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MWP 2015/17
Max Weber Programme

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EUI Working Paper **MWP** 2015/17

ISSN 1830-7728

Printed in Italy
European University Institute
Badia Fiesolana
I – 50014 San Domenico di Fiesole (FI)
Italy
www.eui.eu
cadmus.eui.eu

Abstract
How do firms' sales interact across markets? Recent empirical work has suggested that foreign and domestic sales are substitutes for firms facing financial and physical capacity constraints. Using a large Spanish firm-level database for the period 1990-2011, we study the interconnections between exports and domestic sales. We provide a new measure to determine if firms face physical constraints based on the capacity utilization of the firm, and document that it is independent of firm fundamentals such as value added and productivity.
A firm facing a binding capacity constraint faces a trade-off between selling on the domestic market or the foreign market, and raises prices in order to take advantage of access to foreign markets. We document the existence of these firms, and show that capacity constrained firms substitute sales across locations.

Keywords
Export dynamics, Firm heterogeneity, Capacity constraints, Market access.

JEL Codes: F12, F14, L11, L13.

As of the 3rd December 2016, the working paper has been revised with the intention to contribute in a meaningful way to scholarship.

We gratefully acknowledge Arpad Abraham, Klaus Desmet, and Diego Rodríguez for their valuable advice and insightful comments throughout the development of the paper. We also thank the seminar participants in the UC3M internal seminars, EUI workshops, XVI Conference in International Economics in San Sebastian and 17th ETSG Conference in Paris for their comments that greatly improved both the content and exposition of the paper. The authors gratefully acknowledge funding from the Ministerio de Economía y Competitividad grants ECO2011-30323 (Crespo) and ECO2014-52051-R (Munõz-Sepúlveda).

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1 Introduction

One of the most important effects derived from the recent economic and financial crisis is the sharp contraction observed in domestic demand levels in developed countries, and in particular in southern European economies. This fact contrasts, however, with the significant increase in the export flows and in the number of exporting firms in the years after the beginning of the crisis. Thus, for instance, the total Spanish exports increased about 35% from 2007 to 2015, while the total number of Spanish exporters selling abroad grew approximately by 50% in the same time period.[1] The rationale behind this empirical evidence is simple, when demand at home is short, firms turn to foreign markets to sell the rest of their production and make profits. Although this explanation may seem quite straightforward, it has generated a vast amount of literature in recent years. In general, this literature emphasizes the key role of capacity constraints (physical and financial) in explaining the aforementioned pattern between domestic and export sales.

There is an increasing number of authors that contest new international trade models of heterogenous firms á la Melitz by incorporating the existence of short run increasing marginal costs, and therefore departing from the standard constant marginal costs assumption. These models assume that capacity constraints are the main source of increasing marginal costs for firms (see Blum et al. (2013), Soderbery (2014) or Ahn and McQuoid (2015)), since the capacity of the firm will limit the response available to these firms to external demand shocks. For example, in response to a positive foreign demand shock, a constrained firm would not be able to expand its exports without decreasing the domestic sales unless they undertake a costly investment. Consequently, the entry to new foreign markets may generate an opportunity cost to capacity-constrained firms associated with their domestic sales, which leads to the substitution of sales across different markets. With respect to financial constraints, stands out Manova (2013) who builds a theoretical model and provides empirical evidence of credit constrained firms pricing differently across markets compared to non-constrained firms, which leads to a different behaviour in international markets among these firms, and a smaller presence of financially constrained firms in foreign markets.[2] In this regard, the primary goal of this paper is to empirically evaluate this potential trade-off between domestic and export sales for firms facing capacity constraints, whether of physical or financial nature.

Our contribution to the literature is twofold. First, we present a new indicator to analyze the existence of physical capacity constraints. In contrast to previous studies that established a fixed threshold on the firm's capacity utilization rate,[3] this paper calculates specific capacity thresholds for each industry and year. Therefore, operating at full capacity may not be in itself an indicator of a firm being constrained. Second, we are one of the few studies that uses data from a developed country, Spain, to explore the potential existence of a trade-off pattern

[1] According to the data of the Spanish Chambers of Commerce and the Spanish Tax Agency, the total Spanish exports increased from €185 billion in 2007 to more than €250 billion in 2015. Moreover, the number of exporting firms grew from 97,418 in 2007 to 147,378 in 2015.

[2] See also Muûls (2008), Campello et al. (2010), Belke et al. (2015), Manova et al. (2015) and Chaney (2016).

[3] Smolny (2003) considers that a firm is physically constrained when its capacity utilization rate is higher than 95%, while Ahn and McQuoid (2015) assume that this threshold is equal to 100%. See Hallaert and Munro (2009) for a comprehensive study of developing OECD countries and the constraints to trade.

between sales.[4] In general, previous articles about this issue have used data from emerging or developing countries, which generally have a weaker domestic demand. Furthermore, these countries have developed strong export promotion policies in order to improve their export performance, confirming the potential presence of this trade-off between sales.[5] However, this substitution pattern is not so obvious in developed countries, given that these countries usually present high levels of demand in both domestic and export markets, as the conflicting results of Vannoorenberghe (2012) and Berman et al. (2015) show, the first defending a substitution pattern and the second a complementary one between domestic sales and export sales for France.

The empirical analysis has been conducted using the data from the *Encuesta Sobre Estrategias Empresariales* (ESEE), a large database at the firm level that is representative of the Spanish manufacturing firms. This survey is carried out yearly by the Spanish Ministry of Industry and provides exhaustive information for Spanish manufacturers. On the one hand, this database allows us to calculate a measure of total factor productivity (TFP), which is considered as a proxy for firm productivity. On the other hand, it also allows us to define the presence of capacity constraints by focusing on the physical and financial constraints as the two main sources of increasing marginal costs for firms. With respect to physical constraints, this paper proposes a more refined measure based on the firm's capacity utilization rate, which captures heterogeneity across industries and over time. In particular, each threshold is defined as the sum of the average rate of capacity utilization for each industry and year, and the standard deviation of this rate. Regarding financial constraints, we follow the approach of Whited and Wu (2006) and construct an index of financial dependence that takes values in the interval [0,1]. Then, the closer the index is to zero, the better the financial situation of the firm, which suggests a low probability of facing financial constraints.

The econometric analysis applies an OLS estimation that includes time- and industry-fixed effects to assess the trade-off between sales across markets. First, the results emphasize the relevance of physical and financial capacity constraints. Specifically, the results show that physically constrained firms have lower domestic sales than unconstrained firms. In addition, they also point out that firms with a greater financial dependence present lower sales in domestic market than firms with a better financial status. Second, the estimates confirm the substitution relationship between domestic and export sales when firms face capacity constraints. This result may suggest that capacity-constrained firms cannot freely expand their production after a positive foreign demand shock in order to also supply other markets, and, therefore, they will face a trade-off between sales across markets.

The remainder of the paper is organized as follows. Section 2 reviews the recent strand of the literature that incorporates the role of physical and financial capacity constraints in export dynamics. Section 3 discusses the data and the different measures that would suggest the existence of capacity constraints, and presents some important descriptive results. In Section 4,

[4]The exception being Vannoorenberghe (2012) and Berman et al. (2015) who analyze substitution and complementary patterns between domestic and export sales for France.

[5]Soderbery (2014) documents this substitution relationship using data from Thailand, exploiting changes in the tariffs to identify the expansion of international demand. Ahn and McQuoid (2015) and Blum et al. (2013) exploit as well data of developing countries finding the same substitution pattern in Indonesian and Chile respectively.

we present the econometric analysis and the main results of the paper, along with a variety of robustness exercises. Section 5 concludes.

2 Previous Research

The literature that has addressed the role of physical and financial capacity constraints in export dynamics has increased significantly in the last decade. In general, these studies conclude that the existence of capacity constraints are the main source of increasing marginal costs for firms. Specifically, it is assumed that capacity-constrained firms cannot increase their production beyond its underlying capacity, which implies that these firms face an infinite marginal cost. This assumption indicates, therefore, that firms cannot access new markets by expanding their production, which may suggest the existence of a potential trade-off pattern between sales across markets, and that firms price differently when they are constrained in both the domestic and export markets.

