"Determinants of business R&D investments: evaluating the impact of technology-push and demand-pull engines of innovation"

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Abstract

This paper provides new insights on the relation over time between business R&D efforts and different technology-push and demand-pull factors, particularly considering the role of the State in supporting innovation *via public R&D funding*. Business R&D intensity has been modeled to account for the path dependent and cumulative nature of knowledge and innovation, the role of past profits as the main financial resource for supporting current R&D, the demand pull effect of the perceived potential market for new products, and the effect of the government spending in this area by distinguishing three relevant channels: direct government funding of R&D performed by business and government funding of public R&D performed in public labs and universities. Main findings confirm that, in explaining R&D intensities, both the (technology-push and demand-pull) engines of innovation have to be considered. Indeed, the cumulative and path dependent nature of research and knowledge, external demand and access to finance through the reinvestment of profits play a significant role. Also, the positive role of the State contribution via public funding of university research has been found, confirming the view that when the purpose is to increase business R&D, it is better to give knowledge and technological opportunities than money to business.

Introduction

This paper looks at the changes over time in business R&D intensity by considering a combination of technological factors and demand dynamics, and particularly the role of the State in supporting innovation.

It is broadly accepted that R&D is one of the most important sources of innovation and economic growth (Romer, 1990). Of course, R&D investments are prominent among factors that have a positive influence on the process of development of technological capabilities by firms: indeed, within the evolutionary framework, R&D investments have been shown to be determinant not only of the capacity of firms to internally generate new knowledge and technologies, but also for the development of the *absorptive capacity* critical to their ability to take advantage of knowledge and technology generated elsewhere (Cohen and Levinthal, 1989; 1990).

Nevertheless, despite its benefits, the majority of firms do not invest or under-invest in research and development for several reasons. For instance, because of market failures, that is the problem of incomplete appropriability of the returns to R&D due to knowledge spillovers mechanisms (Arrow, 1962). In addition, high risk for research implies extremely high hurdles, discouraging firms from engaging in such activities, especially when they are small firms for which access to funding is more difficult. Also, firms are

usually more likely to undertake R&D projects that bring greater private short-run profits than to engage in exploratory research activities.

Understanding the determinants of business R&D investments has received much attention by researchers and policy makers. Here, I follow the evolutionary theory of R&D efforts by firms, which as shown that R&D is a path dependent process contingent on several factors both from the technology-push and demand-pull perspectives. Indeed, since the seminal contribution of Schmookler (1966), the closely interconnected influence of demand and technological opportunities to the strategic decision of firms to innovate are well established subjects of research in innovation studies, which have tried to disentangle their relative importance in fostering innovation. So far, however, only the role of the technology-push sources has been largely investigated by neo-Schumpeterian and evolutionary scholars, which have considered and analyzed by various approaches the role of technological opportunities, innovative inputs and industrial dynamic. Especially the influence of financial constraints in limiting the capacity of firms to invest in R&D and innovation has been subject of a disproportionate attention by scholars (see D'Este et al., 2012 and Pellegrino and Savona 2013 for a review of this literature). *Viceversa*, the demand-pull perspective, emphasizing the role of demand dynamic in affecting innovation efforts, has not received the same attention.

Trying to rebalance the overall picture, the present paper adds to the recently renewed debate on demand-pull perspective in innovation studies by examining the role of demand-related incentives in combination with technology-push factors in explaining changes over time of business R&D investments.

Moreover, in order to advance the understanding of this topic, it draws upon the National System of Innovation literature (NSI), which has framed innovation activities within the institutional national context (Lundvall, 1992; Nelson, 1993; Freeman, 1995): according to this framework, the way in which firms carry out innovation activities is affected by a number of specific national features (Archibugi and Pianta, 1992; Lorenz and Lundvall, 2006), such as the nature of the scientific and technological institutions, the education and training system, the financial system, the structure of the labour market and the industrial specialization. Building on this framework, the focus here is on the role of the national Government in supporting scientific and technological research *via public R&D funding*, which is extremely variegated across countries and likely to influence changes in private business R&D over time through various channels. This makes the involvement of the Government in this area an essential factor to control for.

In particular, three relevant channels through which public funding committed to R&D can flow are considered: government direct funding of R&D performed by business and government funding of public R&D performed in public labs and universities. Basically, they are supposed to affect business R&D intensity

by lowering the private cost and uncertainty of research and working out new knowledge and technological opportunities available to firms, thus acting as technology-push.

