# AN ANALYZE OF OIL ROYALTIES IMPACTS ON THE SOUTHEASTERN MUNICIPALITIES PER CAPITA GDP: A SPATIAL ECONOMETRIC APPROACH FOR THE NATURAL RESOURCE CURSE

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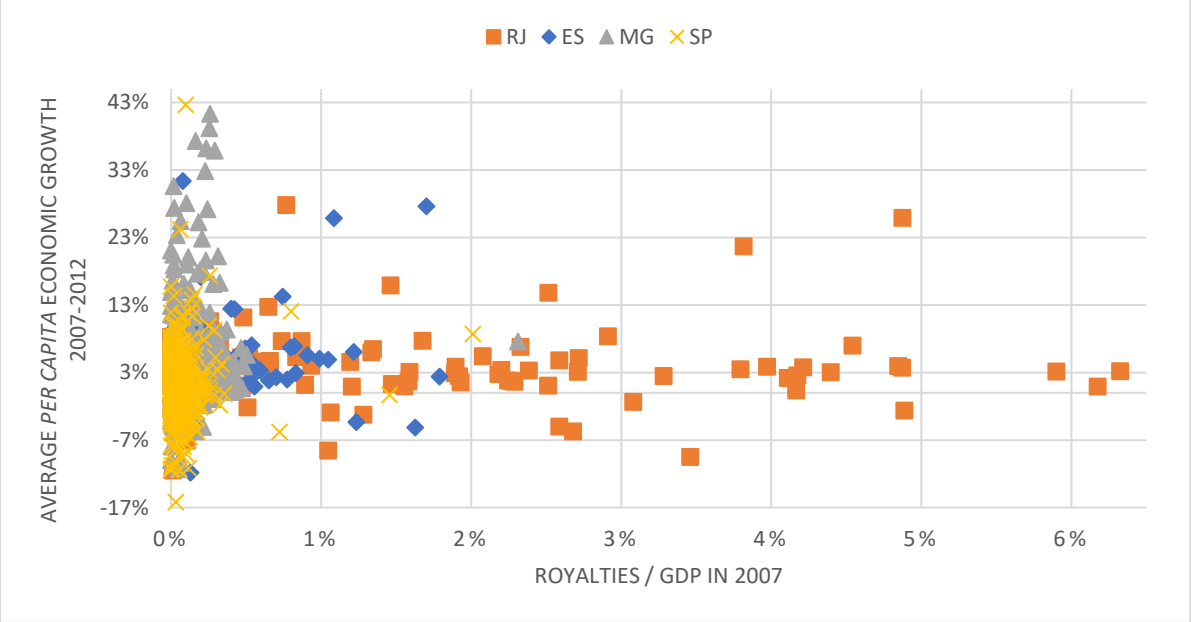
## Overview

The Brazilian Southeastern region is the most important oil producer region in the country, concentrating both the biggest producers of continental platform and those of Pre-Salt layer. Due to the great oil production, the Southeastern municipalities received almost 80% of the oil royalties paid to Brazilian municipalities between 2007 and 2012, meaning approximately US$ 6.3 billion[1].

Nevertheless, oil royalty has not been boosting economy as it was expected. Graph 1 shows the relation between *per capita* economic growth and oil dependency.

**Graph 1 -** Average *per capita* economic growth between 2007 and 2012 x Oil dependency in 2007[2].




According to the Graph 1, the higher the oil dependency the lower economic growth the municipality has. This apparently negative relation between oil royalties and economic growth is known as "natural resource curse". Besides evidences of the "curse", the most dependent municipalities are located in Rio de Janeiro state, which indicates that the curse is worse in the most important oil producer state.

Recent academic papers showed that natural resource curse is not just a country level issue, since there is also local negative effects. For instance, in Brazil, Postali (2009) showed the royalties lowered the economic growth of dependent municipalities by 0,002% in comparison to the non-beneficiary municipalities between 1995 and 2005. James and Aadland (2011) also found evidences of the natural resource in American municipalities.

Most papers, however, ignore the interaction between municipalities and only analyze the effects of resources on the ones that receive or have them. James and Aadland (2011) considered the spatial components in their estimations, but they only estimated the impact of natural resource dependency over the GDP of a referenced city.