Soderbery (2014) is a good example of this growing strand of the literature that evaluates the interconnections between sales across markets. In this article, the author develops a theoretical model in the spirit of Melitz and Ottaviano (2008) that incorporates heterogeneity not only in productivity but also in capacity levels. The key prediction of the model points out the existence of a substitution relationship between domestic and export sales for those firms facing capacity constraints, given that these firms face increasing marginal costs. The main predictions of the model are tested empirically using firm-level data from Thailand for the period 2001-2006, and the obtained results also confirm the trade-off pattern between domestic and foreign sales.

The interrelation between sales is also addressed in Ahn and McQuoid (2015), who also question the validity of the constant marginal costs assumption in standard trade models due to which firms maximize their profits on different markets independently of each other. More specifically, they use plant-level information of medium and large Indonesian firms over the period 1990-1996 to empirically evaluate the role of capacity constraints in export dynamics. In this regard, the authors define two different measures that may suggest the existence of capacity constraints. On the one hand, they assume that a firm is physically constrained when its capacity utilization level is equal to 100%. On the other hand, firms ranked in the lowest 50% of the ratio between cash flow and total assets are categorized as financially constrained firms. The main result of the paper indicates that capacity constraints are central to understand the substitution pattern between domestic and export sales.[6] In the same line of research, the study of Blum et al. (2013) develops a theoretical model in the spirit of Melitz (2003) that introduces heterogeneity in capacity utilization levels. In order to verify the main predictions of the model, the authors carry out an empirical analysis using plant-level information from Chilean manufacturing firms. The results show the existence of a negative correlation between domestic and export sales growth, which confirms the assumption that capacity constrained firms face increasing marginal costs.

[6] In a previous version of this work (Ahn and McQuoid (2013)), the authors also confirm the existence of this trade-off pattern between sales using Chilean firm-level data for the period 1995-2006.

The previous studies are examples of the literature that has assessed the existence of a trade-off pattern between sales across destinations by using data from developing or emerging countries. In general, these countries are characterized by having weak levels of domestic demand, which usually lead them to develop strong export promotion policies in order to improve their export performance. This fact might support, therefore, the existence of this trade-off between sales. However, there are not many studies that have evaluated this relationship using information from developed countries.

The studies of Vannoorenberghe (2012) and Berman et al. (2015) are, to our knowledge, the only ones that have also addressed the interconnections between sales using data from a developed country (France). On the one hand, Vannoorenberghe (2012) introduces a new perspective and focuses on the analysis of the volatility of sales growth in the domestic and export markets. Specifically, he develops a theoretical model that incorporates demand shocks in both domestic and foreign markets, and demonstrates theoretically and empirically the presence of a substitution relationship between domestic and export sales in the short run. In particular, the results show that French firms that have, on average, a high sales growth in the domestic market usually present a low sales growth in the export market, and viceversa. On the other hand, the study of Berman et al. (2015) also analyze the dynamic relationship between domestic and foreign sales in France by considering the presence of exogenous shocks to foreign demand. In general, they find that exports are mainly determined by exogenous changes in the foreign demand conditions. In this regard, the main result of the article indicates that these external shocks lead firms to increase both domestic and export sales, which suggests the existence of a complementary relationship between sales. More specifically, they find that an exogenous increase in exports by 10% causes an increase between 1 and 3% in the domestic sales in the short run. This result might suggest, therefore, that firms also channel foreign exogenous shocks into the domestic business cycle.

The results obtained in Vannoorenberghe (2012) and Berman et al. (2015) may seem contradictory with each other, which might come from using different methodologies or from not taking into account the main sources of increasing marginal costs in the short run. Our paper differs from these two papers in the sense that we consider jointly both physical and financial constraints as the two most likely sources of increasing marginal costs for firms and, therefore, as the main mechanism of the transmission of foreign shocks to the domestic market.

Our estimation approach and objectives are similar to the papers discussed in this section. However, unlike Soderbery (2014) and Ahn and McQuoid (2015), the measures we use to identify the presence of capacity and financial constraints are more precise. First, we use the index proposed by Whited and Wu (2006) to identify financial dependence of firms instead of the cash flow to assets ratio or self-reported indicators of access to credit. Consequently, and by using this index, we avoid any self-reported measure of subjective character since the answer might result from the firm's opinion or judgement and might not take into account other important external factors. Second, regarding physical capacity constraints, firm's capacity utilization level by itself or be operating at full capacity might not reflect the status of the firm of being constrained. This is especially common in industries like *electrical equipment and materials* or

motor vehicles that have traditionally presented high capacity utilization rates. To tackle this issue, we propose a more accurate measure that incorporates heterogeneity across industries and over time, which allows to determine the existence of capacity constraints by taking into account average utilization levels of others firms of the same industry in the same specific year.

3 Data and Descriptive Analysis

The database used is the *Encuesta Sobre Estrategias Empresariales* (ESEE, Business Strategy Survey) for the period 1990-2011. This survey is carried out yearly by the Spanish Ministry of Industry and provides exhaustive information at the firm-level on Spanish manufacturers. This database uses the firm size and the two-digit NACE sector as the main stratification criteria.[7] Specifically, the population of the database covers manufacturing firms with ten or more employees. In addition, and in order to minimise attrition and to ensure that the database remains representative over time, it makes significant efforts to incorporate new firms with the same sampling scheme to replace those firms that leave the database.

The surveyed firms offer annual information on the number of employees, volume of domestic and export sales, two-digit NACE codes, ownership structure (foreign- or nationally-owned) and other important variables related to financial balance sheets.[8] The survey also contains detailed information about firm's demand conditions. In particular, and to the best of our knowledge, the ESEE is one of the few firm-level datasets that provides the rate of the firm's standard capacity utilization. This variable, which is often considered a proxy for the firm's demand conditions, takes values in the range $[0 - 100]$, where high values may suggest the existence of physical capacity constraints.

Using these data, we estimate a measure of the total factor productivity (TFP hereafter) by using the approach of Levinsohn and Petrin (2003). Specifically, we use gross revenue, capital stock (constructed with the perpetual inventory method), labour (measured by the total number of actual hours worked per year) and materials in order to estimate this variable.

The original size of the ESEE for the period considered 1990-2011 is 40,686 observations, which correspond to $5,040$ firms. However, we only consider those firms with information available for at least three consecutive years, in order to avoid the switching behaviour of the sample firms. Additionally, we also drop the observations corresponding to the year 1990 because they are too incomplete. Hence, the final number of observations is equal to $36,700$ corresponding to $4,294$ firms. The main descriptive statistics are given in Table A.2 in the appendix.

We define the existence of capacity constraints by focusing on physical and financial constraints as the two main sources of increasing marginal costs for firms. The remainder of Section 3 provides a detailed explanation about the measurement of both physical and financial constraints.

[7] A comprehensive list of the two-digit NACE sectors can be found in the appendix, in Table A.1.

[8] The ESEE only provides information on total sales and exports. It implies that domestic sales are calculated as the difference between these two variables (Total sales – Exports).

3.1 The measurement of physical constraints

We use the standard capacity utilization rate (U hereafter) as the proxy variable to construct our measure of physical constraints. As was previously mentioned, the variable U takes values in the range [0-100] and indicates the percentage of the firms' capacity that was utilised for production in a given year. In this regard, the average capacity utilization in the sample is about 80 percent and the standard deviation is about 16 percent.

In the literature, binding physical constraints are often associated with high capacity utilization. Smolny (2003), Soderbery (2014) and Ahn and McQuoid (2015), for example, consider that firms have capacity constraints when the capacity utilization rate is higher than 95% , or equal to 100%. The rationale behind these measures is that increasing production further is not possible, and thus one can say that in this case the firm faces an infinite marginal cost. However, we expect that this threshold might be different between industries and over time, as Figures 1 and 2 show.

First, Figure 1 depicts the distribution of capacity utilization for the Spanish manufacturing sector from 2000 to 2010. Two facts stand out. On the one hand, the distributions are skewed to the right, with a high number of firms with capacity utilization over 80%. On the other hand, the distribution is stable until the crisis, when a significant drop in capacity utilization is observed.

