while simultaneously exposing domestic firms to tougher product market competition. The resulting fall in the domestic firms' share in total sales is counteracted by the rise in the share of foreign firms' sales in the U.S. market. Under the added assumptions that firms' productivity is Pareto distributed and that there are no fixed costs of accessing foreign or domestic markets, as in ACDR, these two effects completely offset each other, resulting in no change in market concentration.

Second, we show that the growth of foreign firms' market shares was mostly at the bottom of the sales distribution. In some models, an increase in imports could be consistent with either rising or falling concentration if the Pareto distribution assumption does not hold or if foreign and domestic firms face different fixed costs of market entry (e.g., Melitz (2003) and Chaney (2008)). Our comprehensive firm-level data allows us to pinpoint in which part of the market share distribution foreign firms enter. We find that, on average, the entry of foreign firms with small market shares counteracted the increase in concentration among U.S.-based firms, generating the flat aggregate trend in market concentration.

Our third stylized fact shows a negative relationship between the change in import competition and the change in market concentration. There was a larger fall in market concentration in industries that experienced stronger growth in import competition between 1992 and 2012, which are also the industries that already had high import penetration at the beginning of the sample. In contrast, market concentration rose in most industries with low import penetration. Effectively, production concentration and our market concentration measures differ the most in industries where foreign firms play a significant role. In import-competing industries, such as electronics, the two measures differ significantly – these are the industries that were further liberalized and became less concentrated. By contrast, industries like concrete do not export or import much and thus do not face increased competition from foreign firms. Importantly, our results are not driven by just a handful of industries. We find that the inclusion of foreign firms attenuates the rise in concentration in a broad range of manufacturing industries.

The number of foreign firms competing in the U.S. market has significantly increased, reflected in the doubling of import penetration in recent decades. Did tougher import competition affect U.S. 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 Bartik-type instruments for U.S. imports, using a novel methodology developed by Amiti and Weinstein (2018). We estimate industry-level regressions of the five-year change in concentration on the change in import penetration, using two-stage least squares. Our results are consistent with the predictions of standard trade theory. We find that production concentration, measured as total sales of the top-20 domestic firms as a share of only domestic firms' sales, increases with import penetration. In contrast, higher import penetration leaves market concentration unchanged: the share of the top-20 domestic firms in all firms' sales falls, but this decline is counteracted by a rise in the sales share of foreign firms among the top-20 largest firms in each industry. We also provide evidence of import penetration affecting the extensive margin, reducing the number of domestic firms active in the market. The patterns we find are relatively stronger in industries in which goods are more substitutable.

The findings in our paper have important implications for market power in the product market. Seen through the lens of ACDR, our new finding that market concentration was unchanged over the last few decades suggests that aggregate markups were also unchanged. Since markups are generally unobserved, and their estimation is beyond the scope of this paper, it is useful to consider model-based mappings from market shares to markups. Feenstra and Weinstein (2017) show that a weighted average share of each country's Herfindahl-Hirschman Index (HHI) is a sufficient statistic for aggregate markups in a model with translog preferences. They find that Herfindahl indexes in the U.S. fell between 1992 and 2005 once they take account of U.S. imports.[1] Our work suggests that once foreign firms exporting to the U.S. are taken into account, domestic firms' market power in the U.S. manufacturing sector may have actually declined.

Our results also have implications beyond the possible effects on markups. The distribution of market shares matters for a range of economic outcomes. Rising market power has been associated with a decline in investment (Gutiérrez and Philippon (2017)), a fall in business dynamism (Akcigit and Ates (2019, 2021)), lower productivity growth (De Ridder (2023)), and lower wage-to-price pass-through (Heise, Karahan, and Şahin (2022)). For aggregate consumer welfare, the relevant industry-level prices are a market-share weighted average of prices across all firms active in the industry, including foreign firms. Berthou et al. (2019) emphasize that welfare is related to the weighted average productivity of domestic and foreign firms selling in a market, using these firms' market shares as weights.[2]

Our paper relates to a growing literature on market concentration. A number of studies have shown a rise in concentration by constructing production concentration measures with the confidential census data, e.g, Autor et al. (2020). However, none of these studies have included the sales of all foreign exporters in the U.S. using firm-level foreign exporter data. A second set of studies have defined a market at the local geographical level instead of the national level: Rossi-Hansberg, Sarte, and Trachter (2021) find that local concentration of sales and employment has declined over the last

1. Empirical evidence on the evolution of markups in the U.S. is mixed: while De Loecker, Eeckhout, and Unger (2020) find that markups in the U.S. have increased significantly over the last decades, Traina (2018) and Karabarbounis and Neiman (2018) find relatively unchanged markups, and Gutiérrez and Philippon (2017) and Hall (2018) show a moderate increase in markups in most industries. In studies of other countries, De Loecker et al. (2016) and Edmond, Midrigan, and Xu (2015) find that lower import tariffs reduced markups in India and Taiwan, respectively, and Amiti, Itskhoki, and Konings (2014, 2019) provide evidence that large firms reduced their markups in response to lower competitor prices in Belgium.

2. Instead, aggregate productivity is typically measured as a weighted average across domestic firms, using their total sales as weights. Although aggregate productivity of domestic firms is of policy interest as it relates to economic growth, for welfare one needs to also take account of foreign firms' productivity.

few decades using publicly available NETS data, whereas a more recent study by Autor, Patterson, and Van Reenen (2023), using confidential Census data, finds that local employment concentration fell and local sales concentration rose. Other studies that have used alternative definitions of a market have found declining concentration trends: Freund and Sidhu (2017) define the market at the global level; Bonfiglioli, Crinò, and Gancia (2021) focus only on exporters to the U.S.; and Benkard, Yurukoglu, and Zhang (2021) consider more narrowly defined products at the national level. Defining the relevant market is an open question and largely depends on the question at hand. In general, whether one should focus on the U.S. national market or more local markets depends on how tradable the sector is and whether one's interest is in market power in product or labor markets.[3] Since our focus is on the manufacturing sector, where omitting foreign sales is likely to matter because output is tradable, we define the market at the national level and use the most disaggregated industry level our data allows.[4]

The rest of the paper is organized as follows. Section 2 presents the empirical framework, and Section 3 describes the data. Section 4 describes the stylized facts, Section 5 presents the regression results, and Section 6 concludes.

2 Empirical Framework

A commonly used measure of sales concentration is the sum of the market shares of the top 4 or 20 firms. An alternative measure is the HHI, defined as the sum of squares of all market shares within an industry. Previous studies (e.g., Grullon, Larkin, and Michaely (2019), Autor et al. (2020)) find increasing concentration for all of these measures. What is critical in these measures is the definition of the market over which sales shares are computed. Let f index firms, and denote by F^{US} the set of firms located in the U.S. (U.S. firms) and by F^{*} the set of firms located in the rest of the world selling to the U.S. market (foreign exporters). The standard approach is to define market shares only for domestic firms using shipment data, as follows:

$$S^{P}_{ift} = \frac{shipments_{ift}}{\sum_{f \in F^{US}} shipments_{ift}}, \tag{1}$$

where $shipments_{ift}$ denotes a U.S. firm f's total sales, both domestic sales and exports, in industry i in year t.[5] This equation defines market shares over all firms within industry i located in the U.S. We refer to concentration measures based on this definition of market shares as *production concentration*, since the measure uses only shipments produced in the U.S.

However, if we are interested in concentration as an indicator of market power in the product market, we need to construct market concentration using all sales in the U.S market. Specifically, for

3. For example, for services such as hair cuts a local market measure would be more appropriate. Similarly, local measures are informative for monopsony power in the labor market.

4. We provide robustness at different industry levels of aggregation. We were unable to extend our analysis beyond manufacturing because foreign export sales data at the firm-industry level are unavailable for other sectors.

5. Publicly available U.S. Census data only report concentration measures for U.S. firms, using their total shipments. Note that U.S. firms include establishments of foreign-owned firms that are located in the U.S.

U.S. firms we need to subtract exports from their total shipments and compute the size of the overall market including foreign firms' exports to the U.S. Similarly, for foreign firms, we need to take their exports to the U.S. market and divide by the total market size. Thus, market shares are computed as:

$$S_{ift} = \begin{cases} \frac{shipments_{ift} - exports_{ift}}{\sum_{f\in F^{US}}\left(shipments_{ift} - exports_{ift}\right) + \sum_{f\in F^{*}} exports^{*}_{ift}} & \text{if} \quad f \in F^{US} \\ \\ \frac{exports^{*}_{ift}}{\sum_{f\in F^{US}}\left(shipments_{ift} - exports_{ift}\right) + \sum_{f\in F^{*}} exports^{*}_{ift}} & \text{if} \quad f \in F^{*} \end{cases}, \tag{2}$$

where the top row computes the market share of domestic firms and the bottom one computes the market share of foreign firms, and $exports^{*}_{ift}$ are foreign firms' exports to the U.S. Summing over all exports by foreign firms to the U.S. yields total U.S. imports. Critically, in both expressions the denominator sums the sales of all firms selling to the U.S. market, by both domestic firms and foreign firms. We refer to concentration measures based on this definition of market shares as *market concentration*.

Standard trade theory generates predictions for how a fall in trade costs affects market shares (e.g. Melitz (2003), Bernard et al. (2003), Arkolakis et al. (2019)). We draw on Arkolakis et al. (2019) (ACDR) to illustrate the underlying forces as this model assumes the standard monopolistic competition market structure as in the canonical Melitz (2003) model but features variable markups, providing clear predictions for both market concentration and aggregate markups. In ACDR, a fall in trade costs causes the exit of relatively inefficient firms (which are small) and lowers the remaining firms' domestic sales due to increased foreign competition. Domestic firms reduce their markups as a consequence. At the same time, lower trade costs allow additional foreign exporters to enter the domestic market, and existing foreign exporters increase their sales. Foreign firms expand their markups as a result. By a symmetric argument, lower trade costs allow U.S. exporters (which tend to be large) to increase their sales abroad, and these additional exports tend to more than offset the loss of domestic sales for the largest exporters. Since small U.S. firms shrink while large U.S. firms tend to increase their total sales, production concentration, using the market shares in equation (1), rises. By contrast, the domestic market share of U.S. firms falls, using equation (2) and summing across only the U.S. firms, due to the additional entry and growth of foreign firms in the U.S. market.

The question is what happens to the overall market concentration, computed using the market shares in equation (2) summed across both U.S. and foreign firms, and to aggregate markups. In the ACDR model, where productivity is assumed to have a Pareto distribution and there are no fixed costs of market entry, market concentration remains unchanged in response to a reduction in variable trade costs, since the rise in the foreign firms' market shares exactly offsets the fall in the domestic firms' market shares. Moreover, the markup distribution is also invariant to a decline in trade costs.[6] The two opposing forces exactly offset because the assumption that the productivity distribution is

6. Importantly, this does not mean that there are no gains from trade: trade weakly lowers all prices, which benefits consumers, and increases aggregate efficiency. This outcome still holds in the absence of gains from variety, in the absence of changes in markups, and in the absence of changes in concentration.

Pareto means that it has the same shape parameter regardless of the productivity cutoff.[7]

In contrast, there are a number of trade models where the impact of a trade liberalization on market concentration cannot be unambiguously signed. For example, in the canonical Melitz (2003) model and in Chaney (2008), the change in market concentration can go in either direction since it depends on the market share of the marginal foreign entrant relative to the market share of the marginal domestic firm.[8] The invariance of the market share distribution result holds in a Melitz model only if we assume Pareto distributed productivity and fixed costs of entering a market that are identical for foreign and domestic firms.

Overall, these theories highlight that more concentration among domestic firms, i.e., higher production concentration, is consistent with less market power because of increased competition from foreign firms. While the effect of a trade liberalization on market concentration is generally ambiguous, several standard trade models predict that it has no effect on market concentration. We next examine the relationship between market concentration and trade liberalization empirically.

3 Data

Our analysis relies on three highly disaggregated datasets from the U.S. Census Bureau. We briefly discuss these data here and provide more details in Appendix A.1.

The first dataset is the Census of Manufactures (CMF) for 1992-2012, which reports the total sales for each manufacturing establishment in the U.S. every five years. We merge into this dataset time-consistent North American Industrial Classification (NAICS) 2007 industry codes for each establishment constructed by Fort and Klimek (2018) to make industry activity comparable over time. These time-consistent codes are constructed from information in the economic censuses on an establishment's industry under several classifications, as well as from official concordances.

The new data we bring to the analysis of U.S. market concentration is 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 in the form of a Manufacturer ID (MID), which enables us to construct the market shares of the foreign sellers in the U.S. The MID is an alphanumeric code that combines information on the seller's country, name, street address, and city.[9] Because of our interest in identifying foreign exporters at the firm-level, rather than plant-level, we consider MIDs with the same name and country component but with a different street address or

7. Other models, such as Bernard et al. (2003) (BEJK), also generate this invariance result, even though BEJK assume Bertrand competition instead of monopolistic competition. Amiti, Itskhoki, and Konings (2019) show that the same pattern of markup adjustment between home and foreign firms - with unchanged aggregate markups - is obtained in a model with incomplete exchange rate pass-through without entry and exit of firms.

