

Does Private Equity Impact on Exports?

Evidence from OECD countries

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Abstract

This study looks across countries and industries to assess the impact of private equity on export performance. Using a comprehensive database of 22 OECD countries and 12 aggregated industries, from 1998 to 2012, it was found that private equity has a positive effect on export density and export market share. The above conclusions are confirmed after controlling for endogeneity issues emerging in the relation. These effects are deeper into industries with high levels of added value, productivity and infrastructure availability. These outcomes remain when local and foreign private equity are considered, however, foreign private equity activity show greater capacity to generate exports. Moreover, foreign private equity activity increases the capacity of local private equity to generate exports suggesting a complementary effect. Further, we find that country characteristics such as trade freedom and institutional quality are more productive to generate exports when activity of private equity is higher.

Keywords: Exports; private equity; spillover

JEL classification: F14, F21, G24

1 Introduction

In the literature of Private Equity (PE) is mentioned the importance of PE for economic progress. This literature shows different ways by which PE creates continuous growth and assist to economic development. For instance, financing and supporting the creation of new

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business, achieving and encouraging better industrial innovation, improving the quality of management and increasing the firms' productivity and the markets' competitiveness (Gambardella, Harhoff, and Verspagen 2008; Hellmann and Puri 2002; Kaplan and Stromberg 2009; Kortum and Lerner 2001; Lerner, Sorensen, and Strömberg 2011; Popov and Roosenboom 2013; Samila and Sorenson 2011).

A central hypothesis in the literature, therefore, is that PE has the capacity to improve performance not only of PE backed firms but also firms that do not receive PE investment through spillover effects (Bernstein, Lerner, Sorensen, and Strömberg 2016; Jensen 1989; Kaplan and Stromberg 2009). The spillover effects of PE arise from multiple sources that include an increased competition and link between PE backed firms and non-PE backed firms in the same industrial market (see e.g Aldatmaz and Brown 2016; Bernstein et al. 2016; Chevalier 1995; Kaplan and Stromberg 2009; Oxman and Yildirim 2008). These effects may increase the overall level of productivity of the sector (Aldatmaz & Brown, 2016; Bernstein et al., 2016) and, as a consequence, may increase exports. The main explanation is that firms with better characteristics, for instance productivity, can self-select into export markets (Bernard, Jensen, Redding, and Schott 2012; Redding 2011).

A large number of studies consider the impact of PE on productivity and operational improvement and PE spillover effects and knowledge transfer (e.g Aldatmaz and Brown 2016; Bernstein et al. 2016; Boucly, Sraer, and Thesmar 2008; Chevalier 1995; Cumming, Siegel, and Wright 2007; Harris, Siegel, and Wright 2005; Kaplan 1989; Kaplan and Stromberg 2009; Muscarella and Vetsuypens 1990; Oxman and Yildirim 2008). However, not many empirical studies consider the effect of PE on the export performance. Some exceptions include Lockett, Wright, Burrows, Scholes, and Paton (2008). They find that venture capital firms are a significant source of external resources that help improve export performance of their portfolio companies. Similarly, Smolarski and Kut (2011) find that equity-based venture capital financing affect positively firm's export performance and internationalization. It is worthwhile to note that both studies were carried at firm level (microlevel). As far as we know, this work is the first that examine the links between PE activity and export performance at industry level. A macro-level analysis allows to policy makers, for example, generate tax incentive to attract PE investment.

The study of this phenomenon is relevant due that exports play a major role in the economic progress. Growth in exports contributes directly to GDP, therefore, stimulates economic development. In a labor-surplus economy an export-oriented approach allows a greater expansion of employment and the increase of the real wages. (Abdulai and Jacquet 2002; Krueger 1985). Exports expansion carries with it products of higher quality, due the exposure of the exporters to international consumption habits (Krueger 1985). In addition, exports lead a company to invest in new technology as a alternative to commit to a better scale of production, which may increase the capital formation.(Ghirmay, Grabowski, and Sharma 2001; Rodrik 1988).

So, how relevant is the impact of PE activity on exports performance? What PE activities should be encouraged for export generation? What industrial characteristics affect the PE's contribution to export generation? Do foreign and local PE activity affect in the same way? How to generate market conditions so that PE continues generating support for economic growth? Given that exports play an important role and the benefits of PE markets in the economic progress, it is necessary to answer these questions to guide policy makers in an appropriate way.

The purpose of this work, therefore, is to contribute to the answers of the above questions. For this, we test the significance and direction of the relationship between PE and exports. In addition, we examine how some underlying countries (trade freedom and institutional quality) and industries characteristics (productivity, added value, infrastructure and investment intensity) impact the effects of PE on export performance. We also assess how these relations change when foreign and local PE activity is considered and if exist a crowding out or complementary relation between local and foreign PE in promoting exports.

We use the Thomson ONE Private Equity Database to extract information related to PE transactions of 22 OECD countries during the 1995-2015 period. This database enables us to classify the information at industrial level. We also use the Bilateral Trade by Industry and STAN database, which provides industry data across OECD countries. It contains economic information at the country and industry levels. The resulting sample is a panel data in where the main observation unit is a country-industry-year triple. The panel data analysis has the advantage of allowing to control for country-industry and year effects. Controlling for these effects account for time-invariant and country-invariant specific factors that might affect the industry's export performance.

Since there is no empirical information about the capacity of PE activity to promote exports in an international conditions, we fill this gap by giving the first exhaustive study of the impact of PE on industrial export in 22 OECD countries. Our findings suggest that PE activity is associated with higher export activity. The results are confirmed for different proxies of PE activity and after controlling for endogeneity. These outcomes are the same when local and foreign PE activity are considered, although foreign PE activity show greater capacity to generate exports in the host country. However, foreign PE activity enhances the capability of local PE to generate exports showing a complementary effect, this may be due to a transference of superior knowledge about foreign markets provided by foreign PE firms ¹. We find that the impact of PE is not perturbed by country and industry characteristics that should be determinants in the export generation. In general, the results suggest that the effects of PE over exports are deeper in industries with high levels of added value, productivity, capital and

¹Foreign PE firms may have greater expertise in international markets than local PE firms, even more if we consider that our sample contains traditional activity center for PE funds, as the United States, Netherlands, Sweden, Canada and United Kingdom (Bernstein et al., 2016)

investment intensity. In addition, we find that country characteristics such as trade freedom and institutional quality are more productive to generate exports when activity of private equity is higher.

This study has several contributions to the related literature. First, it adds to the quite limited field of research on the effect of PE on industry-level performance. Second, we provide evidence for a different channel for export spillovers other than multinational corporations which is the most discussed channel in the literature. Third, this study contributes to evidence-based policymaking, by displaying factors that can contribute to exports expansion.

The remainder of this paper is organized in the following way. In section 2 we provide a rationale for this study and a significant literature review. In section 3 we describe the variables employed as well as the justification of control variables. In section 4 we provide a description of the data used, its sources and the match employed to join the main databases. The section 5 describes the empirical methodology. In section 6 we present an analysis of the results obtained. Finally, section 7 contains the conclusions and future researches.

2 Motivations and Related Literature

2.1 Private Equity and Firm's Performance

The main purpose of this subsection is to provide a perspective on the effects of PE on firm performance. This paper deals with the impact of PE investment on the industrial export performance, but to recognize different benefits generated by PE investment in the firm performance allows to understand reasons for expecting positive effects of PE activity on the industrial export performance.

PE is an activity carried out by specialized entities (PE firms), which consists of providing financial resources on a temporary basis (3-10 years) in exchange for a stake (either majority or minority) in unlisted companies with high growth potential. This capital injection is complemented by added value: experience in other sectors or markets, closely monitoring managers, incentivizing managers with equity, advice on specific problems, professionalization of management teams, openness to new business approaches. In general, the purpose of PE is to contribute to the birth, expansion and development of the firm elevating its competitiveness level ([Jensen 1989](#); [Kaplan and Schoar 2005](#); [Kaplan and Stromberg 2009](#)).

PE firms improve operations and create economic value in their portfolio companies using practices that can be summarized under three main headings: financial engineering, governance engineering and operational engineering ([Jensen 1989](#); [Kaplan 1989](#); [Kaplan and Stromberg 2009](#)).

According to [Kaplan and Stromberg \(2009\)](#), financial and governance engineering refer to changes in the structure of ownership and financing that may lead to better monitoring and incentive alignment to overcome agency problems at the portfolio companies, and operational engineering refers to management practices that PE firms use to improve operational efficiencies of their portfolio companies. PE firms change the structure of ownership and financing in their portfolio firms leading to better monitoring and incentive alignment to overcome agency problems. On the other hand, the high degree of leverage involved in PE transactions reduces the free cash flow problems. A large a range of academic works that study the impact of PE transactions on the target companies provides evidence for the positive impacts on firm-level performance (see e.g. [Bergström, Grubb, and Jonsson 2007](#); [Boucly et al. 2008](#); [Cumming et al. 2007](#); [Harris et al. 2005](#); [Kaplan 1989](#); [Kaplan and Stromberg 2009](#); [Muscarella and Vetsuypens 1990](#)).

In summary, PE firms not only provide financial capital into their portfolio companies, they also perform an considerable governance function for their invested companies through monitoring and activities of added value. These financial and governance resources improve the PE-backed firm's productivity and operations. Now, with a higher productivity level PE backed firms are more likely to start exports ([Franco 2013](#); [Lockett et al. 2008](#); [Mijiyawa 2017](#)) and firms that already are exporting could increase their export intensity ([Lockett et al. 2008](#)). In the same sense, governance resources are progressively being as a crucial developer of internationalization ([George, Wiklund, and Zahra 2005](#); [Lockett et al. 2008](#)) and the internationalization process become firms more disposed to export. Finally, according to the absorptive capacity of the firms that do not receive investment, PE resources may not be limited to the companies receiving the investments, they can be transferred through spillover effects to other firms. Thus, spillovers from PE-backed companies may be an important promoter of the industry's exports.

2.2 Private Equity and Industry's Export Performance

In general, PE effects may not be limited to the companies receiving the investments. Operational and financial changes made by PE firms in their portfolio companies likely create spillovers effects into the overall industry. Some academic works have examined how PE transactions can affect other firms, which do not receive PE capital, within the same country and industry ([Aldatmaz and Brown 2016](#); [Bernstein et al. 2016](#); [Chevalier 1995](#); [Hsu, Reed, and Rocholl 2010](#); [Oxman and Yildirim 2008](#)). Although it is still unknown how PE transactions affect industry's export performance, there is a large-established literature that has provided evidence for the existence of industrial spillovers effects on export coming from Foreign Direct Investment (FDI) ([Aitken, Hanson, and Harrison 1997](#); [Anwar and Sun 2017](#); [Chen, Sheng, and Findlay 2013](#); [Franco 2013](#); [Görg and Greenaway 2004](#); [Harding and Javorcik 2012](#); [Lockett et al. 2008](#); [Mijiyawa 2017](#); [H. Sun 2001](#); [Tadesse and Shukralla 2013](#)). We use those theoretical foundations to argue that PE activity can produce spillover effects spreading their practices

to other firms at country and sector level making them prone to export. This spillover effects on exports are transmitted through three main channels: imitation, competition and demonstration.

