Oil booms and subnational public investment: a case-study for colombia

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VIII JORNADAS IBEROAMERICANAS DE FINANCIACIÓN LOCAL

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Objective

To determine whether or not the variation of the international oil price has a disproportionate effect on oil producing departments and municipalities' public investment

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II. Colombian context of royalties and national transfers

III. Methodology: an experimental approach

IV. Results

V. Final conclusions

Economic policies are a key determinant of natural resource booms effects

- Differential effects of natural resource cycles depend on economic policy. Effects of natural resource boom in Mexico and Indonesia were different as Indonesia promoted investment on tradable goods, fiscal and exchange policies (Usui, 1997).
- Risk of terms-of-trade shocks due to increases in public spending. Resources should be focus on infrastructure and sectors with high social returns (McMahon, 1997).

In Colombia, there is no consensus of the management of those resources

- Uncertainty about the management of the resources generated during the oil boom from the public sector (ANIF, 2016; Revista Semana, 2016; Senado de la República; 2018).
- Certainty of the oil price boom and an increase of the resources due to the evolution of oil price (Fernández & Villar, 2014; Marín *et al., 2018).*

The economic literature has not demonstrated a causal relationship between the interest variables

- Theoretically: increases in oil prices cause an increase in public revenue and investment (Murphy, 1992; Macklem, 1993; Servén, 1999).
- Colombia: local authorities receive more resources if oil price increases but investment is discretionary to policy makers.
- Spatafora & Warner (1995) explore the relationship of oil shocks and macroeconomic variables at the national level. Even if they found a positive effect, their methodological set does not suggest a causal relationship.

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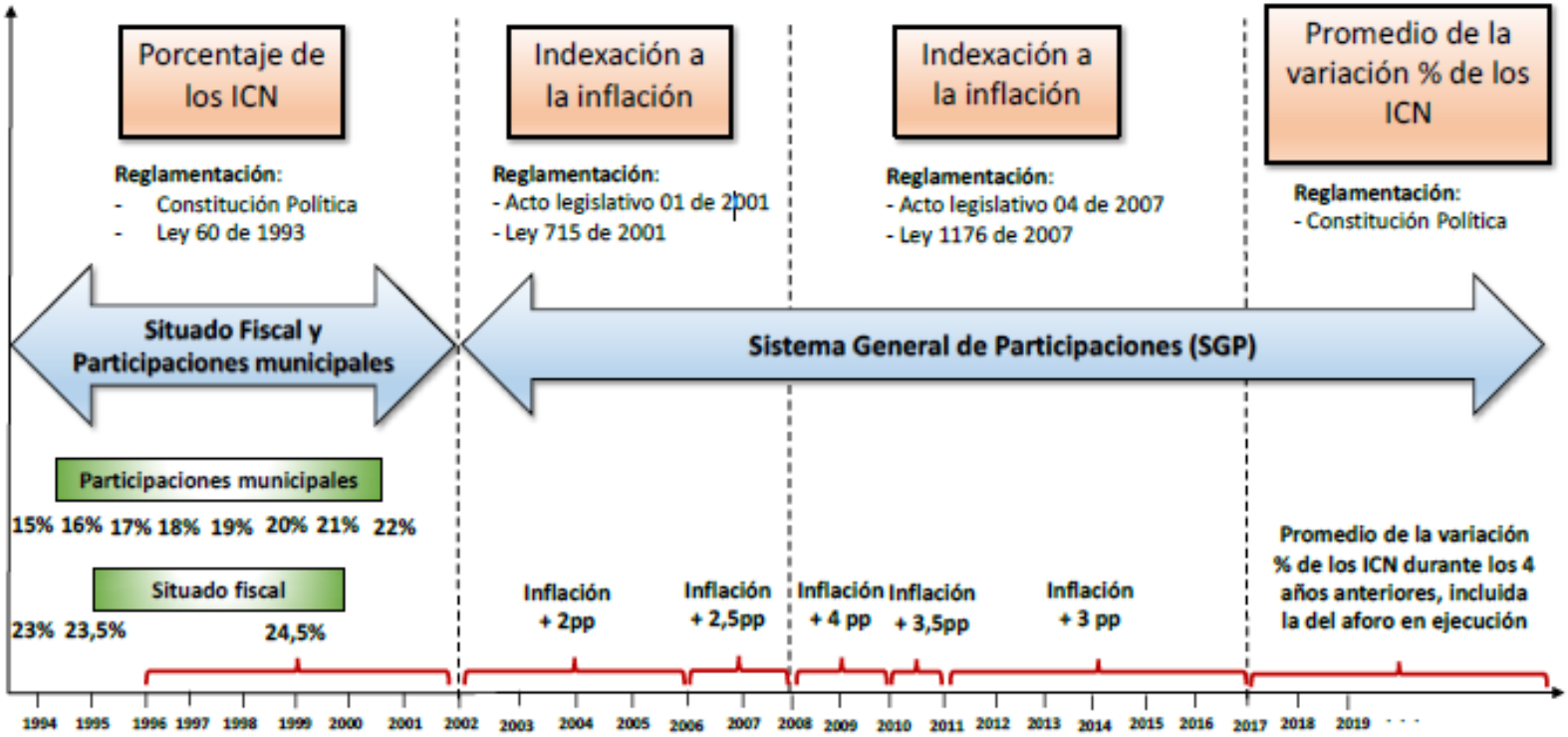
National transfers have faced different reforms over the last two decades

