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Working Paper 19865
<http://www.nber.org/papers/w19865>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 2014

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NBER Working Paper No. 19865
January 2014
JEL No. C81,D22,F14,L11

ABSTRACT

Two otherwise identical firms that enter the same market in different months, one in January and one in December, will report dramatically different annual sales for the first calendar year of operations. This partial year effect in annual data leads to downward biased observations of the level of activity upon entry and upward biased growth rates between the year of entry and the following year. This paper examines the implications of partial year effects using Peruvian export data. The partial year bias is very large: the average level of first-year exports of new exporters is understated by 65 percent and the average growth rate between the first and second year of exporting is overstated by 112 percentage points. This paper re-examines a number of stylized facts about firm size and growth that have motivated rapidly expanding theoretical and empirical literatures on firm export dynamics. Correcting the partial year effect eliminates unusually high growth rates in the first year of exporting, raises initial export levels, and shifts 10 percent of market entrants from below to above the median size. Revisiting an older set of facts on firm size and growth, the paper finds that correcting for partial year biases reduces the number of small firms in the firm size distribution and weakens the negative relationship between firm growth and firm size.

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1 Introduction

The past two decades have seen an explosion of research on the microeconomic determinants of exporting and the complicated relationship between participating in foreign markets and firm performance. This new perspective on international trade has been fostered by access to increasingly detailed data, starting with census data on whether or not an establishment, or firm, exports in a given year, and continuing with panel data at the transaction level from individual customs records with information on exports at the level of the firm-product-destination-year. The most recent round of research is now matching individual sellers to individual buyers by destination, product and year.¹ A growing literature, both empirical and theoretical, is considering the firm-level evolution and dynamics of exports over time by examining the process of entry and growth.

This paper focuses on one specific issue that touches on most of the existing empirical work on export entry and performance and suggests caution when approaching the disaggregated data. The concept is quite simple, almost trivial, yet the implications for the existing stylized facts on export levels and growth rates are profound. Consider two otherwise identical firms that enter the same market in different months, one in January and one in December. These two firms, starting at the same initial size and growing at the same rate per month, will report dramatically different annual sales for the first calendar year of operations. The January entrant will record a full 12 months of sales and its growth rate from its first to second year will reflect the true underlying annual growth rate of the firm in the market. The December entrant, in contrast, will only record one month of sales for its first year so the calendar, or annual sales, of the December firm will be biased downwards relative to its actual sales during its first year in the market. Similarly the recorded first year growth rate of the December firm will be biased upwards as one month of sales will be compared to as many as 12 months of sales in the second calendar year.

This “partial year” effect contaminates all the statistics about market entrants that depend on the first year of activity. For example, the average level of exports for entering firms will contain a downward bias, depending on the distribution of entry months over the year, and the average first year growth rate of entrants will be biased upward. Measures that flow from these averages will, in turn, contain the same bias. There is, of course, a comparable bias in the last year of exporting when the firm totals are based on calendar years. Exiting firms will appear to have annual sales that are lower than the total for their last 12 months of operations and their growth rates just before exit will be biased downward.

This partial year effect in annual data has the potential to lead to large downward biased observations of level of activity upon entry as well as to large upward biased growth rates between the year of entry and the following year. This paper examines the implications of partial year effects

¹See Blum, Claro, and Horstmann (2011), Eaton, Eslava, Jenkins, Krizan, and Tybout (2012), Bernard, Moxnes, and Ulltveit-Moe (2013), and Carballo, Ottaviano, and Martinicus (2013).

using transaction-level export data on Peruvian exports from 1992-2009. The partial year bias is found to be very large, causing the level of first-year exports of all new exporters to be understated by 65 percent on average and overstating the average growth rate between the first and second year of exporting by 112 percentage points. Similar partial year effects are found in the year of exit from the market.

Empirical work using annual firm-level export data by Eaton, Eslava, Kugler, and Tybout (2008) and others has documented a set of strong empirical regularities about the performance of exporters over time. These regularities include the fact that new market entrants, either new exporters or continuing exporters in new markets, have small levels of exports upon entry, a large fraction of entrants export for only a single year before exiting the market, and surviving entrants have extremely rapid export growth between years one and two with more modest growth rates subsequently. These facts have been taken as evidence against models of high sunk costs of entry into export markets as in Roberts and Tybout (1997) and have generated a growing literature on learning and experimentation in export markets.

Correcting for the partial year bias in the calendar year exports of new market entrants eliminates or dramatically mitigates most of these stylized facts. Surviving new entrants still have smaller initial levels than ongoing exporters but on average their adjusted first year sales are increased by more than 76 percent. Surviving entrants have adjusted exports in their first year that are 160 percent greater than those recorded in the annual data.² Extremely rapid growth rates in the first year of exporting, average rates well over 100 percent are typical, are completely eliminated for surviving entrants. Growth rates in the first year are no different on average from those in subsequent years after adjusting for the month of entry.³

In addition, we examine the implications of the partial year bias for an older set of facts on firm size and growth that have been the focus of substantial research in industrial organization. A large fraction of firms are new to the market in each year; from 1994 to 2007, 45.8 percent of Peruvian exporters were new to the US market each year. New entrants are a sizable fraction of firms even in developed economies. Over the same period, an average of 10.5 percent of active US firms (513,000) began operations each year. Correcting for partial year biases increases the average size of new entrants into exporting, reduces the number of small firms in the market, and shifts the overall structure of the firm size distribution of exporters. More than 10 percent of new Peruvian exporters move from below to above the median firm size after adjusting for the partial year bias with commensurate adjustments to their first year growth rates. The adjustments also weaken the negative relationships between firm growth and its variance and firm size as the level and dispersion of growth rates for the smallest quintile of market participants are reduced.

²These results are for new exporters that survive for at least three years.

³Firm exit rates remain very high for new entrants in export markets.

The empirical approach of this paper is heavily influenced by Arkolakis (2011) who develops an analytical framework to study firm and export growth and evaluates the model by comparing results of calibration exercises with the growth of sales of US firms as well as with Brazilian export sales to the US. His argument that the same processes are at work within an economy and in export markets as firms search for customers motivates us to use export data to analyze the impact of partial years for new entrants in a market.

The characteristics and performance of new exporters

The empirical literature on the dynamics of firm-level exports was initiated by the work of Eaton, Eslava, Kugler, and Tybout (2008) on Colombian exporters. Eaton, Eslava, Kugler, and Tybout (2008) set out to generate a new set of stylized facts on export dynamics and destination-specific flows for the same set of producers using annual trade transaction data for Colombian firms. In the abstract to the paper, they state “that nearly half of all Colombian exporters were not exporters in the previous year. These new exporters tend to be extremely small in terms of their overall contribution to export revenues, and most do not continue exporting in the following year.... Nonetheless, out of each cohort of new exporters, a fraction of firms go on to expand their foreign sales very rapidly...” Empirical work on annual firm-level export data that confirms some or all of these facts for other countries includes Lawless (2009) for Irish exporters and Buono and Fadinger (2012) for French exporters.

These stylized facts in turn have been used and extended by others to motivate dynamic models of exporting and learning. In Albornoz, Pardo, Corcos, and Ornelas (2012), firms experiment in a market to learn about export profitability and then expand to new destinations. In their empirical work on Argentine exporters, they confirm the small size, low survival and rapid growth of new exporters. They report that growth rates between the first and second years in a market range from 104 to 190 percent. In every case, they find that second year growth rates in export markets are much lower and are not substantially different from growth rates in subsequent years.

Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) develop a model of search and learning to explain the dynamic pattern of entry and survival by Colombian exporters and to differentiate between the costs of finding new buyers and maintaining relationships with existing ones. Aeberhardt, Buono, and Fadinger (2012) and Araujo, Mion, and Ornelas (2012) model exporter dynamics in the context of contracting, learning and institutional quality, again confirming the small size upon entry of new exporters and their subsequent rapid growth conditional on survival, using annual firm-level French and Belgian data, respectively.

Akhmetova and Mitaritonna (2012) develop a model of experimentation and learning to explain the fact that new exporters exhibit different patterns in a given market than old exporters. They emphasize the facts of Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) for Colombia and Eaton,

Kortum, and Kramarz (2011) for France - many new exporters ship very small quantities and surviving exporters expand rapidly.

Timoshenko (2013) focuses on a different dimension of exporter behavior, the margin of product switching. A model of learning by exporters in new markets is motivated by the fact that Brazilian exporters in their second year in the market have disproportionately greater shares of sales from new products and greater shares of new products in their product mix. Partial year effects potentially play a role in these stylized facts as well, understating the number of products sold abroad in the first year of exporting and in turn overstating the growth in number of exported products and their share in sales between years one and two.⁴

Extensive margins in trade

A related body of work has been attempting to understand the underlying sources of aggregate export growth and the importance of the extensive margins of trade. These extensive margins include new exporters and new destinations and products by existing exporters. Typically annual export growth is decomposed into the contribution of these extensive margins and the intensive margin, i.e. the change of sales of existing products by continuing exporters to previous destinations. Bernard, Jensen, Redding, and Schott (2009) find that the annual variation in aggregate trade is dominated by the intensive margin. The small role for the extensive margin is due primarily to the small size of new entrants relative to incumbents. Related analyses have been conducted by Lawless (2009) (Ireland); Amiti and Freund (2010) (China); Van Beveren, Bernard, and Vandebussche (2012) (Belgium); and Cebeci and Fernandes (2013) (Turkey). The conclusion in all these papers that new exporters, new export destinations and newly exported products contribute only a small fraction to overall annual export growth is subject to potential downward bias from partial year effects.

