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Export wage premium for south Brazilian firms: Interaction between export, human capital, and export destination

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Abstract

This paper looks for evidence of learning-by-exporting effects on firms' average wages and its interaction with human capital level and export destination. This interaction allows us to test the hypothesis that a wage premium for exporting firms should mainly be found in firms employing high-skilled labor. The analysis is based on panel data for the 2010–2013 period and approximately 305,000 south Brazilian firms. We explore different times of entry into export market to use a fixed effects specification. Our results show that on average there are no learning-by-exporting effects on average wages for firms in our sample. However, when interacting firms export status with its human capital level, the effects turn out to be statistically significant. Finally, results suggest that the interaction between export gains and firms' human capital level is driven by firms exporting to developing countries. We explain this last result by the following mechanism. Low wage countries mainly produce low quality goods. Therefore, firms employing high skilled labor can differentiate their products and consequently escape from intense competition from these countries in the foreign market, obtaining higher export gains.

1. Introduction

Exporting activity as a distinguishing factor in the performance of firms, has been the object of study over the last twenty years. This literature was initiated by Bernard et al. (1995) who found evidence of productivity and wage premia in exporting firms. Since then, several studies have reached similar conclusions: exporting firms are more productive and pay higher wages than non-exporters (see Wagner (2012) for a survey).

The literature explains these results through two mechanisms. The first is related to a self-selection effect: only the more productive firms, with higher wages, can bear the extra costs of entering and competing in foreign markets (see Melitz (2003) for a theoretical justification of the self-selection effect). The second stipulates a learning-by-exporting effect: once firms enter into export markets they gain new knowledge and expertise which allows them to improve their efficiency levels. If wages are higher in more productive firms due to higher profits and rent-sharing, we may expect

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that exporting leads to higher wages (Baldwin and Cain, 2000; Bernard and Jensen, 1999, 1997). In this case, the export wage premium comes from a causal effect of exporting. While the self-selection hypothesis has been confirmed by various authors, the evidence on the learning hypothesis has been less clear-cut (Roberts and Tybout, 1997; Bernard and Jensen, 1999; Bernard et al., 1995; Aw et al., 2000; Van Biesebroeck, 2005; De Loecker, 2007; Schank et al., 2010, 2007).

In this paper we look for evidence of an export wage premium for firms. Firstly, we try to disentangle learning-by-exporting and self-selection effects. Secondly, we assess whether and how the wage premium is linked to export destination and human capital. We argue that by looking at the export destination, we can understand better the link between export gains and firms human capital level and test in a more adequate way the hypothesis of Munch and Skaksen (2008) on the interaction between these two. According to the authors, if there is a wage premium for exporting firms, it should mainly be found in firms employing high-skilled labor. The mechanism is the following. Low wage countries mainly produce low quality goods. Thus, firms employing high skilled labor may differentiate their products and consequently escape intense competition in the foreign market from low wage country firms (which employ less skilled labor more frequently). Lower product market competition, in turn, is likely to spill over into wages and lead to better firms performance.

To test this relation, besides looking at the interaction between firms export status and its human capital level, we also propose to look for this interaction with export destination. Our hypothesis is that in the developing countries' market there is a more intense competition among low wage country firms (including the competition with domestic firms in these developing countries). If that is the case, firms exporting especially to developing countries may have a greater export wage premium when employing high educated labor. Our hypothesis finds foundation in Blanes-Cristóbal et al. (2008), which shows that the costs of entering into developed countries' market is higher. Therefore, firms from developing countries are more likely to ship their products only to less developed regions. In that case, competition among low wage country firms is in fact more intense in these markets.

By looking at export destination, this paper also contributes to a recent literature that tests the hypothesis of higher performance levels for firms exporting to more developed countries. Some studies evaluating the productivity of exporting firms corroborate this hypothesis. De Loecker (2007) finds that firms exporting to developed regions have a higher productivity premium due learning effects. Pisu (2008) finds that this is due a self-selection effect. Evaluating German firms, Verardi and Wagner (2012) find that firms that export to countries not located in eurozone are more productive than firms that export only to countries located in eurozone, mainly because of self-selection effects. Therefore, evidence of diverse learning-by-exporting effects by destination is not conclusive. Also, we did not find studies evaluating wages as an outcome. Thus, we will evaluate possible heterogeneities in the export effects on wages according to the income level of the destination country.

Our empirical analysis is based on a firm-level panel data for the four-year period 2010–2013, containing information on firms from a south Brazilian state: Rio Grande do Sul. We explore the possibility of observing firms entering into the foreign market at different times to estimate a fixed effects model and slightly mitigate self-selection effects. Although export timing is not exogenous, we believe that comparing exporting firms with different times of entry into the foreign market can be a way to obtain cleaner estimates of the learning-by-exporting effects on firms average wages and its interaction with firms human capital and export destination. Given the sample in hands, one last contribution of this paper is with the national literature. Although we can not guarantee external validity of our results for the population of Brazilian firms, there is no other study in the national literature evaluating heterogeneous export wage premium by destination and firms' human capital that tries to disentangle learning-by-exporting and self-selection effects.[1]

The remainder of the paper is organized as follows. Section 2 presents and discusses the data, while Section 3 describes our methodology and identification strategy. Finally, Section 4 presents the results and is followed by concluding remarks in Section 5.

