Preparing to Export*

Danielken Molina‡ *UC San Diego*

Marc-Andreas Muendler¶ *UC San Diego, CESifo and NBER*

December 31, 2010

Abstract

We document considerable heterogeneity among Brazilian exporters in export-market participation over time and in employment. But this marked diversity among exporters is not reflected in their workforce composition regarding observed worker skills or occupations. Using linked employer-employee data, we turn to a typically unknown worker characteristic: a worker's prior experience at other exporters. We show that expected export status, predicted with destination-country trade instruments, leads firms to prepare their workforce by hiring workers from other exporters. Hiring former exporter workers predicts both a wider reach of destinations and a deeper penetration of destinations. The evidence is consistent with the hypothesis that exporters actively prepare for expected export-market access and with the idea that few key workers can affect a firm's competitive advantage.

Keywords: International trade; exporter behavior; trade and labor market interactions

JEL Classification: F12, F14, F16

*We thank George Alessandria, Roc Armenter, Don Davis, Gordon Hanson, Ed Leamer, Marc Melitz, Nathan Nunn, Jim Rauch, Tony Venables, Eric Verhoogen, Kei-Mu Yi and seminar participants at the Philadelphia Fed, the NBER, CESifo, Stanford, UC Irvine and IPEA Rio de Janeiro for constructive suggestions, and we thank Natalya Lebedeva and Youjin Hahn for research assistance on earlier drafts. Paulo Furtado provided much appreciated help with RAIS. Muendler acknowledges NSF support (SES-0550699) with gratitude. A comprehensive empirical supplement with additional tabulations and regression specifications is available as an online Appendix at URL *econ.ucsd.edu/muendler*.

‡dmolina@ucsd.edu

¶muendler@ucsd.edu (*www.econ.ucsd.edu/muendler*). Ph: +1 (858) 534-4799.

1 Introduction

A large body of empirical evidence and trade theories suggests that exporters substantively differ from non-exporters regarding their size, productivity and workforce composition.[1] To learn more about successful exporters and continuous export-market participation, this paper compares Brazilian exporters among themselves regarding the time pattern of exporting and their workforce characteristics. We document that firms actively prepare for expected exporting by hiring a few key workers away from other exporters, and we provide evidence that hiring former-exporter workers is a strong predictor of various aspects of export-market success.

There is considerable heterogeneity in performance and sizes among exporters. When we rank Brazilian exporters by their export-market participation over three consecutive years, this performance ranking is mirrored in an almost perfectly monotonic size ranking from only about 80 workers at in-out switching exporters to 550 workers at exporters with a sustained OECD-market presence. Surprisingly, the substantive heterogeneity in export performance and sizes is not reflected in observable workforce characteristics. The workforce composition regarding skills and occupations is economically similar among otherwise diverse exporters and in some cases statistically indistinguishable. This leads us to hypothesize that typically unobserved worker characteristics are important determinants of export-market performance.

We use rich linked employer-employee data for the universe of formal Brazilian manufacturing firms and their export behavior between 1990-2001 to extract an otherwise unobserved worker characteristic: a worker's prior experience at other exporting firms. We define *hires from exporters* as the head count of hired workers whose immediately preceding formal employment was at an exporter. We hypothesize that expected favorable export conditions in the future, predicted by current demand conditions abroad, lead firms to prepare workforces. To provide evidence on the hypothesis, we propose and implement a new identification strategy for export preparations in economically stable times: we use current sector-level imports to destinations outside Latin America from source countries other than Brazil as instruments to predict a Brazilian firm's export status next year.[2] The so instrumented future export status in turn predicts significantly more worker hires from other exporters in the current year.

Firms in Brazilian regions with many exporters, large firms, and firms that expect lasting export-market participation react most responsively in hiring away other exporters' workers. A corollary of our hypothesis is that firms for whom foreign-demand conditions predicted a high probability of export-market participation, but who are subsequently not observed

[1] The literature documents exporter premia for many countries, beginning with Bernard and Jensen (1995) for U.S. manufacturing exporters. Differences typically exist even before export-market entry. Isgut (2001) presents evidence for Colombia and Alvarez and López (2005) for Chile, consistent with firm or plant-level advantages prior to exporting.

[2] Our panel data allow us to simultaneously condition on a rich set of worker and firm characteristics, including a firm's overall employment change, as well as firm, sector and year effects, domestic sector-level absorption and, in some specifications, sector-year trends.

to become exporters, should let go again the recently poached hires from exporters.[3] Our data show indeed that unexpectedly unsuccessful exporters separate again from most of their recently hired former exporter workers.

Former-exporter hires predict both a wider reach of destinations and a deeper export-market penetration. These effects are strongest when there is a large overlap of export destinations between the former and the current employer. Hiring workers from marketing-related occupations at former exporters predicts a wider reach of destinations, whereas hiring skilled production workers from exporters predicts a deeper penetration of destinations.

Our findings are consistent with the idea that exporters actively build up workforce expertise for expected export-market access. Results also suggest that worker mobility may be a crucial mechanism by which knowledge spreads through an economy; we find that firms losing workers to other exporters do not suffer a significant decline in the number of export destinations, only a decline in market penetration, whereas hiring firms experience improvement in both dimensions.

Recent trade models investigate industry dynamics when firms simultaneously engage in innovation and export-market participation, where one activity raises the returns to the other. Yeaple (2005) shows in a static model with ex ante identical firms and heterogeneous workers, whose skill is complementary to innovative technology, that the firms' binary choice of process innovation induces the sorting of more skilled workers to innovative firms, leading to firm heterogeneity ex post and to exporter premia in equilibrium. The Yeaple (2005) model is closely related to our empirical exercise. As multilateral trade costs drop, more firms in the differentiated-goods sector adopt innovative technology and raise their employment, hiring away the top-skilled workers from differentiated-goods producers with lower technology.[4] Departing from ex ante heterogeneous firms, Costantini and Melitz (2008) reintroduce a stochastic productivity component from Hopenhayn (1992) into the Melitz (2003) model and allow firms to choose process innovation. In simulations of the dynamic industry equilibrium, an anticipated future reduction of multilateral trade costs leads firms to adopt innovation in advance, while waiting for export-market participation.[5]

These theory models predict that exporters, and especially larger exporters in Costantini and Melitz (2008), adopt more advanced technology in response to anticipated returns from export-market entry. In our linked employer-employee data for Brazilian exporters, however, we find only minor differences among exporters in workforce skills and occupations, which would expectedly correspond to firm-level technology. There are at least three possible explanations for the puzzlingly small workforce differences: export-market success is mere

[3] We thank Don Davis for this suggestion.

[4] Also considering ex ante identical firms, Ederington and McCalman (2008) allow for a continuous technology choice in a dynamic industry-equilibrium model and show that a drop in foreign trade costs raises the rate of technology adoption at exporters while adoption is delayed at non-exporters; but worker skills do not play a role in their model.

[5] Atkeson and Burstein (2008) address price setting by exporters and also analyze the joint innovation and export-participation choice in a dynamic model of trade with heterogeneous firms, allowing for a continuous technology choice.

luck; export-market success is independent of workforce characteristics if process innovations or product-quality upgrades can be achieved regardless of workforce skill; or typically unobserved workforce characteristics are most important for export-market success. Using the workers' prior job history and their experience at other exporters as a proxy to unobserved skill, we document that the latter explanation is most plausible.

Much empirical research has established evidence that firms with a competitive advantage self-select into exporting. Research by Clerides, Lach and Tybout (1998) on plants in Colombia, Mexico and Morocco or by Bernard and Jensen (1999) on U.S. firms, for instance, shows a significant difference in productivity between exporters and non-exporters but no significant difference in productivity change after export-market entry.[6] Our data allow us to analyze the extent to which firm differences prior to exporting are the outcomes of active firm choices in preparation for exporting.

Much empirical evidence suggests that firms jointly choose innovative activity and export-market participation. Bustos (2010) shows with Argentinean firm data that, once MERCOSUR reduces import duties in Argentina's neighboring export markets, exporters innovate processes and products significantly more rapidly than non-exporters. Trefler (2004) demonstrates that Canadian plants that face deeper tariff cuts in their product markets under the Canada-U.S. Free Trade Agreement raise plant-level labor productivity faster.[7] Verhoogen (2008) documents that Mexico's exchange-rate devaluation during the 1994 Peso crisis leads initially more productive plants to increase exports and to pursue process certification more frequently than initially less productive plants, consistent with process innovation prior to exporting. Those studies rely on large-scale reforms or macro-economic shocks for identification, whereas our instrumentation method equally applies to ongoing exporter behavior during tranquil times. Our instrumental-variable method for the universe of a country's firms provides complementary evidence to structural estimation such as in Aw, Roberts and Xu (2009), who estimate a model of innovation and exporting choices for Taiwanese electronics plants; they show that allowing for both endogenous exporting and innovation contributes to larger estimated productivity gains. In follow-up research on the Mexican Peso crisis, Fías, Kaplan and Verhoogen (2009) argue that observed increases in wage premia at exporters

[6] Most evidence suggests that a firm-level competitive advantage leads to exporting, and typically not the reverse. Exceptions are Van Biesebroeck (2005), who reports evidence that exporting subsequently raises productivity for sub-Saharan African manufacturing firms, and Crespi, Criscuolo and Haskel (2008) who show in survey data for U.K. firms that exporters who report to have mostly learnt from clients exhibit faster productivity growth.

[7] López (2009) documents in a Chilean plant sample that productivity and investment increase prior to export-market entry and in response to increases in foreign income before entry but not afterwards. Iacovone and Javorcik (2008) use additional information on plant-level capital investment and on the unit price of products for Mexican plants and show that the unit price exhibits an increase two years prior to exporting, suggestive of quality upgrading, and that the increase in unit price coincides with a capital-investment spurt. Those studies rely on a notion of Granger (1969) causality for identification, by which subsequent realizations of firm-level variables should not cause current realizations. Our paper, in contrast, uses sector-level foreign demand shocks for identification, which affect realizations of firm-level variables arguably only through the firms' export status.

after the Peso devaluation are largely shared rents and not associated with upgrading of observed or unobserved workforce skills. In contrast, evidence on exporter behavior during stable times in our paper suggests that firms that expect to be exporters engage in targeted hirings of specific skills.

A related literature on spillovers from foreign-owned to domestic firms considers the moves of individual workers between employers, including case studies (Rhee 1990) and survey evidence (Gershenberg 1987, Görg and Strobl 2005).[8] Beyond small-sample evidence, Poole (2009) uses linked employer-employee data from the same Brazilian source as we do and documents a statistically significant increase in earnings of incumbent workers at domestic firms after workers from foreign-owned firms join, but the pay increase is small in economic terms. For export-market participation, in contrast, we find the hiring of a few former exporter workers to be an economically important variable, predicting a probability increase in export-market participation of about 3 percentage points. This is a considerable probability shift, given an overall exporting frequency of only 5 percent in the manufacturing universe, and is similar in magnitude to what only substantive changes in observed workforce characteristics would predict.

The remainder of the paper proceeds as follows. We describe our data in Section 2 and document substantial differences among exporters in size, export performance and especially workforce characteristics in Section 3. In Section 4, we turn to our main analysis of workforce choices in preparation for favorable foreign demand, present the identification strategy, and empirically document active workforce preparations for subsequent exporting. Section 5 explores worker and job characteristics that are closely associated with subsequent exporter behavior. Section 6 concludes.

