



# Demand drops and innovation investments: Evidence from the Great Recession in Spain

Alex Armand<sup>a</sup>, Pedro Mendi<sup>b,\*</sup>

<sup>a</sup> University of Navarra and Navarra Center for International Development – Instituto Cultura y Sociedad, Edificio de Bibliotecas, 31009 Pamplona, Spain

<sup>b</sup> University of Navarra, Department of Business, Edificio Amigos, 31009 Pamplona, Spain

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## ABSTRACT

The Great Recession, which began in 2008, brought about large contractions in aggregate consumption in many countries. In this research, we study the impact of heterogeneous decreases in demand on innovation investments by analyzing the evolution of innovation investments in a panel of Spanish manufacturing firms during the 2004–2013 period. We proxy heterogeneous variation in demand with net exit rates in the productive stratum of each firm, defined as the group of firms in the same industry and size class. These net exit rates are computed considering all firms in the stratum, including firms that are determined to be non-innovative firms. To support the identification strategy, we show that exit rates do not capture idiosyncratic unobservable characteristics among innovative firms. In addition, we control for the effect of time-varying credit constraints. We find that a one standard deviation increase in exit rates is associated with reductions of 1.5% in the share of firms investing in innovation. The drop is larger for smaller firms, which also experience greater decreases in sales. Since smaller firms are most sensitive to demand drops, they are the natural candidates to be the target of policies devoted to increasing R&D activities during crises. As additional analysis, we study firms' perceptions of the main obstacles to innovation to find that net exit rates capture the heterogeneous variation in demand, rather than credit constraints. Finally, when analyzing the exit patterns of firms in the sample, we confirm that the net exit rate in a firm's stratum does not drive the exit of firms in our sample.

## 1. Introduction

Whether expenditures on innovation activities are pro- or counter-cyclical has been the object of study in many contributions to the literature, both theoretical and empirical. Theoretical arguments are mixed (Barlevy, 2007; Arvanitis and Woerter, 2014; Ouyang, 2011). On one hand, pro-cyclicality is supported by a relaxation of liquidity and credit constraints during expansions. On the other hand, counter-cyclicality is justified by the lower opportunity cost of R&D during recessions. Absent a lack of consensus in the theoretical front, the effect of economic crises on firms' investments in innovation has remained an empirical question, indeed a very relevant one. Understanding how different factors affect incentives to invest in innovation is essential, given the key role that innovation plays in the process of total factor productivity growth, which is responsible for large cross-country differences in per capita incomes (Hall and Jones, 1999).

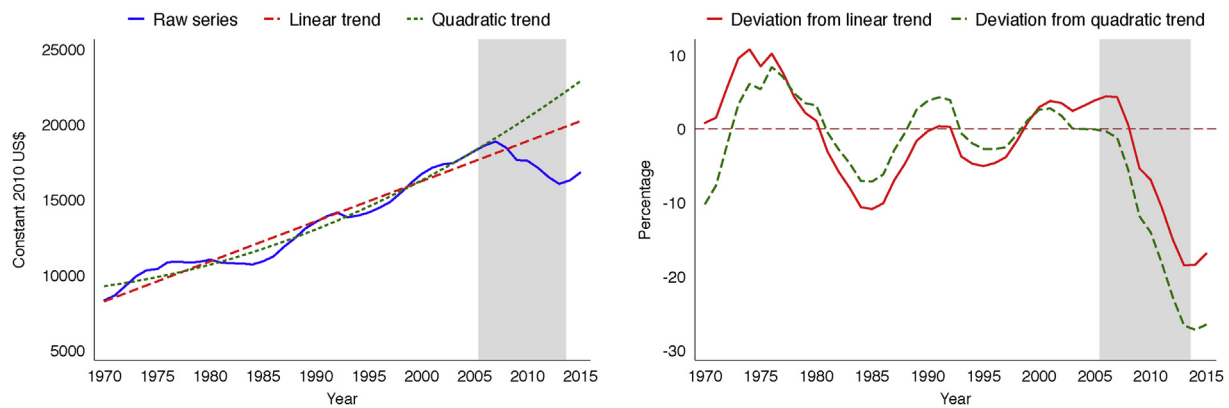
We contribute to the existing literature by analyzing a panel of Spanish manufacturing firms during the 2004–2013 period, which includes the Great Recession years. We exploit time, industry and firm

size variation to supplement the panel with stratum-specific entry and exit rates. The net rate at which firms exit the market allows us to proxy heterogeneous variation in demand. Our results suggest that higher net exit rates relate negatively with innovation investments. Among smaller firms, this relationship is much stronger. This finding is consistent with the theoretical literature that regards differences in productivity as a determinant of both the distribution of firm sizes as well as of firms' incentives to invest in innovation (Melitz, 2003; Bustos, 2011; Dixit and Stiglitz, 1977; Hallak and Sivadasan, 2013; Guadalupe et al., 2012). In fact, smaller firms are also characterized by large drops in sales when exit rates are higher. This suggests a demand-driven effect on innovation. Our estimates are robust, not only for time-invariant (unobservable) firm characteristics, but also for the inclusion of sector-specific trends.

Facing market turbulence (Santos-Vijande and Alvarez-Gonzalez, 2007), firms optimally make their choices of strategies to react to economic crises (Fort et al., 2013), which involves the re-evaluation of ongoing or planned investment projects (Pindyck, 1991). Innovation-related projects are especially sensitive to market turbulence. For

\* Corresponding author.

E-mail addresses: [aarmand@unav.es](mailto:aarmand@unav.es) (A. Armand), [pmendi@unav.es](mailto:pmendi@unav.es) (P. Mendi).