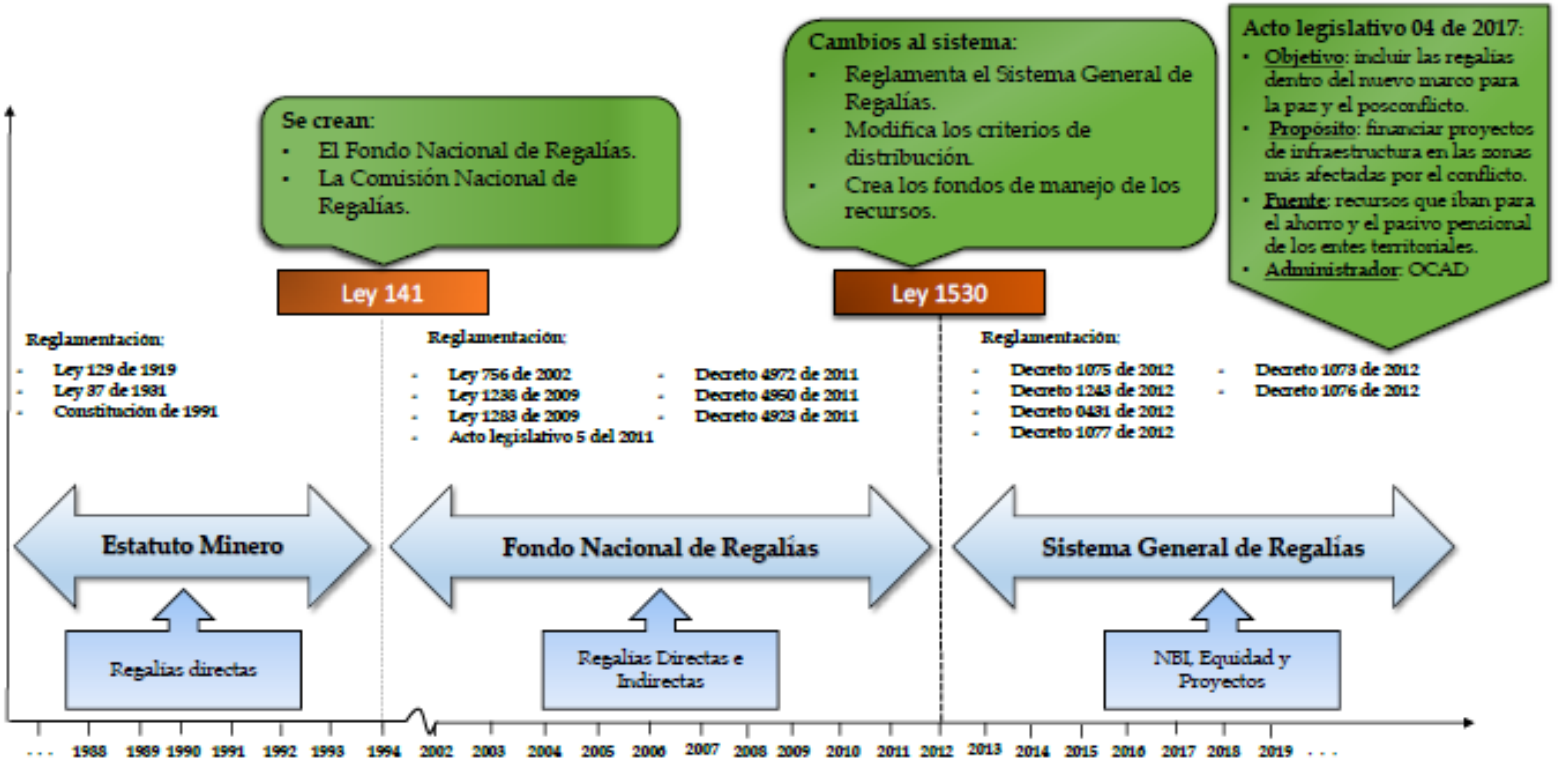
Central government transfers legal framework



Source: Bonet & Pérez (2016).

We include the last royalties reform in our econometric methods

Royalties legal framework



Source: Bonet *et al.* (2017).