2 Data

One data source is the universe of Brazilian exporters: a three-dimensional panel data set by firm, destination country and year between 1990 and 2001. We combine the exporter data with the universe of formal-sector firms and all their formally employed workers. This second data source is a three-dimensional linked employer-employee panel data set by firm, worker and year between 1990 and 2001. The combined employer-employee data provide us with workforce information for exporters in the formal sector, and complement the exporter data with the universe of formal-sector non-exporters. We restrict ourselves to manufacturing firms. We combine these data with worldwide trade flow data by sector to construct instrumental variables (IVs) for a Brazilian firm's export status.

[8] Alvarez and López (2008) document for Chilean plants that the presence of exporters predicts higher productivity at local suppliers, irrespective of foreign ownership, and, within the same industry, that foreign-owned exporters predict higher productivity of competitors. But worker moves are unobserved in their data.

Employer-employee data. Our source for linked employer-employee data is RAIS (*Relação Anual de Informações Sociais*), a comprehensive administrative register of workers formally employed in any sector of Brazil's economy. This register contains the universe of formal Brazilian firms, including non-exporters. RAIS offers information on worker characteristics such as education, a detailed occupational classification of the job, the firm's industry, and the legal form of the company including its foreign ownership, as well as the worker's earnings. We keep observations for the years 1990 through 2001, drop all firms outside manufacturing, and then construct workforce and firm characteristics from employment on December 31st and by tracing recent hires back to their last preceding employer's export status. See Appendix A for more detail on RAIS. RAIS 1990-2001 records a universe of 49 million formal workers employed at 449,390 manufacturing firms (1,767,491 firm-year observations).

Combined with the SECEX exporter data 1990-2001, we find that 23,518 manufacturing firms are exporters in at least one sample year (87,050 exporter-year observations). So only around 5 percent of formal manufacturing firms are exporters, similar to the around 5 percent exporter share in the U.S. universe of manufacturing firms (Bernard, Jensen and Schott 2009). Single-employee firms enter the RAIS records, explaining the apparently low share of exporter firms in the total, compared to data for most other developing countries that censor their samples at a minimum employment level. In terms of employment, manufacturing exporters account for 24 million jobs or roughly half of Brazilian formal employment during the sample period.

Tracing workers to prior and future employers. We track a firm's hires back to their prior employer. We define a relevant hire at a manufacturing firm as a worker accession that is not classified as a transfer between the firm's plants and that lasts at least until December 31st of the calendar year. We then trace the worker back to the last preceding formal-sector employment for up to three prior years and obtain the former employer's export status.[9] This allows us to identify *hires from exporters* as acceding workers whose immediately preceding formal-sector employment during up to three past years was at an exporter. For predictions of exporter performance, we obtain in addition the share of common export destination markets (overlap) between the prior and the current employer, and indicator if the former employer was a continuous exporter for three years, an occupational indicator if the worker's prior employment was in sales (CBO 3-digit classification codes 400 to 499), and another occupational indicator if the worker's prior employment was in an ISCO-88 skilled blue-collar occupation.[10]

[9] For hires from exporters in 1990 or 1991 we use the exporter category in 1992 (see Table 1).

[10] We also constructed a common-sector indicator if the prior and the current employer are in the same subsector IBGE industry, an indicator if the worker is employed in the same occupation at the current employer as at the prior employer, and the worker's tenure at the prior employer. We found none of those variables to be statistically significant predictors of exporter performance (Table 9), conditional on the aforementioned covariates, and omit them.

We also track workers into the future. First, we follow recent hires from exporters into the next calendar year and identify subsequent separations. We define *separations of recent exporter hires* as hires from exporters whose new employment terminates before December 31st of the following year. Second, we track any worker who separates from a firm to the immediately following formal-sector employment for up to three subsequent years and obtain the future employer's export status (mirroring the definition for hires from exporters). This allows us to define *departures to exporters* as separating workers whose immediately following formal-sector employment during up to three future years will be at an exporter.

Exporter data. Exporter data derive from the universe of Brazilian customs declarations for merchandize exports by any firm collected at SECEX (*Secretaria de Comércio Exterior*). For comparability to other studies, we remove agricultural and mining firms as well as commercial intermediaries from the exporter data and only keep manufacturing firms that report their direct export shipments. We deflate export sales to their August-1994 equivalents using the monthly U.S. consumer price index (from Global Financial Data). The choice of August 1994 is motivated by the timing of Brazil's last major currency reform in July 1994, which put the Brazilian Real (BRL) value at an initial exchange rate of one with the U.S. dollar (USD). See Appendix B for more detail on the SECEX data.

Including both non-exporters and exporters, there is a total of 1,767,491 firm-year observations in our manufacturing data (after restricting the sample period to the years 1992-2001 in order to measure export status with two lags). In regression analysis, we will use one lead year so that our basic regression sample will have 1,557,474 firm-year observations for 1992-2000. When we include employment change at the firm level as a covariate in regressions, only firms with observations for two consecutive years remain in the sample, and sample size drops to 1,277,201 firm-year observations for 1992-2000. Given the still large sample size, we will report statistical significance only at the 1-percent significance level throughout this paper.

Worldwide trade flows by sector. Our IVs for expected export status are imports into destinations outside Latin America from source countries other than Brazil, by subsector IBGE. We use WTF data on bilateral trade (Feenstra et al. 2005) from 1991 to 2000 to construct the IVs by subsector IBGE, year and six world destinations. The six world destinations are Asia-Pacific Developing countries (APD), Central and Eastern European countries (CEE), North American countries (NAM excluding Mexico), Other Developing countries (ODV), Other Industrialized countries (OIN), and Western European countries (WEU). We remove Latin American and Caribbean countries (LAC) from our set of IVs. We concord the SITC (Rev. 2) sectors at the four-digit level in WTF to subsector IBGE.[11] We then calculate aggregate imports into each foreign destination region, excepting imports from Brazil, by subsector IBGE. The IVs will prove to be significant predictors of export status in Brazil. Condi-

[11] Our concordance is available at URL *econ.ucsd.edu/muendler/brazil*.

tional on domestic absorption by sector, as well as firm, sector and year effects and detailed firm characteristics, these foreign trade flows are plausibly unrelated to firm- or worker-level outcomes in Brazil other than through export-market shocks.

3 Exporter Types and Workforce Characteristics

Exporter categories. To document export success over time, we adopt a lexicographic ranking of export-market participation. We consider the current year and two preceding years and record in which of the three years a firm was an exporter with at least one reported shipment (8 possible combinations). We first order firms by current-year export status (t), within current-year status by past-year status (t–1), and within those by two-years past status (t–2). Beyond this basic time-pattern ranking, we separate non-exporting firms into those that are permanent non-exporters (non-exporters in every sample year) and current non-exporters (with foreign sales in at least one sample year). We also separate continuous-exporting firms into non-sustained exporters that do not serve one common destination in all three years, into sustained non-OECD exporters that serve at least one non-OECD country for three years, and into sustained OECD exporters that serve at least one OECD country for three years (resulting in a total of 11 possible combinations). Table 1 shows our resulting ranking of export success, with the category in the upper-most row showing the least successful exporters (permanent non-exporters) and the lower-most row containing the most successful exporters (sustained OECD exporters).[12]

We choose these export-status categories to clarify beyond a two-period categorization that there is considerable heterogeneity among exporters, both in terms of workforce sizes and export values. As displayed in Table 1, our time-pattern and destination-market ranking of export-market success is a refinement of a simpler two-period grouping of exporters into *non-exporters* for three consecutive years, exporters that *quit exporting* (including past quitters), firms that *start exporting* (including past starters), and exporters with *continuous exporting*.[13] Curiously, our refined export-status ranking is almost perfectly mirrored in the firms' ranking by workforce size (column 2). For example, permanent non-exporters have an average size of twelve workers, in-out switchers who recently quit exporting employ 76 workers, recent export starters employ 104 workers, while sustained OECD exporters employ 552 workers on average. This surprising workforce-size monotonicity is preserved for all but one pair of neighboring rows.[14] Our refined export-status ranking is also positively

[12] In an alternative ordering, Alvarez and López (2008) classify firms as permanent exporters if they export in all sample years, as sporadic exporters if they export in at least one sample year, and as non-exporters if they do not export during the sample period. Except for permanent non-exporting, our lexicographic ordering does not depend on the number of sample periods.

[13] About 39 percent of manufacturing exporters are starters; they account for employment of four million workers out of a total of 49 million in manufacturing and command 6 percent of export sales.

[14] A two-period classification would have lumped past quitters with non-exporters, but their workforce size turns out to be more similar to other quit-exporting firms under the refinement. Similarly, a two-period classi-

Table 1: EXPORT STATUS ORDERING

Export status	Export period $t-2$	$t-1$	t	Firm-year observations (1)	Workers per firm (2)	Annual exports (3)
Non-Exporter						
Permanent non-exporter[a]	0	0	0	1,596,947	12	
Current non-exporter[a]	0	0	0	60,198	66	
Quit Exporting						
Past quitter	1	0	0	9,101	79	
In-out switcher	0	1	0	7,626	76	
Recent quitter	1	1	0	6,569	102	
Start Exporting						
Recent starter	0	0	1	18,420	104	310.7
Re-entrant	1	0	1	3,181	137	231.0
Past starter	0	1	1	12,252	149	923.1
Continuous Exporting						
Non-sustained continuous exporter[b]	1	1	1	6,044	178	561.3
Sustained non-OECD exporter[b]	1	1	1	21,915	232	888.4
Sustained OECD exporter[b]	1	1	1	25,238	552	10,802.7

[a]Permanent non-exporters do not export in any sample year; current non-exporters export in at least one sample year.

[b]Non-sustained continuous exporters export in three consecutive years but serve no single destination in all three years; sustained non-OECD exporters serve at least one destination (but no 1990-OECD member country) in three consecutive years; sustained OECD exporters serve at least one 1990-OECD member country in all three years.

Source: SECEX 1990 through 2001 (t: 1992-2001), manufacturing firms (subsectors IBGE 2-13).
Notes: Universe of 1,767,491 manufacturing firm-year observations. Exports (fob) in thousands of August-1994 USD.

related to export sales (column 3, correlation coefficient of .11 at the firm level).

The vast majority of formal-sector manufacturing firms (over 90 percent) never exports in any year between 1990 and 2001. The 57,149 firms that quit or start exporting make up more than half of all firms that export in at least one year between 1990 and 2001 but account for only 6 percent of all export sales. Even among the continuous exporters, it is the select group of sustained OECD exporters that dominates. The 25,238 sustained OECD exporters are fewer than one-third of all current exporters, but they ship close to 90 percent of Brazilian exports and employ more than half of all exporters workers (and one-third of all Brazilian manufacturing workers). Table B.2 in the Appendix reports detailed additional summary statistics. Those statistics corroborate that few leading exporters that continue exporting for years account for most export sales and Brazilian employment. We now turn to the workforce characteristics associated with this heterogeneity among exporters.

fication would have lumped past starters with continuous-exporting firms, but their workforce is more similar to other start-exporting firms under the refinement.

Workforce composition. Surprisingly, workforce characteristics do not reflect exporters' performance and size differences (see Table B.2 in the Appendix). The most prevalent occupation in manufacturing, skilled blue-collar work, is performed by 63 percent of workers at the average manufacturing firm and by around 57 percent of workers at exporters, almost independent of the exporters' export status. The most prevalent schooling level in manufacturing is primary education. There are more primary schooled workers at the average manufacturing firm with a share of 76 percent than at exporters with a share of 67 percent, but there is only minor variation among exporters.