8. The effect of a trade liberalization on market concentration is also ambiguous in models with a finite number of firms (Eaton, Kortum, and Sotelo (2013), Gaubert and Itskhoki (2021)), and in Feenstra (2018) with a bounded Pareto distribution.

9. Specifically, the MID consists of the two-digit ISO country code of origin of the good, the first three characters of the first word of the exporter's name, the first three characters of the second word of the exporter's name, the first four numbers of the street address of the foreign exporter, and the first three letters of the foreign exporter's city.

city component to belong to the same exporter, since plants of the same firm located in different locations have a different MID. Our methodology builds on earlier work by Kamal, Krizan, and Monarch (2015), which used the foreign firm identifiers in a different context. Importantly, Kamal, Krizan, and Monarch (2015) and Kamal and Monarch (2018) provide a number of validation exercises for the use of the MID to identify foreign firms, which we describe in Appendix A.1. In particular, they show that the number of MIDs in the Census data matches well with official firm counts once the street address or the city component are omitted.

A key challenge in combining the trade data with the CMF data is that we need to map industry and product codes to each other in a time-consistent way over two decades. In the import data, each transaction contains a 10-digit Harmonized Tariff System (HTS10) code for the product traded (comprising around 17,000 product codes). In contrast, the CMF reports annual sales at the NAICS 6-digit level.[10] The HTS10 product codes are revised every year and the industry codes are revised every five years. Previous studies of production concentration only needed to deal with the NAICS revisions; however, because we need to bring in the trade data, we have to also deal with the HTS10 revisions in the trade data and we have to ensure that the mappings between NAICS and HTS10 are time-consistent. We begin with the concordance by Pierce and Schott (2012a), which maps each HTS10 to a 6-digit NAICS code in each year, and Pierce and Schott (2012b), which generates time-consistent HTS10 codes. We manually adjust these concordances to take account of inconsistent mappings from HTS10 to NAICS that arise due to revisions over time. Our procedure results in a time-consistent NAICS 5-digit level classification for 169 manufacturing industries.[11] Our choice of the 5-digit NAICS level is dictated by the fact that a time-consistent mapping of HTS10 to 6-digit NAICS is not possible without making many arbitrary assignments and without combining many industries into large groups. Appendix A.2 contains more information on the concordance steps and contains some illustrative examples of our approach.

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). 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, which drops 34 percent of total imports. 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.[12]

10. The CMF also reports sales at more disaggregated levels in the "product trailer" files, see, e.g., Kehrig and Vincent (2021). However, we cannot map imports to these finer products since a concordance from HTS10 to NAICS only exists at the 6-digit level.

11. The new concordances are available from https://www.sebastianheise.com.

12. For example, suppose a U.S. firm that produces and sells cars in the U.S. also imports cars and steel from related parties. In this case, we drop the car imports from our analysis since these would already be counted in the firm's shipments but we keep the steel imports as these would be competing imports in the steel industry. As additional robustness checks, in Appendix B we re-compute concentration trends when we either drop all related party imports (65 percent of total imports), or when we keep all imports and show that the results are similar.

The final dataset we use is U.S. 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 5-digit NAICS industry code, based on our own concordance building on Pierce and Schott (2012a, 2012b). 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.

We combine the three datasets, collapsing the sales data from the Census of Manufactures across establishments within the same firm to the time-consistent 5-digit NAICS-firm level. Firms can operate in more than one industry. We count the sales of each establishment in its corresponding industry, and aggregate the sales of all establishments within the same industry to the firm-industry level.[13] Our analysis covers the entire manufacturing sector at the time-consistent 5-digit NAICS level, where we define a market at the national level, spanning across all of the U.S. In Appendix B, we show that our results are robust to defining industries at the more aggregate 4-digit industry level (containing 81 industries) and at the finer 6-digit NAICS level (based on 476 industries), where for the latter we use the HTS10 to 6-digit NAICS mapping by Pierce and Schott (2012a) without making the codes time-consistent.

4 Stylized Facts

In this section, we present a number of new stylized facts about the evolution of market concentration in the U.S. and how it relates to import competition.

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

We begin by considering how concentration evolved in the U.S. manufacturing sector. In panel (a) of Figure 1, we plot the top-20 concentration measures, averaged across all 5-digit NAICS industries in manufacturing, from 1992 and 2012. The solid red line depicts the production concentration measure, showing an upward trend in concentration over the last two decades. This upward trend is consistent with a large empirical literature (e.g., Van Reenen (2018)) that constructs concentration measures as in equation (1). It is also consistent with the theory predictions: a fall in trade costs increases the domestic productivity cutoff, which increases concentration among U.S. firms.

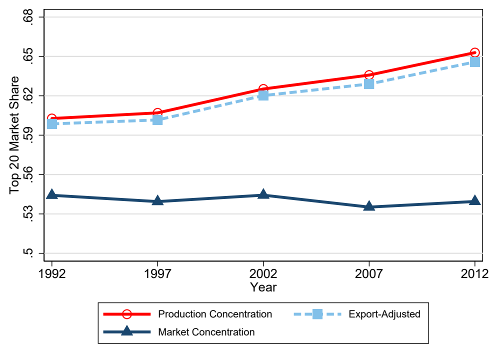
However, the market concentration measures, using market shares based on all sales to the U.S. market as in equation (2) and summing across both foreign and U.S. firms, remained flat between 1992 and 2012, depicted by the solid blue line in panel (a) of Figure 1. This finding is consistent with the predictions of ACDR as discussed in Section 2. Interestingly, it turns out that subtracting U.S. firms' exports from their total shipments makes little difference to the trend in concentration, as

13. For example, if there is a firm with 10 establishments and half of them produce shoes and the other half produce cars, we would aggregate five of the 10 establishments to a firm-car observation and the other five to a firm-shoe observation.

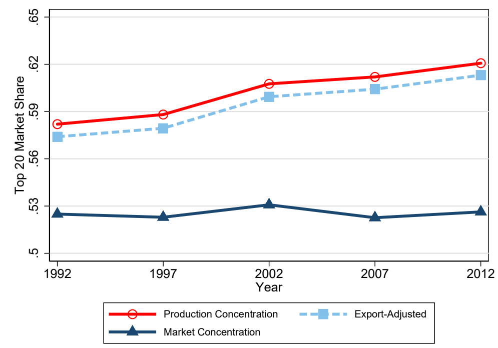
shown by the dashed blue line, and so it is the inclusion of the foreign firms' sales that is responsible for this new finding.

Figure 1: Evolution of Sales Concentration: 1992 to 2012

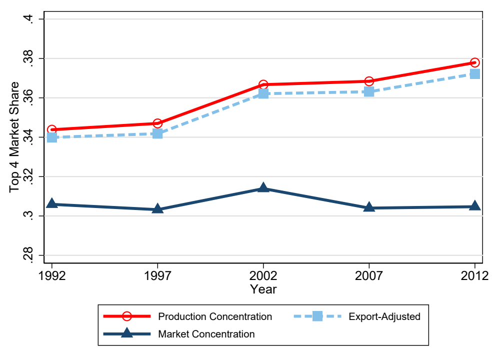
(a) Top-20 Unweighted Concentration



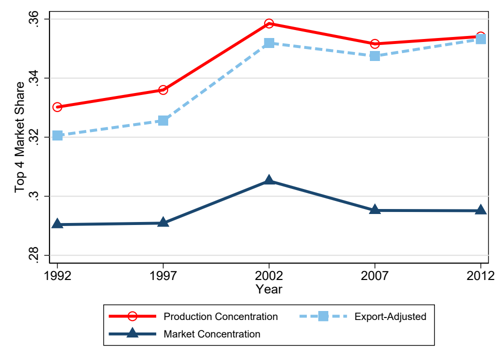
(b) Top-20 Weighted Concentration



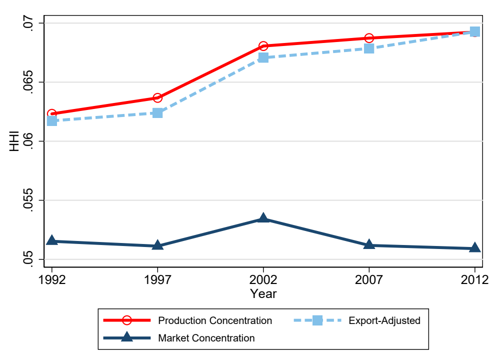
(c) Top-4 Unweighted Concentration



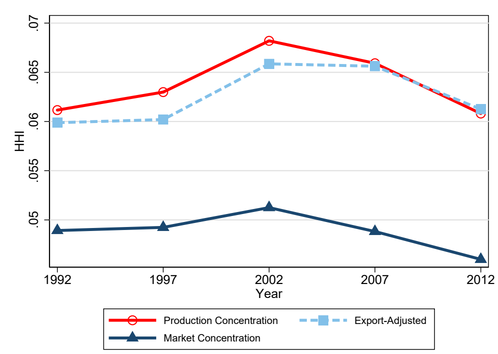
(d) Top-4 Weighted Concentration



(e) HHI Unweighted Concentration



(f) HHI Weighted Concentration



Notes: Data are for census years: 1992, 1997, 2002, 2007, and 2012. The figures show the evolution of three different concentration measures over time. The first row plots the market shares of the top-20 firms; the middle row the market shares of the top-4 firms; and the last row the HHI. In panel (a), the production concentration line measures concentration of the top-20 U.S. firms using market shares defined in equation (1). The export-adjusted line subtracts U.S. firms' exports from their total sales and sums the market shares over domestic firms. The market concentration line constructs market shares as in equation (2) for all firms (both domestic and foreign) selling in the U.S.. The left panels compute a simple average across all NAICS 5-digit manufacturing industries; and the right panels compute weighted averages across all NAICS 5-digit manufacturing industries, using 1992 weights. Production concentration weights by U.S. firms' total shipments; export-adjusted measures weight by shipments minus exports; and market concentration by total absorption, i.e., shipments minus exports plus imports.

Panel (b) of Figure 1 shows an analogous plot where instead of a simple average we take a weighted average across industries, using 1992 sales weights. For the production concentration measure we weight each industry by its U.S. firms' total shipments; for the export-adjusted measure we use shipments minus exports; and for the market concentration measure we weight by total absorption, defined as total shipments by U.S. firms minus exports plus total imports. We find results similar to those obtained before. In the next panels we show that these patterns are robust to using alternative concentration measures. In panels (c) and (d), we define concentration as the market share of the top 4 firms; and in panels (e) and (f) we use the HHI. Importantly, market concentration does not increase under any of these alternative concentration measures. Since all of the measures of concentration point to similar trends in market concentration, we will focus on the top-20 measure as our baseline for the rest of the analysis.[14]

Is the stable trend in market concentration driven by a few large industries or does foreign competition reduce concentration more broadly? To explore this question, Figure 2 plots the change between 1992 and 2012 in the top-20 production concentration measure on the x-axis against the change in the top-20 market concentration measure on the y-axis as a bin scatter. We bin the industries by ranking them by the change in their production concentration measure, and then combine them into 20 groups of 8-9 industries each.[15] Each bubble depicts one of these groups of industries, with the size of the bubble proportional to the industry group's total absorption, i.e., shipments minus exports plus imports. The figure shows that nearly all of the bubbles are below the 45-degree line, indicating that accounting for foreign firms' sales results in a smaller increase in market concentration in almost all industry groups than the production concentration measures would suggest. However, there is a wide range in the size and direction of changes in market concentration, and market concentration rose in a number of industries, as shown by the bubbles in the top right quadrant.

The reason why the growth of foreign firms' sales did not increase market concentration is because their entry and growth was mostly in the bottom part of the market share distribution, with the loss in U.S. firm market shares completely offset by the gain in foreign shares as predicted by ACDR.[16]

Fact 2. *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.*

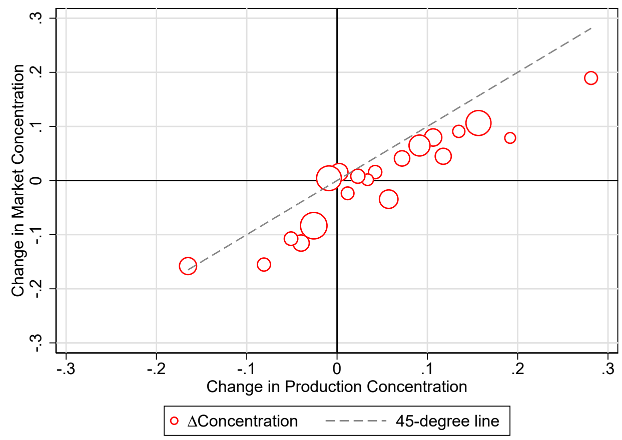
We show how foreign firms affect the overall market share distribution in the U.S. in Figure 3, by

14. In Appendix B, we show similar patterns with alternative measures: In Figure B.1 we use 2012 weights instead of 1992 ones for the weighted average; in Figure B.2 we alter the level of industry aggregation, plotting the evolution of concentration for both more aggregated NAICS industries at the 4-digit and more disaggregated industries at the 6-digit NAICS level; and in Figure B.3 we show that it does not matter if we drop all related party imports or keep all related party imports. All of these measures show increasing production concentration and flat or falling market concentration. The only exception is the production concentration in panel (f) of Figure 1, measured with weighted HHI using 1992 weights, which falls back to its initial level. Using publicly available production concentration measures from the Census Bureau website, one can show that this is driven by NAICS industry 33611 "Automobile and Light Duty Vehicle Manufacturing", which has become a lot less concentrated. If this industry were excluded, the trend in the weighted HHI production concentration with 1992 weights is qualitatively similar to the other production concentration measures.