Firm size distribution

Beyond the literature on export dynamics, the issues raised in this paper relate to the extensive body of work on the firm size distribution as exemplified by Axtell (2001) and Luttmer (2007) for the domestic economy and by Eaton, Kortum, and Kramarz (2011) for exporters by destination market.⁵ All of these papers, and many others, find that the distributions of sales, or employees, closely approximate a Pareto distribution except in the region with the smallest firms. In every

⁴Freund and Pierola (2010) focus on exporter entry and survival in products not previously exported by Peruvian firms. As most of their analysis is on entry and the duration of export spells it is not directly affected by the partial year effects discussed here. However, it remains unknown how adjusting the date of the firm's export year to reflect the initial month of entry would affect the probability of the frequently observed pattern of entry, exit and subsequent re-entry into the export market.

⁵Related work on firm size and growth includes Evans (1987b,a), Dunne, Roberts, and Samuelson (1989, 1988), Cabral and Mata (2003), and the survey by Sutton (1997).

case, the smallest firms are present in greater numbers than suggested by a pure Pareto distribution. Theoretical models in Luttmer (2007), Arkolakis (2011), and Eaton, Kortum, and Kramarz (2011) all incorporate specific elements to handle the large number of small firms. This general feature of firm size distributions is subject to bias if the share of entrants is large, entrants are disproportionately among the smallest firms and their sales or employment only reflect a partial year of activity. Correcting the partial year effect should decrease the share of the smallest firms and may result in firm size distributions that more closely resemble a Pareto.

Arkolakis (2011) develops an analytical framework that integrates aspects of the export dynamics and firm size literatures to study firm and export growth. He compares calibrations of the model both to the growth of sales of US firms as well as to Brazilian exports to the US. Among the stylized facts he uses to motivate and assess the model are the negative relationship between firm size and firm growth rates and their variance, the small size of entrants in a market, the parity of size between entrants and exits, the different distributions of growth rates for large (lognormal) and small (skewed high) exporters, and the relationship between firm growth and firm age conditional on firm size.

A related set of findings focuses on the distribution of growth rates conditional on firm size and age, in particular Cabral and Mata (2003). Arkolakis (2011) shows that the distribution of growth rates for smallest (quartile 1) and largest (quartile 4) Brazilian exporters to the US are starkly different. The distribution of growth rates of the smallest firms is heavily skewed towards higher growth rates while that of the largest firms is approximately lognormal and center around zero. If a large share of entrants is concentrated in the smallest firms, partial year effects may lead to growth rates and their variance being overstated for the smallest firms in the market.

In spite of the potentially pervasive nature of the problem, there has been almost no work examining the degree of bias induced by partial year effects nor any correction in empirical work using firm-level data. In large part this is due to the nature of the data that are available to researchers. Most detailed trade datasets have been aggregated to the exporter-destination-product-year level before being provided to the researchers. Eaton, Kortum, and Kramarz (2011) are typical when they report “All (customs record) data is aggregated first at the monthly level. In the analysis files accessible to researchers, these records are further aggregated by year” However even when the underlying monthly (or daily) data are available, the first step is usually to aggregate the data to the annual level, e.g. Bernard, Jensen, Redding, and Schott (2009). An exception is the recent paper by Berthou and Vicard (2013) who control for the month of entry of exporting in their study of the effect of export experience and export growth for French exporters.⁶

The rest of this paper explores the magnitude of partial year bias in the stylized facts on

⁶Although Berthou and Vicard (2013) do not focus on partial year effects, they report that initial year exports are reduced by 32 percent.

export dynamics and firm size and growth using Peruvian data. The data on Peruvian exports are described in Section 2. Section 3 outlines a simple model of market entry by month and generates benchmark predictions for the bias on firm size and growth. The magnitude of the bias in entry levels and growth rates for surviving exporters is estimated in Section 4. Section 5 examines the importance of partial year effects in estimates of the cross-section firm size distribution and firm growth conditional on firm size. The final section concludes.

2 Data

The data employed in this paper come from Peruvian transaction-level customs data from 1993-2009. The source of the data is SUNAT and it was collected by the Trade and Integration Unit of the World Bank Research Department as part of the effort to build the Exporter Dynamics Database (see Cebeci, Fernandes, Freund, and Pierola (2012)). Although we have daily information on all shipments between years 1992 and 2009, we aggregate the data to the monthly level before any of our analyses. The data have the usual features of transaction-level trade data in that it is possible to create flows of exports by product and destination for all Peruvian exporters. We create two measures of “annual” exports for each firm and each firm-destination in the data. The first measure is a simple aggregation to the calendar year summing across months. This results in an annual data set that is directly comparable to annual firm level export data used by other researchers. The second data set contains annual export data adjusting for the month of entry into the market by the firm.⁷ The first year of exports starts in the month of first entry and runs for the next 11 months. For the same firm and market the second year also starts in the same month.

3 Partial Year Effects - An Example

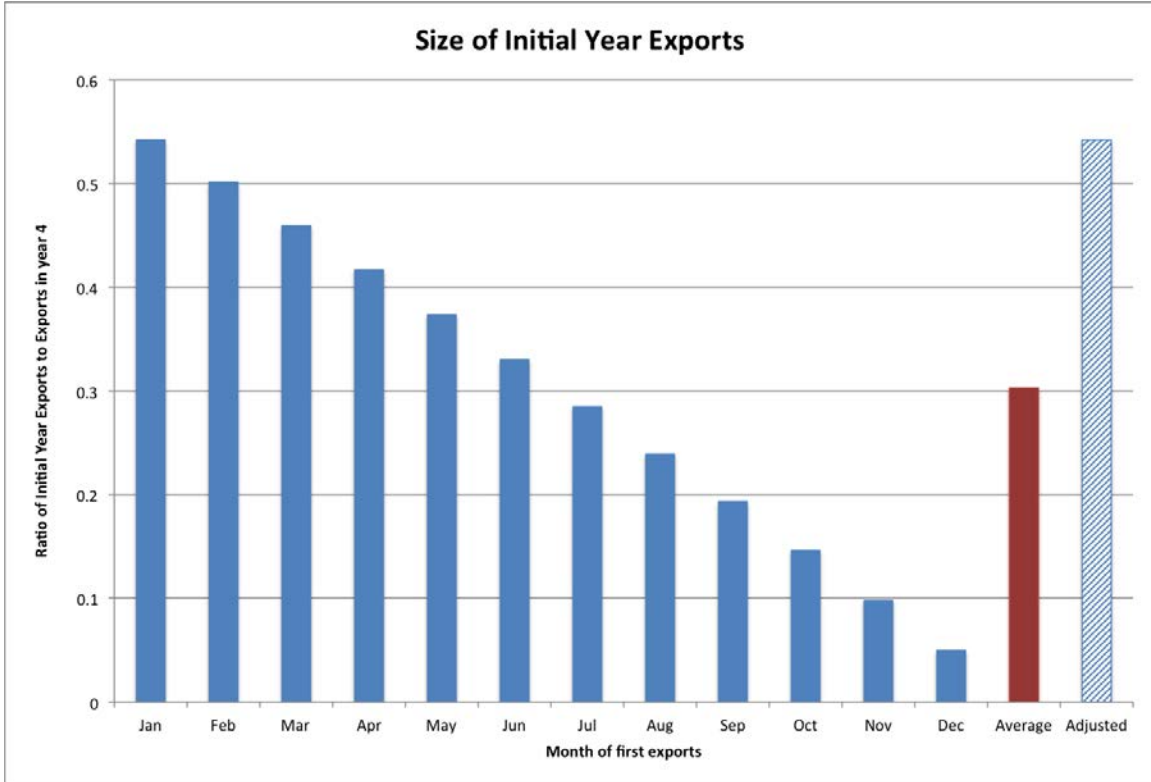
In this section we work through a simple example to demonstrate the potential magnitude of the partial year effect on first year sales and growth in a market. We refer to export sales and output interchangeably throughout this section as the partial year effects will distort both revenue and quantity-based measures of sales. In the subsequent empirical work, we use revenue based measures of exports.

We assume that firms enter the market uniformly across months during the year with identical initial exports. All firms subsequently grow at 22.6 percent per year corresponding to a 1.715 percent compound monthly growth rate and firms do not exit.⁸ The firms that enter in January will record

⁷The market can be a particular export destination or the export market in general. The month of entry will typically differ for a firm across markets and the annual exports will be adjusted correspondingly.

⁸Table 1 shows that the uniform entry assumption is not a bad approximation for the distribution of Peruvian export entrants across months. The growth rate number is designed to match the Peruvian export data on surviving exporters. The assumption of no exits from the market is clearly at odds with the firm-level evidence on new exporters. However, this assumption is useful to facilitate comparisons with growth rates of surviving entrants.