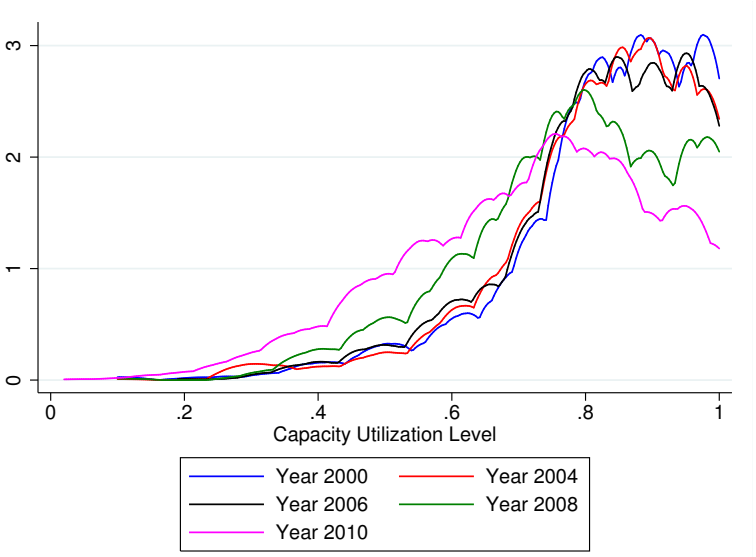
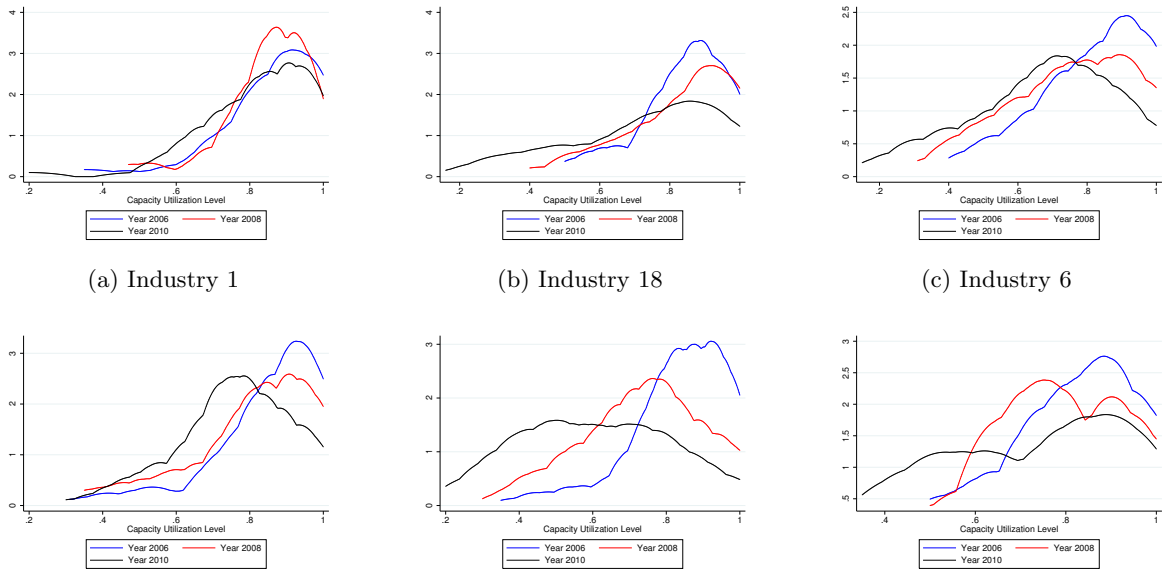


Figure 1: Distribution Capacity Utilization

Second, Figure 2 shows these distributions for some key industries. At first glance, it is clearly visible that industries behave differently, especially in answer to the crisis. For example, we observe that distribution spreads in Industries 1 and 18, but the larger mass of active firms still uses over 80% of their capacity. Moreover, the distribution slowly goes to the left in Industries 6 and 16, indicating a general decrease in the capacity utilization. Finally, Industries 11 and 15 are the ones which react more strongly to the crisis, and their distributions completely

differ from the behaviour of the economy as a whole.



(a) Industry 1 (b) Industry 18 (c) Industry 6

(d) Industry 16 (e) Industry 11 (f) Industry 15

Figure 2: Distribution Capacity Utilization by Industries

The heterogeneity across industries and years in the distributions of capacity utilization provides support for using a more refined measure to identify physically constrained firms. Thus, we propose a dummy variable that takes value one if a firm's capacity utilization is higher than an industry-year threshold (physically-constrained), and zero otherwise (unconstrained). Each threshold is calculated by industry j and year t, and is defined as the sum of the average rate of the capacity utilization for each industry in any specific year and the standard deviation of this rate, thus allowing us to also control for the dispersion in each industry per year. Table 1 shows the main descriptive statistics, distinguishing between physically-constrained and unconstrained firms for the whole panel sample.

The main result from the table indicates the existence of significant differences in firms characteristics among physically constrained and unconstrained firms. Firms that face capacity constraints have a lower number of employees and fewer sales (domestic and export) than unconstrained firms. Furthermore, they are less productive and have lower levels of investment than unconstrained firms. Our measure reveals, that on average, each year 17.48% of the sample firms are physically constrained. Notice that firms with a capacity utilization rate of 100% are not automatically classified as physically constrained. The reason for this is that industries like *electrical equipment and materials* or *motor vehicles*, have a traditionally high capacity utilization rate, and thus being at 100% does not imply being physically constrained with respect to the competitors in the industry. At the same time, we also observe an unusually low threshold – 83% – for being physically constrained firms, due to the coverage of crisis years in the sample. The strong contraction in demand in some industries, like *furniture* or *printing and reproduction of recorded media*, lowers the implied threshold for firms in these industries for those particular

years.

Table 1: Constrained versus Unconstrained

Physically Constrained Firms ($U > U^*_{jt}$)						
Variable	Mean	Median	St.Dev.	Min.	Max.	N.Obs
Domestic Sales (log)	15.08	14.81	2.19	0	22.36	6,319
Export Sales (log)	8.46	11.27	7.47	0	22.26	6,320
Capital Stock (log)	13.74	13.52	2.46	0	21.43	6,337
Investment (log)	9.52	11.15	5.39	0	19.55	6,327
Value Added (log)	14.55	14.13	1.94	7.88	20.72	6,270
TFP (log)	5.03	4.97	0.63	0.42	7.86	6,277
Number of employees	249.95	40.00	843.88	1	14,202	6,337
Capacity Utilization (%)	98.99	100.00	2.46	83	100	6,337

Physically Unconstrained Firms ($U \leq U^*_{jt}$)						
Variable	Mean	Median	St. Dev.	Min.	Max.	N.Obs
Domestic Sales (log)	15.24	15.08	2.06	0	22.17	29,741
Export Sales (log)	9.07	12.13	7.28	0	22.46	29,749
Capital Stock (log)	14.06	14.02	2.31	3.19	21.40	29,797
Investment (log)	9.88	11.50	5.29	0	20.13	29,763
Value Added (log)	14.64	14.42	1.89	5.85	21.97	29,441
TFP (log)	5.04	5.01	0.60	-1.89	7.64	29,512
Number of employees	223.89	52.00	617.03	1	15,003	29,798
Capacity Utilization (%)	76.01	80.00	14.87	2	100	29,798

Note: The average number of firms per year is equal to 1,747.

Finally, Figure 3 shows the evolution of the average threshold. On the one hand, from 1994 until 2008, the threshold is not only quite stable but above the level proposed by Smolny (2003) and Ahn and McQuoid (2015), implying that some firms would be misclassified as being capacity-constrained if we were to use the classical definition. On the other hand, the threshold dramatically drops with the start of the crisis, as expected, given the huge contraction in demand. If we were to use the classical definitions, we would be misclassifying firms as not being physically constrained, implying that an economic downturn eases the production possibilities of firms.