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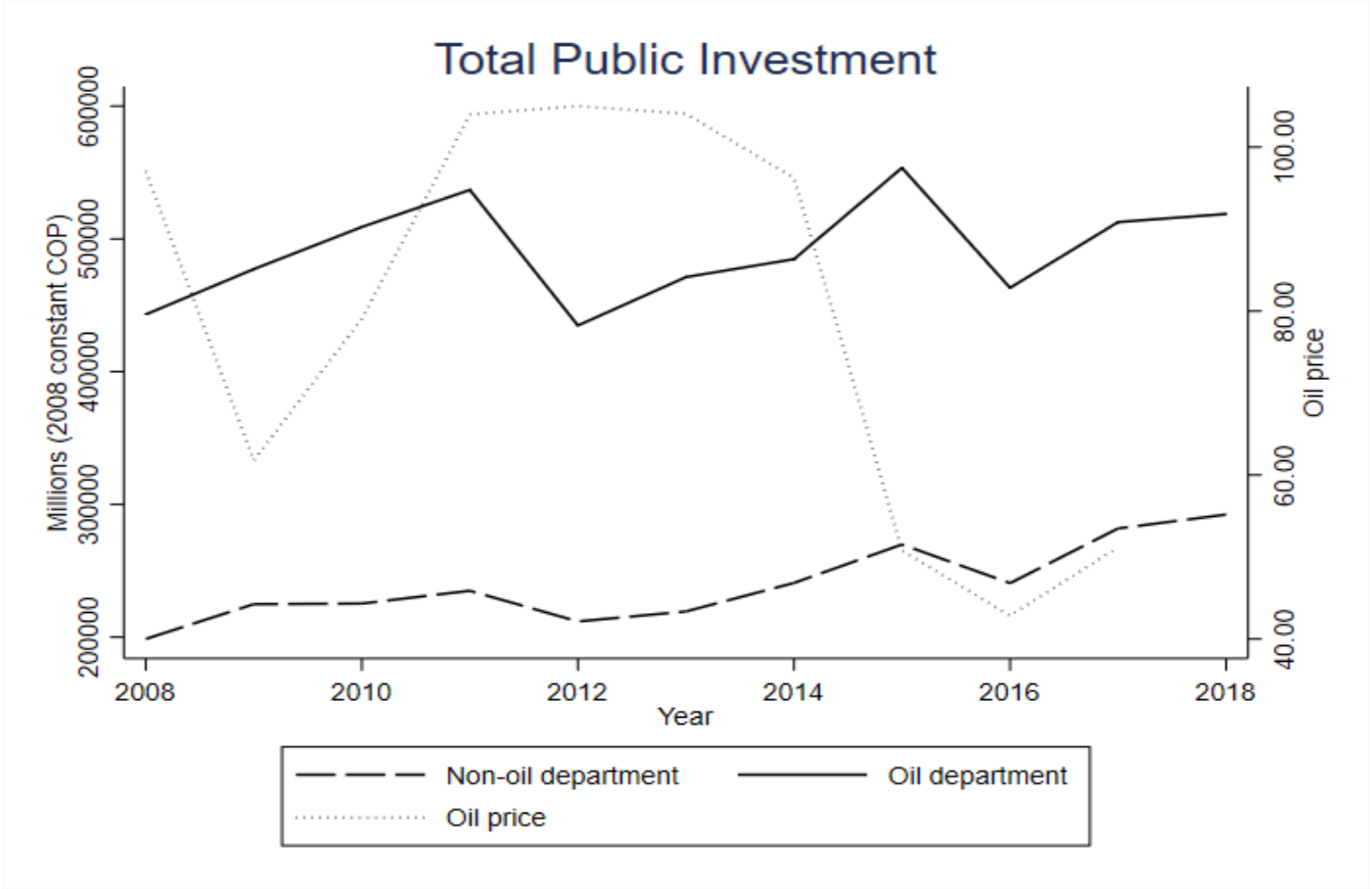
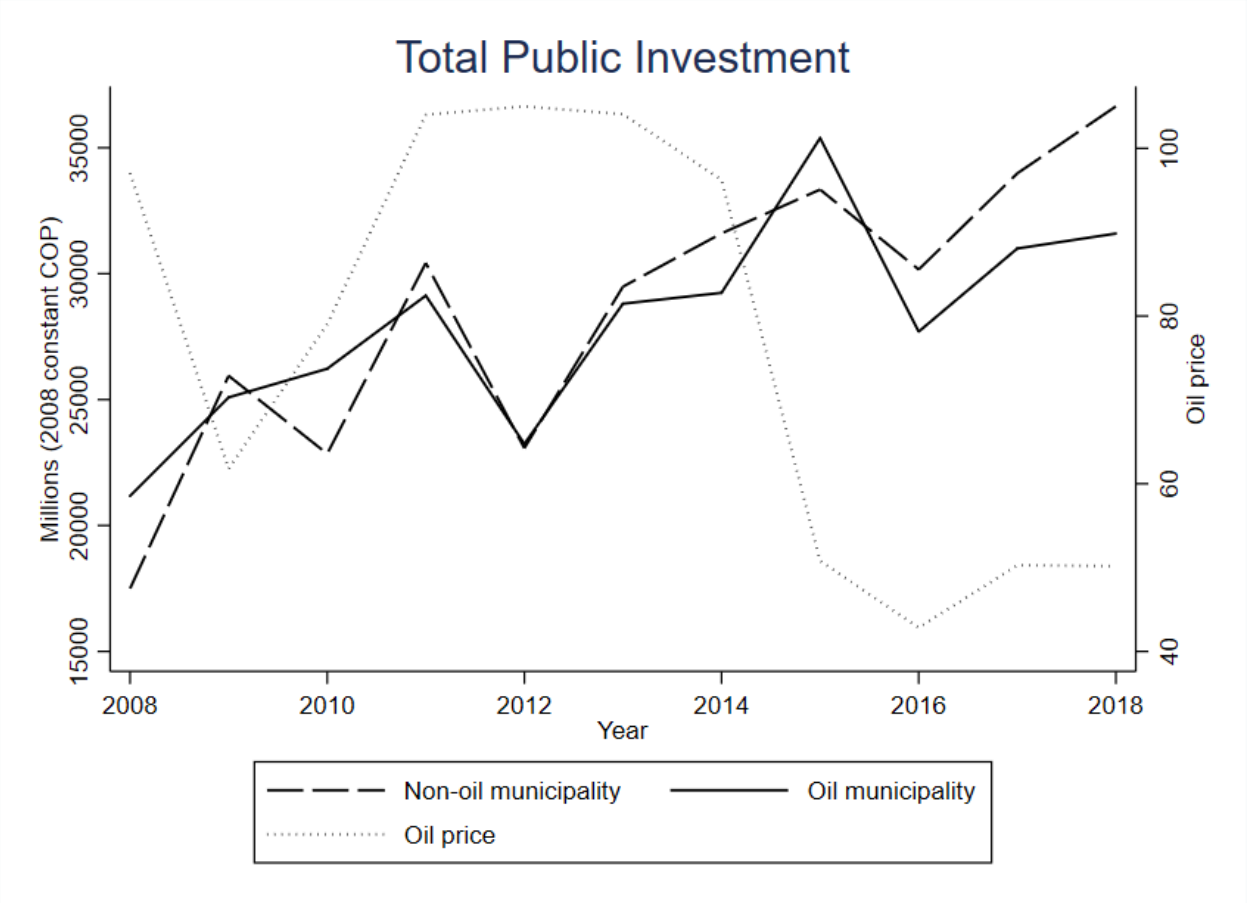
Public investment is larger in oil producing departments