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

16. This conclusion does not hold in every single industry, but it is true on average.

Figure 2: Change in Sales Concentration across Industries, 1992-2012



Notes: The figure shows the change in the top-20 production concentration measure between 1992 and 2012 (x-axis) against the change in the top-20 market concentration measure from equation (2) using all firms selling to the U.S. market (y-axis). Each bubble is a group of 8 or 9 industries, where industries are grouped by their change in the top-20 production concentration 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.

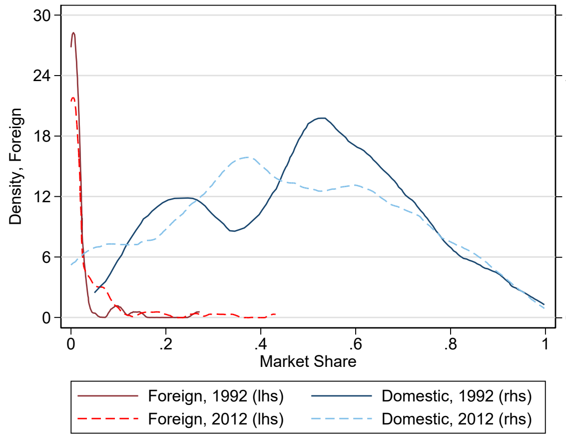
slicing the data in two ways.

First, in panel (a) of Figure 3 we illustrate the distribution of the market shares of the top-20 firms across industries. The figure plots the kernel density of the top-20 market share in each industry accounted for by U.S. firms in blue and by foreign firms in red. To construct the figure, we first identify the top-20 firms in each industry according to equation (2). We then compute separately the market share of the domestic firms that are in the top-20 (using the top part of equation (2)) and the market share of the foreign firms in the top-20 (bottom part of (2)), and construct the density of these two objects across industries. Note that the density on the left axis for foreign firms is 10 times that of the right axis for domestic firms, reflecting that in most industries the market share of foreign firms in the top-20 is close to zero. The foreign densities are conditional on industries in which at least one foreign firm is in the top-20. We find that the number of industries with zero foreign market shares in the top-20 fell from 108 in 1992 to 76 in 2012, but do not show it in the figure in order to zoom in on the positive market share distribution. The figure shows a rightward shift in the foreign firm density between 1992 and 2012 (dashed red line). This shift indicates that foreign firms have increased their presence in the top-20, but in the vast majority of industries the market share of foreign firms in the top-20 remains well below 10 percent. In contrast, the kernel density of domestic firms in the top-20 has shifted to the left (blue lines), indicating that in the average industry the market share of domestic firms in the top-20 has fallen. However, the market share of U.S. firms in the top-20 in the average industry is still large, falling from around 60 percent to around 50 percent between 1992 and 2012.

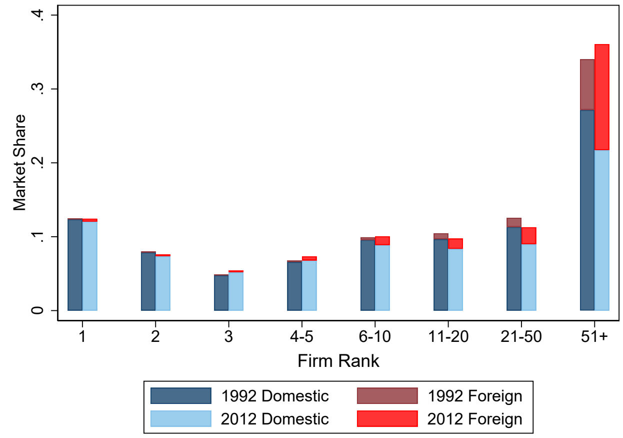
Second, in panel (b) of Figure 3 we plot the market shares accounted for by firms of a given ranking within each industry summed across all industries. Thus, the height of the first bar shows that the market share according to equation (2) of all of the number 1 ranked firms amounts to 12

Figure 3: Market Share Heterogeneity

(a) Density of top-20 Market Shares



(b) Average Share by Rank



Notes: Panel (a) plots the kernel densities of the summed market shares of U.S. firms in the top-20, computed using the top part of equation (2) (blue lines) and of foreign firms in the top-20, computed using the bottom part of equation (2) (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 panel (b) each set of bars plots the weighted average 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 blue bars represent the market share of domestic firms with a given rank and the red bars are the market share of foreign firms with that rank.

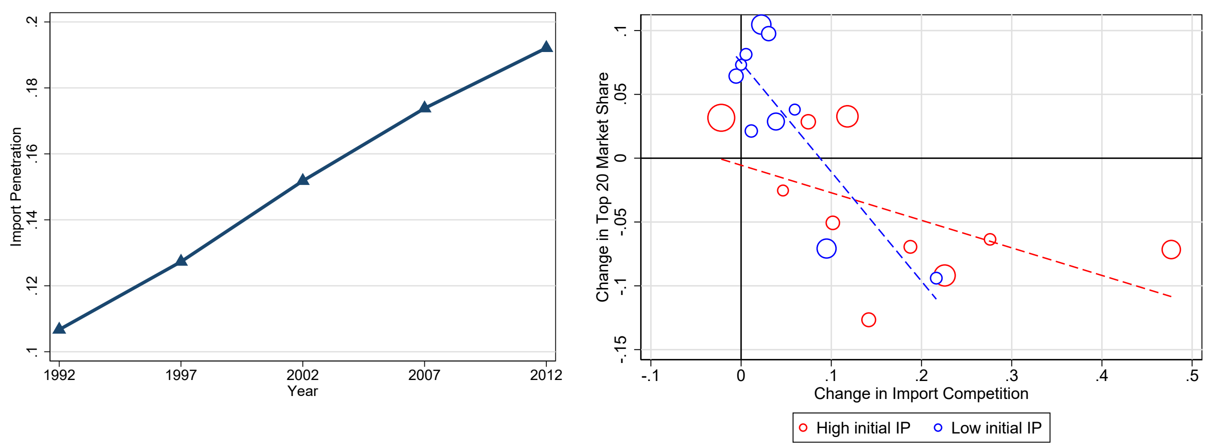
percent of all manufacturing sales in 1992.[17] We split each bar into the market share accounted for by domestic firms (computed using the top part of equation (2)) in blue and into the market share accounted for by foreign firms (computed using the bottom part of equation (2)) in red. It turns out that foreign firms with rank 1 account for a market share of virtually zero in the aggregate. This is mostly due to the fact that there are very few industries where a foreign firm is the top firm. To see how these patterns evolved over the sample period, we plot the analogous information for 2012 with lighter colors. A clear pattern emerges, showing that the largest growth in foreign sales is in the bottom part of the distribution. Foreign firms with a rank higher than 50 more than doubled their market share from 6.9 percent to 14.4 percent. By contrast, the foreign shares of the top ranked firms remained low on average, below 3 percent for each of the top seven bins.

This analysis helps reconcile the increased production concentration (computed using equation (1)) with the flat market concentration (using equation (2) and summed across U.S. and foreign firms). From panel (b) of Figure 3, we see that the market share of domestic firms declined in all the bins with ranks greater than 5, while their market share at the top ranks remained approximately unchanged. As a result, concentration rose among domestic firms themselves, consistent with trade theory, which predicts the exit of lower productivity firms. However, the market share gains of foreign firms, mostly in the lower tail of the distribution, have offset the rise in domestic concentration. As the figure shows, the overall market shares of the top-20 firms barely changed between 1992 and 2012,

17. We aggregate the market share of each X ranked firm across industries using each industry's absorption in 1992 as weight. Summing over the bars of firms with rank 1 to 20 gives the solid blue line in Figure 1b in 1992 and 2012.

Figure 4: Market Concentration and Import Penetration

(a) Import Penetration (b) Changes in Market Concentration vs. Import Penetration



Notes: Panel (a) plots the time series of import penetration, where imports exclude related-party imports in industries in which a firm is active, as described in Section 3. Panel (b) presents a bin scatter plot of the change in the top-20 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 initial absorption in each industry. The size of each dot is proportional to industry absorption in 1992. The "High Initial IP" dots are for industries with an above-median level of import penetration in 1992. The "Low Initial IP" dots are for industries with a below-median level of import penetration in 1992. We sort industries within each of these two groups into 10 deciles based on their change in import competition between 1992 and 2012, and construct each bubble by taking a weighted average of the change in import penetration and the change in the top-20 market share across the industries in each decile. Each bin comprises on average 8-9 industries.

as illustrated by the flat market concentration trend in Figure 1.

Fact 3. *Market concentration fell the most in industries with high import penetration.*

To examine the relationship between market concentration and import competition, we first need a measure for import competition, which we proxy with import penetration for each industry i in year t, as follows:

$$IP_{it} = \frac{Imports_{it}}{Absorption_{it}}. \tag{3}$$

We compute absorption as total sales less exports plus imports, as in the denominator of equation (2). Based on our import measure, which excludes some related-party trade, aggregate import penetration has increased from 10.7 percent to 19.2 percent over our sample period, as shown in panel (a) of Figure 4.

Panel (b) of Figure 4 plots an industry's change in import penetration between 1992 and 2012 against the change in market concentration over the same period as a bin scatter. We distinguish industries with a below-median level of import competition in 1992 (blue bubbles) from those with above-median import competition (red bubbles), and sort industries within each of these two groups into 10 deciles based on their change in import competition between 1992 and 2012. We combine the industries in each decile into industry groups by taking 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.[18] Each bubble represents one of these groups of industries, with the size of the bubble proportional to total absorption in 1992. The figure shows a negative relationship between the change in import penetration and the change in market concentration. Moreover, seven out of ten industry groups with above-median import penetration in 1992 experienced further increases in foreign competition in subsequent years together with a decline in concentration. Examples include audio and video equipment manufacturing, semi-conductor and electronic components, and curtain and linen mills.[19] In contrast, eight out of ten industry groups with low initial import penetration continued to have a low share of foreign firms, and showed an increase in market concentration, for example, concrete industries. Thus, the industries with the largest increase in import competition showed the slowest growth in market concentration. In the next section, we show that an exogenous increase in import competition increases production concentration but leaves market concentration unchanged on average across manufacturing industries.

5 Market Concentration and Import Competition

In this section, we turn to analyzing how import competition affected production concentration and market concentration of the top-20 firms. Since changes in imports are partially due to changes in U.S. demand, we need exogenous shocks that shift the world supply of goods to the U.S. to isolate the causal effect of import competition on U.S. firms. To this end, we construct time-varying instruments for U.S. imports using a methodology developed in Amiti and Weinstein (2018). Our approach is related to the methodology developed by Autor, Dorn, and Hanson (2013), with refinements 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

$$\triangle M_{ijkt} = \alpha_{ikt} + \beta_{ijt} + \epsilon_{ijkt}, \tag{4}$$

where $\triangle M_{ijkt}$ is the percentage change in imports from country j to country k in a 5-digit NAICS industry i over the five-year period up to time t. The dependent variable is regressed on importer country-industry-time fixed effects, α_{ikt}, and exporter country-industry-time fixed effects, β_{ijt}. 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 trading 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

18. As before, Census regulations prevent us from disclosing results for individual industries.
19. These examples are based on publicly available census data for 1997 to 2012.

of the coefficients in equation (4), as described in Appendix D.[20]

We estimate α_{ikt} and β_{ijt} with bilateral HS 6-digit import data from UN COMTRADE, collapsed to the bilateral 5-digit time-consistent NAICS level, for the countries making up the top 50 U.S. trading partners, which cover more than 90 percent of U.S. trade.[21] Importantly, we also include the U.S. as an exporter j and an importer k in the estimation. By including the U.S. trade flows, 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:

$$Instrument\triangle IP_{it} = \sum_{j \neq US} w_{ij,t-5} \tilde{\beta}_{ijt} \tag{5}$$

where the weights are the five-year lagged total imports of industry i from country j as a share of total absorption of that industry i; and $\tilde{\beta}_{ijt}$ is equal to $\hat{\beta}_{ijt}$ (the estimated coefficients from the Amiti-Weinstein methodology, see equations (D.2) and (D.3) in Appendix D) minus the industry-year median coefficient $\bar{\hat{\beta}}_{it}$.[22] This variable will serve as an instrument for import competition, which we proxy with the percentage change in import penetration:[23]

$$\triangle IP_{it} = \frac{Imports_{it} - Imports_{i,t-5}}{Absorption_{i,t-5}}.$$

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

$$\triangle C_{it} = \gamma \triangle IP_{it} + \delta_t + \epsilon_{it}, \tag{6}$$

where ΔC_{it} is the five-year change in top-20 firm concentration in industry i in year t. All regressions include time fixed effects and are weighted by industry shipments or absorption in 1992.