[1] da Silva Catela and Gonçalves (2013) show that the greater the involvement of firms in international trade, whether through imports or exports, the higher the wage premium. However, they do not try to disentangle self-selection bias from learning-by-exporting effects. Casagrande et al. (2018) identify aggregated learning-by-exports effects, but with no differentiation regarding destinations and firms' human capital.

Table 1
Distribution of firms across export status and years (2010–2013).

Year	Non-exporter	Exporter	Total
2010	213,828	1988	215,816
2011	222,606	2048	224,654
2012	229,068	2095	231,163
2013	236,570	2162	238,732
Total	902,072	8293	910,365

Table 2
Distribution of firms across export status, size, and years (2010–2013).

	≤ 50 employees			> 50 employees		
Year	Total (T)	Exporters (E)	Ratio (E/T)	Total (T)	Exporters (E)	Ratio (E/T)
2010	206,198	886	0.43%	9,618	1102	11.46%
2011	214,259	910	0.42%	10,395	1138	10.95%
2012	220,348	927	0.42%	10,815	1168	10.8%
2013	227,762	983	0.43%	10,97	1179	10.75%

Table 3
Distribution of firms across export status, size, destinations,and years (2010–2013).

Year	U	U/T	U&D	U&D /T	D	D/T	Total (T)
				≤ 50 employees			
2010	527	59.48%	200	22.57%	159	17.95%	886
2011	561	61.65%	189	20.77%	160	17.58%	910
2012	223	24.06%	313	33.76%	391	42.18%	927
2013	228	23.19%	327	33.27%	428	43.54%	983
Total	1539	41.53%	1,029	27.77%	1138	30.71%	3,706
				> 50 employees			
2010	453	41.11%	554	50.27%	95	8.62%	1.102
2011	498	43.76%	557	48.95%	83	7.29%	1.138
2012	139	11.90%	761	65.15%	268	22.95%	1.168
2013	125	10.60%	783	66.41%	271	22.99%	1.179
Total	1215	26.49%	2,655	57.88%	717	15.63%	4,587

2. Data

Our empirical analysis relies on the identified firms microdata from Relação Anual de Informações Sociais (RAIS), merged with data on Brazilian exporter firms from Secretaria de Comércio Exterior (SECEX). RAIS and SECEX data contains information on all Brazilian formal firms and all Brazilian exporter firms, respectively. SECEX data also includes information on export destinations. Due to data access restrictions we analyze firms from the Brazilian state of Rio Grande do Sul during the four-period 2010–2013. Since we do not have a random sample of Brazilian formal firms, it is not our intention to guarantee external validity of our results for the population of Brazilian formal firms. Still, the results remain relevant as we are analyzing a large number of firms over the cited period. Moreove, the employment and exports of Rio Grande do Sul are over-represented in Brazil, as it accounts for 5.6% of the national population, 6.4% of employment, 3.4% of manufacturing firms, 11.8% of manufacturing exporting firms and 10.4% of exports. To further describe the exporting industry sample in Rio Grande Sul, we detail the industry distribution of exports from Rio Grande do Sul in Table 11 in the appendix, what confirms the importance of Rio Grande do Sul in many sectors of the national exports (27 over 22 Harmonized System sections).

In Table 1 we present information on the number of firms analyzed. The panel is unbalanced and comprises 305,233 different firms, of which 65% we have data for at least three years. In Table 2 we present dissagregated information

Table 4
Means of firms' selected characteristics, by export status (pooled).

Variable	Non-Exporters (NE)	Exporters (E)	(NE)-(E)
Average hourly wages	20.500	26.650	−6.156***
			(0.401)
Weekly hours	41.680	43.040	−1.366***
			(0.068)
Number of employees	17.370	333.700	−316.3***
			(4.610)
Human Capital	0.050	0.079	−0.0293***
			(0.002)
Average schooling years	10.790	10.720	0.0767**
			(0.024)
Average ages	34.680	33.940	0.734***
			(0.104)
Obs	902,072	8,293	

Note: We pool observations across all years and to compute the shares. According to a t test, significant at 1% (***). In parenthesis, standard errors of the mean-differences. Human capital is measured as the proportion of employees in a firm with at least complete college. Average hourly wages are measured in Brazilian Reais.

Table 5
Learning-by-exporting effects.

	(a)	(b)	(c)	(d)	(e)	(f)
$\beta: Exp$	0.0177	0.0184	0.0315*	0.0299*	−0.0133	−0.0173
	(0.0133)	(0.0132)	(0.0159)	(0.0158)	(0.0181)	(0.0181)
Controls	No	Yes	No	Yes	No	Yes
Sample	All	All	≤50	≤50	>50	>50
Observations	853,718	853,718	809,827	809,827	38,565	38,565
R-squared	0.896	0.897	0.891	0.892	0.968	0.967

Note: Significant at 1% (***), 5% (**), and 10% (*). In all models the dependent variable is the natural logarithm of average hourly wages. Regressions with fixed effect for firm, year and sector-year. In parentheses, robust standard errors clustered at firm level.

for firms with more and less then 50 employees.[2] Among the largest firms the proportion of exporters is much higher (approximately 0.4% vs 10.5%).

