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# Productivity and selection effects in French economics departments

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## Abstract

Using an original database of French academic economists, this paper empirically assesses selection effects and determinants of scientific production. We use the multilevel GMM approach that identifies both a method of testing for selection effects and for consistent estimation of the impact of departmental and individual characteristics if selection effects are important. The results indicate that individual characteristics are important but local factors also play a role. As regards the specific scope of this paper, the results provide evidence that selection effects are weak in French context.

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# 1. Introduction

With the growing contribution of academic research to innovation, universities are frequently seen as a key driver towards the production of knowledge. And yet, even though their importance is recognized, they are facing increasing competition with other universities and pressure to improve their performance. Higher education reforms reinforced by global university rankings have placed more focus on individual productivity in university effectiveness and accountability measures. Indeed, these reforms could even change how university departments select future colleagues in this competitive environment.

Thus, the relationship between departmental location and individual scientific productivity raises an important question that has a direct bearing on policies concerning the allocation of scholars within university departments. With regard to this question, a number of empirical studies have attempted to identify the factors that determine the prestige of a scholar's position (Cole and Cole 1973; Long 1978). Although these studies do not deny the importance of productivity in the selection process, they assume that the connection between scientific productivity and departmental prestige is a reality, given that the best departments are more successful in hiring the most productive researchers.

While evidence supporting the causal impact of productivity on the allocation of positions in departments has been considered, departmental location has also been examined as a determinant of individual productivity (Crane 1965; Hagstrom 1967). A variety of causal mechanisms associated with the effects of departmental location have been proposed (Crane 1970; Hagstrom 1968): e.g. more prestigious departments provide a researcher with more favorable research conditions due to spillovers and access to more resources or better equipment. Being located at a more prestigious department then facilitates greater productivity (Long 1978).

Most studies on this topic use cross-sectional data and therefore fail to shed light on the causal ordering of individual productivity and departmental position (Long 1978). The longitudinal data make it possible to distinguish between departmental effects and selection effects hypotheses. For example, using data on 179 job changes by chemists, biologists, physicists, and mathematicians from one academic institution to another between 1961 and 1975, Allison and Long (1990) suggested that prestige causes productivity. However, Dubois *et al*. (2014) found that selection effects are more important than departmental effects when they used detailed data on mathematicians' careers over the period 1984-2006, including mobility.

Even if no consensus has emerged from the numerous studies, selection effects are believed to be weak in the French university system (Kossi *et al*. 2016; Bosquet and Combes 2017). Indeed, while Bosquet and Combes (2017) noted the role of individual characteristics in initial affiliation, they suggested that most subsequent moves are motivated by friendships or personal reasons rather than publication performance[1]. They also pointed out that most transitions from assistant to full professor concern candidates who have passed the "Agrégation" competitive exam and are, therefore, not directly involved in the choice of university department they are assigned to. Based on the above considerations, selection effects could be weaker than departmental effects.

[1] This is due to the features of the French academic system. As suggested by Bosquet and Combes (2017), mobility has no significant impact on salary since academics are civil servants and receive the same remuneration regardless of university department, even though there may be non-monetary advantages to being in a better department, such as higher social status, access to better students, more interesting colleagues, etc.

Overall, then, little evidence is found for selection effects in France, although this hypothesis has not been fully tested. Using a data set of French economists who participated in the first three PES competitions (2009-2011)[2], we not only address selection concerns, but we also aim to examine the impact of individual and departmental characteristics, simultaneously. We therefore use a multilevel instrumental variables method proposed by Kim and Frees (2007) to provide better and more consistent results. However, this study relies on earlier work by Willms (1986) as well as Bingenheimer and Raudenbush (2004), who acknowledged the problem of Level 2 endogeneity in terms of selection effects. This method precisely addresses that point.

This paper is organized as follows. Section 2 describes the data used and some indicators. Section 3 details the econometric strategy. Section 4 gives the main results and section 5 concludes.

# 2. Data and sample

The French university system we refer to presents institutional specificities that affect scientific production. While academic research was traditionally financed by public funds (allocated mainly according to laboratory size rather than scientific production) and individual scientific productivity was limited mainly to careers and promotions, recent reforms have introduced profound structural changes in the management of human resources within French universities. Specifically, they seek to improve universities' autonomy regarding the management of funding and human resources and provide more incentives for individual and collective scientific production. They also encourage universities to carry out fewer - albeit more cross-disciplinary - projects. So, the aim is twofold: (1) to create the agglomeration effects of a local skills cluster; (2) to introduce incentive schemes based on relative performance.

