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Benefits of forced experimentation on exports*

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Abstract

The severe reduction in domestic demand between 2008 and 2013 in Spain forced many firms to seek new customers in foreign markets. In this paper, we explore whether the increase in the crisis-motivated number of new exporters led to a larger number of regular exporters once domestic demand returned to pre-crisis levels. Using an instrumental variable approach, we find that a 10% increase in new exporters led to a 5% increase in new regular exporters. Since the economic crisis was not anticipated in Spain, our results establish a causal link between experimentation in foreign markets and discovery of new regular exporters. This evidence is consistent with alternative narratives where firms had capacity constraints, were uncertain about the profitability of their export operations, and averse to risk or satisfied with their non-exporter status prior to the crisis.

JEL: F10, F23

Keywords: capacity constraints, risk aversion, experimentation, exports, Spain, Great Recession.

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1 Introduction

In the standard trade model with heterogeneous firms (Melitz, 2003), marginal costs are constant, so the decision to export is independent of the domestic market's economic cycle. However, different papers have shown that firms substitute home sales with foreign sales when domestic demand drops (Blum et al., 2013; Vannoorenberghe, 2012; Belke et al., 2015; Almunia et al., 2018).[1] This positive association is explained by the existence of capacity constraints at the firm level, which generates rising marginal costs. When domestic demand drops, productive capacity is released, the cost of producing goods destined for foreign markets is reduced, and more firms find it profitable to export.

In the capacity-constrained exporter model, if sunk costs or learning-by-exporting effects are absent, the increase in the number of exporters is only temporary and lasts until domestic demand recovers. The aim of this paper is to test the validity of this prediction. We analyze the case of Spain, a country that experienced a severe drop in domestic demand between 2008 and 2013 but underwent a strong recovery between 2014 and 2017. Since the crisis was unexpected, we have a suitable environment to test the causal link between a drop in domestic demand and a permanent increase in the number of exporters. As predicted by the capacity-constrained exporter models, we find a positive association between the drop in domestic demand and the increase in the number of new exporters. However, we also find that the exogenous increase in the number of exporters translated into a larger number of regular exporters once domestic demand had recovered a large share of its pre-crisis level. Specifically, a 10% increase in new exporters born during the crisis led to a 5% increase in the number of new regular exporters. In sum, the experimentation forced by the crisis led to a greater number of permanent exporters.

We show that this result is not related to the existence of sunk costs or learning-by-exporting. Two alternative narratives may explain the positive association between new exporters and new regular exporters. In the first narrative, firms have capacity constraints, are uncertain about their profits in foreign markets, and are risk-averse. Before the crisis, only firms whose expected profits from exporting covered their risk premium and fixed cost of exporting were willing to experiment in foreign markets. The crisis released productive capacity that was previously dedicated to domestic demand, impelled an increased expectation of profits from exports, and led a greater number of firms to experiment in foreign markets. Firms learned whether they could obtain profits from exporting. Once firms had complete information, the number of firms willing to export was larger than that in the pre-crisis situation, where profits from exporting were uncertain and firms were risk-averse. This outcome is equivalent to the production-theory result where, under conditions of perfect information, higher levels of production

[1] Instead, Berman et al. (2015) find a positive association between domestic sales and exports for French exporters.

are realized than in a situation with uncertainty and risk-averse firms (Sandmo, 1971). Therefore, once domestic demand was recovered, the number of exporters was larger than before the crisis.

An alternative narrative argues that, prior to the crisis, many non-exporters were satisfied with their export status. Although some of these firms could increase their profits by selling in foreign markets, they decided not to do so, as they were content with the profits they were obtaining in the domestic market. This narrative draws from Simon (1955), who argued that firms may cease to search for new business ventures once they reach a profit level that they are satisfied with. As explained by Baumol and Quandt (1964), this decision is more likely when costs of searching for new customers in foreign markets are high. Note that in this narrative, firms are non-exporters because they are satisfied with that status and not because they have capacity constraints. However, when a large drop in domestic demand occurs and profits fall, these non-exporters are no longer satisfied with their situation, and are "forced" to find new customers in foreign markets. If they find attractive export opportunities and raise their profits with foreign sales, firms may realize that the new situation is better than the previous one, when they were focused exclusively on domestic market. Therefore, they will continue exporting despite the recovery in the domestic market.[2]

Our empirical analyses provide evidence for the three pillars of our narrative: (i) relation between domestic demand and export status at the firm level; (ii) lower negative effect of an increase in domestic demand on the probability of exporting once firms have some experience exporting, and, as mentioned previously, (iii) positive association between experimentation and emergence of new regular firms.