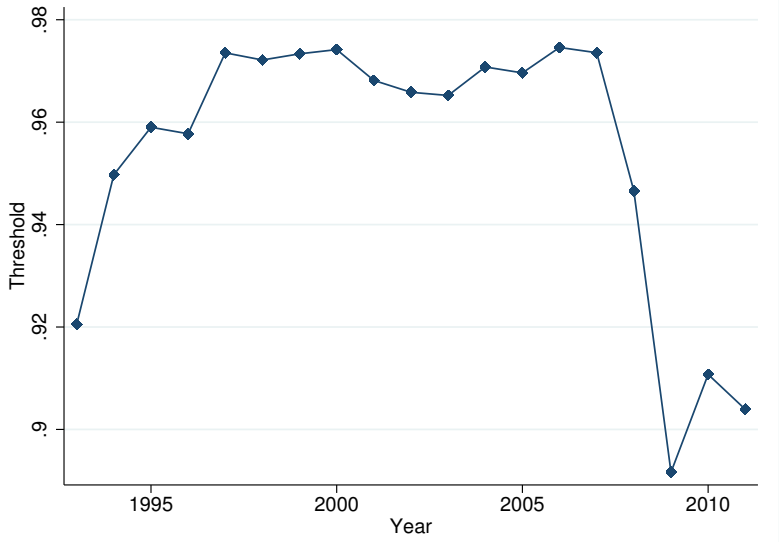


Figure 3: Capacity Threshold

3.2 The measurement of financial constraints

The economic literature that has addressed the impact of financial constraints has proposed a wide range of indirect measures to determine the presence of firm's liquidity restrictions. Two of the most widely used indicators on this topic are the indexes developed by Kaplan and Zingales (1997) and Whited and Wu (2006), which measure the firms' dependence to external finance. Thus, the higher the dependence to external funds, the higher the likelihood of credit and liquidity constraints.

On the one hand, the seminal article by Kaplan and Zingales (1997) (KZ hereafter) computes an ex-ante index on the firm's financial position from a set of observable financial ratios. Specifically, the KZ index is constructed using the Tobin's Q, the cash flow ratio, the long-term leverage rate, the dividends to total assets ratio, and the total liquidity to total assets. On the other hand, the article of Whited and Wu (2006) (WW hereafter) calculates an alternative more complex index to evaluate the financial status of the firm by estimating a set of dynamic equations on the maximization of the expected value of future dividends. Specifically, the WW index can be defined as the relative shadow cost of raising new equity by using external finance. In addition, the article also demonstrate that the WW index allows to identify the presence of financially constrained firms better than the KZ index. For this reason, we will use the WW index to examine the financial status of the distribution of firms across industries and over the years, and its potential relationship with capacity utilization and our capacity constraint measure. [9]

Following the approach of WW, the estimated equation that describes the WW index is:

$$WW_{ijt} = -0.091CF_{it} - 0.062DIVPOS_{it} + 0.021TLTD_{it} - 0.044LNTA_{it} + 0.102ISG_{jt} - 0.035SG_{it},$$

[9] See Manova (2013), Mancusi and Vezzulli (2010) or Mancusi and Vezzulli (2014) among others for papers who use measures of external finance dependence to identify financial constraints.

where CF is the cash flow ratio, $DIVPOS$ is a dummy variable that takes value one if the firm pays cash dividends in year t (and zero otherwise), $TLTD$ is the ratio between long-term debts and total assets, $LNTA$ is the logarithm of total assets, ISG is the firm's industry sales growth with respect to previous year, and SG is the firm's sales growth also with respect to previous year.[10]

In order to improve its interpretation, we scale the index to values in the range from 0 to 1. In this regard, low values close to zero would reflect a better financial situation of the firm and a smaller probability of facing financial distress, while higher values would be related to a greater financial dependence. The evolution of the index for the whole sample of firms over time and across industries is shown in Figure 4 and 5.

Figure 4 depicts the distribution of financial dependence for the Spanish manufacturing sector from 2000 to 2010. As can be seen, this figure shows a significant stability of this index over time, even during the recent crisis period. However, Figure 5 which analyses the distribution across industries exhibits a huge heterogeneity. Thus, for instance, the furniture sector (Industry 19) shows a distribution very skewed to the right with high financial dependence while the basic iron and non-ferrous metals industry (Industry 12) is the complete opposite. This indicates that different industries have different financing strategies, and thus firms are prone to be more or less financially dependent according to their industry.

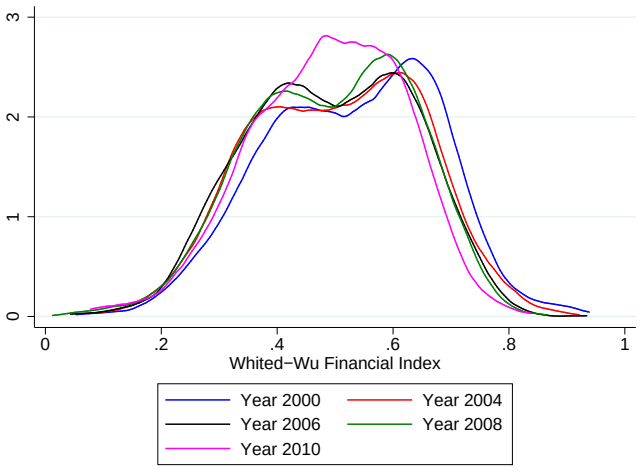
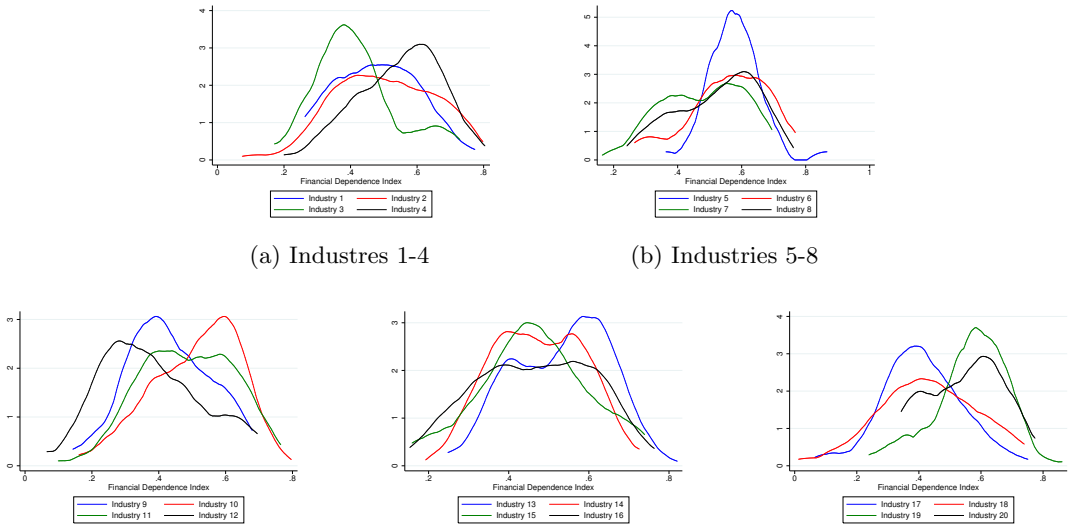


Figure 4: Distribution Financial Dependence Index

[10]The ESEE does not provide information about whether the firm i paid cash dividends in a specific year t. To overcome this issue, we assume that dividends are only paid if the change in equity is lower than the change in profits, meaning that the profits have not been completely used to increase equity 1 to 1.



(a) Industres 1-4 (b) Industries 5-8

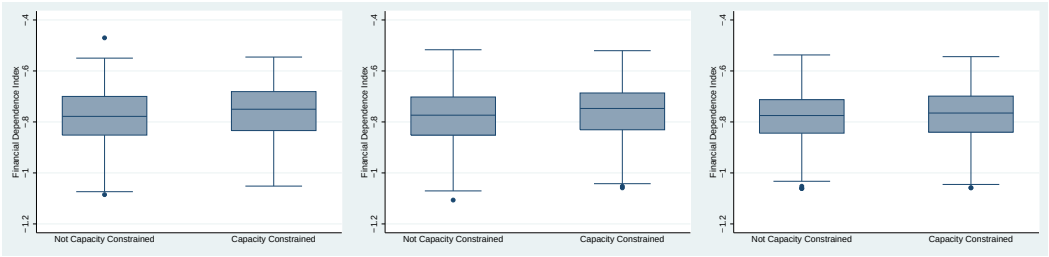
(c) Industries 9-12 (d) Industries 13-16 (e) Industries 17-20

Figure 5: Distribution of Financial Dependence by Industry in 2008

3.3 Interdependence between Measures

Finally, we analyse whether there is a significant difference in the financial dependence of firms when there are physically constrained or not. We expect that firms that are physically constrained are also financially constrained, and thus they should exhibit higher levels of financial dependence.

