The Great Recession and a Missing Generation of Exporters

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Abstract
We study the impact of foreign market entry and exit by firms on the trajectory of U.S. exports during and after the Great Recession. Using confidential micro-data from the U.S. Census Bureau, we find that incumbent exporters were primarily responsible for the changes in aggregate foreign sales during these years. While there was a substantial decline in the number of firms that sold abroad in the midst of the crisis, new exporters during the recovery compensated for this by having larger foreign sales. Thus, while changes in foreign market participation drove substantial shifts in the variety of U.S. goods that were exported, overall they were less important for the trajectory of total foreign sales over time.

Keywords  Great recession · Business cycles · Exports · Entry · Exit · Firm dynamics

JEL Classification  F10 · F40 · E32 · E44 · J2

1 Introduction

The sharp decline in aggregate international trade during the Great Recession has garnered significant attention. As shown by Levchenko et al. (2010), the collapse was unprecedented in its magnitude relative to gross domestic product (GDP). While the initial rebound following the financial crisis was rapid, by 2014 foreign sales were still below their historical post-recession average. The reasons for this are currently not well understood. In this study, we consider how the financial..
crisis affected the number of firms that sold abroad. We then explore the extent to which a potential missing generation of exporters led to lower growth in U.S. foreign sales during the recovery.

We begin our analysis by documenting an increase in firm exits and a concurrent decline in entries into foreign markets during the crisis. Both of these were fairly abrupt changes that were substantial in magnitude. We next estimate a dynamic econometric model in order to better understand these events. We find that the Great Recession had substantial effects on incumbent exporters’ decisions to continue to serve foreign markets. Measured effects are robust across a variety of different specifications and measures of the recession. The evidence suggests that these effects were driven by both foreign and domestic shocks.

Having shown that the Great Recession affected foreign market participation, we consider what effect this had on aggregate outcomes over time. To do so, we rely on an export growth decomposition in order to look at the scarring effects of the changes in the number of firms that sold abroad on the trajectory of aggregate exports over 2008 to 2014. We conduct a set of counterfactual experiments to look at how export dynamics would have evolved if different aspects of foreign sales had followed their historical trends. The main conclusion from these estimations is that changes in the intensive margin of exports from incumbent exporters were the main driver of the decline in foreign sales during the financial crisis. At the same time, the intensive margin outperformed relative to its historical relationship with real GDP growth. Although there was a decline in the number of firms exporting during these years, this was compensated for by the relatively larger volume of foreign sales from new entrants into markets abroad.

Our findings have a number of implications. Firstly, the Great Recession had a substantial impact on welfare internationally. Access to a wider variety of goods has been recognized as one of the primary gains from international trade at least since the work of Hicks (1969): “The extension of trade does not primarily imply more goods...the variety of goods is (also) increased, with all the widening of life that that entails. There can be little doubt that the main advantage that will accrue to those with whom merchants are trading is a gain of precisely this kind.” If one assumes that each firm produces a distinct kind of product, it is reasonable to conclude that the decline in the number of exporters had significant welfare effects. This is particularly true given that a very large share of U.S. exports come from firms with patented technologies (Lin and Lincoln 2017) and that developing countries are often dependent on imports of intermediate capital goods from industrialized markets that embody the latest technologies (Eaton and Kortum 2001).

These variety effects were not the primary drivers of changes in the aggregate volume of exports during this period, however. This finding is broadly consistent with the prior literature in that, on a year-to-year basis, large firms are primarily responsible for changes in trade volumes (e.g., Bernard et al. 2009). Behrens et al. (2013) in particular consider the collapse in Belgian trade during the Great Recession and show that it was driven by adjustments in the quantity of exports by large firms. These results complement those of Bernard et al. (2009) on the effects of the 1997 Asian Financial Crisis on U.S. producers. Our results build on both of these
papers by estimating the importance of the size of entering and exiting firms in determining changes in aggregate export volumes.

At the same time, our findings contrast with the literature that considers the effects of the Great Recession on employment. In particular, Siemer (2019) finds a 30% reduction in firm birth rates during these years and an ensuing fall in employment attributable to young firms. Gourio et al. (2016) and Clementi et al. (2014) similarly show that declines in firm births have a persistent effect on employment and productivity. Our results thus suggest that trade and employment followed fundamentally distinct trajectories over this period and point to the importance of different mechanisms in determining these outcomes during financial crises.

The next section discusses our data sources and presents a number of new stylized facts about U.S. exports during the Great Recession. This is followed by a set of estimations that look at how these events affected firm participation in foreign markets. We then consider the aggregate implications of these extensive margin adjustments over time through a decomposition analysis and a set of counterfactuals. We close with a discussion of potential avenues for further research.

2 Data and Stylized Facts

2.1 Data

Our confidential microdata come from the U.S. Census Bureau and include all export shipments recorded by U.S. Customs and Border Protection. These transactions and the firm identification numbers associated with them are compiled into the Longitudinal Firm Trade Transactions Database (LFTTD). To obtain additional information on firm characteristics, we draw on the Longitudinal Business Database (LBD). This is sourced from Internal Revenue Service records and contains information on the employment, payroll, industry, and geographic location of every tax paying business establishment in the USA. We first aggregate these measures to the firm level and then merge them with the LFTTD. Bernard et al. (2009) were the first to conduct this merge, and recent efforts to improve this mapping have been developed by Barresse et al. (2016). Jarmin and Miranda (2002) provide an extensive description of the construction of the LBD along with an insightful characterization of the data.

We use this matched longitudinal information on firm exports from 1993 to 2014. The data set allows us to follow firms over time and to perform analyses using a firm’s industry, location, and age. Due to the comprehensiveness of our data, and unlike much of the previous literature, we are able to consider sectors outside of manufacturing and can include firms with as few as one employee in our estimations. This makes it possible to provide a much more comprehensive picture of the evolution of exports, particularly with respect to the extensive margin of trade.

In terms of our aggregate measures, total exports, GDP, and the export price index, they are all sourced from the Bureau of Economic Analysis’ national income and product accounts. County- and state-level house price data are obtained from Bogin et al. (2019). We define U.S. business cycles using the National Bureau of
Economic Research (NBER) Business Cycle reference dates and thus treat 2001, 2008, and 2009 as recession years.

2.2 Stylized Facts

2.2.1 Aggregate Stylized Facts

Figure 1 begins our analysis by comparing the log growth of exports after the Great Recession with the typical trajectory following the recessions that began between 1948 and 2001. It shows that the decline in exports after the Great Recession was much larger than what typically occurs during a recession. Foreign sales also did not recover by as much; 24 quarters after the most recent business cycle peak, the level of real goods exports is only 20 log percent above its pre-recession level relative to the comparable figure for prior recessions, which is 25 log percent.

2.2.2 Micro-Level Stylized Facts

Bernard and Jensen (1999) and a long literature following this study have documented that large firms dominate the level of exports in a given year. Gopinath and

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1 The exact dates used to construct these figures are discussed in the Appendix. Other important studies of the collapse include Amiti and Weinstein (2011), Baldwin (2011), Groot et al. (2011), Lane and Milesi-Ferretti (2011), Yi (2011), Gopinath and Neiman (2014), and Bricongne et al. (2012).
Neiman (2014) similarly show that almost all of the annual growth in total exports is due to changes in the foreign sales of incumbent exporters. Over long-time horizons, however, producers that are new to international markets make up the majority of total exports (e.g., Lincoln and McCallum 2018). This points to a potentially important role for any factors that might result in a missing generation of exporters.

Figure 2a plots firm foreign market entry and exit rates over the years in our sample. The entry rate is defined as the number of firms exporting in year $t$ that do not do so in $t - 1$ divided by the total number firms that export in year $t$. The exit rate is similarly defined as the number of firms that export in year $t - 1$ but do not do so in $t$ relative to the number of firms exporting in year $t - 1$. While the entry and exit rates are usually between 30 and 35%, the entry rate drops sharply and the exit rate spikes at the onset of the Great Recession. Figure 2b plots the difference between the entry and exit rates and shows that, even though the net difference is typically small and positive, during this period the difference declined by more than 5 percentage points.

3 Regression Evidence

We now turn to understanding the effect that the last two recessions had on the number of firms that export by focusing on each firm’s individual decision to sell abroad. We begin by considering a set of estimations that use aggregate measures of economic activity. Building on the influential work of Mian and Sufi (2011), we then consider the effects of firm-level proxies of the business cycle. These results in particular draw upon measures of foreign export demand and local conditions in the domestic market. Our findings demonstrate quantitatively that the Great Recession had substantial effects on the extensive margin of firm trade. We then perform a series of estimations that explore the sectoral heterogeneity in these effects.

3.1 The Great Recession and Export Participation

Starting with the work of Dixit (1989) and Baldwin and Krugman (1989), a longstanding theoretical literature has investigated the effects that the upfront costs of entering foreign markets have on the dynamics of aggregate exports. This work shows that these costs lead to a data generating process for the current firm export status that includes a lag of prior export status. The intuition for this result is that the upfront costs of entering foreign markets create an option value for firms to continue to sell abroad, which in turn induces state dependence in export status. We thus begin with evidence from estimating a dynamic linear probability model. This specification is similar to those in Roberts and Tybout (1997), Bernard and Jensen (2004), Lincoln and McCallum (2018), Lee and Lincoln (2019), and McCallum (2019).

In Eq. (1), we introduce a stylized form of the specifications we estimate

$$y_{it} = \alpha y_{it-1} + \beta r_t \times y_{it-1} + X'_{it} \gamma_i + r_t \times X'_{it} \delta + \phi_i + \phi_{it} + \epsilon_{it},$$  (1)
Fig. 2 Foreign market entry and exit rates. Notes Panel A shows foreign market entry and exit rates in percentage terms from 1994 to 2014. The entry rate is defined as the number of firms exporting in year $t$ that do not do so in year $t-1$, divided by the total number firms that export in year $t$. The exit rate is similarly defined as the number of firms that export in year $t-1$ but do not do so in year $t$, relative to the number of firms exporting in year $t-1$. Panel B shows the difference between these entry and exit rates in percentage points. The shaded bars indicate recession years as defined by the National Bureau of Economic Research.
in which \( y_{it} = \{0, 1\} \) indicates if firm \( i \) exports in year \( t \), \( r_i \) is a measure related to the U.S. business cycle in year \( t \), \( \phi_{st} \) and \( \phi_i \) are industry-year and firm fixed effects, and \( \varepsilon_{it} \) is the error term. We define a firm’s industry using one-digit SIC or NAICS classifications. Among the firm-specific variables in \( X_{it} \), we include the log of the average real wage, the log of the number of employees, and an indicator function, \( \text{Young} \), that takes the value one if the firm is less than 5 years old and zero otherwise. The industry-year fixed effects control for changes in variable trade costs, such as tariffs. Kee et al. (2013) in particular analyze trade tariffs and antidumping duties and conclude that the Great Recession was neither a substantial cause nor a consequence of greater protectionism.

Our dynamic linear probability model estimation approach has several advantages. First, it relies on relatively weak assumptions compared to other econometric approaches to estimating this type of data generating process. Second, its simple structure allows for a computationally straightforward consideration of all of the roughly 9.5 million firm-year observations in our main sample from 1993 until 2014. Third, it allows us to exploit the panel structure of the data to control for unobserved heterogeneity at the firm level and allows these individual effects to be correlated with the other independent variables.

As with any econometric technique, however, this approach also has potential drawbacks. Among these are “Nickell Bias,” so named because removing fixed effects by first differencing was shown by Nickell (1981) to give persistence estimates that are biased downward when the true coefficient is positive in dynamic panel data models. We use the within-group transformation with time dummies so that the explicit functional form of that bias is given in Hahn and Moon (2006). Additionally, our estimates may also suffer from the problem of initial conditions bias discussed in Heckman (1981).

With \( T = 22 \) yearly observations, the number of time periods in our panel data set significantly attenuates concerns about both Nickell and initial conditions biases. For fixed \( N \), the asymptotic Nickell bias of our estimator is of order \( O(T^{-1}) \) so that as \( T \to \infty \) the bias eventually disappears (Hahn and Moon 2006). Using Monte Carlo experiments, Arellano (2003) in particular argues that if the number of periods is 20 or more, then the downward bias caused by the within-group estimator is small. While other solutions for both of these problems are possible, such as Arellano and Bond (1991) and Blundell and Bond (1998), these rely on substantially stronger identifying assumptions. Likewise, Heckman (1981) shows that initial conditions bias disappears as \( T \to \infty \).

