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The Great Recession and a Missing Generation of Exporters *

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Abstract

The collapse of international trade surrounding the Great Recession has garnered significant attention. This paper studies firm entry and exit in foreign markets and their role in the post-recession recovery of U.S. exports using confidential microdata from the U.S. Census Bureau. We find that incumbent exporters account for the vast majority of the decline in export volumes during the crisis. The recession also induced a missing generation of exporters, with large increases in exits and a substantial decline in entries into foreign markets. New exporters during these years tended to have larger export volumes, however, compensating for the decline in the number of exporting firms. Thus, while entry and exit were important for determining the variety of U.S. goods that were exported, they were less important for the trajectory of aggregate foreign sales.

JEL: F10, F40, E32, E44, J2
Keywords: entry, exit, business cycles, exports, firm dynamics, recession, financial crisis

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I. Introduction

International trade in a given year is typically dominated by relatively large and old firms. At some point in the past, however, these firms were young, small, and new to international markets. The Great Recession of 2007 to 2009 caused a large decline in U.S. exports along with a decline in entries into exporting. While the initial rebound following the Great Recession was rapid, six years into the recovery, export growth remained below its historical post-recession average. In this study, we explore the extent to which a "missing generation of exporters" created by the Great Recession led to lower U.S. export growth during the recovery. Empirical macroeconomics has historically emphasized the contribution of small firms to job creation and growth (e.g. Davis et al. (1996) Gertler and Gilchrist (1994)). The importance of firm age relative to firm size, however, has recently received greater attention (e.g. Haltiwanger et al. (2013)). The Great Recession had many negative effects, including a reduction in firm birth by 30 percent and an ensuing reduction in U.S. employment accounted for by young firms (e.g. Siemer (2016)). This "missing generation" of firms reduced economic expansion precisely because younger firms tend to account for a disproportionate share of growth.

Gourio et al. (2016) show that a negative shock to firm entry persistently lowers aggregate employment and output growth even when controlling for changes in aggregate demand, financial conditions, and population growth. Growth remains below its pre-crisis trend for an extended period as the missing generation moves through the firm age distribution, even when business creation recovers quickly. Building on Luttmer (2012) and Clementi and Palazzo (2016), Clementi et al. (2014) similarly show that a decline in firm birth can have persistent effects in general equilibrium heterogeneous firm models.

The existence of long-lived aggregate effects due to firm-level entry decisions is also an enduring idea in the international trade literature. This has been influential since Baldwin and Krugman (1989). They argue that following a period of dollar appreciation that leads many exporting firms to exit foreign markets, the existence of sunk export entry costs will lead to persistently lower aggregate exports. In this framework, upfront costs to exporting are the friction that prevents rapid recovery in aggregate exports. This was followed by work by Roberts and Tybout (1997), who show that these costs have substantial effects at the firm level on participation in foreign markets.

There is a natural link between the macro and trade literatures. This is due to the persistent aggregate effects of reduced entries but also because the trade collapse remains one of the most striking and well-known aspects of the Great Recession. As shown by Levchenko et al. (2010), the collapse was unprecedented in the extent of the decline in exports and imports relative to GDP.[1]

Previous studies show large firms account for both the overwhelming majority of aggregate exports as well as the changes to aggregate exports in the short-run (Bernard et al. (2009)). Similarly, Behrens et al. (2013) 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) for the 1997 Asian Financial Crisis. Trade dynamics in the short-run are driven by large firms but the importance of new entrants in the long-run remains an open question.

We begin by documenting a large spike in firm exits and a concurrent decline in entries into foreign markets during the Great Recession. This is perhaps unsurprising given the large decline in trade volumes over the period. However, we find that had entry and exit rates stayed at their historical averages, exports in 2014 would have been 31 percent above the pre-recession level whereas they are only 14 percent above in the data. If one assumes that each firm produces a distinct kind of product, this missing generation of exporters suggests that the Great Recession had long-lasting effects on the variety of goods exported by the United States.

[1]It was also unusually global in scope; Imbs (2010) highlights an unparalleled synchronization in industrial production across economies during the Great Recession and Eaton et al. (2016) document that world trade declined by almost 30 percent. Research about the collapse is summarized by Bems et al. (2013) and Baldwin and Evenett (2011).

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." It is thus reasonable to conclude that the Great Recession also had substantial effects on welfare internationally due to the decline in the number of U.S. exporting firms. This is particularly true as a large share of U.S. exports come from firms with patented technologies (Lin and Lincoln, 2017), and developing countries are often dependent on imports of intermediate capital goods from industrialized markets that embody the latest technologies (Eaton and Kortum, 2001).

We next turn to a more rigorous approach to looking at the effect of the Great Recession on foreign market participation. Borrowing an empirical approach derived from an established theoretical literature, we find that preexisting exporting firms were significantly less likely to sell abroad during the crisis. Measured effects are economically and statistically significant. This is true across a variety of different estimation approaches and measures of the severity of each recession. Moreover, we find that declines in both foreign and local demand significantly reduced participation in foreign markets.

Having shown that the Great Recession had significant effects on foreign market participation, we turn to understanding what effect this had on more aggregate outcomes. We decompose changes in aggregate export volumes into five different margins. Although there was a decline in the number of firms exporting during these years, this was compensated for by the relatively larger volume of exports by new entrants. Thus, while these trends had effects on the variety of goods that were exported, the intensive margin of trade drove changes in aggregate export volumes during these years.

The next section discusses our sources of data 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 the Great Recession affected participation in foreign markets. We then consider the aggregate implications of these events through a decomposition analysis that leads into a set of counterfactuals. We close with a short conclusion of our work and a discussion of avenues for further research.

II. Data and Stylized Facts

Data

Our measures of aggregate exports, gross domestic product, and the export price index for the United States come from the Bureau of Economic Analysis' National Income and Product Accounts. County- and state-level house price data are obtained from Bogin et al. (2016). We define U.S. business cycles using the National Bureau of Economic Research (NBER) Business Cycle reference dates at the quarterly frequency, and we treat 2001 and 2008 through 2009 as recession years.

Our micro data are 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 merge the LFFTD with the Longitudinal Business Database (LBD). The LBD is sourced from Internal Revenue Service records and contains information on the employment, payroll, industry, and geographic location of every business establishment in the United States. These measures can be aggregated to the firm level and then merged with the LFTTD. Bernard et al. (2009) were the first to merge the LFTTD with the LBD and recent additional efforts to improve that 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 utilize the matched export and longitudinal firm-level data from 1993 to 2014, dropping 1992 for data quality concerns. The merged data set has the advantage of allowing us to follow firms over time and to perform analyses using industry and geographical location. 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 provides a much more comprehensive picture of the evolution of exports, particularly with respect to our estimations around the number of firm varieties that are traded.

We also use the Census of Manufactures (CMF), which contains information on the operations of U.S. manufacturing plants, such as plant-level export revenues and detailed plant characteristics. The CMF will not serve as our main firm-level data set because it only includes manufacturing firms and is conducted every five years instead of annually.

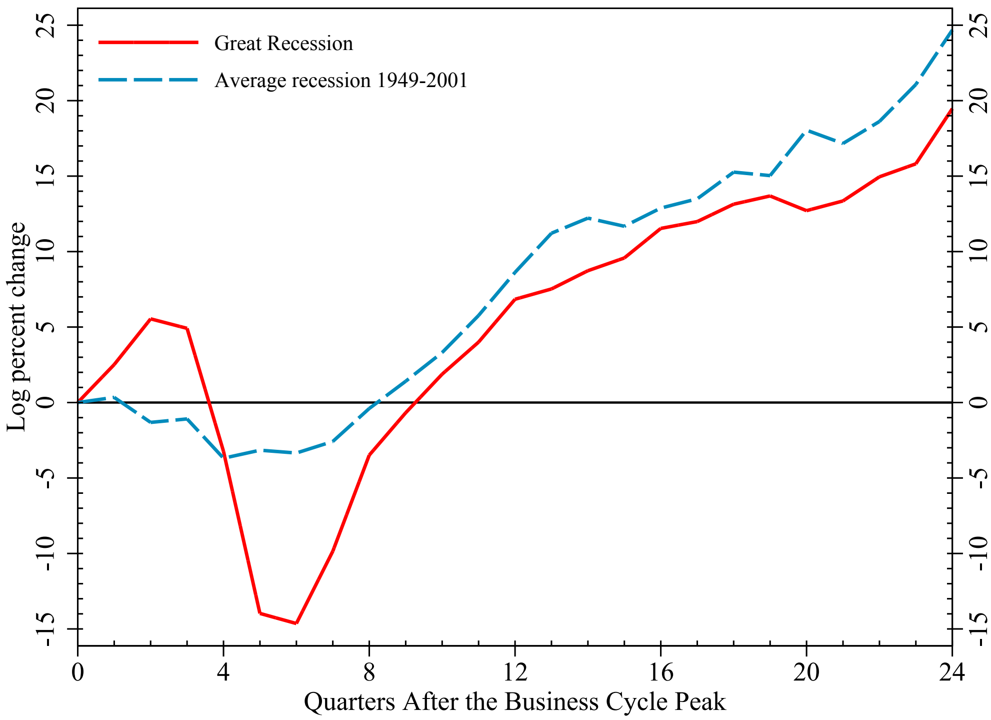
Stylized Facts

Aggregate Stylized Facts

We begin by documenting the response of real U.S. goods exports following recessions.[2] Figure 1 compares the log-growth of exports following the Great Recession to past recessions from 1949 to 2001. It shows that, since the business cycle peak before the Great Recession, exports declined by more and did not recover as much as after the peak before the average U.S. recession. In fact, 24 quarters after the most recent business cycle peak, despite the sharp recovery, the level of real goods exports are only 19.5 percent above their pre-recession peak as compared to 24.7 percent in the average recession. The contour of nominal goods exports is similar to real goods exports. Nominal goods exports were only 27 percent higher after 24 months as opposed to an average of 37.6 percent. The difference between the change in real and nominal exports comes from the fact that goods prices increased an average of 12.9 percent following past recessions while only increasing 7.4 percent following the Great Recession. Appendix A shows the evolution of nominal exports and export prices for the Great Recession and the average of prior U.S. recessions.

[2] Other important studies of the collapse are given by 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).

Figure 1: Real Goods Exports
(Log Percent Change Since Peak)



Notes: The figure shows the typical trajectory of real goods exports following a recession over 1949 to 2001 relative to the same measure after the Great Recession in log percentage changes.

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 Neiman (2014) similarly show that almost all of the annual growth in total exports is due to changes in the exports of incumbent firms. The contribution to growth from incumbent exporters is sometimes called the "intensive margin" of growth. Over long horizons, however, establishments that are new to international markets make up the majority of total exports. Table 1 shows that only 46 percent of total U.S. manufacturing exports as measured in the CMF in 2002 came from plants that were exporting in each CMF year since 1987. Considering plants that exported in both 1987 and 2002, whether or not they exported in the intervening CMF years, raises the contribution somewhat to 57 percent.

Likewise, Figure 2 shows the importance of new entrants to the export market where producers with fewer than five years of exporting experience typically contribute a quarter of

Table 1: Fraction of Exports From Incumbents

	Starting			
Continuing	1987	1992	1997	2002
1987	1			
1992	0.75	1		
1997	0.58	0.79	1	
2002	0.46	0.58	0.71	1

Notes: Table 1 lists the percentage of exports in each Census of Manufacturers (CMF) year that came from plants that exported in each of the previous Census years, starting in 1987. For example, only 46 percent of exports in 2002 came from plants that exported in 1987, 1992, and 1997. Removing any continuous exporting restriction, we find that 57 percent of exports in 2002 are from plants that exported in both 1987 and 2002.