Imitation Effect

The export activities involve sunk costs (Bernard and Jensen 2004; Clerides, Lach, and Tybout 1998; Girma, Greenaway, and Kneller 2004). These might include the establishment of a distribution network, creation of transport infrastructures, studies about foreign markets in order to obtain information about competitors, consumers, regulations among others. These costs would be lower for PE backed firms, since PE firms with international experience may be able to guide their portfolio companies about foreign markets and assist them on adequate entry strategies, this would form the best platform to enhance exports.

Furthermore, through their networks in foreign markets, PE firms may also be able to help identify required management (Lockett et al., 2008). Thus, a transfer of this knowledge from PE backed firms to firm that do not receive investment would constitute an information spillover, allowing the imitation of this superior knowledge about foreign markets, and as consequence, increasing the overall export performance of the industry (Greenaway, Sousa, and Wakelin 2004; Mijiyawa 2017). Therefore, imitation effect of PE refers to the fact that non PE backed firms can learn from PE backed firm in the same industry how to penetrate export markets.

Demonstration Effect

Given the risk inherent of adopting new production or management technologies, firms could be more cautions when adopting them, they could be unsure about the real advantages of new discoveries and even if they are convinced of the benefits, they may have uncertainty about the applicability in their particular environment. Since PE firms have the techniques and the personal able to transfer good experiences from an investment to another (Cumming et al. 2007; Kaplan and Stromberg 2009; Oxman and Yildirim 2008), PE backed firms are prone to adopt news technologies and superior production or management techniques.

When a PE backed firm adopts a new production or management technologies reveals enough information that allow the non-PE backed firms to reduce the perceived risk of adopting them. In this way, non-PE backed firms are more disposed to implement the innovations that could increase their competitiveness, and as consequence, access to international markets (Franco 2013; Greenaway et al. 2004; Mijiyawa 2017). The demonstration effect of PE, therefore, refers to the fact that non-PE backed firms can learn the PE backed firm's superior production or management techniques, and the implementation of new technologies, allowing them to compete more successfully on foreign markets. The above is related to information

costs, which can be very high for a company with limited resources (Nelson 1970).

In Recent studies there is evidence of positive impacts of PE over others non-PE backed firms. Aldatmaz and Brown (2016) find that following investments by PE funds labor productivity, employment, profitability, and capital expenditures increase for publicly-listed companies in the same country and industry. On the other hand, Bernstein et al. (2016) examined the effect of PE on the whole industry, they find that industries with at least one PE transaction in the past five years grow faster in terms of employment and productivity.

Competition Effect

With the entrance of PE investments into an industry, non-PE backed firms could be forced to improve efficiency by utilizing new technologies and practices to compete with the more competitive PE backed firms (see e.g Blomström and Kokko 1998; Franco 2013). There are, therefore, potential industry-wide externalities from the competitive pressure introduced by PE that could be considered like a spillover effect. On one hand, PE firms thanks to their increased competitiveness could access to new markets and reach scale, scope and learning economies. In this way, if non-PE backed firms are capable of absorbing the spillovers from PE backed firms, the industry overall might experience performance gains, whose consequence could increase exports. In this sense, Chevalier (1995) suggest that buyouts have a positive impact in local rivals, which would generate an expansion in their markets. More recently, Oxman and Yildirim (2008), find that after a leveraged buyout the PE corporate governance practices (for instance, more incentive to management team) motivate PE firms' growth and spill over on competitors.

On the other hand, if non-PE firms cannot keep up with the new technologies and survive tougher competition, the efficiency gains at the PE-backed firms could drive away demand from their competitors, so some of them may be pushed out of the market. This selection process increases the productivity level of the industry and, therefore, increasing exports (Franco 2013). In the same sense, the empirical work in Hsu et al. (2010) analyze why PE firms outperform their rivals. They find that some rivals experience a decrease in both stock prices and operating performance around the time of PE investments. Performance differences among competitors are explained by changes introduced by PE funds managing: level of specialization, better corporate governance, technological innovation, managerial incentives and higher efficiency in costs.

The competition effect of PE, therefore, refers to competition between PE-backed firms and firms that do not receive investment on both local and foreign markets, this would induce an improvement in the overall export performance of the industry. Furthermore, a greater competition effect in markets can strengthen the effects of demonstration and imitation, since competition effect generates a motivation to achieve best production techniques, which would

increase export potential of the firms (Görg and Greenaway 2004; Wang and Blomström 1992).

Based on existing literature, in overall terms, the export performance of PE-backed firms and overall industry tend to benefit from the PE by two ways. First, increasing productivity, competitiveness and the channels of access to international markets for PE backed firms. Second, through the imitation, demonstration and competition effect, PE can induce improvements of the same kind for the overall industry. We argue, therefore, that there is a positive relation between PE activity and industrial export performance. However, we do not reject the idea that the relation may be affected by other variables surrounding in the economy. Specifically, in addition to test significance and direction of relation between PE activity and exports, we seek to examine how the relation is altered when PE activity interacts with relevant country and industry factors that can make an environment more fertile to export.

3 Variables description

In this section we describe the variables used in the study. First, we describe the independent variables, followed by the description of dependent variables, and finally we justify the control variables. Their definitions are summarized in table 14.

3.1 Independent variables

For robustness, the explanatory variable (PE activity) is measured by four proxies. The first proxies are related with the total PE investment made at year t in the country i and in the industry j , which are measured as the natural logarithm of one plus the ratio of amount of PE invested to economically active population ² (Da Rin, Nicodano, and Sembenelli 2006; Herrera-Echeverri, Haar, and Salazar-Duque 2017; Kortum and Lerner 2001; Li and Zahra 2012; Popov and Roosenboom 2013), and the natural logarithm of one plus the ratio of a 3-year moving average of the amount of PE invested to economically active population (Popov and Roosenboom (2013); Herrera-Echeverri et al. (2017)). The latter two proxies are related with the number of PE investment deals in each country-industry-year triple and are measured as the natural logarithm of one plus the deals number and the natural logarithm of one plus a 3-year moving average of deals (Cumming and Li 2013; Herrera-Echeverry 2017; Sahaym, Steensma, and Barden 2010), these variables refer to PE concentration. The 3-year moving average of deals and amount of PE is used to capture the holding period in a PE transaction (Herrera-Echeverri et al. 2017; Kaplan and Schoar 2005; Kaplan and Stromberg 2009; Popov and Roosenboom 2013; Strömberg 2008). The above measures are made for each country and industry over our sample period.

²We define economically active population as the number of persons engaged by the industry.

3.2 Dependent variables

The dependent variable is measured using two proxies for the industry export performance: industrial export density and industrial export market share, which are measures related to sales and market size respectively. The industrial export density is measured as the natural logarithm of one plus the exports in a respective industry (Chen et al. 2013; Mijiyawa 2017; H. Sun 2001). The industrial export market share is measured as the natural logarithm of one plus the ratio of exports of an industry in a given country to total exports of that country (Akyol and Akehurst 2003; Baldauf, Cravens, and Wagner 2000; Brouthers and Xu 2002).

3.3 Control variables

We use three main control variables to assure that the relation between PE and industrial exports can be authenticated: industry's value added, GDP growth and the Real Effective Exchange Rate (REER). We expand below.

We need to control for the fact that the effects of PE on exports may be mediated by a change in productivity. A robust finding from recent analyses is that exporters are more productive than non-exporter, since firms with better characteristics (e.g a greater productivity) self-select into export markets (Brandt, Van Biesebroeck, and Zhang 2012; Redding 2011). For this, we use the industry's value added, which is measured as the ratio of value added volumes of a respective industry to the total value added of the economy. This variable captures the productivity at industry level, since value added of a particular industry, as describe in OECD, represents its contribution to national GDP (Webb, 2005). In the same sense, it is known that exist a direct relation between economic development and exports, countries with higher local economies have a more fertile field to support exports. We use GDP growth to control this issue (Jung and Marshall 1985; Sunde 2017; Tekin 2012).

According to WorldBank "The real effective exchange rate (REER) is a nominal effective exchange rate index adjusted for relative movements in national price or cost indicators of the home country, selected countries, and the euro area". It measures the value of a specific currency in relation to an average group of major currencies. Therefore, an increase of the REER implies a depreciation of the local currency. In theory, an depreciation increases the competitiveness of a country in export markets(Anwar and Sun 2017; Mijiyawa 2017; Verhoogen 2008).

4 Data description and sources

In this section we describe the main data sources used in our empirical analysis. First, we explain how we carry out the necessary correspondence to join the databases, since they rely on different industry classifications; then we describe the PE data, the data at industry level,

and by last the data at country level.

4.1 Correspondence between NAICS and ISIC codes

Our main databases are initially available in different industrial classifications. On one side, the industry classifications of PE data provided by the Thomson ONE Private Equity database, relies on North American Industry Classification System (NAICS). On the other hand, industrial information about exports and some control variables, provided by the Bilateral Trade Database by Industry (BTDI) and the Database for Structural Analysis (STAN), is classified by the International Standard Industrial Classification (ISIC). We have to rely on the ISIC classification, since the dependent variables are only defined at this level. To overcome this limitation, we use the mapping from the NAICS code into ISIC code, which is provided by United Nations Statistics Division, to map a NAICS industry into its respective ISIC industry. We then group ISIC sub-industries by using a more aggregated ISIC classification, to balance PE activity and industrial variables across industries. For example, there are 430 PE aggregated transactions within the “chemical and pharmaceutical products” sub-industry classification and only 83 aggregated transactions in the “coke and refined petroleum products” sub-industry, so we group these two sub-industries into a more aggregated industry. Our classification, NAIC-ISIC, leaves a total of 12 exporter industries aggregated.