The empirical investigation is based on European countries sectoral OECD data over the period 2000-2007. I have used a dynamic specification of a R&D investments equation where R&D is autoregressive and dependent on various technology-push and demand-pull factors. Estimates have been carried out using the GMM in Blundell and Bond (1998) version (GMM-sys).

Main findings confirm that, in explaining R&D intensities, both the (technology-push and demand-pull) engines of innovation have to be considered. Indeed, the cumulative and path dependent nature of research and knowledge, external demand and access to finance through the reinvestment of profits play a significant role. Also, the positive role of the State contribution via public funding of university research is confirmed, whereas direct public funding of business R&D as well as public funding of government research (public labs) turn out to be not significant.

The remainder of the paper is organized as follows. The following section briefly discusses the theoretical background of the research. Section three provides an overview of the data and explains the econometric strategy and hypotheses. Section four summarises the main empirical results, whilst some concluding remarks are offered in the last section.

2.Background literature

2.1 Understanding the determinants of business R&D investments

The present work builds on the large literature on R&D determinants. According to the evolutionary framework, business R&D is a path dependent process, supported by both technology-push and demand-pull effects.

First, extensive literature shows the cumulative and path dependent nature of knowledge and R&D (Nelson and Winter, 1982; Dosi, 1982): firms need time to develop a range of diverse capabilities and rarely make jumps into completely new areas of technologies; rather, they proceed incrementally, building on past investments and typically moving from simpler to more complex and advanced technological activities. This implies that any explanation of the present innovative activity necessarily involves considering the role of previous innovative activity.

Second, the interaction between technological factors and demand dynamics has long been recognized as a key element in explaining innovation. This has been the result of an extensive debate between two contrasting perspectives which dominated the 1960' and 1970's literature on the determinants of innovation.

On the one hand, scholars who referred to the so-called *technology-push perspective* pointed the key role of scientific and technological knowledge and opportunities in determining the rate and direction of technological change in industries (Rosenberg, 1974; Freeman, 1974; Mowery, 1979; Dosi, 1982). According to this view, innovation emerges as a deliberate process of change based on firms' efforts to develop new knowledge, accumulate capital and absorb external sources of innovation, thus highly localized and path dependent. It is also persistently characterized by the presence of specific technological capabilities and opportunities in particular fields and industries (Pavitt, 1984; Dosi, 1988; Malerba, 2005; Metcalfe, 2010). Moreover, since firms may be cash constrained (Hall, 2002) and given the difficulty of raising the necessary funds on the financial market due to the specificity of innovation risks, profits from past innovation are likely to play a major role in supporting current R&D efforts (see, among others, Bogliaccino and Pianta, 2010 b, 2011).

On the other hand, scholars embracing the *demand-pull approach* emphasized the importance of demand dynamics in influencing the decision to innovate and the direction of innovative efforts across products and industries (Schmookler,1966; Scherer,1982). The intuition regarding the influence of demand on innovation was sparked by the seminal contribution of Schmookler (1966), who claimed that demand conditions crucially influence the desirability and realization of innovations as the existence of an expected profitability through market expansion represents the key stimulus to which innovation activities react. Efforts to reconcile the dynamic of innovation with demand have then been developed along different paths.

The conclusion of such debate has been that both technology-push and demand-pull factors have to be considered among the determinants of innovation, although since the 1980's the focus of the literature has largely been a supply side story, with demand constraints often assumed to be of minor relevance. As suggested in the latest review of this literature by Di Stefano et al. (2012), only more recently, the debate between the demand-pull versus technology-push perspectives has settled for a more balanced view which sees demand as a complementary (though non dominant) factor determining innovation (García Quevedo et al.,2014). In more recent contributions, for instance, Bogliacino and Pianta (2011) have found that the cumulative nature of research and knowledge, the demand-pull effect of the perceived potential for new products and access to finance through the reinvestment of fast growing profits play a significant role in explaining R&D intensities. García Quevedo et al. (2014) have also found that demand stagnancy has a marked impact on not only the amount of investments in R&D but also on the likelihood of firms engaging in R&D activities.