First, we consider the effect of import competition on the top-20 production concentration measure, $\triangle C^P_{it}$, with the market shares of the top-20 U.S. firms from equation (1). Given the upward sloping red lines in Figure 1, and the predictions of trade theory, we would expect tougher competition to increase production concentration among U.S. firms, as some domestic firms exit and some of the surviving U.S. firms expand their exports to foreign markets. However, using OLS estimation in

20. Amiti and Weinstein (2018) show that this methodology is equivalent to a weighted least squares estimation with lagged values as weights when there are no new trade relationships.

21. https://comtrade.un.org/db/default.aspx. We include the periods 1997-2002, 2002-2007, and 2007-2012; and omit the earlier period 1992-1997 because few countries had adopted the Harmonized System (HS) of reporting in 1992. We could not include the universe of countries because many countries did not start reporting in any HS revision until very late in the sample. Note that the 50th ranked country only accounts for 0.16 percent of U.S imports. We found very similar results when we expanded our sample to 75 countries, which was the largest possible sample of countries reporting in HS.

22. See Borusyak, Hull, and Jaravel (2022) for a discussion of shift-share instruments, and see Borusyak and Hull (2020) on the importance of subtracting the average industry-year value. Moreover, the fixed effects coefficients are generally estimated relative to an arbitrary numeraire so it is more meaningful to construct them relative to their average value. We choose the median rather than the mean as the average value to avoid contamination by outliers, following the approach in Amiti and Weinstein (2018).

23. We proxy for import competition with the percentage change rather than the percentage point change following Autor, Dorn, and Hanson (2013). Moreover, this approach is in parallel with our instruments, which need to be estimated using the percentage change in imports for the adding-up constraints to hold. See Amiti and Weinstein (2018).

Table 1: Change in Sales Concentration and Import Competition

Dependent variable	ΔC_{it}^{P} (1)	ΔC_{it}^{P} (2)	$\Delta C_{it}^{M,dom}$ (3)	$\Delta C_{it}^{M,dom}$ (4)	$\Delta C_{it}^{M,all}$ (5)	$\Delta C_{it}^{M,all}$ (6)	$\Delta C_{it}^{M,for}$ (7)	$\Delta C_{it}^{M,for}$ (8)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
ΔIP_{it}	-0.025	0.209**	-0.238***	-0.289***	-0.072***	0.041	0.191***	0.381***
	(0.027)	(0.089)	(0.028)	(0.083)	(0.024)	(0.074)	(0.016)	(0.053)
First stage		ΔIP_{it}		ΔIP_{it}		ΔIP_{it}		ΔIP_{it}
instrument$_{\Delta IP_{it}}$		0.383***		0.390***		0.390***		0.390***
		(0.050)		(0.049)		(0.049)		(0.049)
Predicted effects		0.005		-0.008		0.001		0.010
Actual		0.033		-0.016		0.003		0.023
N	500	500	500	500	500	500	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations is rounded to hundreds. ΔC_{it}^{P} is the change in the top-20 production concentration measure using total shipments of U.S. firms; $\Delta C_{it}^{M,dom}$ is the change in the top-20 market concentration measure using the top 20 U.S. firms; $\Delta C_{it}^{M,all}$ is the change in the top-20 market concentration measure using the 20 top firms (which could be foreign or domestic); $\Delta C_{it}^{M,for}$ is the change in market share of the foreign firms in the top 20. Regressions in columns 1 and 2 are weighted by each industry's shipments in 1992; regressions in all other columns are weighted by each industry's absorption in 1992. Mean of ΔIP_{it} 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 market concentration measure and 1992 U.S. shipment weights for the production concentration measure. Year fixed effects are included.

column 1 of Table 1, we find a negative, albeit insignificant, coefficient. This result may be due to the endogeneity of import penetration, as changes in U.S. demand could affect the demand for imports and the demand for domestically produced goods simultaneously. Once we instrument for import competition in column 2, we find a positive and significant coefficient, as hypothesized, equal to 0.21. This result implies that a one standard deviation increase in import penetration (equal to 0.098) causes a 2 percentage point increase in production concentration. To get a sense of the aggregate effect on manufacturing, we calculate the implied change in import penetration using the first stage coefficient times the import penetration shock, $Instrument\triangle IP_{it}$, multiplied by the second stage coefficient in column 2. Summing across all industries and time periods, using 1992 shipment weights, we find that the predicted effect is equal to 0.005, which accounts for about one-seventh of the actual rise in production concentration between 1997 and 2012.[24]

In the subsequent columns, we consider the effect of import competition on market concentration, with the market shares using equation (2). According to trade theory, increased competition from foreign firms lowers the domestic sales of U.S. firms. We would therefore expect import competition to lower the domestic sales as a share of absorption of the top ranked U.S. firms. To test

24. The predicted effect is calculated as 0.383x$Instrument\triangle IP_{it}$x0.209, summed across all industries and all time periods using 1992 shipment weights. We construct the actual rise in production concentration using the same weights. This should be viewed as a back-of-the-envelope calculation as with regressions of this type we cannot say how import competition affects the constant.

this, in columns 3 and 4, we replace the dependent variable with the market concentration measure, $\triangle C_{it}^{M,dom}$, calculated by summing the market shares in the top row of equation (2) across the 20 U.S. firms with the highest market shares in each industry. Consistent with trade theory, we find negative and significant coefficients on import competition with the IV coefficient equal to -0.29 in column 4, slightly larger in magnitude than the OLS estimate in column 3. Our IV 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. Using the estimates from the first stage and second stage coefficients in column 4, and aggregating across industries and time, we predict a decline of 0.8 percentage point in the market concentration of the top-20 U.S. firms due to import competition between 1997 and 2012. Import competition therefore accounts for half of the 1.6 percentage points decline in the actual weighted average concentration of the top-20 U.S. firms over this period.

Next, in columns 5 and 6, we consider the effect of import competition on the top-20 market concentration measure that comprises both domestic and foreign firms, $\triangle C_{it}^{M,all}$, calculated by summing the market shares in both rows of equation (2) across the 20 firms with the highest market shares in each industry. Once we take account of the foreign firms in the top-20, we see the rise in their share counteracting the fall in the domestic firms' market share, reflected in an insignificant coefficient close to zero in column 6, consistent with ACDR. This offsetting effect by foreign firms is more explicitly shown in the last two columns, where we replace the dependent variable with the market share of foreign firms in the top-20, $\triangle C_{it}^{M,for}$. This variable is constructed by identifying the top-20 foreign and domestic firms and by summing over the market shares of only the foreign firms. The positive coefficients in columns 7 and 8 show that the foreign firms' market share increases with import penetration.[25]

In Table 2, we turn to estimating the effect of import competition on the extensive margin by replacing the dependent variable with the ratio of the number of domestic firms in t and in $t-5$. The OLS specification in column 1 shows a small but insignificant increase in the number of firms due to import competition. However, once we instrument for import penetration in column 2, we find that the number of U.S. firms falls in industries with increased import competition.[26] Our estimate implies that a one standard deviation increase in import penetration generates a 23 percent fall in the number of U.S. firms. This finding is consistent with trade theory where the domestic exit cutoff rises with lower trade costs.

How can we reconcile the positive effect of import competition on production concentration in

25. An IV regression with the analagous dependent variable for domestic firms in the top-20 results in an IV coefficient of -0.341^{***} (0.087). By construction, the sum of this coefficient and the IV coefficient using only foreign firms in the top-20 in column 8 (0.381) is equal to the IV coefficient of the regression using all top-20 firms in column 6 (0.041). Instead, in columns 3 and 4, we included all of the top-20 US firms for ease of comparison with the production concentration measure in the first two columns. In Appendix C, we show the robustness of these results for: (i) regressions using 5-year lagged weights instead of fixed 1992 sales weights and for unweighted regressions; (ii) market concentration variables defined including all related-party imports, and ones where we drop all related-party imports; and (iii) replacing the top-20 market share concentration measures with the HHI.

26. We show in Appendix C that these results are robust to alternative weighting, using 5-year lagged weights instead of 1992 weights as well as unweighted regressions. Gutiérrez and Philippon (2017) also find that the number of U.S. firms fell in response to Chinese import penetration, using Compustat data.

Table 2: Change in Number of U.S. Firms and Import Competition

Dependent variable	ΔNfirms$_{it}$ (1)	ΔNfirms$_{it}$ (2)
	OLS	IV
ΔIP_{it}	0.219 (0.140)	-2.298*** (0.539)
First stage		ΔIP_{it}
instrument$_{\Delta IP_{it}}$		0.390*** (0.049)
N	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔNfirms$_{it}$ is the ratio of the number of domestic firms in t and in $t-5$. Regressions are weighted by each industry's absorption in 1992. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

column 2 of Table 1 with the unchanged market concentration in column 6 and the increased firm exit in Table 2? 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. Moreover, these firms gain from the exit of domestic competitors.[27] However, once we consider the total sales in the U.S. market, inclusive of imports, we find that the share of the top-20 U.S. firms actually fell, as foreign firms gained some of their market share and replaced some of the exiting domestic firms. Taken together, these results help explain the stable trend in market concentration shown in Figure 1.

Finally, we check whether there are stronger effects in industries in which goods are more substitutable. According to trade theory, a trade liberalization would lead to a bigger demand shift towards foreign firms in those industries where imports are closer substitutes for domestically produced goods. We identify industries with a high elasticity of substitution between varieties as those with above-median elasticity, σ, equal to 4.89.[28] In Table 3, we report IV regressions following Tables 1 and 2, but now additionally include an interaction term between $\triangle IP_{it}$ and a dummy equal to one for industries with an above median elasticity of substitution. The results reveal heterogeneity in the coefficients across industries consistent with theory. Column 1 shows there is more exit by U.S. firms in more competitive industries, also reflected in a greater increase in production concentration in column 2. Column 3 shows that the share of the top-20 U.S. firms in total domestic sales falls for both

27. As described above, in many models firms reduce markups in response to increased competition; e.g., Atkeson and Burstein (2008), Arkolakis et al. (2019), Amiti, Itskhoki, and Konings (2019).

28. We provide a robustness with high elasticity industries defined as those above the 75th percentile in Appendix Table C.8. The elasticities of substitution are estimated using the annual HTS10-country level U.S. import data following Feenstra (1994), Broda and Weinstein (2006) and Soderbery (2015) (See Appendix A.3 for details). Ideally, we would like to have estimates of elasticities of substitution between foreign and domestic varieties, but computing these elasticities would require disaggregated product level price and quantity data for the U.S., which are unavailable. Therefore, these estimates should be viewed as imperfect proxies.

Table 3: Change in Sales Concentration with Heterogeneous Elasticity of Substitution

Dependent variable	ΔNfirms$_{it}$ (1)	ΔC^{P}_{it} (2)	$\Delta C^{M,dom}_{it}$ (3)	$\Delta C^{M,all}_{it}$ (4)	$\Delta C^{M,for}_{it}$ (5)
ΔIP_{it}	-1.080*	0.076	-0.259***	0.027	0.304***
	(0.636)	(0.100)	(0.092)	(0.082)	(0.060)
$\Delta IP_{it} \cdot$ High σ_i	-1.857**	0.186*	-0.046	0.021	0.118*
	(0.738)	(0.110)	(0.107)	(0.095)	(0.070)
N	500	500	500	500	500

Notes: All columns are estimated using 2-stage least squares with the first stages reported in Appendix Table C.7. Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔNfirms$_{it}$ is the ratio of the number of domestic firms in t and in $t-5$; ΔC^{P}_{it} is the change in the top-20 production concentration measure using total shipments of U.S. firms; $\Delta C^{M,dom}_{it}$ is the change in the top-20 market concentration measure using the top 20 U.S. firms; $\Delta C^{M,all}_{it}$ is the change in the top-20 market concentration measure using the 20 top firms (which could be foreign or domestic); $\Delta C^{M,for}_{it}$ is the change in market share of the foreign firms in the top 20. $\Delta IP_{it} \cdot$ High σ_i is an interaction between ΔIP_{it} and a dummy for whether an industry has above-median elasticity of substitution. Regressions in columns 1, 3, 4, and 5 are weighted by each industry's absorption in 1992; regression in column 2 is weighted by each industry's shipments in 1992. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

high and low-elasticity industries, but only marginally (and insignificantly) more in high-elasticity ones. In column 4, we see that the two counteracting forces roughly cancel out in both types of industries, leaving overall market concentration unchanged; and the final column shows that the gains by foreign firms are larger in high-elasticity industries. Reassuringly, Table 3 confirms that our results are not driven by just a few industries.