In Table 3 we disaggregated statistics from table 2 to present information on export destinations. We divide exporters in three categories: those that export only to developing countries, those that export to both developing and developed countries, and those that export only to developed countries. Here, a country is considered developed (D) in the year $t \in \{2010, 2011, 2012, 2013\}$ if according to the World Bank classification (for the year t) this country belongs to the category high-income. In period t, developing (U) countries are the ones classified as low income, low-middle income and high-middle income.[3] From 2010 to 2013, the number of Brazilian firms exporting to developed markets increases substantially,

Finally, in Table 4 we show descriptive statistics on characteristics of the firms in the selected sample using RAIS data. Exporters pay, on average, higher wages, are larger and have a higher number of employees with at least complete college (human capital). The wage variable used in the empirical analysis is constructed from two variables of RAIS database. The first one is the nominal contractual wage, namely "SALARIO CONTRATUAL" and the second one is the contracted hours, namely "HORAS CONTR". The wage variable is the log of the ratio of the former over the latter.

[2] We follow the division in Munch and Skaksen (2008).

[3] Our main empirical results are not sensible if we consider high-middle income countries as developed. For example, Uruguai and Chile belong to the high-middle income category.

3. Empirical strategy

The main model used here to test the learning-by-exporting effect is the following fixed effects specification

$$lnW_{it} = \kappa + \beta Exp_{it} + \lambda_t + \alpha_i + \theta_{st} + u_{it} \quad (1)$$

where lnW_{it} is the natural logarithm of the average hourly wages of a firm i in a period t. The variable Exp_{it} is a binary variable indicating if a firm i exports in a period t, λ_t is a time fixed effect, α_i is a firm fixed effect, θ_{st} is a sector-specific time fixed effect[4], and u_{it} is an idiosyncratic error term. The parameter of interest is β and its OLS estimation is an average of many 2×2 difference-in-differences (DID) estimators (Goodman-Bacon, 2018), where firms that start exporting are compared with never exporters, early exporters with late exporters, and late exporters with early exporters.[5] Since we are considering disaggregated time fixed effects, these comparisons are made inside each of the 270 sectors considered and then averaged according to the sector size. The main (non-testable) assumption for identification of the (variance weighted) average treatment effects on the treated (i.e. the learning-by-exporting effect for exporting firms) is the pairwise common trends assumption between any pair of groups (and over different time periods).[6] This must hold for firms inside a same sector, but not between firms from different sectors.

Although some studies found in the literature evaluating learning-by-exporting effects also uses a DID model, we have some concerns regarding the identification hypothesis. Our main concern is with the existence of time-varying latent determinants of firms performance that follows differential paths between non exporters and exporters. It is already well known that firms with better performance self-select into exporting. If this selection is based on time invariant unobserved characteristic, then the firm fixed effects included in our specification account for it. However it may be that before exporting, firms have positive productivity shocks due time-varying unobserved characteristics that are specific to these firms. If this is the case, the identification assumption may not hold. If the time-varying unobserved characteristics are correlated with firms performance, the outcome of exporting firms, if they had not started exporting, would probably not follow the same path of the outcome of non exporting firms.

To deal to some degree with these issues Eq. (1) includes sector-specific fixed effects interacted with time fixed effects so that we allow differential paths in time-varying latent determinants of firms performance between exporters and non exporters of different sectors. This strategy aims at making the identification assumption more flexible, but of course does not eliminate the bias caused by differential trends within each sector. However, the comparison between early exporters with late exporters, and late exporters with early exporters tends to mitigate part of this selection bias. One may argue that the common trend assumption may hold for firms from the same sector that started exporting in the four-year period 2010–2013 (but with different times of entry in the international market during this period). If that is the case, the bias would be coming only from the comparison between exporters and never exporters inside a same sector and therefore would correspond only to a fraction of the estimate (see Goodman-Bacon (2018) to understand how the bias is weighted).

So far we have discussed some strategies adopted to obtain a cleaner estimation of the learning-by-exporting effects. Even so, we argue that it is not possible to eliminate all the selection bias. It is important then that we know the bias signal in order to interpret the results. We have no arguments to justify selection into export markets based on negative shocks in unobserved characteristics. Also, the literature justify self-selection effect based on positive shocks in firms productivity. Therefore, our estimates may be upward biased and can be understood as an upper bound of the learning-by-exporting effect.

We now present other specifications that seek to explore possible heterogeneities in learning-by-exporting effects according to firms human capital level, export destinations and the interaction between these two. The general argument made for the specification (1) also hold for the following models with trivial adjustments. Learning-by-exporting effects detailed by export destinations are explored in the following equation:

$$lnW_{it} = \kappa + \beta_1 ExpU_{it} + \beta_2 ExpD_{it} + \beta_3 ExpUD_{it} + \lambda_t + \alpha_i + \theta_{st} + u_{it} \quad (2)$$

[4] Sectors are classified according to three digits CNAE 2.0 classification.

[5] When the effects are heterogeneous across groups of treatment and time periods, negative weighting can make the estimates of a two-way fixed-effects model unreliable (de Chaisemartin and d'Haultfoeuille, 2019). Using the Stata package twowayfeweights, we found that very few weights attached to β are negative.