On the wave of the recently renewed interest around the demand-pull perspective in innovation studies, a first contribution of this paper to the existing empirical literature is trying to rebalance the overall picture by examining the parallel dynamic of technological opportunities and demand-related incentives and the impact of this on business R&D investments.

2.2 The role of the State: linking evolutionary perspectives with the NSI

Of course, the national institutional setting also matters. The National System of Innovation (NSI) literature – an institutional framework *par excellence* - has framed innovation activities within the institutional national context (Lundvall, 1992; Nelson, 1993; Freeman, 1995): according to this approach, the way in which firms carry out innovation activities is affected by a number of specific national features (Archibugi and Pianta, 1992; Lorenz and Lundvall, 2006), such as the nature of the scientific and technological institutions, the education and training system, the financial system, the structure of the labour market and the industrial specialization. Building on this framework, this document focuses on the role of the national Government in supporting scientific and technological research *via public R&D funding*. This is extremely variegated across countries and likely to influence changes in business R&D over time through different channels, which makes the contribution of the Government an essential factor to control for.

Beside fulfilling public needs such as defence, the economic rationale for the involvement of the Government in this area has traditionally being related to the existence of market failures associated with private R&D investments, resulting in under-provision of research activities compared to the socially optima level (1962): mainly, inadequate appropriability of the returns to owners from R&D spending and huge uncertainty of success of many R&D projects.

Recall that public support to innovation - through R&D funding - can use different tools: first, government can directly fund business for carrying out research; a second way for government to support business R&D is through fiscal incentives; third, *via* public research, carried out in public laboratories or universities, and funded by government. Hence, a third way is for government to perform R&D itself, in public labs or by funding universities research, generally with the objective of generating basic knowledge. Although contributing to industrial technology is not the direct purpose of *public research*, it may have such an impact mainly through "knowledge spillovers", which certainly include training of scientists.

The analysis of the effects of publicly funded R&D on private R&D investments is a research area of "perennial policy relevance" (David et al., 2000, p.501). So far, a large number of studies have tried to detect whether public spending spillovers affect private firms' decisions about R&D spending, or whether public funds in the form of direct subsidies "crowd-out" private spending, which is an important issue difficult to disentangle at the conceptual and empirical levels. The basic idea is that, thanks to direct government support or to basic knowledge produced on government funds, the private return on investment in R&D is improved, triggering higher expenditure on R&D by firms. Nevertheless, it is also possible that government funding crowds-out business R&D, directly (by giving money to firms for research projects that they would have carried out anyway) or indirectly (by increasing demand and consequently market prices of the resources needed for research). It is still uncertain whether the leverage effect

dominates the crowding-out effect or not. More recently, Mazzucato (2013), looking at the role of the public sector in entrepreneurship, has also shed new light on the important role of public research, showing that what really matters to stimulate firms to invest in R&D and innovation – beyond the conventional measures such as fiscal incentives and other forms of direct support - is the perception of technological and market opportunities which are, in turn, strongly correlated with direct investments, often public, in completely new and complex areas of technology, thus highly risky and uncertain. In this line of argument, issues concerning tax credits as incentives for a greater amount of private investments are eschewed, and the view is restricted to the other three possible channels through which public money can flow: government direct funding of R&D performed by business and government funding of public R&D performed in public labs and universities. The aim is to test whether public direct funding of business R&D and/or public funding of government and university research actually influence business R&D. The main conjecture is that business R&D intensity is highly conditioned by public R&D funding, which essentially may work by lowering the private cost and uncertainty of research and working out new knowledge and technological opportunities available to firms, thus as technology-push. Overall, I expect that both technology-factors and demand dynamics will be important in explaining changes over time in the amount of financial resources devoted to R&D by business.

Econometric analysis

-Data

The dataset used in the empirical analysis covers the 2000-2007 period for 5 European countries (Germany, United Kingdom, France, Italy, Spain) and 18 manufacturing industries. Thus, the unit of observation is the country-industry, for a total of 704 observations (unbalanced panel). I have used OECD STAN for most of the information, coupling it with OECD ANBERD as far as business R&D is concerned and with OECD *Research and Development Statistics* for data on government funded R&D. The main limitations come from the availability of business R&D data from ANBERD. For non-euro countries (UK), data have been transformed into euros using nominal exchange rates from Eurostat sources.

The industries included in the dataset are listed in Table 1.