Figure 1: Partial Year Effects and Initial Export Levels - An Example

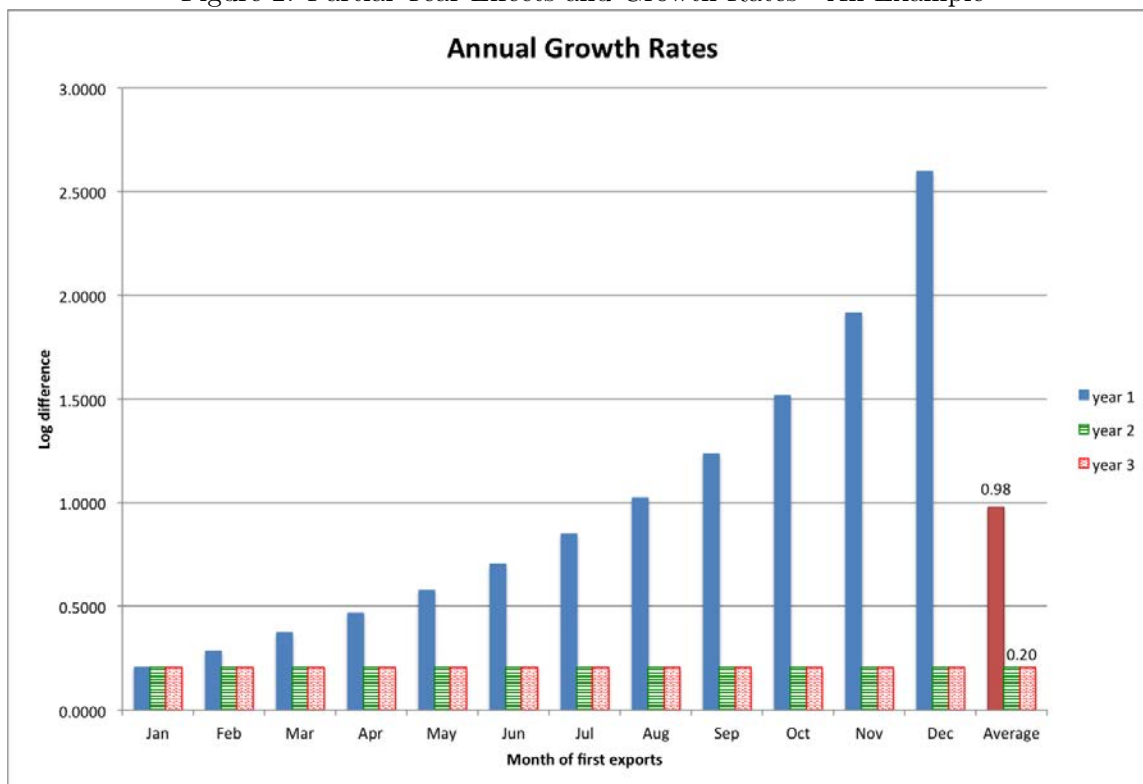


Note: Firms are assumed to be identical except for their month of entry. Firms enter uniformly across months, i.e 1/12th enter in each month. Each firm grows at 22.6 percent per year, corresponding to a 1.715 compound monthly growth rate. All firms survive and the displayed numbers correspond to the ratio of initial year sales to sales in year 4 for firms entering in that month, the calendar year average across all firms and the average adjusting for month of entry. *Average* assumes firms enter uniformly across months, i.e 1/12th enter in each month.

a full year’s initial exports and grow between year 1 and year 2 at 22.6 percent with or without a correction for the initial month of exporting. For all other firms, the reduced number of months in the initial calendar year will mean that the exports recorded in annual, calendar year data will cover only a fraction of the firm’s first year of exporting. This partial year coverage will result in a downward bias in the firm’s recorded first year exports and an upward bias for its first year export growth.

Correcting for the initial month of entry will give every firm the same level of initial exports and the same 22.6 percent year on year growth for all years. Throughout the analysis we compute adjusted/corrected first year exports for a firm that enters the market in year t month m as the sum of exports from month m year t through month $m - 1$ in year $t + 1$. Adjusted exports for subsequent year are calculated in a similar fashion, e.g. year 2 exports for the same firm cover all months between month m in year $t + 1$ through month $m - 1$ in year $t + 2$.

Figure 2: Partial Year Effects and Growth Rates - An Example



Note: Firms are assumed to be identical except for their month of entry. Each firm grows at 22.6 percent per year, corresponding to a 1.715 compound monthly growth rate. All firms survive and the displayed growth rates are the annual differences in log total sales, i.e log exports in year 2 minus log exports in year 1. Adjusted for the month of entry, firm sales grow at a constant rate corresponding to a log difference of 0.20. *Average* assumes firms enter uniformly across months, i.e 1/12th enter in each month.

The results of the simple exercise are best seen in Figures 1 and 2. First year levels of exports are shown in Figure 1 normalized relative to exports for the firm in year 4. The variation across months is large, first year exports are 54.2 percent of year 4 exports for firms that enter the market in January but only 5.0 percent for firms that enter in December. The unadjusted average across all months of entry is 30.3 percent. Adjusting exports to reflect the initial month of exporting raises the ratio to 54.2 percent for all firms. Average annual initial export size is 76 percent higher after correcting for the partial year bias.

Figure 2 shows the results for growth rates expressed in log differences. January entrants record the expected constant growth rate of 20 log points, or 22.6 percent, in every year. Without adjusting for the month of entry, average export growth varies systematically according to the month of entry. The calendar year growth rate for firms entering in December is over 1200 percent. Across all months of entry, the average growth of firms between their first and second year in the market measured using calendar year data is 98 log points or 166 percent. In fact, all these firms are actually growing

at 22.6 percent per year in every year. Using annual calendar exports will overstate the first year growth rate of survivors by more than a factor of 7. Variation in entry across the year will affect these results; entry concentrated in earlier months will reduce the partial year bias while more entry later in the year will exacerbate the effect.

The implications of this form of partial year bias extend to the overall size distribution of firms in the market and the relationship between firm size and growth. Using the assumptions of the example above, the first year size of new entrants is underestimated on average by 80 percent. This will cause the number of small firms to be overestimated and will lead to a corresponding distortion in the firm size distribution. Of course the extent of the bias in the firm size distribution depends on the share of new entrants in the overall number of firms but the potential magnitudes are large: in Peru more than 45 percent of firms are new to exporting each year, while in the US more than 10 percent of firms are new to the domestic market in each year.⁹ In addition, the bias can affect attempts to understand the relationship between firm size and firm growth. Entrants are disproportionately small in the unadjusted data and thus the growth rates of the smallest firms is likely to be subject to greater overstatement.¹⁰

3.1 Bias Approximation

In Table 1, we report the distribution of new Peruvian exporters across months based on their first month of exporting. There is some systematic variation over months; March, April and June have higher shares of entrants while May, July and December have lower shares. However, the monthly averages are reasonably close to what would be expected if entry were uniform across days during the year. This finding suggests both that partial-year bias is likely to be important in the Peruvian export data and that for aggregate or market-specific measures of exporting a relatively simple adjustment might be possible.

The relationship between the firm's exports in its first full year in the market, X_s^{true} , and the observed first year exports, X_s^{obs} , is given by $X_s^{true} = \theta_s X_s^{obs}$, where s is the month of entry into exporting. The adjustment factor for the levels of exports in the first year for each month of an entering cohort is

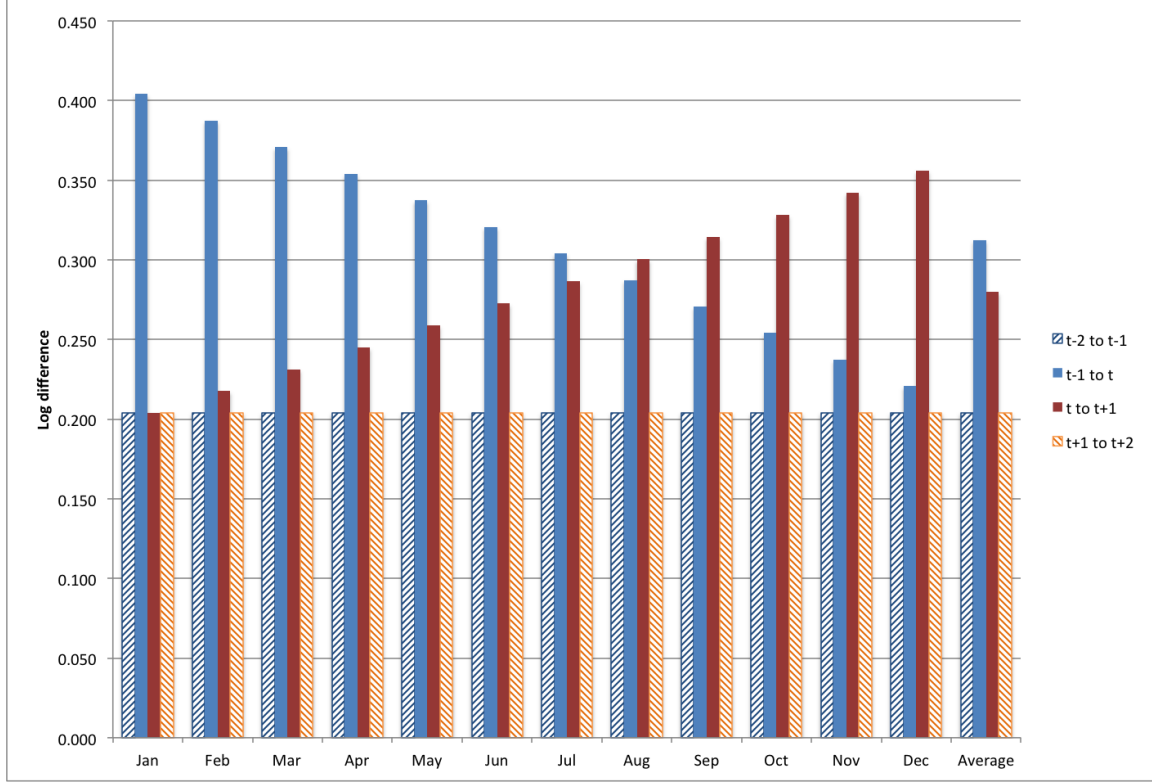
$$\theta_s = \frac{1 - r^{12}}{1 - r^{13-s}}$$

where r is a common constant compound monthly growth rate and average entry levels across months are assumed to be identical. We can also sign the partial year bias in log difference growth

⁹The US numbers are the average share of entrants per year from 1994-2007 tabulated by the authors from the Business Dynamics Statistics database, <http://www.census.gov/ces/dataproducts/bds/data.html>.

¹⁰In the raw data, more than 76 percent of the bottom decile of Peruvian exporters to the US are new entrants.

Figure 3: Growth Rates of Domestic+Export Output



Note: Firms are assumed to be identical except for their month of entry into exporting. Domestic and export output for each firm grows at 22.6 percent per year, corresponding to a 1.715 compound monthly growth rate. All firms survive and the displayed growth rates are the annual differences in log total sales, i.e log revenue in year $t+2$ minus log exports in year $t+1$. Adjusted for the month of entry, firm sales grow at a constant rate corresponding to a log difference of 0.204.

rates, $\beta = \Delta \log (X_0^{true}) - \Delta \log (X_0^{obs})$, for a cohort of firms entering the market in year 0 as

$$\beta = \sum_{s=1}^{12} \frac{N^s}{N} \log \left(\frac{r^{13-s} - r^{13-s+12}}{1 - r^{13-s}} \right) - \log \left(\frac{r^{12} - r^{24}}{1 - r^{12}} \right)$$

where N is the total number of entrants and N^s is the number of entrants in month s . If shares of entering firms are constant across months, the bias in log differences can be closely approximated by

$$\beta = 3.3639 - 2.546r$$

for monthly compound growth rates between 0 and 10 percent, $r \in (1.0, 1.1)$.