Our analysis employs data on French economists who participated in the first three national competitions (2009-2011) for the PES set up by the French Ministry of Higher Education in 2009[3]. Applicants are ranked based on four criteria: scientific production, quality of supervision of doctoral students, scientific responsibilities, and scientific reputation at national and international levels. As unsuccessful candidates can reapply for a new campaign, the study only included information on their initial situation. We therefore created dummy variables identifying different waves of PES experiments. Following Long (1978), only candidates having at least three years of seniority in their current university were considered[4]. Additionally, we eliminated those individuals who had not published any articles during the evaluation[5]. The final sample consisted of 280 candidates from 56 economics departments. This sample represents 14% of the total population of academic economists[6].

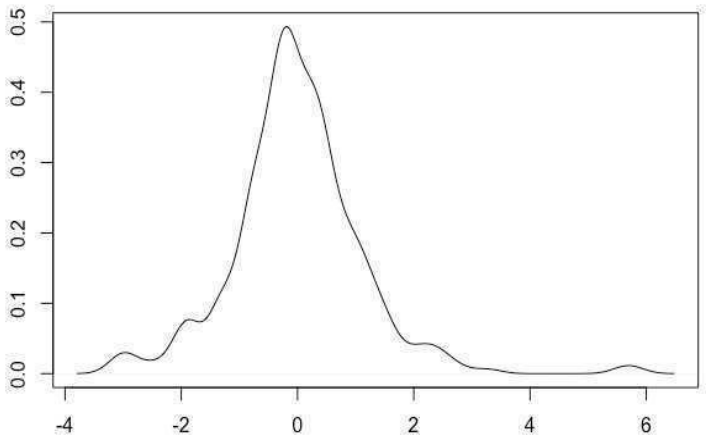
The PES data provides an almost exhaustive source of information, often unavailable in other databases, on individual characteristics and on scientific publications, as well as on teaching activities, collective responsibilities, and career paths. It is well structured and has three main

[2] Note that the grant for research was called "Prime d'Excellence Scientifique" (PES) in France until 2013.
[3] Three campaigns 2009, 2010 and 2011 were evaluated by the National Commissions of experts. The original sample consisted of 476 full and assistant professors in economics departments.
[4] Long (1978) suggests that individual productivity is only influenced by the quality of the institution of arrival from the third year after professional mobility.
[5] The reason is that it is not possible to calculate a ratio of number of co-authors to number of publications for professors without publications.
[6] However, full professors are over-represented in our sample (54.3%) compared to the total population of economists (29.1%). Source: Ministry of Education, December 2008.

features that make it particularly useful for this study. Firstly, various activities are measured in an identical time-window for all candidates; as such, its principle is in accordance with the competitive selection scheme[7]. Secondly, a homogeneous evaluation grid of publications is used, based on the CNRS (French National Centre for Scientific Research) ranking of journals. Thirdly, the PES data gives a precise description of a researcher's area within economics using the "Journal of Economic Literature (JEL) classification" and indicates the institutional affiliation of each professor.

Given our aim was to formulate a synthetic indicator to measure individual publication portfolios, we relied on this ranking which only pertains to France. This indicator is based on journals categorized into 4 levels, each of which reflects a different class of publications: from the most selective (category 1) to the least selective (category 4). However, the publications announced as forthcoming were not considered. We used a principal component analysis to assemble the publication scores of 280 French economists using their number of publications in each of the 4 journal categories. We retained only the first, principal component, which accounted for over 33% of the variance in our publication variables. This component opposed categories 1, 2 and 3 to category 4 (strongly correlated with categories 1 and 2), and could thus be interpreted as a quality measure of the individual publication scores. The distribution of this score (centered at zero) - which served as the dependent variable in the econometric analysis - is given in Figure 1.