Figure 6 shows the distribution of the WW index in 2006, 2008 and 2010 dividing firms into physically constrained and unconstrained using the measure proposed above. While physically constrained firms appear to have higher levels of financial dependence, this is not completely clear from the figures. Therefore, we carry out a quantile regression test to identify whether the median of financial dependence is statistically different between physically constrained firms and non constrained firms. As can be seen from Table 2, physically constrained firms have a higher financial dependence (0.54 median) than non-physically constrained firms (0.51 median), and the difference is statistically significant.



(a) 2006 (b) 2008 (c) 2010

Figure 6: Financial Dependence and Physical Constraints

Table 2: Financial Dependance Difference between Firms

Median regression					Number of obs = 28866	
Raw sum of deviations 3425.778 (about .51783545)						
Min sum of deviations 3421.321					Pseudo R2 = 0.0016	
WW Index	Coefficient	Std. Err.	t	$P > \|t\|$	95% Conf.	Interval
Constant	.5136064	.0015369	334.18	0.000	.510594	.5166189
Physically Constrained	.0250384	.0037172	6.74	0.000	.0177524	.0323243

4 Econometric Approach and Results

The previous descriptive analysis has emphasised the role of capacity constraints in export dynamics. The main objective of this section is to empirically evaluate these connections. First, we investigate the potential endogeneity of capacity decisions taken by the firm. Second, we analyze the existence of a substitution relationship between domestic and export sales for those firms facing capacity constraints. Finally, in order to verify the validity of our results and the proposed measures, we carry out a number of additional robustness tests by using the measures that previous literature has proposed to analyze the existence of physical and financial constraints.

4.1 Analyzing Capacity Constraints

It is important to note that capacity constraints might be a direct consequence of firm decisions made *ex ante* regarding their level of capacity and dynamic capacity adjustment decisions that happen *ex post* as firms learn the true demand they face. In Section 3.1, Figure 3 showed not only the persistence of firms' decisions regarding the utilization of capacity but also the immediate reaction to the global sovereign debt crisis. Thus, and following the approach of Soderbery (2014), this section addresses the potential endogeneity of firms' decisions regarding capacity utilization. We exclude financial constraints from this preliminar analysis given that they are mainly affected by external factors that are not pre-determined by the firm (e.g. business cycle, current climate, banking willingness for credit, etc.).

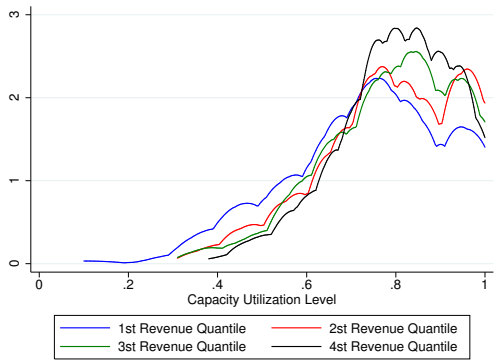
4.1.1 Constraints, TFP and Value Added

The first important regularity is understanding how firms make initial capacity decisions. In a perfect world without uncertainty or entry deterrence, firms would fully utilise capacity and choose the level that maximises their lifetime profits. However, from Figure 2 we can infer that firms may over- and under-invest in capacity. Furthermore, one may think that the firms' capacity utilization is directly related to the firms' sales or productivity, and that, therefore larger firms are less prone to face capacity constraints.

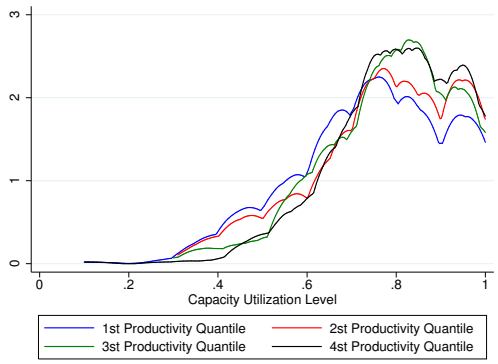
Figure 7a and Figure 7b document this feature of the data for the year 2008.[11] As can be seen, there is no statistical difference between the distribution of sales and productivity across quantiles. Furthermore, this figure documents a number of firms using between 70% and 85% utilization of capacity and a separate group of firms that use 90% or more of their capacity at each value added and productivity quantile. This potential discontinuity in capacity utilization is consistent with the existence of capacity constrained firms, and the similarity among the quantiles evidences that these capacity constraints are independent of firm fundamentals. Therefore, endogenous capacity decisions are taken *ex ante* and dynamic capacity adjustment decisions *ex post*. Hence, we can assume that capacity is randomly assigned.

Figure 7: Distribution Capacity Utilization in 2008

(a) Value Added



(b) TFP



4.1.2 The Persistence of Capacity Constraints

If firms make frequent permanent adjustments to capacity, we should observe a strong relationship between investment and capacity utilization.[12] In this regard, simple OLS estimation of this dynamic may lead to biased results in the presence of unobserved heterogeneity. For this reason, and in order to study the dynamic nature of capacity utilization, we will use the GMM system estimation that was proposed by Blundell and Bond (1998). This methodology is particularly recommended when the evolution of a variable is highly persistent over time, given that the correlation between the variable in differences and its past values in levels will disappear, which we think is the case with capacity utilization.

Table 3 shows the results of the study for dynamic capacity adjustments. Specifications (1) to (4) differ in the use of dummies for industry sectors and years and in the use of lagged variables. The use of industry and year dummies do not change the main results: capacity is highly persistent. The inclusion of lagged control variables, such as sales and investment, emphasises the high persistence of capacity utilization over time, as both lags show a positive and significant impact of the capacity utilization in year t.

[11] We have chosen to present these facts for year 2008, just before the crisis erupted. However, these graphs are consistent across years, both before and after the crisis, as can be seen in the Figures A. 2 and A. 3 in the appendix.

[12] In particular, investment is determined by equipment investment.

Table 3: Persistence of Capacity Utilization (GMM system estimation)

	(1)	(2)	(3)	(4)
Constant	-0.747***	-0.254***	0.132**	0.230***
	(0.035)	(0.064)	(0.059)	(0.083)
U_{t-1}	0.544***	0.450***	0.605***	0.557***
	(0.010)	(0.010)	(0.013)	(0.013)
U_{t-2}	-0.004	-0.029***	0.083***	0.022**
	(0.008)	(0.008)	(0.010)	(0.010)
$Sales_t$	0.065***	0.055***	0.103***	0.026***
	(0.002)	(0.003)	(0.008)	(0.009)
$Sales_{t-1}$	-	-	-0.0107***	-0.019*
			(0.010)	(0.010)
$Sales_{t-2}$	-	-	-0.006	-0.002
			(0.007)	(0.007)
$Investment_t$	0.006***	0.000	0.031***	0.005*
	(0.001)	(0.001)	(0.003)	(0.003)
$Investment_{t-1}$	-	-	-0.008**	0.004
			(0.003)	(0.003)
$Investment_{t-2}$	-	-	-0.000	0.000
			(0.001)	(0.001)
Year dummies	no	yes	no	yes
Industry dummies	no	yes	no	yes
Observations	21,894	21,894	18,673	18,673
Number of firms	3,302	3,302	2,879	2,879

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2 Empirical Results

Firms whose production is constrained by physical or financial restrictions, may not supply the whole market. Instead, they must optimise their sales between domestic and foreign markets to maximise their profits. Thus, they may substitute sales across locations exhibiting a negative relationship between domestic and export sales.

To test this hypothesis, we estimate an OLS regression model that includes time- and industry- fixed effects in order to assess the impact of physical and financial constraints on domestic sales, controlling for firm characteristics. In particular, we estimate :

$$\begin{aligned} Domestic_{it} &= \beta_0 + \beta_1 TFP_{it} + \beta_2 U_{it} + \beta_3 Physical_{it} + \beta_4 Export_{it} + \beta_5 Export_{it} * Physical_{it} \\ &+ \beta_6 WW_{it} + \beta_7 R\&D_{it} + \beta_8 Foreign_{it} + \epsilon_{it}, \end{aligned}$$

where the subscript i refers to firm (i=1,...,N) and the subscript t refers to time period (t=1991,..., 2011). We control for the firm's productivity, by including TFP, the capacity utilization rate of the firm (U), and three dummy variables related to the participation in export and R&D activities and the ownership structure ($Foreign$).[13] We also include our proposed measure of physical constraints ($Physical$) and an interaction between this variable and the export dummy. Finally, the WW index of financial dependence is also included in the analysis.