[6] Which is weaker than the more commonly assumed equal counterfactual trends across groups.

where $ExpU_{it}$ is a binary variable indicating if a firm i exports in period t only to developing countries, $ExpUD_{it}$ is a binary variable indicating if a firm i exports in period t to both to developing and developed countries, and $ExpD_{it}$ is a binary variable indicating if a firm i exports in period t to only developed countries.

The first heterogeneity regarding human capital and export effects is explored in:

$$lnW_{it} = \kappa + \gamma HC_{it} + \beta Exp_{it} + \delta(Exp \cdot HC)_{it} + \lambda_t + \alpha_i + \theta_{st} + u_{it} \quad (3)$$

where HC_{it} is the human capital level of firm i in period t, which is measured as the proportion of firms employees with at least complete college. Following the hypothesis in Munch and Skaksen (2008) we should expect that $\delta > 0$ even if $\beta = 0$.

To study the interaction between learning-by-exporting effects, export destination and firms human capital level we propose to estimate the following model:

$$\begin{aligned} lnW_{it} = \ & \kappa + \beta_1 ExpU_{it} + \beta_2 ExpD_{it} + \beta_3 ExpUD_{it} + \gamma HC_{it} \\ & + \delta_1(ExpU \cdot HC)_{it} + \delta_2(ExpD \cdot HC)_{it} + \delta_3(ExpUD \cdot HC)_{it} \\ & + \lambda_t + \alpha_i + \theta_{st} + u_{it} \end{aligned} \quad (4)$$

We argue that specification (4) is more adequate to test the hypothesis in Munch and Skaksen (2008), which states that firms employing high skilled labor may escape intense competition from low wage countries (where firms employ less skilled labor more frequently) and consequently obtain higher export premium in wages. Since developing countries may demand products that have lower quality, we expect a more intense competition from low wage countries in these markets. Therefore, it is expected that $\delta_3 > 0$ and (especially) $\delta_1 > 0$.

Finally, we also test the stability of the coefficients of interest with the inclusion of observable variables: a third degree polynomial for the average employees schooling years, ages, and experience, and 10 dummies for firms sizes according to RAIS classification.[7] Additionally, the models are also estimated separately for firms with more and less than fifty employees.[8] Regarding inference, our main concern is with serial correlation. The binary variable that indicates firms export status is highly correlated over time (if a firm i exports in period t, it will probably export in $t+1$ too). Since firms performance is also auto correlated, we will over-reject the null of no export effects if we do not correct for serial correlation (see Bertrand et al. (2004)). Therefore, errors in all specifications are clustered at firm level.

4. Results

We start presenting in Table 5 the results from estimations of model (1). The estimates suggest no causal effects of export on firms average wages in the period 2010-2013. For the subsample of firms with less than 50 employees, the coefficient of interest is statistically different from zero only at a significance level of 10%. Then, we argue that this evidence is not sufficient for us to conclude that there is a learning-by-exporting effect for these smaller firms, in view of the previous discussion about the selection bias. These results suggest that the difference in average wages described in Table 4 is probably caused by self-selection effects of the more productive firms in the export market. At first, our results seem to contradict (Casagrande et al., 2018) that find positive impacts of learning-by-exporting on the firms productivity. However, what is found for productivity does not necessarily need to be found for wages. At least, not in the same magnitude[9]

In Table 6 we present estimations of model (2) looking for heterogeneity in learning-by-exporting effects by export destinations. Estimates may suggest that export have causal effects on firms performance for those firms that export to more developed countries, particularly for smaller firms. This would corroborate the results in De Loecker (2007), who found that learning-by-exporting effects are considerably higher for firms shipping products to more developed regions. However, differences in parallel trends may be greater when we compare firms that only export to developed countries and never exporters (especially, among the smaller firms). In fact, Blanes-Cristóbal et al. (2008) showed that

[7] The inclusion of these variables did not change our point estimates and it increased precision.

[8] The selection bias should be smaller in the sample of bigger firms since the share of never exporters is lower.

[9] For example: in an initial analysis, De Loecker (2007) finds that while exporting affects firms' average wages by 16%, the estimated effects on labor productivity is much higher – 30%.

Table 6
Learning-by-exporting effects by export destinations.

	(a)	(b)	(c)	(d)	(e)	(f)
$\beta_1 : ExpU$	0.0000	−0.0025	0.0214	0.0192	−0.0335	−0.0332
	(0.0155)	(0.0154)	(0.0200)	(0.0198)	(0.0219)	(0.0217)
$\beta_2 : ExpD$	0.0336*	0.0360*	0.0520**	0.0506**	−0.00429	0.000121
	(0.0187)	(0.0186)	(0.0237)	(0.0236)	(0.0303)	(0.0302)
$\beta_3 : ExpUD$	0.0250	0.0296	0.0073	0.0046	−0.0031	0.0052
	(0.0211)	(0.0208)	(0.0276)	(0.0273)	(0.0222)	(0.0219)
$\beta_1 - \beta_2$	−0.0336	−0.0385	−0.0306	−0.0314	−0.0292	−0.0333
	[0.1073]	[0.0635]	[0.2783]	[0.2630]	[0.3480]	[0.2800]
$\beta_1 - \beta_3$	−0.0250	−0.0321	0.0141	0.0146	−0.0304	−0.0383
	[0.2116]	[0.1051]	[0.6475]	[0.6342]	[0.1862]	[0.0921]
$\beta_2 - \beta_3$	0.0086	0.0064	0.0447	0.0460	−0.0012	−0.0050
	[0.7139]	[0.7841]	[0.1610]	[0.1463]	[0.9704]	[0.8767]
Controls	No	Yes	No	Yes	No	Yes
Sample	All	All	≤50	≤50	>50	>50
Observations	853,718	853,718	809,827	809,827	38,565	38,565
R-squared	0.896	0.897	0.891	0.892	0.967	0.968