- 17 out of 32 are oil producing departments, and public investment is significantly larger in those departments.

Source: CHIP-FUT, IMF and authors' calculations.

There is not any evident difference between oil producing and non producing municipalities



- 91 out of 1101 are oil producing municipalities, and public investment is significantly larger in those municipalities.

Source: CHIP-FUT, IMF and authors' calculations.

Methodology

- Exogenous distribution is fundamental for our econometric estimation.
- Producing entities are the treatment group and non-producing are the control group.
- Dependent variables: natural logarithm of total public investment and public investment discriminated by sector. In total there are 18 sectors.
- Exogenous variation: variation of oil price which is independent from domestic public investment decisions. We control for endogeneity as we employ oil production in 2008 because the evolution of oil production could be affected by public investment decisions.

Methodology

- Our static model is specified as follows:

$$\ln(Inv_{i,r,t}) = \lambda_i + \tau_t + \alpha trend_{i,r} + \gamma \mathrm{Oil}_{\mathrm{i,r,2008}} * \ln(Int.P_{t-1}) + \beta X_{i,r,t} + \mu_{i,t} \qquad (1)$$

- $\ln(Inv_{i,r,t})$ is the natural logarithm of public investment (total and by sector)
- λ_i and τ_t are department/municipality and time fixed effects
- $trend_{i,r}$ is a regional time trend
- $\mathrm{Oil}_{\mathrm{i,r,2008}}$ is the oil production in 2008
- $Int.P_{t-1}$ is the international oil price in t-1
- $X_{i,r,t}$ is matrix of covariates for local characteristics including the legal reform of 2012.