3.2 Firm Total Revenue Growth

We conclude the theoretical example by showing how the partial year effects in exporting can affect growth rates of total firm output, i.e. output destined for domestic plus export markets.¹¹ All firms are assumed to enter the domestic market with the same size in month 1 of year $t-2$ and their output destined for the domestic market subsequently grows at a constant, identical rate of 1.715 percent per month. Firms start entering the export market in year t with equal numbers entering in each month. As in the previous example, export growth is constant and common across firms and assumed to be equal to output growth in the domestic market. With these assumptions export output is a constant fraction of total output ranging from 15.5 percent for December entrants to 18.1 percent for January entrants.¹²

If calendar years corresponded with the start of exporting, as they do for the January entrants, then growth rates for these firms should be constant except for the year of entry into exporting. The growth rate of total output between year $t-1$ and year t will be twice as large as any other year as the exports are added to domestic sales. With the assumption that exports and domestic sales grow at the same rate, growth rates for earlier periods and subsequent periods should be identical. However, partial year effects bias the total output growth for entrants after January in both the year of entry and in the first year of exporting.

Figure 3 shows the four annual total output growth rates for firms entering in each month. For all firms, the growth rates before entry and after the first year of exporting are identical. Partial year effects bias the measures of total firm growth both between the last year without exports and the year of entry into exporting and between the first and second years in the export market. Except for January entrants, other monthly export cohorts have total output growth rates biased downwards between years $t-1$ and t and growth rates biased upwards between the first and second years in the export market. Firms that enter later in the year show higher growth rates between t and $t+1$ without adjustments for the month of export entry. On average, total output growth in between years $t-1$ and t is biased down by 13.1 percentage points or 36 percent, while total output growth in the first year after the start of exporting is biased up by 7.9 percentage points or 37 percent without partial year adjustments.

The magnitude of the bias in total firm growth depends on the level of domestic sales (the export to sales ratio) upon export entry and the underlying growth of domestic and export outputs.¹³

¹¹We do not have data on total output or domestic output of the exporting Peruvian firms so we cannot take these implications to the data.

¹²Initial domestic sales are assumed to be 300 in month 1 of year $t-2$. Initial export sales are assumed to be 100 in the month of entry in year t . The differences in the export to sales ratios come from the greater size of domestic sales for firms that start exporting later in the year.

¹³We reiterate that partial year effects in total output should appear in measures based on either revenue or quantity.

4 Growth and Levels of Surviving Peruvian Exporters

In this section, we turn our focus to the two main stylized facts from the literature on firm export dynamics: the small levels of exports in the initial year in the market and the very high average growth rate for surviving firms between years one and two. We examine the levels and growth rates of continuing Peruvian exporters using both raw, calendar years (covering twelve months from January through December) and years adjusted for the initial month of exporting (covering twelve months from the first month m of exports in year t through month $m-1$ in year $t+1$).¹⁴ The goal in this section is to estimate the log level of exports for new exporters during their initial years in the market. From the estimated levels, we can calculate the associated growth rates with and without adjusting for partial year effects. Our focus on continuing exporters matches that of the empirical literature on exporter dynamics that explores the growth pattern of surviving exporters.¹⁵

To conduct the exercise we first select a sample of firms with enough data to be able to compare the levels of exports in the initial three years after export entry to export levels in subsequent (non-exit) years. Similarly we examine exports in the final three years of exporting. The sample includes all firms who export for at least four years and have just one change in their export status (entry or exit but not both) for measures of calendar year exports and exports adjusted for the initial month.¹⁶ These criteria mean that firms with gaps in their annual exports (by either method) are excluded, as are all firms who export for brief spells, defined as fewer than 4 consecutive years. The number of firms in the sample is reduced from the overall population of Peruvian exporters because many firms enter and then exit, a large number of firms in the data enter after 2005, and a smaller number of firms have multiple spells of exporting with a gap of at least one calendar year. After limiting our sample in this manner we are left with 2352 firms and 10,580 firm export-years.

For the sample of “continuing” exports we estimate the following regression,

$$\ln Y_{it} = c_i + \sum_{n=0}^2 \delta_{t-n}^{entry} + \sum_{x=1}^3 \delta_{t+x}^{exit} + \delta_t + \varepsilon_{it} \quad (1)$$

where $\ln Y_{it}$ is the log exports of firm i in year t , $\delta_{i,t-n}^{entry}$ is an indicator that equals one if firm i started exporting in year $t-n$, i.e. $Y_{i,t-n-1} = 0$, $Y_{i,t-n} > 0$, and δ_{t+x}^{exit} is an indicator that equals one if the firm stopped exporting in year $t+x$, i.e. $Y_{i,t+x-1} > 0$, $Y_{i,t+x} = 0$. The regression is run on the same set of firms, once using the raw calendar year data and once using the data adjusted for the initial export month. Standard errors are clustered at the firm level.¹⁷

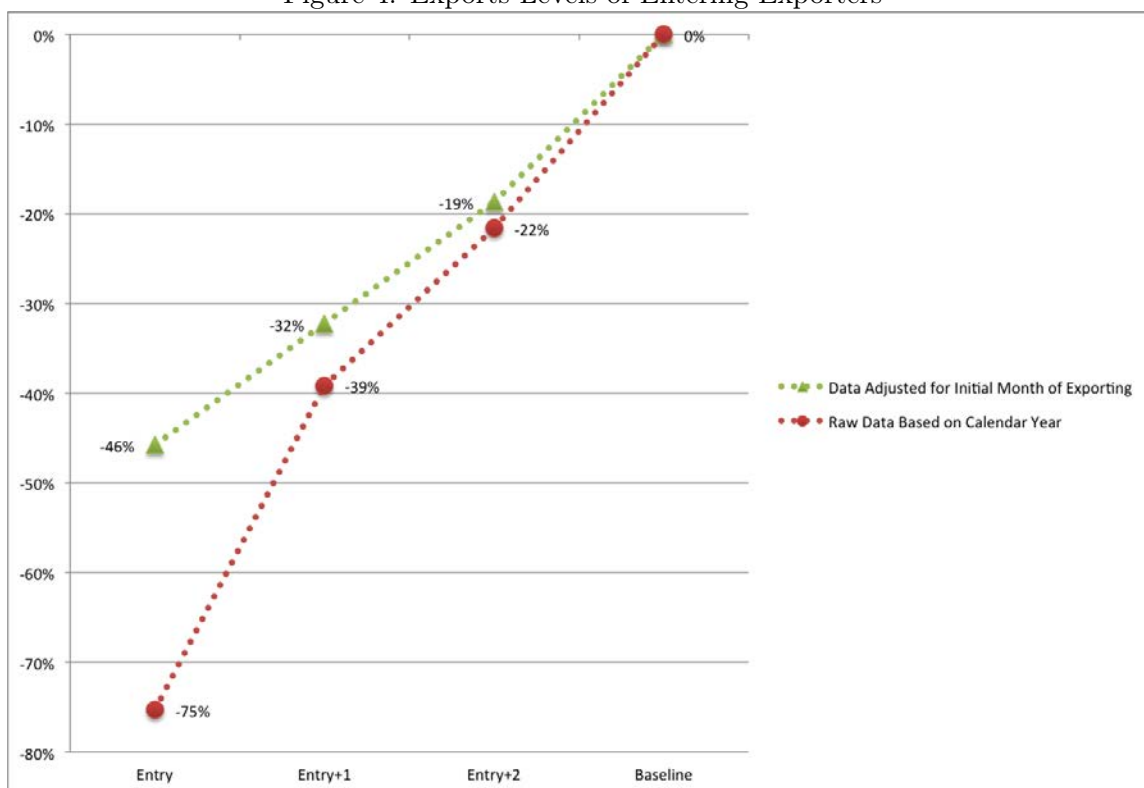
¹⁴We adjust for the final month of exporting in a similar fashion. The last year of exports covers twelve months from month $l+1$ in year $t-1$ through the last month l of exports in year t .

¹⁵We also estimate levels and growth rates for exiting firms in their last years in the market.

¹⁶It is important to make sure there are no 12 months gaps in either the annual calendar data or the data adjusted for initial months as no gaps in one series does not necessarily mean no gaps in the other.

¹⁷This specification means that we lose several years of data at the beginning and end of the sample period so that all the dummies are correctly specified for every firm.

Figure 4: Exports Levels of Entering Exporters



Note: The figure displays the regression coefficients from equation 1 reported in Table 2. The sample of firms includes those who exported continuously for at least 4 years and had one transition in their export status, either entry or exit but not both. Coefficients are estimated in a firm fixed effects specification and report the log levels relative to those for the firm 3+ years after entry or 3+ years before exit.

