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# Does Competition Spur Innovation? Evidence from Labor Productivity Data for the Banking Industry*

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**Abstract**

In this article, I address a research question that bears crucial policy implications and on which economic theory provides controversial conclusions: does innovation emerge from competition? I provide econometric evidence for the EU banking industry, that intensity of price competition does not affect innovation. Results hold across various estimation methods.

**JEL Classification**: *G21, L11, O31*.

**Keywords**: *competition, innovation, labor productivity*.

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# 1 Introduction

Recently, a line of research has been challenging the Schumpeterian thesis by which innovation needs monopoly (Boldrin and Levine 2008a, 2008b). These models build on the idea that first mover competitive advantage can foster innovation activity without the need of monopoly rents. In addition, Etro (2006) shows that in the context of endogenous entry[1] a firm will always have incentive to overinvest in cost-reducing investments, so implementing technological progress, as well as to be more aggressive than competitors under both quantity and price competition. Therefore, in this type of models the competitive pressure induces innovation.

The goal of this paper is to contribute answering a crucial public policy question: does innovation blossom from competitive pressure? To this end, I study empirically the relationship between innovation and competition for the banking sector using a panel data sample of 22 EU Countries over the period 2007 – 2012. First, I estimate a proposed measure of banking competition whose theoretical framework is developed in Tabacco (2013) and applied to EU banking industry (Tabacco, forthcoming). I then use this competition measure to develop and estimate a reduced form econometric model of innovation and competition, where innovation is measured by labor productivity growth.

I use various estimation methods: Fixed Effects, IV Fixed Effects and GMM dynamic panel system. The econometric evidence provided below suggest that in banking intensity of price competition does not affect labor productivity growth hence innovation. This null relationship holds also when dealing with likely endogeneity between lower prices and innovation. The result is also interesting since previous literature, such as Lerner (2006), shows that less profitable firms tend to innovate more in the US financial industry. The financial industry innovation differs from other industries' innovation in that the cost of copy is very small and it is a highly regulated industry. Therefore, research in this area seems to be useful[2].

The view I adopt in this paper is that, most of innovations take place outside patents (e.g. Moser 2013) therefore patent numbers and patent citations would account only for a fraction of innovative activity. In contrast, technological progress, new goods or services, as well as best managerial practices arising from innovation are incorporated into labor

[1] Endogenous entry which implies the free entry equilibrium does not mean assuming that there are no barriers to entry, which would not be the case in the banking industry just as in many other markets. But, it means that the role of these barriers in constraining entry is endogeneised (Etro 2006, footnote 1, pp. 147).

[2] I thank an anonymous referee in making this remark and in pointing to relevant previous literature (Lerner 2006).

productivity growth. This view is consistent with recent empirical literature in the field (Boldrin, Correa, Levine and Ornaghi 2011; Correa and Ornaghi 2014).

The empirical literature about the relationship between innovation and competition is small and produces mixed results (Aghion, Bloom, Blundell, Griffith, and Howitt 2005; Correa 2012; Hashmi 2013; Boldrin, Correa, Levine and Ornaghi 2011; Correa and Ornaghi 2014).

To accumulate a substantial body of empirical evidence on whether and how competition affects innovation, has eminent implications on whether to reform IPR and patent systems. Such issue is involved in a recent debate in the U.S., which has fostered a recent body of empirical research. In addition, even though the empirical literature provides evidence that competition promotes innovation, as some studies do, still it may be the case that in some specific sectors market forces may undersupply innovation. Consequently, I think it needs to study this topic also at single industry level. This is precisely what I do.

The rest of the paper proceeds as follows. Section 2 describes the data. Section 3 provides econometric evidence and results. Section 4 concludes.

## 2 Data and descriptive statistics

Data required is about market size, measured by population[3], and market shares for constructing five-firm concentration ratios (C5) at national level from 2007 to 2012 for 22 EU countries. I adopt a market definition at national level, which is consistent both to EC antitrust investigations in banking and to ECB data set. Data about labor productivity of the financial sector is obtained from the ECB[4].

Data for C5 is obtained by the ECB which measures bank size in base of total assets. C5 for each EU Country is the percentage share of its five largest credit institutions in light of total assets, in the sum of the assets of all the credit institutions in the given Member State. More specifically, C5 is calculated considering a host country residence approach and on a non-consolidated basis. In other words, in the computation of concentration indexes, ECB considers all national and foreign credit institutions and subsidiaries having residence in the given EU Member State, excluding assets of domestic bank branches and subsidiaries resident in foreign countries.

[3] Total population is based on Eurostat statistics, and counts all residents regardless of legal status or citizenship except for refugees not permanently settled in the country of asylum.

[4] Labour productivity data for the financial sector is available for 22 EU countries: Austria, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden.

A non-parametric regression (LOWESS) shows a null relationship between competition and innovation (Figure 1).

Table 1 provides summary statistics for the relevant variables, labor productivity growth and competition. $D$ is the competition measure which hits its maximum with Estonia (the most competitive).

## 3 Econometric evidence

In this section, first, I estimate the competition measure. The following equation is estimated:

$$ln(C5/(1-C5))_{it} = \beta_0 + \beta_1/ln(S)_{it} + v_{it} + \varepsilon_{it} \qquad (1)$$

The dependent variable is the natural logarithm of the logistic transformation of a concentration index which guarantees that $0 < C5 \leq 1$. The variable $S$ denotes market size, while $\beta_0$ and $\beta_1$ are coefficients to be estimated. Further details are in Tabacco (2013; forthcoming). I estimate the lower bound to concentration for means of stochastic frontier technique proposed by Aigner, Lovell and Schmidt (1977).