Figure 1. Distribution of publication scores




In addition to their scientific production, professors can be involved in pedagogical tasks. For these duties, they receive bonuses rewarding specific educational activities (for instance, designing and management of teaching programmes). Although the list of staff categories eligible for the teaching responsibilities bonus is set by the Education Minister, the criteria giving entitlement to the bonus, the list of beneficiaries and the amount of the bonus are set each year by the University council[8]. However, beneficiaries can be authorized to convert all or part of their bonus into a service discharge by the university President. For applicants, information on whether they have already received bonuses is also provided and with this

[7] The period of evaluation went from 01/01/2005 to 01/01/2009 for the 2009 campaign, from 01/01/2006 to 01/01/2010 for the 2010 campaign, and from 01/01/2007 to 01/01/2011 for the 2011 campaign.

[8] Under decree no. 90-50 of January 12, 1990, the teaching responsibilities bonus is separate from the administrative premiums and administrative tasks bonuses. This decree also determines the cases in which the bonus may not be paid, particularly in multiple appointments.

information we created a dummy variable with a value of 1 if they had received a bonus and 0 if they had not. Data on the pedagogical tasks covered about 8.6% of our sample.

Our data revealed some individual characteristics of professors such as age, gender, and seniority in their current department, as well as their fields of research, according to a set of dummies reflecting the JEL classifications of their publications. In economics, as in many other disciplines, the publication scores may, in part, depend upon the field of study so we considered the professors' areas of research, to assess whether articles written in certain research fields benefited from greater interest or visibility (Rauber and Ursprung 2008). We also introduced variables that reflect a professor's individual research characteristics and, to test for path dependency effect among publications scores, we included prior individual citations. For this purpose, we computed the "*h-index*" (Hirsch 2005) for each candidate prior to the PES' evaluation period[9]. This variable is central in our study and may reflect the cumulative advantage process of Merton's (1968) "Mathew Effect" as suggested by Medoff (2003). We also examined professors' average number of authors per publication to evaluate the returns from co-authorship (Sauer 1988).

Finally, we wished to identify whether departments influence scientific productivity, as suggested in many studies of the determinants of publications that consider the significant role of location (economics of science). Indeed, the scientific environment is not homogenous. Combes and Linnemer (2003) note a high concentration of scientific production in Economics in some institutions. However, the PES data set we used did not directly reveal the department's characteristics but instead indicated the institutional affiliation of each candidate. As such, we collected additional data from Bosquet and Combes's (2012) study to further examine professors' scientific environment. The department's characteristics included the impact factors, measured by its citation index per researcher, as well as the number of researchers. The first variable "impacts factors" reflected the potential capacity of a department to create agglomeration effects. Therefore, a positive effect of this local variable on individual productivity was expected. The second variable used as a proxy for the size of the department could also account for differences in productivity. It should be noted that the value of these local control variables refers to 2004-2008, immediately before the PES competitive selection process.

However, our sample could stem from self-selection of candidates for these campaigns as participation in the competitive selection process may not be totally random for the PES. Thus, a selection bias could occur given that applicants to the process may also be the most productive researchers. Unfortunately, this selection process cannot be tested as the scientific production of those who do not apply for PES competitions is not examined. If a selection bias occurred (e.g. if only the most productive professors were examined), our results would obviously be affected. Indeed, if applicants to the PES competition are the most productive researchers, they are more likely to hold positions at prestigious departments in which other productive professors are affiliated (Merton, 1968). Finally, observing only professors who participate in PES competitions could lead to overestimate departmental effects but also hiring effects. The descriptive statistics of individual and departmental variables are given in Table I.

[9] "*A scientist has index h if h of his/her $N_p$ papers have at least h citations each, and the other ($N_p - h$) papers have no more than h citations each"* (Hirsch 2005). $N_p$ represents the total number of papers.