Firm heterogeneity is often described with log premia regressions. Much research has shown with such regressions that non-exporters significantly differ from exporters along several dimensions, including workforce characteristics.Less attention has been paid to differences among exporters. In our exporter-premia regressions, we condition on sector and year effects, as well as on the firm's log employment to control for the part of the exporter premium that is predictable with size differences.

Table 2 shows that workers at continuous exporters earn a wage premium of 55 percent (.44 log units) over workers at non-exporters, and even workers at recent export-market quitters earn 38 percent (.32 log units) more than workers at firms with no exports for three years. Only a small part of this wage premium is due to different workforce compositions, as the log wage residual (from a regression on educational and occupational workforce variables) shows. The residual log wage still exhibits a premium between 28 and 42 percent (.25 and .35 log units) over non-exporters. This is consistent with the hypothesis that mostly unobserved worker characteristics are associated with a firm's export status.

Workforce composition differences in Table 2 are economically small and not generally statistically significant (at the 1-percent significance level in the universe of firms). Skilled blue-collar occupations, for instance, are the dominant jobs in manufacturing (Table B.2) and are roughly constant at a 7 to 8 percent premium for exporters of any status over non-exporters. For primary educated workers, the most frequent schooling level in manufacturing workforces, there are differences also among exporters of different status (whereas the raw mean differences in Table B.2 show no marked variation among exporters of different status). The differences in educational attainment are economically small, however.

One typically unobserved worker characteristic is the worker's prior work experience at an exporter. Continuous exporters hire 43 percent (.36 log units) more workers from other exporters than export starters. Especially when compared to the substantive differences in typically unobserved gross hires from other exporters, observed workforce composition differences in Table 2 appear small.[15]

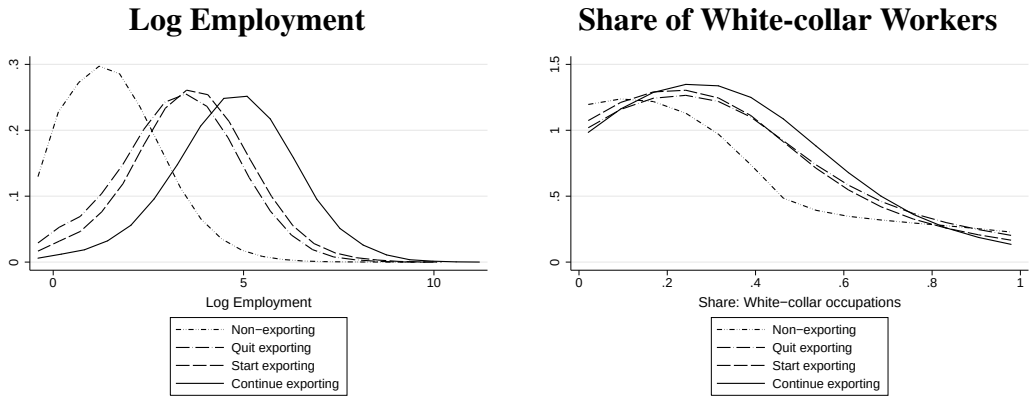
In Figure 1, we look beyond mean comparisons and plot nonparametric estimates of densities for firm characteristics. In the left graph of the Figure, the kernel estimates for log employment reflect the marked size rankings from Table 1 before, with continuous exporters'

[15]The differences in pay and gross hires of former exporter workers are even more pronounced in premia regressions that do not condition on size, and workforce characteristics premia are economically more similar among exporters (see online Appendix).

Table 2: EXPORTER PREMIA CONDITIONAL ON LOG FIRM SIZE

	Export Status			t-tests of null-hypothesis	
	Continuous	Start	Quit		
Firm characteristic	(1)	(2)	(3)	(1)==(2)	(2)==(3)
Earnings					
Log Annual Wage	.440	.307	.316	$\neq$	
	(.003)	(.003)	(.004)		
Residual Log Annual Wage	.351	.248	.256	$\neq$	
	(.003)	(.003)	(.003)		
Workforce composition					
Share: Unsk. blue-collar occ.	-.021	-.003	-.001	$\neq$	
	(.001)	(.001)	(.002)		
Share: Skilled blue-collar occ.	-.081	-.070	-.085	$\neq$	$\neq$
	(.001)	(.002)	(.002)		
Share: White-collar occ.	.102	.073	.086	$\neq$	$\neq$
	(.001)	(.001)	(.002)		
Share: Primary school education	-.111	-.076	-.061	$\neq$	$\neq$
	(.001)	(.001)	(.002)		
Share: High school education	.047	.034	.021	$\neq$	$\neq$
	(.0009)	(.001)	(.001)		
Share: Tertiary education	.064	.042	.040	$\neq$	
	(.0006)	(.0008)	(.001)		
Workforce background					
Log Gross Hires from Exp.	.834	.475	.185	$\neq$	$\neq$
	(.005)	(.005)	(.005)		

Sources: SECEX and RAIS 1992-2001, manufacturing firms (subsectors IBGE 2-13).
Notes: Premia are coefficients from linear regressions of the firm characteristic on export status dummies, controlling for the firms' log employment, sector and year effects in the universe of 1,767,491 manufacturing firm-year observations. Export status as defined in Table 1. The omitted baseline category is non-exporters for three years. Workforces on December 31st. Annualized December wages in thousands of August-1994 USD, residual log wage from a linear regression on educational and occupational workforce composition variables. Log number of gross hires from exporters set to missing if zero. Robust standard errors in parentheses. In columns 4 and 5, rejections of the null hypothesis of equality are reported for t tests at 1-percent significance.



Sources: SECEX and RAIS 1992-2001, manufacturing firms (subsectors IBGE 2-13).
Note: Export status as defined in Table 1. Workforces on December 31st. Epanechnikov kernels with bandwidths .4 (employment) and .2 (white-collar occupations).

Figure 1: **Density Estimates of Sizes and White-collar Shares**

sizes exhibiting a clearly right-shifted probability mass over firms that start exporting, firms that quit exporting, and non-exporters in this order. The ranking becomes less clear-cut for shares of white-collar occupations in the right graph of Figure 1. While there is still a pronounced difference between non-exporters and exporters, the density functions for exporters with different status exhibit multiple crossings and do not suggest as clear a ranking as there appears to be for sizes. The minor economic differences of workforce characteristics among exporters in Table 1 and the right graph of Figure 1 suggest that more successful and larger exporters employ scaled-up workforces with similar compositions as their less successful and smaller competitors.

Predictions of future export-market participation. This evidence leads us to hypothesize that former exporter workers possess unobserved skills that are associated with exporter performance and could be more relevant performance predictors than conventional observable workforce differences. Before we investigate this hypothesis in detail in the following Section, we turn to a descriptive regression of future export status on current firm-level characteristics to assess the predictive power of workforce characteristics for export status.

Table 3 reports binomial logit predictions for future export-market participation ($t+1$), given today's export participation and firm-level characteristics.[16] All specifications condition on sector and year effects as well as sector-level absorption (to control for sector-level business cycles).[17] Consistent with much prior evidence, firms with larger employment are

[16]The binomial exporter-nonexporter dichotomy makes this initial specification closely comparable to Clerides, Lach and Tybout (1998), Alvarez and López (2005) or Crespi, Criscuolo and Haskel (2008) and also to our first-stage regressions in the next Section.

[17]A conditional logit specification for firm-fixed effects performs poorly, reducing the estimation sample by

Table 3: LOGIT PREDICTION OF FUTURE EXPORT-MARKET PARTICIPATION

	Exporter $(t+1)$			
Predictor (t)	(1)	(2)	(3)	(4)
Log Employment	.673	.566	.568	.518
	(.005)*	(.006)*	(.007)*	(.007)*
Share: High school education	.248	.214	.214	.230
	(.027)*	(.029)*	(.030)*	(.030)*
Share: Tertiary education	.818	.674	.675	.731
	(.047)*	(.053)*	(.053)*	(.053)*
Share: Skilled blue-collar occ.	-.224	-.207	-.207	-.168
	(.026)*	(.028)*	(.028)*	(.028)*
Share: Other white-collar occ.	-.046	-.032	-.033	-.084
	(.050)	(.054)	(.054)	(.056)
Share: Techn. or supervis. occ.	-.028	.017	.017	-.147
	(.041)	(.045)	(.045)	(.059)
Share: Profess. or manag'l. occ.	.597	.516	.516	.327
	(.058)*	(.066)*	(.066)*	(.077)*
Indic.: Exporter	3.326	3.286	3.286	4.261
	(.025)*	(.026)*	(.026)*	(.032)*
Log # Destinations	.579	.620	.621	.670
	(.018)*	(.019)*	(.019)*	(.018)*
Log Exports/Destination	.175	.176	.176	.190
	(.007)*	(.007)*	(.007)*	(.007)*
Indic.: Affiliate of foreign MNE	-.351	-.243	-.242	-.265
	(.482)	(.474)	(.474)	(.432)
Rel. Employment Chg. ($t-1$ to t per t)		.007	.007	.012
		(.004)	(.004)	(.005)
Indic.: Hires from Exporters		.532	.536	1.121
		(.016)*	(.017)*	(.021)*
Log Gross Hires from Exp.			-.007	.056
			(.011)	(.010)*
Indic.: High-skill firm				.296
				(.028)*
Indic.: High-skill firm × Indic.: Exporter				-.512
				(.030)*
Indic.: High-skill firm × Indic.: Hires from Exporter				-1.439
				(.030)*
Observations	1,557,474	1,284,996	1,284,996	1,284,996
Pseudo R^2	.628	.637	.637	.642
Predicted probability $\hat{P}$	.048	.055	.055	.055

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), manufacturing firms (subsectors IBGE 2-13).
Notes: Logit regressions, controlling for sector and year effects, and sectoral absorption. Binary present and future exporter indicators represent firms that start exporting and that continue exporting. Workforces on December 31st. Exports (fob) in thousands of August-1994 USD. Log number of destinations and log exports per destination set to zero for non-exporters. Log number of gross hires from exporters set to zero if zero hires. High-skill firms are firms with share of technical/supervisory and professional/managerial occupations in top quartile of firm-year observations. Robust standard errors in parentheses; asterisk marks significance at 1-percent level.

more likely to be exporters than non-exporters one year later, and firms with more highly educated workers or with more skill-intensive occupations are more likely to be exporters than non-exporters. But, conditional on schooling, only the most skill-intensive professional occupations are a statistically significant predictor of next-period exporting (at the 1-percent significance level). In line with existing evidence on sunk costs of export-market entry (e.g. Roberts and Tybout 1997), current exporting is a highly significant predictor of future exporting with a predicted marginal probability increase of roughly .2.[18] Hysteresis in exporting is better explained by a firm's presence in more export destinations than by its market penetration of given destinations. Among the exporters, firms with double the current number of export destinations have about a four times larger predicted marginal probability than firms with double the current exports per destination.[19] There is no evidence that being an affiliate of a foreign multinational enterprise (MNE) is a significant predictor of future exporting after controlling for current exporting. These estimates are highly robust across specifications.