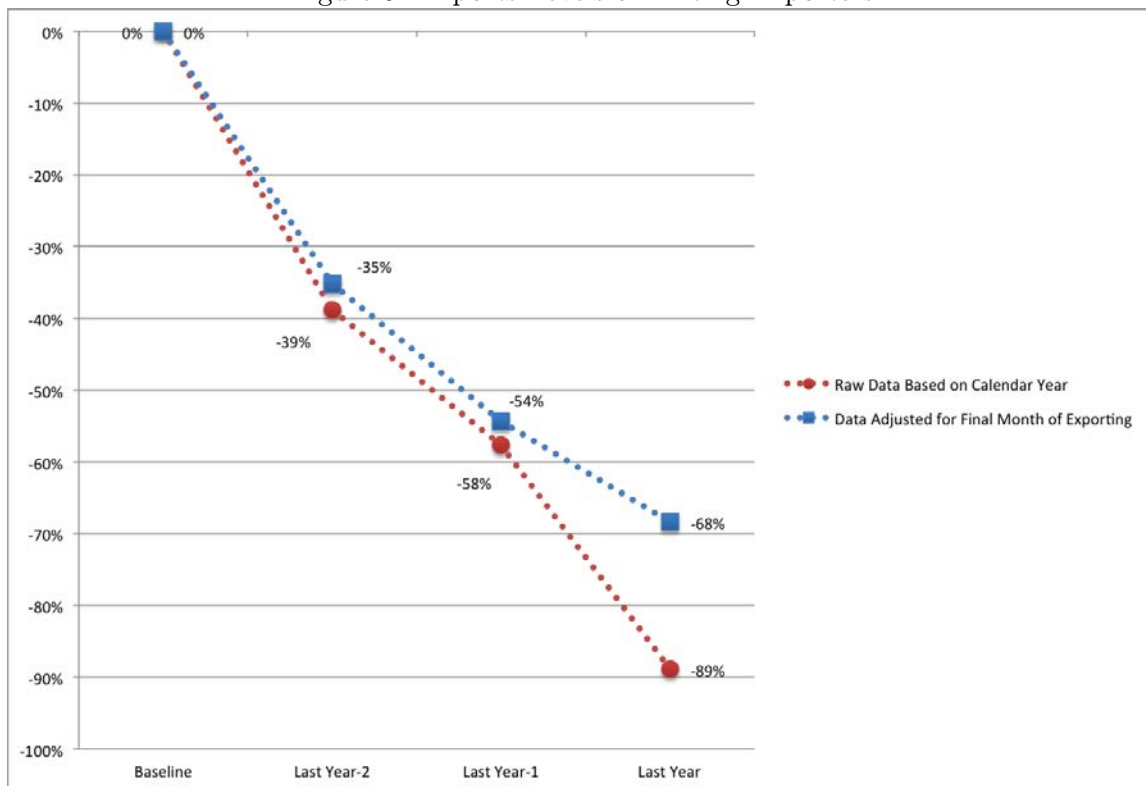
Table 2 reports coefficients on dummy variables for the first, second and third year of exporting and the last, second to last, and third to last year of exporting. Firm and year fixed effects are included so all coefficients give log levels relative to average firm exports in years outside the first three and last three.

Figure 4 shows the average within-firm deviations in percentages for new exporters in their first three years. The baseline is the within-firm average over the period of active exporting. The red series of circles is calculated from the raw data without any partial year corrections. These numbers correspond to the often-reported facts entering exporters. New exporters are small at entry, 75 percent below their within sample average. However within several years most of the difference is erased, in their third year of exporting these firms are just 22 percent below their average.

The green triangles give comparable size measures for the same sample of firms adjusting for the month of entry. The differences from the unadjusted numbers are remarkable. Entrants are still smaller but the magnitudes are greatly reduced. Entering exporters are 46 percent smaller than their sample average compared to 75 percent smaller in the raw data. Adjusting for the month of

entry and allowing first year exports to represent 12 months for each firm raises the size of entrants substantially.

Figure 5: Exports Levels of Exiting Exporters



Note: The figure displays the regression coefficients from equation 1 reported in Table 2. The sample of firms includes those who exported continuously for at least 4 years and had one transition in their export status, either entry or exit but not both. Coefficients are estimated in a firm fixed effects specification and report the log levels relative to those for the firm 3+ years after entry or 3+ years before exit.

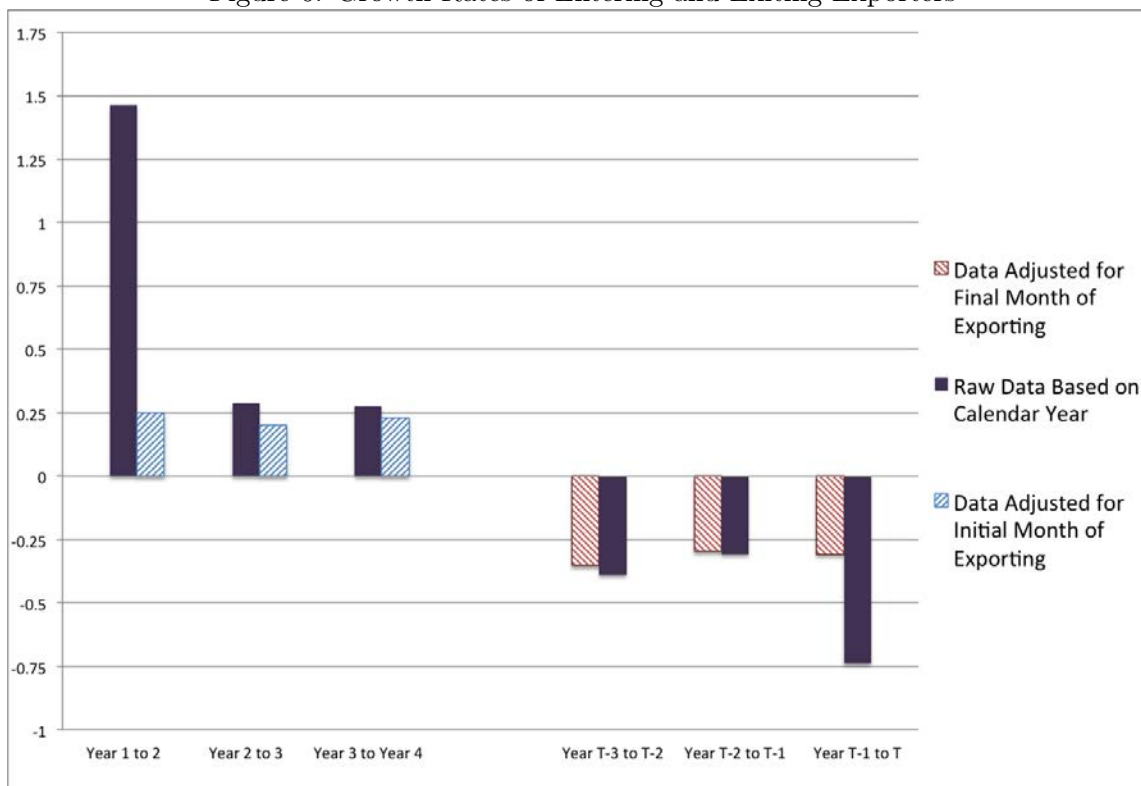
Figure 5 shows the average within-firm deviations in percentages for exiting exporters in the last three years. The baseline again is the within-firm average over the period of active exporting and the red series of circles is calculated from the raw data without any partial year corrections. Firms contract in the years prior to ceasing exporting but are particularly small in their final year at which point exiting firms have shrunk by 89 percent.

The blue squares give size measures for the same sample of firms adjusting for the month of exit. In the year before exit, stoppers have shrunk by 68 percent, compared to 89 percent in the raw data. Adjusting for the month of exit increases the size of exits in the final 12 months of operation.

The numbers with and without partial year corrections in Table 2 are remarkably close to those in the simple example represented in section 3.¹⁸ In the unadjusted data, new surviving exporters

¹⁸In the example the only number designed to match the Peruvian data was the average growth rate of surviving exporters.

Figure 6: Growth Rates of Entering and Exiting Exporters



Note: The figure displays growth rates (log differences) calculated from the regression coefficients in Table 2 (equation 1). The sample of firms includes those who exported continuously for at least 4 years and had one transition in their export status, either entry or exit but not both.

are 25 percent of their size in year 4 while the average in the example is 30 percent. Adjusting for partial year effects the average first year export level is 54 percent of the value of year 4 exports in both the data and the example.

The comparisons of the first and last years are instructive. Arkolakis (2011) emphasizes the comparable size of entrants and exits in the data in discriminating between competing models. Sunk costs should raise the size of entrants and induce exporters to stay in the market longer in the face of adverse shocks in order to retain the option value of the sunk cost. Entrants should be closer to ongoing exporters while exits should be much smaller. Adjusting for partial year effects increases the size of entrants relative to exiting firms in the Peruvian data.

Using the same regression results (Table 2), we calculate raw and adjusted growth rates for entering and exiting exporters in Figure 6. The growth rates from the raw data are calculated as percentage changes and displayed in the solid columns. These unadjusted growth rates closely resemble those found in the existing literature across a wide range of data sets. Surviving exporters grow extremely quickly in the first year, 146 percent or 90 log points, but growth slows down sharply

in the next two years to 29 and 28 percent respectively. However, adjusting for the starting month of exporting produces dramatic changes as seen in the striped columns. These same firms now show average annual growth rates in the first three years of exporting of 25, 20 and 23 percent respectively. The unusually large growth rate between years 1 and 2 is completely eliminated. Instead of an anomalous first year, new, surviving exporters grow quickly but steadily after entry.¹⁹

Again the numbers with and without partial year corrections are remarkably close to those in the simple example. Unadjusted first year growth rates are 90 log points in the data and 98 log points in the example. Adjusted first year growth rates are 22 and 20 log points in the data and the example respectively.

Adjusting for the month of entry eliminates the first year growth rate anomaly and raises initial export size. Similarly adjusting for the month of exit eliminates the last year growth rate anomaly and increases the relative size of first year exports to last year exports. The results suggest that the stylized facts on growth rates and levels for new exporters may be substantially different than are typically reported in the literature.

4.1 Productivity and Learning-by-exporting

Our findings on the bias in initial export levels and growth rates have potential implications beyond the new literature on exporter dynamics. The relationship between exporting and productivity remains an ongoing question for research using micro-data on firms engaged in international trade. More productive firms select into exporting but the evidence is more mixed on the existence of learning-by-exporting or, more precisely, whether productivity growth is faster at a firm after it enters the export market.