Table I. Descriptive statistics

| | Mean | S.D. | Min | Max |
|---|---|---|---|---|
| **Dependent variable** | | | | |
| Publication score | 1.22e-09 | 1.126 | -3.086 | 5.774 |
| **Individual variables +Wave dummies** | | | | |
| Male | 0.718 | | 0 | 1 |
| Seniority in current department (years) | 11.600 | 8.070 | 3 | 41 |
| Full professors | 54.290 | | 0 | 1 |
| H-index during the previous period | 5.486 | 5.671 | 0 | 44 |
| Average co-authors per article | 1.240 | 0.855 | 0 | 7.286 |
| Pedagogical duties bonus (Yes=1) | 8.570 | | 0 | 1 |
| Wave 2009 | 0.464 | | 0 | 1 |
| Wave 2010 | 0.282 | | 0 | 1 |
| Wave 2011 | 0.254 | | 0 | 1 |
| History of Economic Thought and Economic Methodology | 0.061 | | 0 | 1 |
| Mathematical and Quantitative Methods | 0.068 | | 0 | 1 |
| Microeconomics | 0.093 | | 0 | 1 |
| Macroeconomics and Monetary Economics | 0.114 | | 0 | 1 |
| International Economics | 0.057 | | 0 | 1 |
| Financial Economics | 0.079 | | 0 | 1 |
| Public Economics and Law and Economics | 0.061 | | 0 | 1 |
| Health, Education, and Welfare and Labour economics | 0.121 | | 0 | 1 |
| Industrial Organization | 0.121 | | 0 | 1 |
| Economic History | 0.050 | | 0 | 1 |
| Economic Development, Technological Change, and Growth | 0.061 | | 0 | 1 |
| Agricultural and Natural Resource Economics; Environmental and Ecological Economics | 0.064 | | 0 | 1 |
| Urban, Rural, Regional, Real Estate, and Transportation Economics | 0.050 | | 0 | 1 |
| **Departmental variables** | | | | |
| Departmental citation index per researcher (logs) | 2.462 | 0.766 | 0.300 | 4.617 |
| Number of researchers in departments (logs) | 3.984 | 0.947 | 1.609 | 5.366 |

# 3. Multilevel Modelling and endogeneity problems

Although the objective of this paper is to test selection effects hypothesis, the impact of individual and collective factors on individual productivity was also taken into consideration. To achieve this objective an original dataset was used in which the professor represents the unit of analysis. Given the natural nesting of professors within departments, we used multilevel models that are useful for analyzing clustered data (Bryk and Raudenbush 1992; Snijders and Bosker 1999). We considered $y_{ij}$, typically, a publication score for professor i $(i = 1, 2, \dots, n_j)$ in department j $(i = 1, 2, \dots, J)$. This model can be written in multiple stages as following:

$$\text{Level 1: } y_{ij} = \beta_{0j} + X_{ij}\beta + \varepsilon_{ij}, \quad (1)$$

$$\text{Level 2: } \beta_{0j} = \alpha + W_j\gamma + \mu_j. \quad (2)$$

In the level-1 model, $\beta_{0j}$ is a department-specific intercept, $X_{ij}$ is a vector of professor characteristics associated with a vector of coefficients $\beta$, and $\varepsilon_{ij}$ is a professor level error term with mean 0 and variance $\sigma_\varepsilon^2$. In the level-2 model for the department-specific intercept, $\alpha$ is the overall intercept, $W_j$ a vector of departmental variables associated with a vector of coefficients $\gamma$, and $\mu_j$ is a department-level random intercept with mean 0 and variance $\sigma_\mu^2$. The error terms $\varepsilon_{ij}$ and $\mu_j$ are uncorrelated with each other, $\mu_j$ is uncorrelated across departments, and $\varepsilon_{ij}$ is uncorrelated across departments and professors. The model can be expressed more succinctly by substituting the equations for $\beta_{0j}$ into the Level-1 equation as follows:

$$y_{ij} = \alpha + X_{ij}\beta + W_j\gamma + \mu_j + \varepsilon_{ij}. \quad (3)$$

Under exogeneity assumptions that the error terms $\varepsilon_{ij}$ and $\mu_j$ are uncorrelated with all explanatory variables, this model can be consistently estimated using random effects (RE) estimators. However, endogeneity arises when an explanatory variable is correlated with the error term. Given the set of error terms at distinct levels, the problem of endogeneity may concern error terms at each level (Grilli and Rampichini 2006). The variables are defined as Level-1 endogenous if they are correlated with the Level-1 random error term $\varepsilon_{ij}$ and as Level-2 endogenous if they are correlated with the Level-2 random error $\mu_j$ (Castellano *et al*. 2014). In this article, we only focus on the level 2 endogeneity. As evidenced by Willms (1986), this problem known as selection effects occurs because individuals (professors) are not randomly assigned to groups (departments).