We expect domestic sales to be positively correlated to productivity, capacity utilization, participating in R&D activities and foreign ownership, consistent with empirical literature in international trade. Similarly, we expect a negative relationship with financial dependance and being physically constrained. Finally, the sign of the interaction between exports and being constrained (β_5), will determine if there is a complementary or substitution pattern among domestic sales and exports.[14]

Table 4 presents the results of the estimates. Columns (1) to (3) test the relationship between domestic and export sales with physical constraints. First, the capacity utilization rate is positive and significant, which suggests that a high capacity utilization increases domestic sales. Second, our proxy variable for physical constraints is negative and significant, supporting the expectation that physically constrained firms have lower domestic sales than unconstrained firms. Third, the relationship between domestic sales and export status is positive unless firms are physically constrained, confirming the substitution relationship between domestic and export sales when firms face physical constraints. These results are consistent with the inclusion of control variables such as R&D, ownership structure and productivity.

Columns (4) to (6) test the relationship between domestic and export sales with financial constraints. Here the substitution effect is even larger. Not only do firms with higher financial dependence have lower domestic sales than their counterparts; once we control for financial constraints, the export status of the firm is negatively related with domestic sales. The results are consistent with the inclusion of the control variables, and in line with the empirical findings of Manova (2013) and Ahn and McQuoid (2015).

Finally, in column (7) we consider both physical and financial constraints. Once we control for these restrictions, the relationship between domestic sales and export status is negative, and the substitution is even larger for firms that are physically constrained. In summary, these results support a substitution relationship between domestic and export sales when firms are under capacity constraints.

[13] Specifically, the variable $Foreign$ takes value one if the firm is mainly foreign-owned, and zero otherwise

[14] Notice that if this coefficient is consistently non-significant then it would imply that firms sales across markets are unrelated, which would verify the classical assumption of recent models of international trade with heterogeneous firms, such as Melitz (2003), Bernard et al. (2003) or Helpman et al. (2004).

Table 4: The effect of capacity and financial constraints on domestic sales

Dependent Variable: *log(Domestic Sales)*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.766***	0.985***	2.310***	9.240***	9.323***	9.267***	9.179***
	(0.0640)	(0.0654)	(0.0674)	(0.0929)	(0.0927)	(0.0927)	(0.0947)
TFP	2.855***	2.789***	2.618***	1.820***	1.840***	1.817***	1.808***
	(0.00874)	(0.00968)	(0.0105)	(0.0126)	(0.0126)	(0.0127)	(0.0130)
U	0.108***	0.0927**	0.105***				0.249***
	(0.0368)	(0.0367)	(0.0361)				(0.0344)
Physical	-0.149***	-0.0932***	-0.0889***				-0.0580***
	(0.0148)	(0.0211)	(0.0207)				(0.0201)
Export		0.188***	0.0890***		-0.156***	-0.179***	-0.171***
		(0.0120)	(0.0120)		(0.0107)	(0.0108)	(0.0116)
Export × Physical		-0.0762***	-0.0634***				-0.0530**
		(0.0248)	(0.0243)				(0.0234)
WW Index				-5.497***	-5.709***	-5.517***	-5.521***
				(0.0519)	(0.0537)	(0.0553)	(0.0559)
R&D			0.367***			0.142***	0.139***
			(0.0114)			(0.0108)	(0.0109)
Foreign			0.276***			0.0609***	0.0653***
			(0.0133)			(0.0125)	(0.0126)
Observations	35,633	35,633	35,407	28,928	28,928	28,766	28,396
R-squared	0.797	0.798	0.807	0.858	0.859	0.860	0.860

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.3 Robustness

In order to test the validity of our results, we have repeated the previous estimates using the less refined measures of physical and financial constraints that have been proposed by the recent literature on this topic. Furthermore, we will also split the sample between small and medium firms ($\leq$ 200 employees) and large firms ($>$ 200 employees), since the ESEE by construction contains all large firms with 200 employees and only a representative sample of small and medium firms.

As robustness measure for physical capacity, we consider the thresholds for high levels of capacity that have been traditionally used to determine if firms are capacity constrained or not, that is, firms are constrained if the utilization rate is higher than 95% or equal to 100. The results of the estimates are shown in Table 5. As can be seen, all the key variables have the expected signs which would confirm again the existence of a substitution relationship between domestic and export sales for constrained firms. These effects are slightly larger when we consider that firms are capacity constrained only if they operate at full capacity ($U = 100$), but when we include all firms with utilization rate over 95% the effects are not only smaller but also weaker,

becoming even insignificant in column (8). This result would imply, therefore, that firms sales across markets are unrelated for all firms, and that constrained firms do not face increasing marginal costs in the short-run. The reason behind these results is clear: the use of arbitrary thresholds that do not take into account intrinsic industry or time characteristics (e.g. $U \geq 95$) may be misclassifying many firms as physically constrained, and viceversa. This fact reinforces, therefore, our arguments of constructing a more defined measure that incorporates heterogeneity across industries and over time.

Table 5: The effect of capacity and financial constraints on domestic sales by using the thresholds U=100 and U≥95 for physical constraints

Dependent Variable: *log(Domestic Sales)*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	0.804***	1.021***	1.751***	9.198***	0.797***	1.017***	1.746***	9.190***
	(0.0634)	(0.0648)	(0.0663)	(0.0946)	(0.0637)	(0.0651)	(0.0666)	(0.0947)
TFP	2.851***	2.786***	2.616***	1.808***	2.856***	2.789***	2.618***	1.808***
	(0.00877)	(0.00969)	(0.0105)	(0.0130)	(0.00874)	(0.00968)	(0.0105)	(0.0130)
U	0.0984***	0.0812**	0.0868**	0.219***	0.0762**	0.0643*	0.0778**	0.234***
	(0.0355)	(0.0354)	(0.0348)	(0.0331)	(0.0364)	(0.0364)	(0.0357)	(0.0341)
U= 100	-0.168***	-0.112***	-0.105***	-0.0619***				
	(0.0155)	(0.0216)	(0.0212)	(0.0206)				
U≥ 95					-0.131***	-0.0884***	-0.0827***	-0.0579***
					(0.0149)	(0.0213)	(0.0209)	(0.0202)
Export		0.184***	0.0846***	-0.175***		0.185***	0.0867***	-0.173***
		(0.0118)	(0.0119)	(0.0115)		(0.0119)	(0.0120)	(0.0116)
Export × U= 100		-0.0751***	-0.0522**	-0.0336				
		(0.0265)	(0.0260)	(0.0251)				
Export × U≥ 95						-0.0558**	-0.0464*	-0.0375
						(0.0250)	(0.0245)	(0.0234)
WW Index				-5.520***				-5.526***
				(0.0560)				(0.0559)
R & D			0.365***	0.139***			0.367***	0.139***
			(0.0114)	(0.0109)			(0.0114)	(0.0109)
Foreign			0.275***	0.0642***			0.276***	0.0649***
			(0.0133)	(0.0126)			(0.0133)	(0.0126)
Observations	35,633	35,633	35,407	28,396	35,633	35,633	35,407	28,396
R-squared	0.797	0.798	0.807	0.860	0.797	0.798	0.806	0.860

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As robustness measure for financial dependance we use two dummy variables based on the cash flow and on the WW index described in Section 3.2. Specifically, the dummies take value 1 to indicate that the firm is financially constrained when (i) the cash flow ratio is below 50% or when (ii) the WW index is higher than the average index plus the standard deviation rate per industry and year.

The first measure based on the cash flow ratio classifies firms between financially constrained or unconstrained given the internal finance dependence of the firm. This measure, and in particular the allocation to the constrained or unconstrained groups we apply on the robustness

test, has been used as financial distress indicator by some of the recent papers on capacity constraints such as Ahn and McQuoid (2015). However, there is a large controversy in the literature regarding the use of measures based on cash flow ratios.