Our paper is linked to five strands of literature. First, it is related to the capacity-constrained exporters' literature (Vannoorenberghe, 2012; Blum et al., 2013; Soderbery, 2014; Belke et al., 2015; Berman et al., 2015; Ahn and McQuoid, 2017). This line of research highlights the fact that, in the short run, firms may face constraints related to productive capital, management time, or financial resources. We contribute to this literature by showing that if firms are risk-averse, the increase in the number of exporters due to a severe reduction in domestic demand may not be followed by a symmetric reduction in the number of exporters when domestic demand is recovered.

Second, it is linked with the literature that analyzes firms' uncertainty about foreign markets. This uncertainty may arise because firms are not able to predict the reliability of suppliers (Rauch and Watson, 2003), exporting costs (Segura-Cayuela and Villarrubia, 2008), or the appeal of their products in foreign markets (Albornoz et al., 2012; Nguyen,

[2]In a context very different to the one analyzed in this paper, Larcom et al. (2017) analyze the behavior of commuters that were forced to change their routes due to a strike in the London Underground service. They show that some commuters decided to keep the new route once the strike had ended.

2012). Since firms can only determine their profitability by experimenting in foreign markets, uncertainty would explain the large turnover in the number of exporters and their low survival rate (Eaton et al., 2008; Albornoz et al., 2016). We contribute to this literature by highlighting that the business cycle, firms' attitude toward risk and satisfaction with their current status may also determine the level of experimentation they are willing to undertake in foreign markets.

Third, it is linked to the risk aversion and export literature. De Sousa et al. (2017) show that if managers are risk-averse, the extensive and intensive margin of exports will be lower in destinations where demand is more uncertain. Esposito (2017) shows that firms will select destinations for which demand is negatively or mildly correlated with another destinations' demand. From sourcing perspective, Gervais (2017) argues that in order to minimize problems with the supply chain, risk-averse managers will import inputs from a wider set of countries. We contribute to this literature by showing that risk aversion may explain the positive association between the level of experimentation and emergence of new regular exporters.

Fourth, it is also related with the literature arguing that economic agents do not always keep on searching until they find the situation that maximizes their utility. On the contrary, they may give up searching if they find a situation that satisfies them, even when it is not the global optimum (Simon, 1955; Baumol and Quandt, 1964; Larcom et al., 2017). We contribute to this literature by providing an example where the behavior of firms is consistent with the existence of local optimums and forced experimentation.

Finally, it is also related to the literature that examines the contribution of the extensive and the intensive margin to export growth. Studies using firm-level data show that new exporters, if they survive, substantially contribute to export growth (Bernard et al., 2009; de Lucio et al., 2011). Our paper adds to this literature by showing that an economic crisis, triggering an increase in experimentation in foreign markets, raises the number of new regular exporters, and may have a positive effect on the aggregate value of exports in the medium and long terms.

The rest of the paper is organized as follows. Section 2 documents the evolution of domestic demand and of different categories of exporters between 2008 and 2017. Section 3 provides econometric evidence pertaining to the association between domestic demand and experimenting with foreign markets, the risk aversion of managers, and the positive association between the number of new exporters that emerged during the Spanish crisis and the number of new regular exporters left standing once domestic demand recovered. The last section concludes the study.

2 The Great Recession and increase in the number of new exporters in Spain

Figure 1 shows the evolution of the Spanish domestic demand (GDP - exports + imports) and of different exporter categories over the 2008–2017 period. Domestic demand is calculated at 2010 constant prices by using data from the Spanish Statistics Institute.[3] Data on Spanish exporters come from the Customs and Excise Department of the Spanish Tax Agency. This dataset covers the universe of Spanish exporters. We consider a firm as an exporter if it carries out an export operation, defined as a combination of firm + product + destination, of, at least, 1,500 euros.