3.1.1 Aggregate Measures of the Business Cycle

We consider two alternative aggregate measures of the U.S. business cycle. The first uses recession years defined by the NBER as indicators. For \( r_i = \{0, 1\} \), we have \( r_{2001} = 1 \), \( r_{2008} = 1 \), and \( r_{2009} = 1 \), while all other years have \( r_i = 0 \). The second measure uses the log growth of annual real U.S. GDP. These partial equilibrium specifications essentially treat the aggregate business cycle measures as exogenous to the decisions of the firm. This approach is well justified by prior work. Groot et al. (2011) and Eaton et al. (2016), for example, show that the declines in export
volumes during this period can be attributed to a shift away from spending on tradable goods.

Table 1 presents our first set of results. Throughout the paper, we multiply each coefficient estimate and the associated standard error by 100 for presentation purposes. The interpretation of each of the coefficients is that a change equal to one in the covariate is associated with a percentage point (ppt.) change in the probability of exporting equal to the value of the coefficient estimate. For example,
coefficient on “Exported last year” is the marginal ppt. increase in the probability of selling abroad this year if the firm did so last year. Similarly, the coefficient on “Log employment” is the marginal ppt. increase in the probability of exporting this year if a firm’s employment increased by 100 log percent. The coefficient on the interaction terms, “Recession × Log employment,” for example, captures the effect during a recession of increasing a firm’s employment by 100 log percent. Importantly, the total effect of a recession and higher employment would need to consider the linear and interacted terms together. Regressions including export status lagged by 3 years give similar results, and the same is true of estimations that lag the control variables by 1 year. This is consistent with the prior literature.

As shown in Fig. 2, we expect the probability of exit to rise during downturns. These results are borne out, as the coefficient on the interaction term between the recession indicator and prior exporting status is negative for both the first and second lags. Focusing on columns (1) and (2), we can see that recessions reduced the probability of exporting by about 1 ppt. for firms that exported last year. In columns (3) and (4), the effect of recessions on firms that exported last year is somewhat lower. The effect on the interaction with exporting 2 years ago, however, is substantial. More broadly, we find that larger firms and those with a more skilled workforce, as measured by employment and average wages, are more likely to export. This is consistent with the broader empirical and theoretical trade literature. Young firms are also less likely to sell abroad overall. However, they are more likely to engage in exporting during recessions than older firms. This is an understudied issue and suggests that young firms may turn more toward foreign markets during downturns.

We consider a similar set of estimations in which we use separate indicators for the two recessions in our sample in the Appendix. While both downturns had a negative impact on export participation, the effect of the Great Recession was about twice as large. Interestingly, here and in the following estimations larger firms and those with a more skilled workforce fared better during the Great Recession. As these firms are more likely to export in the first place, it is natural that they would have a stronger attachment to foreign markets during downturns. Consistent with Table 1, young firms were also more likely to export both during the 2001 recession and during the Great Recession.

Table 2 replaces the recession year indicators in these estimations with U.S. real GDP growth. The interpretation of the coefficients on these variables is the same as in Table 1, so that 100 log percent GDP growth is associated with a ppt. change in the probability of exporting equal to the coefficient for firms that exported in the previous year. As such, column (1) implies that a recession with negative one log percent growth lowers the probability of exporting by 0.4 ppt. for firms that sold abroad last year. Note that the main coefficients of interest using growth intuitively have the opposite sign of those on the interactions included in Table 1. The size and significance of the coefficients are broadly consistent with those in the previous estimations. With regards to young firms, we again find that these businesses are more likely to export than older firms during times of low real GDP growth.

In the same vein as work by Blum et al. (2013), we also estimated the specification in column (4) of Table 2 separately for perennial and occasional exporters.
We define occasional exporters as those having sold abroad at least once during our sample period but also having 5 years or less of observed exporting experience. As this definition would imply, perennial exporters exhibit higher export status persistence compared to occasional exporters. Real GDP growth, however, affects the probability that these two types of firms continue exporting in much the same way as it did in our estimations for all firms.

The table presents the results from estimating variants of the following equation:

\[ y_{it} = ay_{it-1} + \beta \Delta \log \text{RGDP}_t \times y_{it-1} + \chi_{it} + \Delta \log \text{RGDP}_t \times \Delta \log \text{RGDP}_t \times X_{it} + \phi_i + \phi_{st} + \epsilon_{it}. \]

\( y_{it} = \{0, 1\} \) indicates if firm \( i \) exports in year \( t \). \( \Delta \log \text{RGDP}_t \) is U.S. real GDP growth in year \( t \). \( \phi_i \) and \( \phi_{st} \) are firm and industry-year fixed effects, \( X_{it} \) is a set of controls, and \( \epsilon_{it} \) is the error term. \( \text{Young} \) is an indicator variable for whether the firm is less than 5 years old. The scaling of the results is generally done as in Table 1, which implies that 100 log percent GDP growth changes the probability of exporting by coefficient percentage points. \( R^2 \) values range between 21 and 25 percent. Standard errors are in parentheses and are clustered by firm, with significance levels of 1%, 5%, and 10% denoted by ***, **, and *, respectively.

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3.1.2 Foreign and Domestic Channels

In this section, we consider measures of foreign and local conditions to understand the channels through which the Great Recession affected export participation. In particular, we use the log difference in industry-level exports and U.S. county-level house prices to proxy for firm-specific foreign and local U.S. conditions. Our foreign exports measure accounts for the export demand shock that a firm might face. On the domestic side, many recent studies have documented the effect of changes in local house prices and economic activity during and after the Great Recession (Mian and Sufi 2011; Adelino et al. 2015; Schmalz et al. 2017). Following this work, we use the change in county-level house price indexes from Bogin et al. (2019) as a measure of changes in local conditions. This approach captures local demand shocks as well as the effect of local credit supply shocks.

Specifically, our measures of foreign and local shocks are given by

\[ d_{it} = \sum_{s} E_{ist} \Delta \ln(D_{st}), \quad p_{it} = \sum_{c} E_{ict} \Delta \ln(P_{ct}). \quad (2) \]

We define the firm-level export demand shock \( d_{it} \) as the geometric average of the change in industry-level real exports. We use the share of total employment, \( E_{ist} \), for firm \( i \) in industry \( s \) in year \( t-1 \) to apportion the log difference in U.S. industry-level real exports, \( \Delta \ln(D_{st}) = \ln(D_{st}) - \ln(D_{st-1}) \), to each firm. Similarly, we define the firm-level house price shock \( p_{it} \) as the geometric average of the change in county-level house prices. We use the share of employees \( E_{ict} \) for firm \( i \) located in county \( c \) in year \( t-1 \) to apportion the log difference in county-level house price changes \( \Delta \ln(P_{ct}) \) to each firm. The units for each of these measures are 1-year log percent changes.

The underlying assumption behind using geometric averages in Eq. (2) is that foreign demand shocks to a particular industry will affect each firm in proportion to its employment in that particular industry. Likewise, county-level shocks are assumed to affect a firm according to the share of its employees who work at establishments in that geographic area. Since the LBD records employment at the industry and county level for establishments within each firm, employment shares can vary over time within the same firm as different establishments grow or shrink. We lag the shares by 1 year so that they do not change in response to current developments. On average across years and firms, our foreign demand measure grew by about 5% annually, while the local house price measure grew by roughly 3% each year.

Using these measures of domestic and foreign shocks, we estimate three specifications. A stylized version encompassing all three is

\[ y_{it} = a y_{it-1} + \beta d_{it} + \gamma p_{it} + \delta d_{it} \times y_{it-1} + \zeta p_{it} \times y_{it-1} + X'_{it} \eta + d_{it} \times X'_{it} \lambda + p_{it} \times X'_{it} \theta + \phi_i + \phi_{st} + \varepsilon_{it}. \quad (3) \]

The definitions of the other covariates here are the same as in Eq. (1). The three specifications will, in turn, include only foreign shocks, only local shocks, and then
both types of shocks together. Considering them simultaneously will allow us to compare the roles of foreign and local conditions.

Table 3 presents the results. Column (1) shows that a negative 100 log percent foreign demand shock reduces the probability that a firm exports by about 1/3 ppt., which is approximately the same size effect as that of a local house price shock in column (2). Column (3) includes both types of shocks, finding that the coefficients on each of these factors remain essentially the same when considered simultaneously. Although the coefficient on local house prices is insignificant, in each of these approaches the point estimates suggest that the magnitude of foreign and local effects was broadly similar.

Column (4) takes the specification in column (1) and additionally interacts the covariates with the foreign demand shock. It shows that the overall effect of changes in foreign demand works through its interaction with last year’s export status. Intuitively, in response to a decline in foreign demand, firms that exported last period become less likely to export this period. Coefficients on the linear terms are little changed, and the interacted foreign demand effects are small and mostly insignificant. Column (5) instead adds interaction terms to the house price shocks specification. As in column (4), we find significant effects for the interaction of house prices with previous export status and the magnitude of this coefficient is much larger than the foreign demand effects. Finally, column (6) includes all of the covariates and interaction terms together and leads to similar conclusions.

### 3.1.3 Sectoral Patterns

While much of the literature on international trade has focused on manufacturing, our results in Tables 1, 2, and 3 include firms in all industries that ever sell abroad. This section exploits the comprehensiveness of our data to examine the effects across three broadly defined sectors: (1) manufacturing, (2) services, and (3) wholesale and retail. These industries account for the overwhelming majority of U.S. exports.²

Table 4 presents the results. We find that there is substantial heterogeneity across sectors with regards to firms’ exporting behavior. First, export status in the previous 2 years has stronger effects for the manufacturing sector than for the wholesale/retail and services sectors. At the same time, firms in manufacturing and wholesale/retail that sold abroad in previous years appear to be more responsive to changes in real GDP growth than firms in the services sector. While not determinative, this suggests that a secular shift in the economy toward services could reduce the responsiveness of aggregate exports to recessions through a composition effect. Second, when real GDP growth is high, firms in the wholesale/retail sector are less likely to export when they are large or pay high wages. They are substantially more likely to sell abroad during recessions, however. Firms in other sectors do not show nearly the same type of differential response for any of these interaction effects. This suggests

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² Trade in the services sector in particular has gained substantial attention in recent years. See, for example, Jensen (2011), Lincoln (2012), and Blinder and Krueger (2013). Lewis et al. (2019) similarly study how structural change toward services affects an economy’s trade behavior.
Table 3  Export participation, foreign demand, and local house prices

| Dependent variable: $y_{it} = \{0, 1\}$ | (1)         | (2)         | (3)         | (4)         | (5)         | (6)         |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Exported last year ($y_{it-1}$)          | 16.83***    | 16.83***    | 16.83***    | 16.80***    | 16.81***    | 16.78***    |
|                                          | (0.05)      | (0.05)      | (0.05)      | (0.05)      | (0.06)      | (0.06)      |
| Foreign demand ($d_{it}$)                | 0.36***     | 0.36***     | 0.15        | 0.23        |             |             |
|                                          | (0.05)      | (0.05)      | (0.19)      |             |             |             |
| Local house prices ($p_{it}$)            | 0.34        | 0.33        | -6.31***    | -6.22***    |             |             |
|                                          | (0.24)      | (0.24)      | (0.82)      | (0.82)      |             |             |
| Foreign demand $\times$ Exported last year ($d_{it} \times y_{it-1}$) | 0.58***     | 0.56***     |             |             |             |             |
|                                          | (0.13)      |             |             |             |             |             |
| Local house prices $\times$ Exported last year ($p_{it} \times y_{it-1}$) | 0.91**      | 0.81**      |             |             |             |             |
|                                          | (0.38)      |             |             |             |             |             |
| Log employment ($x_{1it}$)               | 7.16***     | 7.16***     | 7.16***     | 7.16***     | 7.17***     | 7.17***     |
|                                          | (0.03)      | (0.03)      | (0.03)      | (0.03)      | (0.03)      | (0.03)      |
| Log average wages ($x_{2it}$)            | 4.26***     | 4.27***     | 4.26***     | 4.26***     | 4.21***     | 4.21***     |
|                                          | (0.04)      | (0.04)      | (0.04)      | (0.04)      | (0.04)      | (0.04)      |
| Young ($x_{3it}$)                        | 0.69***     | 0.69***     | 0.69***     | 0.68***     | 0.64***     | 0.63***     |
|                                          | (0.05)      | (0.05)      | (0.05)      | (0.05)      | (0.05)      | (0.05)      |
| Foreign demand $\times$ Log employment ($d_{it} \times x_{1it}$) | 0.07        |             |             |             |             |             |
|                                          | (0.06)      |             |             |             |             |             |
| Foreign demand $\times$ Log average wages ($d_{it} \times x_{2it}$) | 0.14        |             |             |             |             |             |
|                                          | (0.11)      |             |             |             |             |             |
| Foreign demand $\times$ Young ($d_{it} \times x_{3it}$) | -0.21*      | -0.20*      |             |             |             |             |
|                                          | (0.11)      |             |             |             |             |             |
| Local house prices $\times$ Log employment ($p_{it} \times x_{1it}$) | 2.03***     | 2.00***     |             |             |             |             |
|                                          | (0.23)      |             |             |             |             |             |
| Local house prices $\times$ Log average wages ($p_{it} \times x_{2it}$) | 1.14*       | 1.12*       |             |             |             |             |
|                                          | (0.58)      |             |             |             |             |             |
| Local house prices $\times$ Young ($p_{it} \times x_{3it}$) | 4.74        | 4.74        |             |             |             |             |
|                                          | (9.47)      |             |             |             |             |             |