Note: Significant at 1% (***), 5% (**), and 10% (*). In all models the dependent variable is the natural logarithm of average hourly wages. Regressions with fixed effect for firm, year and sector-year. In parentheses, robust standard errors clustered at firm level. In brackets, p-values from F tests for the significance in the difference across coefficients.

Table 7
Interaction between learning-by-exporting effects and firms human capital level.

	(a)	(b)	(c)	(d)	(e)	(f)
$\delta : Exp \cdot HC$	0.141**	0.135**	0.091	0.0900	0.237**	0.195*
	(0.0680)	(0.0672)	(0.0680)	(0.0670)	(0.119)	(0.112)
$\beta : Exp$	0.0070	0.0069	0.0231	0.0211	−0.0322	−0.0262
	(0.0153)	(0.0152)	(0.0177)	(0.0176)	(0.0215)	(0.0212)
$\gamma : HC$	0.264***	0.263***	0.248***	0.239***	0.968***	0.898***
	(0.0104)	(0.0153)	(0.0104)	(0.0144)	(0.109)	(0.112)
Controls	No	Yes	No	Yes	No	Yes
Sample	all	all	≤50	≤50	>50	>50
Observations	853,718	853,718	809,827	809,827	38,565	38,565
R-squared	0.896	0.897	0.892	0.892	0.968	0.969

Note: Significant at 1% (***), 5% (**), and 10% (*). In all models the dependent variable is the natural logarithm of average hourly wages. Regressions with fixed effect for firm, year and sector-year. In parentheses, robust standard errors clustered at firm level.

export self-selection effect is higher when destination of exports are developed markets. Therefore, our results must be analyzed with care and we argue that it is not possible to reach solid conclusions about the causal effects of export to developed regions on firms performance. Moreover, the coefficients on the different types of destination countries are not statistically different from each other, except for the difference between β_1 and β_2 in column (b). Finally, we highlight that the estimates suggest that there are no learning-by-exporting effects for firms that only export to developing markets and for firms that export to both developing and developed countries.

Munch and Skaksen (2008) argue that export wage premium may be possible only for firms with higher human capital. Our estimates from equation (3) support this hypothesis (Table 7). Although previous results suggest that, on average, there is no learning-by-exporting effects in our sample, this is not true in firms employing high educated labor. Overall, our results may indicate some learning-by-exporting effect for firms employing skilled workers and this result is driven by larger firms.

We argue in this study that the interaction between export wage premium and human capital should be higher when export destinations include developing countries. As already discussed, low wage countries mainly produce low quality goods. Then, firms employing high skilled labor can differentiate their products and consequently escape from intense

Table 8
Interaction between learning-by-exporting effects, firms'export destinations and human capital.

	(a)	(b)	(c)	(d)	(e)	(f)
$\delta_1 : ExpU \cdot HC$	0.233***	0.231***	0.164**	0.159**	0.457***	0.420***
	(0.0866)	(0.0856)	(0.0792)	(0.0779)	(0.162)	(0.153)
$\delta_2 : ExpD \cdot HC$	−0.0479	−0.0564	−0.103	−0.108	0.202	0.143
	(0.0721)	(0.0715)	(0.0800)	(0.0795)	(0.129)	(0.125)
$\delta_3 : ExpUD \cdot HC$	0.314**	0.302**	0.414**	0.402**	0.163	0.121
	(0.141)	(0.139)	(0.180)	(0.177)	(0.156)	(0.146)
$\beta_1 : ExpU$	−0.0167	−0.0195	0.00871	0.00628	−0.0607**	−0.0572**
	(0.0178)	(0.0177)	(0.0218)	(0.0217)	(0.0273)	(0.0270)
$\beta_2 : ExpD$	0.0368*	0.0392*	0.0600**	0.0589**	−0.0140	−0.00848
	(0.0216)	(0.0215)	(0.0276)	(0.0275)	(0.0347)	(0.0346)
$\beta_3 : ExpUD$	0.000765	0.00516	−0.0331	−0.0361	−0.0138	−0.00274
	(0.0252)	(0.0250)	(0.0323)	(0.0321)	(0.0253)	(0.0249)
$\gamma : HC$	0.263***	0.263***	0.247***	0.239***	0.988***	0.895***
	(0.0104)	(0.0152)	(0.0104)	(0.0144)	(0.109)	(0.126)
$\delta_1 - \delta_2$	0.2809	0.2874	0.2670	0.2670	0.2550	0.2770
	[0.0050]	[0.0037]	[0.0121]	[0.0114]	[0.0769]	[0.0449]
$\delta_1 - \delta_3$	−0.0810	−0.0710	−0.2500	−0.2430	0.2940	0.2990
	[0.5177]	[0.5638]	[0.1073]	[0.1109]	[0.1120]	[0.0922]
$\delta_2 - \delta_3$	−0.3619	0.-3584	−0.5170	−0.5100	0.0390	0.0220
	[0.0121]	[0.0117]	[0.0055]	[0.0055]	[0.8082]	[0.8859]
$\beta_1 - \beta_2$	−0.0535	−0.0587	−0.0513	−0.0526	−0.0467	−0.0487
	[0.0282]	[0.0156]	[0.1173]	[0.1068]	[0.1979]	[0.1763]
$\beta_1 - \beta_3$	−0.0175	−0.0247	0.0418	0.0424	−0.0469	−0.0545
	[0.4720]	[0.3057]	[0.2507]	[0.2408]	[0.1062]	[0.0577]
$\beta_2 - \beta_3$	0.0360	0.0340	0.0931	0.0950	−0.0002	−0.0057
	[0.1944]	[0.2179]	[0.0130]	[0.0108]	[0.9953]	[0.8802]
Controls	no	yes	no	yes	no	yes
Sample	all	all	≤50	≤50	>50	>50
Observations	853,718	853,718	809,827	809,827	38,565	38,565
R-squared	0.896	0.897	0.892	0.892	0.968	0.968