Starting with specification 2, we investigate the predictive power of hiring former exporter workers. Whereas relative net employment expansions have no statistically significant effect on next-year exporting (at the 1-percent level), the indicator for hiring former exporter workers is highly significant. In economic terms, hiring at least one former exporter worker has a similar predictive power for future exporting (an increase of export participation by 3 percentage points) as has the share of tertiary educated workers in the workforce at current exporters.[20] This suggests that hiring key workers with an exporting background from prior employers is strongly associated with future export-market participation. Specification 3 includes the log number of gross hires from exporters, if non-zero. The included variable reduces the coefficient on the indicator for hiring former exporter workers by little and has itself a significantly positive coefficient. This suggests that it is a small number of key workers with an exporting background that matters most for the prediction.

So as to understand at which firms hiring former exporter workers has the strongest predicted effect on future export-market participation, we construct an indicator variable for high-skill firms. We classify a firm as high-skill intensive if its current share of technical/supervisory and professional/managerial occupations falls into the top quartile of firm-

more than 90 percent to only 98,731 observations and predicting an export-market participation rate of 26.2 percent, far above the actual 4.9 percent. In contrast, a linear probability model with firm-fixed effects, similar to our first-stage instrumental-variable regression below (Table 4) performs reasonably well, with negative predicted probabilities for just 2 percent of the sample. The linear model shows a strong association between hiring former exporter workers and export-market participation. For descriptive evidence, we limit our discussion to the more conservative estimates from binomial logit.

[18] Estimates vary from $.048(1-.048) \cdot 3.326 = .152$ in specification 1 to .218 in specification 4.

[19] The implied probability increases are $\ln(2) \cdot .048(1-.048) \cdot .579 = .018$ for export destinations and $\ln(2) \cdot .048(1-.048) \cdot .175 = .005$ for exports per destination.

[20] The respective predictions are that hiring former exporter workers is associated with a probability increase for next-year export-market participation by $.055(1-.055) \cdot .532 = .0277$ percentage points in specification 2. By comparison, increasing the share of tertiary educated workers at exporters eightfold from .1 to .8, thus substituting the primary-educated share of the workforce (Table B.2), is associated with a $.055(1-.055) \cdot .7 \cdot .674 = .0245$ point probability increase.

year observations. Specification 4 includes the high-skill firm indicator and its interactions with the exporting indicator and the indicator for hiring former exporter workers. Coefficient estimates show that, at high-skill firms, the association between future exporting and hiring former exporter workers is absent. This suggests that hiring key workers with an exporting background matters most for exporting at firms with lower initial skill intensity.

To summarize, research documents that workforce characteristics differ between non-exporters and exporters. Our descriptive evidence shows in addition that export-market performance and sizes also differ markedly among exporters of different status. But commonly observed workforce characteristics such as educational attainment and occupations are quite similar among exporters despite substantive diversity in export performance and size. Instead unobserved workforce characteristics, in particular a worker's background from experience at other exporters, is an important predictor of future export-market participation. We now query to what extent the hiring of former exporter workers occurs in preparation for export-market participation.

4 Preparing to Export

In trade models with endogenous technology adoption such as Yeaple (2005) and Costantini and Melitz (2008), falling variable trade costs induce more firms in differentiated-goods industries to adopt innovative technology and raise their employment, hiring away from differentiated-goods producers with lower productivity (in Costantini and Melitz 2008) or hiring away the top-skilled workers from firms with inferior technology (in Yeaple 2005). The timing of hiring and technology-adoption decisions is explicitly modelled by Costantini and Melitz who show in simulations that anticipated future drops in variable trade costs lead firms to adopt innovation before the anticipated favorable trade shock manifests itself.

Estimation model. Motivated by these theories, we adopt a straightforward model of the firm's employment and export decision in two parts. First, a firm i observes export-market conditions $\mathbf{z}_{it}$ abroad at time t and uses them to linearly estimate the probability of its own future export-market participation next year $x_{i,t+1}$, conditional on its current firm characteristics and domestic market conditions $\mathbf{y}_{it}$:

$$x_{i,t+1} = \mathbf{y}'_{it}\boldsymbol{\gamma}_y + \mathbf{z}'_{it}\boldsymbol{\gamma}_z + \eta_{it}, \tag{1}$$

where η_{it} is a mean independent error term and $\boldsymbol{\gamma}_y$ and $\boldsymbol{\gamma}_z$ are vectors of regression coefficients. The measures of export-market conditions $\mathbf{z}_{it}$ are sector-level imports into foreign destinations (outside Latin America) from source countries other than Brazil. The idea for these foreign-demand IVs is that Brazilian firms inform themselves about foreign market conditions through the media, trade fairs, or specialized trade journals on their product markets, and follow foreign market conditions by observing their own expected residual demand.

Second, firm i uses the prediction of its future export status $\hat{x}_{i,t+1} = \mathbf{y}'_{it}\hat{\boldsymbol{\gamma}}_y + \mathbf{z}'_{it}\hat{\boldsymbol{\gamma}}_z$ to choose the number of its hires from exporters h_{it}:

$$\log(1 + h_{it}) = \mathbf{y}'_{it}\boldsymbol{\beta}_y + \hat{x}_{i,t+1}\beta_x + \epsilon_{it}, \tag{2}$$

where ϵ_{it} is a mean independent error term that is uncorrelated with $\mathbf{z}_{it}$, conditional on the set of covariates $\mathbf{y}_{it}$. The measure $\log(1 + h_{it})$ of log gross hiring from exporters is zero for zero hires and increases monotonically at a decreasing rate in the number of hires so that regression coefficient reflect semi-elasticities.[21] Our main hypothesis is that β_x is strictly positive. When firms observe a favorable foreign import-demand shock so that they can expect a higher chance of exporting next year, they prepare their workforces similar to technology upgrading in Costantini and Melitz (2008) and top-skill hiring in Yeaple (2005).

The control variables $\mathbf{y}_{it}$ include firm fixed effects, sector fixed effects, year fixed effects and domestic sector-level absorption (to control for a potentially co-integrated sector-level business cycle abroad and in Brazil), three indicators for the firm's current export status (to capture different degrees of persistence in export market participation), the firm's employment change between $t-1$ and t relative to employment at t (to control for total net hiring that coincides with the hiring of exporter workers), employment, workforce composition shares of worker education and occupation categories, an indicator if the firm is directly foreign owned, and an indicator if the firm is high-skill intensive (its current share of technical/supervisory and professional/managerial occupations falls into the top quartile of firm-year observations). Some specifications also include sector-year trends.

Our main identifying assumption is that current foreign market conditions $\mathbf{z}_{it}$ in destinations outside Latin America affect the hiring of exporter workers h_{it} only through expected export-market participation next year (conditional on the firm's current export status, its other characteristics and domestic market conditions). While a large swing in the real exchange rate or dismantling trade barriers offers substantive variation beyond a firm's control, findings from such large-scale experiments, which can have considerable macroeconomic consequences, are arguably less instructive about exporter behavior during stable times. We therefore adopt an instrumentation strategy that relates a firm's export-market participation next year to current destination-market shocks.

Export-market shocks. There is little econometric guidance to date for the selection among multiple valid IVs when some IVs are potentially weak but others strong. If the F statistic for the hypothesis that the instrumental-variable coefficient is non-zero on the first stage surpasses a value of 10, an instrument is commonly considered a strong one (Stock, Wright and

[21] We experimented with three more specifications of the left-hand side outcome in equation (2): $\log h_{it}$ (which is only defined for non-zero hires), h_{it}, and an indicator $\mathbf{1}(h_{it} > 0)$. Those specifications result in the same significance and sign patterns as the specifications reported below (see online Appendix). When we use exports two periods in advance, $\hat{x}_{i,t+2}$, expected exporting two years into the future is associated with about half the hiring response compared to expected exporting one year into the future but significance and sign patterns are again preserved (see online Appendix).

Table 4: FOREIGN DEMAND AND FUTURE EXPORT-MARKET PARTICIPATION

	Exporter	Export Status ($t+1$)		
	($t+1$)	Continuous	Start	Quit
Instrument (t)	(1)	(2)	(3)	(4)
A: Sectoral Foreign Imports by Region, no trend (IV)				
Non-Brazil Imports in NAM	-.037	.013	-.051	-.002
	(.014)*	(.009)	(.012)*	(.011)
Non-Brazil Imports in OIN	-.185	-.119	-.066	.067
	(.041)*	(.028)*	(.037)	(.032)
Non-Brazil Imports in WEU	.032	.006	.026	-.027
	(.010)*	(.007)	(.009)*	(.008)*
Observations	1,284,996	1,284,996	1,284,996	1,284,996
R^2 (within)	.044	.219	.083	.198
F statistic	19.65	6.43	13.61	8.09
B: Sectoral Foreign Imports $\times$ Exporter Status, no trend (IV $\times$ Exp.)				
Non-Brazil Imports WW $\times$ Cont. Exp.	-.083	-.037	-.046	.037
	(.002)*	(.002)*	(.002)*	(.002)*
Non-Brazil Imports WW $\times$ Start Exp.	-.063	-.009	-.054	.032
	(.002)*	(.002)*	(.002)*	(.002)*
Non-Brazil Imports WW $\times$ Quit Exp.	-.022	-.008	-.014	-.018
	(.002)*	(.002)*	(.002)*	(.002)*
Observations	1,284,996	1,284,996	1,284,996	1,284,996
R^2 (within)	.046	.219	.084	.198
F statistic	546.00	186.25	305.03	299.01
C: Sectoral Foreign Imports $\times$ Exporter Status, with sector trend (IV $\times$ Exp.)				
Non-Brazil Imports WW $\times$ Cont. Exp.	-.085	-.039	-.047	.041
	(.002)*	(.002)*	(.002)*	(.002)*
Non-Brazil Imports WW $\times$ Start Exp.	-.064	-.010	-.054	.034
	(.002)*	(.002)*	(.002)*	(.002)*
Non-Brazil Imports WW $\times$ Quit Exp.	-.023	-.009	-.015	-.016
	(.002)*	(.002)*	(.002)*	(.002)*
Observations	1,284,996	1,284,996	1,284,996	1,284,996
R^2 (within)	.046	.220	.084	.198
F statistic	536.34	190.13	294.86	318.45

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), manufacturing firms (subsectors IBGE 2-13).
Notes: Linear regressions, controlling for firm fixed effects, sector and year effects, and sectoral absorption, panel C also controlling for linear sector trends. Binary future exporter indicator represents firms that start exporting at $t+1$ or that continue exporting at $t+1$; future and current export status as defined in Table 1. Non-Brazilian imports in Other Industrialized countries (OIN), Western European countries (WEU), North American countries (NAM excluding Mexico), and worldwide (WW excluding Latin America and Caribbean). Additional regressors: current export status, workforce characteristics and MNE indicator as in Table 5. Standard errors in parentheses; asterisk marks significance at 1-percent level.

Yogo 2002). We have six potential IVs but need at most three IVs in later regressions. To select the strongest possible set of IVs, we use the F statistic like an information criterion. We first regress the binary future exporting indicator on all six IVs and other exogenous variables, conditioning on firm, sector and year effects. From this initial regression we select the three IVs with the highest t statistics. We then set out to add IVs in the order of their t statistics, from next highest to lowest, and observe the evolution of the F statistic as we include IVs, with the intent to stop including IVs as soon as the F statistic starts falling. We find the import-demand IVs of OIN, WEU and NAM to have similarly high t statistics (between 3.9 and 3.4 in absolute value) and then add CEE to the regression, which has the next highest t statistic (1.7 in absolute value). With this addition, the F statistic for joint significance of the IVs drops, however, from 18.0 to 14.1. We therefore use no IVs other than import demand in OIN, WEU and NAM.