6 Conclusion

This paper uncovers a new stylized fact: market concentration in the U.S. manufacturing sector remained stable between 1992 and 2012. We obtain this fact by incorporating the sales of foreign firms to the U.S into the analysis, using confidential U.S. Census data, allowing us to study the full distribution of market shares. Previous studies have focused exclusively on the sales of U.S. firms, documenting the rise in concentration among large domestic firms. While this rise in *production concentration* is relevant for questions on market power in the labor market, we need to take account of the sales of foreign firms in the U.S. for questions on market power in the product market.

Consistent with trade theory, we show that import competition led to the exit of domestic firms and an increase in production concentration among U.S. firms. In contrast, import competition caused the largest U.S. firms to lose sales as a share of total sales in the U.S. market while the market share of foreign firms increased, resulting in no change on average in market concentration. Our findings have important implications for market power. Interpreting our findings through the lens of standard trade models suggests that markups of domestic firms have fallen and those of foreign firms have risen, offsetting each other and resulting in stable aggregate markups.

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Appendix

A Data

A.1 Data Construction

We combine three datasets of the U.S. Census Bureau.

Census of Manufactures This dataset contains the universe of U.S. manufacturing establishments from the Census Bureau. 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. Total shipments are defined by the Census Bureau as "...the net selling values (exclusive of freight and excise taxes) of all products shipped including installation and repair, sales of scrap, and sales of products bought and sold without further process. Included are all products physically shipped by the establishments". We merge into this dataset each establishment's time-consistent 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 with more than 100 possible NAICS codes according to Fort and Klimek (2018). We also drop establishments with missing NAICS codes and inactive establishments with zero employees.

To facilitate the merge with the trade data, we aggregate across establishments to the time-consistent 5-digit NAICS-firm level, where the 5-digit NAICS codes are constructed to map consistently to HTS10 trade codes, as we describe in Section A.2. Thus, a firm with establishments active in multiple industries would be recorded in each of these industries with the corresponding sales in each year. Our time-consistent industry aggregation consists of 169 NAICS industries at the 5-digit level for the manufacturing sector. We drop outlier firms whose increase in 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. This step removes firms that report implausibly large sales relative to their number of employees when the sales are extremely different from the firms' previous reporting.

Longitudinal Firm Trade Transactions Database (LFTTD) - Imports 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 the form of a Manufacturer ID (MID) in addition to the identifier for the U.S. importer for each transaction. As described in Kamal and Monarch (2018), the MID is an alphanumeric code that consists of the two-digit ISO country code of origin of the good, the first three characters of the first word of the exporter's name, the first three characters of the second word of the exporter's name, the first four numbers of the street address of the foreign exporter, and the first three letters of the foreign exporter's city. For example, the exporter "Quan Kao Company", at 1234 Beijing Lane in Beijing, China would have the MID "CNQUAKAO1234BEI". Since the MID differs across establishments of the same firm in different locations and since we are interested in firm-level exports to the U.S., we replace the MID with a shortened identifier that contains only the country ISO code and the name portion of the ID, as described in the main text. Transactions with a missing foreign firm identifier account for 1.1 percent of total imports and 0.2 percent of total sales (imports plus domestic sales) in the U.S. We keep imports with missing identifiers for the denominator of the market shares. We drop all transactions with a negative value and imports flagged as warehouse entries.

External validation of the ability of the MIDs to identify foreign firms is provided in Kamal, Krizan, and Monarch (2015). They compare the number of MIDs in the Census data to the number of foreign exporters for 43 countries from the World Bank's Exporter Dynamics Database (EDD), which is based on foreign national government statistics and private company data. Kamal, Krizan, and Monarch (2015) show that the number of MIDs in the Census data matches well with the number of sellers in the EDD when the street address or the city component are omitted. Kamal and Monarch (2018) provide further support that the MID is a good identifier of foreign exporters as follows. First, errors due to manual data entry are likely low because most firms use customs brokers for their official customs invoice and nearly all entries are filed electronically using specialized customs software. Second, the MID is used for regulatory purposes, such as enforcing anti-dumping measures or tracking compliance with U.S. restrictions for textile shipments, which provide an incentive for the U.S. government to ensure that the MIDs are correct. Third, as an external validation, Kamal and Monarch (2018) assess whether the MID can distinguish between distinct exporters using Chinese data: they construct artificial MIDs from exporter names and addresses in the Chinese Annual Survey of Industrial Firms, and show that they tend to be unique firm identifiers within sectors.

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 industry code of the imports falls within any 5-digit NAICS code in which the U.S. importer sells, as these imports are already likely included in the U.S. firm's shipments. We do not drop related-party imports that are not within any of the firm's output industries, as these are imports that will be competing in the other industries. For example, if a U.S. car producer imports cars from a related party we drop those imports from our calculations; whereas if the car producer imports steel, we count those steel imports as competing in the steel industry. This step removes about 34 percent of U.S. imports at the 5-digit NAICS level, and around 28 percent in our robustness checks at the 6-digit NAICS level.

Each import transaction is recorded with a 10-digit Harmonized Tariff System (HTS10) code for the product traded, which we map to time-consistent 5-digit NAICS codes, as we describe in Section A.2. We finally aggregate across transactions to the foreign exporter-year-5-digit NAICS level.

Longitudinal Firm Trade Transactions Database (LFTTD) - Exports 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 5-digit NAICS codes using a concordance which we construct analogously to the import data, as described in Section A.2. We then compute 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 are not by a manufacturing firm in the Census of Manufactures.

In further robustness checks, we also experiment with using the exports reported in the Census of Manufactures to construct domestic sales and find this makes little difference to our calculations (see Figure B.4).

A.2 Concordances

We describe how we construct our concordance from Harmonized Tariff System (HTS) 10-digit product codes in the LFTTD to time-consistent 5-digit NAICS industries. First, we need to make the HTS10 import and export product codes time consistent. There are around 17,000 codes, with some revisions every year. These revisions either result in a change in the product code, combine several codes into a new one, or split a code into more than one product. The revisions are major every census year when the internationally consistent 6-digit Harmonized System (HS) codes are revised. Note that the first six digits of the HTS10 codes are the same as the 6-digit HS codes.

Our starting point for making the HTS10 codes time consistent are the concordances over time constructed by Pierce and Schott (2012b) for our sample period.[29] These concordances assign HTS10 codes that disappear at a given point in time to new HTS10 codes. The data provide the year and month in which an HTS10 code became obsolete and give one or several new codes that replace it. We manually check a subset of mappings where the first six digits of the obsolete code differ from the first six digits of the new code and there is no such change in the HS 6-digit revisions provided by the United Nations. We adjust linkages that appear incorrect based on the item descriptions. Rows 1-2 of Table A.1 contain an example, where one old HTS10 maps to two new HTS10 codes in the same year in the original Pierce-Schott concordance. Based on the descriptions, in row 1 we drop the mapping of the HTS10 code for cordless handset telephones to a code for video monitors that seems problematic, and we keep the mapping in row 2 from the original concordance between cordless telephones and telephones with cordless handsets.

In the second step, we combine obsolete and new codes that are mapped to each other over time into "grouped" HTS10 codes (HTS10g). This step generates several very large and heterogeneous groupings, which we break up into subsets of smaller homogeneous groups by re-assigning HTS10 to groups based on their description. We provide two illustrative examples in Table A.2. In rows

29. The concordances are available from Peter Schott's website: https://sompks4.github.io/sub_data.html. The import concordance is available to 2019 but the export concordance ends in 2009 and so we extended it to 2012 manually.

1-3, we see that linking HTS10 codes over time leads to the grouping of several HTS10 codes for sprinkler systems with a code for spraying appliances used in the manufacture of semiconductors. We re-assign the spraying appliances that were included with sprinkler systems to a different, more relevant, group (row 2) so that semiconductors and sprinkler systems are not grouped together. As a second example, rows 4-6 show that both plastics and copper articles are linked by the Pierce-Schott concordance to connectors for optical fibers, leading to a large product group containing plastics, copper products, and semiconductors. We break these links so that the three types of products remain in separate groups.

In the third step, we use the Pierce and Schott (2012a) concordance from HTS10 to NAICS to map the HTS10g codes to industries. We identify in the concordance cases where the same HTS10 code with the same description maps to different NAICS industries over time. We correct these instances manually by comparing the NAICS descriptions and selecting the NAICS industry that best fits the HTS10 description. We then check whether all the constituent HTS10 of each grouped HTS10g (from step 2) map to a unique NAICS code. Mappings from a grouped HTS10g to many NAICS codes are problematic because in such cases we need to either i) manually select one of the NAICS industries to map to the overall HTS10 group, ii) combine the different NAICS codes into one grouped industry code, or iii) distribute the trade across all industries based on some assignment rule.

We examined mappings of the HTS10g codes to NAICS industries, both the 5-digit and the 6-digit NAICS level. At the 5-digit level, we were able to map all but two of the HTS10g codes to either a unique 5-digit NAICS industry or, for a small number of HTS10g, to a grouped 5-digit NAICS code. We started off with 184 5-digit NAICS codes in the manufacturing sector and end up with 169 time-consistent codes. At the 6-digit level the mapping of HTS10g codes to unique and time-consistent industries is more problematic: there were 531 grouped HTS10 codes (accounting for 27% of total import value) that mapped to multiple NAICS 6-digit industries but mapped to a unique NAICS 5-digit code. Each of these instances requires a judgment call on how to assign the HTS10g. Since the accurate classification of industries in a time-consistent way is central to our analysis of industry concentration, we decided to go to the 5-digit NAICS level where we need to make far fewer manual adjustments.[30]

We provide a few examples of how we deal with cases where a grouped HTS10g maps to several 5-digit NAICS codes. In many cases we are able to assign a unique NAICS code to the grouped HTS10. We illustrate this case in the first five rows of Table A.3. Here, the grouped HTS10 code 2106906075gg contains an original code for coffee whiteners, which only exists in 1992 and is mapped in 1993 by the Pierce-Schott concordance to a number of new codes, including orange juice and herbal teas. From the HTS10-NAICS concordance, coffee whiteners belong to NAICS 31151 (Dairy Product Manufacturing), while orange juice belongs to NAICS 31141 (Frozen Food Manufacturing) and herbal teas belong to NAICS 31192 (Coffee and Tea Manufacturing). As a result, the grouped

30. As shown in Appendix B, we find very similar concentration trends at the 6-digit NAICS level (based on 476 industries) when we use the mapping of ungrouped HTS10 codes to 6-digit NAICS by Pierce and Schott (2012a) without making the codes time-consistent.

HTS10 code maps to three different NAICS during the period 1992-1994. We manually remove the code for orange juice from the grouped code and assign it to a different group which contains juice, and similarly move the code for herbal tea to a group that contains teas. Thus, our final HTS10 group 2106906075gg only contains constituent codes which map to NAICS 31151.

In some cases, it is impossible to split the HTS10 grouping so instead we combine multiple NAICS codes into a single grouped 5-digit NAICS code, as illustrated in rows 6-8 of Table A.3. In this case, the grouped HTS10 code 6112192010gg consists of codes for track suit jackets. In 1993-1994, the HTS10 code combines both genders. The successor HTS10 codes in later years split out male and female track suit jackets. This is problematic because according to the HTS10-NAICS concordance by Pierce and Schott (2012a) male track suits belong to NAICS 31522 (Men's and Boys' Cut and Sew Apparel Manufacturing) while female track suits map to NAICS 31523 (Women's and Girls' Cut and Sew Apparel Manufacturing). Since there are a number of such cases, we choose not to assign the HTS10 codes to one or the other NAICS, but instead combine industries 31522 and 31523 into a grouped 5-digit NAICS code 31522g.

Finally, there are two problematic HTS10 codes which are more difficult to assign. These are 8517700000, "PARTS OR APPS FOR TRASMISIT/RECP OF VOICE/IMG/DATA" and 8517620050, "MACH FOR RECP/CONV/REGEN VOICE/IMAGE/DATA. NESOI". Constituents of the groups formed by these HTS10 map to NAICS 33421, "Telephone Apparatus Manufacturing", NAICS 33422, "Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing", and NAICS 33441, "Printed Circuit Assembly (Electronic Assembly) Manufacturing". If we map these groups to only one of the NAICS, we get a large trend break in industry-level import penetration in 2007 for these industries. At the same time, combining the NAICS is not possible without forming a very large group. We therefore keep the NAICS separate and apportion the HTS10 groups to each code based on their trade share in 2006 (the year before the two problematic HTS10 codes are introduced).