Note: Significant at 1% (***), 5% (**), and 10% (*). In all models the dependent variable is the natural logarithm of average hourly wages. Regressions with fixed effect for firm, year and sector-year. In parentheses, robust standard errors clustered at firm level. In brackets, p-values from F tests for the significance in the difference across coefficients.

competition from low wage country firms in the foreign market. This may lead to an increase in firms performance and consequently a higher export wage premium. Estimates presented in Table 8 corroborate our argumentation. These results suggest a statistically significant wage premium (at 1% level) for firms that employ high educated labor and export to developing countries. As our hypothesis suggests this is especially true for firms exporting only to developing countries. This result holds for all samples and it is higher for larger firms (as results from Table 7).

The point estimates (in column b) indicate that firms that export only to developing countries have a positive premium in their average wages at the proportion of 25% of their human capital levels (which are on average 0.08), in this case an increment of 1 p.p. in human capital increases firm's average wage in 0.231%. The impact of human capital differs according to the size of firms. For firms with less than 50 employees (in column d), this impact is lower, a variation of 1 p.p. in human capital increases firm's average wage in 0.159%. For firms with more than 50 employees (in column f) an increment of 1 p.p. in human capital leads to an increase of 0.42% in the average wage. These results are robust in specifications without controls (columns a, c and e), what indicates that human capital presents a positive impact on exporters' average wage suggesting that human capital may shelter firms in differentiated product markets. It is worth to note that in column f (large firms) the wage premium is positive only if firm's human capital is above 0.136, what is higher than the average (0.050). Thus, most of firms that export only to developing countries (those with less than 13.6% of employees with college degree) present a negative wage premium. This result could indicate that firms with relatively low levels of human capital suffer from intense competition in these markets. Other interaction terms also present significant coefficients, but in a lower level of significance (10%). Namely, they are the interaction of human capital with exports to developing and developed countries in columns a, b, c and d. Given the lower level of significance of these coefficients and the predominance of developing countries in all significant results, we can infer that the impact of human capital on wage premium is primarily driven by the exports to developing countries. It is worth to mention that firms that export to developed countries robustly present higher average wages, as β_2 is significant in columns (a) to (d). However, this differential is constant and does not vary with the firm's level of human capital. In fact, δ_2 is statistically lower than δ_1 in columns (a) to (f), and is statistically lower than δ_3 in columns (a) to (d).

5. Conclusion

This paper investigates the empirical evidence of export wage premium for south Brazilian firms, focusing on cleaner estimates of learning-by-exporting effects, and then on the interaction between export effects, firms' export destinations and human capital. We argue that by looking at this interaction we can test the hypothesis of Munch and Skaksen (2008), which state that firms employing high skilled labor may escape intense competition from low wage countries in foreign markets, obtaining higher export premium in wages. Since developing countries may demand less exigent products, we expect a more intense competition from low wage countries in these markets. This underlying mechanism justifies our strategy of looking at the interaction between export and human capital for different economic development levels of export destination. The empirical analysis is based on a fixed effects model and uses a firm-level panel data for the four-year period 2010–2013 containing information on approximately 305,000 firms from a south Brazilian state (Rio Grande do Sul).

Our first results pointed out that, on average, there is no learning-by-exporting effects for firms in our sample, looking at average wages as outcome. This result contributes mainly to the national literature, where most studies on export gains use methodologies that are not able to identify cleaner estimates of the learning-by-exporting effects. Then, by looking at heterogeneous effects according to export destination economic development (developing country, developed country, or both) our results suggested no learning effects for firms exporting to developing countries and to both developing and developed regions. Some estimates may suggest export effects on wages for firms exporting only to developed countries. However, we argue that these results must be analyzed with care since the estimates may be upward biased. These results contribute to a recent literature that looks for higher export gains for firms exporting to developed regions, with contradictory results (De Loecker, 2007; Pisu, 2008; Verardi and Wagner, 2012).