The table presents the results from estimating variants of the following equation:

$$y_{it} = a y_{it-1} + \beta d_{it} + \gamma p_{it} + \delta d_{it} \times y_{it-1} + \zeta p_{it} \times y_{it-1} + X_{it}' \eta + d_{it} \times \theta + p_{it} \times \theta + \phi_{i} + \phi_{it} + \epsilon_{it}$$

$y_{it} = \{0, 1\}$ indicates if firm $i$ exports in year $t$, $d_{it}$ is a measure of foreign demand shocks, $p_{it}$ is a measure of local house price shocks, $\phi$, and $\phi_{it}$ are firm and industry-year fixed effects, $X_{it}$ is a set of controls, and $\epsilon_{it}$ is the error term. Young is an indicator variable for whether the firm is less than 5 years old. The scaling of the results is done as in Table 2. $R^2$ values are roughly 22% across each of the estimations. Standard errors are in parentheses and are clustered by firm, with significance levels of 1%, 5%, and 10% denoted by ***, **, and *, respectively
Table 4 Export participation and GDP growth by sector

| Dependent variable: \( y_{it} = \{0, 1\} \) | (1) All Firms | (2) Manufacturing | (3) Services | (4) Wholesale/Retail |
|---------------------------------------------|---------------|-------------------|-------------|---------------------|
| Exported last year (\( y_{it-1} \))         | 15.23***      | 20.03***          | 12.20***    | 15.07***            |
|                                              | (0.07)        | (0.16)            | (0.14)      | (0.11)              |
| Exported 2 years ago (\( y_{it-2} \))       | 4.27***       | 6.09***           | 2.94***     | 4.20***             |
|                                              | (0.06)        | (0.15)            | (0.13)      | (0.10)              |
| \( \Delta \log RGD P \times \text{Exported} \) last year (\( r_t \times y_{it-1} \)) | 31.85***      | 28.48***          | 19.98***    | 28.32***            |
|                                              | (2.06)        | (4.64)            | (4.38)      | (3.24)              |
| \( \Delta \log RGD P \times \text{Exported} \) 2 years ago (\( r_t \times y_{it-2} \)) | 28.03***      | 30.54***          | 12.59***    | 30.91***            |
|                                              | (2.00)        | (4.56)            | (4.16)      | (3.18)              |
| Log employment (\( x_{1it} \))             | 7.00***       | 8.43***           | 5.81***     | 7.92***             |
|                                              | (0.03)        | (0.07)            | (0.07)      | (0.06)              |
| Log average wages (\( x_{2it} \))          | 4.19***       | 5.60***           | 2.75***     | 5.36***             |
|                                              | (0.04)        | (0.11)            | (0.08)      | (0.07)              |
| Young (\( x_{3it} \))                       | -0.35***      | -0.74***          | -0.58***    | 0.13                |
|                                              | (0.08)        | (0.19)            | (0.17)      | (0.13)              |
| \( \Delta \log RGD P \times \text{Log} \) employment (\( r_t \times x_{1it} \)) | -1.99***      | -0.54             | 1.04        | -4.91***            |
|                                              | (0.49)        | (1.06)            | (0.92)      | (0.91)              |
| \( \Delta \log RGD P \times \text{Log} \) average wages (\( r_t \times x_{2it} \)) | -0.74         | 3.94              | 2.65        | -10.22***           |
|                                              | (1.06)        | (2.93)            | (1.85)      | (1.81)              |
| \( \Delta \log RGD P \times \text{Young} \) (\( r_t \times x_{3it} \)) | -5.36***      | 1.96              | -0.22       | -11.05***           |
|                                              | (2.39)        | (5.31)            | (4.85)      | (3.77)              |
| Industry \times Year FE (\( \phi_{it} \))  | Yes           | Yes               | Yes         | Yes                 |
| Firm FE (\( \phi_{i} \))                   | Yes           | Yes               | Yes         | Yes                 |
| Obs. (millions)                             | 9.47          | 2.14              | 2.20        | 3.64                |

The table presents the results from estimating variants of the following equation:

\[
y_{it} = \alpha y_{it-1} + \beta \Delta \log RGD P \times x_{it} + X_{it}' \gamma + \Delta \log RGD P \times X_{it}' \delta + \phi_i + \phi_{it} + \epsilon_{it}.
\]

\( y_{it} = \{0, 1\} \) indicates if firm \( i \) exports in year \( t \), \( \Delta \log RGD P \) is U.S. real GDP growth in year \( t \), \( \phi_i \) and \( \phi_{it} \) are firm and industry-year fixed effects, \( X_{it} \) is a set of controls and \( \epsilon_{it} \) is the error term. \( \text{Young} \) is an indicator variable for whether the firm is less than 5 years old. The scaling of the results is done as in Table 2. Column (1) shows the estimates for all firms together, while columns (2)–(4) provide the results for the manufacturing, services, and wholesale/retail sectors, respectively. Across columns (1)–(4), \( R^2 \) values are roughly 25, 38, 12, and 21%. Standard errors are in parentheses and are clustered by firm, with significance levels of 1%, 5%, and 10% denoted by ***, **, and *, respectively.

that the response of large, high wage, and young firms to recessions for the whole sample in these estimations is primarily driven by the firms in the wholesale/retail sector.

In Table 5, we consider different types of sectoral heterogeneity. We estimate specifications that make three primary distinctions based on what kinds of goods firms produce and the nature of their production processes: (1) durable versus nondurable goods, (2) intermediate versus final goods, and (3) externally financially dependent versus not externally financially dependent. Analysis of the effects of
Table 5 Export participation and GDP growth: durable goods, final goods, and high external finance dependence sectors

| Dependent variable: $y_{it} = \{0, 1\}$ | (1) Manufacturing | (2) Durables | (3) Final goods | (4) High EFD |
|-----------------------------------------|------------------|-------------|----------------|-------------|
| Exported last year ($y_{it-1}$)        | 20.03***         | 19.27***    | 20.85***       | 19.87***    |
|                                         | (0.16)           | (0.29)      | (0.46)         | (0.17)      |
| Exported 2 years ago ($y_{it-2}$)      | 6.09***          | 4.81***     | 5.73***        | 6.08***     |
|                                         | (0.15)           | (0.27)      | (0.43)         | (0.16)      |
| $\Delta \log RGDP \times Exported$     | 28.48***         | 6.51        | 39.21***       | 25.88***    |
| last year ($r_t \times y_{it-1}$)      | (4.64)           | (8.63)      | (13.63)        | (5.01)      |
| $\Delta \log RGDP \times Exported$     | 30.54***         | 32.81***    | 10.42          | 30.13***    |
| 2 years ago ($r_t \times y_{it-2}$)    | (4.56)           | (8.48)      | (13.41)        | (4.93)      |
| Exported last year $\times$ Indicator  | 1.04***          | −0.92*      | 1.06**         |             |
|                                         | (0.35)           | (0.49)      | (0.45)         |             |
| Exported 2 years ago $\times$ Indicator| 1.77***          | 0.41        | 0.04           |             |
|                                         | (0.32)           | (0.46)      | (0.41)         |             |
| $\Delta \log RGDP \times Exported$     | 30.87***         | −12.24      | 17.75          |             |
| last year $\times$ Indicator            | (10.23)          | (14.48)     | (13.29)        |             |
| $\Delta \log RGDP \times Exported$     | −3.51            | 22.77       | 2.73           |             |
| 2 years ago $\times$ Indicator          | (10.06)          | (14.24)     | (13.00)        |             |
| Log employment ($x_{1it}$)              | 8.43***          | 8.33***     | 8.92***        | 8.45***     |
|                                         | (0.07)           | (0.14)      | (0.20)         | (0.08)      |
| Log employment $\times$ Indicator       | 0.15             | −0.56**     | −0.07          |             |
|                                         | (0.17)           | (0.22)      | (0.20)         |             |
| Log average wages ($x_{2it}$)           | 5.60***          | 5.18***     | 5.95***        | 5.51***     |
|                                         | (0.11)           | (0.18)      | (0.27)         | (0.12)      |
| Log average wages $\times$ Indicator    | 0.58***          | −0.39       | 0.54**         |             |
|                                         | (0.20)           | (0.28)      | (0.25)         |             |
| Young ($x_{3it}$)                       | −0.74***         | −0.25       | −0.59          | −1.09***    |
|                                         | (0.19)           | (0.38)      | (0.55)         | (0.21)      |
| Young $\times$ Indicator                | −0.66            | −0.17       | 1.69***        |             |
|                                         | (0.43)           | (0.58)      | (0.43)         |             |
| $\Delta \log RGDP \times$ Firm Covariates | Yes             | Yes         | Yes            | Yes         |
| $\Delta \log RGDP \times$ Firm Covariates $\times$ Indicator | Yes             | Yes         | Yes            | Yes         |
| Industry $\times$ Year FE ($\phi_{it}$) | Yes             | Yes         | Yes            | Yes         |
| Firm FE ($\phi_i$)                      | Yes             | Yes         | Yes            | Yes         |
| Obs. (millions)                         | 2.14            | 2.14        | 2.14           | 2.14        |

The table presents the results from estimating variants of the following equation:

$$y_{it} = \alpha y_{it-1} + \beta \Delta \log RGDP_t \times y_{it-1} + X'_{it} \gamma + \Delta \log RGDP_t \times X'_{it} \delta + \phi_i + \phi_{it} + \phi_{it} + \epsilon_{it}.$$  

$y_{it} = \{0, 1\}$ indicates if firm $i$ exports in year $t$. $\Delta \log RGDP_t$ is U.S. real GDP growth in year $t$. $\phi_i$ and $\phi_{it}$ are firm and industry-year fixed effects, $X_{it}$ is a set of controls, and $\epsilon_{it}$ is the error term. “Indicator” denotes a variable that takes a value of one for the respective measure in each column and zero otherwise. The scaling of the results is done as in Table 2. The $R^2$ values are roughly 25 percent in column (1) and 38% in columns (2)–(4). Standard errors are in parentheses and are clustered by firm, with significance levels of 1%, 5%, and 10% denoted by ***, **, and *, respectively.
these forms of firm heterogeneity has played a substantial role in the prior literature on the Great Recession.

Levchenko et al. (2010) in particular show that a large portion of the decline in goods trade during the Great Recession can be explained by the decline in durables. They further argue that restrictions in trade credit did not play a large role in the trade collapse. di Giovanni and Levchenko (2010) relatedly show that vertical linkages were an important factor for business cycle comovement during this period. A large literature more broadly considers the role of financial constraints during the Great Recession, such as Duygan-Bump et al. (2015) and Siemer (2019). Given the nature of these distinctions as well as the importance of manufacturing to aggregate trade, here we limit our analysis to firms in this sector.  