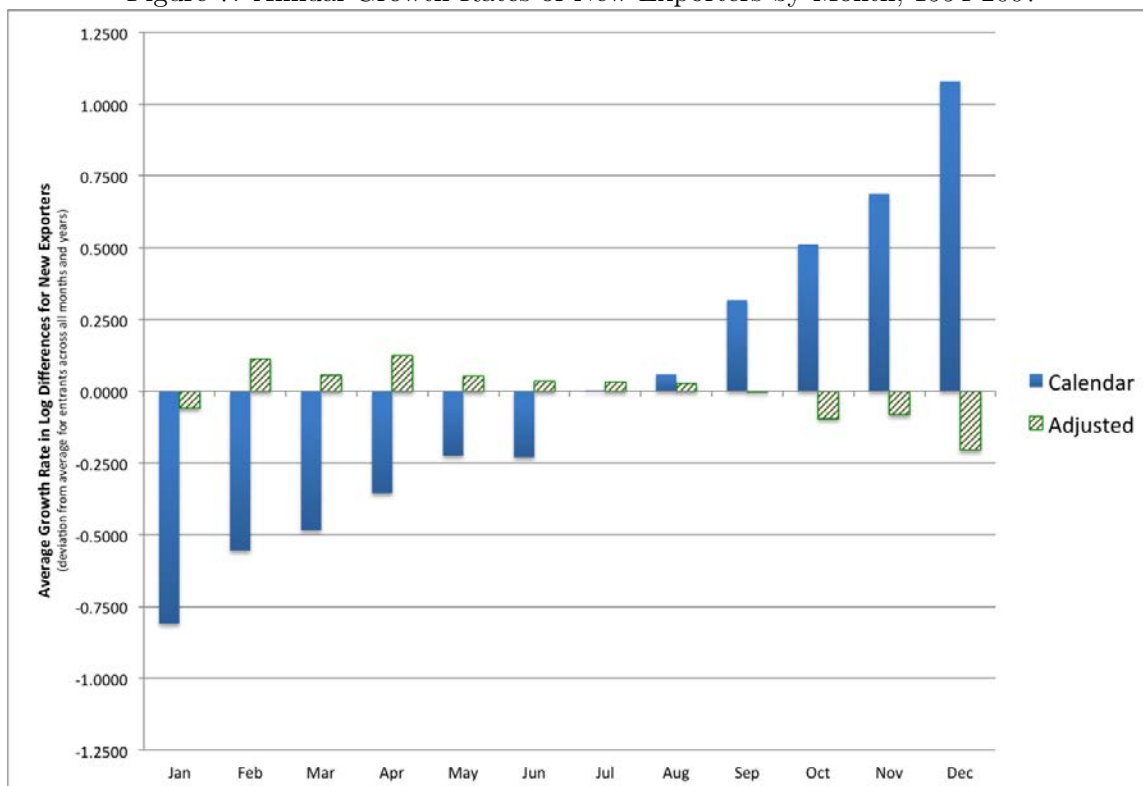
To the extent that authors have found evidence of exporting effects on productivity, the higher productivity growth is often concentrated in the period just after export entry.²⁰ The results presented here suggest that output growth, domestic plus export revenue, measured on an annual basis will be biased around the years of entry into the export market. On average, the recorded level in the year of export entry will not reflect a full year of exports and the growth rate of total firm output will be biased. The bias will be negative for firm growth between year $t-1$ and year t and positive between years t and $t+1$.²¹

¹⁹Partial year adjustments for the month of exit also eliminate the unusually rapid decline in exports just before exit. Exiting exporters decline steadily for several years before leaving the export market entirely.

²⁰De Loecker (2007) argues that Slovenian firms increase their productivity after entry into the export market and finds that almost all the productivity increase in the Slovenian data occurs between the first and second years in the export market. Delgado, Farina, and Ruano (2002) find that productivity growth is higher for new exporters. Many other authors, e.g. Lileeva and Trefler (2010), report average annual growth rates for a multi-year period after exporting which attenuates but does not eliminate the bias in total firm output. In Appendix 3.2, five year average output growth rates starting in the year of export entry remain on average 7 percent above the true underlying change in annual total output.

²¹As before the bias will be greatest for firms that enter the new market later in the year.

Figure 7: Annual Growth Rates of New Exporters by Month, 1994-2007



Note: This figure reports the average growth rate (log differences) of new exporters by month for the cohorts from 1994 to 2007. The monthly averages are reported as deviations from the average across all months and years. The solid color columns are calculated from the unadjusted calendar year exports while the striped columns are calculated from exports adjusting for the initial month of entering exporters.

While total firm output growth is biased due to the partial year effects of export entry, firm productivity may not be subject to the same effects. The partial year effects in firm output growth in firm output will only feed into productivity to the extent that inputs and outputs adjust differentially in the period around export entry.

5 Firm Size - Distribution and Growth

In this section we extend our sample to include all firms in the export market and examine how partial year effects might affect the overall firm size distribution and the relationship between firm size and growth.

5.1 New Entrant Growth

Figure 7 shows the relationship between firm export growth and the month of entry for new Peruvian exporters from 1994-2007. The sample of firms is all entrants into exporting in a year t who report

some exports in the following calendar year $t+1$. The solid columns are the average first year growth rates by month of entry for all firms using the raw calendar data. The growth rates are given as the deviation from the average across all months and years. As expected, partial year effects cause the growth rates based on the calendar year data to rise systematically across the months with the lowest for January entrants (81 log points below the mean) and the highest for December entrants (108 log points above the mean). The striped columns show the same growth rates relative to the mean for first year export growth adjusting for the month of entry. The systemic relationship between entry month and export growth is eliminated and the pattern partly reverses.²² On average the growth rates of all new exporters is 112 percent higher using calendar year data instead of the adjusted data.

5.2 Export Levels of Entrants

Table 3 reports the average size of all new exporters in their first year relative to continuing exporters by year for the entire set of firms. As emphasized in the exporter dynamics literature, entrants are indeed much smaller than continuing exporters. However, adjusting for partial year effects increases entrant size by 65 percent.²³ In addition there is a noticeable downward trend over time in the relative size of entrants, calculated by either method. This decline is due to the systematic increase in the size of continuing exporters rather than a decline in the size of entrants. Table 4 shows that adjusting for partial year effects varies systematically across months. Entrants in December on average have a 599 percent increase in the measured first year exports.

5.3 Firm Size Distribution

The downward bias in levels for new exporters in a market has the potential to shift the export firm size distribution. In the raw data typically used to calculate the firm size distribution, new entrants are not measured with a full year's sales in the market. Measuring their firm size with a full year of export sales would increase their size and since exporters are typically smaller firms these adjustments should have the biggest effects in the left tails of the distribution. We investigate the effects of partial year effects on the export size distribution of Peruvian firms in the US market, the largest destination for Peruvian exports.²⁴

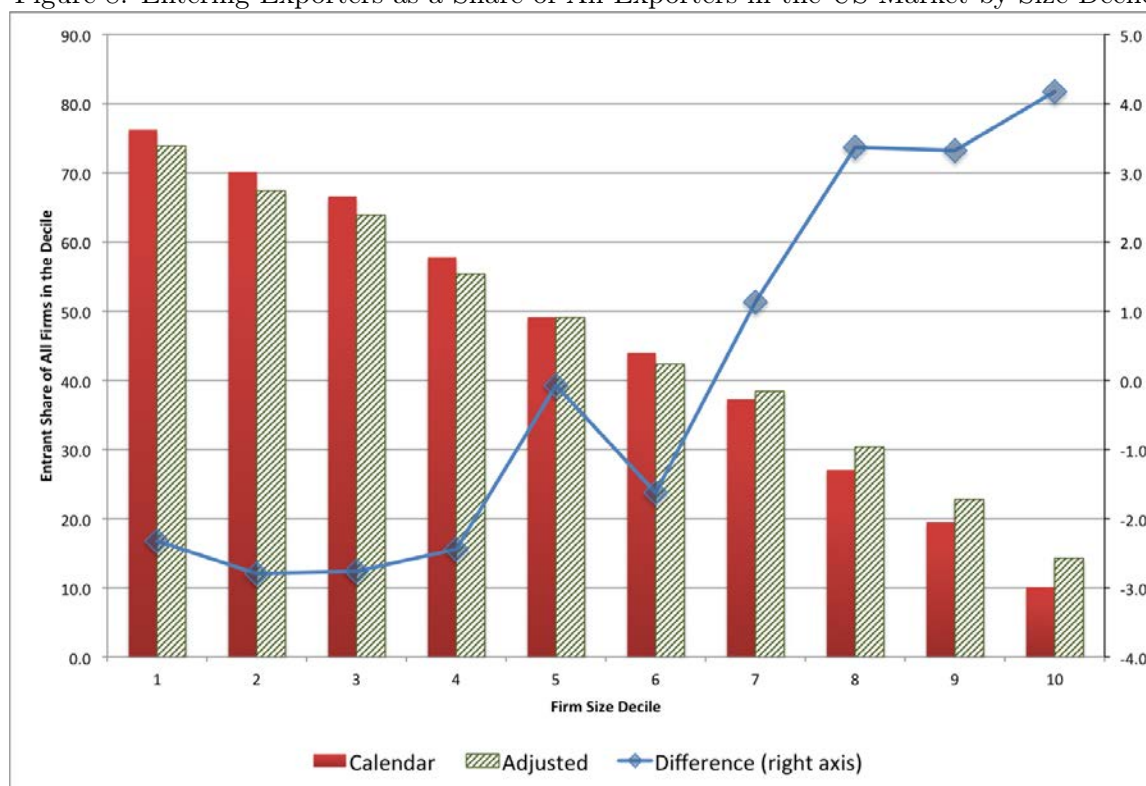
As is the case in many exporting countries, a large fraction of Peruvian exporters are new to the market each year. The US market is no exception, fully 45.8 percent of Peruvian exporters in the US are new in each year. These new exporters vary substantially in initial size. Figure 8 shows the

²²The lower growth rates for entrants in later months comes from a truncation of the sample. Firms are included if they report exports in years t and $t+1$ whether or not they continue to export past December, $t+1$. The later months include a greater fraction of firms that no longer export to the US in year $t+2$ and thus have small exports in their second year in the market due to exit.