The upper panel (A) in Table 4 shows the results from linear regressions of future exporting on these pure demand IVs, conditional on our set of control variables.[22] There is no a priori expected sign for coefficients on our foreign import-demand measures. A positive sign is consistent with favorable consumer demand conditions at the foreign destination both for Brazilian and non-Brazilian exporters. A negative sign is consistent with unfavorable residual demand at the foreign destination for Brazilian exporters in the wake of large competing shipments by non-Brazilian export countries. By this interpretation of coefficients in Table 4, shipments from non-Brazilian export countries to North America and other industrialized countries tend to substitute Brazilian exports whereas others' shipments to Western Europe tend to complement Brazilian exports (columns 1 through 3). Expectedly, signs of significant coefficients are reversed for Brazilian firms that quit exporting (column 4).

Foreign market conditions $\mathbf{z}_{it}$ vary by sector and year and capture pure demand effects, which are common to all firms within a sector. While instrument validity is unaffected by this limited variation, predictive power of the IVs can be a concern. The F statistic clearly exceeds 10 for the binary future exporter indicator and for export starters, but the F statistic falls below the threshold of 10 for continuous exporting status and for firms that quit exporting. We will therefore interpret second-stage results for continuous exporters and export quitters with caution.

In the presence of sunk entry costs the firms' responses to changing foreign market conditions depend on the firm's current export status (Dixit 1989). Among the control variables $\mathbf{y}_{it}$ we include the firm's current export status, thus capturing the direct effect of current exporting on hiring exporter workers on the second stage (2). As a consequence, the joint effect of worldwide market conditions and the vector of current export status indicators $z_{it}^{ww}\mathbf{x}_{it}$ are valid instruments as long as persistent firm-level export-supply shocks are summarized by the current export status and hence do not confound second-stage estimation. We exclude imports into any Latin American economy from the measure of worldwide imports z_{it}^{ww} and interact worldwide import demand with indicators for the three export status categories other

[22] Firms are not nested within sectors in our data so sector fixed effects are separately identified but common clustering of standard errors in the two-stage least squares regression becomes inviable.

than non-exporters (Table 1).

The middle panel (B) in Table 4 shows the results for the first-stage of the according interacted instrumental variable regression. Expectedly, the F statistics now far exceed the threshold of 10. In the lower panel (C) in Table 4, we introduce sector-year trends in addition and the F statistics remain above the threshold of 10.[23] The identifying assumption for the new set of instruments (B and C) is more restrictive. So we will check second-stage estimates from the alternative sets of instruments (A-C) against each other to assess robustness and query their implied validity.

Hiring away exporter workers. We now consider the hiring of former exporter workers at time t as a preparation for export-market participation in the next year. For this purpose, we use expected export-market participation at $t+1$, predicted by the above-mentioned observed foreign import-demand shocks at t.

Results in Table 5 show that expected future exporting is significantly positively associated with advance hiring of former exporter workers across all four specifications, irrespective of instrumentation. In magnitude, coefficient estimates are strictly larger when future exporting is instrumented (columns 2 through 4) than in ordinary regression (column 1). Note that our IV regressions measure the effect of expected future export-market participation (the treatment) on responding firms that are susceptible to favorable foreign demand conditions (treatment responders). In contrast, the ordinary regression (column 1) measures the covariation of observed future export-market participation on the universe of firms, including the bulk of never-exporting firms that are not susceptible to favorable foreign demand (never-responders). So coefficients in IV regressions expectedly exceed those from ordinary regression. We will provide evidence on the most responsive firms below, consistent with this interpretation (Table 6).

Using pure foreign-demand IVs (column 2) predicts that firms prepare for an expected 10 percentage-point increase in the probability of export-market participation next year with one gross hire of former exporter workers in advance at the sample mean.[24] This is a plausible number. The average firm in the sample exports with a probability of 4.9 percent (Table B.2). The average exporter contracts twelve former exporter workers per year during the sample period, while recent export quitters just hire three former exporter workers on average and the mean manufacturing firm just hires one (Table B.2). Using foreign-demand IVs interacted with the firm's present export status (columns 3 and 4), leads to a smaller magnitude: by this measure, an expected 10 percentage-point increase in the exporting probability next year results in advance gross hiring of only .4 former exporter workers.

Interestingly, numerous coefficients on covariates are consistent with the interpretation that strong firm-side performance up to the current year is not typically associated with hiring

[23] Sector-year trends would depress F statistics below 10 in the upper panel of Table 4 (see online Appendix).

[24] By the coefficient estimate in column 2, implied gross hiring of former exporter workers is $.1 \cdot 4.549 \cdot (1 + \bar{h}) = .96$ workers for a 10 percentage-point increase in the exporting probability and mean former exporter hires $\bar{h} = 1.1$ (Table B.2). It is $.1 \cdot 2.055 \cdot (1 + \bar{h}) = .43$ by column 3 and $.1 \cdot 1.745 \cdot (1 + \bar{h}) = .37$ by column 4.

Table 5: HIRES FROM EXPORTERS

	Log[1 + Hires from Exporters] (t)			
		IV	IV × Exp.	
	FE	FE (A)	FE (B)	FE, trend (C)
Predictor (t unless noted otherwise)	(1)	(2)	(3)	(4)
Indic.: Anticip. Exporter ($t+1$)	.119	4.549	2.055	1.745
instr. in (2)-(4)	(.003)*	(.669)*	(.080)*	(.076)*
Indic.: Continue Exporting	.044	-.579	-.228	-.178
	(.004)*	(.095)*	(.013)*	(.012)*
Indic.: Start Exporting	.081	-.713	-.266	-.208
	(.003)*	(.120)*	(.015)*	(.014)*
Indic.: Quit Exporting	-.032	.278	.104	.086
	(.003)*	(.047)*	(.007)*	(.007)*
Rel. Employment Chg. ($t-1$ to t per t)	.002	-.00007	.0009	.001
	(.00006)*	(.0003)	(.00008)*	(.00008)*
Log Employment	.230	.141	.191	.197
	(.0007)*	(.013)*	(.002)*	(.002)*
Share: High school education	.005	-.005	.0005	.002
	(.002)	(.004)	(.002)	(.002)
Share: Tertiary education	-.025	-.027	-.026	-.025
	(.004)*	(.007)*	(.005)*	(.004)*
Share: Skilled blue-collar occ.	-.006	-.019	-.012	-.011
	(.002)	(.005)*	(.003)*	(.003)*
Share: Other white-collar occ.	-.064	-.053	-.059	-.061
	(.004)*	(.009)*	(.005)*	(.005)*
Share: Techn. or supervis. occ.	.036	.041	.038	.038
	(.004)*	(.008)*	(.005)*	(.005)*
Share: Profess. or manag'l. occ.	.009	.047	.026	.022
	(.006)	(.013)*	(.007)*	(.007)*
Indic.: Affiliate of foreign MNE	.035	.101	.064	.060
	(.038)	(.076)	(.047)	(.045)
Indic.: High-skill firm	-.052	-.071	-.060	-.059
	(.002)*	(.005)*	(.002)*	(.002)*
Indic.: High-skill firm × Exporter	-.103	.105	-.012	-.027
	(.004)*	(.033)*	(.007)	(.006)*
Observations	1,284,996	1,284,996	1,284,996	1,284,996
R^2 (overall)	.453	.296	.404	.423

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), manufacturing firms (subsectors IBGE 2-13).
Notes: Linear regressions, controlling for firm fixed effects, sector and year effects, and sectoral absorption; for linear sector trends in specification 4. Specifications 2, 3 and 4 use instrumented binary future exporter indicator (column 1 of Table 4). Binary future exporter indicator represents firms that start exporting at $t+1$ or that continue exporting at $t+1$; current export status as defined in Table 1. Workforces on December 31st. High-skill firms are firms with share of technical/supervisory and professional/managerial occupations in top quartile of firm-year observations. Standard errors in parentheses; asterisk marks significance at 1-percent level.

former exporter workers. Continuous exporting firms and recent export starters hire strictly fewer former exporter workers than non-exporters, whereas firms that just quit exporting in the current period contract more former exporter workers, arguably in anticipation of a mean reversion in their export participation. Similarly, firms with more tertiary educated workers and a higher skill intensity hire strictly fewer former exporter workers (with a minor coefficient alteration for the fraction of exporters among high skill intensive firms). As the only exception to the overall pattern, a larger share of skill-intensive white-collar occupations is associated with hiring more former exporter workers, conditional on the education composition of the workforce and the firm's rank in the skill intensity distribution. The overall pattern broadly supports the interpretation that initially less well staffed firms pursue the strongest advance hiring of former exporter workers.

A comparison of results from the three different sets of instruments (A-C) shows that signs and significance patterns are highly robust across specifications (columns 2 through 4), with signs identical when significant for thirteen out of fifteen covariates. Given robustness across sets of instruments, we now return to the difference in coefficient magnitudes between the instrumented and non-instrumented variables. To assess our explanation, we investigate which firms most responsively hire former exporter workers.

Hiring away exporter workers by region and firm size. We interact the indicator of exporting one year in advance with the firm's location in one of three broad regions in Brazil, having three instruments at hand. São Paulo state is Brazil's manufacturing center, hosting about half of Brazil's manufacturing value added during the 1990s. The South and South East of Brazil (excluding São Paulo state) exhibit higher per-capita incomes than the North, North East and Center West, but neither the South nor the remaining South East (Rio de Janeiro, Minas Gerais and Espírito Santo) can match São Paulo's concentration of manufacturing industries.

Results in the upper panel of Table 6 corroborate our earlier interpretation that instrumented regressions reflect the responses of firms that are susceptible to favorable foreign demand conditions. We ignore results from the relatively weak set of instruments (A in column 2). Only firms in São Paulo state significantly respond to favorable foreign demand by hiring away exporter workers (columns 3 and 4). Arguably only the industry agglomeration in São Paulo offers a sufficiently thick labor market to permit effective worker poaching.

We also interact the indicator of exporting one year in advance with the firm's log size. Results in the lower panel of Table 6 for this interaction provide further evidence in favor of our interpretation of firm responsiveness (columns 3 and 4). Only relatively large firms with an arguably strong competitive advantage respond to favorable foreign demand conditions by hiring former exporter workers.