Table 1: Private Equity Distribution by industry

Industry	Total deals	Local deals	Foreign deals	Total amount	Local Amount	Foreign amount
1. Agriculture, hunting, forestry and fishing	653	580	73	27.13	15.77	11.36
2. Mining and quarrying	1686	1301	385	303.78	198.17	105.62
3. Food products, beverages and tobacco	2832	2467	365	195.63	112.43	83.20
4. Textiles, wearing apparel, leather and related products	2726	2376	350	98.22	53.37	44.85
5. Wood and paper products, and printing	7790	7013	777	325.45	231.42	94.03
6. Coke, refined petroleum, Chemical and pharmaceutical products	14811	12985	1826	1092.85	751.90	340.95
7. Rubber and plastics products, and other non-metallic mineral products	3294	2855	439	322.60	165.58	157.02
8. Basic metals and fabricated metal products, except machinery and equipment	3745	3374	371	193.30	140.01	53.29
9. Machinery and equipment	25260	22571	2689	1907.70	1307.00	600.70
10. Transport equipment	1095	976	119	127.21	72.29	54.92
11. Furniture, other manufacturing	4395	3997	398	192.48	140.48	52.00
12. Electricity, gas, steam and air conditioning supply	1219	992	227	711.22	538.50	172.72
Total	69506	61487	8019	5497.58	3726.92	1770.65
13. Other activities	116632	103376	13256	10067.08	7049.72	3017.35

Table 1 summarizes the data on PE aggregated over the period 2001–2013 by Industry. Columns 2, 3 and 4 contain total, local and foreign PE deals signed from 1995-2015. Columns 5, 6 and 7 contain total, local and foreign invested amount, respectively, over the period reported, in billions of US dollars. Data come from Thomson ONE Private Equity Capital database.

4.2 Private Equity Information

The PE data come from Thomson ONE Private Equity Capital database. This database contains information about PE transactions realized in several countries, over a 21-year period from January 1, 1995 to December 31, 2015. PE activities in this database includes various

forms of early and later stages transactions by PE firms, such as, venture capital, leveraged buyout, management buyout, mezzanine or acquisition. These investments can be made by PE firms located in the same country in which their portfolio firms is located, but also by foreign PE firms, this enables us to classify PE activity in local and foreign PE activity. We downloaded all PE deals from Thomson ONE Private Equity Capital for 22 OECD countries included in the STAN database (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Poland, Portugal, South Korea, Spain, Sweden, Switzerland, UK and US), for the period 1995–2015, in current US dollars.

This gives us a sample with around 171.690 transactions, involving 69.506 distinct firms. Finally, aggregate values of PE capital invested and numbers of PE deals in each sector are calculated for each country-industry-year with the NAIC-ISCI classification developed.

Table 1 summarizes PE data by industry, in billions of US dollars. It contains information on the total, local and foreign numbers of deals per industry over the 1995–2015 period, as well as on the total, local and foreign amount invested in PE transactions. Clearly, PE activities varies markedly across industries. There is a heavy PE activity in traditional sectors, such as “Wood and paper products, and printing”; “Coke, refined petroleum, Chemical and pharmaceutical products”; “Machinery and equipment”; and “Furniture, other manufacturing”. These results are consistent with the study of [Bernstein et al. \(2016\)](#), where similar industries and countries are considered, but its data source is different and they only considered buyouts and acquisition activities. “Other activities” is an industry included in BTDI, which is not included in our sample because it is related with investments in non-export industries.

Table 2 summarizes information related to the numbers of PE deals by country over the period 1995–2015, as well as the total, local and foreign amount invested in PE transactions. We record sizeable variations of PE activity across countries. There is a great activity in traditional hubs for PE firms, as the United States, the United Kingdom, France, Canada, and Netherlands, which attracted over our period of study on average more than 120 US billions of dollars amount invested in PE transactions. By the contrary, countries like Austria, New Zealand, Poland and Portugal attracted no more than 10 US billions of dollars. In terms of local and foreign PE activities, in each country more than 60% of PE deals correspond to local PE deals, but in terms of the amount invested, no more than 40% corresponds to local amount invested ³. This suggests that while the number of local transactions in each industry is greater than foreign transactions, a greater amount of PE investment is involved in foreign transactions.

Table 3 shows cumulative information by year on the number of PE deals and PE investment. We observe that PE deals in OECD countries peaked during the dot-com bubble in

³With the exception of US where 80% of all PE amount invested, during the period in question, come from local PE firms

Table 2: Private Equity Distribution by Country

Country	Total deals	Local deals	Foreign deals	Total amount	Local amount	Foreign amount
Australia	1089	917	172	43.47	18.86	24.61
Austria	233	132	101	8.68	1.85	6.83
Belgium	442	292	150	22.26	5.61	16.65
Canada	9408	8619	789	192.80	91.85	100.95
Denmark	604	442	162	12.50	3.35	9.15
Finland	858	736	122	22.23	6.63	15.60
France	3590	3027	563	192.27	86.88	105.38
Germany	2644	1791	853	196.00	30.98	165.03
Ireland	320	223	97	41.34	1.18	40.15
Italy	810	544	266	103.23	32.57	70.66
Japan	543	442	101	23.58	14.42	9.16
Netherlands	763	554	209	152.24	18.31	133.93
New Zealand	153	90	63	8.70	0.51	8.19
Norway	353	278	75	10.88	2.62	8.26
Poland	175	122	53	2.65	0.98	1.67
Portugal	180	168	12	3.15	0.71	2.43
South Korea	1637	1505	132	40.62	23.76	16.86
Spain	735	578	157	28.05	13.18	14.87
Sweden	1225	937	288	65.09	36.69	28.40
Switzerland	536	299	237	72.06	11.41	60.65
United Kingdom	3770	3066	704	280.99	129.23	151.75
United States	39438	36725	2713	3974.80	3195.35	779.45
Total	69506	61487	8019	5497.58	3726.92	1770.65

Table 2 summarizes the data on private equity aggregated over the period 1995–2015 by country. Columns 2, 3 and 4 contain total, local and foreign PE deals signed from 1995–2015. Columns 5, 6 and 7 contain total, local and foreign invested amount, respectively, over the period reported, in billions of US dollars. Data come from Thomson ONE Private Equity Capital database.

2000. Similarly, they had other peak during the financial crisis in 2007–2008. On the contrary over the period 2003–2004 and 2009–2010, transactions fell around two thirds from their peaks, only to recuperate again in following years. Although there are two peaks in the PE deals distribution, in terms of the amount invested, most of PE investment were in the peak of 2008, almost double the amount invested in the peak of 2000. The recovery in PE amount investment in the mid-2000s until reaching its highest peak in 2008, was due to a chain of regulatory positive changes to PE. (Bernstein et al. 2016; Popov and Roosenboom 2013).

Although the variation of PE activity across certain industries, years, and countries can be seen as a potential concern, our analysis includes country-industry and year fixed effects. This, together with the fact that country-industry-year is the unit of observation, ensures that the results obtained are not driven by a few industry, year, or country outliers. In addition, all variables used in this paper have been winsorized at 1% and 99%.

4.3 Industry Information

For the export data we use BTID which provides detailed trade flows by manufacturing industry between OECD declaring countries and a selection of partner countries and geographical regions. From this database were extracted the total volume of exports of the 22 countries

Table 3: Private Equity Distribution by Year

Year	Total deals	Local deals	Foreign deals	Total amount	Local amount	Foreign amount
1995	1290	1160	130	23.08	19.88	3.20
1996	2039	1746	293	40.83	34.23	6.60
1997	2429	2171	258	58.30	39.39	18.91
1998	2781	2482	299	82.13	66.22	15.90
1999	3329	2888	441	162.42	123.45	38.97
2000	4418	3915	503	425.54	337.75	87.79
2001	3475	3097	378	186.43	135.34	51.10
2002	2822	2464	358	181.25	94.22	87.03
2003	3287	2943	344	170.16	132.72	37.44
2004	3792	3385	407	230.43	175.89	54.53
2005	3998	3556	442	208.93	131.90	77.03
2006	4232	3767	465	682.21	329.51	352.77
2007	4390	3928	462	1040.82	772.75	268.07
2008	4157	3732	425	294.19	157.57	136.62
2009	2791	2511	280	170.85	98.29	72.56
2010	3586	3198	388	178.76	118.11	60.65
2011	3629	3217	412	251.33	168.46	82.87
2012	3497	3119	378	208.03	145.37	62.65
2013	3297	2910	387	265.97	208.64	57.33
2014	3222	2753	469	219.40	146.44	72.96
2015	3045	2545	500	416.51	290.79	125.73
Total	69506	61487	8019	5497.58	3726.92	1770.65

Table 3 summarizes the data on private equity investment. The data are aggregated over countries, as well as over industries, per year over the 1998–2008 period. Columns 2, 3 and 4 contain total, local and foreign PE deals signed from 1995–2015. Columns 3, 5 and 7 contain total, local and foreign invested amount, respectively, over the period reported, in billions of US dollars. Data come from Thomson ONE Private Equity Capital database.

in our sample and for our 12 selected aggregate industries. On the other hand, the STAN database provides industry data across OECD countries compiled from national statistics offices. It contains economic information at the country, year, and industry levels. STAN database includes measures of employment, gross fixed capital formation, value added and productivity, all them used in our work.

In Table 4, we report exports by industry over the 1995–2015 period. Clearly, the variation of industrial exports is substantial. Industries 6, 9 and 10 exported around 62% of all exports in our sample. "Other activities" did not export more than 0,8% of all exports, contrary to what happened in the PE distribution where attracted most of investment.

4.4 Country Information

The country level data come from World Development Indicators (WDI), according to World Bank this “is the primary World Bank collection of development indicators, compiled from officially-recognized international sources. It presents the most current and accurate global development data available, and includes national, regional and global estimates⁴”. Definitions

⁴ For more information about WDI following the link <https://data.worldbank.org/products/wdi>

Table 4: Exports Distribution by industry

Industry	Total Exports	Total Exports(%)
1.Agriculture, hunting, forestry and fishing	3521.48	2.67%
2.Mining and quarrying	6068.71	4.59%
3.Food products, beverages and tobacco	7881.37	5.96%
4.Textiles, wearing apparel, leather and related products	5023.65	3.80%
5.Wood and paper products, and printing	3920.50	2.97%
6.Coke, refined petroleum, Chemical and pharmaceutical products	23276.94	17.62%
7.Rubber and plastics products, and other non-metallic mineral products	5541.66	4.19%
8.Basic metals and fabricated metal products, except machinery and equipment	11866.09	8.98%
9.Machinery and equipment	35272.36	26.69%
10.Transport equipment	23862.72	18.06%
11.Furniture, other manufacturing	4510.51	3.41%
12.Electricity, gas, steam and air conditioning supply	345.37	0.26%
13.Other activities	1045.80	0.79%
Total	132,137,161.13	100.00%

Table 4 summarizes the data on export aggregated for our 12 selected industries over the period 2001–2013. Column 2 contains total volume of exports in billions of US dollars. Column 3 contains the exports like share of all exports in our sample.

are summarized in Table 14.