²³This is twice as large as the size correction reported for new French exporters by Berthou and Vicard (2013).

²⁴The patterns in other destinations market are largely unchanged.

Figure 8: Entering Exporters as a Share of All Exporters in the US Market by Size Decile

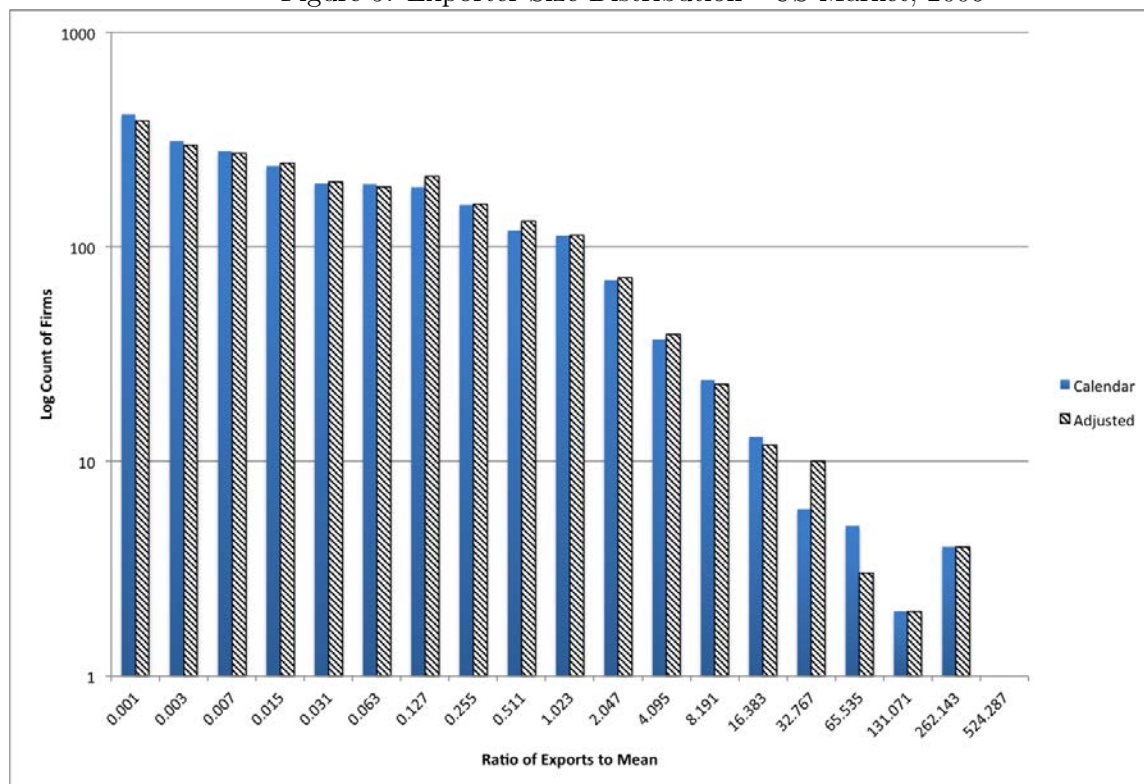


Note: This figure reports new exporters to the US as a fraction of all firms exporting to the US by firm size decile. The solid color columns are calculated from the unadjusted calendar year exports while the striped columns are calculated from exports adjusting for the initial month of entering exporters.

percentage of new exporters in the export size distribution for firms serving the US market. The calendar year shares are given by the solid red columns and, as expected, new exporters are most common in the smallest group of firms (76.2 percent) and relatively infrequent in the largest size decile (10.1 percent).

Adjusting for partial year effects shifts the location of new exporters in the size distribution towards the larger groups of firms (striped columns in the figure). More than 10 percent of the new entrants move from below the median to above the median, with the biggest drops in the smallest deciles and the biggest gains in the largest. These results point to an important extension of the findings so far - the overall size distribution of firms, not just that of exporters, is biased as a result of the presence of entrants who have been active for less than a full year. While new entrants are particularly prevalent in individual export markets, they also are important in the overall distribution of firms. Between 2001-2007 in the US, new firms accounted for more than 10 percent of all firms in any given year, with the entrants heavily concentrated in the smallest size

Figure 9: Exporter Size Distribution - US Market, 2006



Note: This figure reports the distribution exporter sizes in the US market. The solid color columns are calculated from the unadjusted calendar year exports while the striped columns are calculated from exports adjusting for the initial month of entering exporters. Continuing exporters have the same size (exports to US) in both the calendar and adjusted calculations.

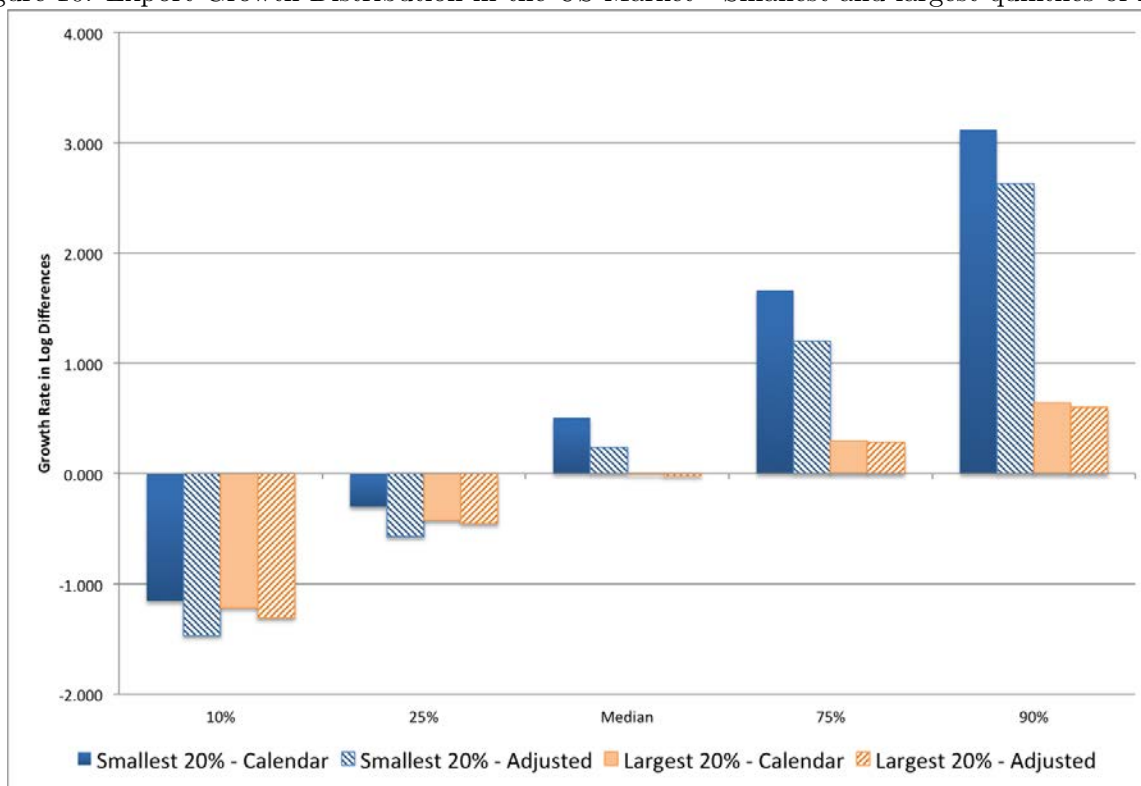
categories.²⁵

Next we examine the change in the firm size distribution itself. Figure 9 shows the firm size distribution for Peruvian exporters to the US market in 2006. The solid columns are tabulated with the raw data while the striped columns are calculated with the adjusted data. The lower part of the size distribution does shift rightward as expected but the magnitude of the shift in the distribution is quite small.

There are two competing effects at work. Entry and exit rates are high among Peruvian exporters. On the one hand, high entry means that many firms can potentially have their first year export numbers adjusted upwards. This effect shifts the size distribution to the right. On the other hand with high firm exit, many entrants quickly exit the export market and so their partial year exports represent their entire first (and only) year in the market. This effect reduces, but does not eliminate, the magnitude of the partial year adjustment on the firm size distribution. The results

²⁵The partial year adjustment is not necessarily larger in market with more new firms. If both entry and exit rates are high, the net effect on the firm size distribution might be small.

Figure 10: Export Growth Distribution in the US Market - Smallest and largest quintiles of firms



Note: This figure reports statistics of the growth rate distribution for the lowest and highest size quintiles of Peruvian firms exporting to the US market for the years 1994-2007. Growth rates are calculated as log differences between year t and $t+1$ while the size distribution is based on exports in year t in the US. The figure reports values for the 10th, 25th, 50th, 75th and 90th percentiles. The solid color columns are calculated from the unadjusted calendar year exports while the striped columns are calculated from exports adjusting for the initial month of entering exporters. Continuing exporters have the same size (exports to US) in both the calendar and adjusted calculations.

in Section 4 for continuing exporters and the big differences in growth rates reported in this section exclude one year exporters and are not subject to the latter effect.²⁶

5.4 Distributions of Growth Rates Conditional on Size

In this section we turn our attention to the relationship between firm growth and firm size. The stylized example in Section 3 closely matches the average growth rates of entering firms and provides a useful rule of thumb for adjusting the average growth rates and levels of entering firms. However recent work including Arkolakis (2011) also focuses on explaining variation in firm growth rates for firms conditional on size.

Arkolakis (2011) shows that the distribution of growth rates for Brazilian exporters to the US in quartile 1 (smallest) and firms in quartile 4 are starkly different. The distribution of growth rates

²⁶We reiterate that high entry and exit rates among exporting firms are robust to partial year adjustments.

of the smallest firms is heavily skewed towards higher growth rates while the distribution of growth rates of the largest firms is approximately lognormal and centers around zero.