The collapse of Lehman Brothers in September 2008 led to a severe worsening of credit conditions worldwide and triggered a burst of the housing bubble and a sudden stop in building sector activity in Spain. These events led to a profound reduction in domestic demand in 2009. After stabilizing in 2010, the economy fell into a second recession due to the increase in the risk premium demanded by foreign investors on Spanish sovereign and private debt. The softening of the risk premium on the Spanish sovereign debt from July 2012 onwards triggered a recovery of the Spanish economy, which remained until 2017. In the Spanish Congress' Commission on the Financial crisis, the Spanish Economic Minister at the time of the crisis and the Governor of the Bank of Spain recognized that they anticipated neither the recession triggered by the financial crisis nor the crisis set off by the sharp increase in the risk premium demanded by investors on Spanish sovereign and private debt.[4]

The economic crisis coincided with a very large increase in the number of new exporters, defined as firms that did not export during the previous four years. The number of new exporters rose by 54 points between 2009 and 2013. However, coinciding with the recovery of domestic demand, from 2013 onwards, the number of new exporters began to decline; by 2017, the number of new exporters was similar to that in 2008.

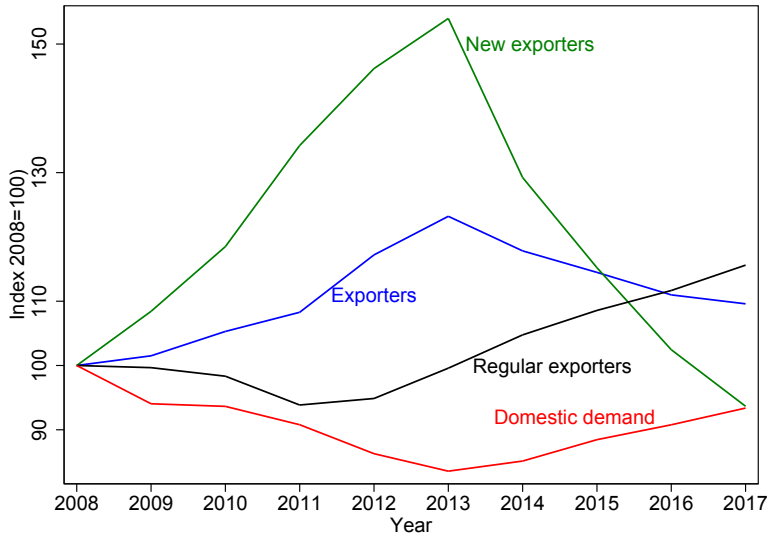
The figure also shows the evolution of the number of regular exporters, defined as firms that export during four consecutive years. This variable declined from 2009 to 2011, but rose afterwards. By 2017, the number of regular exporters was 16% larger than it was at the beginning of the crisis. Finally, we observe that the total number of exporters rose with the drop in domestic demand and declined with the recovery of domestic demand. Nevertheless, the number of exporters in 2017 was 10% larger than it was at the beginning of the crisis.

Figure 1 shows that the drop in domestic demand is associated with an increase in the

[3] Available at www.ine.es

[4] Journal of Debates of the Spanish Congress 12th of July 2007 and 10th January 2018. Available at http://www.congreso.es/portal/page/portal/Congreso/Congreso/Publicaciones/DiaSes/ComInv.

Figure 1: Exporters and domestic demand, 2008–2017



Note: New exporters are defined as firms that did not export, at least, during the previous four years. Regular exporters are firms that export during four consecutive years. Source: Exporters' data from Customs. Domestic demand index from the Spanish Statistics Institute.

number of new firms that experiment with foreign markets, and the recovery in domestic demand coincides with a decline in the number of new firms experimenting in domestic markets. However, by 2017 the number of exporters and regular exporters was larger than it was at the beginning of the crisis. In the next section, we use firm and industry-level data to explore the relations between domestic demand, new exporters, and new regular exporters.

3 Regression analyses

Our narrative establishes three empirical predictions: (i) a positive relation between the drop in domestic demand and the increase in the number of new exporters; (ii) a lower impact of domestic demand on the probability to export once firms have acquired experience in foreign markets; and (iii) a positive relation between an exogenous increase in experimentation and the number of new regular exporters once domestic demand recovers its pre-crisis level. In this section, we carry out regression analyses to test the validity of these predictions.

3.1 Domestic demand and the probability of becoming a new exporter

We analyze whether a drop in domestic demand raises the probability that a firm becomes a new exporter. We defined new exporters in Section 2: a firm that has not exported in the previous four years. To calculate domestic demand at the firm level, we match Customs with Bureau Van Dijk-SABI. The Bureau Van Dijk-SABI dataset provides detailed financial and accounting records of Spanish firms that disclosed their accounts in the Business Register. Customs and SABI do not use the same firm-identifier. We use the correspondence built by de Lucio et al. (2018a), that produces a sample covering more than 80% of the value of Spanish exports. We calculate firm-level domestic demand as the difference between firm revenues and exports.