5 Empirical Methodology

The aim of this research is to measure how PE activity influences the industrial export performance in OECD countries. For this propose, we use the following specification of a panel regression:

$$y_{ijt} = \beta_0 + \beta_1 x_{ijt-1} + \beta_2 ValueAdded_{ijt-1} + \beta_3 REER_{it} + \beta_4 GDPgrowth_{it} + \mu_{ij} + \eta_t + \epsilon_{ijt}. \quad (1)$$

Where the unit of observation is the country-industry-year triple. The subscripts i , j , and t denote country, industry, and years respectively. The variable y_{ijt} represents an export measure and the independent variable x_{ijt} represents a PE activity measure. $ValueAdded_{ijt-1}$, $REER_{it}$, and $GDPgrowth_{it}$ are the above-mentioned control variables. The variables μ_{ij} and η_t are country-industry fixed effect and year fixed effect, respectively. They are included to assure that the results are not controlled by a few industry, year, or country outliers. Additionally, all variables used in equation 1 have been winsorized at 1% and 99%. By last, ϵ_{ijt} is the residual error term.

Equation 1 suggest that the industrial export density and the export market share depends of PE activity and certain country and industry characteristics. It is used the lagged value of PE activity as an independent variable to consider the lag between a PE investment and its impacts on production and exports. In the same sense, the lagged value of ‘ValueAdded’ captures the change in exports due to the change in productivity of the previous period.

Moreover, this variable help us to account for the change in exports due to the exports of the previous period. Other studies have employed static models to explain similar phenomena, for instance, to examine the effects on exports from foreign direct investment ([Anwar and Nguyen 2011](#); [Chen et al. 2013](#); [Greenaway et al. 2004](#); [H. Sun 2001](#); [S. Sun 2009](#)).

A Hausman Specification Test suggests a model with fixed effects. A Pesaran CD Test indicates that residuals errors are correlated across entities. We detect auto-correlation using a Wooldridge Test. Similarly, a modified Wald Test detects heteroskedasticity. Robust standard errors for panel regressions are used in the estimation. Specifically, we use Driscoll-Kraay estimators to solve problems of auto-correlation, contemporaneous correlation, and heteroskedasticity. Correction through Discroll-Kraay models applies for our period of time and sample (see [Hoechle 2007](#)).

6 Analysis of Results

This section shows the results obtained from: our main regression, the instrumental variable regression which correct the endogeneity problem of the PE series, and various robustness checks.

6.1 Private Equity and Industrial Export Performance

Table 5, column (1) reports the estimates from our basic panel regression. An observation is a country-industry-year triple. The dependent variable export density and the main explanatory variable is PE concentration. The coefficient associated to the PE variable is significant and positive, implying that industrial export density is higher in industries with higher private equity concentration. The numerical interpretation is: increasing PE concentration in 1% during previous period, increases the current industrial export density on average 0,05%. Now, we wonder whether the previously observed effect is caused by the upper end of PE concentration, or average PE concentration accounts for the most of the result. In table 5, column (2) we report the results from a regression where the PE concentration variable is replaced by interactions with dummies for high and low PE concentration industries ⁵. We find greater industrial export density associated to economic sectors with high PE concentration. This suggests that higher PE inflows have a greater positive impact on industrial export density than average PE concentration.

Since the holding period in a PE transaction can take more than a year ([Cumming and](#)

⁵When defining the ‘High PE activity’ and ‘Low PE activity’ variables, we calculate the mean of the respective PE activity across industries for each country-year. In this way ‘High PE deals’, for instance, is an interaction variable between ‘PE deals’ and a dummy equal to 1 if the number of deals above the mean of their industry distribution for a given country-industry.

Table 5: Private Equity and Export Density

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Export Density							
PE deals _{t-1}	0.0497*** (0.0133)							
High PE deals _{t-1}		0.0536*** (0.0127)						
Low PE deals _{t-1}		0.0312* (0.0161)						
3-year PE deals			0.0668*** (0.0164)					
High 3-year PE deals				0.0701*** (0.0161)				
Low 3-year PE deals				0.0396** (0.0182)				
PE amount _{t-1}					0.0168** (0.00646)			
High PE amount _{t-1}						0.0183*** (0.00590)		
Low PE amount _{t-1}						-0.00667 (0.0175)		
3-year PE amount							0.0174*** (0.00542)	
High 3-year PE amount								0.0211*** (0.00539)
Low 3-year PE amount								-0.00851 (0.0184)
Added Value t-1	15.58*** (2.103)	15.46*** (2.076)	15.52*** (2.044)	15.40*** (2.001)	16.06*** (2.076)	16.02*** (2.070)	15.23*** (2.161)	15.19*** (2.139)
REER	0.00295*** (0.000466)	0.00281*** (0.000448)	0.00307*** (0.000459)	0.00289*** (0.000444)	0.00319*** (0.000568)	0.00318*** (0.000553)	0.00310*** (0.000604)	0.00309*** (0.000595)
GDP growth	0.00932** (0.00434)	0.00947** (0.00427)	0.00975** (0.00438)	0.00975** (0.00437)	0.0123* (0.00606)	0.0121* (0.00602)	0.0136** (0.00502)	0.0135** (0.00504)
Observations	5,104	5,104	5,104	5,104	4,265	4,265	4,818	4,818
Number of groups	261	261	261	261	260	260	260	260
Fixed Effects	Country-Industry and year							
Within R ²	0.501	0.501	0.501	0.501	0.474	0.474	0.483	0.483

Table 5 reports estimates from panel data regressions. An observation is a country-industry-year triple. The dependent variables for models 1–8 is the natural logarithm of one plus exports of a respective industry. ‘PE deals’ is the natural logarithm of one plus the number of PE deals for the respective country-industry-year. ‘3-year PE deals’ denotes the natural logarithm of one plus average deals in the respective country-industry-year the last 3 years. ‘PE amount’ is the natural logarithm of one plus the ratio of PE investment for the respective country-industry-year to economically active population in each industry-country-year. ‘3-year PE amount’ denotes the natural logarithm of one plus the ratio of average PE investment in the respective country-industry-year over the last 3 years to economically active population in each industry-country-year. ‘High PE activity’ or ‘Low PE activity’ are interactions between a given PE activity (PE deals, 3-year PE deals, PE amount, 3-year PE amount) and indicators for whether the measured PE activity is above or below the mean activity level (High-Low). ‘Value added’ is the value added shares of a respective industry. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Driscoll and Kraay standard errors are reported in parentheses. Data sources can be seen in Table 14. ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

Li 2013; Lerner et al. 2011; Strömberg 2008), PE spillovers also can take more than a year to impact the exports of specific economic sector. In Table 5 column (3) an alternative proxy for PE activity is used, the logarithm of one plus 3-year average of PE deals. Coefficient in the model is again positive and significant, implying a persistent effect of PE activity on industrial export density. This outcome is confirmed by model in column (4) where again PE activity have been replaced by interactions with dummies for high and low PE activity industries, but in this case PE activity is represented by the logarithm of one plus 3-year average of PE deals. Once more, a persistent effect of PE activity on industrial export density is associated to economic sectors with high PE relatively to low PE activity.

In order to confirm the positive relation between PE and exports, we repeat above procedure using alternative proxies for PE activity built over PE capital invested. Table 5, column (5) uses the lagged value of the natural logarithm of one plus the ratio of amount of PE invested to economically active population in each industry-country-year (PE investment). Column (6)

Table 6: Private Equity and Export Market Share

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Export Market Share							
PE deals _{t-1}	0.00120*** (0.000409)							
High PE deals _{t-1}		0.00160*** (0.000408)						
Low PE deals _{t-1}		-0.000618 (0.000530)						
3-year PE deals			0.00157*** (0.000517)					
High 3-year PE deals				0.00191*** (0.000498)				
Low 3-year PE deals				-0.00125 (0.000767)				
PE amount _{t-1}					0.000828 (0.000489)			
High PE amount _{t-1}						0.000834 (0.000499)		
Low PE amount _{t-1}						0.000725 (0.000784)		
3-year PE amount							0.00121** (0.000464)	
High 3-year PE amount								0.00139** (0.000511)
Low 3-year PE amount								-8.85e-05 (0.000379)
Added Value t-1	1.490*** (0.167)	1.479*** (0.166)	1.489*** (0.168)	1.477*** (0.164)	1.542*** (0.177)	1.542*** (0.178)	1.442*** (0.175)	1.440*** (0.174)
REER	3.04e-05 (1.80e-05)	1.72e-05 (1.80e-05)	3.30e-05* (1.79e-05)	1.47e-05 (1.84e-05)	3.78e-05** (1.64e-05)	3.78e-05** (1.62e-05)	3.14e-05** (1.44e-05)	3.07e-05* (1.47e-05)
GDP growth	-0.000195* (0.000110)	-0.000181 (0.000105)	-0.000185 (0.000108)	-0.000186* (0.000105)	-0.000198 (0.000117)	-0.000198 (0.000117)	-5.77e-05 (6.72e-05)	-6.51e-05 (6.57e-05)
Observations	5,104	5,104	5,104	5,104	4,265	4,265	4,818	4,818
Number of groups	261	261	261	261	260	260	260	260
Fixed Effects	Country-Industry and Year							
Within R ²	0.160	0.164	0.160	0.166	0.173	0.173	0.157	0.158

Table 6 reports estimates from panel data regressions. An observation is a country-industry-year triple. The dependent variables for models 1–8 is the natural logarithm of one plus the ratio of exports of an country-industry-year to total exports of that country-year. ‘PE deals’ is the natural logarithm of one plus the number of PE deals for the respective country-industry-year. ‘3-year PE deals’ denotes the natural logarithm of one plus average deals in the respective country-industry-year over the last 3 years. ‘PE amount’ is the natural logarithm of one plus the ratio of PE investment for the respective country-industry-year to economically active population in each industry-country-year. ‘3-year PE amount’ denotes the natural logarithm of one plus the ratio of average PE investment in the respective country-industry-year over the last 3 years to economically active population in each industry-country-year. ‘High PE activity’ or ‘Low PE activity’ are interactions between a given PE activity (PE deals, 3-year PE deals, PE amount, 3-year PE amount) and indicators for whether the measured PE activity is above or below the mean activity level (High-Low). ‘Value added’ is the value added shares of a respective industry. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Driscoll and Kraay standard errors are reported in parentheses. Data sources can be seen in Table 14.

***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

has the interaction of PE investment with dummies for high and low PE investment industries. Column (7) has the logarithm of one plus the ratio of a 3-year moving average of the amount of PE invested to economically active population (PE investment). Column (8) has the interaction of 3-year moving average of PE invested with dummies for high and low 3-year moving average PE investment industries (above or below of the mean of their industry distribution). In last case the resulting coefficients are again positive and significant at 1% confirming the hypothesis that PE activities, in this case through capital committed, has a real contribution to industrial export density. In column (8), it can be seen that coefficient associated to ‘Low 3-year PE amount’ is not significant and shows a negative sign, but ‘High 3-year PE amount’ coefficient continues positive, significant at 1% and with a higher value than coefficient associated to ‘3-year PE amount’. This behavior, also presented when comparing coefficients in columns (1) with (2); (3) with (4) and (5) with (6), indicates that the increase PE activity has favored the export density for countries and economic sector studied in our sample.