We also find that the coefficient associated with the interaction between firms' export status and their human capital level is statistically significant, corroborating the hypothesis and results of Munch and Skaksen (2008). By looking at this interaction among different export destinations, results confirm our initial hypothesis: the wage premium is stronger for firms with high levels of human capital and export to developing countries. This may suggest that firms competing in the foreign market within low wage countries can obtain higher export gains by employing high educated labor. These results may be especially important to policy makers from developing countries who seek to implement policies to incentivize firms in entering into export markets. Since these countries have less educated labor, it is important that the synergy between export and human capital is taken into account to improve policy results.

Appendix A

Besides defining export destinations income level according to the World Bank classification, we present here alternative results where the countries are categorized according to their income level relative to Brazil, so there is a group above Brazil (ABR) and a group below Brazil (BBR). The income indicator used was the gross national income (GNI) per capita (Atlas method, current US$). Learning-by-exporting effects by export destinations are explored in the following equation:

$$lnW_{it} = \kappa + \beta_1 ExpBBR_{it} + \beta_2 ExpABR_{it} + \beta_3 ExpABBR_{it} + \lambda_t + \alpha_i + \theta_{st} + u_{it} \quad (5)$$

where $ExpBBR_{it}$ is a binary variable indicating if a firm i exports in period t only to countries with GNI per capita lower than the Brazilian, $ExpABR_{it}$ is a binary variable indicating if a firm i exports in period t only to countries with

Table 9
Learning-by-exporting effects by export destination.

	(a)	(b)	(c)	(d)	(e)	(f)
$\beta_1 : ExpBBR$	−0.00763	−0.00788	−0.00861	−0.0106	−0.0241	−0.0247
	(0.0186)	(0.0184)	(0.0254)	(0.0252)	(0.0236)	(0.0231)
$\beta_2 : ExpABR$	0.0304*	0.0289*	0.0545**	0.0511**	−0.0210	−0.0180
	(0.0176)	(0.0175)	(0.0216)	(0.0215)	(0.0265)	(0.0264)
$\beta_3 : ExpABBR$	0.0263	0.0263	0.0230	0.0179	−0.0196	−0.00990
	(0.0232)	(0.0229)	(0.0287)	(0.0284)	(0.0251)	(0.0248)
$\beta_1 - \beta_2$	−0.0380	−0.0368	−0.0631	−0.0031	−0.0617	−0.0067
	[0.0813]	[0.0892]	[0.0363]	[0.9174]	[0.0391]	[0.8166]
$\beta_1 - \beta_3$	−0.0339	−0.0342	−0.0316	−0.0045	−0.0285	−0.0148
	[0.1479]	[0.1416]	[0.3146]	[0.8670]	[0.3601]	[0.5745]
$\beta_2 - \beta_3$	0.0041	0.0026	0.0315	−0.0014	0.0332	−0.0081
	[0.8432]	[0.8983]	[0.2808]	[0.9456]	[0.2518]	[0.6931]
Controls	no	yes	no	yes	no	yes
Sample	all	all	≤50	≤50	>50	>50
Observations	853,718	853,718	809,827	809,827	38,565	38,565
R-squared	0.896	0.897	0.891	0.892	0.967	0.968

Note: Significant at 1% (***), 5% (**), and 10% (*). In all models the dependent variable is the natural logarithm of average hourly wages. Regressions with fixed effect for firm, year and sector-year. In parentheses, robust standard errors clustered at firm level. In brackets, p-values from F tests for the significance in the difference across coefficients.

GNI per capita higher than the Brazilian, and $ExpABBR_{it}$ is a binary variable indicating if a firm i exports in period t to both groups (ABR and BBR). To study the interaction between learning-by-exporting effects, export destination and firms human capital level we estimate the following regression:

$$\begin{aligned} lnW_{it} = \; & \kappa + \beta_1 ExpBBR_{it} + \beta_2 ExpABR_{it} + \beta_3 ExpABBR_{it} + \gamma HC_{it} \\ & + \delta_1 (ExpBBR \cdot HC)_{it} + \delta_2 (ExpABR \cdot HC)_{it} + \delta_3 (ExpABBR \cdot HC)_{it} \\ & + \lambda_t + \alpha_i + \theta_{st} + u_{it} \end{aligned} \quad (6)$$

Table 9 presents the estimates from Eq. (5), while Table 10 presents the estimates from Eq. (6). Overall, the results are very similar to the ones where we used the World Bank Classification to define the development level of the trade destinations. Estimates may suggest some learning-by-exporting effects only to firms that export exclusively to countries with income level above the Brazilian. Moreover, there is a large wage premium in exporting firms that employ more educated workers. This bonus is primarily driven by the exports to countries with lower income level of GNI per capita (relative to Brazil).

Table 10
Interaction between learning-by-exporting effects,firms' export destinations and human capital – Robustness check.