[TABLE 1 ABOUT HERE]

-Estimation strategy and variables

I have opted for a standard dynamic R&D equation, where industry R&D is autoregressive and dependent on various technology-push and demand-pull factors. Thus, the estimated equation is the following:

(1) $\log(R\&D_{ijt}) = \beta_0 + \beta_1 \log(R\&D_{ijt-1}) + \beta_2 \log(EXPO_{ijt}) + \beta_3 \log(GOPS_{ijt-1}) + \beta_5 \log(pfunR\&D_{ijt}) +$

$+ \beta_6 \log(plabsR\&D_{ijt}) + \beta_7 \log(uniR\&D_{ijt}) + \beta_8 \, 'C + \beta_9 \, 'S + \beta_{10} \, 'T + \alpha_{ij} + \varepsilon_{ijt}$

where I, j and t indicate, respectively, industry, country and year.

The dependent variable (R&D) is the business R&D intensity, measured as the share of industry R&D on value added. The lagged dependent variable is also included to account for path dependence and cumulativeness of knowledge.

The most dynamic component of demand - external demand (EXPO) measured as the share of industry exports on value added - has been included to account for the relationship between innovation and business cycles (Schumpeter, 1939). On the grounds that international markets tend to be characterized by higher levels of competition (Archibugi and Iammarino, 1999; Narula and Zanfei, 2003), this variable should exert a positive influence on business R&D. Nevertheless, the role of demand is not always obvious: indeed, on the one hand, it may offer greater opportunities for the success of new products and the increase of innovative turnover through market expansion; on the other hand, a strong demand growth may reduce the competitive pressure to innovate, as even non-innovators can maintain their market shares.

The role of past profits (GOPS) is also taken into account, by including the share of industry gross operating surplus on value added. Indeed, as extensive research shows, profits are not only the outcome of innovation but also the main driver of it, providing the necessary financial resources, given the difficulty of raising the necessary funds on the financial market, due to the specificity of innovation risks (Bogliacino and Pianta,2010). Thus, lagged profits fund current R&D activities, which means that a significant and positive sign of the relative coefficient is expected.

Next, "pfunR&D" accounts for government direct funding of business R&D, measured as the amount of public funds received over total business R&D expenditure. This is a measure of direct public funding intensity, which aims at capturing the business research dependence on direct public support.

Then, the impact of public research is considered: "plabsR&D" stands for government funded R&D performed by public research labs over value added; whereas "uniR&D" refers to government funded research performed by universities over value added.

The rationale behind the inclusion of these variables is to assess whether direct public funding to business R&D and/or public(government or university) research actually act as a (technology-push) stimulus for business R&D or whether a crowding-out effect prevails.

Finally, C is a set of country dummies, to control for the possible impact of different national macroeconomic contexts; S is a set of industry dummies to account for technological opportunities

available to firms in specific industries; T is a set of time dummies capturing the economic business cycle; α_{ij} is the time-invariant fixed effect and ε_{ijt} the usual error terms. All the variables - except dummies - are in log scale. Table 2 summarises the list of the variables employed in the empirical analysis and their definition.

[TABLE 2 ABOUT HERE]

Several econometrics problems may arise from estimating equation (1). First of all, the lag in R&D flow is endogenous with regards to the disturbance term by construction, since they both include ε_{ijt-1}. Also, exports can be argued to be endogenous, as causality may run in both directions: as R&D improves the capabilities of firms, it also enables them to penetrate foreign markets. Similarly, the possible endogeneity of variables related to public R&D funding has to be taken into account, since the intensity of private R&D is likely to influence the level of government expenditure in this area. Moreover, time invariant individual characteristics (fixed effects) may be correlated with the explanatory variables. The presence of the lagged dependent variable ($R\&D_{ijt-1}$) gives also raise to autocorrelation. Finally, the panel dataset has few time periods (t=8) and many units of observations (88 country-industries).

As well known by scholars of panel theory, the above dynamic specification cannot be correctly estimated either by OLS or by the fixed-effect estimator. Accordingly, estimates have been carried out using the GMM in Blundell and Bond (1998) version (GMM-sys). The excluded instruments are lagged profits and the usual time, industry and country dummies.