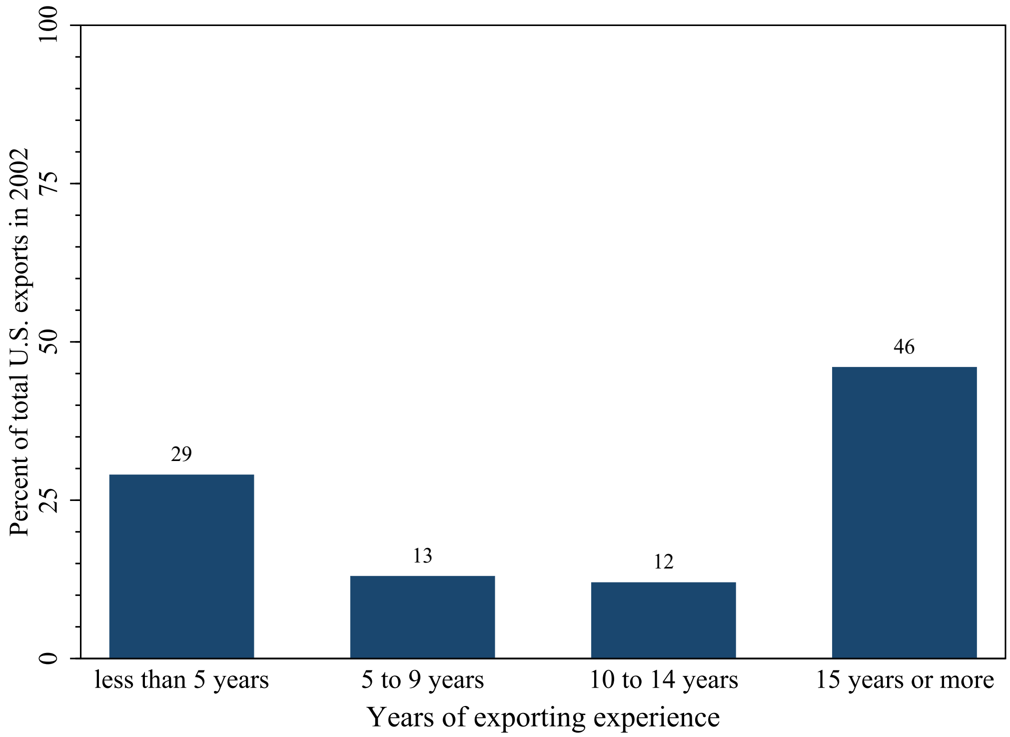
U.S. exports. Those with less than 10 years of experience make up 39 percent of exports on average, pointing to an important role for the entry margin and any factors that might result in a missing generation of exporting firms. Next, Figure 3 plots firm entry and exit rates over the years in our sample. While the entry rate is usually between 30 and 35 percent, it drops sharply at the onset of the Great Recession. Similarly, the exit rate is typically slightly lower than the entry rate but spikes during the Great Recession.[3] Figure 3b plots the difference between the entry and exit rates and shows that even though the net difference is typically small and positive, during the Great Recession the difference collapsed to more than negative 5 percentage points.

III. Regression Evidence

This section seeks to understand how recessions affect the number of firms that export by focusing on each firm's decision to export. We begin by analyzing the effect that aggregate measures of recessions have on these decisions. We then consider the effects of firm-level proxies of business cycles, namely measures of foreign export demand and local conditions in the domestic market.

[3]Both exit and entry rates are on a slight downward trend over the sample, which might be related to an overall decline in business dynamism as documented in Pugsley and Sahin (2014) and Decker et al. (2016). The long-run importance of the decline in export business dynamism remains an open question that we leave for future research.

Figure 2: The Contribution to Exports by Exporting Experience



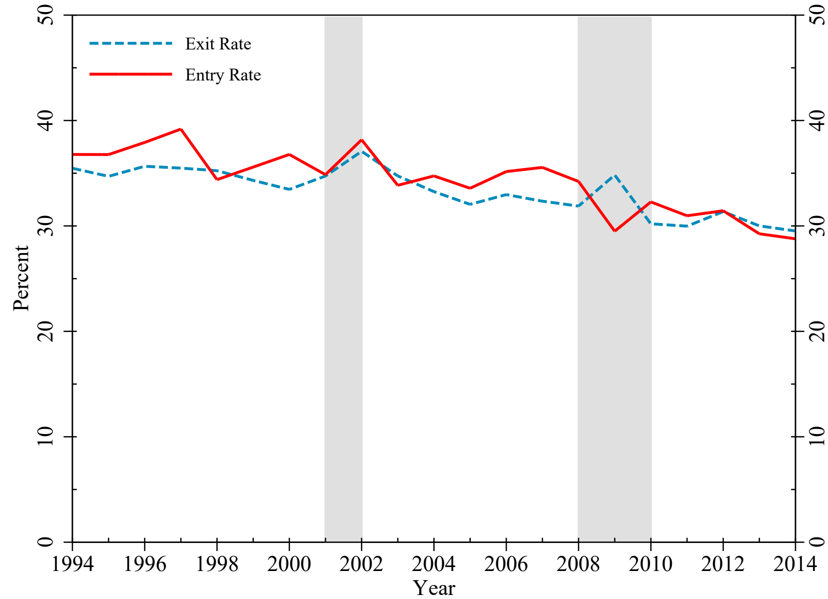
Notes: The figure shows the average contribution to total U.S. exports in the Census of Manufacturers for the years 1987, 2002, 1997, and 2002.

The Great Recession and Export Participation

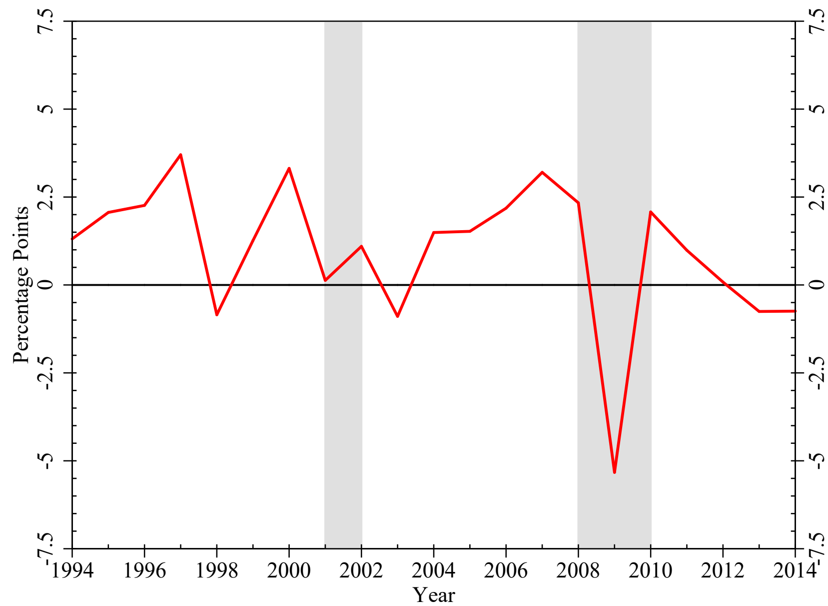
Starting with the work of Dixit (1989) and Baldwin and Krugman (1989), a long theoretical literature has investigated the effects that up-front costs of entering foreign markets have on the dynamics of aggregate exports. This work shows that these costs lead to a data generating process for firm export status that includes a lag of prior export status. The intuition for this result is that up-front costs create an option value to firms of continuing to be an exporter, which in turn induces state dependence in export status. We thus begin with evidence from estimating a dynamic linear probability model (DLPM). This approach is similar to the specification in Roberts and Tybout (1997), Bernard and Jensen (2004), Lincoln and McCallum (2016), and McCallum (2017) and serves to document how recessions affect the probability of entry and exit for individual firms.

A DLPM specification has several advantages. First, its simple linear structure allows computationally easy consideration of all of the roughly 9.5 million firm-year observations in

Figure 3: Foreign Market Entry and Exit Rates 1994 to 2014



(a) Entry and Exit Rates



(b) Difference in Entry and Exit Rates

Notes: Panel A shows foreign market entry and exit rates in percent from 1994 to 2014. The entry rate is defined as the number of firms exporting in year t that did not export 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 export 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.

our sample from 1993 until 2014. Second, it allows us to easily exploit the panel structure of the data to control for unobserved heterogeneity at the firm level. Third, it is straightforward to interpret the estimated coefficients as marginal effects.

As with any econometric technique, this approach also has potential weaknesses. Among these are ''Nickell Bias'' so named because removing fixed effects by first differencing (FD) was shown by Nickell (1981) to give persistence estimates that are biased downward when the true coefficient is positive. We use the within-group (WG) transformation with time dummies so that the explicit functional form of that bias is given in Hahn and Moon (2006). They show that WG, with or without time effects, like FD, is asymptotically biased if the ratio N/T goes to a constant even as N and T individually go to infinity. Relatedly, we may also suffer from initial conditions bias discussed in Heckman (1981) as the year in which we start the sample may include idiosyncratic factors that affect entry and exit dynamics in later years.

At $T = 22$ yearly observations, the long time dimension of our panel dataset significantly attenuates both of these concerns. For fixed N, the asymptotic bias of our estimator is order $O\left(T^{-1}\right)$ from Hahn and Moon (2006) so that as $T \to \infty$ the asymptotic bias eventually disappears. More practically, using Monte Carlo experiments, Arellano (2003) argues that if the number of periods is at least 10, then the downward bias caused by the within-group estimator is likely small. Other solutions for both of these problems, which we do not employ here, are the Arellano and Bond (1991) and Blundell and Bond (1998) system GMM estimators.

In equation (1), we introduce a stylized form of the specifications we estimate in order to explain the intuition for our estimates and the interpretation of the coefficients.

$$y_{it} = \alpha y_{it-1} + \beta r_t \times y_{it-1} + X_{it}'\gamma + r_t \times X_{it}'\delta + \phi_i + \phi_{st} + \varepsilon_{it}, \tag{1}$$

in which $y_{it} = \{0, 1\}$ denotes if firm i exports in year t, r_t is a measure related to the U.S.

business cycle in year t, ϕ_i and ϕ_{st} are firm and industry-year fixed effects, and ε_{it} is the error term. We define industry here using one digit SIC or NAICS classifications. Among the firm-specific variables X_{it}, we include the log of the average real wage, the log of the number of employees, and the age of the firm in years. We rely on the industry-year fixed effects to control for changes in variable trade costs, such as tariffs. Relatedly, Kee et al. (2013) analyze trade tariffs and anti-dumping duties and conclude that the Great Recession was neither a cause nor consequence of greater protectionism.

Including observable firm-level variables will be important, but there is evidence of sizable permanent unobserved heterogeneity among firms that also needs to be properly conditioned out in any regression. There is a large literature that documents the importance of firms' differences, and Melitz and Redding (2014) provide a good survey emphasizing those in the international trade context. In order to control for this unobserved time-invariant heterogeneity, we rely on fixed effects, denoted by ϕ_i in equation (1). Factors that affect all firms in a given year are similarly captured by the time fixed effects, ϕ_t. Using time fixed effects ensures that we control for the myriad of differences between years in our sample at the cost of limiting our ability to estimate the direct effect of a recession on the probability of exporting. It does not, however, inhibit our understanding of how recessions interact with prior exporting experience nor how they interact with firm size, age, or wages.

Aggregate measures of the business cycle

We use two alternative aggregate measures of the U.S. business cycle. The first uses NBER-defined recession years as an indicator so that for $r_t = \{0, 1\}$ we have $r_{2001} = 1$, $r_{2008} = 1$, and $r_{2009} = 1$, while all other years have $r_t = 0$. We also consider separate indicators for the 2001 and Great Recession. The second measure uses annual real U.S. GDP log-growth. These partial equilibrium specifications essentially treat the aggregate business cycle measures as exogenous to 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 can be accounted for by a shift away from spending on tradable goods.

Table 2: Export Participation and Recessions

	Dependent variable: $y_{it} = \{0,1\}$			
	(1)	(2)	(3)	(4)
Exported last year (y_{it-1})	16.99***	17.00***	16.07***	16.08***
	(0.04)	(0.04)	(0.04)	(0.04)
Exported two years ago (y_{it-2})			5.08***	5.09***
			(0.04)	(0.04)
Recession × exported	−0.95***	−1.01***	−0.46***	−0.51***
last year ($r_t \times y_{it-1}$)	(0.07)	(0.07)	(0.08)	(0.09)
Recession × exported			−0.92***	−0.96***
two years ago ($r_t \times y_{it-2}$)			(0.09)	(0.09)
Log employment (x_{1it})	7.19***	7.18***	6.98***	6.97***
	(0.03)	(0.03)	(0.03)	(0.03)
Log average wages (x_{2it})	4.27***	4.24***	4.17***	4.13***
	(0.03)	(0.03)	(0.03)	(0.03)
Firm age (x_{3it})	0.05	0.06	0.04	0.05
	(1329)	(1329)	(1328)	(1328)
Recession × log		0.02		0.04*
employment ($r_t \times x_{1it}$)		(0.02)		(0.02)
Recession × log		0.18***		0.21***
average wages ($r_t \times x_{2it}$)		(0.05)		(0.05)
Recession × age ($r_t \times x_{3it}$)		−0.01***		−0.02***
		(0.00)		(0.00)
Industry × Year FE (φ_{st})	Yes	Yes	Yes	Yes
Firm FE (φ_i)	Yes	Yes	Yes	Yes
R^2 (percent)	53.2	53.2	53.3	53.3
Obs. (millions)	9.47	9.47	9.47	9.47

Notes: The table presents the results from estimating the following equation:

$$y_{it} = \alpha y_{it-1} + \beta r_t \times y_{cit-1} + X_{it}'\gamma + r_t \times X_{it}'\delta + \phi_i + \phi_{st} + \varepsilon_{it},$$

in which $y_{it} = \{0,1\}$ denotes if firm i exports in year t, r_t is an indicator for a U.S. recession in year t, ϕ_i and ϕ_{st} are firm and industry-year fixed effects, X_{it} is a set of controls and ε_{it} is the error term. All estimations include 9,471,000 observations (rounded to the nearest 1000 observations for the purposes of disclosure). Throughout, we multiply each coefficient estimate and the associated standard error by 100 for presentation purposes. This scaling implies the probability of exporting changes by coefficient percentage points when an indicator variable equals one, when a log-continuous variable increases by 100 percent, and when firm age increases by one year. Standard errors are in parentheses with significance levels denoted by 1% ***, 5% **, and 10% *, respectively.