We apply the steps described above for both HTS10 import codes and export codes. Since the HTS10 codes are not the same for imports and exports, we verify in the last step that the mappings from HTS10 to 5-digit NAICS for imports and exports are consistent. In particular, we flag all cases where HTS10 codes with the same first six digits are mapped to different NAICS codes on the import side than on the export side. We then check in such cases whether the descriptions of the HTS10 export codes and import codes are similar. If two HTS10 codes refer to the same product but map to a different 5-digit NAICS on the export side than on the import side, we update the mapping so that these HTS10 map to the same 5-digit NAICS industry for both exports and imports. Our final concordance maps each HTS10 import and export code in 1992-2012 to one of 169 time-consistent 5-digit NAICS codes, which we use for our analysis. Given our interest in the trend in concentration over time, it is essential that the industry codes can be meaningfully compared over time.

A.3 Elasticities of Substitution

We estimate elasticities of substitution across product varieties g defined at the HTS10-country level within an HS 6-digit industry, σ_g, following the methodology described and coded in Appendix 2.1 of Feenstra (2010). This elasticity is the parameter that enters a constant elasticity price index (CES). For example, in Bernard et al. (2003), the price of good j is $P_n(j)$ and there is a single elasticity σ, yielding a price index of $p_n = (\int_0^1 P_n(j)^{1-\sigma} dj)^{1/(1-\sigma)}$. We estimate elasticities across products from publicly available U.S. Census imports, which comprise both import values and quantities. We proxy the product price with the unit value, calculated as the ratio of values to quantities. Our estimation is at the annual level covering the period 1997 to 2012. The unit values are cleaned by dropping price ratios (the unit value in t relative to $t-1$) less than $1/10$ or greater than 10. For any HS6 industry where the elasticity could not be estimated because of non-convergence, we use the median elasticity of the associated HS4 industry. We calculate the elasticity at the NAICS 5-digit level by taking the simple mean of the HS 6-digit industries within that industry. The median elasticity is 4.89.

Table A.1: Manually Adjusted Mappings in the HTS10 Concordance

	Old HTS10	Obsolete Description	New HTS10	New Description	Year	Method
(1)	8525205000	CORDLESS HANDSET TELEPHONES	8528211000	VIDEO MONITORS, COLOR, INCOMPLETE, NESOI	1996	Drop
(2)	8525205000	CORDLESS HANDSET TELEPHONES	8517110000	LINE TELEHPONE SETS WITH CORDLESS HANDSETS	1996	Keep

Table A.2: Examples of Adjusted HTS10 Groupings

	HTS10 group	Obsolete HTS10	New HTS10	Description	Years	New HTS10 group
(1)		8424890010		SPRINKLER SYSTEMS (FIRE EXTINGUISHING EQUIPMENT)	1992-1994	8424890000gg
(2)	8424890000gg		8424893040	SPRAYING APPL USED IN SEMICONDUCTOR MANUFACTURE	1995-	8421193000gg
(3)			8424899010	SPRINKLER SYSTEMS (FIRE EXTINGUISHING EQUIPMENT)	1995-1997	8424890000gg
(4)		3926909880		OTHER ARTICLES OR PLASTIC, NESOI	1997-2006	3926909010gg
(5)	3926909010gg	7419995050		OTHER ARTICLES OR COPPER, NESOI	1992-2006	7419995050
(6)			8536700000	CONNECTORS FOR OPTICAL FIBERS, BUNDLES OR CABLES	2007-	8536700000

Table A.3: Examples of Manually Adjusted HTS10-NAICS Mappings

	HTS10 group	Obsolete HTS10	New HTS10	Description	Years	NAICS code	New HTS10 group	New NAICS code
(1)		2106906075		COFFEE WHITENERS, NON-DAIRY	1992	31151	2106906075gg	31151
(2)			2106901600	ORANGE JUICE, FORTIFIED W/VITAMINS OR MINERALS	1993-1994	31141	2106901600gg	31141
(3)	2106906075gg		2106906575	COFFEE WHITENERS, NON-DAIRY	1993	31151	2106906075gg	31151
(4)			2106906587	HERBAL TEAS & HERBAL INFUSIONS OF MIXED HERBS	1993	31192	2106906087gg	31192
(5)			2106906975	COFFEE WHITENERS, NON-DAIRY, NESOI	1994	31151	2106906075gg	31151
(6)		6112192010		JACKET FOR TRACK STS OT TEX MAT CON 70% SILK, KNIT	1993-1994	31522	6112192010gg	31522g
(7)	6112192010gg		6112194010	MEN/BOYS KNIT TRACK SUITS OT TEX MAT CONT 70% SILK	1995-	31522	6112192010gg	31522g
(8)			6112194020	W/G KNIT TRACK SUTS OTH TEX MAT CONT 70% SILK	1995-	31523	6112192010gg	31522g

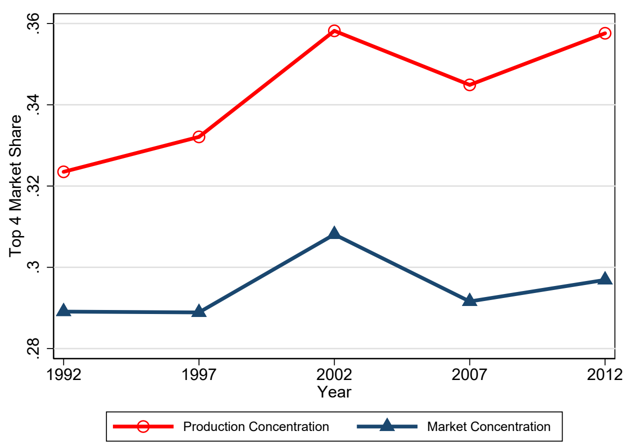
B Evolution of Market Concentration using Alternative Measures

In this section, we show that the concentration trends documented in Figure 1 are robust to alternative specifications.

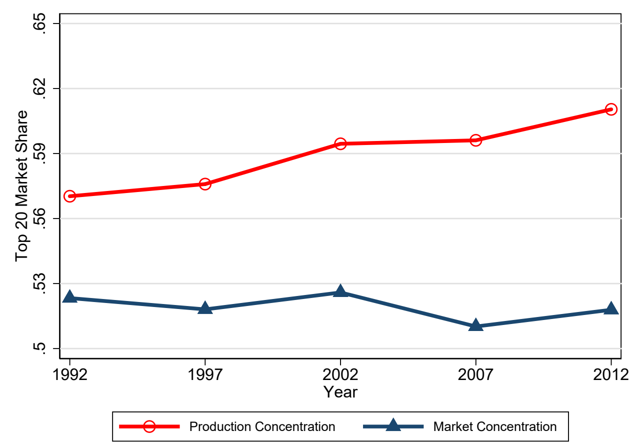
Figure B.1 shows weighted concentration using 2012 sales weights instead of the 1992 ones used in the right panels of Figure 1. We find that production concentration increases significantly under all measures, while market concentration is relatively unchanged, as before.

Figure B.1: Weighted Average Concentration Using Weights in 2012

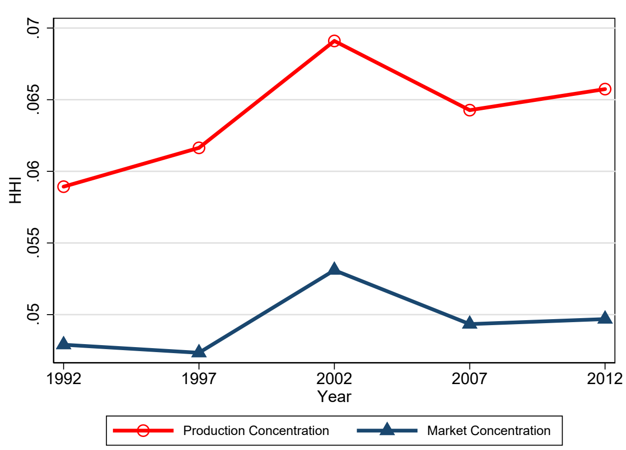
(a) Top-4 Concentration



(b) Top-20 Concentration



(c) Herfindahl-Hirschman Index (HHI)

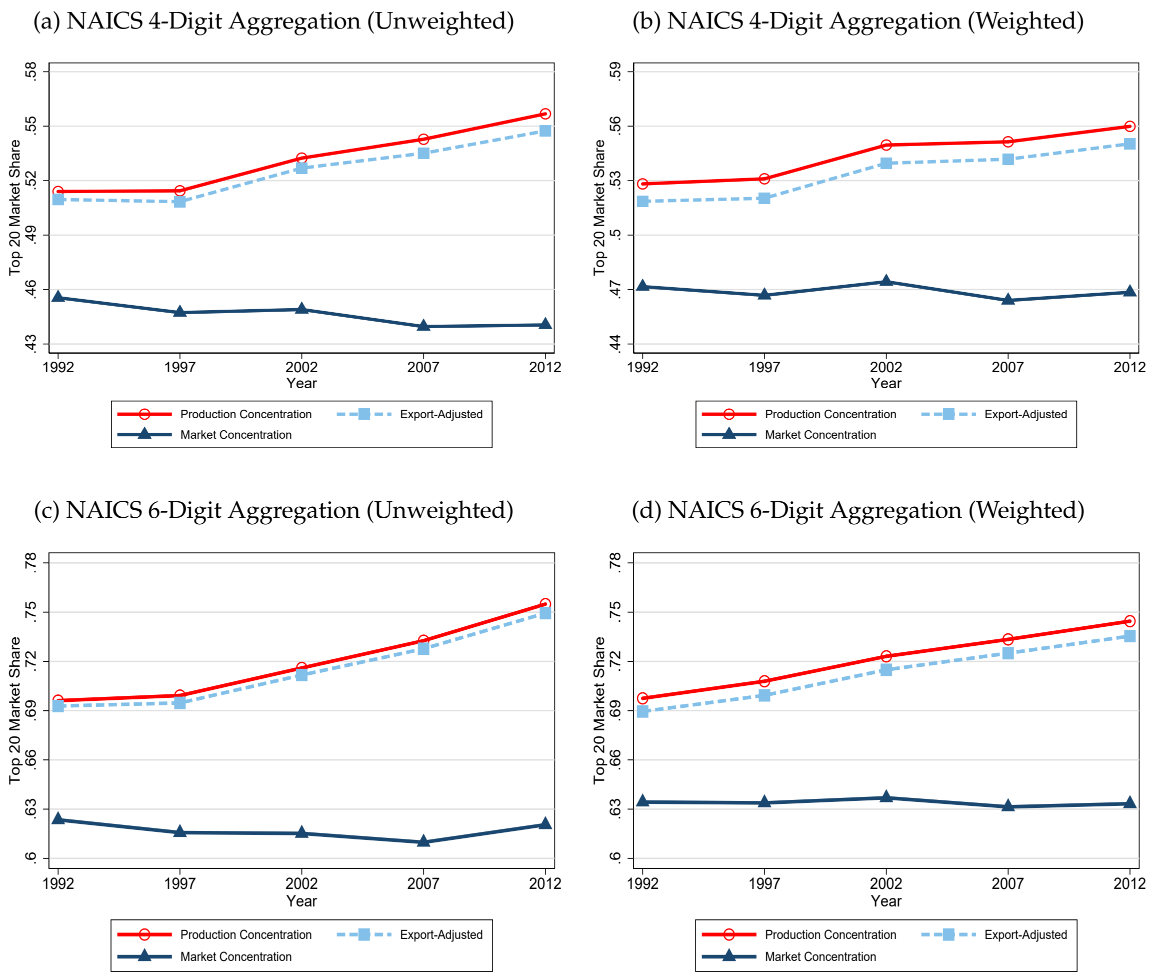


Notes: The figures show the evolution of concentration over time. Data are for census years: 1992, 1997, 2002, 2007, and 2012. The production concentration line measures concentration over all U.S. firms using market shares defined in equation (1). The market concentration line constructs market shares as in equation (2) for all firms selling in the U.S. irrespective of where the firm is located. Panel (a) computes the top-4 concentration, panel (b) computes the top-20 concentration, and panel (c) the HHI. All panels show weighted averages across all NAICS 5-digit manufacturing industries using 2012 weights. For the production concentration measure we weight each industry by its U.S. firms' total shipments; for the market concentration measure we use total absorption, i.e., shipments minus exports plus imports.

We present the top-20 concentration measure using alternative levels of industry aggregation in

Figure B.2, with concentration computed at the 4-digit NAICS level in the top row and at the 6-digit level in the bottom row. We construct the 4-digit NAICS industries by aggregating from our time-consistent 5-digit industry classification, giving us 81 industries. For the 6-digit industries we use the mapping from HTS10 to NAICS from Pierce and Schott (2012a) without making these codes time consistent, giving a total of 476 manufacturing industries. We aggregate over these industries using an unweighted average in the left panels and 1992 weights in the right panels. The results are similar to the baseline 5-digit NAICS level industry aggregation.