Hiring away exporter workers by expected export status. Theory implies that firms with the largest anticipated gains from exporting have the strongest incentive to engage in preparatory investments and hiring (Yeaple 2005, Costantini and Melitz 2008). One proxy to

Table 6: HIRES FROM EXPORTERS WITH REGION AND SIZE INTERACTIONS

	Log[1 + Hires from Exporters] (t)			
		IV	IV × Exp.	
	FE	FE (A)	FE (B)	FE, trend (C)
Predictor (t unless noted otherwise)	(1)	(2)	(3)	(4)
Regional Interactions				
Indic.: Antic. Exp. (t+1)	.104	-11.053	2.963	2.549
in São Paulo	(.004)*	(32.948)	(.223)*	(.193)*
Indic.: Antic. Exp. (t+1)	.127	-34.345	2.015	1.448
in South/SouthEast	(.004)*	(159.413)	(.864)	(.841)
Indic.: Antic. Exp. (t+1)	.159	-301.604	.841	1.732
in North/NorthEast/CenterWest	(.009)*	(746.287)	(2.951)	(2.814)
Observations	1,284,670	1,284,670	1,284,670	1,284,670
R^2 (overall)	.453	.026	.359	.382
Log Size Interaction				
Indic.: Anticip. Exporter (t+1)	-.605	-12.145	-.168	-.091
	(.007)*	(1.604)*	(.475)	(.460)
Log Employment	.220	.095	.183	.189
	(.0007)*	(.014)*	(.002)*	(.002)*
Indic.: Antic. Exp. (t+1)	.189	3.001	.419	.351
× Log Employment	(.002)*	(.261)*	(.088)*	(.087)*
Observations	1,284,996	1,284,996	1,284,996	1,284,996
R^2 (overall)	.498	.233	.489	.498

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), manufacturing firms (subsectors IBGE 2-13).
Notes: Linear regressions, controlling for firm fixed effects, sector and year effects, and sectoral absorption; for linear sector trends in specification 4. 1,284,996 observations. Specifications 2, 3 and 4 use instrumented binary future exporter indicator (column 1 of Table 4). Additional regressors: current export status as defined in Table 1, workforce and MNE control variables as in Table 5. Standard errors in parentheses; asterisk marks significance at 1-percent level.

returns from export-market participation is the expected exporter category, with continuous exporters arguably locking in larger gains than export starters. We accordingly estimate equation 1 for a vector of expected exporter status over three categories.

Table 7 reports the results (first stages shown in Table 4, column 2 through 4). We ignore results from the relatively weak set of instruments (A in column 2), which produce a poor R^2 fit. As theory suggests, expected continuous exporters exhibit the strongest response in hiring former exporter workers, and export starters an intermediate response. Compared to non-exporters, firms that are predicted to quit exporting given foreign demand shocks still hire significantly more former exporter workers. That sign is not what we expected. Note, however, that for a firm to be a quitter next year it must be an exporter this year. A consistent interpretation of the sign then is that current exporters whose foreign demand shocks predict export-market exit next period may still have a stronger incentive to poach former exporter workers than non-exporters because a current exporter's expected returns from catching up

Table 7: HIRES FROM EXPORTERS AND ANTICIPATED EXPORT STATUS

	Log[1 + Hires from Exporters] (t)			
		IV	IV × Exp.	
	FE	FE (A)	FE (B)	FE, trend (C)
Predictor (t unless noted otherwise)	(1)	(2)	(3)	(4)
Anticip. Continue Exporting ($t+1$)	.177	4.468	3.921	3.366
instr. in(2)-(4)	(.005)*	(4.520)	(.300)*	(.279)*
Anticip. Start Exporting ($t+1$)	.111	2.960	2.300	1.913
instr. in(2)-(4)	(.003)*	(2.397)	(.250)*	(.247)*
Anticip. Quit Exporting ($t+1$)	.035	16.128	1.654	1.302
instr. in(2)-(4)	(.004)*	(3.308)*	(.287)*	(.281)*
Observations	1,284,996	1,284,996	1,284,996	1,284,996
R^2 (overall)	.454	.002	.362	.386

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), manufacturing firms (subsectors IBGE 2-13).
Notes: Linear regressions, controlling for firm fixed effects, sector and year effects, and sectoral absorption; for linear sector trends in specification 4. Specifications 2, 3 and 4 use instrumented future export status indicator (columns 2 through 4 of Table 4). Future and current export status as defined in Table 1. Additional workforce and MNE control variables as in Table 5. Standard errors in parentheses; asterisk marks significance at 1-percent level.

to well staffed exporters, and re-entering the export market subsequently, are larger than for the bulk of never-exporters in the sample.

Firing recent exporter hires upon unexpected export failure. Regression specifications so far offer evidence for our main hypothesis that a firm hires away exporter workers when it can expect to export next year. A corollary of our hypothesis is that a firm with favorable foreign-demand conditions, which currently predict a high probability of export-market participation next year, should lay off again its currently poached hires from exporters if it fails to become an exporter by next year. To pursue this placebo-like treatment, we follow recent hires from exporters in the current year into the next calendar year and identify separations that occur before the end of the next calendar year. We define *separations of recent exporter hires* as hires from exporters in the current year whose new employment terminates before December 31st of the next year. We then restrict the firm sample in two ways. First, we keep only those firm observations whose predicted export indicator for next year is above the sample median, consistent with a favorable expectation of export-market participation. Of those firm observations, we only keep the ones that turn out to be non-exporters next year. Second, we keep only firm observations with predicted exporting next year above the 75th percentile, and of those only the non-exporters next year.

For each restricted sample of unexpectedly failing exporters, we replicate equation 2 and regress separations from current exporter hires $\log(1 + s_{i,t+1})$ on the prediction of the firm's future export status $\hat{x}_{i,t+1}$ and the control variables. We know from estimates of equation 2

Table 8: SEPARATIONS OF RECENT EXPORTER HIRES AT UNEXPECTEDLY UNSUCCESSFUL EXPORTERS

	Log[1 + Separations of Recent Exp. Hires]$_{(t+1)}$		
	IV	IV × Exp.	
	FE (A)	FE (B)	FE, trend (C)
Predictor (predictors at t not reported)	(1)	(2)	(3)
Unsuccessful Exporters with Pred. Export Indic. above Median			
Pred. Indic. Anticip. Exporter ($t+1$)	4.064	.755	.634
	(1.257)*	(.264)*	(.248)
Observations	576,311	576,218	576,214
R^2 overall (subsample)	.257	.256	.257
Unsuccessful Exporters with Pred. Export Indic. above 75th Percentile			
Pred. Indic. Anticip. Exporter ($t+1$)	3.991	.585	.487
	(2.279)	(.287)	(.283)
Observations	257,767	257,623	257,587
R^2 overall (subsample)	.260	.262	.261

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), manufacturing firms (subsectors IBGE 2-13).
Notes: Linear regressions, controlling for firm fixed effects, sector and year effects, and sectoral absorption; for linear sector trends in specification 3. Additional workforce and MNE control variables as in Table 5. Standard errors from 50 bootstraps over both stages in parentheses; asterisk marks significance at 1-percent level.

that a higher propensity of exporting next year leads to more hires of exporter workers in the current year. If those hires mainly serve for export-market entry, and little else, then we should expect in the restricted sample of unexpectedly failing exporters that a higher propensity of exporting next year leads to more firings of these recently hired exporter workers over the next year. Results in Table 8 corroborate exactly this implication. The coefficient estimate on the exporting predictor for next year is strictly positive. So unexpectedly failing exporters fire more recent exporter hires if the exporting predictor induced them to poach more exporter workers in the current year. Given our endogenous sample restriction based on first-stage estimates, we bootstrap the standard errors over both estimation stages. The coefficients are statistically significant at the one-percent level in the larger sample with the median export indicator as the cutoff for a firm's predicted export indicator (and at the five-percent level in the smaller sample for instrument set B). Comparing estimates in the upper panel of Table 8 to the hiring estimates (Table 5) suggests that unexpectedly failing exporters let go again of between one-third to 90 percent of the recently poached hires from exporters.[25]

In summary, firms hire former exporter workers in advance of expected favorable export conditions, and especially firms in regions with thick manufacturing labor markets contract exporter workers in response to expected export-market participation. Large firms and firms that anticipate to become continuous exporters pursue relatively more such advance hires.

[25]The coefficient ratios range from .36 and .37 under instrument sets (B) and (C) to .89 under instrument set (A).

Conversely, unexpectedly failing exporters lay off a significant fraction of their recently hired former exporter workers. We now return to a descriptive investigation into the importance of advance hiring of exporter workers for a firm's performance in foreign markets.

5 Predictors of Exporter Performance

Performance after hiring away exporter workers. We now restrict the sample to exporters only and seek additional evidence on two aspects of exporter performance. We decompose the log of a firm's exports into the log number of its export destinations (market reach) and its log exports per destination (market penetration). We relate these two outcomes next year to the firm's present characteristics, including its hires of former exporter workers.

Table 9 shows two sets of three regressions for exporting firms, one set with the log number of destinations as dependent variable (columns 1 through 3) and one set with the log exports per destination as dependent variable (columns 4 through 6). Each regression conditions on the other outcome variable to isolate the covariation of predictors. A firm's workforce characteristics exhibit similar covariations with the outcomes as in our binomial regression of exporting on current characteristics (Table 3), so we suppress the workforce shares and the MNE indicator for brevity.

In a short regression, neither the indicator for hiring former exporter workers nor the log number of hired exporter workers are significant predictors of market reach at the 1-percent significance level (column 1). The log number of hired exporter workers, however, is a significant predictor of export-market penetration in a short regression (column 4). We next bring to bear exporter categories in our data to discern between hires from continuous exporters and hires from recent export starters. For both outcomes at the hiring firm, market reach (column 2) and market penetration (column 5), now the log number of workers hired from continuous exporters is a significant predictor of better export performance, but not the number of hires from export starters. This finding is consistent with the idea that workers with a background at continuous exporters have unobserved characteristics that are more important for reaching more destinations and deeper into destination than workers just with prior experience at recent export starters.

Finally, we bring to bear both additional worker-level and exporter information in our data to gain more detailed insight from long regressions. Among the hires from exporters, mostly workers in marketing occupations at the prior employer predict a wider market reach at the hiring firm (column 3) but not a deeper export-market penetration (column 6). Mostly workers in skilled blue-collar occupations at the prior employer predict a deeper market penetration by the hiring firm (column 6) but not a wider export-market reach (column 3). A larger overlap of export destinations between the prior employer and the current employer predicts a higher success for both market reach and penetration at the hiring firm. These findings are consistent with the idea that workers bring with them destination-specific knowledge. The findings also invite speculation that salespersons may be more important to

Table 9: PREDICTIONS OF FUTURE EXPORTER PERFORMANCE

	Log # Destinations $(t+1)$			Log Exports/Dest. $(t+1)$		
Predictor (t unless noted)	(1)	(2)	(3)	(4)	(5)	(6)
Log # Destinations $(t+1)$				.114 (.012)*	.114 (.012)*	.104 (.012)*
Log Exports/Destination $(t+1)$	.029 (.003)*	.029 (.003)*	.026 (.003)*			
Log Employment	.204 (.008)*	.198 (.008)*	.186 (.008)*	.275 (.016)*	.276 (.016)*	.261 (.017)*
Rel. Empl. Chg. ($t-1$ to t per t)	-.001 (.0008)	-.001 (.0008)	-.001 (.0008)	-.002 (.001)	-.002 (.001)	-.002 (.001)
Indic.: Hires from Exporters	-.010 (.008)			-.002 (.016)		
Log Gross Hires from Exp.	.009 (.004)			.039 (.007)*		
Indic.: Hires from Start Exp.		-.009 (.006)	.010 (.006)		.023 (.012)	.031 (.012)
Log Gross Hires from Start Exp.		.006 (.005)	.016 (.005)*		.014 (.009)	.015 (.010)
Indic.: Hires from Cont. Exp.		.007 (.007)	-.001 (.010)		.010 (.014)	.010 (.020)
Log Gross Hires from Cont. Exp.		.011 (.004)*	-.003 (.005)		.029 (.008)*	.007 (.009)
Indic.: Skld. Bl. Hires fr. Exp.			.009 (.009)			-.034 (.020)
Log Gr. Skld. Bl. Hires fr. Exp.			-.005 (.004)			.029 (.009)*
Indic.: Mkt. Occ. Hires fr. Exp.			-.0007 (.006)			.008 (.012)
Log Gr. Mkt. Occ. Hires fr. Exp.			.014 (.005)*			-.006 (.010)
Mean # Overlapping Dest.			.048 (.002)*			.026 (.003)*
Indic.: High-skill firm	.022 (.010)	.023 (.010)	.016 (.010)	.004 (.021)	.004 (.021)	.004 (.021)
Indic.: High-sk. frm. $\times$ Ind.: Hires fr. Exp.			-.070 (.010)*			-.044 (.022)
Observations	56,141	56,141	56,141	56,141	56,141	56,141
R^2 (within)	.042	.042	.060	.034	.034	.036

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), current and future manufacturing exporters (subsectors IBGE 2-13).