To test the association between domestic demand and the probability of becoming a new exporter, we estimate the following regression equation:

$$NewExporter_{ikt} = \beta_1 \ln dd_{ikt} + \beta_2 \ln TFP_{ikt} + \beta_3 \ln wpw_{ikt} + \gamma_i + \gamma_{kt} + \epsilon_{ikt} \qquad (1)$$

where $NewExporter_{ikt}$ is a dummy variable that takes the value of 1 if firm i operating in industry k becomes a new exporter at year t and zero otherwise, dd_{ikt} is domestic demand, TFP_{ikt} is total factor productivity,[5] wpw_{ikt} is wage per employee, γ_i and γ_{kt} are firm and industry-year fixed effects, respectively, and ϵ_{ikt} is the disturbance term.

Since equation (1) includes two sets of high-dimensional fixed effects, we estimate it using a linear probability model. The period of analysis is 2001–2016. We transform current into constant values by using industrial price indexes from the Spanish Statistics Institute. Industries are defined at the four-digit NACE revision 2 level. It is noteworthy that the sample comprises only firms that become new exporters.

Table 1-column (1) presents the results of the estimation. The domestic demand coefficient is negative and statistically significant, indicating that a reduction in domestic demand raises the probability of becoming a new exporter. According to the domestic

[5] We estimate a separate production function for each 4-digit NACE revision 2 industry using all firms in SABI with complete information about sales revenues, cost of intermediate inputs, value of physical capital, and number of employees. Revenue is deflated by the corresponding 4-digit NACE revision 2 industrial production price index published by the Spanish National Statistics Institute (INE; Available at www.ine.es). Labor is measured as the total number of employees. Physical capital is proxied by the book value of material tangible assets and transformed into constant values using the deflator of aggregated production capital obtained from IVIE (available at www.ivie.es). Materials is proxied by the consumption of intermediate inputs and deflated by the Spanish intermediate goods production price index obtained from INE. We use Stata's Levinsohn and Petrin's (2003) levpet routine to estimate the production coefficients using intermediate inputs (materials) as control for unobservable productivity shocks.

demand coefficient in column (1), a standard deviation decrease in the (log) of domestic demand raises the probability of becoming a new exporter by 7.5 percentage points (-1.34x-0.056). Our results are in line with Almunia et al. (2018), who, using another dataset, also found that Spanish firms have a larger probability of becoming exporters when domestic demand drops.[6]

As predicted by the standard heterogeneous firm model of trade (Melitz, 2003), more productive firms are likelier to become new exporters. This model also predicts that lower wages facilitate entry into foreign markets. Our wage per employee coefficient has a negative sign, but it is not precisely estimated.

Table 1: Domestic demand, new exporters, and risk aversion

	(1)	(2)
Domestic demand(log)	-0.056**	-0.074***
	(0.027)	(0.012)
TFP(log)	0.110***	0.034*
	(0.035)	(0.020)
Wages per employee(log)	-0.035	0.005
	(0.046)	(0.028)
Experience		-0.352
		(0.297)
Domestic demand(log)*Experience		0.077***
		(0.007)
TFP(log)*Experience		0.048**
		(0.020)
Wage per employee(log)*Experience		-0.060**
		(0.030)
Observations	4104	12011
R^2	0.527	0.545

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: In column (1), the dependent variable is the probability that a non-exporter becomes a new exporter. In column (2), the dependent variable is the probability that a non-exporter becomes an exporter, or a new exporter resumes its exporting activity. The regression equation includes firm and industry-year fixed effects. Standard errors are in parentheses. ***, **, * statistically significant at 1%, 5% and 10% respectively.

To sum up, the firm-level evidence confirms that the reduction in domestic demand

[6] Banco de España (2017), Almunia et al. (2018) and de Lucio et al. (2018b) also find a negative association between domestic demand and the intensive margin of trade.

is associated with a larger probability of firms becoming exporters. Although our specification does not allow a causal interpretation, our results are in line with the predictions of the capacity-constrained exporters' model prediction. They also concord with the predictions of a model wherein firms are satisfied with a non-exporter status, so long as the domestic market generates enough profits.