Regarding the control variables. ‘Value Added ’ is positive and significant, in all specifications, which capture the fact that an impact on exports may be positively altered by an impact on productivity. This result is consistent with previous studies in which it is argued that firms with better characteristics, such as a greater productivity, self-select into export markets (Brandt et al. 2012; Redding 2011). The coefficients of ‘REER’ and ‘GDP growth’ also are positive and significant at each specification. The sign of ‘REER’ confirms the fact that a depreciation of the local currency makes a country more competitive in export markets, as a consequence, increasing the industry’s exports (Anwar and Sun 2017; Herrera-Echeverri et al. 2017; Mijiyawa 2017; Verhoogen 2008).

Table 7: Private Equity and Export Performance Without U.S.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Export Density				Export Market Share		
PE deals _{t-1}	0.0448*** (0.0145)				0.00118** (0.000428)			
3-year PE deals		0.0616*** (0.0196)				0.00153** (0.000554)		
PE amount _{t-1}			0.0145** (0.00629)				0.000855 (0.000537)	
3-year PE amount				0.0175*** (0.00564)				0.00122** (0.000482)
Added Value _{t-1}	15.26*** (2.062)	15.20*** (1.995)	15.60*** (2.050)	14.80*** (2.132)	1.475*** (0.167)	1.474*** (0.167)	1.525*** (0.177)	1.425*** (0.174)
REER	0.00255*** (0.000645)	0.00271*** (0.000637)	0.00268*** (0.000774)	0.00266*** (0.000828)	2.69e-05 (1.93e-05)	3.05e-05 (1.94e-05)	2.98e-05 (1.90e-05)	2.40e-05 (1.60e-05)
GDP growth	0.00939** (0.00435)	0.00981** (0.00444)	0.0121* (0.00597)	0.0135** (0.00496)	-0.000197* (0.000109)	-0.000185* (0.000107)	-0.000205* (0.000116)	-6.28e-05 (6.60e-05)
Observations	4,864	4,864	4,033	4,586	4,864	4,864	4,033	4,586
Number of groups	249	249	248	248	249	249	248	248
Fixed Effects				Country-Industry and Year				
Within R ²	0.497	0.497	0.471	0.480	0.158	0.158	0.171	0.155

Table 7 reports estimates from panel data regressions using a sub-sample without data about United States . An observation is a country-industry-year triple. The dependent variables for models 1–4 is the natural logarithm of one plus exports of the respective country-industry-year, for model 5-8 is the natural logarithm of one plus the ratio of exports of an country-industry-year to total exports of that country-year. ‘PE deals’ is the natural logarithm of one plus the number of PE deals for the respective country-industry-year. ‘3-year PE deals’ denotes the natural logarithm of one plus average deals in the respective country-industry-year over the last 3 years. ‘PE amount’ is the natural logarithm of one plus the ratio of PE investment for the respective country-industry-year to economically active population in each industry-country-year. ‘3-year PE amount’ denotes the natural logarithm of one plus the ratio of average PE investment in the respective country-industry-year over the last 3 years to economically active population in each industry-country-year. ‘Value added’ is the value added shares of a respective industry. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Driscoll and Kraay standard errors are reported in parentheses. Data sources can be seen in Table 14. ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

For add robustness to what we are measuring, we run the above regressions, replacing industrial export density by the export market share of the respective industry, which is measured as the natural logarithm of one plus the ratio of exports of an industry in an given country to total exports of that country. Table 6, column (1)-(8) show the estimates from the main panel regression when the dependent variable is the export market share. Similar results are obtained. Again, control variables have the expected behavior but surprisingly, the effect of ‘GDP growth’ is negative however not significant. Respect to PE variables, all above confirm that there is a positive effect of PE deal and capital invested over industrial export performance measured by the export market share of the industry.

Before we control by endogeneity issues emerging in the previous relation, it is interesting to explore whether the impact of PE on exports is different when consider a sub-sample with-

out data about United States. Besides that the level of PE activity is greater in the United States than in other countries (even higher than continental Europe countries together), its PE industry is also more established. In Table 7, we repeat our main regressions reported in Tables 5 and 6 with the restricted sub-sample. The principal effects previously observed remain practically unchanged for this sub-sample, this suggest that the results are not mainly controlled by the United States. Moreover, although this reduced sample is naturally smaller than initial sample, which reduce its statistical power to determine the effect of PE activity, we observe that the estimates coefficients are not statistically different.

6.2 Endogeneity

The empirical methodology used so far could have endogeneity problems. Positives coefficients in the regressions do not imply necessarily that PE is associated with a better export performance at an industry level in our sample. It could be that PE activity is focused to sectors with high exports possibilities or omitted variables in the aggregate models can affect simultaneously industrial PE activity and exports. One simple way to account for the possible endogeneity of current PE and export is to use lagged values and historical moving average data of PE. All the models in this work use lagged valued for PE variables and average of PE activity over the last 3 years. Lagged data and averages would be less correlated with current export, therefore, could partially solve the issues that PE activity and industrial export react the same way to current economic conditions or other investment opportunities. The correlation that might arise due to the omitted variables in our basic model, can be addressed with a similar argument.

However, the lagged PE variable is not a perfect solution to this problem since PE activity and industrial export could be correlated along longer periods. Therefore, the endogeneity issues caused by the PE variable is addressed using an instrumental variables (IV) technique. A instrument suggested by the PE literature ([Bernstein et al. 2016](#); [Kortum and Lerner 2001](#); [Popov and Roosenboom 2013](#)), is the size of the private pension and insurance company asset pool in the nation and year, expressed as a percentage of GDP ⁶.

The relevance condition for the instrument have been justified in the PE literature. On the one hand, [Gompers and Lerner \(1999\)](#) mentioned that "the 1979 clarification of the Employee Retirement Income Security Act -ERISA- by the US Department of Labour led to a considerable increase in PE investment in the next two decades". In the same sense, European laws offers variation in that respect over time and across countries. For example [Popov and Roosenboom \(2013\)](#) mentioned that "EU-wide Directive 2003/41/EC in 2003 eliminated, for many European countries, restrictions on the investment behavior of pension funds, only allowing national governments some discretion on maximum amounts pension funds are allowed to invest in risk capital markets ([Popov & Roosenboom, 2013](#)).

⁶The OECD defines financial assets as currency and deposits, securities other than shares such as bills and bonds, loans, equities, and other financial assets. The data for the instrument is collected from the OECD's Annual Statistics on Institutional Investors database.

Now, for the exclusion restriction, we need that changes in pension assets to be independent of the error term in the regression, that is, independent of industrial export. While this is difficult to establish empirically, in theory, there is no evidence that these changes are motivated by a perception that PE has the ability to increase the industrial exports, since pension funds primarily change as a result of pension reforms, and these changes in pension policies for country like Germany, Sweden, and the United Kingdom are driven by: rules governing long-term savings, demographic pressures and the desire to increase the labor supply (Bernstein et al., 2016). Finally, it is clear that the amount of capital invested by pension funds in risk capital markets depends on the size of their assets.

Table 8, panel A columns (1), (2), (5) and (6) report the estimates from the 2SLS procedure where the fraction of assets held by domestic institutional investors to GDP is used as instruments for PE variables. In panel A columns (3), (4), (6) and (7), we use the average ratio of assets held by domestic institutional investors over the past 3 year to GDP like instrument of 3-year PE deals and 3-year PE amount. The previous results of a positive effect of PE activity on industrial export performance remain robust. For both instruments, in the first regression (unreported results) we found that the effect on PE from the instrument is positive and significant at the 1%, which suggest that the instrument is relevant. The F-statistics are greater than the critical value needed for the IV estimates do not have more than 10 percent of bias of the estimates obtained by OLS (see Stock and Yogo 2002).

Notice that the instrumental variable that we used is a variable at country level, which is common to all sectors in a specific country-year, on the contrary, our main unit of observation is at sectoral level. To account for this problem, we use two approaches suggested by the PE literature (Bernstein et al. 2016; Kortum and Lerner 2001; Popov and Roosenboom 2013). In panel B in first regression the instruments used in the previous regression is interacted with industry indicators. Once more, results of the first regression suggests the instrument’s relevance, additionally, F-statistics are greater than the critical value needed. The results show that the 2SLS estimate remains positive and significant at the 1% in all cases. In most cases the effect’s magnitude is similar to those reported in panel A.

Finally, we also create the variable “PE activity share” which denotes the PE activity (PE deals, PE amount, 3-year PE deals or 3-year PE amount) in a specific country–industry-year as a share of total PE activity in the respective country-year. Next, we interact “PE activity share” with the instrument used in panel A for the respective PE activity. The resulting variable of this interaction varies across each country–industry-year, relating the assets holds by pension funds and insurance company in a given country to the intensity of PE of a specific industry. Panel C report the estimates when in the first regression we use this interaction variable as instrument. Again, we get relevant instruments with F-statistics greater than the critical value. In most cases, the positive effect of PE activity on industrial export remains robust. Notice that the magnitude of the effect is less than reported in panel A and B and closer to those reported in table 5 and table 6.