Notes: Linear regressions, controlling for firm fixed effects, sector and year effects, and sectoral absorption. Workforces on December 31st. Exports (fob) in thousands of August-1994 USD. Log number of gross hires from exporters set to zero if zero hires. High-skill firms are firms with share of technical/supervisory and professional/managerial occupations in top quartile of firm-year observations. Additional workforce and MNE control variables as in Table 5. Robust standard errors in parentheses; asterisk marks significance at 1-percent level.

Table 10: PREDICTIONS OF FUTURE EXPORTER PERFORMANCE, CONTROLLING FOR DEPARTING WORKERS TO EXPORTERS

	Log # Destinations ($t+1$)			Log Exports/Dest. ($t+1$)		
Predictor (t)	(1)	(2)	(3)	(4)	(5)	(6)
Indic.: Departures to Exporters	.011	.012	.017	.0008	.002	-.004
	(.006)	(.006)	(.007)	(.013)	(.013)	(.014)
Log Gross Departures to Exp.	.001	-.0004	-.008	-.017	-.019	-.023
	(.004)	(.004)	(.004)	(.007)	(.007)	(.008)*
Observations	56,141	56,141	44,463	56,141	56,141	44,463
R^2 (within)	.042	.042	.067	.034	.035	.038

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), current and future manufacturing exporters (subsectors IBGE 2-13).
Notes: Linear regressions, controlling for firm fixed effects, sector and year effects, and sectoral absorption. Additional workforce and MNE control variables as in Table 9. Robust standard errors in parentheses; asterisk marks significance at 1-percent level.

reach additional destinations (perhaps because they know market characteristics and clients), whereas production skills (perhaps for high quality and timely delivery) are more relevant for deeper penetration of a market with additional sales.

Performance after departures of workers to exporters. For a final investigation as to how knowledge may move with workers, we consider the effect of departing workers on an exporter's success. For this purpose, we track a worker who separates from a firm to the immediately following formal-sector employment for up to three subsequent years and obtain the future employer's export status (mirroring the definition for hires from exporters). This allows us to define *departures to exporters* as separating workers whose following formal-sector employment is at an exporter.

We include an indicator for such worker departures to exporters and the log number of departures to exporters as additional regressors into the specifications of market reach and market penetration before. Table 10 reports the results for the two new variables. Remarkably, the log number of departures is a significant predictor only for market penetration (in the specification of column 6). A consistent interpretation is that current exporters might only suffer a significant loss in market penetration but not in market reach, once they know how to access a given set of foreign markets.

This result is interesting in at least two regards. First, the result offers a potential explanation why worker poaching can be successful. While the hiring firm may expect to improve export outcomes in two dimensions, both regarding market reach and market penetration, the losing firm may expect to suffer only in the dimension of market penetration. This difference in product-market outcomes potentially raises the marginal product of the poached worker for the hiring firm above the value for the losing firm. Second, the result offers suggests that worker mobility may be an efficient mechanism by which knowledge spreads through

an economy. If the moving worker's marginal product increases with the move, the spread of knowledge is welfare improving.

6 Concluding Remarks

Using rich linked employer-employee data that track Brazilian manufacturing firms, their exports and individual workers over more than a decade, we document substantive size and performance differences among exporters, not just between exporters and non-exporters. Despite this diversity in export-market performance and employment, the workforce composition varies little among exporters. Looking into typically unobserved aspects of workers' job histories, we find that hiring a small number of former exporter workers is an important predictor of a firm's export-market success. To measure the extent of active workforce preparations for future exporting, we use import demands for non-Brazilian goods outside Latin America as instruments. We find that firms hire former exporter workers in response to favorable demand conditions abroad and in advance of expected export-market entry.

Hiring workers from marketing-related occupations at former exporters predicts a wider reach of destinations, and hiring skilled blue-collar workers from exporters predicts a deeper penetration of destinations. Yet the exact origins of former exporter workers' skills remain a matter for future research. Former exporter workers may have special skills from passive learning or active training at former exporters, they may know individual clients or have broad insight into destination-market characteristics, or their prior exporter employment may simply signal a screened ability.

Our results are consistent with the idea that firms, especially firms with long-term export potential, actively contract a competitive workforce to add to their initial advantage, and then select to export. So firms prepare for expected export-market participation through prior workforce upgrading. These workforce preparations are consistent with recent trade models where firms can both choose export-market participation and engage in innovation, while each activity raises the return to the other. So a firm's competitive advantage is partly under its own control, and firms share in an economy's knowledge pool through mobile workers.

Appendix

A RAIS linked employer-employee information

Brazilian law requires every Brazilian plant to submit detailed annual reports with individual information on its workers and employees to the ministry of labor (*Ministério de Trabalho*, MTE). The collection of the reports is called *Relação Anual de Informações Sociais*, or RAIS, and typically concluded at the parent firm by March for the preceding year of observation. RAIS is a nationwide, comprehensive annual record of workers formally employed in any sector (including the public sector). RAIS covers, by law, all formally employed workers, captures formal-sector migrants, and tracks the workers over time. By design, however, workers with no current formal-sector employment are not in RAIS. The data provides monthly spell information on individually identified workers at individually identified plants. Similar to our treatment of the SECEX data, we aggregate the monthly worker-plant information to years and firms. Annual aggregation removes seasonal fluctuations in worker accession and separation rates from the data.

RAIS primarily provides information to a federal wage supplement program (*Abono Salarial*), by which every worker with formal employment during the calendar year receives the equivalent of a monthly minimum wage. A strong incentive for compliance is that workers' benefits depend on RAIS so that workers follow up on their records. The payment of the worker's annual public wage supplement (*Abono Salarial*) is exclusively based on RAIS records. The ministry of labor estimates that currently 97 percent of all formally employed workers in Brazil are covered in RAIS, and that coverage exceeded 90 percent throughout the 1990s.

We keep observations for the years 1990 through 2001, drop all firms outside manufacturing, and then use the data for the construction of several sets of variables. First, we use employment on December 31st to obtain information on the firm's workforce size and composition across all its plants. We pay attention mainly to the education and occupation categories and construct according shares (see Appendix A for definitions). Second, we use worker IDs to trace recent hires at potential exporting firms back to their preceding employer and count the number of gross hires who were employed at an exporter in their immediately preceding job. For the purpose of worker tracking, we restrict the worker sample to all proper worker IDs (11-digit *PIS*).

Third, we obtain industry information for every firm. RAIS reports industries at the subsector IBGE classification (roughly comparable to the *NAICS 2007* three-digit level) over the full sample period. Subsector IBGE industries are recorded by plant, however. There are multi-plant firms in our sample, and we assign the industry associated with most employees in a given year to multi-plant firms. At the subsector IBGE level, there are twelve manufacturing industries in RAIS. The main sector affiliation of firms varies over time. There are 36,599 observations of firms that change sector so that firm effects are not nested within sector ef-

Table A.1: FIRM CHARACTERISTICS BY INDUSTRY

Subsector IBGE	Firm-year observ.	Workers per firm	Share (%) exporters	Workers per exp.	Exports per exp.
Non-metallic mineral products	137,091	18.8	.026	212.5	1,574.7
Metallic products	201,093	24.8	.046	288.4	5,974.8
Machinery, equipment and instruments	73,976	39.4	.152	167.9	1,962.3
Electrical and telecomm. equipment	40,603	51.9	.123	285.8	2,618.3
Transport equipment	39,169	80.9	.103	622.4	13,010.7
Wood products and furniture	234,913	15.2	.042	120.1	1,064.9
Paper and paperboard, and publishing	132,108	23.0	.023	349.9	5,118.3
Rubber, tobacco, leather, and prod. nec.	96,152	25.3	.082	173.1	2,805.6
Chemical and pharmaceutical products	131,110	37.2	.099	206.4	2,100.9
Apparel and textiles	332,926	20.6	.025	314.1	1,290.1
Footwear	48,881	46.5	.099	335.2	2,630.4
Food, beverages, and ethyl alcohol	299,469	34.1	.024	637.2	9,372.6
Total	1,767,491	27.7	.049	278.9	3,598.7

Sources: SECEX and RAIS 1990-2001, manufacturing firms (subsectors IBGE 2-13).
Notes: Employment on December 31st. Exports (fob) in thousands of August-1994 USD.

fects in later empirical analysis. While RAIS offers comprehensive workforce information, data on domestic sales are neither available from SECEX nor RAIS.

Table A.1 reports firm counts, the share of exporters (from the link to SECEX exporter information) and select firm characteristics by subsector IBGE. On average, only about 5 percent of Brazilian formal-sector manufacturing firms are exporters, a considerably smaller share than in Chile, where 21 percent of manufacturing plants are exporters in 1990-96 (Alvarez and López 2005), or Colombia (18 percent of plants in 1991 Brooks 2006), Mexico (36 percent of plants in 1996, Iacovone and Javorcik 2008) or the United States (18 percent of firms in 2002, Bernard et al. 2007). Exporting is most frequent in machinery and equipment manufacturing industries, where workforce sizes per firm also tend to be large. Except for transportation equipment, the industries with most frequent exporting are populated by firms with below-average sizes and below-average exports per firm. We will account for sector differences with industry-fixed effects in all later regressions.

B SECEX exports data

All export values in the SECEX exports data are reported in current U.S. dollars (USD), free on board (fob). We have observations on exporting plants, declared export values and export destinations for the years 1990 through 2001. We aggregate monthly plant-level export information to years and firms. As mentioned in the text, we deflate export sales to their August-1994 equivalents using the monthly U.S. consumer price index (from Global Financial Data). Table A.1 reports firm counts, exporter shares and select firm characteristics by

Table B.2: SUMMARY STATISTICS

	All firms	Ex-porters	Export Status (t)		
			Continuous	Start	Quit
Variable	(1)	(2)	(3)	(4)	(5)
Foreign-market participation					
Indic.: Exporter (t)	.049	1.000	1.000	1.000	
Indic.: Affiliate of foreign MNE (t)	.0001	.0005	.0007	.0002	.0002
Log # Destinations (t)	.986	.986	1.375	.376	
Log Exports/Destination (t)	3.832	3.832	4.423	2.906	
Anticip. Continuous Exporting ($t+1$)	.031	.619	.854	.252	
Anticip. Start Exporting ($t+1$)	.017	.136		.350	.192
Anticip. Quit Exporting ($t+1$)	.013	.163	.076	.298	.398
Anticip. Non-exporter for three years ($t+1$)	.741				.287
Size					
Employment (t)	28.2	285.4	386.1	127.9	87.2
Net Employment Change ($t-1$ to t)	-.2	-5.5	-13.0	7.2	-6.1
Workforce characteristics					
Share: Unskilled blue-collar occupation (t)	.130	.127	.120	.137	.132
Share: Skilled blue-collar occupation (t)	.631	.576	.573	.580	.560
Share: White-collar occupation (t)	.239	.297	.306	.283	.309
Share: Primary school education (t)	.756	.673	.662	.690	.690
Share: High school education (t)	.207	.232	.234	.229	.228
Share: Tertiary education (t)	.037	.095	.104	.081	.081
Workforce background					
Indic.: Hires from Exporters (in t)	.205	.741	.786	.671	.529
Gross Hires from Exporters (in t)	1.1	12.1	15.2	7.3	3.5

Sources: SECEX and RAIS 1990-2001 (t: 1992-2000), manufacturing firms (subsectors IBGE 2-13).
Notes: 1,557,474 regression sample observations (employment change based on 1,277,201 observations of firms with consecutive-year presence). Export status as defined in Table 1. Current exporters (column 2) include firms with continuous exporting (column 3) or that start exporting (column 4) but not firms that recently quit exporting (column 5). Workforces on December 31st. Exports (fob) and annualized December wages in thousands of August-1994 USD.