3.2 Firms were either risk-averse or satisfied with their non-exporter status before the crisis

In our narrative, experimentation leads to discovery of new successful exporters because some firms were risk-averse and/or satisfied with their non-exporter status prior to the crisis. Experimentation in foreign markets allows these firms to learn whether profits can be obtain from exporting. If firms get profits from their foreign sales, they will continue exporting even when domestic demand returns to normal levels. Hence, changes in domestic demand will have a lower effect on firms' export status once they have some experience in foreign markets.

To test the validity of this hypothesis, we estimate the following regression equation,

$$\begin{aligned} Exporter_{ikt} = \beta_1 \ln dd_{ikt} + \beta_2 \ln TFP_{ikt} + \beta_3 \ln wpw_{ikt} + \beta_4 Experience_{ikt} \\ +\beta_5(\ln dd_{ikt} * Experience_{ikt}) + \beta_6(\ln TFP_{ikt} * Experience_{ikt}) \\ +\beta_7(\ln wpw_{ikt} * Experience_{ikt}) + \gamma_i + \gamma_{kt} + \epsilon_{ikt} \end{aligned} \tag{2}$$

In the previous estimation (Table 1-column 1), we only analyzed the transition of firms from non-exporters to new exporters. Now, we also analyze the dynamics of new exporters' export status. In equation (2), $Exporter_{ikt}$ takes the value of 1 if firm i exported at year t. This happens when firm i becomes a new exporter, when the new exporter continues exporting, but also when a new exporter, after a short period without exporting, resumes making sales to foreign markets. $Experience_{ikt}$ is a dummy variable that takes the value of 1 if the firm has some export experience.

Equation (2) includes domestic demand, TFP and wages per employee, and the interactions of these three variables with $Experience_{ikt}$. Since an increase in domestic demand has less of a negative effect on the probability of exporting once firms have some export experience, we expect $\beta_5 > 0$.

Table 1- column (2) presents the results of the estimations. As in column (1), we find that domestic demand has a negative effect on the probability that a firm will become a new exporter. However, the negative effect disappears once the firm has some experience in foreign markets. This result is in line with our prediction: an increase in domestic

demand has a smaller negative effect on the probability of exporting once firms have some experience in foreign markets. We also find that the overall probability of exporting once the firm has some experience in foreign markets is not precisely estimated. This result rules out either the possibility that the sunk costs of exporting or some learning-by-exporting effects are driving our results. TFP has a positive coefficient, and its effect becomes stronger once the firm has some export experience. Wages per employee has a negative effect on exporting once the firm has some export experience.

To sum up, these results provide support for the hypotheses that some firms were either risk averse or satisfied with their non-exporter status prior to the crisis.

3.3 Experimentation and the emergence of new regular exporters

In this subsection, we analyze whether the exogenous, crisis-led increase in experimentation leads to the emergence of new regular exporters.

To test this relationship, we estimate the following equation:

$$\ln\left(\frac{regular_k^{2016}}{n_k^{2008}}\right) = \alpha + \beta \ln\left(\frac{\widehat{new_k^{2009-2013}}}{n_k^{2008}}\right) + \epsilon_k \tag{3}$$

where $new_k^{2009-2013}$ is the number of new exporters that emerged during the crisis (2009–2013) in NACE, revision 2, four-digit industry k, and n_k^{2008} the number of exporters in industry k before the crisis. Hence, the $\frac{new_k^{2009-2013}}{n_k^{2008}}$ ratio measures the rate of entry of new exporters in industry k during the crisis. $regular_k^{2016}$ are the number of new exporters emerging during the crisis, which exported without interruption until 2016. Therefore, the $\frac{regular_k^{2016}}{n_k^{2008}}$ ratio measures the rate of new regular exporters in industry k.

As explained in the introduction, the economic crisis was not expected in Spain. Therefore, it does not seem plausible that anticipating a future reduction in domestic sales, firms had already invested in new technologies, processes, or skilled workers that would enable them to enter foreign markets. Therefore, we can consider the economic crisis as an exogenous shock to experimentation.

To capture this exogenous effect, we estimate (3) in two stages. First, we regress the rate of entry of new exporters on the average annual percentage drop in domestic demand between 2008 and 2013.

$$\ln\left(\frac{\widehat{new_k^{2009-2013}}}{n_k^{2008}}\right) = \gamma + \psi drop_k + \epsilon_k \tag{4}$$

where $drop_k$ is the average annual percentage drop in domestic demand between 2008 and 2013. To calculate domestic demand at the industry level we use Euro-

stat's Prodcom database, that provides data on the value of exports, imports, and production at the NACE, revision 2, four-digit level. We calculate domestic demand as production+imports-exports. Second, we regress the instrumented new exporters' entry rate on the regularity rate.