Table 8: Private equity and industrial export: Endogeneity

PANEL A								
Variables	(1)	(3) Export Density		(4)	(5)	(7) Export Market Share		(8)
PE dealst _{t-1}	1.437*** (0.0789)				0.00862*** (0.00190)			
3-year PE deals		1.402*** (0.0603)				0.0101*** (0.00197)		
PE amountt _{t-1}			2.441*** (0.266)				0.0160*** (0.00378)	
3-year PE amount				1.731*** (0.124)				0.0127*** (0.00257)
Added Value t-1	1.491 (2.252)	5.049** (2.033)	8.559 (6.538)	8.937** (3.855)	1.340*** (0.188)	1.391*** (0.190)	1.499*** (0.211)	1.420*** (0.196)
REER	0.0121*** (0.00198)	0.0117*** (0.00147)	0.000700 (0.00380)	0.00270 (0.00221)	8.13e-05 (4.99e-05)	8.15e-05* (4.63e-05)	2.79e-05 (5.36e-05)	3.25e-05 (4.42e-05)
GDP growth	0.00196 (0.00678)	0.0264*** (0.00443)	0.0803*** (0.0233)	0.0691*** (0.0119)	-1.07e-05 (0.000140)	0.000233 (0.000145)	0.000366 (0.000244)	0.000547*** (0.000197)
Observations	3,937	4,243	3,391	4,102	3,937	4,243	3,391	4,102
Number of groups	237	237	236	236	237	237	236	236
Fixed Effects		Country-Industry and Year				Country-Industry and Year		
F-Statitisc	394	605.7	84.84	193.6	394	605.7	84.84	193.6

PANEL B								
Variables	(1)	(3) Export Density		(4)	(5)	(7) Export Market Share		(8)
PE deals _{t-1}	1.182*** (0.0648)				0.00767*** (0.00187)			
3-year PE deals		1.149*** (0.0516)				0.00929*** (0.00185)		
PE amount _{t-1}			1.514*** (0.155)				0.0195*** (0.00363)	
3-year PE amount				1.171*** (0.0813)				0.0179*** (0.00220)
Added Value _{t-1}	0.777 (1.991)	3.401** (1.728)	4.540 (4.064)	4.741* (2.648)	1.338*** (0.187)	1.386*** (0.186)	1.514*** (0.209)	1.460*** (0.193)
REER	0.0114*** (0.00172)	0.0110*** (0.00131)	0.00375 (0.00249)	0.00434*** (0.00166)	7.89e-05 (4.91e-05)	7.91e-05* (4.53e-05)	1.65e-05 (5.76e-05)	1.72e-05 (4.79e-05)
GDP growth	-0.00869 (0.00577)	0.0148*** (0.00395)	0.0282** (0.0140)	0.0348*** (0.00777)	-5.04e-05 (0.000143)	0.000195 (0.000146)	0.000562** (0.000259)	0.000868*** (0.000200)
Observations	3,937	4,243	3,391	4,102	3,937	4,243	3,391	4,102
Number of groups	237	237	236	236	237	237	236	236
Fixed Effects		Country-Industry and Year				Country-Industry and Year		
F-Statitisc	40.31	66.57	10.10	25.62	40.31	66.57	10.10	25.62

PANEL C								
Variables	(1)	(3) Export Density		(4)	(5)	(7) Export Market Share		(8)
PE deals _{t-1}	0.210*** (0.0193)				0.00148 (0.00133)			
3-year PE deals		0.332*** (0.0226)				0.00212 (0.00167)		
PE amount _{t-1}			0.0908*** (0.0162)				0.00182* (0.00102)	
3-year PE amount				0.111*** (0.0165)				0.00269** (0.00118)
Added Value _{t-1}	-1.942 (2.104)	-1.923 (1.972)	-1.627 (2.373)	-3.201 (2.352)	1.320*** (0.181)	1.339*** (0.175)	1.438*** (0.194)	1.346*** (0.177)
REER	0.00903*** (0.00121)	0.00861*** (0.00110)	0.00842*** (0.00139)	0.00743*** (0.00120)	6.37e-05 (4.80e-05)	5.82e-05 (4.43e-05)	7.44e-05 (5.25e-05)	6.15e-05 (4.55e-05)
GDP growth	-0.0493*** (0.00366)	-0.0225*** (0.00435)	-0.0518*** (0.00416)	-0.0301*** (0.00491)	-0.000309** (0.000140)	-0.000133 (0.000151)	-0.000430*** (0.000149)	-6.24e-05 (0.000153)
Observations	3,937	4,243	3,391	4,102	3,937	4,243	3,391	4,102
Number of groups	237	237	236	236	237	237	236	236
Fixed Effects		Country-Industry and Year				Country-Industry and Year		
F-Statitisc	399.3	445.1	358.2	392.9	399.3	445.1	358.2	392.9

Table 8 reports the results from 2SLS regressions. The main unit of observation is the country-industry-year. The dependent variables are the industrial export density (columns 1-4) and the export market share (columns 5-8) of the respective industry. ‘PE deals’ is the natural logarithm of one plus the number of PE deals for the respective country-industry-year. ‘3-year PE deals’ denotes the natural logarithm of one plus average deals in the respective country-industry-year over the last 3 years. ‘PE amount’ is the natural logarithm of one plus the ratio of PE investment for the respective country-industry-year to economically active population in each industry-country-year. ‘3-year PE amount’ denotes the natural logarithm of one plus the ratio of average PE investment in the respective country-industry-year over the last 3 years to economically active population in each industry-country-year. The 2SLS specifications in panel A use the fraction of assets held by domestic institutional investors to GDP as instruments for PE in the first stage. Specifications in panel B use a first stage where the instrument is interacted with industry indicators. In panel C, the instrument is interacted with ‘PE activity share’ which denotes the PE activity in a particular country-industry-year as a share of total PE activity in a country-year. Specifications in panel B and C are to allow for differential effects of the instrument at the industry level. ‘Value added’ is the value added shares of a respective industry. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Robust standard errors are presented in parentheses. Data sources can be seen in Table 14.

***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

6.3 Sensitivity to Export Facilities

Because a good country's trade environment favors exports (Beach & Kane, 2008), it could be argued that effect of PE activities over exports could be explained by that condition. Therefore, our measures of PE activities may partially capture the effects of trade freedom. Similarly, countries with dynamic export sectors would tend to have greater institutional quality (Herrera-Echeverry 2017; Li and Zahra 2012; McMullen, Bagby, and Palich 2008). So again taking into account that institutional quality favors PE activity and exports, our estimates may be contaminated by this effect and could be biased.

We want to know if PE activity continues being strong to encourage exports after controlling above possibilities. For this purpose, we interact our PE variables with trade freedom (Trafree) and institutional quality (InstQual). Trade freedom is a quantitative measurement of the facility of exporting and importing goods and services. The measure is between 0 and 100, where 100 is comparable to a nation with a maximum attractiveness of trade environment. It is included in the regression as the natural logarithm of one plus trade freedom. This measure is contained in the "Index of Economic Freedom (IEF) of the Heritage Foundation" (Beach & Kane, 2008). Other researches have used variables of the IEF for akin purposes (Aidis, Estrin, and Mickiewicz 2012; Claessens and Laeven 2003; De Haan and Sturm 2000; Herrera-Echeverri et al. 2017; Klapper, Laeven, and Rajan 2006). Institutional quality for a nation is calculated as the natural logarithm of one plus an average of six variables of "Worldwide Governance Indicator": "voice and accountability", "political stability and absence of violence", "government effectiveness", "regulatory quality", "rule of law" and "control of corruption". Other studies also use this variable to explore other phenomena (Herrera-Echeverri et al. 2017; Herrera-Echeverry 2017; Li and Zahra 2012; McMullen et al. 2008; Van Stel, Storey, and Thurik 2007; Wennekers, Van Wennekers, Thurik, and Reynolds 2005).

In Table 9 we report the effect of PE activities on industrial export density alongside the effect of these country's characteristic. Column (1) shows the results of a model in which we include a interaction variable between a measure of trade freedom and a dummy variable equal to 1 if the respective industry in the respective country has received any PE investment in the last 3 years, the dependent variable is the industrial export density and the main explanatory variable is '3-year PE deals'. Notice that the effect of "3-year PE deals" remains positive and significant after controlling by trade freedom issues. Coefficient associated to "TraFree \times 3-Year PEInd" is positive and statistically significant, implying that trade freedom can be relevant to increase exports in PE-intensive industries. Now we analyze the effect of trade freedom in industries with higher and low PE activity level. In column (2) "TraFree" interact with a dummy variable equal to 1 if the respective country-industry-year had any PE investment in the last 3 years and if the respective PE activity in the regression is above or below the mean activity level. Again coefficient of '3-year PE deals' remains positive and significant but with a smaller magnitude. On the other hand, the effect of trade freedom on industrial export density is higher in PE intensive industries with high PE activity level. For robustness we repeat

Table 9: Sensitivity to country characteristics

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Export Density							
3-year PE deals	0.0833*** (0.0202)	0.0621*** (0.0215)			0.0697*** (0.0185)	0.0478** (0.0192)		
3-year PE amount			0.0166** (0.00734)	0.0149* (0.00724)			0.0158* (0.00873)	0.0155* (0.00885)
TraFree×3-Year PEInd	0.0182** (0.00831)		0.0248** (0.00927)					
TraFree×High 3-Year PEInd		0.0295*** (0.00588)		0.0282*** (0.00847)				
TradFree×Low 3-Year PEInd		0.0157** (0.00637)		0.0221*** (0.00731)				
InstQual.×3-Year PEInd					0.0722* (0.0401)		0.0988** (0.0442)	
InstQual.×High 3-Year PEInd						0.146*** (0.0276)		0.0978** (0.0427)
InstQual.×Low 3-Year PEInd						0.0479 (0.0330)		0.0796* (0.0388)
Value added t-1	16.29*** (2.580)	15.10*** (2.017)	16.48*** (2.778)	14.97*** (2.150)	16.87*** (2.188)	15.40*** (1.842)	17.06*** (2.324)	15.35*** (2.001)
REER	0.00345*** (0.000687)	0.00294*** (0.000500)	0.00274*** (0.000726)	0.00269*** (0.000617)	0.00304*** (0.000663)	0.00276*** (0.000503)	0.00242*** (0.000562)	0.00264*** (0.000635)
GDP growth	0.00847* (0.00427)	0.00934** (0.00426)	0.0115** (0.00462)	0.0133** (0.00482)	0.00814** (0.00366)	0.00827** (0.00382)	0.0111*** (0.00359)	0.0119*** (0.00378)
Observations	4,822	5,104	4,572	4,781	4,192	4,355	3,997	4,099
Number of groups	261	261	260	260	261	261	260	260
Fixed effect				Country-Industry and Year				
Within R ²	0.526	0.504	0.510	0.486	0.521	0.508	0.509	0.491

Table 9 reports estimates from panel data regressions. An observation is a country-industry-year triple. The dependent variables for models 1–8 is the natural logarithm of one plus exports of a respective industry. ‘3-year PE deals’ denotes the natural logarithm of one plus average deals in the respective country-industry-year over the last 3 years. ‘3-year PE amount’ denotes the natural logarithm of one plus the ratio of average PE investment in the respective country-industry-year over the last 3 years to economically active population in each industry-country-year. ‘3-year PEInd’ is a dummy variable equal to 1 if the respective country-industry-year had any PE investment in the last 3 years. ‘High (Low) 3-year PEInd’ is a dummy variable equal to 1 if the respective country-industry-year had any PE investment in the last 3 years and if the respective PE activity in the regression (3-year PE deals and 3-year PE amount) is above (below) the mean activity level. ‘TraFree’ denotes the natural logarithm of one plus the Trade Freedom of the respective country-year. ‘InstQual’ denotes the country’s institutional quality. ‘Value added’ is the value added shares of a respective industry. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Driscoll and Kraay standard errors are reported in parentheses. Data sources can be seen in Table 14.