Table 2 presents the results. 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 one-unit change in the covariate is associated with a percentage point (ppt.) change in the probability of exporting equal to the coefficient. The coefficient on "Exported last year", for example, is the marginal ppt. increase in the probability of exporting this year if the firm exported last year. Regressions including export status lagged by three years or including one- and two-year lags of the control variables give similar results and echo the results of Roberts and Tybout (1997).

Based on Figure 3, we expect the probability of entry to drop and the probability of exit to rise during recessions. These results are borne out, as the coefficient on 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, but the effect on firms that exported two years ago ensures the sum of the effect of a recession over two years is higher.

In Table 3, we use separate indicators for the 2001 recession and Great Recession. Specifically, we define these indicators so that for $r_{2001,t} = \{0, 1\}$ we have $r_{2001,2001} = 1$ while all other years have $r_{2001,t} = 0$. Likewise for the Great Recession we have $r_{GR,2008} = 1, r_{GR,2009} = 1$ while all other years have $r_{GR,t} = 0$. While both recessions had negative effects, the effect of the Great Recession was about twice as large as the 2001 recession. Interestingly, larger and more productive firms, as measured by employment and average wages, fared better during the Great Recession, while size was less of an asset during the 2001 Recession.

Table 4 replaces the recession year indicators with U.S. real GDP growth. The interpretation of the coefficients on growth is that a 1 log-percent change in growth is associated with a percentage point (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 1 log-percent growth lowers the probability of exporting by 0.41 ppt. for firms that exported last year. Note that the coefficients using growth intuitively have the opposite sign as the recession indicator. Our estimates in column (4) suggest that in 2009 firms that exported in the prior two years were 0.88 ppt. less likely to export because U.S. Real GDP shrank by −0.3 log-percent in 2008 and shrank by an additional −2.8 log-percent in 2009.

The size and significance of the coefficients included in Table 4 are similar to those in the previous estimations. Growth interacted with firm characteristics also imply that larger and older firms have a higher probability of remaining exporters during recessions.

Firm-level proxies of the business cycle

In this section, we use the log-difference in industry-level exports and U.S. county-level home prices to proxy for firm-level foreign and local U.S. conditions. By separately including proxies for foreign and local conditions, we can make statements about the proximate channels through which the Great Recession affected export participation.

Our foreign exports measure, d_{it}, can be interpreted as a proxy for the export demand shock that a firm might face. Our measure is inspired by the import competition measure used to study the effect of U.S. imports from China on local labor markets in Autor et al. (2013). Relatedly, many recent studies have documented the effect of changes in local home prices and economic activity during and after the Great Recession. This includes studies by Adelino et al. (2015), Mian and Sufi (2011), and Schmalz et al. (2017). Following this work, we use the change in county-level home price indexes from Bogin et al. (2016) as a measure of changes in local conditions.

Our two measures of foreign and local shocks are given by

$$d_{it} = \sum_{s} \frac{E_{ist-1}}{E_{it-1}} \Delta \ln \left(D_{st} \right) \qquad p_{it} = \sum_{c} \frac{E_{ict-1}}{E_{it-1}} \Delta \ln \left(P_{ct} \right). \tag{2}$$

We define the firm-level export demand shock, d_{it}, as the geometric average of the change in

Table 3: Export Participation and the 2001/Great Recessions

	Dependent variable: $y_{it} = \{0, 1\}$			
	(1)	(2)	(3)	(4)
Exported last year (y_{it-1})	16.99***	17.00***	16.07***	16.08***
	(0.04)	(0.04)	(0.04)	(0.04)
Exported two years ago (y_{it-2})			5.08***	5.09***
			(0.04)	(0.04)
2001 Recession × exported	−0.53***	−0.5***	−0.01	0.00
last year ($r_{2001,t} \times y_{it-1}$)	(0.12)	(0.12)	(0.14)	(0.14)
2001 Recession × exported			−0.91***	−0.9***
two years ago ($r_{2001,t} \times y_{it-2}$)			(0.14)	(0.15)
Great Recession × exported	−1.15***	−1.26***	−0.68***	−0.77***
last year ($r_{GR,t} \times y_{it-1}$)	(0.08)	(0.09)	(0.10)	(0.10)
Great Recession × exported			−0.94***	−1.01***
two years ago ($r_{GR,t} \times y_{it-2}$)			(0.10)	(0.10)
Log employment (x_{1it})	7.19***	7.18***	6.98***	6.97***
	(0.03)	(0.03)	(0.03)	(0.03)
Log average wages (x_{2it})	4.27***	4.24***	4.17***	4.14***
	(0.03)	(0.03)	(0.03)	(0.03)
Firm age (x_{3it})	0.04	0.05	0.03	0.04
	(1330)	(1329)	(1328)	(1328)
2001 Recession × log		−0.19***		−0.17***
employment ($r_{2001,t} \times x_{1it}$)		(0.04)		(0.04)
2001 Recession × log		0.35***		0.38***
average wages ($r_{2001,t} \times x_{2it}$)		(0.07)		(0.07)
2001 Recession × firm age ($r_{2001,t} \times x_{3it}$)		0.02*		0.02
		(0.01)		(0.01)
Great Recession × log		0.13***		0.14***
employment ($r_{GR,t} \times x_{1it}$)		(0.03)		(0.03)
Great Recession × log		0.08*		0.11*
average wages ($r_{GR,t} \times x_{2it}$)		(0.05)		(0.05)
Great Recession × firm age ($r_{GR,t} \times x_{3it}$)		−0.03***		−0.03***
		(0.00)		(0.00)
Industry × Year FE (φ_{st})	Yes	Yes	Yes	Yes
Firm FE (φ_i)	Yes	Yes	Yes	Yes
R^2 (percent)	53.2	53.2	53.3	53.3
Obs. (millions)	9.47	9.47	9.47	9.47

Notes: The table presents the results from estimating the following equation:

$$y_{it} = \alpha y_{it-1} + \beta_1 r_{2001,t} \times y_{cit-1} + X_{it}'\gamma + r_{2001,t} \times X_{it}'\delta_1 + \beta_2 r_{GR,t} \times y_{cit-1} r_{GR,t} \times X_{it}'\delta_2 + \phi_i + \phi_{st} + \varepsilon_{it},$$

in which $y_{it} = \{0, 1\}$ denotes if firm i exports in year t, $r_{2001,t}$ is an indicator for the 2001 U.S. recession, and $r_{GR,t}$ is an indicator for the Great Recession, ϕ_i and ϕ_{st} are firm and industry-year fixed effects, X_{it} is a set of controls and ε_{it} is the error term. Throughout, we multiply each coefficient estimate and the associated standard error by 100 for presentation purposes. This scaling implies that the probability of exporting changes by coefficient percentage points when an indicator variable is on, when a log-continuous variable increases by 100 percent, and when firm age increases by one year. Standard errors are in parentheses with significance levels denoted by 1% ***, 5% **, and 10% *, respectively.

Table 4: Export Participation and GDP Growth

	Dependent variable: $y_{it} = \{0, 1\}$			
Exported last year (y_{it-1})	15.86***	15.82***	15.26***	15.23***
	(0.05)	(0.05)	(0.05)	(0.05)
Exported two years ago (y_{it-2})			4.30***	4.28***
			(0.05)	(0.06)
$\Delta \log RGDP \times$ exported last year ($r_t \times y_{it-1}$)	0.41***	0.43***	0.31***	0.32***
	(0.02)	(0.02)	(0.02)	(0.02)
$\Delta \log RGDP \times$ exported two years ago ($r_t \times y_{it-2}$)			0.27***	0.28***
			(0.02)	(0.02)
Log employment (x_{1it})	7.20***	7.24***	6.98***	7.03***
	(0.03)	(0.03)	(0.03)	(0.03)
Log average wages (x_{2it})	4.27***	4.27***	4.18***	4.19***
	(0.03)	(0.04)	(0.03)	(0.04)
Firm age (x_{3it})	0.03	0.01	0.02	0.00
	(1329)	(1329.5)	(1328)	(1328)
$\Delta \log RGDP \times$ log employment ($r_t \times x_{1it}$)		−2.27***		−2.61***
		(0.47)		(0.47)
$\Delta \log RGDP \times$ log average wages ($r_t \times x_{2it}$)		−0.39		−0.91
		(0.99)		(0.99)
$\Delta \log RGDP \times$ firm age ($r_t \times x_{3it}$)		0.85***		0.77***
		(0.08)		(0.08)
Industry × Year FE (φ_{st})	Yes	Yes	Yes	Yes
Firm FE (φ_i)	Yes	Yes	Yes	Yes
R^2 (percent)	53.2	53.2	53.3	53.3
Obs. (millions)	9.47	9.47	9.47	9.47

Notes: The table presents the results from estimating the following equation:

$$y_{it} = \alpha y_{it-1} + \beta \Delta \log RGDP_t \times y_{cit-1} + X'_{it}\gamma + \Delta \log RGDP_t \times X'_{it}\delta + \phi_i + \phi_{st} + \varepsilon_{it},$$

in which $y_{it} = \{0, 1\}$ denotes if firm i exports in year t, $\Delta \log RGDP_t$ is U.S. real GDP growth in year t, ϕ_i and ϕ_{st} are firm and industry-year fixed effects, X_{it} is a set of controls and ε_{it} is the error term. All estimations include 9,471,000 observations (rounded to the nearest 1000 observations for the purposes of disclosure). Except for RGDP growth, we multiply each coefficient estimate and the associated standard error by 100 for presentation purposes. This scaling implies the probability of exporting changes by coefficient percentage points when an indicator variable is on, when a log-continuous variable increases by 100 percent, and when firm age increases by one year. For the variables that include RGDP growth, we scale the results so that log-growth of one percent changes the probability of exporting by the coefficient percentage points. Standard errors are in parentheses with significance levels denoted by 1% ***, 5% **, and 10% *, respectively.

industry-level real exports. We use the share of total employment, $\frac{E_{ist-1}}{E_{it-1}}$, for firm i in year $t-1$ and industry s 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 also define the firm-level home price shock, p_{it}, as the geometric average of the change in county-level home prices. We use the share of employees, $\frac{E_{ict-1}}{E_{it-1}}$, for firm i located in country c in year $t-1$ to apportion the log-difference county-level home prices changes, $\Delta \ln(P_{ct})$, to each firm. Home prices can be seen as capturing local demand conditions but possibly to some extent also credit conditions.

One way to motivate using the geometric averages in equation (2) is by assuming that foreign demand shocks to a particular industry will impact each firm in proportion to that firm's employment in that industry. Likewise, county-level shocks are assumed to affect a firm according to the share of its employees that work at establishments located in each county. We also note that the LBD records employment at the industry- and county-level for establishments within each firm. As such, employment shares can vary over time within the same firm as different establishments grow or shrink. Lastly, along the lines of Bartik (1991), we lag the shares by one year so that they do not change in response to current shocks.

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

$$\begin{aligned} y_{it} &= \alpha y_{it-1} + \beta d_{it} + \gamma p_{it} + \delta d_{it} \times y_{t-1} + \zeta p_{it} \times y_{t-1} \\ &+ X_{it}'\eta + d_{it} \times X_{it}'\eta + p_{it} \times X_{it}'\theta + \phi_i + \phi_{st} + \varepsilon_{it}. \end{aligned} \tag{3}$$

The definitions of the other covariates here are the same as in the results in Tables 2, 3, and 4. The three specifications will, in turn, include only d_{it} shocks, only the p_{it} shocks, and then both types of shocks together. Considering both types together will allow us compare the role of foreign relative to local conditions simultaneously.

Table 5 presents the results. Column (1) shows that a -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 of a local home price shock in column (2). Column (3) includes both shocks together, showing that the probability of exporting declines by about 1/3 ppt. in response to a -100 log-percent shock to either foreign demand or local home prices. This finding is important as it shows that both foreign and local demand conditions have significant effects on the likelihood of exporting and in particular have effects in the same direction and of similar magnitude.

Column (4) interacts the covariates with the foreign demand shock and shows that the overall effect of recessions works primarily through the interaction of foreign demand with export status last year as well as firm size and firm age. In particular, in response to a decline in foreign demand, firms that exported last period become less likely to export this year. Moreover, younger firms become less likely to export and larger firms become more likely to export.