The seminal paper of Fazzari et al. (1988) was the first to establish as a empirical strategy the identification of financially constrained firms by analysing the sensitivity to changes in the cash flow across groups of firms with similar characteristics. If a firm is financially constrained it will be unable to obtain external funds to carry out any investment, then in order to do so they must use their own funds to finance them. However there is a large body of papers that discourages the use of cash flow measures as indicators of financial constraints because cash flow do not reflect the real situation of the firm regarding investments, it depends on the financial development of the country, the relationship of cash flow and innovation is highly dependent on firm size and/or does not control for expected profitability among other arguments.[15] Furthemore, some authors have even reported a negative relation between investment-cash flow sensitivity and the existence of financial constraints (See Kadapakkam et al. (1998) and Cleary (2006)).

The second measure is calculated in the spirit of the proposed measure for physical constraints, because in the main regressions we have included financial dependance and not classified firms into being financially constrained or not, which this threshold may measure better.

As can be seen in Table 6, the results of these new measures are mixed. While the results remain unchanged when we use the WW threshold, the cash flow threshold effect is positive. That is, if the cash flow ratio of a firm is below the 50%, the more likely to have a positive effect on the domestic sales. While puzzling the effects regarding the substitution pattern remain unchanged, and given the extensive empirical research that avails that the cash flow is an skewed measure, we determine that our results are also robust to other measures.

[15]See among others Chirinko (1993), Kaplan and Zingales (1997), Hubbard (1998), Gomes (2001), Bond et al. (2002) and Carpenter and Guariglia (2008).

Table 6: The effect of capacity and financial constraints on domestic sales by using the cash flow and WW thresholds for financial constraints

Dependent Variable: *log(Domestic Sales)*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Constant	0.528***	0.733***	1.454***	1.424***	1.821***	1.882***	3.078***	2.438***
	(0.0594)	(0.0611)	(0.0633)	(0.0681)	(0.0688)	(0.0695)	(0.0734)	(0.0760)
TFP	2.883***	2.823***	2.661***	2.658***	2.680***	2.658***	2.512***	2.508***
	(0.00859)	(0.00958)	(0.0104)	(0.0106)	(0.0104)	(0.0110)	(0.0118)	(0.0119)
U				0.146***				0.156***
				(0.0367)				(0.0391)
Physical				-0.128***				-0.115***
				(0.0145)				(0.0157)
Export		0.152***	0.0607***	0.0576***		0.0720***	-0.00864	-0.00999
		(0.0110)	(0.0111)	(0.0112)		(0.0121)	(0.0122)	(0.0123)
Export × Physical				-0.0645***				-0.0619**
				(0.0243)				(0.0266)
Cash Flow Threshold	0.134***	0.135***	0.111***	0.116***				
	(0.00962)	(0.00960)	(0.00946)	(0.00953)				
WW Threshold					-0.526***	-0.509***	-0.481***	-0.478***
					(0.0148)	(0.0150)	(0.0148)	(0.0150)
R&D			0.343***	0.339***			0.332***	0.330***
			(0.0112)	(0.0113)			(0.0121)	(0.0122)
Foreign			0.256***	0.260***			0.232***	0.237***
			(0.0131)	(0.0132)			(0.0141)	(0.0142)
Observations	34,786	34,786	34,564	34,051	28,928	28,928	28,766	28,396
R-squared	0.803	0.804	0.811	0.812	0.812	0.812	0.818	0.819

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In Table 7, we combine the robustness measures for both financial and capacity constraints. Results with the utilization of the WW threshold and full capacity, confirm the existence of a negative relationship between domestic sales and exports for constrained firms. Results when we use the looser threshold of capacity ($U \geq 95$) are weaker or non-significant for the reasons exposed above, we are included firms there that are not truly constrained. Finally, any regression with the cash flow threshold exhibits the same problems as in Table 6 but does still not affect at all to the substitution pattern.

Table 7: The effect of capacity and financial constraints on domestic sales by using the thresholds U=100 and U≥95 for physical constraints and the cash flow and WW thresholds for financial constraints

Dependent Variable: *log(Domestic Sales)*					
	(1)	(2)	(3)	(4)	(5)
Constant	8.512***	1.454***	2.467***	1.449***	2.465***
	(0.0940)	(0.0675)	(0.0754)	(0.0678)	(0.0757)
TFP	1.808***	2.657***	2.507***	2.659***	2.508***
	(0.0130)	(0.0106)	(0.0119)	(0.0106)	(0.0119)
U	0.249***	0.118***	0.130***	0.109***	0.123***
	(0.0344)	(0.0354)	(0.0377)	(0.0364)	(0.0388)
Physical	-0.0580***				
	(0.0201)				
U= 100		-0.102***	-0.0872***		
		(0.0213)	(0.0235)		
U≥ 95				-0.0802***	-0.0689***
				(0.0210)	(0.0230)
Export	-0.171***	0.0650***	-0.00285	0.0669***	-0.00153
	(0.0116)	(0.0119)	(0.0130)	(0.0120)	(0.0131)
Export × Physical	-0.0530**				
	(0.0234)				
Export × U= 100		-0.0535**	-0.0531*		
		(0.0260)	(0.0285)		
Export × U≥ 95				-0.0464*	-0.0431
				(0.0245)	(0.0267)
WW Index	-5.521***				
	(0.0559)				
Cash Flow Threshold		0.115***		0.115***	
		(0.00953)		(0.00953)	
WW Threshold			-0.479***		-0.480***
			(0.0150)		(0.0150)
R&D	0.139***	0.338***	0.328***	0.340***	0.330***
	(0.0109)	(0.0113)	(0.0122)	(0.0113)	(0.0122)
Foreign	0.0653***	0.258***	0.236***	0.259***	0.236***
	(0.0126)	(0.0132)	(0.0142)	(0.0132)	(0.0142)
Observations	28,396	34,051	28,396	34,051	28,396
R-squared	0.860	0.812	0.819	0.812	0.818

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In summary, the previous robustness analysis suggest that the measures that we define to determine the existence of physical and financial constraints are mostly consistent with the results obtained by using other alternatives measures or indicators. This fact reinforces again the use of the new proposed measures for two main reasons. On the one hand, and regarding

the measure of physical constraint, our measure allows to incorporate a new dimension in the analysis: the presence of heterogeneity in the capacity utilization across industries and over time. On the other hand, the use of the WW index allows to take into account other important external variables that are also relevant in determining the financial status of the firm and the potential existence of financial constraints.

Finally, in tables 8 and 9 we divide the sample in large firms (those with more than 200 employees) and small firms (those with less than or equal to 200 employees) respectively. As can be seen, the substitution pattern between sales and the effects of both physical and financial constraints remain strong in the small and medium firms. For large firms, the negative relationship between domestic and foreign sales remains unchanged, but we find a positive relationship between domestic sales and being physically constrained, which turns insignificant once the financial dependence is taken into account.

The overall effect on physically constrained firms ($\beta_3 + \beta_5$) is still negative if you are a large physically constrained exporter. This effect is still larger than for medium and small firms despite β_3 being positive or insignificant. Large firms, whether or not exporting, do not exhibit any impact on domestic sales from being at maximum capacity. Thus, any capacity expansion that might be needed by large capacity constrained firms goes toward expanding their presence in the foreign market since such firm have already fully exploited the domestic market. This result would be consistent with the larger effect presented by the estimated β_5 when comparing the results of Table 8 with those of Table 9.

Table 8: The effect of capacity and financial constraints on domestic sales, large firms (> 200 employees).

Dependent Variable: *log(Domestic Sales)*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	3.149***	3.336***	3.369***	8.055***	8.457***	8.386***	8.349***
	(0.197)	(0.198)	(0.198)	(0.237)	(0.237)	(0.200)	(0.242)
TFP	2.430***	2.452***	2.409***	1.860***	1.874***	1.865***	1.868***
	(0.0222)	(0.0222)	(0.0227)	(0.0269)	(0.0266)	(0.0268)	(0.0271)
U	-0.183**	-0.175**	-0.162**				0.0762
	(0.0752)	(0.0747)	(0.0749)				(0.0804)
Physical	-0.00151	0.207***	0.195**				0.118
	(0.0270)	(0.0764)	(0.0765)				(0.0830)
Export		-0.305***	-0.340***		-0.450***	-0.463***	-0.444***
		(0.0344)	(0.0347)		(0.0339)	(0.0344)	(0.0379)
Export × Physical		-0.239***	-0.227***				-0.152*
		(0.0786)	(0.0787)				(0.0852)
WW Index				-5.135***	-5.216***	-5.150***	-5.124***
				(0.133)	(0.131)	(0.133)	(0.133)
R& D			0.109***			0.0415**	0.0434**
			(0.0195)			(0.0205)	(0.0206)
Foreign			0.106***			0.0476**	0.0516***
			(0.0178)			(0.0185)	(0.0186)
Observations	10,221	10,221	10,094	8,270	8,270	8,178	8,144
R-squared	0.604	0.610	0.612	0.662	0.669	0.670	0.670

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9: The effect of capacity and financial constraints on domestic sales, small firms ($\leq$ 200 employees).