Column (1) of Table 5 presents the estimates for all manufacturing firms together using the specification considered in column (2) of Table 2. Columns (2)–(4) show estimations that interact an indicator variable for the measure corresponding to the heading with other covariates. Thus, in column (2) the indicator variable takes the value of 1 for durable goods sectors, in column (3) it takes the value of 1 for final goods sectors, and in column (4) it takes the value of 1 for sectors that are dependent on external finance (EFD sectors). These indicators are constant across time for each firm, so their direct effect on export status is captured by the firm fixed effects. The main coefficients of interest in these specifications are those on the triple interaction terms between real GDP growth, lagged export status, and the sectoral indicators. For parsimony, here we report only the main results for these estimations. The Appendix presents the full results.

Consistent with the findings in Levchenko et al. (2010), durable goods firms show the most significant difference relative to other firms. Relative to others, producers in this sector are more likely to export if they have sold abroad in the past 2 years. These firms are also more responsive to real GDP growth if they exported last year. The final goods sector essentially behaves like other firms. Finally, firms in sectors with high dependence on external financing behave similarly to other manufacturing firms. The main exception here is that young firms are more likely to export than other manufacturing firms.

Table 6 extends the analysis in Table 5 by exploring sectoral heterogeneity in the response of firms to foreign versus local shocks. Here, we similarly restrict the sample to manufacturing producers and consider the same types of distinctions between firms. In column (2), durable goods manufacturers are more affected by foreign demand than others, while the differential effect of local conditions is not statistically significant. Column (3) shows that neither foreign nor local shocks have a statistically significant effect on export participation for final goods firms relative to other producers.

---

3 We rely on the sectoral credit constraint measures that were developed by Rajan and Zingales (1998) and Cetorelli and Strahan (2006). Our analysis follows the latter study to construct our estimates of external financial dependence. To do so, we compute the sum of a firm’s total capital expenditures over all years and then subtract cash flow from operations for all mature Compustat firms from 1980 to 1997. These firms are all more than 10 years old in Compustat data. The sectoral measure is then defined as the median external financial dependence value of all firms in a given two-digit SIC sector. To construct the indicator variable for final goods, we classify firms based on the median level of the upstream variable reported in di Giovanni and Levchenko (2010).
Lastly, in column (4) we find that firms which are dependent on external finance are less sensitive to foreign shocks but much more sensitive to local house price shocks. Our estimates imply that, holding all else equal, the probability that exports from firms that are dependent on external finance would fall by about 5 percentage

### Table 6  Export participation, foreign demand, and local house prices by sector

| Dependent variable: $y_{it} = \{0, 1\}$ |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| (1)                             | (2)                             | (3)                             | (4)                             |
| **Manufacturing**               | **Durables**                    | **Final goods**                 | **High EFD**                    |
| Exported last year ($y_{it-1}$) | 22.30***                        | 20.58***                        | 23.23***                        | 22.05***                        |
|                                 | (0.12)                          | (0.22)                          | (0.34)                          | (0.13)                          |
| Exported last year ($y_{it-1}$)× Indicator | 2.38***                        | –1.06***                        | 1.69***                         | 2.05***                         |
|                                 | (0.26)                          | (0.36)                          | (0.33)                          | (0.33)                          |
| Foreign demand ($d_{it}$)       | 0.31                            | –0.30                           | 0.29                            | 0.46**                          |
|                                 | (0.21)                          | (0.31)                          | (0.39)                          | (0.22)                          |
| Foreign demand ($d_{it}$) × Indicator | 1.08***                        | 0.03                            | –0.83*                          |                                        |
|                                 | (0.39)                          | (0.44)                          | (0.49)                          |                                        |
| Local house prices ($p_{it}$)   | 0.98*                           | 0.66                            | 1.70                            | 0.20                            |
|                                 | (0.55)                          | (0.86)                          | (1.14)                          | (0.58)                          |
| Local house prices ($p_{it}$) × Indicator | 0.42                            | –0.85                           | 4.82***                         | 4.28***                         |
|                                 | (0.93)                          | (1.18)                          | (1.04)                          | (1.04)                          |
| Log employment ($x_{1it}$)      | 8.73***                         | 8.56***                         | 9.18***                         | 8.73***                         |
|                                 | (0.07)                          | (0.13)                          | (0.19)                          | (0.08)                          |
| Log employment ($x_{2it}$) × Indicator | 0.24                            | –0.52**                         | –0.02                           |                                        |
|                                 | (0.16)                          | (0.21)                          | (0.19)                          |                                        |
| Log average wages ($x_{3it}$)   | 5.82***                         | 5.50***                         | 6.16***                         | 5.75***                         |
|                                 | (0.09)                          | (0.16)                          | (0.25)                          | (0.09)                          |
| Log average wages ($x_{3it}$) × Indicator | 0.45**                          | –0.38                           | 0.42*                           |                                        |
|                                 | (0.19)                          | (0.26)                          | (0.24)                          |                                        |
| Young ($x_{3it}$)               | –1.08***                        | –0.53**                         | –1.08***                        | –1.17***                        |
|                                 | (0.11)                          | (0.21)                          | (0.31)                          | (0.12)                          |
| Young ($x_{3it}$) × Indicator   | –0.75***                        | –0.00                           | 0.51*                           |                                        |
|                                 | (0.25)                          | (0.32)                          | (0.27)                          |                                        |
| Industry × Year FE ($\phi_{it}$) | Yes                             | Yes                             | Yes                             | Yes                             |
| Firm FE ($\phi$)                | Yes                             | Yes                             | Yes                             | Yes                             |
| Obs. (millions)                 | 2.14                            | 2.14                            | 2.14                            | 2.14                            |

The table presents the results from estimating variants of the following equation:

$$y_{it} = \alpha y_{it-1} + \beta d_{it} + \gamma p_{it} + \delta d_{it} \times y_{it-1} + \zeta p_{it} \times y_{it-1} + X_{it}^\prime \eta + d_{it} \times X_{it}^\prime \lambda + p_{it} \times X_{it}^\prime \mu + \phi_i + \phi_{it} + \epsilon_{it}$$

$y_{it} = \{0, 1\}$ indicates if firm $i$ exports in year $t$, $d_{it}$ is a measure of foreign demand shocks, $p_{it}$ is a measure of local house price shocks, $\phi_i$ and $\phi_{it}$ are firm and industry-year fixed effects, $X_{it}$ is a set of controls, and $\epsilon_{it}$ is the error term. Young is an indicator variable for whether the firm is less than 5 years old. $d_{it}$ and $p_{it}$ are given in Eq. (2). “Indicator” denotes a variable that takes a value of one for the respective measure in each column and zero otherwise. The scaling of the results is done as in Table 2. The $R^2$ values are roughly 25% in column (1) and 34% in columns (2)–(4). Standard errors are in parentheses and are clustered by firm, with significance levels of 1%, 5%, and 10% denoted by ***, **, and *, respectively.
points more than other firms if house prices declined by 1%. Fluctuations in the value of real estate as collateral could be a potential explanation for these estimates that would be supported by theory.

4 Aggregate Implications and Counterfactuals

The previous section showed that the Great Recession substantially impacted firms’ individual export participation decisions. However, our results are not dispositive about whether firms’ participation choices had quantitatively important implications for aggregate export growth over time. It could be, for example, that while there are fewer firms exporting, this does not affect total foreign sales substantially. This mapping from micro- to macro-effects allows us to estimate how much the extensive margin affected the trajectory of aggregate exports after the Great Recession ended.

In this section, we consider a different estimation approach from the previous section. This allows us to consider how aggregate foreign sales would have evolved after the Great Recession if different margins of exports had followed their historical trajectory. We first present an exact decomposition of export growth, which includes the role of changes in behavior by incumbent exporters as well as the contribution from firms entering and exiting foreign markets. This approach allows us to connect aggregate growth in foreign sales with the outcomes of individual firms during and after the Great Recession. We then study the implications of several partial equilibrium counterfactuals, which consider the importance of different margins of exports on the recovery from the Great Recession.

4.1 An Exact Export Growth Decomposition

Our decomposition of total real export growth is based on the work of di Giovanni et al. (2014). Log growth of total exports over $h$ years $g^h_t$ can be decomposed into five margins as

$$
g^h_t = \ln \left( \frac{\bar{X}_t(I_{t+h})}{\bar{X}_{t-h}(I_{t+h})} \right)$$

$$+ \ln \left( \frac{N_t(I_t)}{N_t(I_{t+h})} \right) + \ln \left( \frac{\bar{X}_t(I_t)}{\bar{X}_t(I_{t+h})} \right) - \ln \left( \frac{N_{t-h}(I_{t-h})}{N_t(I_{t+h})} \right) - \ln \left( \frac{\bar{X}_{t-h}(I_{t-h})}{\bar{X}_t(I_{t+h})} \right)$$

$$= e^h_t = \text{entry extensive}$$

$$e^h_t = \text{entry intensive}$$

$$x^h_t = \text{exit extensive}$$

$$x^h_t = \text{exit intensive}$$

$$n^h_t = \text{net extensive margin}$$

\[ (4) \]
$I_t$ is the set of firms that export in year $t$, $N_t(I_t)$ is the number of exporting firms in year $t$, and $\bar{X}_t(I_t)$ is average foreign sales per firm in year $t$. $I_{t\cap t-h}$ is the set of firms that sell abroad in both years $t$ and $t-h$. Likewise, $N_{t}(I_{t\cap t-h})$ is the number of firms that export in both years $t$ and $t-h$ and $\bar{X}_{t}(I_{t\cap t-h})$ denotes the average foreign sales per incumbent exporting firm in year $t$. The decomposition uses the fact that exports for any subset of firms can be written as the product of the number of firms selling abroad and the average foreign sales of each firm in the relevant subset. For example, total exports in year $t$ by incumbents with $h$ years of exporting history can be written as $\sum_{i\in I_{t\cap t-h}} X_{it} = N_{t}(I_{t\cap t-h}) \bar{X}_{t}(I_{t\cap t-h})$. A detailed derivation and an additional discussion of this decomposition are included in the Appendix.

The term $i_{t}^{h}$ in Eq. (4) is the intensive margin contribution in year $t$ to total log growth over the past $h$ years by firms that exported in both years $t$ and $t-h$. By definition, the number of these incumbent exporters in year $t$ is the same as the number in year $t-h$ so that $N_{t}(I_{t\cap t-h}) = N_{t-h}(I_{t\cap t-h})$. As such, the intensive margin is unaffected by changes in the number of firms and is summarized by changes in the average exports of incumbents. The remaining four margins of Eq. (4) together compose the net extensive margin $n_{t}^{h}$. As the name implies, this includes the entry margin $e_{t}^{h}$ minus the exit margin $x_{t}^{h}$.

We define $e_{t}^{h}$ as the contribution to total export growth of firms that sold abroad in year $t$ but did not do so in year $t-h$. Similarly, we define $x_{t}^{h}$ as the contribution to export growth of firms that sold abroad in year $t-h$ but did not do so in year $t$. We further decompose the entry and exit margins into the contribution of the number of exporting firms and average exports per entering and exiting firm. The entry margin is made up of the entry extensive margin $ee_{t}^{h}$, which captures the number of entrants relative to the number of incumbents, and the entry intensive margin $e_{t}^{h}$, which captures the effect of the average size of those entrants.

For the purposes of giving intuition for the discussion of our results, note that the entry extensive margin can also be written as

$$\ln \left( \frac{N_t(I_t)}{N_{t}(I_{t\cap t-h})} \right) = \ln \left( 1 + \frac{N_{t-h}(I_{t\cap t-h})}{N_{t}(I_{t\cap t-h})} \right).$$

The measure of the entry rate given by the ratio in the right-hand side of Eq. (5) is the number of firms that exported in year $t$ but did not do so in year $t-h$ divided by the total number of firms that exported in both periods. We use set notation to denote the set of firms that are new entrants which is formally given by $I_{t\setminus t-h} = \{ i : i \in I_t, i \notin I_{t-h} \}$.