Column (5) adds interaction terms to the home price shocks specification. As in column (4), we find significant effects of the interaction of house prices with previous export status as well as with firm size and firm age. Conditional on all other covariates, home price increases of 100 percent reduce the probability of exporting by about 5.5 percent for firms that did not export last year and about 4.6 percent for firms that did. At first glance the -7.65 coefficient on home prices seems large. However, the LBD reports payroll in thousands of dollars so our measure of the log average real wage corresponds to 3.2, 3.9, and 4.6 for firms paying, respectively, \$25k, \$50k, and \$100k per year. Combining the linear effect of home prices with the effect of the firm that, for example, pays an average wage of \$50k per year gives an effect of home prices of $(7.65 - 2.00)\ln(50,000) = 0.17$. In fact, only when the wage is less than about \$45.8k, is this combined effect negative. Lastly, the negative coefficient on local home prices interacted with firm size means that a decline in local house prices makes larger firms relatively more likely to export.

Column (6) includes all covariates and interactions simultaneously and leads to similar conclusions. We find the robustness of the results on this score to be reassuring.

Table 5: Export Participation, Foreign Demand, and Local Home Prices

	Dependent variable: $y_{it} = \{0, 1\}$					
	(1)	(2)	(3)	(4)	(5)	(6)
Exported last year (y_{it-1})	16.84***	16.84***	16.84***	16.82***	16.81***	16.79***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Foreign demand (d_{it})	0.36***		0.36***	−0.06		0.04
	(0.05)		(0.05)	(0.20)		(0.20)
Local home price (p_{it})		0.32*	0.32*		−7.65***	−7.52***
		(0.22)	(0.22)		(0.79)	(0.79)
Foreign demand × exported last year ($d_{it} \times y_{it-1}$)				0.59***		0.57***
				(0.12)		(0.12)
Local home price × exported last year ($p_{it} \times y_{it-1}$)					0.97***	0.87***
					(0.34)	(0.35)
Log employment (x_{1it})	7.19***	7.19***	7.19***	7.19***	7.2***	7.2***
	(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***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Firm age (x_{3it})	0.04	0.04	0.04	0.04	0.03	0.03
	(1329.45)	(1329.41)	(1326.00)	(1329.47)	(1329.44)	(1329.30)
Foreign demand × log employment ($d_{it} \times x_{1it}$)				−0.06***		−0.05***
				(0.03)		(0.03)
Foreign demand × log average wages ($d_{it} \times x_{2it}$)				0.07		0.04
				(0.06)		(0.06)
Foreign demand × firm age ($d_{it} \times x_{3it}$)				0.01***		0.01***
				(0.00)		(0.01)
Local home price × log employment ($p_{it} \times x_{1it}$)					−0.26***	−0.24***
					(0.11)	(0.11)
Local home price × log average wages ($p_{it} \times x_{2it}$)					2.00***	1.97***
					(0.22)	(0.22)
Local home price × firm age ($p_{it} \times x_{3it}$)					0.08***	0.08***
					(0.02)	(0.02)
Industry × Year FE (φ_{st})	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE (φ_i)	Yes	Yes	Yes	Yes	Yes	Yes
R^2 (percent)	53.2	53.2	53.2	53.2	53.2	53.2
Obs. (millions)	9.47	9.47	9.47	9.47	9.47	9.47

Notes: The table presents the results from estimating equation

$$y_{it} = \alpha y_{it-1} + \beta d_{it} + \gamma p_{it} + \delta d_{it} \times y_{t-1} + \zeta p_{it} \times y_{t-1} + X'_{it}\eta + d_{it} \times X'_{it}\eta + p_{it} \times X'_{it}\theta + \phi_i + \phi_{st} + \varepsilon_{it}.$$

in which $y_{it} = \{0, 1\}$ denotes if firm i exports in year t, d_{it} is a measure of foreign demand shocks, p_{it} is a measure local home price shocks, ϕ_i and ϕ_{st} are firm and industry-year fixed effects, X_{it} is a set of controls and ε_{it} is the error term. All estimations include 9,471,000 observations (rounded to the nearest 1000 observations for the purposes of disclosure). We multiply each coefficient estimate and the associated standard error by 100 for presentation purposes. This scaling implies the probability of exporting changes by coefficient percentage points when an indicator variable is on, when a log-continuous variable increases by 100 percent, and when firm age increases by one year. Note that our scaling of d_{it} and p_{it} therefore differ from the scaling of RGDP growth in Table 4. Standard errors are in parentheses with significance levels denoted by 1% ***, 5% **, and 10% *, respectively.

In summary, our definitions of foreign and local shocks have very different effects on the probability of exporting. While the likelihood of exporting is positively correlated with our foreign demand measure, its effect on the probability of exporting is small. In contrast, home price increases have large negative effects on the probability of exporting.

IV. Aggregate Implications and Counterfactuals

In this section, we first present an exact decomposition of export growth. This includes the contribution from incumbent exporters as well as the contribution from firms entering and exiting foreign markets. This decomposition will allow us to connect aggregate export growth with the outcomes of individual firms during and after the Great Recession. Using this decomposition, we then study the aggregate implications of several partial equilibrium counterfactuals.

Exact Export Growth Decomposition

We connect the evolution of aggregate exports to changes in the outcome of individual firms using a decomposition of total real export growth based on the work of Di Giovanni et al. (2014). Log growth of total exports over h years, g_t^h, can be decomposed into five margins as

$$\begin{aligned} g_t^h \equiv\ & \underbrace{\ln\left(\frac{\bar{X}_t\left(I_{t\cap t-h}\right)}{\bar{X}_{t-h}\left(I_{t\cap t-h}\right)}\right)}_{i_t^h=\text{ intensive margin}} \\ & + \underbrace{\underbrace{\underbrace{\ln\left(\frac{N_t\left(I_t\right)}{N_t\left(I_{t\cap t-h}\right)}\right)}_{ee_t^h=\text{ entry extensive}} + \underbrace{\ln\left(\frac{\bar{X}_t\left(I_t\right)}{\bar{X}_t\left(I_{t\cap t-h}\right)}\right)}_{ei_t^h=\text{ entry intensive}}}_{e_t^h=\text{ entry margin}} \underbrace{- \underbrace{\ln\left(\frac{N_{t-h}\left(I_{t-h}\right)}{N_{t-h}\left(I_{t\cap t-h}\right)}\right)}_{xe_t^h=\text{ exit extensive}} - \underbrace{\ln\left(\frac{\bar{X}_{t-h}\left(I_{t-h}\right)}{\bar{X}_{t-h}\left(I_{t\cap t-h}\right)}\right)}_{xi_t^h=\text{ exit intensive}}}_{x_t^h=\text{ exit margin}}}_{n_t^h=\text{ net extensive margin}} \end{aligned} \tag{4}$$

in which I_t is the set of firms that export in year t and $I_{t\cap t-h}$ is the set of firms that export in both years t and $t-h$, which we can define formally as the intersection $I_{t\cap t-h} = \{i : i \in I_t, i \in I_{t-h}\}$. Using this notation, we define $N_t\left(I_t\right)$ as the number of exporting firms in year t, while $\bar{X}_t(I_t)$ denotes average exports per firm in year t. 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 average exports per incumbent 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 and average exports per firm in the relevant subset. For example, total exports by incumbents in year t can be written as $\sum_{i\in I_{t\cap t-h}} X_{it} \equiv N_t(I_{t\cap t-h})\,\bar{X}_t(I_{t\cap t-h})$. A detailed derivation and additional discussion of this decomposition are included in Appendix B.

The first term in equation (4), the intensive margin contribution in year t to total log growth over the past h years, i_t^h, is defined as the log growth of exports of firms that exported in both t and in $t-h$. By definition, the number of these incumbent exporters in t is the same as the number in $t-h$ so that $N_t(I_{t\cap t-h}) = N_{t-h}(I_{t\cap t-h})$. As such, the intensive margin is not affected by changes in the number of incumbents and is summarized by changes in the average exports of incumbents.

The remaining four margins of equation (4) together comprise the net extensive margin, n_t^h. As the name implies, the net extensive margin includes the gross entry margin, e_t^h, minus the gross exit margin, x_t^h. We define the entry margin as the contribution to total export growth of firms that export in year t but did not export in year $t-h$. Similarly, we define the exit margin as the contribution to export growth of firms that exported in $t-h$ but did not export in 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. Thus, the entry margin is made up of the entry extensive margin, ee_t^h, which captures the effect of the number of entrants relative to the number of incumbents, and the entry intensive margin, ei_t^h, which captures the effect of those entrants on average exports.

Note that the entry extensive margin can also be written as

$$\ln\left(\frac{N_t\left(I_t\right)}{N_t\left(I_{t\cap t-h}\right)}\right)=\ln\left(1+\frac{N_t\left(I_{t\setminus t-h}\right)}{N_t\left(I_{t\cap t-h}\right)}\right), \tag{5}$$

in which the last term, a measure of the entry rate, is the ratio of the number of firms that exported in year t but not in year $t-h$ relative to the number of firms that exported in both years. We use set notation to denote the set of new entrants, $I_{t\setminus t-h}$, which is formally the set-theoretic difference or relative complement given by $I_{t\setminus t-h}=\{i : i\in I_t, i\notin I_{t-h}\}$.

Similar to the entry margin, the exit margin is made up of the exit extensive margin, xe_t^h, which captures the effect of the number of exiting firms relative to the number of incumbents, and the exit intensive margin, xi_t^h, which captures the effect of exiting firms on average exports. We can write the contribution to total export growth from the number of exiting firms as

$$\ln\left(\frac{N_{t-h}\left(I_{t-h}\right)}{N_t\left(I_{t\cap t-h}\right)}\right)=\ln\left(1+\frac{N_{t-h}\left(I_{t-h\setminus t}\right)}{N_t\left(I_{t\cap t-h}\right)}\right), \tag{6}$$

in which the latter term, a measure of the exit rate, is the ratio of the number of firms that export in period $t-h$ but not in period t relative to the number of firms that export in both periods. Again we define this set-theoretic difference as $I_{t-h\setminus t}=\{i : i\notin I_t, i\in I_{t-h}\}$.

Panel A of Table 6 presents each of the five terms of equation (4) for all U.S. firms that exported between 1993 and 2006 for horizons between one year and six years, $h=1,\ldots,6$. Panel B shows the same decomposition for 2008.[4] The figures for 1993 to 2006 give us a baseline to compare the evolution of exports during and after the Great Recession. As shown in column $h=1$ in Panel A of Table 6, one-year log growth averaged 6.1 log-percent per year between 1993 and 2006. The intensive margin on average contributes 6.8 lppt. to total log growth while the net extensive margin contributes -0.7 lppt. That is, on average, export

[4]Table 8 in Appendix C shows the decomposition for the 2008 to 2014 period. Note that due to differences in data availability the figures for 1993 to 2006 and 2008 to 2014 include columns with averages based on different years. For example, at the 1-year horizon, data are available for each year 2008 to 2014 whereas at the 6-year horizon, data in the 2008 to 2014 period are only available for the start and end years of 2008 and 2014.

Table 6: Real Export Log Growth Decomposition, 1993 to 2006 vs. 2008

	$h=1$	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$
	Panel A: 1993-2006 Average					
Total growth	6.08	5.72	5.41	5.10	4.78	4.67
Intensive margin	6.82	6.54	6.24	5.96	5.66	5.60
Net extensive	-0.74	-0.82	-0.83	-0.86	-0.88	-0.94
Entry margin	2.91	2.71	2.64	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	-3.53	-3.47	-3.44	-3.42	-3.43
- extensive	-42.41	-27.29	-21.50	-18.34	-16.28	-14.75
- intensive	38.76	23.76	18.03	14.90	12.86	11.33
	Panel B: 2008					
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	-42.42	-25.53	-19.28	-16.58	-12.10	-13.16
- intensive	40.12	22.70	16.40	13.63	11.78	10.61

Notes: The table presents the results of decomposing changes in aggregate real exports over the period from 1993 to 2006 relative to the period following 2008. The different margins are calculated as in equation (4). 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. All exports were deflated using the goods export deflator from the NIPA accounts with 2000 as the base year.