Dependent Variable: *log(Domestic Sales)*							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	3.007***	3.175***	3.512***	9.204***	9.260***	9.237***	9.094***
	(0.0762)	(0.0774)	(0.0782)	(0.101)	(0.101)	(0.101)	(0.103)
TFP	2.340***	2.291***	2.209***	1.663***	1.680***	1.672***	1.661***
	(0.0114)	(0.0121)	(0.0125)	(0.0138)	(0.0139)	(0.0140)	(0.0143)
U	0.180***	0.172***	0.175***				0.288***
	(0.0377)	(0.0376)	(0.0373)				(0.0358)
Physical	-0.159***	-0.124***	-0.118***				-0.0870***
	(0.0158)	(0.0201)	(0.0199)				(0.0194)
Export		0.143***	0.0810***		-0.0996***	-0.114***	-0.106***
		(0.0119)	(0.0121)		(0.0106)	(0.0107)	(0.0117)
Export $\times$ Physical		-0.0593**	-0.0451*				-0.0485**
		(0.0256)	(0.0253)				(0.0244)
WW Index				-4.604***	-4.756***	-4.668***	-4.678***
				(0.0587)	(0.0608)	(0.0621)	(0.0630)
R&D			0.274***			0.115***	0.112***
			(0.0132)			(0.0124)	(0.0126)
Foreign			0.225***			0.00406	0.00625
			(0.0184)			(0.0174)	(0.0175)
Observations	25,412	25,412	25,313	20,658	20,658	20,588	20,252
R-squared	0.678	0.680	0.687	0.763	0.764	0.765	0.766

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5 Conclusions

This paper has analyzed empirically the existence of substitution patterns between domestic and export sales when firms are capacity constrained using the ESEE — a micro level database of the Spanish manufacturing sector.

We consider both physical and financial constraints as the main sources of increasing marginal costs for firms. On the one hand, to determine if a firm is physically constrained we compare the firm's capacity utilization rate with an industry-year specific threshold defined as the sum of the average rate of capacity utilization for each industry and year, and the standard deviation of this rate. This measure not only incorporates heterogeneity across industries and over time but is able to differentiate between firms that are truly constrained when operating at full capacity and those that are not. On the other hand, we construct the White and Wu index to evaluate the financial dependence of firms. This index takes values in the range from 0 to 1, where low values close to zero indicate a better financial position or a lower likelihood of facing financial constraints.

The econometric analysis applies an OLS estimation that includes time- and industry-fixed effects to assess the potential substitution of sales across markets. First, the results show that physically constrained firms have lower domestic sales than unconstrained firms. In addition, they also point out that firms with a greater financial dependence present lower sales in domestic market than firms with a better financial status. Second, the estimates also confirm the substitution relationship between domestic and export sales when firms face capacity constraints. This result may suggest that capacity-constrained firms cannot freely expand their production after a positive foreign demand shock in order to also supply other markets, and, therefore, they will face a trade-off between sales across markets.

The previous results are robust to a variety of different measures of physical and financial constraints. Furthermore, due to the nature of the ESEE we split the sample between small and medium firms (≤ 200 employees) and large firms (> 200 employees). While the main result regarding the substitution pattern between domestic and export sales also hold when we split the sample, the estimate also reveal unsual patterns when we consider only large firms, where capacity constraints do not have negative effects over the domestic sales and the substitution pattern for these firms is much weaker. Future research will therefore concentrate on how the composition of firms in the economy can impact the substitution pattern between domestic and export sales.

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Appendix

Tables

Table A.1: Industry Classification

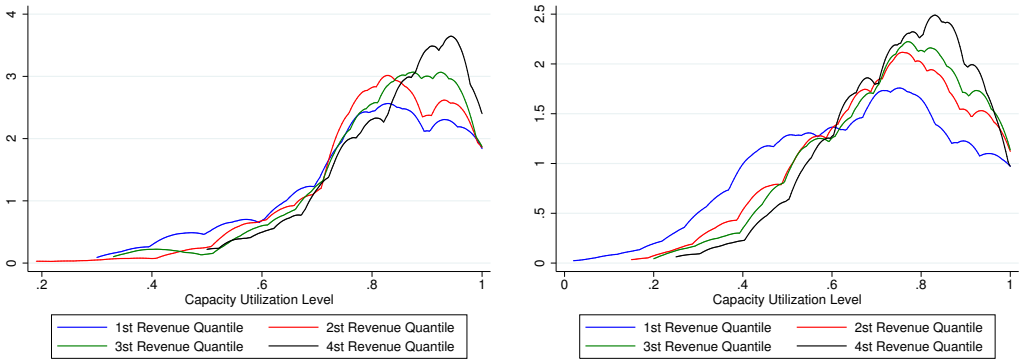
Industry Code	Description
1	Meat products
2	Food products (excluding meat) and tobacco
3	Beverages
4	Textiles and wearing apparel
5	Leather and related products
6	Wood and cork products (excluding furniture)
7	Paper products
8	Printing and reproduction of recorded media
9	Chemicals and pharmaceutical products
10	Rubber and plastic products
11	Non-metallic mineral products
12	Basic iron and non-ferrous metals
13	Fabricated metal products
14	Agricultural and industrial machinery and equipment
15	Computer, electronic and optical products
16	Electrical equipment and materials
17	Motor vehicles
18	Other transport equipment
19	Furniture
20	Other manufacturing

Table A.2: Variable Descriptive Statistics

Variable	Mean	Median	St.Dev.	Min.	Max.	N.Obs
Domestic Sales (log)	15.20	15.01	2.08	0	22.36	36,622
Export Sales (log)	8.88	11.92	7.33	0	22.46	36,632
Capital Stock (log)	13.97	13.90	2.35	0	21.43	36,699
Investment (log)	9.78	11.41	5.31	0	20.13	36,653
Value Added (log)	14.61	14.35	1.89	5.84	21.97	36,254
TFP (log)	5.03	5.00	0.60	-1.89	7.86	36,329
Number of employess	227.64	48.00	663.62	1	15,003	36,700

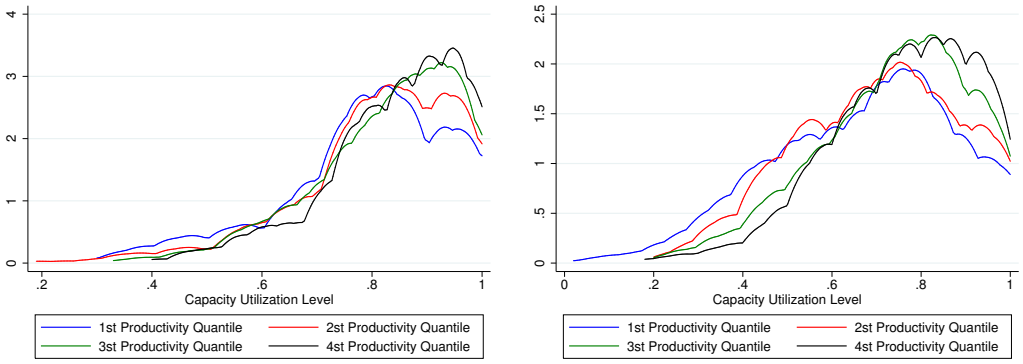
Note: The average number of firms per year is equal to 1,747.

Graphs



(c) 2006 (d) 2010

Figure A.1: Distribution of Capacity Utilization by Value Added



(a) 2006 (b) 2010

Figure A.2: Distribution of Capacity Utilization by TFP