**Fig. 1.** Household final consumption expenditure per capita, Spain 1970–2015. *Note.* The left panel presents the series of household final consumption expenditure, which is reported in constant prices (2010 US\$) and in per capita terms (source: World Bank). It also presents the linear and the quadratic trend (source: authors' calculations). The right panel presents deviations from the linear and the quadratic trends. The linear trend series is computed using predicted values from a linear regression of the raw series on the year variable (re-scaled to have 1970 = 1) for the pre-crisis sample (1970–2008). The quadratic trend is computed using predicted values from a linear regression of the raw series on the year variable and its square. The shaded area highlights the period 2004–2013, which is the object of our empirical analysis.

instance, [Paunov \(2012\)](#) uses firm-level data from several Latin American countries to provide evidence that many firms stopped their innovation efforts during the crisis, mainly due to financial constraints and negative demand shocks. The effect of the crisis on firm innovation may be heterogeneous depending on firm capabilities. In this line, [Amore \(2015\)](#) uses Compustat data to argue that those firms that have previous innovation experience during recessions have better performance in terms of patent outcomes during future downturns. In a similar way, [Archibugi et al. \(2013b\)](#) present evidence from a number of European countries on the impact of the crisis on innovation, suggesting that the crisis significantly reduced firms' willingness to invest in innovation, although the effect is heterogeneous. Such heterogeneity may be driven by product characteristics. For instance, [Fabrizio and Tsolmon \(2014\)](#) present empirical indicating that R&D spending is more pro-cyclical in industries characterized by faster product obsolescence.

The effect of recessions is not confined to business expenditures on R&D. Regarding public research, [Cruz-Castro and Sanz-Menéndez \(2016\)](#), document a sharp decrease in public R&D funds during the crisis, implemented via large budget cuts (see also [Filippetti and Archibugi, 2011](#); [Laperche et al., 2011](#)). On the other hand, the crisis may have affected persistence of R&D activities ([Geroski et al., 1997](#); [Roper and Hewitt-Dundas, 2008](#); [Cefis, 2003](#); [Cefis and Orsenigo, 2001](#)), as well as the composition of the set of innovating firms. [Archibugi et al. \(2013a\)](#) use panel data from the British version of the CIS, covering the period 2002–2008 to search for differences in the identity of innovating firms before and during the crisis to find that the crisis concentrated innovation activities mainly in previous innovators and some fast-growing new entrants.

Innovation has long-lasting effects on economic performance and hence, performance is ultimately affected by factors that impact firms' decisions to invest in innovation. In fact, using a sample of Chilean firms, [Santi and Santoleri \(2017\)](#) analyze the impact of innovation on subsequent sales growth to find that process, but not product, innovations increase sales among larger and mature firms. At a macro level, R&D efforts and imports of disembodied technology have been found to increase the total factor productivity of countries ([Coe and Helpman, 1995](#); [Mendi, 2007](#)). Interestingly, a strand of the literature discusses the scope for a reverse direction of causality, namely lack of significant innovation as a cause in the recession. This thesis was proposed by [Archibugi \(2017a\)](#), prompting replies by [Lundvall \(2017\)](#), [Steinmueller \(2017\)](#), and [Archibugi \(2017b\)](#).

Oftentimes, the impact of a crisis on innovation prompts government intervention. Research on the impact of a crisis may shed light on

policy design. [Hud and Hussinger \(2015\)](#) use data from the Mannheim Innovation Panel for 2006–2010 to study the impact of public R&D subsidies on small- and medium-sized firms in Germany. They find evidence consistent with a positive effect of subsidies, but also of the existence of a crowding-out effect. In this line, [Brautzsch et al. \(2015\)](#) using German data, find that R&D subsidies mitigated the decline of German GDP by half a percentage point in the year 2009. [Bartz and Winkler \(2016\)](#) show that young firms are more intensely affected by a crisis than larger firms, although in normal times they tend to grow faster.

As mentioned above, this paper makes use of Spanish firm-level data in a time span that includes the Great Recession. During this period, which began in 2008, the Spanish economy faced a sharp contraction in demand. Industrial production dropped by roughly 30%, and unemployment rose from 8% to 26% in 2013 ([Bentolila et al., 2012](#)). To illustrate the extent of the dramatic decrease, [Fig. 1](#) presents the series of household final consumption expenditure (in per capita terms) over the period 1970–2015. The left panel presents the level of household final consumption expenditure in constant prices, as well as the linear and quadratic trends of the series. The sharp decrease in consumption during the Great Recession is apparent in this panel. This sudden drop is also illustrated in the right panel of [Fig. 1](#), which shows the deviation of consumption from its pre-crisis trend.

An important consequence of this drop in demand was that during this period, a large number of firms ceased operations, resulting in a sharp increase in net exit rates across industries ([García-Macia, 2017](#)). This turbulent environment is likely to have affected firms' prospects for future returns on different types of investments. In particular, investment in innovation, riskier than many other investment categories, may be particularly affected. Indeed, according to the OECD, from 2008 to 2013, Business Enterprise R&D decreased in Spain by 14.5% in nominal terms. Yet, it is not clear how such a large reduction in demand was distributed across different industries and size groups.

The Great Recession had deep consequences in the composition of many industries in Spain ([García-Macia, 2017](#)). It is not clear that exit rate variation is fully caused by demand heterogeneity. Lack of financing could also have aggravated exit rates. In fact, lack of access to financing has been regarded as an important obstacle to innovation. [Lee et al. \(2015\)](#) studied a dataset of British firms to conclude that innovative firms are typically less likely to have access to financing, although the crisis impacted non-innovating firms relatively more (see also [López-García et al. \(2013\)](#) for an analysis using Spanish data). [Pellegrino and Savona \(2017\)](#) studied the relative importance of financing versus knowledge and market-related factors as obstacles to

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