Figure B.2: Top-20 Concentration with Different NAICS Industry Aggregation



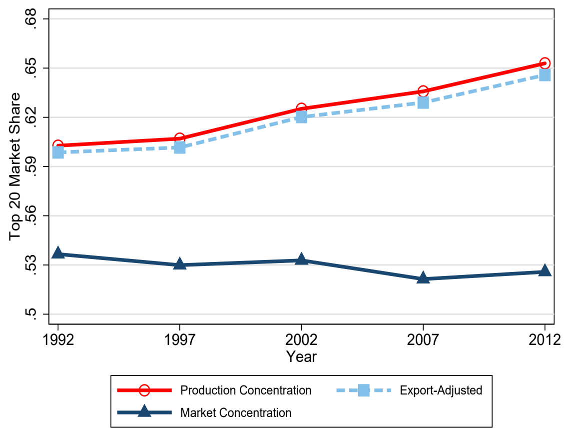
Notes: Panels (a) and (c) plot a simple average of the top-20 concentration. Data are for census years: 1992, 1997, 2002, 2007, and 2012. The production concentration line measures concentration over all U.S. firms using market shares defined in equation (1). The export-adjusted line subtracts U.S. firms' exports from their total sales and sums the market shares over domestic firms. The market concentration line constructs market shares as in equation (2) for all firms selling in the U.S. irrespective of where the firm is located. Panels (b) and (d) plot a weighted average of the top-20 concentration. For the production concentration 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 market concentration measure we use total absorption in 1992, i.e., shipments minus exports plus imports. Panels (a) and (b) are computed across all NAICS 4-digit manufacturing industries, while panels (c) and (d) are across all NAICS 6-digit manufacturing industries

Our baseline results drop related party imports that overlap with an industry code in which the

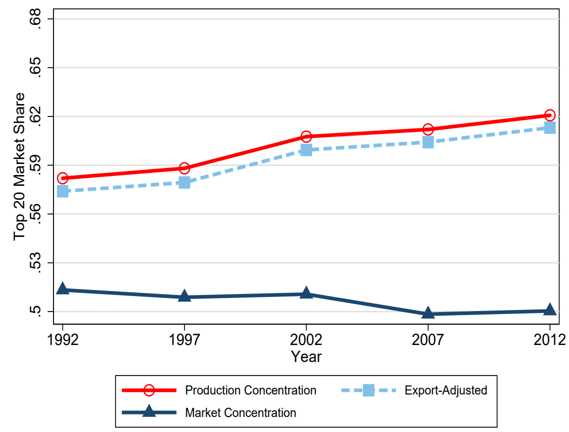
U.S. importing firm reports domestic sales. In Figure B.3, we show that the evolution of market concentration is robust to how we define competing imports. In the top row, we keep all related party imports and in the bottom panels we drop all related party imports (dropping 65 percent of total imports).

Figure B.3: Top-20 Concentration: with and without Related Party Imports

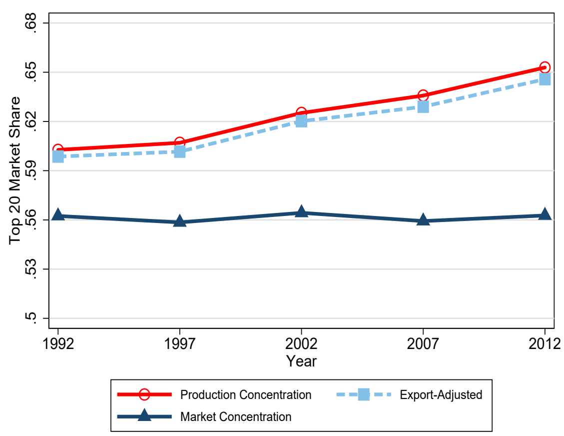
(a) With All Related Party Imports (Unweighted)



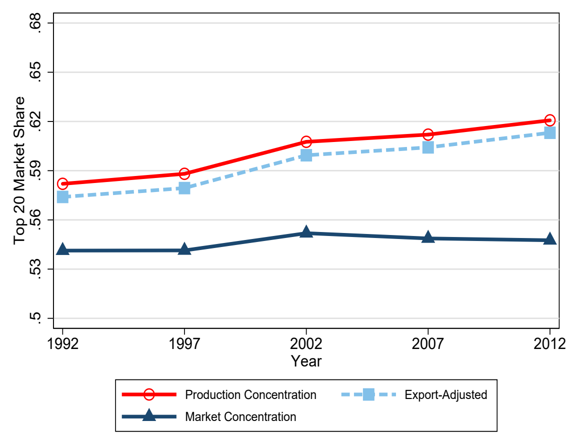
(b) With All Related Party Imports (Weighted)



(c) Without Related Party Imports (Unweighted)



(d) Without Related Party Imports (Weighted)

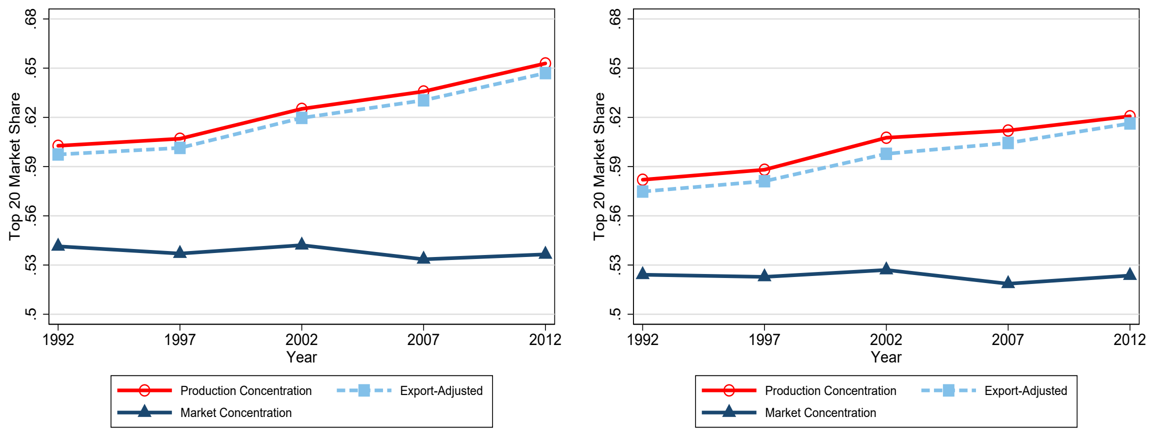


Notes: Panels (a) and (c) plot a simple average of the top-20 concentration. Data are for census years: 1992, 1997, 2002, 2007, and 2012. The production concentration line measures concentration over all U.S. firms using market shares defined in equation (1). The export-adjusted line subtracts U.S. firms' exports from their total sales and sums the market shares over domestic firms. The market concentration line constructs market shares as in equation (2) for all firms selling in the U.S. irrespective of where the firm is located. Panels (b) and (d) plot a weighted average of the top-20 concentration. For the production concentration 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 market concentration measure we use total absorption in 1992, i.e., shipments minus exports plus imports. Panels (a) and (b) keep all related party trade while panels (c) and (d) drop all related party trade.

Finally, in Figure B.4, we replace the exports from customs records with the exports firms report in the Census of Manufactures. This change makes little difference to the concentration trends.

Figure B.4: Top-20 Concentration: with Exports from the Census of Manufactures

(a) With Exports from the CMF (Unweighted) (b) With Exports from the CMF (Weighted)



Notes: The figures show the evolution of concentration over time. Data are for census years: 1992, 1997, 2002, 2007, and 2012. The production concentration line measures concentration over all U.S. firms using market shares defined in equation (1). The export-adjusted line subtracts U.S. firms' exports from their total sales and sums the market shares over domestic firms. The market concentration line constructs market shares as in equation (2) for all firms selling in the U.S. irrespective of where the firm is located. For the production concentration 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 market concentration measure we use total absorption in 1992, i.e., shipments minus exports plus imports. Exports used are those reported in the Census of Manufactures instead of exports from the LFTTD.

C Robustness of Regression Results

In this section, we provide robustness checks of our baseline regression results. We show that our results are robust to estimating equation (6) under the following alternative specifications. In Table C.1, we reestimate Table 1 with 5-year lagged weights instead of 1992 fixed weights, and in Table C.2 we estimate the specification without weighting the regression. We find that these alternative weights do not change our conclusions. In Table C.3, we also show that our baseline extensive margin results in Table 2 are robust to these alternative weights.

In Tables C.4 and C.5, we show that the results are robust to including all related-party imports as well as to dropping all related-party imports. When we include all related-party trade, all patterns are as expected but the overall change in market concentration (column 4 of Table C.4) becomes marginally significant. When we exclude all related-party trade, all signs are as expected except that the change in the top-20 market share of domestic firms (column 3 of Table C.5) is insignificant at conventional levels. We view our baseline treatment of related-party trade as the most reasonable approach since including all related-party imports may lead to double counting of sales. Instead, excluding all related-party trade removes two thirds of imports and does not take into account that some of these related-party imports crowd out purchases from domestic firms.

In Table C.6, we show that the results also hold when we replace our top-20 market share concentration measure with the HHI. In the first two columns, we compute the HHI using only domestic firms' total sales and the market shares from equation (1), analogous to our production concentration measure. In columns 3 and 4, we compute the HHI using all firms' sales in the U.S. market and the market shares from equation (2), similar to our market concentration measure. The IV regressions indicate an increase in production concentration but no change in market concentration as a result of the trade shock, consistent with the baseline results.

Table C.7 reports the first stage regression results for the regression in Table 3. We find that all first stages are strong, with F-stats above 30.

Finally, Table C.8 presents the IV results from a regression where we define high elasticity of substitution industries as those with an elasticity of substitution above the 75th percentile ($\sigma = 7.37$). Similar to Table 3 where we define a high elasticity industry as above the median, we find that such industries experience a greater decline in the number of domestic firms and a greater increase in the market share of foreign firms among the top-20 firms. We also find a stronger decline in the market share of the top-20 domestic firms in the overall market for high substitution industries, while the change in production concentration is not significantly different between both types of industries. Table C.9 presents the first stage associated with these regressions.

Table C.1: Change in Concentration Regressions with 5-year Lagged Weights

Dependent variable	ΔC_{it}^{P} (1)	ΔC_{it}^{P} (2)	$\Delta C_{it}^{M,dom}$ (3)	$\Delta C_{it}^{M,dom}$ (4)	$\Delta C_{it}^{M,all}$ (5)	$\Delta C_{it}^{M,all}$ (6)	$\Delta C_{it}^{M,for}$ (7)	$\Delta C_{it}^{M,for}$ (8)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
ΔIP_{it}	-0.041	0.247**	-0.263***	-0.321***	-0.085***	0.107	0.198***	0.496***
	(0.031)	(0.110)	(0.029)	(0.089)	(0.026)	(0.082)	(0.017)	(0.065)
First stage		ΔIP_{it}		ΔIP_{it}		ΔIP_{it}		ΔIP_{it}
instrument$_{\Delta IP_{it}}$		0.347***		0.375***		0.375***		0.375***
		(0.048)		(0.048)		(0.048)		(0.048)
Predicted effects		0.004		-0.008		0.003		0.012
Actual		0.030		-0.015		0.002		0.020
N	500	500	500	500	500	500	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔC_{it}^{P} is the change in the top-20 production concentration measure using total shipments of U.S. firms; $\Delta C_{it}^{M,dom}$ is the change in the top-20 market concentration measure using the top 20 U.S. firms; $\Delta C_{it}^{M,all}$ is the change in the top-20 market concentration measure using the 20 top firms (which could be foreign or domestic); $\Delta C_{it}^{M,for}$ is the change in market share of the foreign firms in the top 20. Regressions in columns 1 and 2 are weighted by each industry's 5-year lagged shipments; regressions in all other columns are weighted by each industry's 5-year lagged absorption. Mean of ΔIP_{it} 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 market concentration measure and 5-year lagged U.S. shipment weights for the production concentration measure. Year fixed effects are included.