***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

this procedure using “3-year PE amount” like dependent variable (see Table 9, columns (3) and (4)). These results suggest a complementarity between PE activity and trade freedom to generate exports, that is, the capacity of trade freedom to generate more exports is intensified in PE-intensive industries with high PE activity level.

As we did with trade freedom, we advance testing the effect of PE on exports when is included the institutional quality of a country. Column (5) shows that the effect of ‘3-year PE deals’ remains positive and significant after controlling country’s institutional quality issues. The significance of the coefficient associated to “InstQual×3-Year PEInd” implies that institutional quality is relevant to encourage exports in PE-intensive industries. In column (6) we interact institutional quality with dummies build to indicate higher and low PE industrial activity level. Again the coefficient of ‘3-year PE deals’ remains positive and significant. Similar to trade freedom, the effect of institutional quality to generate export is intensified in PE-intensive industries with a higher PE activity level. For robustness we repeat this procedure using “3-year PE amount” like dependent variable (see Table 9, columns (7) and (8)). As in the case of trade freedom, results confirm a complementarity between PE activity and country’s institutional quality to favor exports. These results suggest that the effect of PE on industrial export density do not capture country’s characteristics that facility the capacity to

export of a country. On the contrary, good characteristics of the trade environment are deeper in generation of export in those PE-intensive industries with high PE activity level.

Table 10: Sensitivity to Industry Characteristics

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Export Density							
3-year PE deals×High ValAdd	0.0851*** (0.0181)							
3-year PE deals×Low ValAdd	0.0459** (0.0192)							
3-year PE amount×High ValAdd		0.0542*** (0.0131)						
3-year PE amount×Low ValAdd		-0.0144 (0.0134)						
3-year PE deals×High LabProd			0.148*** (0.0353)					
3-year PE deals×Low LabProd			0.0244 (0.0288)					
3-year PE amount×High LabProd				0.126*** (0.0359)				
3-year PE amount×Low LabProd				-0.0458* (0.0259)				
3-year PE deals×High GFCF					0.104*** (0.0169)			
3-year PE deals×Low GFCF					0.0485* (0.0278)			
3-year PE amount×High GFCF						0.0855*** (0.0271)		
3-year PE amount×Low GFCF						-0.0176 (0.0216)		
3-year PE deals×High InvInt							0.104*** (0.0173)	
3-year PE deals×Low InvInt							0.0578** (0.0236)	
3-year PE amount×High InvInt								0.0977*** (0.0323)
3-year PE amount×Low InvInt								-0.00823 (0.0150)
Value added t-1	15.01*** (2.029)	14.88*** (2.131)	13.21*** (2.286)	13.80*** (2.266)	15.81*** (1.962)	15.72*** (2.163)	14.89*** (1.967)	14.65*** (2.164)
REER	0.00311*** (0.000466)	0.00319*** (0.000630)	0.00384*** (0.000691)	0.00316*** (0.000611)	0.00245*** (0.000461)	0.00198*** (0.000486)	0.00185*** (0.000437)	0.00119** (0.000511)
GDP growth	0.00993** (0.00439)	0.0136** (0.00497)	0.0140** (0.00524)	0.0144** (0.00504)	0.0105** (0.00381)	0.0123*** (0.00396)	0.0104** (0.00376)	0.0124*** (0.00393)
Observations	5,104	4,818	4,885	4,818	4,214	4,079	4,192	4,057
Number of groups	261	260	260	260	220	220	220	220
Fixed Effects				Country-Industry and Year				
Within R ²	0.501	0.484	0.489	0.492	0.546	0.539	0.538	0.531

Table 10 reports estimates from panel data regressions. An observation is a country-industry-year triple. The dependent variables for models 1–8 is the natural logarithm of one plus exports of a respective industry. ‘3-year PE deals’ denotes the natural logarithm of one plus average deals in the respective country-industry-year over the last 3 years. ‘3-year PE amount’ denotes the natural logarithm of one plus the ratio of average PE investment in the respective country-industry-year over the last 3 years to economically active population in each industry-country-year. ‘High (Low) ValAdd’ is a dummy equal to 1 if the value added share of the respective country-industry-year is in the upper (lower) half of its distribution for the respective country-year. ‘High (Low) GCF’ is a dummy equal to 1 if the gross capital formation of the respective country-industry-year is in the upper (lower) half of its distribution for the respective country-year. ‘High (Low) LabProd’ is a dummy equal to 1 if the labor productivity of the respective country-industry-year is in the upper (lower) half of its distribution for the respective country-year. ‘Value added’ is the value added shares of a respective industry. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Driscoll and Kraay standard errors are reported in parentheses. Data sources can be seen in Table 14.

***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

6.4 Sensitive to Industry Characteristics

Another concern is that the sensitivity to PE activity could be correlated with the standard determinants of a industry to export, since PE activity could be picking up those effects of standard industry-level determinants of exports. Specifically, industrial exports are affected positively by productivity and capital investment levels (Aitken et al. 1997; Anwar and Sun

2017; Franco 2013; Harding and Javorcik 2012), and simultaneously, PE firms are possibly attracted by more productive industries or economic sectors where capital investment generates competitive advantage (Aldatmaz and Brown 2016; Bernstein et al. 2016; Jeng and Wells 2000; Popov and Roosenboom 2013; Schertler and Tykvová 2011). Therefore, it is necessary to test if previous results about effects of PE over exports are driven by the industry characteristics that increase the attractiveness to PE activity.

Table 11: Private Equity and Industries Characteristics

Variables	(1)	(2)
	Export	Density
3-year PE deals	0.0636*** (0.0210)	
3-year PE amount		0.0193*** (0.00639)
GFCF _{t-1}	1.209** (0.547)	1.232** (0.544)
LabProd _{t-1}	0.000462*** (0.000102)	0.000435*** (0.000102)
InvInt _{t-1}	-2.282* (1.132)	-2.306* (1.127)
Value added _{t-1}	10.66*** (2.007)	11.39*** (2.126)
REER	0.000777 (0.000705)	0.000076 (0.000590)
GDP growth	0.0120*** (0.00413)	0.0124*** (0.00413)
Observations	3,889	3,825
Number of groups	208	208
Fixed Effects	Country-Industry and Year	
Within R ²	0.540	0.537

Table 11 reports estimates from panel data regressions. An observation is a country-industry-year triple. The dependent variables the natural logarithm of one plus exports of a respective industry. ‘3-year PE deals’ denotes the natural logarithm of one plus average deals in the respective country-industry-year over the last 3 years. ‘3-year PE amount’ denotes the natural logarithm of one plus the ratio of average PE investment in the respective country-industry-year over the last 3 years to economically active population in each industry-country-year. ‘Value added’ is the value added shares of a respective country-industry-year. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Driscoll and Kraay standard errors are reported in parentheses. Data sources can be seen in Table 14. ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

In columns (1)-(4) of Table 10, we examine the effect of PE on exports in high and low productivity industries using two proxies (as defined by OECD, see Webb 2005 for details): the value added (ratio of value added volumes of a respective industry to the total value added of the economy) and labor productivity (ratio of value added volumes to the number of employees engaged). In terms of specification, we just replace the measure of ‘3-year PE deals’ and ‘3-year PE amount’ at the country-industry-year level by its interaction with dummies equal to 1 if the value added (column 1-2) or the labor productivity (column 3-4) of the industry is in the upper or lower half of their industry’s distribution for the respective country-year. We find that the effect of PE activities is positive and statistically higher in both added value intensive and in labor productivity intensive industries. In addition, in those the coefficient’s

magnitude on PE variables is higher than reported in Table 5 for the respective variables, suggesting that PE is complementary to value added and to labor productivity in generate exports. A possible explanation for this phenomenon could be that the effect of PE on exports is not automatic; it occurs reducing supply-side constraints to exporting by increasing productive capacity.

Table 12: Local-Foreign Private Equity and Export Density

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Export Density							
Local PE deals _{t-1}	0.0357*** (0.0125)							
Foreign PE deals _{t-1}		0.0349** (0.0140)						
Local 3-year PE deals			0.0384** (0.0137)					
Foreign 3-year PE deals				0.0694*** (0.0192)				
Local PE amount _{t-1}					0.0226* (0.0124)			
Foreign PE amount _{t-1}						0.0144** (0.00659)		
Local 3-year PE amount							0.0210 (0.0154)	
Foreign 3-year PE amount								0.0181*** (0.00535)
Value added t-1	15.76*** (2.129)	15.73*** (2.122)	15.77*** (2.113)	15.57*** (2.043)	16.47*** (2.001)	15.04*** (2.176)	15.25*** (2.171)	14.96*** (2.168)
REER	0.00289*** (0.000461)	0.00263*** (0.000456)	0.00294*** (0.000438)	0.00259*** (0.000484)	0.00271*** (0.000540)	0.00329*** (0.000587)	0.00300*** (0.000598)	0.00320*** (0.000620)
GDP growth	0.00952** (0.00432)	0.00978** (0.00436)	0.00986** (0.00441)	0.00953** (0.00433)	0.0152*** (0.00507)	0.0103* (0.00540)	0.0136** (0.00501)	0.0137** (0.00492)
Observations	5,104	5,104	5,104	5,104	4,265	4,489	4,809	4,862
Number of groups	261	261	261	261	260	260	260	260
Fixed Effects	Country-Industry and Year							
Within R ²	0.500	0.499	0.499	0.500	0.466	0.486	0.480	0.483

Table 12 reports estimates from panel data regressions. An observation is a country-industry-year triple. The dependent variables for models 1–8 is the natural logarithm of one plus exports of a respective industry. ‘Local (foreign) PE deals’ is the natural logarithm of one plus the number of local (foreign) PE deals in the respective country-industry-year. ‘Local (foreign) 3-year PE deals’ denotes the natural logarithm of one plus average local (foreign) deals in the the respective country-industry-year over the last 3 years. ‘Local (foreign) PE amount’ is the natural logarithm of one plus the ratio of local (foreign) PE investment for the the respective country-industry-year to economically active population in each industry-country-year. ‘Local (foreign) 3-year PE amount’ denotes the natural logarithm of one plus the ratio of average local (foreign) PE investment in the respective country-industry-year over the past 3 years to economically active population in each industry-country-year. ‘Value added’ is the value added shares of a respective industry. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Driscoll and Kraay standard errors are reported in parentheses. Data sources can be seen in Table 14.

***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

‘PE deals’ is the natural logarithm of one plus the number of PE deals for the respective country-industry-year. ‘3-year PE deals’ denotes the natural logarithm of one plus average deals for the respective country-industry-year over the last 3 years. ‘PE amount’ is the natural logarithm of one plus the ratio of PE investment for the respective country-industry-year to economically active population in each industry-country-year’. ‘3-year PE amount’ denotes the natural logarithm of one plus the ratio of average PE investment for the respective country-industry-year over the last 3 years to economically active population in each industry-country-year.