In Table 2, estimates suggest a null relationship between market size and concentration, and the lower bound ($C5^{\infty}$) is above zero.

The estimated lower bound is then used to compute the measure of competition. I compute the distance between observed market structure and lower bound as $D_{it} = C5_{it} - C5^{\infty}$. Where $C5_{it}$ is the observed concentration level in a given Country at certain year, and $C5^{\infty}$ is the estimated lower bound for each observation (EU Member State). In addition, $-1 < D_{it} < 1$. The closer $D_{it}$ is to 1 the more intense is price competition, whilst a value of zero indicates that an observation lies exactly on the lower bound. Negative values, $D_{it} < 0$, occur for observations lying below the lower bound, that is, when $C5_{it} < C5_{it}^{\infty}$.

Now, I turn to the competition – innovation relationship. I proceed to estimate the following reduced form model:

$$\Delta LP_{it} = \alpha_i + \gamma_t + \beta D_{it} + \delta D_{it}^2 + \varepsilon_{it} \qquad (2)$$

$\Delta LP_{it}$ is labor productivity growth of country $i$ at time $t$, $\alpha_i$ represents country fixed effects and $\gamma_t$ captures time effects. I include in the model both a linear and quadratic term for the measure of competition: $D$, with $\beta$ and $\delta$ parameters to be estimated. Finally, $\varepsilon_{it}$ is an error

term specific to each country and time period. I estimate equation (2) using several approaches. First, I use Fixed Effects estimator whose estimates are presented in the first column of Table 3. As competition and innovation may affect each other, endogeneity is likely to be present. In the second column of the Table 3, I estimate the model using lags of competition variables (both linear and quadratic term) as instruments for dealing with the endogeneity issue. Finally, in the third column, I employ system GMM dynamic panel data estimation proposed by Arellano and Bover (1995) and Blundell and Bond (1998), where also $D$ and $D^2$ are treated as endogenous variables instrumented by the lags.

In addition, in order to address a potential problem of serial correlation, after estimating the system GMM dynamic model, I perform the Arellano–Bond test for zero autocorrelation in first-differenced errors for both first order and second order. The p-values are quite large (order 1: p-value 0.2637; order 2: p-value 0.2386) suggesting evidence that we cannot reject the null hypothesis of no autocorrelation, hence it appears that the model does not suffer from serial correlation.

Results from Table 3 suggest evidence of a null relationship between competition and labor productivity growth, in all the estimation methods. Consequently, at least for this dataset competition does not affect innovation in the banking industry.

# 4 Conclusion

In this article, I add empirical evidence about the relationship competition – innovation for one specific sector, banking. Estimates suggest evidence for a null relationship, therefore regarding the question posed in the title, the answer is no. In the banking industry competition does not spur innovation.

Future research may be directed to investigate the competition – innovation relation in various other industries.

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**Figure 1 – Non parametric regression between Competition and LP growth**

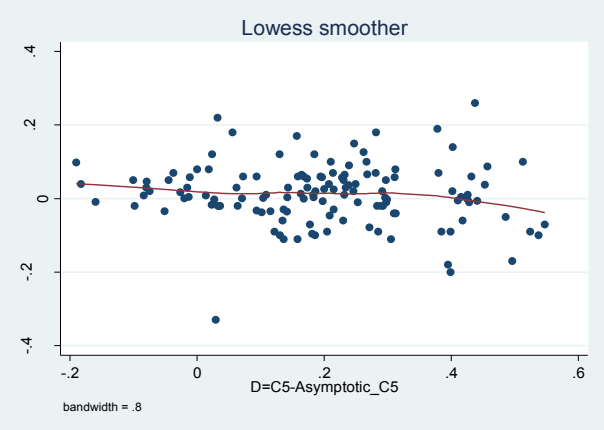


**Table 1 – Labor productivity growth and competition: Summary Statistics**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| $\Delta LP$ | 132 | 0.012 | 0.082 | -0.33 | 0.26 |
| $D$ | 132 | 0.196 | 0.165 | -0.19 | 0.547 |

**Table 2 – Lower Bound: Stochastic Frontier**

| | $ln(C5/1-C5)$ |
|---|---|
| $\beta_0$ | -4.363** |
| | (2.176) |
| $\beta_1$ | 44.902 |
| | (27.797) |
| $C5^{\infty}$ | 0.41 |

**Significance at 5% level;

Standard errors in parentheses.

**Table 3 – Competition–Innovation**

| | (1) FE (Robust std.err. in parenthesis) | (2) FE IV | (3) GMM dynamic (robust std. Err.) |
|---|---|---|---|
| D | 0.005 | -0.039 | -0.452 |
| | (0.190) | (0.907) | (0.309) |
| $D^2$ | 0.142 | -2.404 | 1.028 |
| | (0.685) | (2.116) | (0.865) |
| $\Delta LP_{t-1}$ | | | -0.389*** |
| | | | (0.107) |
| $\Delta LP_{t-2}$ | | | -0.037 |
| | | | (0.106) |
| Country dummies | Yes | Yes | No |
| Year dummies | Yes | Yes | Yes |
| Constant | 0.002 | 0.165 | 0.029* |
| | (0.058) | (0.166) | (0.017) |
| Observations | 132 | 88 | 88 |

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