Table C.3: EDUCATION CATEGORIES

	RAIS category	Education Level
1.	8.-9.	Some College or College Graduate
2.	6.-7.	Some High School or High School Graduate
3.	1.-5.	Illiterate, or Primary or Middle School Educated (*reference category*)

subsector IBGE.[26]

Table B.2 summarizes variables for the universe of manufacturing firms, restricting the sample to 1992-2000 to account for one lead in addition to two lags in export status. There are substantive differences in export-market participation among exporters. Compared to firms that start exporting, continuous exporters serve 2.7 times (one log unit) more destinations and have 4.6 times (one-and-a-half log units) larger sales per destination. Continuous exporters have only a one-in-twelve chance to quit exporting, while firms that recently started exporting (within the past two years) quit exporting with a one-in-three chance.

Exporting is transitory for most Brazilian exporters. Similar to evidence in Brooks (2006) for Colombian plants between 1981 and 1991, only a fraction of any cohort of first-time exporters continues to export after a year. Of the 1993 cohort, for instance, less than a quarter of firms is still an exporter by 1998, five years later. Of the 1996 cohort, only slightly more than a quarter of firms is still an exporter by 2001.[27]

XXX negative net employment change at continuous exporters, consistent with evidence in Menezes-Filho and Muendler (2007). XXX

C Education and occupation categories in RAIS

We group education information from nine RAIS education categories into three categories as shown in Table C.3.

Occupation indicators derive from the 3-digit CBO classification codes in our nationwide RAIS data base, and are reclassified to conform to ISCO-88.[28] We map RAIS occupations into ISCO-88 categories and regroup them into five categories as shown in Table C.4.

Earnings. For descriptive purposes, we use the monthly December wage paid to workers with employment on December 31st of a given year. RAIS reports the December wage in

[26] We consider as industrialized countries the 24 OECD member countries in 1990: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal (including Madeira Islands), Spain (including Alborán, Parsley Island, and Canary Islands), Switzerland, Turkey, United Kingdom (including Channel Islands), and the United States. We exclude the following types of exports and destinations: immediate reexports of imports, on-board aircraft consumption, and non-declared destinations.

[27] An empirical supplement with according tabulations is available at URL *econ.ucsd.edu/muendler*.

[28] See online documentation at URL *econ.ucsd.edu/muendler/brazil*.

multiples of the current minimum wage. We use the log of annualized December wages as our earnings measure, defined as the reported monthly wage times the December U.S. dollar equivalent of the current minimum wage times 12. Similar to export values, we deflate this earning measure to its August-1994 equivalent using the monthly U.S. consumer price index (from Global Financial Data).

Sector and legal form. Sector information for the firm is not available from the exporter data (SECEX), which only reports exported products, so we extract a firm's industry from RAIS. We use the annual mode of subsector IBGE across the firms' workers because, within the firms, plants can operate in different sectors. Subsector IBGE information is reported for the full sample period, whereas finer industry categories only become available in later years.

RAIS also reports a firm's legal form, including its direct foreign ownership by a foreign company (the according legal form code is "branch or office of foreign company"). Indirect foreign ownership, minority foreign ownership, or portfolio holdings do not fall under this category. We use the annual mode of legal form across the firms' workers to deal with occasional coding errors of legal form. The self-reported foreign-ownership category in RAIS potentially differs from foreign ownership in Poole (2009), who uses independent information on direct and indirect foreign ownership from the Central Bank of Brazil for a shorter sample period.

Table C.4: OCCUPATION CATEGORIES

	ISCO-88 occupation category	Occupation Level
1.	Legislators, senior officials, and managers	Professional or Managerial
	Professionals	Professional or Managerial
2.	Technicians and associate professionals	Technical or Supervisory
3.	Clerks	Other White Collar
	Service workers and sales workers	Other White Collar
4.	Skilled agricultural and fishery workers	Skilled Blue Collar
	Craft and related workers	Skilled Blue Collar
	Plant and machine operators and assemblers	Skilled Blue Collar
5.	Elementary occupations	Unskilled Blue Collar (*reference category*)

References

Alvarez, Roberto, and Ricardo A. López. 2005. "Exporting and Performance: Evidence from Chilean Plants." *Canadian Journal of Economics*, 38(4): 1384–1400.

Alvarez, Roberto, and Ricardo A. López. 2008. "Is Exporting a Source of Productivity Spillovers?" *Review of World Economics*, 144(4): 723–749.

Atkeson, Andrew, and Ariel T. Burstein. 2008. "Pricing-to-Market, Trade Costs, and International Relative Prices." *American Economic Review*, 98(5): 1998–2031.

Aw, Bee Yan, Mark J. Roberts, and Daniel Yi Xu. 2009. "R&D Investment, Exporting, and Productivity Dynamics." *NBER Working Paper*, 14670.

Bernard, Andrew B., and J. Bradford Jensen. 1995. "Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987." *Brookings Papers on Economic Activity: Microeconomics*, 1995(1): 67–112.

Bernard, Andrew B., and J. Bradford Jensen. 1999. "Exceptional Exporter Performance: Cause, Effect, or Both?" *Journal of International Economics*, 47(1): 1–25.

Bernard, Andrew B., J. Bradford Jensen, and Peter K. Schott. 2009. "Importers, Exporters, and Multinationals: A Portrait of Firms in the U.S. that Trade Goods." In *Producer Dynamics: New Evidence from Micro Data*. Vol. 68 of *Studies in Income and Wealth*, , ed. Timothy Dunne, J. Bradford Jensen and Mark J. Roberts, Chapter 14, 513–552. Chicago:University of Chicago Press.

Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott. 2007. "Firms in International Trade." *Journal of Economic Perspectives*, 21(3): 105–30.

Brooks, Eileen L. 2006. "Why Don't Firms Export More? Product Quality and Colombian Plants." *Journal of Development Economics*, 80(1): 160–78.

Bustos, Paula. 2010. "Trade Liberalization, Exports and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinean Firms." *American Economic Review*. forthcoming.

Clerides, Sofronis K., Saul Lach, and James R. Tybout. 1998. "Is Learning by Exporting Important? Micro-dynamic Evidence from Colombia, Mexico, and Morocco." *Quarterly Journal of Economics*, 113(3): 903–47.

Costantini, James A., and Marc J. Melitz. 2008. "The Dynamics of Firm-Level Adjustment to Trade Liberalization." In *The Organization of Firms in a Global Economy*. , ed. Elhanan Helpman, Dalia Marin and Thierry Verdier, Chapter 4, 107–141. Cambridge, Mass.:Harvard University Press.

Crespi, Gustavo, Chiara Criscuolo, and Jonathan Haskel. 2008. "Productivity, Exporting and the Learning-by-Exporting Hypothesis: Direct Evidence from U.K. Firms." *Canadian Journal of Economics*, 41(2): 619–638.

Dixit, Avinash K. 1989. "Hysteresis, Import Penetration, and Exchange Rate Pass-Through." *Quarterly Journal of Economics*, 104(2): 205–28.

Ederington, Josh, and Phillip McCalman. 2008. "Endogenous Firm Heterogeneity and the Dynamics of Trade Liberalization." *Journal of International Economics*, 74(2): 422–40.

Feenstra, Robert C., Robert E. Lipsey, Haiyan Deng, Alyson C. Ma, and Hengyong Mo. 2005. "World Trade Flows: 1962-2000." *NBER Working Paper*, 11040.

Fías, Judith A., David S. Kaplan, and Eric A. Verhoogen. 2009. "Exports and Wage Premia: Evidence from Mexican Employer-Employee Data." Columbia University, unpublished manuscript.

Gershenberg, Irving. 1987. "The Training and Spread of Managerial Know-How, a Comparative Analysis of Multinational and Other Firms in Kenya." *World Development*, 15(7): 931–39.

Görg, Holger, and Eric Strobl. 2005. "Spillovers from Foreign Firms through Worker Mobility: An Empirical Investigation." *Scandinavian Journal of Economics*, 107(4): 693–709.

Granger, Clive W.J. 1969. "Investigating Causal Relations by Econometric Models and Cross-spectral Methods." *Econometrica*, 37(3): 424–38.

Hopenhayn, Hugo A. 1992. "Entry, Exit, and Firm Dynamics in Long Run Equilibrium." *Econometrica*, 60(5): 1127–50.

Iacovone, Leonardo, and Beata S. Javorcik. 2008. "Shipping Good Tequila Out: Investment, Domestic Unit Values and Entry of Multi-product Plants into Export Markets." University of Oxford, unpublished manuscript.

Isgut, Alberto E. 2001. "What's Different about Exporters? Evidence from Colombian Manufacturing." *Journal of Development Studies*, 37(5): 57–82.

López, Ricardo A. 2009. "Do Firms Increase Productivity in Order to Become Exporters?" *Oxford Bulletin of Economics and Statistics*, 71(5): 621–642.

Melitz, Marc J. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica*, 71(6): 1695–1725.

Menezes-Filho, Naércio Aquino, and Marc-Andreas Muendler. 2007. "Labor Reallocation in Response to Trade Reform." *CESifo Working Paper*, 1936.

Poole, Jennifer P. 2009. "Knowledge Transfers from Multinational to Domestic Firms: Evidence from Worker Mobility." University of California, Santa Cruz, unpublished manuscript.

Rhee, Yung Whee. 1990. "The Catalyst Model of Development: Lessons from Bangladesh's Success with Garment Exports." *World Development*, 18(2): 333–46.

Roberts, Mark J., and James R. Tybout. 1997. "The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs." *American Economic Review*, 87(4): 545–64.

Stock, James H., Jonathan H. Wright, and Motohiro Yogo. 2002. "A Survey of Weak Instruments and Weak Identification in Generalized Method of Moments." *Journal of the American Statistical Association*, 20(4): 51829.

Trefler, Daniel. 2004. "The Long and Short of the Canada-U.S. Free Trade Agreement." *American Economic Review*, 94(4): 870–95.

Van Biesebroeck, Johannes. 2005. "Exporting Raises Productivity in Sub-Saharan African Manufacturing Firms." *Journal of International Economics*, 67(2): 373–91.

Verhoogen, Eric A. 2008. "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector." *Quarterly Journal of Economics*, 123(2): 489–530.

Yeaple, Stephen R. 2005. "A Simple Model of Firm Heterogeneity, International Trade, and Wages." *Journal of International Economics*, 65(1): 1–20.