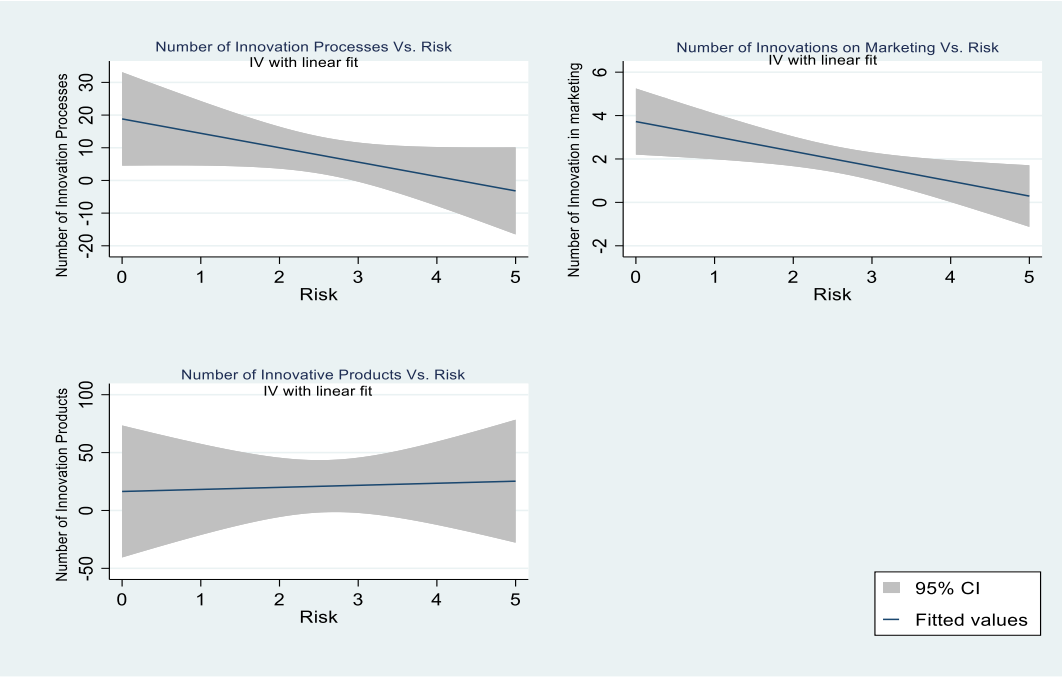
A59004718

Motivation and theoretical underpinnings

Private innovation could be considered as a positive externality derived from public investments in science and human development (Coccia, 2011). The firm's decision of assuming risks to implement novel products or processes can be an indicator of the success of a country at promoting an environment of innovation. From a Schumpeterian[1] perspective, innovators must increase their risk appetite level for trying different combinations of a process or a product that might yield in adding more value for a client (Malerba & McKelvey, 2020). This regression analysis is focused on analyzing the relationship between risk as a driver of innovation for the Poland context with the intention of getting some intuition of the success level in the innovation national framework.

Exploratory Analysis

The graph of innovation per processes and marketing versus the risk level per firm shows an initial relationship that contradicts the Schumpeterian thesis: those firms who indicated to have greater appetite for risk at the same time develop a smaller number of innovative processes, or marketing innovations. This is a generalized observation about innovators across Europe: "innovators are significantly risk averse, which hampers their ability to design and propose new solutions" (OCDE, 2015).



[1] Joseph Schumpeter.

Regression Analysis

The regressions in "first model" (table No.1) inquiries about: is the risk a good parameter for describing the amount of innovation? The results contradict Schumpeter's perception and formalizes the intuition provided by the exploratory analysis: there is a negative relationship between the amount of innovation and risk, with exception for product innovation. The regression is:

$$Number\ of\ innovations\ (i*^{2}) = B_0 + B_1 \times Risk + u_i$$

The only significant relationship is the number of innovations in marketing and the level of risk. For that case, one unit change in the risk-taking perception leads to a decrease of 0.734 innovations. This coefficient shows a weak relationship with the dependent variable but brings insight between variables' relationship.

A second model

A priori, market players like Google or Facebook have higher levels of R&D spending and more returns in innovation (Rodrik Danni, 2020). Furthermore, a more profitable company might be willing to invest surpluses in producing new competitive advantages. In this sense, the second model includes the amount of R&D spending and profitability for contrasting what literature on innovation has traditionally determined: financial indicators are not decisive in understanding the innovation drivers in a firm (HBR, 2019). It was applied a log transformation over the variable R&D spending considering that the variable assumed a closer approximation to the normal distribution when its transformed version was graphed in a histogram.

The results of model 2 seem to provide support for the literature's argument: neither R&D spending level nor the firm's profitability explain the amount of innovation for the sample of Polish firms. However, the obtained results for the marketing innovation regression show a significant relationship: a one unit spent in R&D increases the number of marketing innovations by 0.699/100. This shows a very weak association between both variables.