Equation (3) uses the variation across industries to estimate the relation between exogenous new exporters' entry rate and new regular exporters' rate.[7] The capacity-constrained exporter model predicts that all new firms that entered foreign markets will cease to export once domestic demand returns to pre-crisis levels. Therefore, this model does not expect any relation between the entry and the regularity rates. In contrast, we expect a positive relation between the two.

Table 2 presents the results of the first stage regression. Column (1) presents the results when equation (3) is estimated with all the industries with available data in the NACE, revision 2, four-digit classification. The coefficient for the drop in domestic demand is positive and very precisely estimated. It denotes that the increase in the rate of entry of new exporters is strongly correlated with the drop in domestic demand. The F-statistic confirms the validity of our instrument.

Table 2: First stage: Drop in domestic demand and number of new exporters across industries

	(1)	(2)
Drop in domestic demand (%)	2.177***	2.148***
	(0.439)	(0.476)
Industry	All	Similar domestic demand
Observations	196	78
F-statistic	24.625	20.368

Note: The dependent variable is the log of new exporters' entry rate. Robust standard errors are in parentheses. ***, **, * statistically significant at the 1%, 5% and 10% levels, respectively.

To test the relation between experimentation and regularity, the level of domestic demand at the end of the period (2016) should be similar to the one before the crisis (2008). To address this concern, we select a sample of industries wherein domestic demand was similar in 2008 and 2016. We consider that an industry had a similar domestic demand level if domestic demand in 2016 was between 80% and 120% of the domestic demand in 2008. Table 2-column (2) reports the results of the estimation. When we introduced this condition, there was a sizable reduction in the number of observations. However, the estimated coefficient had a similar value and remained statistically significant.

Table 3 presents the results of the second-stage estimations. Column (1) reports

[7]This variation controls for the effects that are common across industries, such as the variations in the real effective exchange rate, the cost of transport, or the business cycle in foreign markets, which may influence the level of experimentation, and the likelihood of new exporters becoming regular.

Table 3: Second stage: Effect of experimentation on the emergence of new regular exporters

	(1)	(2)
New exporters' entry rate (log)	0.480***	0.484**
	(0.116)	(0.232)
IV	Yes	Yes
Industry	All	Similar domestic demand
Observations	196	78
R-squared	0.565	0.451

Note: The dependent variable is the (log) of new regular exporters' entry rate. Robust standard errors are in parentheses. ***, **, * statistically significant at the 1%, 5% and 10% levels, respectively.

the elasticity of the rate of regularity to a percentage change in the (exogenous) rate of new exporters. The coefficient is positive and very precisely estimated, indicating that an increase in experimentation leads to an increase in the number of new firms that become regular exporters. In particular, a 10% increase in the rate of entry leads to a 5% increase in the regularity rate. This result suggests that there is a causal positive relationship between experimentation and emergence of new regular exporters.

Table 3-column (2) reports the results of the estimation when we narrow the sample to industries with a similar demand in 2008 and 2016. The instrumented new exporters' entry rate coefficient remains positive and statistically significant. Furthermore, the value of the coefficient is similar to that reported in column (1).

4 Conclusion

We show that the severe drop in domestic demand between 2009 and 2013 forced many Spanish firms to seek new customers in foreign markets. Furthermore, we also find that industries that experienced a larger increase in the entry of new exporters experienced a larger increase in the number of new regular exporters. Since the crisis was not anticipated, our instrumental variable approach provides evidence on a causal link between experimentation in foreign markets and emergence of new regular exporters. This result is consistent with alternative narratives wherein firms had capacity constraints, were uncertain about their profits in foreign markets and risk-averse; or firms were satisfied with their non-export status prior to the crisis.

Given that new exporters, if they survive, substantially contribute to export growth in the medium and long terms, the economic crisis may lead to a permanent increase in the aggregate value of Spanish exports. Our results also suggest that, in the presence of uncertainty and risk aversion, or situations where firms are satisfied with a sub-optimal situation, measures reducing the cost of experimentation may lead firms to explore foreign

markets and become regular exporters.

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