Even if the fixed-effects approach can be used to handle Level-2 endogeneity, this approach fails to estimate $\gamma$. Although the Mundlak model (including the group means) can produce estimates of departmental variables, these estimates are biased in the presence of level-2 endogeneity. To overcome the omitted variable bias, an instrumental variable approach is adopted using the Kim and Frees (2007) method that adapts the GMM technique to cover multilevel RE models. It uses both the between and within variations of the exogenous variables and only the within variation of the variables assumed endogenous as instruments to produce consistent estimates.

For this purpose, we maintain the assumption that individual and departmental variables are Level-1 exogenous, that is, uncorrelated with level 1 error terms. If this assumption is breached, that is, the omitted individual level variables are correlated with the explanatory variables, additional external instrumental variables are required. However, finding instruments that are

sufficiently correlated with the explanatory variables is tricky. Even if such instruments were available, new methods and techniques would be needed to exploit them (Ebbes *et al*. 2004; Castellano *et al*. 2014)[10].

# 4. Results

One of the most important research questions examined in this study is: how much of the variation in individual productivity can be attributed to the departments where professors are located? The results show that 15.8% of the total variance is at the department level, which suggests that departments do indeed contribute to differences in individual scientific productivity. The results are in Table II.

Table II. Variance analysis of the individual publication score

| **Variable** | Empty model<br>Coefficient<br>(Std. Err.) | RE<br>Coefficient<br>(Std. Err.) | Mundlak<br>Coefficient<br>(Std. Err.) |
|---|---|---|---|
| Individual variables | NO | NO | YES |
| Mundlak Correction | NO | NO | YES |
| Departmental variables | NO | YES | NO |
| Departmental citation index per researcher (logs) | | 0.360***<br>(0.138) | |
| Number of researchers in departments (logs) | | -0.237**<br>(0.109) | |
| Constant | -0.044<br>(0.097) | -0.002<br>(0.400) | 0.158<br>(0.631) |
| Individual-level variance | 1.084 | 1.072 | 0.886 |
| Department-level variance | 0.204 | 0.173 | 0.085 |
| Total variance | 1.288 | 1.245 | 0.971 |
| Proportion of variance at department level | 0.158 | 0.139 | 0.088 |
| Observations | 280 | 280 | 280 |

***: significant at 1%; **: significant at 5%; significant at 10%

Column 1 which refers to the unconditional model or the empty model. The likelihood-ratio test compares the empty model with the OLS regression and if the null hypothesis is true, OLS can be used instead of a multilevel model. The test results provide support that the multilevel approach should be used.

[10] For instance, Ebbes *et al*. (2004) showed that if Level 1 dependencies are present, both random-effects and fixed-effects estimation yields biased estimates. Therefore, as an alternative they recommended using Lewbel's (1997) approach to identify the potential Level-1 endogenous variables. We thus address the issue of endogeneity of co-authorship (Ductor 2015; Besancenot *et al*. 2017) and pedagogical tasks but we do not find any conclusive evidence of the problem of the endogeneity. However, we find that a teaching load (total contact hours) is endogenous. Therefore, we exclude this variable to avoid bias in our analysis. The results are available upon request. In addition, as we lack instruments to identify departmental effects, we use lagged values of departmental variables, and we believe that this may help to reduce the Level-1 endogeneity.

Another research question on departmental effectiveness concerns the relationship between departmental variables and individual scores. The results (see Table II, column 2) show that both local variables are statistically significant. However, the variance that remains after controlling for the effects of departmental characteristics (citation, size) is generally smaller than the variance in the unconditional model. We use the difference in the two department-level variance estimates to determine how much of the unconditional variance is explained by the model containing these two local characteristics. The results indicate that 15% of the total variance between departments in mean publication score is accounted for by the two departmental characteristics.

As the preceding results show, all the variance in individual score at the department level cannot be attributed to the effects of departments. Some of that variance is due to the individual characteristics of the professors, which affect their publication scores no matter where they are located. However, as mentioned earlier, the correlations between individual characteristics and omitted departmental variables may generate endogeneity bias. The model without local variables is estimated, using a multilevel approach based on the Mundlak (1978) technique to tackle bias and provide consistent estimates. The results indicate that individual variables explain 8.8% of the department-level variance.