Like the entry margin, the exit margin is made up of the exit extensive margin $xe_{t}^{h}$, which captures the number of exiting firms relative to the number of incumbents, and the exit intensive margin $x_{t}^{h}$, which captures the average size of exiting firms. We similarly can write the contribution to total export growth from the number of exiting firms as

$$\ln \left( \frac{N_{t-h}(I_{t-h})}{N_{t}(I_{t\cap t-h})} \right) = \ln \left( 1 + \frac{N_{t-h}(I_{t-h\setminus t})}{N_{t}(I_{t\cap t-h})} \right).$$


The ratio on the right-hand side of Eq. (6) provides a measure of the exit rate, which is the number of firms that export in year $t-h$ but not in year $t$ divided by the number of firms that export in both periods. Similarly, we define the set in the numerator as \[ I_{t-h} \setminus I_t = \{ i : i \not\in I_t, i \in I_{t-h} \}. \]

The entry and exit extensive margins as written in (5) and (6) give a sense of how the regressions based on Eq. (1) in the prior section are connected to this decomposition. When $h = 1$, the fraction of firms that enter \[ N_t(I_{t-1}) \] is akin to the model’s predicted probability of entry, \[ P[y_{it} = 1 \mid y_{it-1} = 0, X_{it}]. \] The fraction of firms that exit \[ N_t(I_{t-1}) \] is similarly linked to the probability of exit, \[ P[y_{it} = 0 \mid y_{it-1} = 1, X_{it}]. \]

Panel A of Table 7 presents annualized estimates of each of the five terms in Eq. (4) for all U.S. firms that exported at least once between 1993 and 2006 for horizons between 1 and 6 years. This gives us a historical baseline that we can use to compare to the evolution of exports during and after the Great Recession. Panel B shows the same decomposition starting in 2008. All measures of exports are adjusted using the goods exports deflator from the national income and product

| Table 7 Annualized real export log growth decomposition, 1993–2006 versus 2008–2014 |
|---------------------------------|--------|--------|--------|--------|--------|--------|
|                                 | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | $h = 5$ | $h = 6$ |
| Total growth                    | 6.08   | 5.67   | 5.34   | 5.10   | 4.78   | 4.67   |
| Intensive margin                | 6.82   | 6.54   | 6.24   | 5.96   | 5.66   | 5.60   |
| Net extensive                   | -0.74  | -0.87  | -0.90  | -0.86  | -0.88  | -0.93  |
| Entry margin                    | 2.91   | 2.71   | 2.63   | 2.58   | 2.54   | 2.49   |
| Extensive                       | 44.64  | 29.48  | 23.64  | 20.41  | 18.29  | 16.79  |
| Intensive                       | -41.73 | -26.77 | -21.01 | -17.83 | -15.75 | -14.30 |
| Exit margin                     | -3.65  | -3.58  | -3.53  | -3.44  | -3.42  | -3.42  |
| Extensive                       | -42.41 | -27.26 | -21.50 | -18.34 | -16.28 | -14.75 |
| Intensive                       | 38.76  | 23.68  | 17.97  | 14.90  | 12.86  | 11.33  |

Panel B: 2008–2014

| Total growth                    | -15.65 | -1.06  | 1.47   | 2.21   | 2.24   | 2.35   |
| Intensive margin                | -15.11 | -0.41  | 2.09   | 3.05   | 2.89   | 3.00   |
| Net extensive                   | -0.53  | -0.65  | -0.62  | -0.84  | -0.64  | -0.65  |
| Entry margin                    | 2.17   | 2.18   | 2.25   | 2.12   | 2.10   | 1.90   |
| Extensive                       | 34.96  | 23.11  | 18.14  | 15.76  | 13.65  | 12.26  |
| Intensive                       | -32.79 | -20.93 | -15.89 | -13.65 | -11.55 | -10.36 |
| Exit margin                     | -2.70  | -2.83  | -2.88  | -2.96  | -2.74  | -2.55  |
| Extensive                       | -42.82 | -25.53 | -19.28 | -16.58 | -12.10 | -13.16 |
| Intensive                       | 40.12  | 22.70  | 16.40  | 13.63  | 11.78  | 10.61  |

The table presents the results from decomposing changes in aggregate real exports over the periods 1993–2006 and 2008–2014. The findings for the different margins are calculated using Eq. (4). Each column corresponds to a different value of $h$, the time horizon over which the changes are estimated. For ease of comparison, we annualize the log growth rates and contributions from each margin by dividing each figure by $h$. 

The ratio on the right-hand side of Eq. (6) provides a measure of the exit rate, which is the number of firms that export in year $t-h$ but not in year $t$ divided by the number of firms that export in both periods. Similarly, we define the set in the numerator as \[ I_{t-h} \setminus I_t = \{ i : i \not\in I_t, i \in I_{t-h} \}. \]

The entry and exit extensive margins as written in (5) and (6) give a sense of how the regressions based on Eq. (1) in the prior section are connected to this decomposition. When $h = 1$, the fraction of firms that enter \[ N_t(I_{t-1}) \] is akin to the model’s predicted probability of entry, \[ P[y_{it} = 1 \mid y_{it-1} = 0, X_{it}]. \] The fraction of firms that exit \[ N_t(I_{t-1}) \] is similarly linked to the probability of exit, \[ P[y_{it} = 0 \mid y_{it-1} = 1, X_{it}]. \]

Panel A of Table 7 presents annualized estimates of each of the five terms in Eq. (4) for all U.S. firms that exported at least once between 1993 and 2006 for horizons between 1 and 6 years. This gives us a historical baseline that we can use to compare to the evolution of exports during and after the Great Recession. Panel B shows the same decomposition starting in 2008. All measures of exports are adjusted using the goods exports deflator from the national income and product.
accounts (NIPA) with 2000 as the base year and are reported as annualized rates so that they can be compared across different horizons. As shown in column $h = 1$ in Panel A, 1-year log growth averaged 6.1 log percent per year between 1993 and 2006. The intensive margin on average contributes 6.8 log percentage points (lppt.), while the net extensive margin contributes negative 0.7 lppt. That is, on average, export growth between two consecutive years during this period was entirely driven by incumbents. Firms entering and exiting foreign markets on net contribute negatively to total export growth.

This small negative net contribution contains significant gross churn in the entry and exit margins, which on average contribute 2.9 and negative 3.7 lppt., respectively. A closer examination of the extensive margin reveals that, relative to incumbents, a large number of new firms begin to export each period. However, these entrants tend to be relatively small. The number of new exporters contributes 45 lppt. via the entry extensive margin. Since new exporters sell less abroad than incumbents, bringing down the average, they also reduce total log growth by 42 lppt. through the entry intensive margin. Finally, the number of exits subtracts about 42 lppt. via the exit extensive margin. As exiting firms are smaller than the average incumbent, their exit from foreign markets raises average exports, contributing 39 lppt. to total growth.

With the importance of gross churn and the magnitude of each contribution for 1 year in mind, we document the evolution of each of these margins in the 6 years after the Great Recession. Panel B of Table 7 shows the same decompositions as in Panel A but starts in 2008. We select 2008 as the starting point because 2009 is the first year with a decline in total foreign sales. A comparison of column $h = 6$ in Panel A with the corresponding column in Panel B reveals that average export growth in pre-crisis years was 4.7 lppt., whereas it was only 2.4 lppt. over 2008–2014. This fact is at the heart of the motivation for our analysis; exports grew more slowly after the Great Recession relative to how they performed in the recent past (Fig. 1).

The decomposition provided in Table 7, column $h = 6$, allows us to consider each margin in an attempt to understand the reasons underlying slower overall export growth since 2008. The intensive margin contribution was smaller by about 2.6 lppt. relative to the 1993–2006 average (3 lppt. versus 5.6 lppt.) but other margins’ contributions also differ. The net extensive margin historically contributed — 0.9 lppt. but contributed — 0.7 lppt. since 2008, the entry margin contribution fell from 2.5 to 1.9 lppt. and the exit margin rose from — 3.4 to about — 2.6 lppt. Figure 3 graphically illustrates the differences between the 2008–2014 and 1993–2006 periods at the $h = 6$ horizon. Here, we simply subtract the estimate in Panel B from the corresponding estimate in Panel A.

The entry extensive margin shows the largest change and pulled export growth down by 4.5 lppt. more than it did on average between 1993 and 2006. This large drag was offset somewhat by an increase in the size of the average new exporter, which added 3.9 lppt., leaving the total entry margin effect at — 0.6 lppt. A similar pattern holds for the exit extensive and exit intensive margins so that the exit margin’s total effect is to add 0.9 lppt. to total export growth more than the average contribution. Taking both entry and exit margins together shows that the net extensive margin added 0.3 lppt. more to aggregate real export growth after the Great
Recession than during 1993–2006. In contrast, slower intensive margin growth contributed 2.6 lppt. less per year since 2008 than what averages over 1993–2006 would imply. As a result, slower export growth since the Great Recession is largely explained by slower growth in the intensive margin for existing exporters.

4.1.1 Export Growth Decomposition by Sector

In results reported in the Appendix, we extend the preceding analysis to firms in different sectors. In estimations akin to those in Table 7, we break down the sample across manufacturing, services, and wholesale/retail. Considering manufacturing firms first, it is clear that this sector drives the results for the economy as a whole. The findings here are very similar to the overall figures. The biggest discrepancies occur with respect to the entry and exit margins. Here, there are relatively few new exporters contributing to export growth on the entry extensive margin. However, new exporters in manufacturing tend to be bigger on the entry intensive margin. This finding holds for both the 1993–2006 and 2008–2014 periods. A similar picture also emerges with respect to the effects of exits; while there are fewer exits in manufacturing than in the economy as a whole, they tend to be somewhat bigger. Since the financial crisis, the net extensive margin also contributed positively to export growth, in contrast to the results for all firms.

When considering exports in services, we see significant differences relative to the manufacturing sector and the overall economy. Whereas 1-year log growth averaged 6.1 log percent per year between 1993 and 2006 for the economy as a whole, it averaged 46 log percent for this sector over the same time period. Even at the
6-year horizon during this period, exports as a whole grew 6.1 log percent annually, whereas in services they grew almost 23 log percent annually. When we consider exports since the financial crisis, however, the picture changes dramatically. While both total exports and services exports fall by about 15 log percent initially, their subsequent recovery was very different. The 6-year annual average export growth rate starting in 2008 averaged 2.4 log percent for the economy overall, whereas it averaged negative 11 log percent for the services sector.

With regards to the intensive and extensive margins, the services sector also shows significant differences from the economy as a whole. The biggest difference has to do with the fact that the importance of intensive and net extensive margins are reversed in services. During the 1993–2006 period, the net extensive margin contributed 40 log percent to 1-year export growth whereas the intensive margin contributes about 6 log percent. In contrast, during 2008–2014 the net extensive contribution to 1-year export growth is −42%, whereas it is 27% for the intensive margin. A similar pattern is found at the $h = 6$ horizon. Exporting firms in services struggled during the recovery, as a much larger fraction of firms in this industry decided to exit following the crisis.

Finally, we find that exports by the wholesale and retail sectors boomed in both the 1993–2006 and 2008–2014 periods. Remarkably, overall export growth in this sector accelerated in the post-2008 period compared to the 1993–2006 period. In the 6 years following 2008, exports increased on average at 34 log percent per year. This compares to an average growth rate of roughly 19% over the same time horizon during the 1993–2006 period and a growth rate of 2.4% for overall exports. Both the intensive and the net extensive margins contributed to these post-2008 increases. Relative to the pre-recession years, however, the net extensive margin was much more important after 2008.

### 4.2 Partial Equilibrium Counterfactuals

In this section, we consider two sets of counterfactuals. First, we consider a hypothetical economy in which at least one of the margins in our decomposition in Eq. (4) did not follow the path that it took during the Great Recession but instead behaved according to its typical historical trajectory. These estimations illustrate the extent to which the recovery from the Great Recession differed from those of the past. Second, we examine a similar set of counterfactuals in which we allow for comovement between the extensive and intensive margins of exports. For this purpose, we first establish the historical relationship between each margin and real GDP growth. We then perform a set of estimations in which we consider how exports would have evolved after the Great Recession if one of the margins had behaved as it had in the past relative to GDP growth.

#### 4.2.1 Great Recession Versus Historical Averages

We begin by considering four simple exercises. In each, we estimate how exports would have evolved after the Great Recession if a given margin of foreign sales had
followed its historical trajectory, while others behaved as they did in the 2008–2014 data. The first counterfactual examines the importance of the intensive margin. In this exercise, we keep the export growth rate of incumbents, $i^h_t$ in Eq. (4), at its 1993–2006 average. In the second, we examine the importance of firm entry and keep $e^h_t$ and $e^h_{th}$ constant at their 1993–2006 average. In the third, we similarly study the relevance of the exit margin and impose that $x^h_t$ and $x^h_{th}$ remain at their prior levels. In the last, we consider the role of the net extensive margin and fix $n^h_t$ at its historical average. All other margins in each of these estimations are allowed to follow the same trajectory as they actually did in the data over the 2008 to 2014 period.