The summary statistics of export growth rates (log differences) for firms selling to the US market for the quintile of the smallest firms and the quintile of the largest firms are given in Table 5. The left-hand columns report statistics on growth rates for the smallest quintile of firms, first using the raw, calendar data and then adjusting levels and growth rates of new exporters for the initial month of entry. The right hand pair of columns reports the same statistics for the largest quintile of firms.

The Peruvian exporter growth rate distributions in the US vary across firm sizes in much the same way as the Brazilian growth rates reported in Arkolakis (2011). Growth in the smallest firms is high on average, is skewed towards higher values, and shows a large amount of dispersion. Growth rates in the largest firms are centered around zero, are skewed towards negative growth rates and have relatively compact support.

Performing the partial year adjustments for new exporters, we find large changes in the features of the distribution that vary systematically across the size groups. Figure 10 shows characteristics of the growth rate distribution for the smallest and largest size quintiles of firms. The partial year adjustments dramatically lower the mean and median growth for the group of the smallest firms and shift the distribution of their growth rates leftward over the entire range but particularly for the highest values. The dispersion and skewness also fall for these smaller firms. As expected, the largest quintile of firms shows relatively little change since there are many fewer new exporters in this part of the firm size distribution. The distribution of growth rates for the largest firms also shifts to the left but the changes are small.

Overall we have shown that partial year effects are responsible for some of the observed regularities in the firm size distribution and the growth rate distribution for firms of different sizes. These effects provide a partial explanation for the presence of large numbers of small firms. They also reduce the mean and dispersion of growth rates for the smallest firms in the market. However, it is important to recognize that, for Peruvian exporters to the US, adjusting for partial year effects does not overturn the stylized facts on overall firm size and firm growth.

5.5 Employment versus Sales

The focus of the empirical work in this paper has been on export sales and the firm size distribution measured by exports. There is every reason to believe that the findings on exports will largely be replicated when looking at overall firm sales or sales in the domestic market.²⁷ However, most of the empirical work on firm size and growth has looked at the employment levels of firms in an economy. To the extent that employment is a variable factor of production and covaries systematically with

²⁷Obviously, exports do differ from domestic sales in a number of dimensions, particular the level of activity, the selection of firms into the market, and the duration of the market participation spells.

sales levels, our findings should apply more broadly to the employment size distribution and growth rates. In contrast, if labor is a fixed factor that does not adjust with firm output growth, the biases documented here for exports will be less likely to distort the empirical results based on firm employment. The extent to which partial year effects are important in analyses of employment levels and growth across firms remains a question for future research.

6 Conclusion

This paper has taken a first step towards a deeper understanding of the performance of firms in their first years in a market. The motivation for the work is the rapidly growing literature on firm export dynamics that is heavily based on the twin stylized facts that exporters start small and grow very rapidly in their first year in the foreign market. This paper shows that these two facts are largely explained by the fact that exporters enter the market throughout the year and only part of their first year sales are recorded in the calendar year of entry.

Aggregated to the calendar year, the Peruvian data used in this paper match the stylized facts in the literature quite closely. Adjusting for the month of entry changes the findings dramatically. Exporters are larger upon entry, although still smaller than continuing exporters, and their growth in their first year in the market is no different from subsequent years. The motivating stylized facts on new exporter size and growth are not robust to partial year adjustments.

These findings have implications for a variety of research efforts using detailed micro-data on exports. A number of papers have examined the contributions of extensive and intensive margins to annual export growth and during specific events such as the Asian Crisis and the Great Recession. The use of annual data will understate the contribution of the extensive margins in annual export growth. New exporters will contribute less to overall growth in their year of entry because only part of their first year sales are recorded. Symmetrically their growth rates will be biased upwards between the year of entry and the following year and will be recorded as increases in the intensive margin of exporting.

Partial year effects also distort total firm growth in and after the year of export entry. The growth rates between year $t-1$ and t , the year of export entry, will be reduced and the growth rate between t and $t+1$ biased upward. Depending on the timing of input purchases this may lead to perceived higher productivity growth after entry and mistaken conclusions that there is learning-by-exporting.

The potential consequences of partial year effects go beyond firm export dynamics and include effects on the firm size distribution and the relationships between firm size and growth. We examine the implications for the firm size and growth distributions of Peruvian exporters in the US market. After adjusting for partial year effects the size distribution is shifted to the right (towards large firm sizes), albeit modestly, and the growth distribution of the smallest firms in the market is shifted

to the left (towards lower growth rates). More work using data on firms active in the domestic market is needed to understand how important the partial year effect is for measures of output and employment growth and for the overall firm size distribution.

The consequences of partial year effects may extend to work on more aggregated data such as that assembled in the Exporter Dynamics Database at the World Bank and described by Cebeci, Fernandes, Freund, and Pierola (2012). Stylized Fact 1 in that paper states that more developed and larger countries have larger average exporter size and exhibit significantly lower exporter entry and exit rates. However, the findings reported here suggest that large shares of entrants and exits will by themselves be likely to induce downward bias in firm size as measured in unadjusted annual export flows. As a result, the cross-country correlation between average exporter size and GDP per capita may be driven in part by partial year effects. The importance of entry and exit in the exporting sector and the reliance on export value data for analysis means that such comparisons based on even aggregate data must be viewed with caution.

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Table 1: The Distribution of Entry by Peruvian Exporters across Months, average 1994-2007

	Share of Entrants	% high/low
January	8.7	4.0
February	8.2	-1.2
March	8.8	5.0
April	9.2	10.7
May	7.6	-9.0
June	8.8	5.4
July	7.9	-4.7
August	8.3	-0.6
September	8.5	1.7
October	8.5	1.9
November	8.6	3.7
December	6.9	-17.2

Note: The first column reports the share of new exporters that start exporting in that month averaged across 1994-2007. The second column shows the percentage difference of the monthly average from the benchmark of new entrants arriving uniformly across the days of the year.

Table 2: Export Levels after Entry and before Exit for Continuing Firms, Calendar and Adjusted

	Raw	Adjusted
First year	-1.40*** (0.09)	-0.61*** (0.08)
Second year	-0.50*** (0.07)	-0.39*** (0.06)
Third year	-0.24*** (0.05)	-0.21*** (0.05)
Third to last year	-0.49*** (0.10)	-0.43*** (0.09)
Second to last year	-0.86*** (0.13)	-0.78*** (0.12)
Last year	-2.20*** (0.17)	-1.15*** (0.14)
Year FEs	Yes	Yes
Firm FEs	Yes	Yes
N	10,580	10,580
# of firms	2,352	2,352
\bar{R}^2	0.82	0.84

Note: This table reports coefficients on dummy variables for first, second and third year of exporting and last, second to last, and third to last year of exporting. Firm and year fixed effects are included so all coefficients give log levels relative to average firm exports in years outside the first three and last three. The sample includes all firms who export for at least four years and have just one change in their export status (entry or exit but not both) for measures of calendar year exports and exports adjusted for the initial month. These criteria means that firms that both enter and exit are excluded, as are those with gaps in their annual exports (by either method) and those that export for brief spells, fewer than 4 years.

Table 3: Export Levels of New Exporters, 1994-2007

	Calendar	Adjusted	Ratio
1994	12.6%	15.4%	1.23
1995	7.0%	9.0%	1.27
1996	5.2%	13.8%	2.66
1997	5.1%	7.4%	1.47
1998	12.6%	18.2%	1.44
1999	3.7%	6.4%	1.74
2000	2.3%	3.7%	1.59
2001	3.1%	4.2%	1.35
2002	4.5%	7.5%	1.65
2003	1.9%	3.2%	1.64
2004	1.8%	3.1%	1.73
2005	1.7%	2.4%	1.42
2006	1.7%	3.2%	1.94
2007	1.2%	2.4%	1.98
Average	4.6%	7.1%	1.65

Note: This table reports the average size of new exporters in their first year relative to continuing exporters. Column 1 uses raw calendar data for both entrants and continuing exporters, while column 2 adjusts the exports of entrant to reflect a full 12 months of exporting. Continuing exporter levels are the same in both columns. Column 3 reports the ratio of column 2 to column 1.

Table 4: Partial Year Adjustment Factor for New Exporters by month

	Ratio
January	1.00
February	1.07
March	1.19
April	1.26
May	1.37
June	1.53
July	1.76
August	2.09
September	2.42
October	2.73
November	4.23
December	5.99

Note: This table reports the ratio of adjusted first year exports to calendar first year exports for all new exporters by month, averaged over 1994-2007.

Table 5: Characteristics of Growth Rates in the US Market by Size Quintile

	Smallest Quintile		Largest Quintile	
	Calendar	Adjusted	Calendar	Adjusted
1%	-4.05	-4.39	-4.37	-4.73
5%	-1.85	-2.17	-1.98	-2.11
10%	-1.16	-1.47	-1.21	-1.31
25%	-0.30	-0.57	-0.42	-0.45
Median	0.51	0.24	-0.00	-0.02
75%	1.67	1.21	0.29	0.28
90%	3.12	2.63	0.64	0.60
95%	4.40	3.87	0.93	0.85
99%	8.30	7.59	1.67	1.52
Mean	0.80	0.47	-0.22	-0.25
Std. Dev.	2.06	2.00	1.11	1.16
Skewness	1.06	1.02	-3.60	-3.86

Note: This table reports statistics from the distribution of exporter growth rates for the largest and smallest quintile of exporters in the US market. Besides the percentiles (1, 5, 10, 25, 50, 75, 90, 95, 99) the tables reports the mean, standard deviation and skewness of the growth rate distributions. Calendar refers to firm sizes and growth rates that have not be adjusted for the initial month of exporting to the US while Adjusted refers to the same variables after having adjusting for month in initial exporting.