Methodology

- Lag is included as the constraint of local governments to execute resources during the same period of the increase in oil prices.
- Oil price elasticity of public investment:

$$\varepsilon(\gamma, \text{Oil}_{\text{i,r,2008}})_{op,pi} = \frac{\partial \ln(Inv_{i,r,t})}{\partial \ln(Int.P_t)} = \gamma \text{Oil}_{\text{i,r,2008}}, \qquad (2)$$

$$\text{Oil}_{\text{i,r,2008}} = \overline{Oil_{2008}} = 0.341 \quad (3) \qquad \text{Oil}_{\text{i,r,2008}} = \overline{Oil_{2008}} = 0.063 \quad (4)$$

$$\varepsilon(\gamma)_{op,pi} = 0.341\gamma \quad (5) \qquad \varepsilon(\gamma)_{op,pi} = 0.063\gamma \quad (6)$$

Methodology

- Reform during our sample period took place in 2012. To control for that change we include a dummy variable for the 2012 onwards period.
- We restricted the sample to two periods: 2008-2011 and 2012-2017.
- To consider a potential lag effect due to harder constraints during the budgeting process, we estimate a dynamic model specified as follows:

$$\ln(Inv_{i,r,t}) = \lambda_i + \tau_t + \alpha trend_{i,r} + \sum_{s=1}^{4} \delta_s \mathrm{Oil}_{\mathrm{i,r,2008}} * \ln(Int.P_{t-s}) + \beta X_{i,r,t} + \mu_{i,t} \qquad (5)$$

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0.08 oil Price elasticity of total public investment: sectors priortize are coherent with economic theory

Baseline models: Departments

Dependent variable	(1) Total	(2) Transports	(3) Justice	(4) Attention to vulnerable population	(5) Recreation and sports	(6) Agriculture
Oil production x log oil price (t-1)	0.221**	0.953***	0.593**	0.782***	0.835**	0.882***
	(0.0934)	(0.249)	(0.287)	(0.269)	(0.357)	(0.243)
Controls	X	X	X	X	X	X
Department fixed effects	X	X	X	X	X	X
Time fixed effects	X	X	X	X	X	X
Linear time trend	X	X	X	X	X	X
Observations	283	278	269	282	280	262
R-squared	0.274	0.231	0.264	0.294	0.128	0.215
Number of departments	32	32	32	32	32	31

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: CHIP-FUT, IMF and authors' calculations.

No effect on total public investment: institutional sectors were priortize

Baseline models: Municipalities

Dependent variable	(1) Justice	(2) Equipment	(3) Institutional strengthening	(4) Recreation and sports
Oil production x log oil price (t-1)	0.996*	1.970*	1.715***	1.037**
	(0.604)	(1.196)	(0.625)	(0.483)
Controls	X	X	X	X
Department fixed effects	X	X	X	X
Time fixed effects	X	X	X	X
Linear time trend	X	X	X	X
Observations	9,718	9,293	9,677	9,746
R-squared	0.209	0.061	0.100	0.174
Number of municipalities	1,100	1,100	1,100	1,100

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: CHIP-FUT, IMF and authors' calculations.

Oil Price increased investment in Most sectors the period after the reform

Restricted models: Departments

Sectors	Oil production x log oil price (t-1)	Observations	R-square	Number of departments
Agriculture	0.882***	262	0.215	31
	(0.243)			
Pre reform	0.266	87	0.360	31
	(0.511)			
Post reform	1.192***	175	0.247	31
	(0.350)			
Attention to vulnerable population	0.782***	187	0.094	32
	(0.269)			
Pre reform	-0.715	92	0.135	32
	(1.186)			
Post reform	0.985***	190	0.401	32
	(0.303)			
Recreation and sports	0.835**	280	0.128	32
	(0.357)			
Pre reform	-0.282	92	0.094	32
	(0.569)			
Post reform	0.904**	188	0.169	32
	(0.428)			
Justice	0.593**	269	0.264	32
	(0.287)			
Pre reform	-0.909	84	0.083	31
	(1.524)			
Post reform	0.732**	185	0.330	32
	(0.299)			
Total	0.221**	283	0.274	32
	(0.0934)			
Pre reform	0.0685	93	0.184	32
	(0.0920)			
Post reform	0.246**	190	0.309	32
	(0.109)			
Transport	0.953***	278	0.231	32
	(0.249)			
Pre reform	0.224	91	0.193	32
	(0.559)			
Post reform	1.031***	187	0.287	32
	(0.294)			

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: CHIP-FUT, IMF and authors' calculations.