Interpreting the results from these estimations requires comparing the counterfactual evolution of overall foreign sales with what actually occurred. Before we go into the details, it is useful to briefly discuss how to interpret our findings. If the evolution of exports is pictured to be above that which is found in the data, this means that foreign sales would have grown faster had the margin of interest remained at its historical average. Said differently, if the trajectory of exports is shown to be above the actual one in the figures, the margin of interest performed worse since 2008 than it did historically.

Figure 4 shows the findings from each of these four counterfactuals. The first, labeled “Intensive margin,” shows that the decline in exports during the recession is driven by incumbent exporters. If these firms would have performed as they did in the past, exports would have continued to grow steadily. In 2014, they would have
been 29 log percent above their 2008 level relative to the realized differential of 14 log percent; the intensive margin contributed much less to exports since 2008 than it did historically.

The extensive margin counterfactuals show much smaller effects. The second exercise, labeled “Entry margin,” shows that if $e^h_t$ had followed its historical trajectory, foreign sales would have been 17 log percent above their 2008 level at the end of 2014, which is only 3 lppt. above the level in the data. Firm entry during and after the crisis contributed less to export growth than it had historically. In the third counterfactual labeled “Exit margin,” we find that if $x^h_t$ is set to its prior value, it would result in a 2014 level of exports about 5 lppt. below the actual increase. This implies the drag on export growth from exiting firms following the Great Recession was less negative than in the past, which can also been seen in Table 7.

The fourth counterfactual, labeled “Net extensive margin,” shows the evolution of exports if the net extensive margin $n^h_t$, which captures both entry and exit effects, would have followed its historical trajectory. In these estimations, aggregate exports would have evolved similarly as in the data, since the implied deviations of each margin from the data roughly offset each other. As our subsequent estimations will make clear, minimal deviation of the net counterfactual from actual growth does not imply that the entry and exit into exporting are not important. It only suggests that the impacts of changes in the components of the net extensive margin happen to roughly cancel each other out.

In Fig. 5, we explore the effects of changes in the extensive margin after the Great Recession in further depth. Figure 5a considers three counterfactuals with respect to the entry margin. We begin by exploring the implications of holding $ee^h_t$ in Eq. (4) at its historical average. In the second set of estimations, we hold $e^h_t$ at its prior contribution. In the first exercise, exports in 2014 would have been more than 40 log percent above their 2008 level, which is more than twice the increase seen in the data. This fact, however, is largely offset by a relative increase in the size of new entrants into foreign markets. As seen in the second exercise, if the exports of entrants had stayed at their 1993–2006 average, then the level of total foreign sales in 2014 would have been almost 10 log percent below its 2008 level. Thus, while there were fewer new exporters after 2008, those that did enter tended to export more than in the past. We keep both entry margins, $ee^h_t$ and $e^h_t$, at their historical levels in the third exercise and find that this leads exports to follow a trajectory similar to what actually happened.

Figure 5b shows the three corresponding counterfactuals for the exit margin. In the first two, we fix $xe^h_t$ and $x^h$ in Eq. (4) at their historical averages. Again, we see two largely offsetting movements, albeit with a somewhat smaller absolute magnitude as in Fig. 5a. As a consequence, in the third counterfactual where we keep both $xe^h_t$ and $x^h$ at their historical contributions, the trajectory is similar to the one observed in the data. The Appendix gives additional details about these figures.

### 4.2.2 A Different Approach: Allowing for Comovement

The previous counterfactuals explored how foreign sales would have changed if various export margins had followed their historical averages instead of the paths that
Fig. 5 Entry and exit counterfactuals. Notes The figure shows the observed growth of aggregate exports since 2008 in the data relative to counterfactuals based on Eq. (4) in each panel. Panel A plots the evolution of exports if the entry extensive margin $eeh_t$ and the entry intensive margin $eih_t$ remained at their historical averages. Panel B plots the evolution of exports if the exit extensive margin $xeh_t$ and the exit intensive margin $xih_t$ remained at their historical averages. The shaded bar indicates the recession period as defined by the National Bureau of Economic Research.
they actually took. One limitation of this approach is that it does not allow the evolutions of different margins to be correlated. To overcome this, we account for one main source of comovement between the various components of exports by allowing each one to change with GDP growth. For each margin $m_h \in \{i_t, e_t, x_t, x_{th}, e_{th}, x_h\}$ defined in Eq. (4) and for every time horizon $h = 1, ..., 6$, we estimate the following regression using the sample over 1993–2006

$$m_h = \alpha + \beta \Delta \log RGDP + \epsilon$$  \hspace{1cm} (7)$$

Using the estimates for $\hat{\alpha}$ and $\hat{\beta}$ for each $h = 1, ..., 6$, we then construct how each margin would have evolved during the 2008–2014 period had it maintained its past relationship with GDP growth as

$$\hat{m}_h = \hat{\alpha} + \hat{\beta} \Delta \log RGDP_h.$$  \hspace{1cm} (8)$$

Conceptually, the counterfactuals based on averages in the prior section undertake a similar exercise but simply estimate Eq. (7) with only the constant included in the regression.

Figure 6 reports the results in which the different margins under consideration follow Eq. (8), while the others evolve as they actually did. Replacing the intensive margin with the relevant estimate shows that exports in 2014 would have been about 15 log percent below their pre-recession level and about 30 lppt. below the actual level. This implies that incumbent exporters contributed much more to foreign sales.
growth during the recovery than would have been expected based on their historical behavior with respect to GDP.

In contrast with these results, the entry margin performed as expected relative to changes in total output during the recovery. Had the foreign sales of new exporters evolved according to their historical relationship with GDP growth in Eq. (8), exports would have risen to 14.4 log percent above the pre-recession level relative to the 14.2 log percent that we see in the data. Like the results for incumbent exporters, the exit margin performed better than expected given GDP growth after the Great Recession. In the exit counterfactual changes in real exports would have been about 4.7 lppt. lower than the actual value. The relative contribution from incumbent exporters, however, was much larger. Because the exports of entrants performed as their historical relationship with output growth would have suggested, the net extensive margin counterfactual tracks the trajectory for the exports of exiting firms. These results suggest that firms’ decisions to start or stop exporting following the Great Recession contributed more to total export growth than would have been expected.

Compared to the results in Fig. 4, the estimates in Fig. 6 have somewhat different implications. The first is that, while incumbent exporters contributed less to total export growth than they did on average historically in Fig. 4, they outperformed in comparison with their prior relationship with changes in total output in Fig. 6. Second, the net extensive counterfactual behaved as it did in the past in that deviations from historical growth by entering and exiting exporters roughly offset each other and together result in about the same amount of growth as what was observed. However, the net extensive margin fared better than what the prior relationship with GDP would have suggested.

These counterfactual estimates are novel and require firm-level data to construct. They add a new perspective to our understanding of the slowdown in global trade growth since the Great Recession and highlight the differential evolution of these margins (Cabrillac et al. 2016; Aslam et al. 2018). In the Appendix, we present tables that show the numerical estimates that were used to construct these figures. We further include results for the same types of exercises across the manufacturing, services, and wholesale and retail sectors.

### 5 Conclusion

In this study, we have considered the effect of the Great Recession on the trajectory of U.S. exports over time. We find evidence of substantial exits and a decline in entries into international markets during the financial crisis. Decomposing the log growth of total exports, we show that the drop in entries and spike in exits were offset by the fact that new entrants into foreign markets tended to be bigger than they were historically. Thus, while a missing generation of exporters had effects on the variety of goods sold by the USA internationally, the effect of these trends on aggregate export volumes was small compared to historical averages.

Despite the sizable literature on the trade collapse during the Great Recession, many unanswered questions remain. To the best of our knowledge, this is the first study to
consider the scarring effects of the crisis on firm exports. Quantifying the welfare effects of this decline in the number of varieties along with the rise in foreign market entrant size in a general equilibrium framework would particularly further our understanding of these events. Because international trade flows have still not returned to trend growth, such analyses would be valuable for central bank economists, elected officials, and academics alike.

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Appendix

Aggregate Exports

Figure 7 shows the evolution of nominal aggregate exports during the Great Recession in comparison with the average trajectory during recessions over 1948–2001. Overall, this is similar to the results for real goods exports in Fig. 1 of the main

![Graph showing nominal export growth after the Great Recession.](image)
As shown with the dashed line, historically these periods had only a minor impact, with exports staying roughly flat over the first eight quarters after the start of the downturn. The Great Recession, however, showed an initial increase in foreign sales over the first several quarters followed by a dramatic decline, falling to 20% below the initial level after six quarters. With regards to the recovery, exports initially rebounded faster after the Great Recession than they did in the past. Despite this, the recovery fails to catch up with the historical average by 2014.

Figure 8 shows the evolution of goods exports prices during the Great Recession relative to the typical trajectory for recessions during 1948–2001. The periods used to construct this, as well as Fig. 1 of the main text, are 2007q4–2014q4, 2001q1–2007q1, 1990q3–1996q3, 1981q3–1987q3, 1980q1–1986q1, 1973q4–1979q4, 1969q4–1975q4, 1960q2–1966q2, 1957q3–1963q3, 1953q3–1959q3, and 1948q4–1954q4, in which the year is indicated and followed by the relevant quarter. Unlike in the past, the Great Recession initially brought along a temporary decline in export prices in the second year. Prices subsequently catch up with the typical trajectory before flattening out roughly 3 years after the peak.
Log Export Growth Decomposition

In this section, we present an exact decomposition of total export growth that follows di Giovanni et al. (2014). We begin by considering a three-term decomposition that is then extended into one with five terms. The log growth rate of total exports over $h$ years $g^h_t$ can be decomposed into three additive terms as follows:

$$g^h_t = \ln(X_t) - \ln(X_{t-h})$$

$$= \ln\left(\frac{\sum_{i \in I_{t-h}} X_{it}}{\sum_{i \in I_{t-h}} X_{it-h}}\right) + \ln\left(\frac{\sum_{i \in I_t} X_{it}}{\sum_{i \in I_{t-h}} X_{it-h}}\right) - \ln\left(\frac{\sum_{i \in I_{t-h}} X_{it-h}}{\sum_{i \in I_{t-h}} X_{it-h}}\right)$$

$$i^h_t = \text{intensive margin}$$

$$e^h_t = \text{entry margin}$$

$$x^h_t = \text{exit margin}$$

$$n^h_t = \text{net extensive margin}$$

(9)

in which $I_t = \{i : X_{it} > 0\}$ is the set of firms that export in year $t$. The set of firms that export in year $t$ and in year $t - h$ is given by $I_{t\cap t-h} = \{i : i \in I_t, i \in I_{t-h}\}$ while the set that export in year $t$ but not in year $t - h$ is denoted by $I_{t \setminus t-h} = \{i : i \in I_t, i \notin I_{t-h}\}$. Lastly, firms that export in year $t - h$ but not in year $t$ are in the set $I_{t-h \setminus t} = \{i : i \notin I_t, i \in I_{t-h}\}$. Prior work, including Gopinath and Nei- man (2014) and Kamal and Krizan (2012), has considered related decompositions.

The intensive margin $i^h_t$ in Eq. (9) is the log percentage point contribution to total export growth between years $t$ and $t - h$ and is defined as the log growth in sales by all firms that sold abroad in both years. We define the entry margin $e^h_t$ as the contribution to the growth of foreign sales by firms that exported in year $t$ but not in year $t - h$. Similarly, we define the exit margin $x^h_t$ as the contribution to export growth of firms that sold abroad in year $t - h$ but did not do so in year $t$. Foreign sales for any set of exporting firms can be written as the product of the number of exporters and average foreign sales per firm that are in the relevant set. For example, total exports in year $t$ can be written as $\sum_{i \in I_t} X_{it} = N_t(I_t) \bar{X}_t(I_t)$ in which the number of firms is $N_t(I_t)$ and average exports per firm is $\bar{X}_t(I_t) = \frac{1}{N_t(I_t)} \sum_{i \in I_t} X_{it}$. Likewise, exports by incumbents can be written as $\sum_{i \in I_{t-h}} X_{it} = N_t(I_{t-h}) \bar{X}_t(I_{t-h})$.