	(a)	(b)	(c)	(d)	(e)	(f)
$\delta_1 : ExpBBR \cdot HC$	0.394**	0.385**	0.232**	0.220**	0.307	0.298
	(0.159)	(0.158)	(0.0991)	(0.0971)	(0.194)	(0.184)
$\delta_2 : ExpABR \cdot HC$	0.00220	−0.00242	−0.0395	−0.0420	0.163	0.119
	(0.0717)	(0.0713)	(0.0720)	(0.0716)	(0.133)	(0.130)
$\delta_3 : ExpABBR \cdot HC$	0.376***	0.369***	0.366**	0.357**	0.307	0.243
	(0.139)	(0.137)	(0.159)	(0.156)	(0.187)	(0.173)
$\beta_1 : ExpBBR$	−0.0388*	−0.0391*	−0.0292	−0.0312	−0.0441	−0.0432
	(0.0234)	(0.0232)	(0.0282)	(0.0280)	(0.0316)	(0.0310)

Table 10 (*Continued*)

	(a)	(b)	(c)	(d)	(e)	(f)
$\beta_2 : ExpABR$	0.0302	0.0286	0.0577**	0.0545**	−0.0291	−0.0247
	(0.0199)	(0.0198)	(0.0246)	(0.0245)	(0.0293)	(0.0292)
$\beta_3 : ExpABBR$	−0.00361	−0.00410	−0.0156	−0.0208	−0.0354	−0.0230
	(0.0270)	(0.0268)	(0.0329)	(0.0327)	(0.0291)	(0.0287)
$\gamma : HC$	0.263***	0.263***	0.247***	0.239***	0.984***	0.893***
	(0.0104)	(0.0152)	(0.0104)	(0.0144)	(0.109)	(0.126)
$\delta_1 - \delta_2$	0.3918	0.3874	0.2715	0.2620	0.1440	0.1790
	[0.0170]	[0.0178]	[0.0202]	[0.0227]	[0.4799]	[0.3637]
$\delta_1 - \delta_3$	0.0180	0.0160	−0.1340	−0.1370	0.0000	0.0550
	[0.9118]	[0.9217]	[0.3476]	[0.3277]	[0.9982]	[0.8058]
$\delta_2 - \delta_3$	−0.3738	−0.3714	−0.4055	−0.3990	−0.1440	−0.1240
	[0.0048]	[0.0045]	[0.0080]	[0.0080]	[0.4100]	[0.4484]
$\beta_1 - \beta_2$	−0.0690	−0.0677	−0.0869	−0.0857	−0.0150	−0.0185
	[0.0102]	[0.0113]	[0.0111]	[0.0118]	[0.6832]	[0.6135]
$\beta_1 - \beta_3$	−0.0352	−0.0350	−0.0136	−0.0104	−0.0087	−0.0202
	[0.2211]	[0.2218]	[0.7065]	[0.7701]	[0.8090]	[0.5686]
$\beta_2 - \beta_3$	0.0338	0.0327	0.0733	0.0753	0.0063	−0.0017
	[0.1622]	[0.1733]	[0.0301]	[0.0255]	[0.7944]	[0.9421]
Controls	no	yes	no	yes	no	yes
Sample	all	all	≤50	≤50	>50	>50
Observations	853,718	853,718	809,827	809,827	38,565	38,565
R-squared	0.896	0.897	0.892	0.892	0.968	0.968

Note: Significant at 1% (***), 5% (**), and 10% (*). In all models the dependent variable is the natural logarithm of average hourly wages. Regressions with fixed effect for firm, year and sector-year. In parentheses, robust standard errors clustered at firm level. In brackets, p-values from F tests for the significance in the difference across coefficients.

Table 11
Industry distribution of exports from Rio Grande do Sul.

HS Section	Description	RS Prop.
I	Lives animals; Animal products	11.3%
II	Vegetable products	14.8%
III	Animal or vegetable fats and oils and their clevage products; Prepared edible fats; Animal or vegetable waxes	17.2%
IV	Prepared foodstuffs, beverages, spirits and vinegar, tobacco and manufactured tobacco substitutes	13.5%
V	Mineral products	0.7%
VI	Products of the chemical or allied industries	9.3%
VII	Plastics and articles thereof; Rubber and articles thereof	27.5%
VIII	Raw hides and skins, leather, furskins and articles thereof; Saddlery and harness; Travel goods, handbags and similar containers; Articles of animal gut	21.3%
IX	Wood and articles of wood; Wood charcoal; Cork and articles of cork; Manufactures of straw, of esparto or of other plaiting materials; Basketware and wickerwork	6.6%
X	Pulp of wood or of other fibrous cellulosic material; Recovered (waste and scrap) paper or paperboard; Paper and paperboard and articles thereof	2.5%
XI	Textiles and textiles articles	7.1%
XII	Footwear, headgear, umbrellas, sun umbrellas, wlaking-sticks, seat-sticks, whips, riding-crops; Prepared feathers; Artificial flowers; Articles of human hair	40.0%
XIII	Articles of stone, plaster, cement, asbestos, mica or similar materials; Ceramic products; Glass and glassware	4.7%
XIV	Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal, and articles thereof; Imitation jewellery; Coins	2.7%
XIX	Arms and ammunition; parts and accessories thereof	42.6%
XV	Base metals and articles of base metal	3.3%

Table 11 (*Continued*)

HS Section	Description	RS Prop.
XVI	Machinery and mechanical appliances; Electrical equipment and parts thereof; Sound recorders and reproducers	7.5%
XVII	Vehicles, aircraft, vessels and associated transport equipment	23.6%
XVIII	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; Clocks and watches; Musical instruments;	4.8%
XX	Miscellaneous manufactured articles	25.7%
XXI	Works of art, collectors' pieces and antiques	0.02%
XXII	Special transactions	4.9%

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