Table C.2: Change in Concentration Unweighted Regressions

Dependent variable	ΔC^{P}_{it} (1)	ΔC^{P}_{it} (2)	$\Delta C^{M,dom}_{it}$ (3)	$\Delta C^{M,dom}_{it}$ (4)	$\Delta C^{M,all}_{it}$ (5)	$\Delta C^{M,all}_{it}$ (6)	$\Delta C^{M,for}_{it}$ (7)	$\Delta C^{M,for}_{it}$ (8)
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
ΔIP_{it}	-0.007	0.122*	-0.184***	-0.339***	-0.088***	-0.075	0.119***	0.291***
	(0.023)	(0.072)	(0.026)	(0.081)	(0.024)	(0.072)	(0.012)	(0.043)
First stage		ΔIP_{it}		ΔIP_{it}		ΔIP_{it}		ΔIP_{it}
instrument$_{\Delta IP_{it}}$		0.446***		0.446***		0.446***		0.446***
		(0.056)		(0.056)		(0.056)		(0.056)
Predicted effects		0.003		-0.009		-0.002		0.008
Actual		0.046		-0.016		0.000		0.021
N	500	500	500	500	500	500	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔC^{P}_{it} is the change in the top-20 production concentration measure using total shipments of U.S. firms; $\Delta C^{M,dom}_{it}$ is the change in the top-20 market concentration measure using the top 20 U.S. firms; $\Delta C^{M,all}_{it}$ is the change in the top-20 market concentration measure using the 20 top firms (which could be foreign or domestic); $\Delta C^{M,for}_{it}$ is the change in market share of the foreign firms in the top 20. Mean of ΔIP_{it} 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. Year fixed effects are included.

Table C.3: Change in Number of Firms with Alternative Weighting

Dependent variable	ΔNfirms$_{it}$ (1)	ΔNfirms$_{it}$ (2)	ΔNfirms$_{it}$ (3)	ΔNfirms$_{it}$ (4)
Regression weights	Lagged Weights		Unweighted	
	OLS	IV	OLS	IV
ΔIP_{it}	0.254*	-2.243***	0.106	-0.959***
	(0.150)	(0.567)	(0.098)	(0.325)
First stage		ΔIP_{it}		ΔIP_{it}
instrument$_{\Delta IP_{it}}$		0.375***		0.375***
		(0.048)		(0.048)
N	500	500	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔNfirms$_{it}$ is the ratio of the number of domestic firms in t and in $t-5$. Regressions in columns 1 and 2 are weighted by each industry's 5-year lagged absorption. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

Table C.4: Regressions with All Related Party Imports

Dependent variable	ΔNfirms$_{it}$ (1)	ΔC_{it}^{P} (2)	$\Delta C_{it}^{M,dom}$ (3)	$\Delta C_{it}^{M,all}$ (4)	$\Delta C_{it}^{M,for}$ (5)
ΔIP_{it}	-3.291***	0.344**	-0.207*	-0.195*	0.444***
	(0.956)	(0.147)	(0.111)	(0.108)	(0.090)
First stage	ΔIP_{it}	ΔIP_{it}	ΔIP_{it}	ΔIP_{it}	ΔIP_{it}
instrument$_{\Delta IP_{it}}$	0.223***	0.188***	0.223***	0.223***	0.223***
	(0.044)	(0.043)	(0.044)	(0.044)	(0.044)
N	500	500	500	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔNfirms$_{it}$ is the ratio of the number of domestic firms in t and in $t-5$; ΔC_{it}^{P} is the change in the top-20 production concentration measure using total shipments of U.S. firms; $\Delta C_{it}^{M,dom}$ is the change in the top-20 market concentration measure using the top 20 U.S. firms; $\Delta C_{it}^{M,all}$ is the change in the top-20 market concentration measure using the 20 top firms (which could be foreign or domestic); $\Delta C_{it}^{M,for}$ is the change in market share of the foreign firms in the top 20. Regressions in columns 1, 3, 4, and 5 are weighted by each industry's absorption in 1992; regression in column 2 is weighted by each industry's shipments in 1992. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

Table C.5: Regressions without any Related Party Imports

Dependent variable	ΔNfirms$_{it}$ (1)	ΔC_{it}^{P} (2)	$\Delta C_{it}^{M,dom}$ (3)	$\Delta C_{it}^{M,all}$ (4)	$\Delta C_{it}^{M,for}$ (5)
ΔIP_{it}	-5.750***	0.615***	-0.251	-0.099	0.279***
	(1.540)	(0.226)	(0.180)	(0.174)	(0.066)
First stage	ΔIP_{it}	ΔIP_{it}	ΔIP_{it}	ΔIP_{it}	ΔIP_{it}
instrument$_{\Delta IP_{it}}$	0.220***	0.207***	0.220***	0.220***	0.220***
	(0.042)	(0.043)	(0.042)	(0.042)	(0.042)
N	500	500	500	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔNfirms$_{it}$ is the ratio of the number of domestic firms in t and in $t-5$; ΔC_{it}^{P} is the change in the top-20 production concentration measure using total shipments of U.S. firms; $\Delta C_{it}^{M,dom}$ is the change in the top-20 market concentration measure using the top 20 U.S. firms; $\Delta C_{it}^{M,all}$ is the change in the top-20 market concentration measure using the 20 top firms (which could be foreign or domestic); $\Delta C_{it}^{M,for}$ is the change in market share of the foreign firms in the top 20. Regressions in columns 1, 3, 4, and 5 are weighted by each industry's absorption in 1992; regression in column 2 is weighted by each industry's shipments in 1992. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

Table C.6: Change in HHI Concentration and Import Competition

Dependent variable	ΔHHI_{it}^{dom} (1)	ΔHHI_{it}^{dom} (2)	ΔHHI_{it}^{all} (3)	ΔHHI_{it}^{all} (4)
	OLS	IV	OLS	IV
ΔIP_{it}	0.000	0.002**	-0.010	0.053
	(0.000)	(0.001)	(0.011)	(0.034)
First stage				
instrument$_{\Delta IP_{it}}$		0.383***		0.390***
		(0.049)		(0.049)
N	500	500	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔHHI_{it}^{dom} is the change in the HHI computed using only domestic firms' total sales and the market shares from equation (1), analogous to our production concentration measure, and ΔHHI_{it}^{all} is the change in the HHI computed using all firms' sales in the U.S. market and the market shares from equation (2), analogous to our market concentration measure. Regressions in columns 1 and 2 are weighted by each industry's shipments in 1992; regressions in columns 3 and 4 are weighted by each industry's absorption in 1992. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

Table C.7: Change in Concentration Regressions with Heterogeneous Elasticity of Substitution (First Stage)

Dependent variable	ΔIP_{it} (1)	ΔIP_{it} (2)	ΔIP_{it} (3)	ΔIP_{it} (4)	ΔIP_{it} (5)
instrumentΔIP_{it}	0.582***	0.599***	0.582***	0.582***	0.582***
	(0.094)	(0.105)	(0.094)	(0.094)	(0.094)
instrument$\Delta IP_{it} \cdot$ High σ_i	-0.257**	-0.271**	-0.257**	-0.257**	-0.257**
	(0.108)	(0.117)	(0.108)	(0.108)	(0.108)
F-stat	34.4	32.9	34.4	34.4	34.4
N	500	500	500	500	500
Dependent variable	$\Delta IP_{it}\cdot$ High$_i$	$\Delta IP_{it}\cdot$ High$_i$	$\Delta IP_{it}\cdot$ High$_i$	$\Delta IP_{it}\cdot$ High$_i$	$\Delta IP_{it}\cdot$ High$_i$
instrumentΔIP_{it}	-0.137	-0.176*	-0.137	-0.137	-0.137
	(0.085)	(0.096)	(0.085)	(0.085)	(0.085)
instrument$\Delta IP_{it} \cdot$ High σ_i	0.527***	0.566***	0.527***	0.527***	0.527***
	(0.097)	(0.107)	(0.097)	(0.097)	(0.097)
F-stat	31.5	32.9	31.5	31.5	31.5
N	500	500	500	500	500

Notes: Columns 1 through 5 are the first-stage regressions corresponding to columns 1 through 5 of Table 3 in the main text. Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. High σ_i is a dummy for whether an industry has above-median elasticity of substitution. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

Table C.8: Change in Concentration Regressions with Heterogeneous Elasticity of Substitution (Cut-off at P75)

Dependent variable	ΔNfirms$_{it}$ (1)	ΔC^{P}_{it} (2)	$\Delta C^{M,dom}_{it}$ (3)	$\Delta C^{M,all}_{it}$ (4)	$\Delta C^{M,for}_{it}$ (5)
ΔIP_{it}	-1.408**	0.237**	-0.200**	0.060	0.289***
	(0.614)	(0.102)	(0.093)	(0.083)	(0.055)
$\Delta IP_{it} \cdot$ High σ_i	-1.824**	-0.048	-0183*	-0.039	0.190***
	(0.716)	(0.113)	(0.108)	(0.097)	(0.065)
N	500	500	500	500	500

Notes: Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. ΔNfirms$_{it}$ is the ratio of the number of domestic firms in t and in $t-5$; ΔC^{P}_{it} is the change in the top-20 production concentration measure using total shipments of U.S. firms; $\Delta C^{M,dom}_{it}$ is the change in the top-20 market concentration measure using the top 20 U.S. firms; $\Delta C^{M,all}_{it}$ is the change in the top-20 market concentration measure using the 20 top firms (which could be foreign or domestic); $\Delta C^{M,for}_{it}$ is the change in market share of the foreign firms in the top 20. $\Delta IP_{it} \cdot$ High σ_i is an interaction between ΔIP_{it} and a dummy for whether an industry has an elasticity of substitution above the 75th percentile. Regressions in columns 1, 3, 4, and 5 are weighted by each industry's absorption in 1992; regression in column 2 is weighted by each industry's shipments in 1992. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

Table C.9: Change in Concentration Regressions with Heterogeneous Elasticity of Substitution (Cut-off at P75, First Stage)

Dependent variable	ΔIP_{it} (1)	ΔIP_{it} (2)	ΔIP_{it} (3)	ΔIP_{it} (4)	ΔIP_{it} (5)
instrumentΔIP_{it}	0.435***	0.452***	0.435***	0.435***	0.435***
	(0.069)	(0.076)	(0.069)	(0.069)	(0.069)
instrument$\Delta IP_{it} \cdot$ High σ_i	-0.088	-0.116	-0.088	-0.088	-0.088
	(0.095)	(0.097)	(0.095)	(0.095)	(0.095)
F-stat	31.6	30.7	31.6	31.6	31.6
N	500	500	500	500	500
Dependent variable	$\Delta IP_{it}\cdot$ High$_i$	$\Delta IP_{it}\cdot$ High$_i$	$\Delta IP_{it}\cdot$ High$_i$	$\Delta IP_{it}\cdot$ High$_i$	$\Delta IP_{it}\cdot$ High$_i$
instrumentΔIP_{it}	-0.078**	-0.103**	-0.078**	-0.078**	-0.078**
	(0.039)	(0.048)	(0.039)	(0.039)	(0.039)
instrument$\Delta IP_{it} \cdot$ High σ_i	0.536***	0.538***	0.536***	0.536***	0.536***
	(0.054)	(0.061)	(0.054)	(0.054)	(0.054)
F-stat	72.3	64.3	72.3	72.3	72.3
N	500	500	500	500	500

Notes: Columns 1 through 5 are the first-stage regressions corresponding to columns 1 through 5 of Table C.8. Decimals have been rounded to at most four significant digits per Census Bureau disclosure guidelines. The number of observations has been rounded to hundreds. High σ_i is a dummy for whether an industry has elasticity of substitution above the 75th percentile. Mean of ΔIP_{it} is 0.052; standard deviation is 0.098. Year fixed effects are included.

D 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:

$$\triangle M_{ijkt} = \alpha_{ikt} + \beta_{ijt} + \epsilon_{ijkt}, \tag{D.1}$$

where the dependent variable is the percentage 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 $E[\epsilon_{ijkt}] = 0$.

A major shortcoming in using standard fixed effects regressions 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 $t-5$. The gap between the predicted aggregate imports and actual imports thus depends 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_{ijt}, can be obtained by summing equation (D.1) across all destination countries k; and the percentage change in a country k's total imports of industry i, D_{ikt}, can be obtained by summing equation (D.1) across all source countries to give us the following moment conditions:

$$D_{ijt} \equiv \frac{\sum\limits_k M_{ijkt} - \sum\limits_k M_{ijk,t-5}}{\sum\limits_k M_{ijk,t-5}} = \beta_{ijt} + \sum_k \phi_{ijk,t-5}\alpha_{ikt}, \text{with } \phi_{ijk,t-5} \equiv \frac{M_{ijk,t-5}}{\sum_k M_{ijk,t-5}}; \tag{D.2}$$

and

$$D_{ikt} \equiv \frac{\sum\limits_j M_{ijkt} - \sum\limits_j M_{ijk,t-5}}{\sum\limits_j M_{ijk,t-5}} = \alpha_{ikt} + \sum_j \theta_{ijk,t-5}\beta_{ijt}, \text{with } \theta_{ijk,t-5} \equiv \frac{M_{ijk,t-5}}{\sum_j M_{ijk,t-5}}. \tag{D.3}$$

These are $J + K$ equations in $J + K$ unknowns, which will produce unique α_{ikt} and β_{ijt} up to a numeraire in each industry i. These adding-up constraints ensure that exporting equals importing, and the predicted values will exactly match aggregate exporting at the exporting country level, importing country level, and time level. Note that the denominator in the first equation is country $j's$ total exports of industry i, since 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.