Oil Price increased investment in Most sectors the period after the reform, except institutions

Restricted models: Municipalities

Sectors	Oil production x log oil price	Observations	R-square	Number of municipalities
PWBS	0.369	9,686	0.117	1,100
	(0.545)			
Pre reform	-0.107	3,174	0.034	1,098
	(0.732)			
Post reform	1.015**	6,512	0.097	1,100
	(0.499)			
Recreation and sports	1.037**	9,746	0.174	1,100
	(0.483)			
Pre reform	-0.628	3,169	0.063	1,099
	(0.487)			
Post reform	1.548***	6,577	0.182	1,100
	(0.511)			
Community development	1.018	7,178	0.017	1,091
	(1.038)			
Pre reform	-1.177	2,326	0.009	1,013
	(1.919)			
Post reform	2.453*	4,852	0.017	1,069
	(1.290)			
Equipment	1.970*	9,293	0.061	1,100
	(1.196)			
Pre reform	0.517	3,042	0.020	1,093
	(1.137)			
Post reform	2.790*	6,251	0.083	1,100
	(1.457)			
Disasters prevention	1.027	8,983	0.050	1,100
	(0.972)			
Pre reform	0.585	2,958	0.114	1,087
	(2.046)			
Post reform	1.438*	6,025	0.033	1,100
	(0.858)			
Development promotion	1.542	6,468	0.033	1,067
	(0.997)			
Pre reform	-1.073	2,092	0.012	913
	(2.026)			
Post reform	2.396***	4,376	0.032	1,032
	(0.875)			
Total	0.172	9,771	0.263	1,100
	(0.143)			
Pre reform	-0.116	3,183	0.056	1,099
	(0.275)			
Post reform	0.390**	6,588	0.256	1,100
	(0.162)			

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: CHIP-FUT, IMF and authors' calculations.

Most sectors the effect occured on the first lag, while avp and agricultura negative effect on the second lag

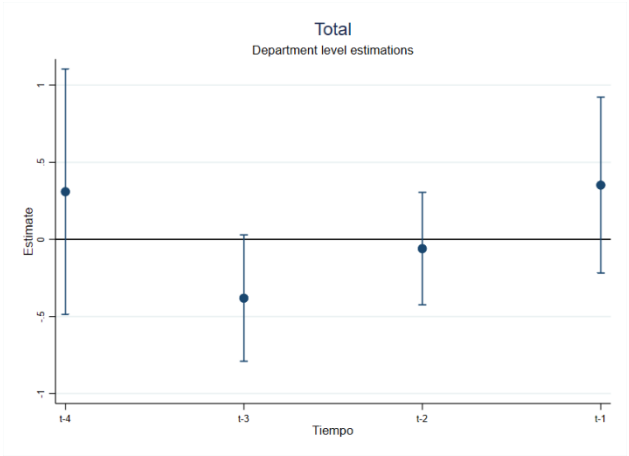
Dynamic models: Departments

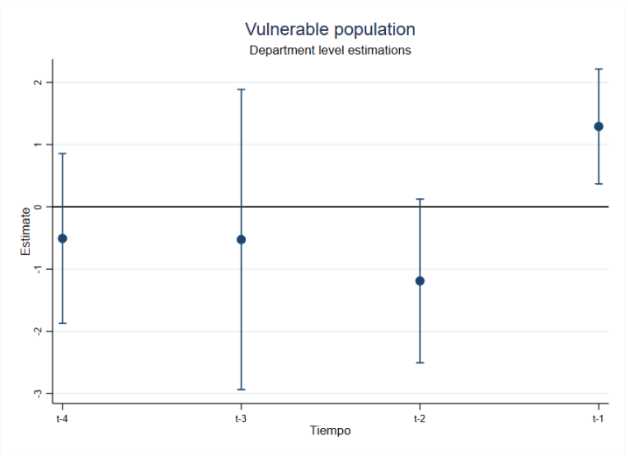
Dependent variable	(1) Total	(2) Attention to vulnerable population	(3) Culture	(4) Environment	(5) Education	(6) Agriculture
Oil production x log oil price (t-1)	0.352	1.291**	0.573*	2.252**	-0.0670	1.954**
	(0.291)	(0.471)	(0.286)	(0.878)	(0.0855)	(0.733)
Oil production x log oil price (t-2)	-0.0608	-1.190*	-0.380	-1.286	0.157**	-1.042**
	(0.186)	(0.671)	(0.284)	(0.805)	(0.0646)	(0.409)
Oil production x log oil price (t-3)	-0.381*	-0.526	0.318	2.743***	-0.214	-0.321
	(0.209)	(1.230)	(0.408)	(0.916)	(0.244)	(0.805)
Oil production x log oil price (t-4)	0.309	-0.508	-0.134	0.796	0.0436	0.327
	(0.406)	(0.696)	(0.320)	(0.946)	(0.242)	(1.709)
Observations	185	185	185	155	185	170
R-squared	0.381	0.410	0.329	0.266	0.258	0.257
Number of municipalities	32	32	32	32	32	31