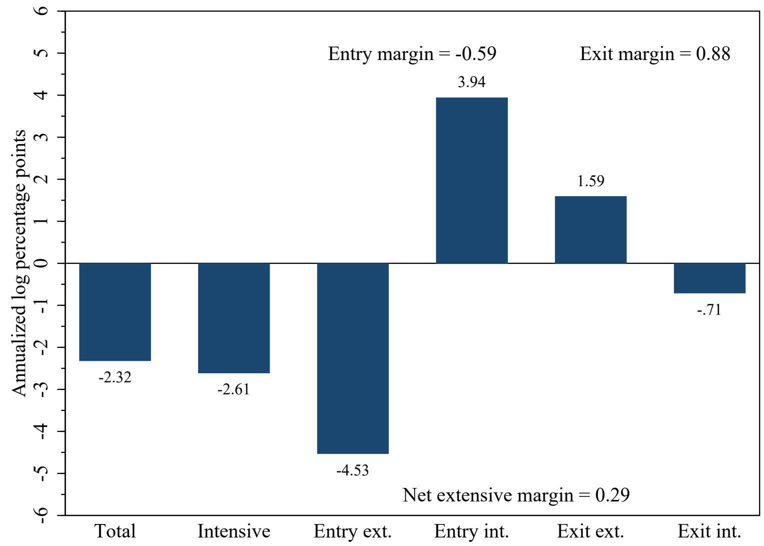
growth between two consecutive years during this period was essentially entirely driven by incumbents. Firms starting to export and firms exiting foreign markets on net contribute slightly negatively to total export growth.

As mentioned above, this small negative net contribution obscures the significant gross churn in the entry and exit margins, which on average contribute 2.9 and −3.7 lppt., respectively. A closer examination of the extensive margin reveals that, relative to incumbents, there is a large number of new firms starting to export each period. However, these exporters tend to be relatively small. The number of new exporters contributes 44.7 lppt. via the entry extensive margin. Because new exporters export less than incumbents, bringing down average exports, they also reduce total log growth by 41.7 lppt. via the entry intensive margin. Finally, the number of exits subtracts about 42.4 lppt. via the exit extensive margin. Because exiting firms are smaller than the average incumbent, their exit raises average exports contributing 38.7 lppt. to total growth.

Looking at column $h = 6$, we can see that the net extensive margin becomes more important, while the intensive margin becomes less important, over longer horizons. This echoes the summary statistics in Table 1. As one increases the horizon h, the contribution to growth of firms that entered during the h intervening periods increases.

Panel B of Table 6 shows the same decomposition for 2008, which was chosen as the starting point because 2009 is the first year exhibiting a decline in total exports. At $h = 1$, the immediate effect of the Great Recession on export growth is apparent in the large drag from the intensive margin and a decline in exports from incumbent exporters. Comparing column $h = 6$ in Panel A and Panel B, however, reveals that average export growth in pre-crisis years was 4.7 lppt., whereas it has been only 2.4 lppt. since 2008. The intensive margin contribution to export growth declined by about 2.6 lppt. while the entry extensive margin contribution fell by about 4.5 lppt. This was offset by an increase in the size of the average new exporter raising the drag from the entry intensive margin from the typical drag of −14.3 lppt. to −10.4 lppt. since 2008.

Figure 4: Six Year Contribution Differences
2008-2014 Minus The 1993-2006 Average



Notes: This figure shows the differences between the 2008-2014 and the 1993-2006 period at the $h = 6$ horizon graphically. These difference correspond to Panel A of Table 6 column $h = 6$ minus Panel B of Table 6 for column $h = 6$.

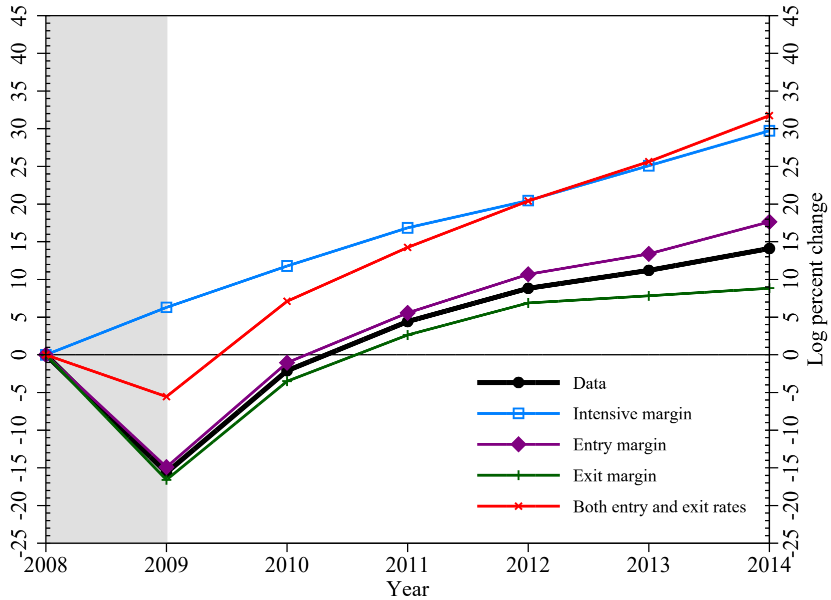
Figure 4 illustrates the differences between the 2008-2014 and the 1993-2006 period at the $h = 6$ horizon graphically. While the entry margin shows the largest change, the movement of the extensive and the intensive entry margin largely offset each other. Similarly, the changes in the extensive and intensive exit margins largely offset each other also, such that the total change is largely accounted for by changes in the intensive margin of existing exporters.

Partial Equilibrium Counterfactuals

In the following counterfactuals, we focus on the role of the intensive margin and the extensive margin and their importance for the evolution of exports since 2008. We start by considering four simple counterfactuals around the Great Recession based on the decomposition in equation (4) and their actual evolution since 2008. The counterfactuals aim to quantify the importance of several margins of adjustment for export growth during and after the Great Recession. In particular, we focus on the importance of the intensive and extensive margin.

The first counterfactual examines the importance of the intensive margin: How did

Figure 5: Counterfactual Real Export Growth



Notes: This figure shows the growth of aggregate exports since 2008 in the data and three counterfactuals based on equation (4). The intensive margin counterfactual plots the evolution of exports if i_t^h remained at its 1993 to 2006 average. The entry margin counterfactual plots the evolution of exports if ee_t^h and ei_t^h remained at their historic averages. The exit margin counterfactual plots the evolution of exports if xe_t^h and xi_t^h remained at their historic averages. The counterfactual for both the entry and exit rates together shows the evolution of exports if ee_t^h and xe_t^h had both remained at their historic averages.

incumbent exporters respond to the recession? In this exercise we keep the export growth rate of incumbents, i_t^h in equation (4), at its 1993 to 2006 average, whereas all other margins, entry and exit, behave as in the data. In the second counterfactual, we examine the importance of firm entry and keep the growth contribution of the entry margin, ee_t^h and ei_t^h in equation (4), constant at their 1992 to 2006 average. In the third counterfactual, we study the relevance of the exit margin and thus impose that xe_t^h and xi_t^h in equation (4) remain at their historic averages. In the fourth counterfactual, we examine the role of the number of firms entering into exporting and exiting from exporting. In this scenario ee_t^h and xe_t^h remain at their historic average, whereas the other margins behave as in the data.

Figure 5 shows the implications of the four counterfactuals on the level of exports. The first counterfactual, labeled "Intensive Margin," shows that the decline in exports during the recession is driven by incumbent exporters. In the absence of a decline in the intensive margin, exports would have continued to grow during the recession. In 2014, exports would have been 29 lppt. above their 2008 level vs. 14 lppt. in the data if the intensive margin would have performed at it's historic average.

The extensive margin counterfactuals show much smaller effects. The second counterfactual, labeled ‘‘Entry Margin,” shows that if the entry margin were at its historic average, exports would have been 17 lppt above their 2008 level at the end of 2014. Thus, firm entry during and since the crisis contributed less to export growth than it has historically. During the recession, the effect of the entry margin is rather small. This illustrates the existence of a ‘‘missing generation’’ of exporters. The third counterfactual, labeled ‘‘Exit Margin,” shows that the effect of the exit margin is also rather small during the recession and that by 2014 aggregate exports would have been only 9 lppt above their 2008 level. Perhaps surprisingly, the exit margin contributed less negatively to export growth since 2008 than it did historically, which implies that the level of exports under the counterfactual is lower in 2014 than in the data.

The fourth counterfactual, labeled ‘‘Entry and Exit Rate,’’ shows the evolution of exports if the relative number of entrants and the relative number of exiters had remained had their historic averages. Note, however, that the relative sizes of entrants and exiters are allowed to behave as in the data. Had the relative numbers of entrants and exiters remained at their 1993 to 2006 average, aggregate exports would have been 32 lppt. above their 2008 level. This scenario illustrates the potential importance of the extensive margin, as exports in the fourth scenario outperformed exports under the ‘‘intensive margin’’ scenario.

The finding that the intensive margin was the driving force of export growth during the crisis masks large underlying changes in the extensive margin. To illustrate the important changes in the extensive margin, we consider four additional counterfactuals in Figure 6. Figure 6a considers two counterfactuals around the entry margin. First, we explore the implications of holding the relative number of exporting firms, ee_t^h in equation (4), at its pre-recession value. In the second counterfactual around the entry margin, we hold average relative exports of entrants, ei_t^h in equation (4), at its historic average. It becomes clear that the net measure masks two largely offsetting changes. If the number of new firms had stayed at its historic average, exports in 2014 would have been more than 40 percent above the 2008 level, more than twice the increase than in the data. The large decline in the number of entrants since 2008, however, is largely offset by a relative increase in the sizes of new entrants. If the sizes of new exporters had stayed at their 1993 to 2006 average, the level of total exports in 2014 would have been almost 10 percentage points below its 2008 level. Thus, while there were fewer new exporters after 2008, those that did enter seemed to be more productive (i.e., larger).

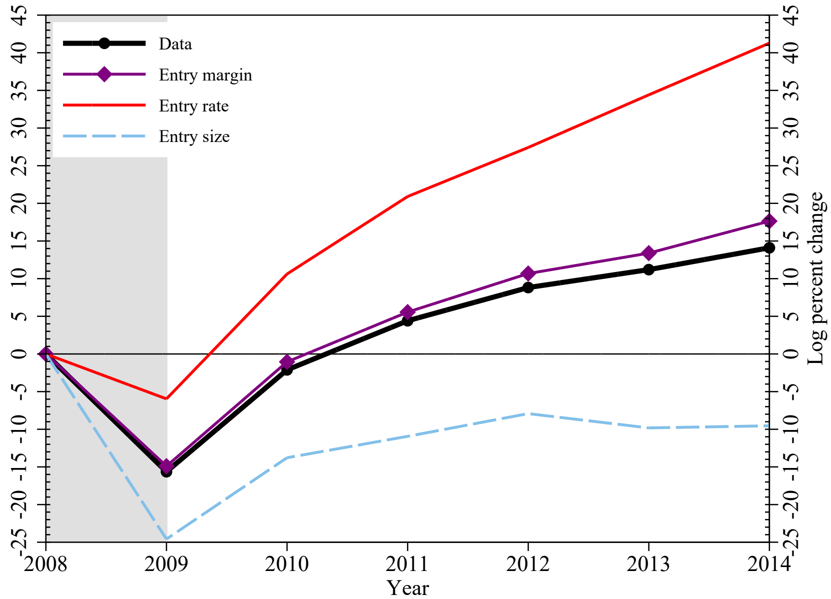
Figure 6b shows the two corresponding counterfactuals for the exit margin. In the first exit counterfactual, we keep the exit extensive margin, xe_t^h in equation (4) at its historic average, while in the second exit counterfactual we keep the exit intensive margin, xi_t^h in equation (4), at its 1993 to 2006 average. Again, we see two largely offsetting movements, albeit at a somewhat smaller absolute magnitude. Unlike on the entry dimension, however, the movements in the size and number of exiters were for the most part in the opposite direction, with fewer but larger exiters.

Table 7 shows the detailed results of the counterfactuals for the first and the last years of the figures shown above. In summary, while the counterfactuals suggest that a missing generation of exporters exists, they also show that the effect of the missing generation may be relatively muted, as fewer entrants are compensated by relatively larger entrants.

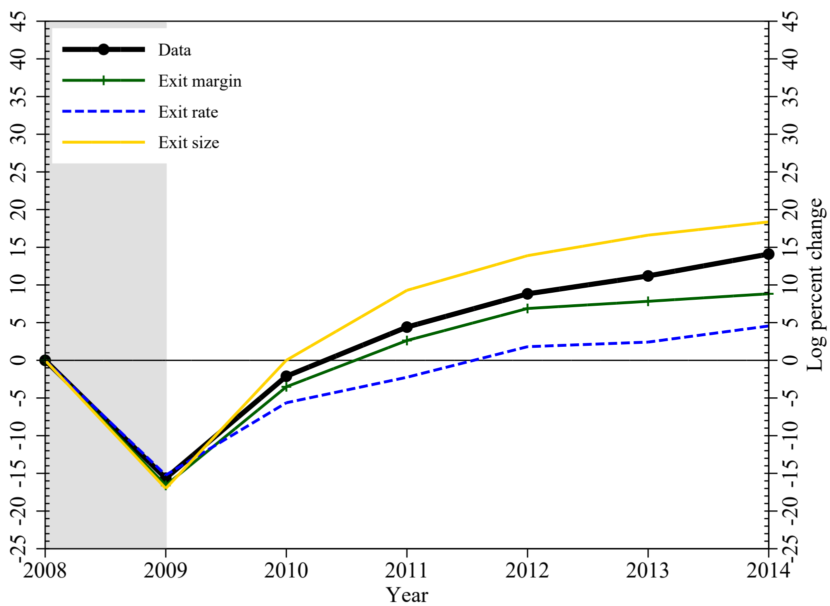
V. Theory

The prior counterfactuals documented that total export growth since the Great Recession would have been lower if the decline in the number of new exporters had not been offset by an increase in their average size. We compare and contrast this result to the predictions of the influential model of Chaney (2008). We conclude that a standard steady-state trade theory cannot capture what we observe and propose possible roles for financial constraints, variable markups, changing entry costs, demand shocks, and declines in entrepreneurship to explain this phenomenon.