To test the selection effects hypothesis, we refer to Long (1978) who shows that if prestigious departments select more productive researchers, then a correlation between their productivity and the prestige of their academic location should be found. As suggested by Allison and Long (1990), we consider prestige as one aspect of a scientist's work environment, that may fall into the categories of facilities, intellectual stimulation, and motivation, thus representing unobservable variables in our model. We precisely address the selection concerns by relying on prior studies that have investigated the role of scientists' past performance as measured by citations or publications in obtaining position in a prestigious department (Cole and Cole 1973; Long 1978).

In what follows, we question the exogeneity of the past performance (proxied by the variable "*h-index"* in our data) in the model. In other words, some of the beneficial effects of unobserved department characteristics may be falsely attributed to individual past productivity. Thus, we estimate a two-level model with *h-index* assumed endogenous. If *h-index* is correlated with the level-two error, then only fixed effects and GMM estimators are robust. The model proposed by Kim and Frees (2007) is implemented in the *REndo* R package (Gui *et al*. 2023). This package encompasses a function that returns the estimates obtained with fixed effects (FE), RE and the GMM estimators, allowing the comparison between the models and thus, the choice of the most reliable model specification[11].

Finally, we compare GMM and RE estimators. Since the null hypothesis of no omitted level-two effects is rejected only at 10% significance level, we cannot conclude severe bias in the RE estimator. Hence, it is unlikely that past productivity is highly correlated with departmental prestige. This result may be in line with prior empirical evidence which suggests that past productivity plays a marginal role in the selection process (Crane 1970; Long 1978). However, young professors may be hired based on their individual characteristics. But due to the features of the French university system, hiring decisions for other professors do not necessarily depend on their publications (Bosquet and Combes, 2017). According to this institutional specificity, the selection effects are likely to be weak. The results are presented in Table III.

[11] Kim and Frees (2007) also propose an omitted variable test based on the Hausman test (Hausman 1978).

Table III. Determinants of individual publication scores

| | FE | GMM | RE |
|---|---|---|---|
| Variable | Coefficient (Std. Err.) | Coefficient (Std. Err.) | Coefficient (Std. Err.) |
| Male | -0.153 (0.155) | -0.151 (0.143) | -0.168 (0.143) |
| Years of seniority in current department | -0.014 (0.009) | -0.020** (0.008) | -0.022*** (0.008) |
| Full professors | 0.097 (0.157) | 0.086 (0.144) | 0.035 (0.142) |
| H-index during the previous period | 0.040* (0.016) | 0.048*** (0.015) | 0.062*** (0.014) |
| Average number of co-authors per article | 0.009 (0.080) | 0.043 (0.074) | 0.042 (0.074) |
| Pedagogical duties bonus (Yes=1) | 0.644** (0.254) | 0.574** (0.227) | 0.577** (0.227) |
| Wave 2009 | Ref. | Ref. | Ref. |
| Wave 2010 | -0.192 (0.173) | -0.011 (0.158) | -0.033 (0.158) |
| Wave 2011 | -0.116 (0.186) | 0.036 (0.170) | -0.012 (0.169) |
| History of Economic Thought and Economic Methodology | 0.866** (0.367) | 0.601* (0.321) | 0.579* (0.321) |
| Mathematical and Quantitative Methods | 0.246 (0.325) | 0.480 (0.301) | 0.446 (0.300) |
| Microeconomics | 0.456 (0.292) | 0.475* (0.269) | 0.438 (0.269) |
| Macroeconomics and Monetary Economics | Ref. | Ref. | Ref. |
| International Economics | -0.400 (0.335) | -0.197 (0.314) | -0.238 (0.314) |
| Financial Economics | -0.052 (0.295) | 0.029 (0.278) | 0.021 (0.278) |
| Public Economics and, Law and Economics | 0.404 (0.325) | 0.350 (0.307) | 0.340 (0.307) |
| Health, Education and Welfare and Labor Economics | 0.011 (0.269) | -0.022 (0.255) | -0.060 (0.255) |
| Industrial Organization | 0.215 (0.276) | 0.222 (0.257) | 0.163 (0.256) |
| Economic History | -0.085 (0.378) | -0.143 (0.331) | -0.180 (0.330) |
| Economic Development, Technologic Change, and Growth | -0.595* (0.340) | -0.654** (0.307) | -0.671** (0.307) |
| Agricultural and Natural Resource Economics; Environmental and Ecological Economics | -0.388 (0.360) | -0.003 (0.316) | -0.072 (0.314) |
| Regional, Real Estate, and Transportation Economics | 0.204 (0.387) | -0.152 (0.333) | -0.159 (0.333) |
| Departmental citation index per researcher (logs) | | 0.270** (0.131) | 0.238* (0.130) |
| Number of researchers in departments (logs) | | -0.192* (0.100) | -0.182* (0.100) |
| Constant | | -0.105 (0.441) | -0.036 (0.440) |
| Observations | 280 | 280 | 280 |