Using the number of exporters and their average exports, the three terms in Eq. (9) can be decomposed further into the five terms in Eq. (4) of the main text as follows:
This five term decomposition denotes the definition for average exports of firms in year $t$ as $\bar{X}_t(I_t)$, the average in year $t-h$ as $\bar{X}_{t-h}(I_{t-h})$, and the average for firms in year $t$ that sell abroad in both years as $\bar{X}_t(I_{t, t-h})$. Similarly, $\bar{X}_{t-h}(I_{t, t-h})$ denotes the average foreign sales in year $t-h$ of firms that export in both year $t$ and in year $t-h$. $N_t(I_t)$ and $N_{t-h}(I_{t-h})$ are the number of firms that export in years $t$ and $t-h$, respectively. By definition, the number of firms in year $t$ that exported in both years is the same as the number that export in $t-h$ so $N_t(I_{t, t-h}) = N_{t-h}(I_{t, t-h})$. As such, the only way the intensive margin contributes to the total is through growth in average exports of firms that sell abroad in both years $t$ and $t-h$.

Writing Eq. (10) using symbols for each margin gives

$$
\bar{g}_t^h = \bar{Y}_t^h + ee_t^h + e\bar{e}_t^h - x\bar{e}_t^h - x\bar{e}_t^h
$$

(11)

in which total growth $\bar{g}_t^h$ is in log percent growth since year $t-h$ and the units of each of the terms on the right-hand side are contribution to total growth in log percentage points.

**Additional Export Participation Regressions**

Table 1 in the main text shows the effect of recessions on export participation. Table 8 extends this analysis and allows for differential impacts across the two
Table 8 Export participation and different recessions

|                       | (1)       | (2)       | (3)       | (4)       |
|-----------------------|-----------|-----------|-----------|-----------|
| **Dependent variable:** $y_{it} = \{0, 1\}$ |           |           |           |           |
| Exported last year ($y_{it-1}$)       | 16.98***  | 16.99***  | 16.06***  | 16.07***  |
|                                      | (0.06)    | (0.06)    | (0.05)    | (0.05)    |
| Exported 2 years ago ($y_{it-2}$)     |           |           | 5.07***   | 5.07***   |
|                                      |           |           | (0.05)    | (0.05)    |
| 2001 recession $\times$ Exported      |           |           |           |           |
| last year ($r_{2001,t} \times y_{it-1}$) | -0.53***  | -0.51***  | -0.01     | -0.01     |
|                                      | (0.12)    | (0.13)    | (0.17)    | (0.17)    |
| 2001 recession $\times$ Exported      |           |           |           |           |
| 2 years ago ($r_{2001,t} \times y_{it-2}$) | -0.91***  | -0.89***  |           |           |
|                                      | (0.16)    | (0.16)    |           |           |
| Great Recession $\times$ Exported     |           |           |           |           |
| last year ($r_{GR,t} \times y_{it-1}$) | -1.15***  | -1.23***  | -0.67***  | -0.74***  |
|                                      | (0.09)    | (0.09)    | (0.11)    | (0.12)    |
| Great Recession $\times$ Exported     |           |           |           |           |
| 2 years ago ($r_{GR,t} \times y_{it-2}$) | -0.94***  | -0.99***  |           |           |
|                                      | (0.11)    | (0.11)    |           |           |
| Log employment ($x_{1it}$)            | 7.16***   | 7.16***   | 6.96***   | 6.95***   |
|                                      | (0.03)    | (0.03)    | (0.03)    | (0.03)    |
| Log average wages ($x_{2it}$)         | 4.27***   | 4.24***   | 4.17***   | 4.14***   |
|                                      | (0.04)    | (0.04)    | (0.04)    | (0.04)    |
| Young ($x_{3it}$)                     | -0.68***  | -0.71***  | -0.50***  | -0.54***  |
|                                      | (0.05)    | (0.05)    | (0.05)    | (0.05)    |
| 2001 recession $\times$ Log           |           |           | -0.17***  | -0.15***  |
| employment ($r_{2001,t} \times x_{1it}$) |           |           | (0.03)    | (0.03)    |
| 2001 recession $\times$ Log           |           |           | 0.36***   | 0.38***   |
| average wages ($r_{2001,t} \times x_{2it}$) |           |           | (0.07)    | (0.07)    |
| 2001 recession $\times$ Young ($r_{2001,t} \times x_{3it}$) | 0.15      | 0.17      |           |           |
|                                      | (0.15)    | (0.15)    |           |           |
| Great Recession $\times$ Log          |           |           | 0.10***   | 0.11***   |
| employment ($r_{GR,t} \times x_{1it}$) |           |           | (0.02)    | (0.03)    |
| Great Recession $\times$ Log          |           |           | 0.07      | 0.10*     |
| average wages ($r_{GR,t} \times x_{2it}$) |           |           | (0.06)    | (0.06)    |
| Great Recession $\times$ Young ($r_{GR,t} \times x_{3it}$) | 0.26*     | 0.29**    |           |           |
|                                      | (0.14)    | (0.14)    |           |           |
| Industry $\times$ Year FE ($\phi_{st}$) | Yes       | Yes       | Yes       | Yes       |
| Firm FE ($\phi_{i}$)                  | Yes       | Yes       | Yes       | Yes       |
| Obs. (millions)                        | 9.47      | 9.47      | 9.47      | 9.47      |

The table presents the results from estimating variants of the following equation:

$$y_{it} = \alpha y_{it-1} + \beta_1 r_{2001,t} \times y_{it-1} + X'_{it} \delta_1 + \beta_2 r_{GR,t} \times y_{it-1} + r_{GR,t} \times X'_{it} \delta_2 + \phi_i + \phi_s + \epsilon_{it},$$

$y_{it} = \{0, 1\}$ indicates if firm $i$ exports in year $t$, $r_{2001,t}$ is an indicator for the 2001 U.S. recession, $r_{GR,t}$ is an indicator for the Great Recession, $\phi_i$ and $\phi_s$ are firm and industry-year fixed effects, $X_{it}$ is a set of controls, and $\epsilon_{it}$ is the error term. The scaling of the results is done as in Table 2 of the main text. $R^2$ values are roughly 22% in columns (1)–(2) and roughly 25% in columns (3)–(4). Standard errors are in parentheses and are clustered by firm, with significance levels of 1%, 5%, and 10% denoted by ***, **, and *, respectively.
Table 9 Export participation and GDP growth: durable goods, final goods, and high external finance dependence sectors

|                              | Dependent variable: $y_{it} = \{0, 1\}$ |
|------------------------------|------------------------------------------|
|                              | (1)           | (2)           | (3)           | (4)           |
| Exported last year ($y_{it-1}$) | 20.03*** (0.16) | 19.27*** (0.29) | 20.85*** (0.46) | 19.87*** (0.17) |
| Exported 2 years ago ($y_{it-2}$) | 6.09*** (0.15) | 4.81*** (0.27) | 5.73*** (0.43) | 6.08*** (0.16) |
| $\Delta \log RGDP \times Exported$ | 28.48*** (4.64) | 6.51 (8.63) | 39.21*** (13.63) | 25.88*** (5.01) |
| last year ($r_t \times y_{it-1}$) | 30.54*** (4.56) | 32.81*** (8.48) | 10.42 (13.41) | 30.13*** (4.93) |
| $\Delta \log RGDP \times Exported$ | 1.04*** (0.35) | −0.92* (0.49) | 1.06** (0.45) |
| × Indicator | 1.77*** (0.32) | 0.41 (0.46) | 0.04 (0.41) |
| Exported 2 years ago | 1.77*** (0.32) | 0.41 (0.46) | 0.04 (0.41) |
| $\Delta \log RGDP \times Exported$ | 30.87*** (10.23) | −12.24 (14.48) | 17.75 (13.29) |
| × Indicator | −3.51 (10.06) | 22.77 (14.24) | 2.73 (13.00) |
| Exported last year | 8.43*** (0.07) | 8.33*** (0.14) | 8.92*** (0.20) | 8.45*** (0.08) |
| $\Delta \log RGDP \times Exported$ | 5.60*** (0.11) | 5.18*** (0.18) | 5.95*** (0.27) | 5.51*** (0.12) |
| × Indicator | 0.15 (0.17) | −0.56** (0.22) | −0.07 (0.20) |
| Log employment ($x_{1it}$) | 0.15 (0.17) | −0.56** (0.22) | −0.07 (0.20) |
| Log average wages ($x_{2it}$) | 0.58*** (0.20) | −0.39 (0.28) | 0.54** (0.25) |
| × Indicator | −0.74*** (0.19) | −0.25 (0.38) | −0.59 (0.55) | −1.09*** (0.21) |
| Young ($x_{3it}$) | −0.66 (0.43) | −0.17 (0.58) | 1.69*** (0.43) |
| $\Delta \log RGDP \times Young$ | −0.54 (1.06) | −1.04 (2.11) | −0.02 (2.92) | −1.01 (1.20) |
| × Indicator | 3.94 (2.93) | 8.40** (3.51) | 4.21 (4.32) | 4.68 (2.99) |
| $\Delta \log RGDP \times Young$ | 1.96 (5.31) | −2.50 (10.78) | −5.45 (15.83) | 10.62* (5.99) |
| × Indicator | −5.85** (2.43) | −0.38 (3.12) | −4.23 (2.51) |
| $\Delta \log RGDP \times Young$ | 6.10 (12.32) | 8.32 (16.75) | −40.53*** (12.79) |
| × Indicator | 0.47 (2.43) | −0.58 (3.12) | 2.12 (2.51) |
| Industry × Year FE ($\phi_{ij}$) | Yes | Yes | Yes | Yes
Table 9 (continued)

| Dependent variable: $y_{it} = \{0, 1\}$ | (1) | (2) | (3) | (4) |
|----------------------------------------|-----|-----|-----|-----|
| Manufacturing                          | Yes | Yes | Yes | Yes |
| Durable                                | Yes | Yes | Yes | Yes |
| Final goods                            | Yes | Yes | Yes | Yes |
| High EFD                               | Yes | Yes | Yes | Yes |
| Firm FE ($\phi_i$)                     | Yes | Yes | Yes | Yes |
| Obs. (millions)                        | 2.135 | 2.135 | 2.135 | 2.135 |

See the notes to Tables 8 and 5 of the main text

Table 10 Summary statistics

|                          | (1)          | (2)          |
|--------------------------|--------------|--------------|
| Export status ($100 \times y_{it}$) | 34.83        | 47.64        |
| Exported last year ($y_{it-1}$)      | 0.3453       | 0.4755       |
| Exported 2 years ago ($y_{it-2}$)    | 0.3338       | 0.4716       |
| Recession $\times$ Exported last year ($r_t \times y_{it-1}$) | 0.0537       | 0.2254       |
| 2001 recession $\times$ Exported last year ($r_{2001} \times y_{it-1}$) | 0.0163       | 0.1266       |
| Great Recession $\times$ Exported last year ($r_{GR} \times y_{it-1}$) | 0.0374       | 0.1898       |
| Recession $\times$ Exported 2 years ago ($r_t \times y_{it-2}$) | 0.0509       | 0.2197       |
| 2001 recession $\times$ Exported 2 years ago ($r_{2001} \times y_{it-2}$) | 0.0152       | 0.1225       |
| Great Recession $\times$ Exported 2 years ago ($r_{GR} \times y_{it-2}$) | 0.0356       | 0.1854       |
| Log employment ($x_{1it}$)           | 2.469        | 1.622        |
| Log average wages ($x_{2it}$)        | 3.334        | 0.7553       |
| Young ($x_{3it}$)                    | 0.1696       | 0.3753       |
| Recession $\times$ Log employment ($r_t \times x_{1it}$) | 0.3658       | 1.075        |
| 2001 recession $\times$ Log employment ($r_{2001} \times x_{1it}$) | 0.1247       | 0.6558       |
| Great Recession $\times$ Log employment ($r_{GR} \times x_{1it}$) | 0.2411       | 0.886        |
| Recession $\times$ Log average wages ($r_t \times x_{2it}$) | 0.4988       | 1.222        |
| 2001 recession $\times$ Log average wages ($r_{2001} \times x_{2it}$) | 0.1644       | 0.7413       |
| Great Recession $\times$ Log average wages ($r_{GR} \times x_{2it}$) | 0.3345       | 1.027        |
| Recession $\times$ Young ($r_t \times x_{3it}$) | 0.0242       | 0.1535       |
| 2001 recession $\times$ Young ($r_{2001} \times x_{3it}$) | 0.0096       | 0.0977       |
| Great Recession $\times$ Young ($r_{GR} \times x_{3it}$) | 0.0145       | 0.1196       |
| Foreign demand ($d_{it}$)            | 0.0487       | 0.2488       |
| Local house prices ($p_{it}$)        | 0.0293       | 0.0747       |
| Foreign demand $\times$ Exported last year ($d_{it} \times y_{it-1}$) | 0.0156       | 0.1208       |
| Local house price $\times$ Exported last year ($p_{it} \times y_{it-1}$) | 0.0095       | 0.0474       |
| Foreign demand $\times$ Log employment ($d_{it} \times x_{1it}$) | 0.1205       | 0.7649       |
| Foreign demand $\times$ Log average wages ($d_{it} \times x_{2it}$) | 0.1651       | 0.8225       |
| Foreign demand $\times$ Young ($d_{it} \times x_{3it}$) | 0.0088       | 0.1051       |
| Local house price $\times$ Log employment ($p_{it} \times x_{1it}$) | 0.0737       | 0.2113       |
| Local house price $\times$ Log average wages ($p_{it} \times x_{2it}$) | 0.0992       | 0.2599       |
| Local house price $\times$ Young ($p_{it} \times x_{3it}$) | 0.0059       | 0.0333       |