Figure 6: Entry and Exit Counterfactuals: Number vs. Size



(a) Entry: Components



(b) Exit: Components

Notes: This figure shows the growth of aggregate exports since 2008 in the data and three counterfactuals based on equation (4). In Panel A, the entry margin counterfactual plots the evolution of exports if the entry extensive margin ee_t^h and the entry intensive margin ei_t^h margin remained at their historic averages. In Panel B, the exit margin counterfactual plots the evolution of exports if the exit extensive margin xe_t^h and the exit intensive xi_t^h margin remained at their historic averages.

Table 7: Data vs. Counterfactuals

	Data	Intensive	Entry			Exit		
			Total	Number	Size	Total	Number	Size
PANEL A: IMMEDIATE EFFECT, h=1								
TOTAL GROWTH	-0.16	0.06	-0.15	-0.06	-0.25	-0.17	-0.15	-0.17
INTENSIVE MARGIN	-0.15	0.07	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15
Entry extensive	0.35	0.35	0.45	0.45	0.35	0.35	0.35	0.35
Entry intensive	-0.33	-0.33	-0.42	-0.33	-0.42	-0.33	-0.33	-0.33
Exit extensive	0.43	0.43	0.43	0.43	0.43	0.42	0.42	0.43
Exit intensive	-0.40	-0.40	-0.40	-0.40	-0.40	-0.39	-0.40	-0.39
PANEL B: LONGER-TERM EFFECT, h=6								
TOTAL GROWTH	0.14	0.30	0.18	0.41	-0.10	0.09	0.05	0.18
INTENSIVE MARGIN	0.18	0.34	0.18	-0.15	-0.15	-0.15	-0.15	-0.15
Entry extensive	0.74	0.74	1.01	1.01	0.74	0.74	0.74	0.74
Entry intensive	-0.62	-0.62	-0.86	-0.62	-0.86	-0.62	-0.62	-0.62
Exit extensive	0.79	0.79	0.79	0.79	0.79	0.89	0.89	0.789
Exit intensive	-0.64	-0.64	-0.64	-0.64	-0.64	-0.68	-0.64	-0.68

Notes: This table presents the trade growth decomposition and seven counterfactuals in 2008 for the immediate effect (1 year) in panel A and the longer-term impact (6 years) in panel B. The first column shows the decomposition in the data. Columns (2) through (8) show various counterfactuals on the intensive margin (column (2)), the entry margin (column (3)), and the exit margin (column (6)). Entry and exit margin counterfactuals are then broken down into the number of entrants/exiters (columns (4) and (7)) as well as the size of entrants/exiters (columns (5) and (8)).

In the following derivations, because we are simply using the Chaney (2008) model, we retain his notation at the expense of using notation that is inconsistent with the sections above. In the model, average exports, $\bar{x}_{ij} = \dfrac{X_{ij}}{M_{ij}}$, are the ratio of total exports, X_{ij}, from country i to country j divided by the number (mass) of firms, M_{ij}, in i that export to j.

A pivotal quantity for our results is the threshold productivity necessary to export $\bar{\varphi}_{ij}$. This threshold is generated by the existence of a fixed cost, f_{ij}, that firms in country i pay to enter a foreign market j. In the Chaney (2008) framework, less productive firms do not generate enough profits abroad to cover the fixed cost of entering a foreign market. This threshold productivity is given in Chaney (2008) equation (9) which we reproduce here

$$\bar{\varphi}_{ij} = \lambda_4 \times \left(\frac{Y}{Y_j}\right)^{1/\gamma} \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right) \times f_{ij}^{1/(\sigma-1)} \tag{7}$$

In this equation, λ_4 is a group of parameters, Y is world income, Y_j is income in country j, w_i is the equilibrium wage in country i, and σ is the elasticity of substitution between varieties. Variable "iceberg" costs in the amount of $\tau_{ij} \geq 1$ are incurred for each unit shipped from country i to country j. Lastly, θ_j is a "multi-lateral resistance" term which captures the effect of equilibrium price indexes through the world, as defined and explained by Anderson and van Wincoop (2003).

The ex-ante probability that a firm receives a productivity draw above the threshold necessary to export is $P\left(\bar{\varphi}_{ij} < \varphi\right) = \bar{\varphi}_{ij}^{-\gamma}$ so that productivity is Pareto distributed with shape parameter γ and minimum draw equal to one.

Using this, the mass of exporters is then defined as the mass of firms that take a draw times the probability that the firm receives a productivity draw above the threshold necessary to export to country j

$$M_{ij} = \xi_i w_i L_i \bar{\varphi}_{ij}^{-\gamma} \tag{8}$$

Chaney (2008) assumes that each country i has a mass of entrepreneurs, $\xi_i w_i L_i$, that draw a productivity which is proportional to the size of the economy $w_i L_i$. This assumption allows larger economies to have a larger stock of entrepreneurs. Countries here can differ in their labor endowment L_i, equilibrium wage w_i, and also by a constant ξ_i that captures exogenous structural factors that proportionally affect the number of entrepreneurs $\xi_i \in [0, \infty)$. Among others, these could include such factors as risk aversion and attitudes toward entrepreneurship.

Having explained the model's expression for the number of exporters, we turn to aggregate exports which are given in equation (10) of Chaney (2008). Aggregate exports are defined as the sum of exports of each firm, $x_{ij}(\varphi)$, given by Chaney (2008) equation (9), for firms that have productivity above the threshold, $\varphi \geq \bar{\varphi}_{ij}$. Because we are interested in total exports, this integral must be computed against the measure of productivity, $\xi_i w_i L_i dG(\varphi)$, instead of the productivity distribution, $dG(\varphi)$. As such, the expression is

$$X_{ij} = \xi_i w_i L_i \int_{\bar{\varphi}_{ij}}^{\infty} x_{ij}(\varphi)\, dG(\varphi) = \xi_i w_i L_i \left(\frac{\sigma\gamma}{\gamma - (\sigma - 1)} \right) f_{ij} \bar{\varphi}_{ij}^{-\gamma} \tag{9}$$

in which $\gamma - (\sigma - 1) > 0$ and $\sigma, \gamma \geq 1$ to ensure finite aggregate exports. The integral is simple due to the assumption of Pareto distributed productivity and isoelastic preferences. We show explicitly how to relate aggregate exports provided in proposition 1 of Chaney (2008) to a function of the threshold productivity as we have written it in (9) in appendix D.

With equations (8) and (9) in hand, it is easy to see that average exports resolves to

$$\bar{x}_{ij} = \frac{X_{ij}}{M_{ij}} = \left(\frac{\sigma\gamma}{\gamma - (\sigma - 1)} \right) f_{ij}. \tag{10}$$

Equation (10) shows that average exports in Chaney (2008) are a function only of the elasticity of substitution σ, the Pareto shape parameter γ, and the fixed costs of exporting f_{ij}. Average exports thus only change in response to these quantities. The reason for this is that changes to other quantities in the model have exactly offsetting effects on the number of exporters and aggregate exports. For example, a reduction in foreign income will reduce both the number of exporters and aggregate exports with those effects exactly offsetting, leaving average exports unchanged.

While we use the Chaney (2008) model to present this result in a parsimonious way, related expressions can be derived from more complex steady-state trade models that share similar assumptions of monopolistic competition, isoelastic preferences, and exogenously Pareto distributed productivity. For example, Eaton et al. (2011) equation (28) provides a result analogous to equation (10) above. Next we discuss, in the context of this result from the Chaney (2008) model, to what extent various hypotheses can explain our observations in the data.

First, holding structural parameters fixed, equation (10) implies that an increase in average exports would require a increase in the fixed cost of exporting. Direct evidence for a change in fixed costs since the Great Recession is limited. However, an increase in fixed costs could indirectly resulted from credit frictions. In particular, a rise in credit spreads may have increased the cost of borrowing during the Great Recession and thus increased the cost of exporting. This idea is explored by Manova (2013), who argues credit constraints affect trade partly through the selection of heterogeneous firms into exporting.

Second, because firms are monopolistically competitive in the Chaney (2008) model, they charge the markup $\mu = \dfrac{\sigma}{\sigma - 1}$ over marginal cost. In a more elaborate model with time-varying markups, a change in markups would directly affect average firms size via equation (10). A decline in markups would imply that goods are more substitutable which would trace through to an increase in average exports. How markups vary over the business cycle has been an area of significant research in macroeconomics. Many of the points surrounding entry and markups in the present paper are related to Jaimovich and Floetotto (2008). There the author uses a model that gives endogenous procyclical business formation and variation in the number of operating firms to get countercyclical variations in markups. In other words, in recessions new business formation is lower and this leads to less competition and higher markups. Higher markups and less business formation would go some way to explain the empirical patterns in the data but would run counter to the predictions of equation (10) because that equation implies lower and not higher markups. De Loecker and Warzynski (2012) find that markups significantly increase for firms entering into foreign markets. A decline in the number of firms entering foreign markets might then be mechanically related to a decline in markups and corresponding increase in average exports. This perspective would ignore any competitive effects as well as match the data and the intuition from equation (10).

Third, according to Bems et al. (2013) and others the trade collapse can be primarily viewed as a response to a large negative aggregate demand shock. A decline in aggregate demand in the model of Chaney (2008) would be captured by a decline in output in the exporting country, Y_i, the importing partner, Y_j, or the world, Y. Given the results in equation (10), however, a negative demand shock would not change average exports. In fact, in order for a negative demand shock to increase average exports, aggregate exports would need to decline less than the decline in the number of exporting firms.

A fourth and final hypothesis not captured by the prediction of the Chaney (2008) model is that the Great Recession was a negative demand shock that lead to lower exports but also much lower rates of overall entrepreneurship. The stylized result in equation (10) has the mass of entrepreneurs, $\xi_i w_i L_i$, having the same effect on the number of exporters and aggregate sales. It is possible to imagine that the Great Recession reduced total exports via a negative shock to income in the U.S. or abroad and also separately reduced new business formation. Even if the same fraction of new businesses become exporters, a decline in the overall rate of new business formation, as documented in Siemer (2016), might result in a decline in the number of exporters more than a decline in aggregate exports. This would match the evolution of the data highlighted in the counterfactual exercises.

VI. Conclusion

In this study, we have considered the effect of the Great Recession on the extensive margin of U.S. firm-level exports. We find evidence of substantial exits and a decline in entries during these years. This is evident in descriptive analyses as well as regression estimations. By decomposing the log growth in aggregate exports, we find that the drop in entries and spikes in exits were offset by the fact that new entrants into foreign markets tended to be bigger. Thus, while this missing generation of exporters had effects on the variety of goods sold internationally, the effects on aggregate export volumes were more muted.

Despite the sizable literature on the trade collapse during the Great Recession, many 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 further our understanding of the effects of the Great Recession. Because international trade flows have not still returned to trend growth following the first major shock to worldwide trade, such analyses would be valuable for central bank economists, elected officials, and academics alike.