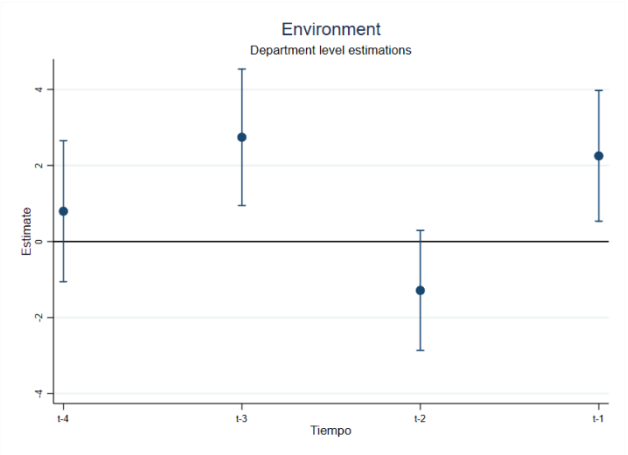
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

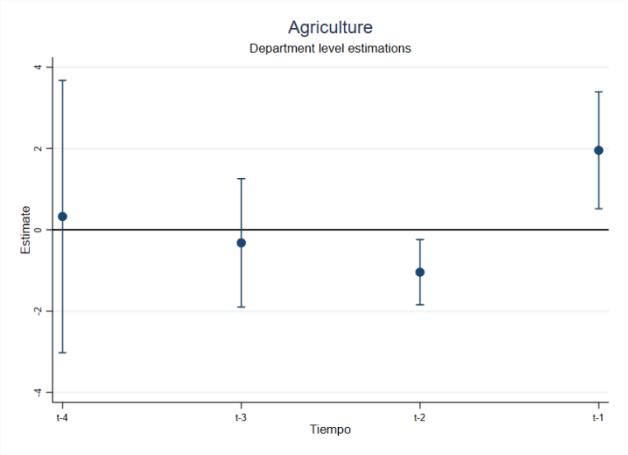
Source: CHIP-FUT, IMF and authors' calculations.

Dynamic models: Departments









Source: CHIP-FUT, IMF and authors' calculations. .

0.05 oil Price elasticity of public investment: 6 sectors with only positive effects

Dynamic models: Municipalities

Dependent variable	(1) Transports	(2) Total	(3) Disasters attention	(4) Institutions	(5) Equipment	(6) Community development
Oil production x log oil price (t-1)	1.156	0.813***	2.289	1.886**	2.988*	0.0244
	(1.858)	(0.237)	(1.438)	(0.950)	(1.772)	(1.536)
Oil production x log oil price (t-2)	-0.477	-0.400	0.767	-0.114	-0.0196	3.729**
	(2.620)	(0.325)	(1.575)	(0.656)	(2.231)	(1.856)
Oil production x log oil price (t-3)	8.018**	0.963	6.620***	1.564	2.819	-0.776
	(3.180)	(0.599)	(1.956)	(1.388)	(2.969)	(1.791)
Oil production x log oil price (t-4)	-1.223	0.114	-0.473	-0.867	-1.298	-1.455
	(1.332)	(0.342)	(0.825)	(0.733)	(1.171)	(1.576)
Observations	6,547	6,588	6,025	6,547	6,251	4,852
R-squared	0.236	0.256	0.036	0.061	0.083	0.017
Number of municipalities	1,100	1,100	1,100	1,100	1,100	1,069

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: CHIP-FUT, IMF and authors' calculations.

Results

Dynamic models:

Dependent variable	(1) Development promotion	(2) Public services	(3) Environment	(4) Recreation and sports
Oil production x log oil price (t-1)	5.446***	4.006***	3.855**	3.590***
	(1.523)	(1.086)	(1.632)	(1.106)
Oil production x log oil price (t-2)	-5.123**	-4.814***	-5.143**	-2.672***
	(2.605)	(1.143)	(2.082)	(0.954)
Oil production x log oil price (t-3)	2.196	4.421**	4.530**	3.056
	(2.886)	(2.222)	(2.296)	(1.945)
Oil production x log oil price (t-4)	0.221	0.702	-1.425	0.484
	(0.724)	(0.651)	(1.086)	(0.977)
Observations	4,376	5,944	5,782	6,577
R-squared	0.033	0.059	0.063	0.183
Number of municipalities	1,032	1,087	1,097	1,100

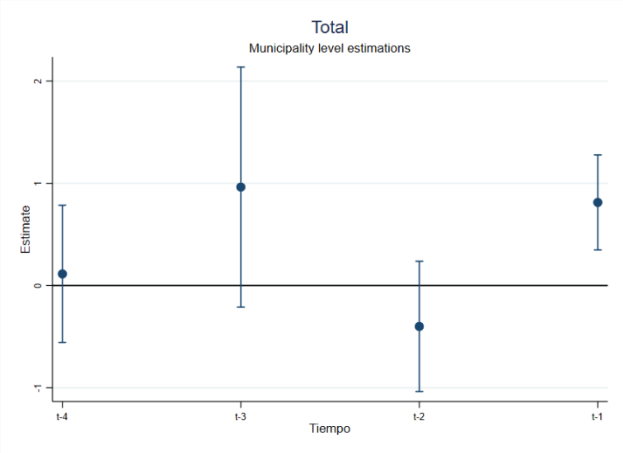
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