Table No.1

DV number	**Model 1**			**Model 2**			**Robust**
Innovation per:	**Process**	**Product**	**Marketing**	**Process**	**Marketing**	**Product**	**Marketing**
Risk rate	-4.477 (2.617)	1.489 (10.35)	-0.734** (0.272)	0.402 (1.125)	-0.553 (0.521)	-1.948 (3.335)	-0.088 (0.099)
Log R&D expenditure				0.663 (0.667)	0.699* (0.309)	3.560 (1.990)	0.0035 (0.059)
Profitability				-0.00116 (0.0402)	0.00119 (0.0186)	0.0941 (0.120)	0.0034 (0.0035)
Constant	19.26** (7.411)	17.38 (29.48)	3.962*** (0.772)	1.539 (5.317)	-0.420 (2.464)	-4.694 (15.84)	1.012 (0.4719)
Observations	347	350	349	148	148	150	148
Adjusted R2	0.006	-0.003	0.018	-0.013	0.027	0.013	-

Standard errors in parentheses.

Postestimation Analysis

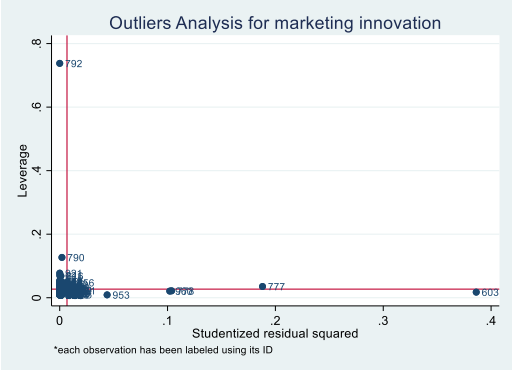
[2] There were regressed three different regressions per different type of innovation: product, marketing, and processes.

Considering the limited scope of this study, it will be illustrated the following analysis by using the case of the regression for innovation in marketing given that it is the model with more explicative power considering the significance of one of its regression coefficients and its adjusted R squared.

Omitted Variable Bias (OVB): an OVB was detected for the three regressions between model 1 and model 2. Changes in the regression coefficient of interest (risk) between model 1 and model 2 are noticeable. For example, after running a correlation between the variables i_marketing, risk, Log RDspending, and Profitability, the risk coefficient was being overestimated considering that: $\boldsymbol{B_2} * \boldsymbol{\delta_1}$ *assumes a positive value*:

- $\boldsymbol{B_2}$: *the relationship between the marketing innovation and RDspending is negative*
- $\boldsymbol{\delta_1}$: *the relationship between RDspending and risk is negative*

Distribution of the errors: the graph of outliers in the regression for marketing innovation shows the presence of several outliers. Using the Cooks distance to analyze the possible impact over the regression, it was decided to not omit any outlier considering that there is not any theoretical reason to exclude those valid points.



Heteroskedasticity: using Breusch-Pagan test, it was detected the presence of not constant variance for the residuals at 95% CI. Possible explanations come from looking at the functional form of the regressions: i) as the number of financial indicators improve (e.g., better profitability), less incentives for the company to innovate. Therefore, σ_i^2it is expected to decrease, ii) the model is incorrectly specified because it does not contain the right predictors of innovation. In the table No.1 (In the last column), it was applied a robust regression using Huber's weights in predictions. This model uses Cook's distance to analyze if dropping outliers change the regressor's coefficients. The robust regression shows no significance in the selected regressors.

Multicollinearity: not detected using VIF criteria: VIF<=10.

Conclusion

Amidst the limitations of the present study, the analyzed relationships show an important insight: companies who innovate assume a low level of risk. The state should further analysis for observing the level of coordination between the private and the public sector in terms of innovation. This analysis should respond to: is it necessary to strengthen institutional environment of innovation to bring more leverage to innovative firms: e.g., credit access or capital acquisition? This probably implies a stronger presence of the subsidized innovation from the national level to reduce the risk perception and increase rent seeking behavior through innovation.

Bibliography

Malerba, F., & McKelvey, M. (2020). Knowledge-intensive innovative entrepreneurship integrating. Springer Link, 504-505. https://link.springer.com/article/10.1007/s11187-018-0060-2

World Bank. (2015). Toward an innovative Poland: The entrepreneurial discovery process (EDP) and business needs analysis. In OCDS. http://pubdocs.worldbank.org/en/241921464873442816/1615116-EDP-Poland-REPORT-ENGLISH.pdf

Rodrik, Danni. (2020, September 9). Private or public: What's really driving technological innovation? World Economic Forum. https://www.weforum.org/agenda/2020/08/democratizing-innovation/

Coccia, M. (2011). The interaction between public and private R&D expenditure and national productivity. Prometheus, 29(2), 121–130. https://doi.org/10.1080/08109028.2011.601079

Real Innovation Requires More Than an R&D Budget. (2019, December 19). Harvard Business Review. https://hbr.org/2019/12/real-innovation-requires-more-than-an-rd-budget