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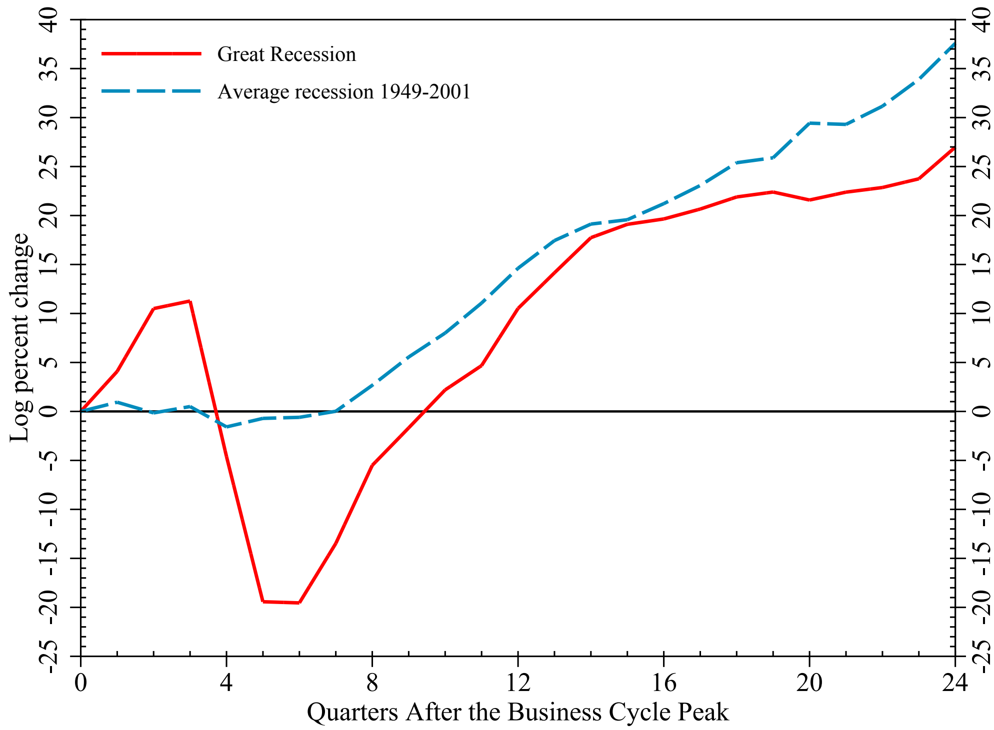
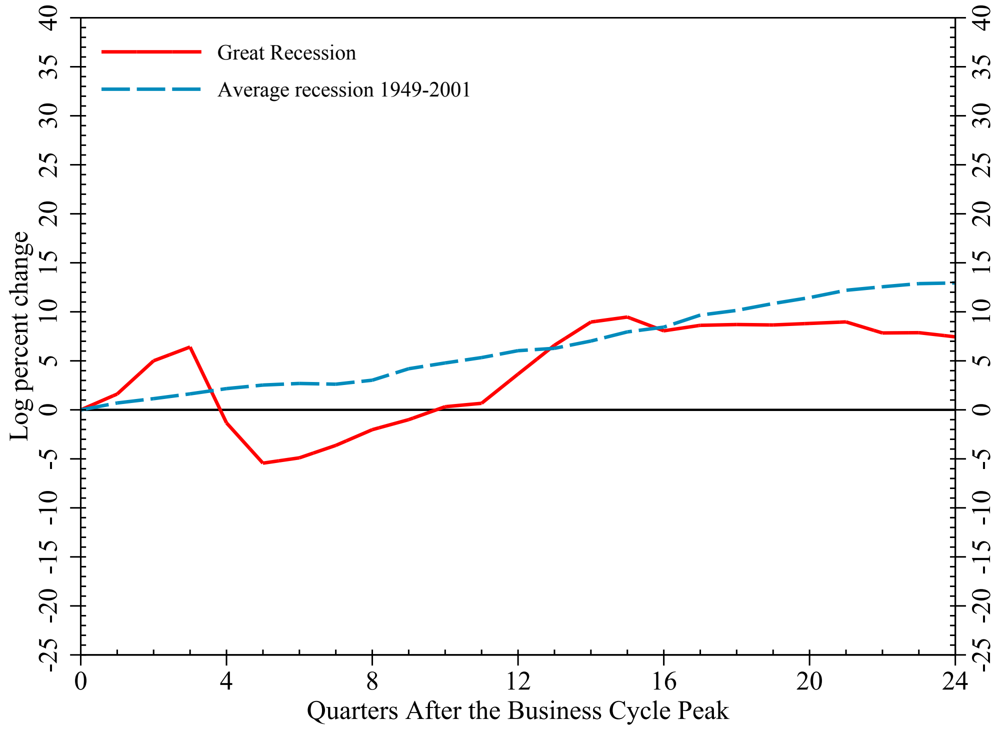
A. Aggregate Exports

Figure 7: Nominal Goods Exports
(Log percent change since peak)



Notes: The growth of nominal exports following the Great Recession was about 10 percentage points lower than after the average recession. In fact, 24 quarters after the most recent business cycle peak, nominal goods exports were only 27 percent higher after 24 months as opposed to an average of 37.6 percent higher after past recessions.

Figure 8: Goods Exports Prices
(Log percent change since peak)



Notes: Prices for exported goods declined 5 percent before rising almost 10 percent about 14 quarters after the peak of the most recent business cycle. 24 quarters after the peak before the Great Recession, however, goods exports prices have increased by about 7.5 percent, which is about 5.5 percentage points less than after the average recession.

B. Log Export Growth Decomposition

Intensive, entry, and exit margins

In this section, we present an exact decomposition of total export growth inspired by Di Giovanni et al. (2014). The log-difference growth rate of total exports over h years, g_t^h, can be decomposed into these margins as

$$\begin{aligned} g_t^h &\equiv \ln(X_t) - \ln(X_{t-h}) \qquad (11) \\ &= \ln\left(\frac{\sum_{i\in I_{t\cap t-h}} X_{it}}{\sum_{i\in I_{t\cap t-h}} X_{it-h}}\right) + \ln\left(\frac{\sum_{i\in I_t} X_{it}}{\sum_{i\in I_{t\cap t-h}} X_{it}}\right) - \ln\left(\frac{\sum_{i\in I_{t-h}} X_{it-h}}{\sum_{i\in I_{t\cap t-h}} X_{it-h}}\right) \\ &= \underbrace{\ln\left(\frac{\sum_{i\in I_{t\cap t-h}} X_{it}}{\sum_{i\in I_{t\cap t-h}} X_{it-h}}\right)}_{i_t^h=\text{intensive margin}} + \underbrace{\underbrace{\ln\left(1+\frac{\sum_{i\in I_{t\setminus t-h}} X_{it}}{\sum_{i\in I_{t\cap t-h}} X_{it}}\right)}_{e_t^h=\text{entry margin}} - \underbrace{\ln\left(1+\frac{\sum_{i\in I_{t-h\setminus t}} X_{it-h}}{\sum_{i\in I_{t\cap t-h}} X_{it-h}}\right)}_{x_t^h=\text{exit margin}}}_{n_t^h=\text{net extensive margin}} \end{aligned}$$

in which I_t is the set of firms that export in year t and $I_{t\cap t-h}$ is the set of firms that export in both years t and $t-h$, which we can define formally as the intersection

$I_{t\cap t-h}=\{i:i\in I_t, i\in I_{t-h}\}$. Using this notation, we define $N_t\left(I_t\right)$ as the number of exporting firms in year t, while $\bar{X}_t\left(I_t\right)$ denotes average exports per firm in year t. Likewise, $N_t\left(I_{t\cap t-h}\right)$ is the number of firms that export in both years t and $t-h$ and $\bar{X}_t\left(I_{t\cap t-h}\right)$ denotes average exports per incumbent firm in year t. The contribution to total growth over h years from the intensive margin, i_t^h, in year t is defined as the log growth of exports by firms that exported in both year t and in year $t-h$. We define the contribution from the entry margin, e_t^h, as the contribution to total export growth of firms that export in period t but did not export in period $t-h$. Similarly, we define the exit margin, x_t^h, as the contribution to export growth of firms that exported in year $t-h$ but did not export in t. As expected, entrants add to total growth while exiters subtract from it. In this way, the entry and exit margins are individually gross contributions to growth that together determine the net effect of entry and exit, hence the name "net extensive margin." Prior work, including Gopinath and Neiman (2014) and Kamal and Krizan (2012), has considered related decompositions.

Five-term decomposition

We further decompose total export growth using the fact that exports for any subset of firms can be written as the product of the number of firms and average exports per firm in the relevant subset. For example, total exports can be written as $\sum_{i\in I_t} X_{it}\equiv N_t\left(I_t\right)\bar{X}_t\left(I_t\right)$ and exports by incumbents can be written as $\sum_{i\in I_{t\cap t-h}} X_{it}\equiv N_t\left(I_{t\cap t-h}\right)\bar{X}_t\left(I_{t\cap t-h}\right)$. Starting with the log growth contributions from formula (11), we can decompose these further into changes in the number and average exports per firm as follows:

$$\begin{aligned}\underbrace{g_t^h}_{\text{total growth}} &= \ln\left(\frac{\sum_{i\in I_{t\cap t-h}} X_{it}}{\sum_{i\in I_{t\cap t-h}} X_{it-h}}\right)+\ln\left(\frac{\sum_{i\in I_t} X_{it}}{\sum_{i\in I_{t\cap t-h}} X_{it}}\right)-\ln\left(\frac{\sum_{i\in I_{t-h}} X_{it-h}}{\sum_{i\in I_{t\cap t-h}} X_{it-h}}\right)\\ &= \underbrace{\ln\left(\frac{\bar{X}_t\left(I_{t\cap t-h}\right)}{\bar{X}_{t-h}\left(I_{t\cap t-h}\right)}\right)}_{i_t^h=\text{intensive margin}}+\underbrace{\ln\left(\frac{N_t\left(I_t\right)}{N_t\left(I_{t\cap t-h}\right)}\right)}_{ee_t^h=\text{entry extensive margin}}\\ &+\underbrace{\ln\left(\frac{\bar{X}_t\left(I_t\right)}{\bar{X}_t\left(I_{t\cap t-h}\right)}\right)}_{ei_t^h=\text{entry intensive}}-\underbrace{\ln\left(\frac{N_{t-h}\left(I_{t-h}\right)}{N_{t-h}\left(I_{t\cap t-h}\right)}\right)}_{xe_t^h=\text{exit extensive}}-\underbrace{\ln\left(\frac{\bar{X}_{t-h}\left(I_{t-h}\right)}{\bar{X}_{t-h}\left(I_{t\cap t-h}\right)}\right)}_{xi_t^h=\text{exit intensive}}\end{aligned} \quad (12)$$

Writing the expression using symbols for each margin gives

$$\underbrace{g_t^h}_{\text{total growth}}=\underbrace{i_t^h}_{\text{intensive}}+\underbrace{ee_t^h}_{\text{entry extensive}}+\underbrace{ei_t^h}_{\text{entry intensive}}-\underbrace{xe_t^h}_{\text{exit extensive}}-\underbrace{xi_t^h}_{\text{exit intensive}} \quad (13)$$

This five-term decomposition includes the definition for average exports of firms in year t as $\bar{X}_t\left(I_t\right)$, average exports in year $t-h$ as $\bar{X}_{t-h}\left(I_{t-h}\right)$, and average exports of firms in year t that export in both years as $\bar{X}_t\left(I_{t\cap t-h}\right)$. Similarly, $\bar{X}_{t-h}\left(I_{t\cap t-h}\right)$ is the average exports in year $t-h$ of firms that export in both year t and in year $t-h$. The number of firms that export are defined in comparable ways with $N_t\left(I_t\right)$, with the number that exported in year $t-h$ being $N_{t-h}\left(I_{t-h}\right)$. Additionally, the number that export in both years is given by

$N_t\left(I_{t\cap t-h}\right)$. By definition, the number of firms in t that exported in both years is the same as the number that export in $t-h$ so $N_t\left(I_{t\cap t-h}\right) = N_{t-h}\left(I_{t\cap t-h}\right)$. As such, the only way the intensive margin contributes to total growth is by growth in average exports of firms that export in both t and $t-h$.

C. Additional Decompositions

Table 8: Real Export Log-Growth Decomposition 2008 to 2014

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 6$
Total growth	2.35	4.10	4.32	4.33	4.10	2.35
Intensive margin	3.04	4.90	5.11	5.10	4.77	3.00
Net extensive	-0.68	-0.77	-0.78	-0.73	-0.67	-0.65
Entry margin	2.42	2.27	2.22	2.14	2.02	1.90
- extensive	36.22	23.36	18.48	15.77	13.84	12.26
- intensive	-33.80	-21.09	-16.26	-13.63	-11.82	-10.36
Exit margin	-3.10	-3.03	-3.00	-2.87	-2.70	-2.55
- extensive	37.12	23.55	18.51	15.80	14.03	13.16
- intensive	-34.02	-20.52	-15.51	-12.93	-11.34	-10.62

Notes: To ease comparison, we annualized the log growth rates and contributions by dividing each term in equation (4) by h. All exports were deflated using the goods export deflator from the NIPA accounts with 2000 as the base year.