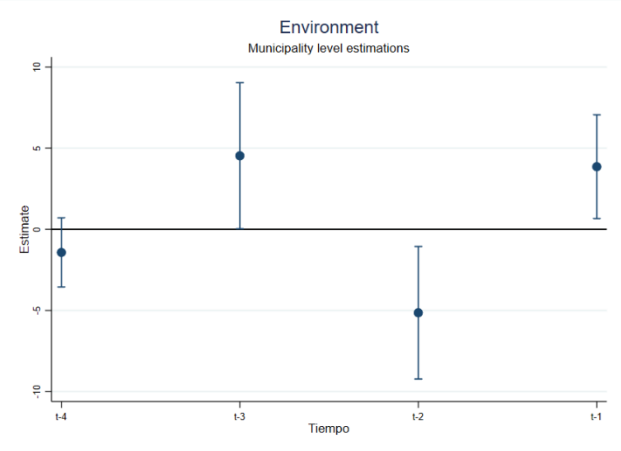
- Positive effect on the first lag and negative on the second. This result could be due to the unsustainability of the implemented policies that had to be suspend.
- The effect on the third lag in public services and environment theoretically is hard to explain.

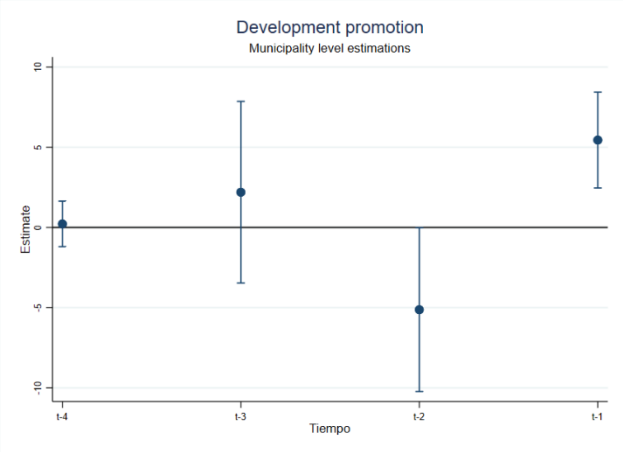
Source: CHIP-FUT, IMF and authors' calculations.

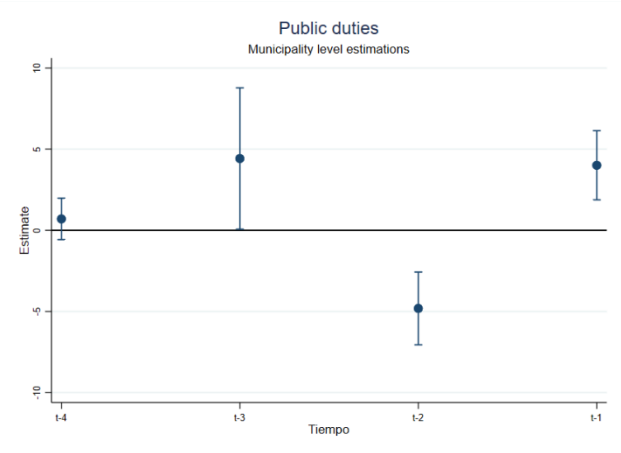
Results

Dynamic models:









Source: CHIP-FUT, IMF and authors' calculations.

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Results interpretation

- Sectors prioritize are coherent with the theoretical framework: infrastructure development and high returns in social capital.
- However, the magnitude of the effect is reduced as the largest effect for municipalities is a 0.5% change in investment due a 1% change in oil price. For departments, the largest mean elasticity is 0.94.
- Concerning the negative effect in some sectors. Our interpretation is that policy makers had to stop policy implementation due to their financial unsustainability without a continuous increase in oil price.

Concluding remarks

- The oil boom expanded the fiscal constraint of local authorities and there was an effect on public investment.
- The resources were properly allocated, however the magnitude of the effect was small.
- The expansion in some sectors was cyclical and had to be constrained after the end of the boom.
- The limitation: public investment data. In some cases, it accounts for public expenditures unrelated with investments.
- Further research: effect of those increases in public investment on socio-economic indicators. The objectives are twofold: expand knowledge on public expenditure efficient and effect on welfare of natural resource booms.

Policy implications

- Economic policies oriented towards independence from international price cycles. Sustainability of implemented policies.
- Reform to increase participation of oil producing departments and municipalities in the royalties system. Argument is the lack of incentives for producers as independently of production every local entity is receiving royalties resources.
- Our results suggest, even with equal distribution of royalties, oil producing departments and municipalities are able to investment disproportionally more than non-producers.

THANK YOU

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