***: significant at 1%; **: significant at 5%; significant at 10%

Several studies have found that women publish less than men (Taylor *et al*. 2006; Lissoni *et al*. 2011). However, we find that women are as productive as men (Fox and Mohapatra 2007)[12]. It also appears that scientific production decreases with each year of seniority in a given department. We find no significant impact between associated and full professors on the publication scores. Nevertheless, our estimations support the dependency theory "Matthew effect" (Merton 1968; Carayol 2006; Lesueur 2012). We find that past productivity (*h-index*) is positively related to publication scores. However, we find no evidence for the effect of collaboration on productivity (Medoff 2003).

Moreover, in our sample, involvement in pedagogical duties resulting in a bonus seems to be positively related to publication scores. Therefore, the volume of teaching duties for which time off has been granted may be sufficient to give priority to research activity[13]. Our results also suggest that different research fields receive different amounts of interest resulting in different quantities of research output. In the field of History of Economic Thought and Economic Methodology and in the field of Microeconomics, professors show higher productivity than those who are in the field of Macroeconomics and Monetary Economics whereas, the field of Development, Technological Change and Growth seems to have less visibility.

As regards departmental characteristics, the two variables (i.e. citation index and departmental size) have a significant coefficient. In line with results of previous literature, we find that a researcher that belongs to a productive department shows higher productivity (Hansen *et al*. 1978). A 10% increase in the departmental citation index per researcher increases the publication score of 0.027 within four years. However, relative to this effect, our results report a moderate negative relationship between scientific productivity and departmental size (Turner and Mairesse 2005). Even if this effect is weak, it shows the interest that should be given to a small group of dynamic researchers rather than to the size of the academic institutions to which they are affiliated[14].

# 5. Conclusion

In this study, we have attempted to shed some light on selection effects and their implications for estimation strategies. Selection procedure operates to assign professors with certain characteristics to certain types of departments. Hence, this analysis explores level 2 endogeneity problems in multilevel modelling of individual scientific productivity which arises from correlations between researchers' characteristics and omitted departmental variables. Using PES data, we apply multilevel instrumental variables method which allows us to appropriately handle endogeneity bias, and to provide more accurate results on which policies can rely.

The results suggest that the main individual factor of higher future scientific productivity for an economist is obviously the quality of his current publication records. However, our analysis suggests that departmental selection depends only marginally on past individual performance,

[12] However, since the self-selection of PES candidates is not totally excluded, it is possible, with reference to the literature in experimental economics on gender and competition, that self-selection is slightly more marked for women than for men; this could change the expected effect of gender on productivity (Niederle and Vesterlund 2007; Datta Gupta *et al*. 2013).

[13] Note that professors can be discharged all or part of the teaching hours by converting administrative tasks bonuses. This can explain the positive effect observed for pedagogical duty bonus on scientific publications.

[14] For instance, we find that being affiliated with a joint research unit (UMR) has no impact on the quality of publications.

and thus the selection effects are weak. This result may be related to previous research findings that networks (defined as professional links between candidates and the jury members who take the recruitment decisions) play a more significant role than candidates' publication records (number and quality of articles) in hiring decisions (Combes *et al*. 2008).

The relationship between productivity and location may be, therefore, explained by the effects of local variables other than prestige. We find that more highly ranked departments are likely to be characterized by high productivity. However, top ranked departments also tend to have more resources, making them more effective (Chevaillier 2014; Musselin 2017). Thus, less-favored departments may be trapped in low competitiveness. In this context, efforts aimed at providing proper incentives to researchers and more efficient allocation of resources may thus represent a means to help lower ranked departments escape the vicious circle of low productivity.

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