D. Aggregate Exports and the Threshold

Total exports, X_{ij}, in the Chaney (2008) model are presented in proposition 1. The proof of that proposition is in the appendix on page 1718. Note that the proof includes an integral against the productivity PDF and that it states the PDF to be integrated against is $\frac{\varphi^{-\gamma-1}}{\gamma}$. This is a typo. The CDF given in Chaney (2008) equation (3) implies that the PDF must be $dG(\varphi) = \gamma_h \varphi^{-\gamma_h - 1}$. The fact that the correct PDF is $\gamma_h \varphi^{-\gamma_h - 1}$ instead of $\frac{\varphi^{-\gamma-1}}{\gamma}$ is confirmed because integrating against $\frac{\varphi^{-\gamma-1}}{\gamma}$ does not deliver the final expression from his proof. We do not replicate the proof of proposition 1 or rely on this correction here but instead lay out how to write total exports as a function of the threshold productivity $\bar{\varphi}_{ij}$. In these derivations, we abstract from having many differentiated goods sectors and therefore suppress sector h subscripts. First, using the threshold from Chaney (2008) equation (9) write

$$
\begin{aligned}
\bar{\varphi}_{ij} &= \lambda_4 \times \left(\frac{Y}{Y_j}\right)^{1/\gamma} \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right) \times f_{ij}^{1/(\sigma-1)} \\
\frac{\bar{\varphi}_{ij}}{\lambda_4} &= \left(\frac{Y}{Y_j}\right)^{1/\gamma} \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right) \times f_{ij}^{1/(\sigma-1)} \\
\left(\frac{\bar{\varphi}_{ij}}{\lambda_4}\right)^{-\gamma} &= \left(\frac{Y}{Y_j}\right)^{-1} \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right)^{-\gamma} \times f_{ij}^{-\gamma/(\sigma-1)} \\
\xi_i \mu Y_i \left(\frac{\bar{\varphi}_{ij}}{\lambda_4}\right)^{-\gamma} f_{ij} &= \xi_i \mu Y_i \left(\frac{Y_j}{Y}\right) \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right)^{-\gamma} \times f_{ij}^{-\gamma/(\sigma-1)} f_{ij} \\
\xi_i \mu Y_i \bar{\varphi}_{ij}^{-\gamma} \lambda_4^{\gamma} f_{ij} &= \xi_i \mu \times \frac{Y_i Y_j}{Y} \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right)^{-\gamma} \times f_{ij}^{-\left(\frac{\gamma}{\sigma-1} - 1\right)} \qquad (14)
\end{aligned}
$$

Next, we will use the definition of λ_5 from equation (9) on page 1713 of Chaney (2008) and also the definition of λ_4 from footnote 11 on page 1714, namely

$$
\frac{1}{1+\lambda_5} = \frac{w_i L_i}{Y_i}
$$

$$
\lambda_4 = \left[\frac{\sigma}{\mu} \times \frac{\gamma}{\gamma - (\sigma-1)} \times \frac{1}{1+\lambda_5}\right]^{1/\gamma}
$$

We can use these two definitions to rewrite the left hand side of equation (14) as

$$
\begin{aligned}
\xi_i \mu Y_i \bar{\varphi}_{ij}^{-\gamma} \lambda_4^{\gamma} f_{ij} &= \xi_i \mu Y_i \bar{\varphi}_{ij}^{-\gamma} \frac{\sigma}{\mu} \times \frac{\gamma}{\gamma - (\sigma-1)} \times \frac{1}{1+\lambda_5} f_{ij} \\
&= \xi_i \mu Y_i \bar{\varphi}_{ij}^{-\gamma} \frac{\sigma}{\mu} \times \frac{\gamma}{\gamma - (\sigma-1)} \times \frac{w_i L_i}{Y_i} f_{ij} \\
&= \xi_i w_i L_i \left(\frac{\sigma\gamma}{\gamma - (\sigma-1)}\right) f_{ij} \bar{\varphi}_{ij}^{-\gamma}
\end{aligned}
$$

Combining this with our original manipulation of the threshold given in equation (14) we can write

$$\begin{aligned}
\xi_i \mu Y_i \bar{\varphi}_{ij}^{-\gamma} \lambda_4^{\gamma} f_{ij} &= \xi_i \mu \times \frac{Y_i Y_j}{Y} \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right)^{-\gamma} \times f_{ij}^{-\left(\frac{\gamma}{\sigma-1}-1\right)} \\
\xi_i w_i L_i \left(\frac{\sigma\gamma}{\gamma-(\sigma-1)}\right) f_{ij} \bar{\varphi}_{ij}^{-\gamma} &= \xi_i \mu \times \frac{Y_i Y_j}{Y} \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right)^{-\gamma} \times f_{ij}^{-\left(\frac{\gamma}{\sigma-1}-1\right)}
\end{aligned}$$

Substituting this into total exports from proposition 1 gives

$$\begin{aligned}
X_{ij} &= \xi_i \mu \times \frac{Y_i Y_j}{Y} \times \left(\frac{w_i \tau_{ij}}{\theta_j}\right)^{-\gamma} \times f_{ij}^{-\left(\frac{\gamma}{\sigma-1}-1\right)} \\
&= \xi_i w_i L_i \left(\frac{\sigma\gamma}{\gamma-(\sigma-1)}\right) f_{ij} \bar{\varphi}_{ij}^{-\gamma}
\end{aligned}$$

And we have shown how to express total exports as we do in equation (10) of the main text.

Table 9: Export Participation and Recessions

	Dependent variable: $y_{it} = \{0, 1\}$			
	(1)	(2)	(3)	(4)
Exported last year (y_{it-1})	17.14***	17.14***	16.19***	16.19***
	(0.04)	(0.04)	(0.04)	(0.04)
Exported two years ago (y_{it-2})			5.22***	5.23***
			(0.04)	(0.04)
Recession × exported	−0.64***	−0.69***	−0.24***	−0.29***
last year ($r_t \times y_{it-1}$)	(0.07)	(0.07)	(0.08)	(0.08)
Recession × exported			−0.74***	−0.77***
two years ago ($r_t \times y_{it-2}$)			(0.08)	(0.09)
Log employment (x_{1it})	7.07***	7.07***	6.86***	6.86***
	(0.03)	(0.03)	(0.03)	(0.03)
Log average wages (x_{2it})	4.19***	4.15***	4.09***	4.05***
	(0.03)	(0.03)	(0.03)	(0.03)
Firm age (x_{3it})	0.32	0.33	0.28	0.29
	(219.8)	(219.8)	(219.5)	(219.5)
Recession × log		0.00		0.02
employment ($r_t \times x_{1it}$)		(0.02)		(0.02)
graetRecession × log		0.21***		0.23***
average wages ($r_t \times x_{2it}$)		(0.04)		(0.04)
Recession × age ($r_t \times x_{3it}$)		−0.01***		−0.01***
		(0.00)		(0.00)
Year FE (φ_t)	Yes	Yes	Yes	Yes
Firm FE (φ_i)	Yes	Yes	Yes	Yes
R^2 (percent)	53.1	53.1	53.2	53.2
Obs. (millions)	9.47	9.47	9.47	9.47

Notes: The table presents the results from estimating the following equation:

$$y_{it} = \alpha y_{it-1} + \beta r_t \times y_{cit-1} + X'_{it}\gamma + r_t \times X'_{it}\delta + \phi_i + \phi_t + \varepsilon_{it},$$

where $y_{it} = \{0, 1\}$ denotes if firm i exports in year t, r_t is an indicator for U.S. recession in year t, ϕ_i and ϕ_t are firm and year fixed effects, X_{it} is a set of controls, and ε_{it} is the error term. All estimations include 9,471,000 observations (rounded to the nearest 1000 observations for the purposes of disclosure). Throughout, we multiply each coefficient estimate and the associated standard error by 100 for presentation purposes. Standard errors are in parentheses with significance levels denoted by 1% ***, 5% **, and 10% *, respectively.

Table 10: Export Participation and the 2001/Great Recessions

	Dependent variable: $y_{it} = \{0, 1\}$			
	(1)	(2)	(3)	(4)
Exported last year (y_{it-1})	17.14***	17.14***	16.19***	16.19***
	(0.04)	(0.04)	(0.04)	(0.04)
Exported two years ago (y_{it-2})			5.22***	5.22***
			(0.04)	(0.04)
2001 Recession × exported	−0.83***	−0.84***	−0.16	−0.18
last year ($r_{2001,t} \times y_{it-1}$)	(0.11)	(0.12)	(0.14)	(0.14)
2001 Recession × exported			−1.07***	−1.08***
two years ago ($r_{2001,t} \times y_{it-2}$)			(0.14)	(0.14)
Great Recession × exported	−0.55***	−0.63***	−0.28***	−0.33***
last year ($r_{GR,t} \times y_{it-1}$)	(0.08)	(0.08)	(0.1)	(0.1)
Great Recession × exported			−0.58***	−0.62***
two years ago ($r_{GR,t} \times y_{it-2}$)			(0.1)	(0.1)
Log employment (x_{1it})	7.07***	7.07***	6.86***	6.86***
	(0.03)	(0.03)	(0.03)	(0.03)
Log average wages (x_{2it})	4.19***	4.15***	4.09***	4.05***
	(0.03)	(0.03)	(0.03)	(0.03)
Firm age (x_{3it})	0.32	0.33	0.28	0.29
	(219.8)	(219.8)	(219.5)	(219.5)
2001 Recession × log		−0.13***		−0.1***
employment ($r_{2001,t} \times x_{1it}$)		(0.04)		(0.04)
2001 Recession × log		0.39***		0.42***
average wages ($r_{2001,t} \times x_{2it}$)		(0.07)		(0.07)
2001 Recession × firm age ($r_{2001,t} \times x_{3it}$)		0.01*		0.01
		(0.01)		(0.01)
Great Recession × log		0.07***		0.08***
employment ($r_{GR,t} \times x_{1it}$)		(0.03)		(0.03)
Great Recession × log		0.12***		0.13***
average wages ($r_{GR,t} \times x_{2it}$)		(0.05)		(0.05)
Great Recession × firm age ($r_{GR,t} \times x_{3it}$)		−0.02***		−0.02***
		(0.00)		(0.00)
Year FE (φ_t)	Yes	Yes	Yes	Yes
Firm FE (φ_i)	Yes	Yes	Yes	Yes
R^2 (percent)	53.1	53.1	53.2	53.2
Obs. (millions)	9.47	9.47	9.47	9.47

Notes: The table presents the results from estimating the following equation:

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

in which $y_{it} = \{0, 1\}$ denotes if firm i exports in year t, $r_{2001,t}$ is an indicator for 2001 U.S. recession, and $r_{GR,t}$ is an indicator for the Great Recession, ϕ_i and ϕ_{st} are firm and year fixed effects, X_{it} is a set of controls and ε_{it} is the error term. Standard errors are in parentheses with significance levels denoted by 1% ***, 5% **, and 10% *, respectively.

Table 11: Export Participation and GDP Growth

	Dependent variable: $y_{it} = \{0,1\}$			
	(1)	(2)	(3)	(4)
Exported last year (y_{it-1})	16.56***	16.53***	15.75***	15.73***
	(0.05)	(0.05)	(0.05)	(0.05)
Exported two years ago (y_{it-2})			4.78***	4.76***
			(0.05)	(0.05)
$\Delta \log RGDP$ × exported last year ($r_t \times y_{it-1}$)	0.2***	0.21***	0.17***	0.18***
	(0.01)	(0.02)	(0.02)	(0.02)
$\Delta \log RGDP$ × exported two years ago ($r_t \times y_{it-2}$)			0.14***	0.15***
			(0.02)	(0.02)
Log employment (x_{1it})	7.07***	7.1***	6.86***	6.89***
	(0.03)	(0.03)	(0.03)	(0.03)
Log average wages (x_{2it})	4.19***	4.21***	4.09***	4.12***
	(0.03)	(0.04)	(0.03)	(0.04)
Firm age (x_{3it})	0.32	0.31	0.29	0.28
	(219.8)	(219.8)	(219.5)	(219.5)
$\Delta \log RGDP$ × log employment ($r_t \times x_{1it}$)		−0.01***		−0.01***
		(0.00)		(0.00)
$\Delta \log RGDP$ × log average wages ($r_t \times x_{2it}$)		−0.01		−0.01
		(0.01)		(0.01)
$\Delta \log RGDP$ × firm age ($r_t \times x_{3it}$)		0.01***		0.00***
		(0.00)		(0.00)
Year FE (φ_t)	Yes	Yes	Yes	Yes
Firm FE (φ_i)	Yes	Yes	Yes	Yes
R^2 (percent)	53.1	53.2	53.2	53.2
Obs. (millions)	9.47	9.47	9.47	9.47

Notes: The table presents the results from estimating the following equation:

$$y_{it} = \alpha y_{it-1} + \beta \Delta \log RGDP_t \times y_{cit-1} + X'_{it}\gamma + \Delta \log RGDP_t \times X'_{it}\delta + \phi_i + \phi_t + \varepsilon_{it},$$

where $y_{it} = \{0,1\}$ denotes if firm i exports in year t, $\Delta \log RGDP_t$ is U.S. real GDP growth in year t, ϕ_i and ϕ_t are firm and year fixed effects, X_{it} is a set of controls, and ε_{it} is the error term. All estimations include 9,471,000 observations (rounded to the nearest 1,000 observations for the purposes of disclosure). Standard errors are in parentheses, with significance levels denoted by 1% ***, 5% **, and 10% *, respectively.