The system GMM-sys estimator uses the levels equation (equation (1) in this case) to obtain a system of two equations: one differenced and one in levels. By adding the second equation, additional instruments can be obtained. Thus, the variables in levels in the second equation are instrumented with their own first differences, which usually increases efficiency. Estimations obtained applying this method are not affected by omitted variables time invariant (the so-called fixed effects); furthermore, an overall better estimation of the coefficients - due to the use of instrumental variables - is assured, this way also overcoming the problems related to endogeneity and measurement errors.

Some descriptive statistics are shown in table 3.

[TABLE 3 ABOUT HERE]

-Results

Preliminary results of the GMM estimation of equation (1) are reported in Table 4, column (4). In columns (3), (2) and (1) GMM-dif (see Arellano and Bond, 1991), fixed and random effects estimators are also shown for completeness, though comments are based on column (4), as the one providing more reliable results.

[TABLE 4 ABOUT HERE]

The persistent nature of the R&D variable is fully confirmed, since a strong first lag effect of R&D efforts has been found. The coefficient related to the demand variable, proxied by export intensity, turns out to be positive and significant (at 10%), showing that R&D efforts are pulled by the perception of a potential market for new products. The feedback effect of economic performance on R&D efforts has also been confirmed, as the coefficient of lagged profits is significant (at 5%) and positive. On the whole, as expected, business R&D appears as an AR1 process pulled by demand and finance constrained, with profits playing a supporting role, which is also consistent with findings of some previous studies (see, among others, Bogliacino and Pianta, 2011; Bogliacino and Pianta, 2010).

Turning to the effect of public R&D funding, the variable related to government funding of research performed in universities turns out to be significant (at 10%) and positively associated with the dependent variable. On the contrary, direct government funding of business R&D and government funding of research carried out in public laboratories seem not to affect business R&D intensity. Hence, financing university research seems to be the only channel trough which government funds actually exert a leverage effect on business R&D, whereas the other two channels through which public expenditure committed to R&D can flow appear to be neutral, that is neither acting as stimulus nor producing a displacement effect. This is in line with Mazzucato's view that, when the purpose is to increase business R&D, it is better to give knowledge and technological opportunities than money to business. Indeed, if some have argued that the kind of science produced by public research facilities is irrelevant to the business sector (see, for instance, Kealey, 1996), with the idea that if it were useful, business would do it itself, it must be reminded that weak appropriability of basic knowledge makes it difficult for firms to reap its rewards. Rather, present results suggest that the necessity to capture (and take advantage from) the basic knowledge and opportunities worked out by university research represents the key stimulus to which private businesses actually react. On the other hand, government research carried out in public labs is probably more close to the kind of research performed by business sector, which may result in technology that is directly used by business without inducing it to increase its research expenditure.

Time and country dummies are never significant, whereas industry dummies overall confirm the expected link between high and medium/high-technology sectors and business R&D efforts.

In terms of the standard GMM-sys diagnostic tests, the AR(2) for autocorrelation in levels is reassuring, whereas the null of correct instrumentation (Hansen test) is rejected at 10% level. The failure of the Hansen test should not generate too much worries for at least three reasons. First, neither the Sargan nor the Hansen tests should be relied upon too faithfully, as they are prone to weaknesses (see Roodman, 2006, p.12). Second, in their Monte Carlo experiments, Blundell and Bond (2000) "observe some tendency for this test statistic to reject a valid null hypothesis too often in these experiments and this tendency is greater at higher values of the autoregressive parameter" (Blundell and Bond, 2000, p. 329). Third, because the large number of observations per year makes the occurrence of a significant Hansen test more likely.

In order to check the robustness of these results, alternative estimations have been run: interestingly enough, the positive and significant role of lagged R&D and external demand is fully confirmed across different models, random and fixed effects shown in columns (1) and (2) and GMM-dif shown in column (3), whereas the supporting role of lagged profits emerges only from GMM estimations.

Public(university)research funding is still positive and significant in the GMM-dif estimation (where the relative coefficient gains both in significance and magnitude), but it reveals not significant when the model is tested with fixed and random effects estimators, which however are likely to be biased for the reasons mentioned above. Direct public funding of business R&D and public labs research funding are never significant.

-Concluding remarks

This paper aimed at providing new insights on the relation over time between business R&D efforts and different technology-push and demand-pull factors, particularly considering the role of the State in supporting innovation *via* public R&D funding.