### Empirical Strategy

This paper aims to estimate both the direct and the spillover effects of oil royalties over *per capita* GDP of Southeastern municipalities in Brazil and, thus, analyze the oil effect on the beneficiary *per capita* GDP and also the effect on its neighbors' *per capita* GDP. To do so, several spatial econometric models were estimated, but focusing on the Durbin model (SDM), since it fits better for growth regressions purposes, according to LeSage and Fisher (2009). The other spatial models: SAR, SEM, SAC, SDEM and SLX were estimated for the robustness

[1] The exchange rate used was US$ 1.00 = R$ 3.26, the exchange rate of 05/30/2017. R$ is the Brazilian currency.
[2] SP – São Paulo; ES – Espírito Santo; RJ – Rio de Janeiro; MG – Minas Gerais. These are the Southeastern states of Brazil.

check of the SDM estimators. The Haversine inverse distance matrix with a radius of 200 km was used for all these models. The econometric model functional form is given by[3]:

$$\ln(per\ capita\ GDP)_{it} = \mu_i + \vartheta_t + \beta_2 \ln(\frac{Royalties}{GDP})_{it} + \beta_3 \ln(\frac{\text{Royalties}}{\text{GDP}})^2_{it} + \beta_4 \ln(\frac{Royalties}{GDP})_{it-1} + \beta_5 \ln(Institutions)_{it} + \beta_6 \ln(Investiment\ Exp.)_{it} + \beta_7 \ln(Education\ Exp.)_{it} + \beta_8 \ln(Health\ exp.)_{it} + \beta_9 \ln(Social\ security\ exp.)_{it} + \beta_{10} \ln\left(\frac{Government\ aid}{GDP}\right)_{it} + \beta_{11} \ln(Cultivated\ area)_{it} + \beta_{12} \ln(Cattle) + \beta_{13} \ln(per\ capita\ GDP)_{it-1} + \theta_2 W \ln(\frac{Royalties}{GDP})_{it} + \theta_3 W \ln(\frac{\text{Royalties}}{\text{GDP}})^2_{it} + \theta_4 W \ln(\frac{Royalties}{GDP})_{it-1} + \theta_5 W \ln(Institutions)_{it} + \theta_6 W \ln(Investimento\ exp)_{it} + \theta_7 W \ln(Education\ Exp.)_{it} + \theta_8 W \ln(Health\ exp.)_{it} + \theta_9 W \ln(Social\ security\ exp.)_{it} + \theta_{10} W \ln\left(\frac{Government\ aid}{GDP}\right)_{it} + \theta_{11} W \ln(Cultivated\ area)_{it} + \theta_{12} W \ln(Cattle) + \theta_{13} W \ln(per\ capita\ GDP)_{it-1} + \varepsilon_{it} \quad (1)$$

Two other models were estimated after the one described in Eq. (1). The second took all of the Southeastern municipalities into consideration, but an interaction term between oil dependency and institutions action was added. In the third model, the sample was narrowed only to the Rio de Janeiro municipalities, because of the high dependency in the state.

The econometric models main results are showed in Table 1.

**Main Results**

The Table 1 shows the paper main results.

**Table 1 -** Econometric models main results

| Variables | Model 1 | | Model 2 | | Model 3 | |
|---|---|---|---|---|---|---|
| | DE | SE | DE | SE | DE | SE |
| Royalties dependency | -0.022*** | -0,012 | 0.0069** | 0.014 | 0.010 | -0.190* |
| (Royalties dependency)$^2$ | 0.032*** | 0.048*** | 0.038*** | 0.045*** | -0.009* | 0.024 |
| Interaction | | | 0.005* | -0.024 | | |
| N | 10,008 | | 10,008 | | 552 | |
| $R^2$ overall | 0.292 | | 0.293 | | 0.727 | |
| $R^2$ within | 0.891 | | 0.892 | | 0.503 | |
| Log-Likelihood | 7,549.56 | | 7,551.71 | | 363.65 | |
| Hausman p-value | 0.000 | | 0.000 | | 0.000 | |

*, **, *** represents the statistical significances at 10%, 5% e 1%, respectively.
DE = Direct Effect; SE = Spillover Effect.

**Conclusion**

Model 1 direct effect allowed us to conclude that there is evidence of natural resource curse presence in the Brazilian Southeastern municipalities. But the spillover effect showed that the oil dependency non-linearly affects the *per capita* GDP of the neighbors, indicating that the effect can be either positive or negative depending on the case. The results of Model 2 shows that institutions action can reverse the curse symptoms due to the interaction term positive coefficient.

Yet, in the Model 3, the oil royalties non-linearly affected the *per capita* GDP of Rio de Janeiro municipalities. The negative sing of the square term evidences this impact is given in a form of inverse "U". Nevertheless, the spillover effect was negative and significant at 1% level, indicating that the effect of oil royalties is worse on the neighbors than in the beneficiary municipalities. Thus, it gives us evidences of a presence of a "*fluminense* oil royalties curse"[4].

**References**

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[3] W represents the spatial lagged variables.
[4] *Fluminense* means native of *Rio de Janeiro*. So, in this case, *fluminense* is referring to the *Rio de Janeiro* municipalities.