The table presents the mean and standard deviation of the dependent and independent variables used throughout the paper, reported in the same units as included in each regression specification.
recessions in our sample (2001 and 2007–2008). The main conclusion is that while both recessions had effects, the Great Recession had a larger one. This conclusion is consistent with the results in Table 2, which shows that export participation is positively associated with GDP growth. The Great Recession has a larger effect because it was more severe than the 2001 recession. Table 9 shows the unabridged version of Table 5 in the main text with coefficients for all covariates that are included in that regression. Table 10 provides summary statistics on our sample.

**Sectoral Decompositions**

Tables 11, 12, and 13 present the decomposition estimations from Table 7 of the main text for the manufacturing, services, and wholesale/retail sectors, respectively. All exports were deflated using the goods exports deflator from the national income and product accounts with 2000 as the base year. There are noticeable differences across the results for these three sectors. Manufacturing is by far the most influential sector in terms of aggregate exports. As a consequence, the results for manufacturing are quite similar to the results for overall aggregate exports shown in Table 7. At
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The same time, both services and wholesale/retail exports have been increasing in relative importance over the past couple of decades. In Tables 12 and 13, we see that both of those sectors grew at significantly faster rates than overall exports did during the 1993–2006 period. The 1-year log growth of services foreign sales averaged about 46%, whereas for wholesale/retail it averaged about 18%. This compares to roughly 6% growth for manufacturing and aggregate exports overall.

During the Great Recession, exports in manufacturing, in services, and in the overall economy declined by about 15% in the first year of the recession. In wholesale/retail, however, exports actually increased by about 72%. Six years after the beginning of the Great Recession, total exports and manufacturing exports on average grew about 2.4% per year, whereas in services they fell by about 11% per year and in wholesale/retail they rose by about 34% per year. With regards to the intensive and extensive margins, the picture is similar: Manufacturing exports behave like the aggregate figures, while in the services and wholesale/retail sectors, exports have higher growth rates along both margins. In particular, the wholesale/retail sector stands out as having the largest contribution from the net extensive margin.

Table 12  Real export log growth decomposition: services sector

|                | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | $h = 5$ | $h = 6$ |
|----------------|---------|---------|---------|---------|---------|---------|
| Total growth   | 45.83   | 43.78   | 30.51   | 26.10   | 26.88   | 22.95   |
| Intensive margin | 5.83    | 11.95   | 10.71   | 19.01   | 18.07   | 12.08   |
| Net extensive  | 40.00   | 31.83   | 19.80   | 7.09    | 8.81    | 10.87   |
| Entry margin   | 73.68   | 64.90   | 53.80   | 48.33   | 54.29   | 46.20   |
| Extensive      | 73.13   | 49.49   | 41.64   | 39.21   | 36.92   | 30.12   |
| Intensive      | 0.55    | 15.41   | 12.16   | 9.12    | 17.37   | 16.08   |
| Exit margin    | −33.68  | −33.07  | −34.00  | −41.24  | −45.48  | −35.33  |
| Extensive      | −66.73  | −43.18  | −35.28  | −32.88  | −30.27  | −24.24  |
| Intensive      | 33.05   | 10.11   | 1.28    | −8.36   | −15.21  | −11.09  |

Panel A: 1993–2006 Average

Panel B: 2008–2014

The table presents the results from decomposing changes in aggregate real exports over the periods 1993–2006 and 2008–2014. The different margins are calculated using Eq. (4) of the main text. Each column corresponds to a different value of $h$, the time horizon over which the changes are estimated. For ease of comparison, we annualized the log growth rates and contributions by dividing each term by $h$. 
Table 13  Real export log growth decomposition: wholesale and retail sectors

|                  | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | $h = 5$ | $h = 6$ |
|------------------|---------|---------|---------|---------|---------|---------|
| **Panel A: 1993–2006 Average** |         |         |         |         |         |         |
| Total growth     | 17.77   | 18.36   | 18.45   | 20.58   | 18.77   | 18.93   |
| Intensive margin | 9.41    | 10.27   | 10.96   | 11.84   | 10.05   | 11.83   |
| Net extensive    | 8.36    | 8.09    | 7.49    | 8.74    | 8.72    | 7.10    |
| **Entry margin** |         |         |         |         |         |         |
| Extensive        | 15.96   | 16.79   | 17.55   | 19.21   | 17.67   | 15.85   |
| Intensive        | 40.07   | 26.48   | 22.18   | 19.88   | 17.29   | 15.78   |
| Exit margin      | −24.11  | −9.69   | −4.63   | −0.67   | 0.38    | 0.07    |
| Extensive        | −35.99  | −23.56  | −19.06  | −16.76  | −14.26  | −12.51  |
| Intensive        | 28.39   | 14.86   | 9.00    | 6.29    | 5.31    | 3.76    |
| **Panel B: 2008–2014** |         |         |         |         |         |         |
| Total growth     | 71.72   | 38.16   | 30.80   | 26.53   | 23.86   | 34.23   |
| Intensive margin | 28.60   | 2.42    | 2.42    | 10.85   | 13.13   | 14.36   |
| Net extensive    | 43.12   | 35.74   | 28.38   | 15.68   | 10.73   | 19.87   |
| **Entry margin** |         |         |         |         |         |         |
| Extensive        | 44.92   | 43.25   | 30.84   | 25.16   | 18.42   | 26.92   |
| Intensive        | 42.42   | 27.12   | 23.10   | 16.75   | 15.28   | 13.37   |
| Exit margin      | 2.50    | 16.13   | 7.74    | 8.41    | 3.14    | 13.55   |
| Extensive        | −1.80   | −7.51   | −2.46   | −9.48   | −7.69   | −7.05   |
| Intensive        | 36.84   | 14.72   | 13.04   | 4.83    | 5.17    | 4.50    |

The table presents the results from decomposing changes in aggregate real exports over the periods 1993–2006 and 2008–2014. The different margins are calculated using Eq. (4) of the main text. Each column corresponds to a different value of $h$, the time horizon over which the changes are estimated. For ease of comparison, we annualized the contributions of the separate margins by dividing each by $h$.

Table 14  Real export log growth decomposition: allowing for comovement

|                  | $h = 1$ | $h = 2$ | $h = 3$ | $h = 4$ | $h = 5$ | $h = 6$ |
|------------------|---------|---------|---------|---------|---------|---------|
| **Total growth** | −11.6   | −4.86   | −4.4    | −4.22   | −4.17   | −3.29   |
| **Intensive margin** | −11.3   | −3.85   | −3.11   | −3.09   | −3.03   | −1.9    |
| **Net extensive** | −0.3    | −1.01   | −1.29   | −1.13   | −1.14   | −1.39   |
| **Entry margin** | 3.99    | 2.85    | 2.31    | 2.11    | 1.97    | 1.94    |
| **Extensive**    | 42.46   | 29.08   | 22.42   | 18.04   | 15.6    | 14.3    |
| **Intensive**    | −38.47  | −26.23  | −20.11  | −15.93  | −13.63  | −12.36  |
| **Exit margin**  | −4.29   | −3.86   | −3.6    | −3.24   | −3.11   | −3.33   |
| **Extensive**    | −43.91  | −28.65  | −22.15  | −18.33  | −15.99  | −14.5   |
| **Intensive**    | 39.62   | 24.79   | 18.55   | 15.09   | 12.88   | 11.17   |

The table presents the results for the counterfactual growth rates constructed using Eq. (8) after estimating the regression specification in Eq. (7) of the main text. Each column corresponds to a different value of $h$, the time horizon over which the changes are estimated and predicted. For ease of comparison, we annualized the contributions of the separate margins by dividing each by $h$. 
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Partial Equilibrium Counterfactuals

Great Recession Versus Historical Averages

The detailed results for the counterfactuals shown in Fig. 4 can be calculated directly from Table 7. To do so, simply substitute the relevant counterfactual margin of interest from Panel A into the row of the same name in Panel B and then recalculate
total growth in Panel B. While the Great Recession induced a missing generation of exporters, firms that started exporting tended to be bigger than they were historically. This fact muted the overall effect that the missing generation had on aggregate exports.

**Allowing for Comovement with GDP Growth**

Tables 14 and 15 present counterfactuals that allow various margins of export growth to follow their historical relationship with real GDP growth according to Eq. (8) in the main text. All exports are deflated using the goods exports deflator from the national income and product accounts with 2000 as the base year. Table 14 presents the results for exports across all sectors. If export growth followed its historical relationship with GDP growth, then it should have declined by 12 log percent by 2009 instead of declining by 16% as it did in the data (Table 7, Panel B, “Total Growth”). While the decline in exports was larger than expected, the recovery was significantly faster. In the 6 years following 2008, exports would have declined 3.3 log percent per year on average had they behaved relative to real GDP as they did in the past. In reality, exports grew 2.4 log percent per year and both the intensive and the net extensive margins outperformed their historical relationships with GDP growth. The intensive margin did better than the past by almost 5 log percentage points. In contrast, the net extensive margin contribution was only slightly larger than would be expected.

In Table 15, we separate the results for the whole economy shown in Table 14 into manufacturing, services, and wholesale/retail sectors. Comparing Table 15, Panel A to Table 11, Panel B, we see that manufacturing performed worse in the first year after the Great Recession in the data compared to what the past relationship would have suggested, but better after 6 years than what the historical relationship to GDP growth would have predicted. Better performance after 6 years in the data is led by the intensive margin, which performed about 5 log percentage points better than expected. The net extensive margin performed about 1 log percentage point better after 6 years.

Services exports fared much worse both 1 and 6 years after the Great Recession than the estimates with regards to their historical relationship with GDP growth in Eq. (8) implied. Those estimates would have predicted 27 log percent growth 1 year after the Great Recession and 20 log percent growth annually in each of the 6 years after (Table 15, Panel B). In contrast, services exports in the data fell 15 and 11 log percent 1 and 6 years after the Great Recession, respectively (Table 12, Panel B). At 5.5 log percent growth per year versus 44 log percent declines predicted by the model, the services sector had much faster intensive margin growth 6 years after the Great Recession than predicted. The net extensive margin, however, performed much worse in the data than predicted by the model. The entry intensive margin has the largest difference between the actual and predicted values. Six years after the Great Recession, this margin declined 1.6 log percent annually, but the model would have predicted an increase of 57 log percent. This implies that after the Great
Recession, new exporters in the services sector were much smaller in the data than would have been predicted by the historical relationship with GDP growth.

For the wholesale/retail sector, our estimates in Table 15, Panel C, would predict 79 log percent growth when growth was actually 72 log percent after 1 year. Six years after, the predicted value is 42 log percent, whereas the actual one is 34 log percent. Overall, the actual value was lower than predicted at both horizons. Unlike the manufacturing sector, at the 6-year horizon this relatively worse performance is driven by the net extensive margin, which added 26 log percent in the model and only 20 log percent in the data. The entry margin appears to have been particularly important for the wholesale/retail sector. The exit margin contribution between the model and the data differed by about 2.2 log percentage points but at 8.2 log percentage points, the entry margin differed by substantially more.

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