Drawing upon the extensive literature on R&D determinants combined with the NIS framework, business R&D intensity has been modeled to account for the path dependent and cumulative nature of innovation, the role of past profits as the main financial resource for supporting current R&D, the demand pull effect of the perceived potential market for new products, and the effect of the government spending in this area by distinguishing three relevant channels: direct government funding of R&D performed by business and government funding of public R&D performed in public labs and universities.

Main findings confirm that, in explaining R&D intensities, both the (technology-push and demand-pull) engines of innovation have to be considered. Indeed, the cumulative and path dependent nature of research and knowledge, external demand and access to finance through the reinvestment of profits play a

significant role. Also, the positive role of the State contribution via public funding of university research is confirmed, whereas direct public funding of business R&D as well as public funding of research carried out in public labs turn out to be not significant. All in all, these results confirm the view that when the purpose is to increase business R&D, it is better to give knowledge and technological opportunities than money to business. Perhaps, the necessity to capture (and take advantage from) the basic knowledge and opportunities worked out by university research represents the key stimulus to which private businesses actually react. On the other hand, government research carried out in public labs is probably more close to the kind of research performed by business, which may result in technology that is directly used by business without inducing it to increase its research expenditure.

Appendix

Table 1. The variables: acronyms and definitions.

log(R&D)   = Natural log of business R&D expenditure over value added

log(EXPO) = Natural log of business exports over value added

log(GOPS) = Natural log of business gross operating surplus over value added

log(pfunR&D) = Natural log of government direct funding of business R&D over business R&D

log(plabsR&D) = Natural log of government funded R&D performed by public labs over value added

log (uniR&D) = Natural log of government funded R&D performed by universities over value added

Table 2: list of the industries included in the dataset.

High-Medium/High-Tech

Chemicals and chemical products
Machinery and equipment, nec
Electrical machinery and apparatus, n.e.c
Office, accounting and computing machinery
Medical, precision and optical instruments
Radio, television and communication equipment
Motor vehicles, trailers and semi-trailers
Other transport equipment

Low-Medium/Low-Tech

Food products, beverages and tobacco
Textiles, textile products, leather and footwear
Wood and products of wood and cork
Pulp, paper, paper products, printing and publishing
Coke, refined petroleum products and nuclear fuel
Rubber and plastics products
Mineral products
Basic metals
Fabricated metal products
Manufacturing nec and recycling

Table 3: descriptive statistics

Standard deviation (Between and Within) of the variables

	Mean	Standard Deviation			
		Overall	BETWEEN	WITHIN	obs.
log (R&D)	-3.61	1.49	1.48	0.24	704
log (EXPO)	0.18	0.78	0.77	0.14	720
log (GOPS)	-1.17	0.39	0.34	0.18	716
log(pfunR&D)	-15.97	0.41	0.36	0.20	720
log (plabsR&D)	-18.13	0.36	0.34	0.12	720
log (uniR&D)	-17.76	0.27	0.24	0.12	720

Table 4: estimation results.

Dependent variable: share of business R&D on value added

	(1)	(2)	(3)	(4)
	RE	FE	GMM-dif	GMM-sys
log (R&Dijt-1)	0.960	0.442	0.432	0.845
	[0.009]***	[0.080]***	[0.098]***	[0.065]***
log (EXPOijt)	0.053	0.266	0.808	0.204
	[0.019]***	[0.084]***	[0.187]***	[0.113]*
log (GOPSijt-1)	0.031	0.004	0.115	0.090
	[0.023]	[0.052]	[0.072]	[0.040]**
log(pfunR&Dijt)	0.019	-0.033	-0.052	0.018
	[0.014]	[0.051]	[0.156]	[0.148]
log (plabsR&Dijt)	-0.017	0.163	0.137	-0.251
	[0.028]	[0.314]	[0.302]	[0.336]
log (uniR&Djjt)	0.050	0.233	0.480	0.446
	[0.037]	[0.221]	[0.240]**	[0.247]*
C	not inlcuded	not included	not included	included
S	not inlcuded	not included	not included	included
T	included	included	included	included
N. Obs	612	612	520	612
Hansen			73.16	69.06
p value			0.375	0.057
AR(1)			-4.67	-4.04
p value			0.000	0.000
AR(2)			1.67	1.48
pvalue			0.095	0.139

Notes: robust standard errors in brackets. One, two and three stars indicate significance respectively at 10, 5 and 1 percent.

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