Regarding to industry capital investment level. In columns (5)–(8), we run our main regression, accounting for this issues, using gross capital formation (the ratio of gross fixed capital formation of the industry to gross fixed capital formation of all economy) and investment intensity (ratio of gross fixed capital formation to value added) as proxies (Webb, 2005). The

coefficients show that these characteristics intensify the capacity of private equity to generate exports. For example, the coefficient's magnitude of '3-year PE deals' in column (5) is almost twice as high as those reported in the Table 5 column (3), in industries with a high gross capital formation. Our results confirm that the effect of PE on exports is complementary to the gross capital formation and the investment intensity of industry to increase exports.

Finally, the effect of PE on industrial export survives once again, when all industry's characteristics above mentioned are included into the regression (see Table 11).

6.5 Local-Foreign Private Equity and Industrial Export

We now are interesting in testing if the above relation between PE and industrial exports is driven in a different way by local or foreign PE activity when they are considered separately. For this, we run our main regression after splitting PE activity in local and foreign PE activity. Table 12, columns (1), (3), (5) and (7) show the estimates when local PE activity is considered. The coefficients of the explanatory variables remains positive, but their significance, compared to those reported in Table 5, decreases. Even for 'Local PE 3-year amount' it becomes not significant. On the other hand, coefficients associated to foreign PE variables (column 2 and 5) remains significantly positive in all cases, and with a greater magnitude than local PE activity for variables related to PE concentration (columns 1-4). Numerically, estimates in columns (3) and (4) imply that an increase in the average local PE concentration over the 3 past year in 1% raises the industrial export density on average 0.038%, while an increase in the average foreign PE concentration over the 3 past year in 0.069%. When we use the PE variables associated to amount of PE invested, a higher magnitude on coefficient associated to local PE activity is found, although foreign PE activity have greater significance (columns 5-8).

The previous analysis is in favour of the argument that foreign PE activity has a greater potential to impulse exports in the host country, this could be due to the greater foreign PE firms' knowledge about foreign markets. The above conclusion is also related to a large literature examining spillover effects of foreign direct investments and/or multinational companies' presence on the host country's exports. Several authors have empirically evidenced a positive spillover effect on exports from foreign direct investment at country, industry and firm level (Aitken et al. 1997; Anwar and Sun 2017; Chen et al. 2013; Franco 2013; Harding and Javorcik 2012; Lockett et al. 2008; Mijiyawa 2017; H. Sun 2001; Tadesse and Shukralla 2013).

Based on previous results, one natural question is whether the capacity of local PE activity to generate exports is crowded by foreign PE activity. To examine this, we interact local PE activity with dummies equal to 1 if the respective foreign PE activity is in the upper or lower half of its distribution across industries. The results in Table 13 confirm that there are more benefits of local PE activity on industrial export density in industries with higher foreign PE activity. For example, coefficient associated to 'local 3- year PE deals' moved to

Table 13: Crowding effect - Local development

Variables	(1)	(2)	(3)	(4)
		Export Density		
(Local PE deals×High foreign PE activity) _{t-1}	0.0371** (0.0141)			
(Local PE deals×Low foreign PE activity) _{t-1}	0.0344*** (0.0113)			
Local 3-year PE deals×High foreign PE activity		0.0457*** (0.0151)		
Local 3-year PE deals×Low foreign PE activity		0.0270* (0.0139)		
(Local PE amount×High foreign PE activity) _{t-1}			0.0277* (0.0133)	
(Local PE amount×Low foreign PE activity) _{t-1}			-0.00117 (0.0154)	
Local 3-year PE amount×High foreign PE activity				0.0213 (0.0157)
Local 3-year PE amount×Low foreign PE activity				0.0185 (0.0196)
Value added t-1	15.75*** (2.131)	15.72*** (2.094)	16.33*** (1.837)	15.18*** (2.161)
REER	0.00289*** (0.000460)	0.00288*** (0.000445)	0.00286*** (0.000505)	0.00307*** (0.000611)
GDP growth	0.00952** (0.00431)	0.00987** (0.00438)	0.0121** (0.00562)	0.0134** (0.00492)
Observations	5,104	5,104	3,981	4,794
Number of groups	261	261	260	260
Fixed Effects		Country-Industry and Year		
Within R ²	0.500	0.500	0.469	0.480

Table 13 reports estimates from panel data regressions. An observation is a country-industry-year triple. The dependent variables for models 1–4 is the natural logarithm of one plus exports of a respective industry. ‘High (Low) foreign PE activity’ is a dummy equal to 1 if the respective measure of foreign PE activity (PE deals, 3-year PE deals, PE amount and 3-year PE amount) in the respective country-industry-year is above (below) the mean of its industry distribution for the respective country-year. ‘Local PE deals’ is the natural logarithm of one plus the local number of PE deals in the respective country-industry-year. ‘Local 3-year PE deals’ denotes the natural logarithm of one plus average local deals in the respective country-industry-year over the last 3 years. ‘Local PE amount’ is the natural logarithm of one plus the ratio of local PE investment in the respective country-industry-year to economically active population in each industry-country-year. ‘Local 3-year PE amount’ denotes the natural logarithm of one plus the ratio of average local PE investment in the respective country-industry-year over the past 3 years to economically active population in each industry-country-year. ‘Value added’ is the value added shares of a respective industry. ‘REER’ is the real effective exchange rate of a respective country. ‘GDP growth’ is the growth rate of gross domestic product of a respective country. All regressions include a constant, country-industry dummies and year dummies, not reported. Driscoll and Kraay standard errors are reported in parentheses. Data sources can be seen in Table 14.

***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively.

0,038% in an average industry to 0,046% in industries with a high foreign PE concentration, while in industries with a low foreign PE concentration moved to 0,027% with less significance.

These results imply that the capacity of local PE activity to generate export is intensified by foreign PE activity. A possible explanation for this phenomenon could be a spillover effect of foreign PE practices. Foreign PE activity provides a stronger expertise in subjects like international markets and exports channels. So, the local PE funds, and consequently their portfolio companies, could access to more opportunities to become exporters. Therefore, in the host country, foreign PE activity not only encourage exports but also push the local PE funds to engage the firms under their control to export.

7 Conclusions

In this work a large panel of 22 OECD’s countries and 12 aggregated industries over the 1995-2015 period is used to identify the impact of PE activity on industrial exports. The result is

confirmed when industrial export density and export market share of the respective industry is used as a dependent variable, and controlling for: time characteristics, country-industry characteristics, and the endogeneity issues emerging in the relation. The latter is controlled by using an IV procedure in which the size of the private pension and insurance company asset pool in the nation and year, expressed as a percentage of GDP to identify the supply of PE activity.

After test robustness with different proxies for exports and PE activity and control endogeneity issues, we confirm that there is a positive effect of PE deals and capital invested over industrial export performance measured by the export market share of the industry. We check that PE activity continues being strong to encourage exports after controlling by country characteristics such as trade freedom and institutional quality. Our results confirm a complementarity between PE activity and those country's environment characteristics that favor exports. In the same way, the effect of PE activity on industrial export remains robust after controlling by industry characteristics that have been suggested by the literature as important determinants to generate export and PE activity itself. Particularly, we examine the effect of PE over exports in high and low productivity industries using two proxies: the value added and labor productivity. The effect of PE activities is positive and statistically higher in both value-added and labor productivity intensive industries, again, suggesting that PE is complementary to both in generating exports. Similar findings are found in industries with high capital investment levels. Another finding is that the effect does not change when the PE activity splits in local PE and foreign PE activity. Moreover, there is an effect of complementarity between the foreign PE activity and local PE activity, that is, the capacity of local PE activity to generate export is intensified in industries with higher foreign PE activity.

A number of important questions emerge due to this research. First, it would be interesting to look whether the above results are also obtained when considering emerging economies. Second, the PE could also play a big role in import competing industries, so it would be interesting to examine this phenomenon in both developed and developing economies. Third, given the importance of PE for economic progress and the value added of PE in an industry, it is relevant to examine the impacts of PE activity on industry export quality, that is, the effects on export prices. Finally, due to the growing importance of globalization, is important to determine whether the PE activity affects export-diversification. Future research can contribute to the compendium of knowledge by addressing those questions.

Appendices

Appendix A

Table 14

Table 14: Variables, definitions and sources

Variable	Definition	Source
ExpDen	‘The natural logarithm of one plus the total export of a respective industry’	OECD’s Structural Analysis Database
Export Market Share	‘The natural logarithm of one plus the ratio of exports of an industry in an given country to total exports of that country’	OECD’s Structural Analysis Database
PE deals	‘The natural logarithm of one plus the total number of PE investment deals in each country-industry-year’.	Thomson ONE private equity database
PE amount	‘The natural logarithm of one plus a 3-year moving average of deals’	Thomson ONE private equity
3-year PE deals	‘The natural logarithm of one plus the total Private Equity investment made, at the year i by country j, in million of current U.S dollars, normalized by economically active population’	Thomson ONE private equity
3-year PE amount	The natural logarithm of one plus the ratio of a 3-year moving average of the amount of PE invested to economically active population	Thomson ONE private equity
3-year PEInd	A dummy variable equal to 1 if the respective country–industry had any PE investment in the past 3 years.	Thomson ONE private equity
ValAdd	‘Ratio of value added volumes of a respective industry to the total value added of the economy’	OECD’s Structural Analysis Database
REER	‘The weighted average of a country’s currency relative to an index or basket of other major currencies, adjusted for the effects of inflation’.	World development indicators.
GDP growth	‘Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2010 U.S. dollars’.	World development indicators.
InstQual	‘Indicates perceived institutional quality in a country and is the average of the six dimensions of “Worldwide Governance Indicators (WGI)” the previous year’.	World Wide Governance Indicators. World Bank
TraFreed	‘Trade freedom is a quantitative measurement of the facility of exporting and importing goods and services. The score goes from 0 to 100, where 100 is equivalent to a country with a trade environment of maximum attractiveness’.	The Heritage foundation, index of economic freedom.
LabProd	‘Ratio of value added volumes to the number of employees engaged’	OECD’s Structural Analysis Database
GFCF	‘Ratio of gross fixed capital formation of the industry to gross fixed capital formation of all economy’	OECD’s Structural Analysis Database
InvInt	‘Ratio of the and as the ratio of gross fixed capital formation to value added of the respective industry’	OECD’s Structural Analysis Database
Pension funds	‘The natural logarithm of one plus financial assets held by domestic pension funds and insurance corporations from the OECD’	OECD’s Annual Statistics on Institutional Investors database

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