

Local Economic Impacts of Wind Power Deployment in Denmark

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Work in progress

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Context and motivation


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Brexit
UN climate talks
Paris Agreement

EU €750 billion Covid recovery fund comes with green conditions

Published on 27/05/2020, 2:37pm

A quarter of spending has been earmarked for climate action and a 'do no harm' clause rules out environmentally damaging investments



European Commission president Ursula von der Leyen enters the European Parliament with officials (Pic: Etienne Ansotte/EC - Audiovisual Service)

The European Green Deal as the EU's recovery strategy:

- *A massive **renovation wave** of our buildings and infrastructure and a more **circular economy**, bringing local jobs;*
- *Rolling out **renewable energy projects**, especially **wind, solar** and kick-starting a clean hydrogen economy in Europe;*
- ***Cleaner transport and logistics**, including the installation of one million charging points for electric vehicles and a boost for rail travel and clean mobility in our cities and regions;*
- *Strengthening the **Just Transition Fund** to support re-skilling, helping businesses create new economic opportunities.*

European Commission press release „Europe’s moment: repair and prepare for the next generation“, 27 May 2020

Context and motivation

Constraints / Oppositions to renewable energy deployment

- Public cost of support policies
- Environmental impacts
- Local opposition (ex: NIMBY syndrome)

Research question

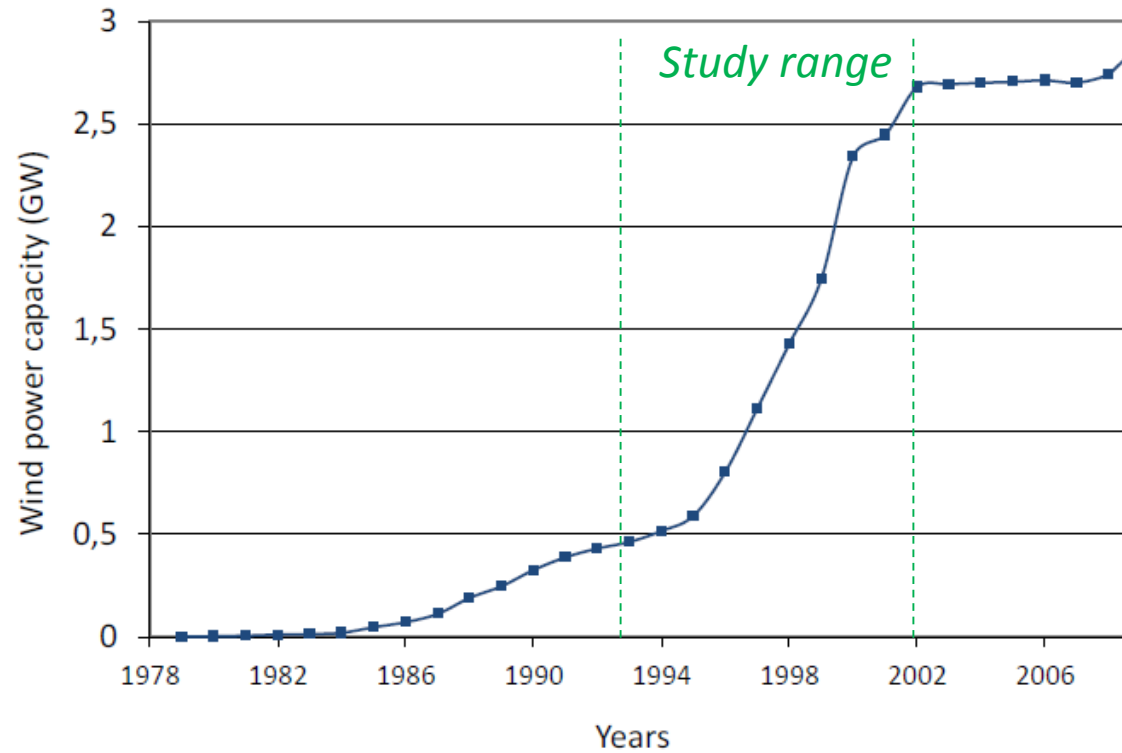
What are the local economic impacts of wind power development?

What we do

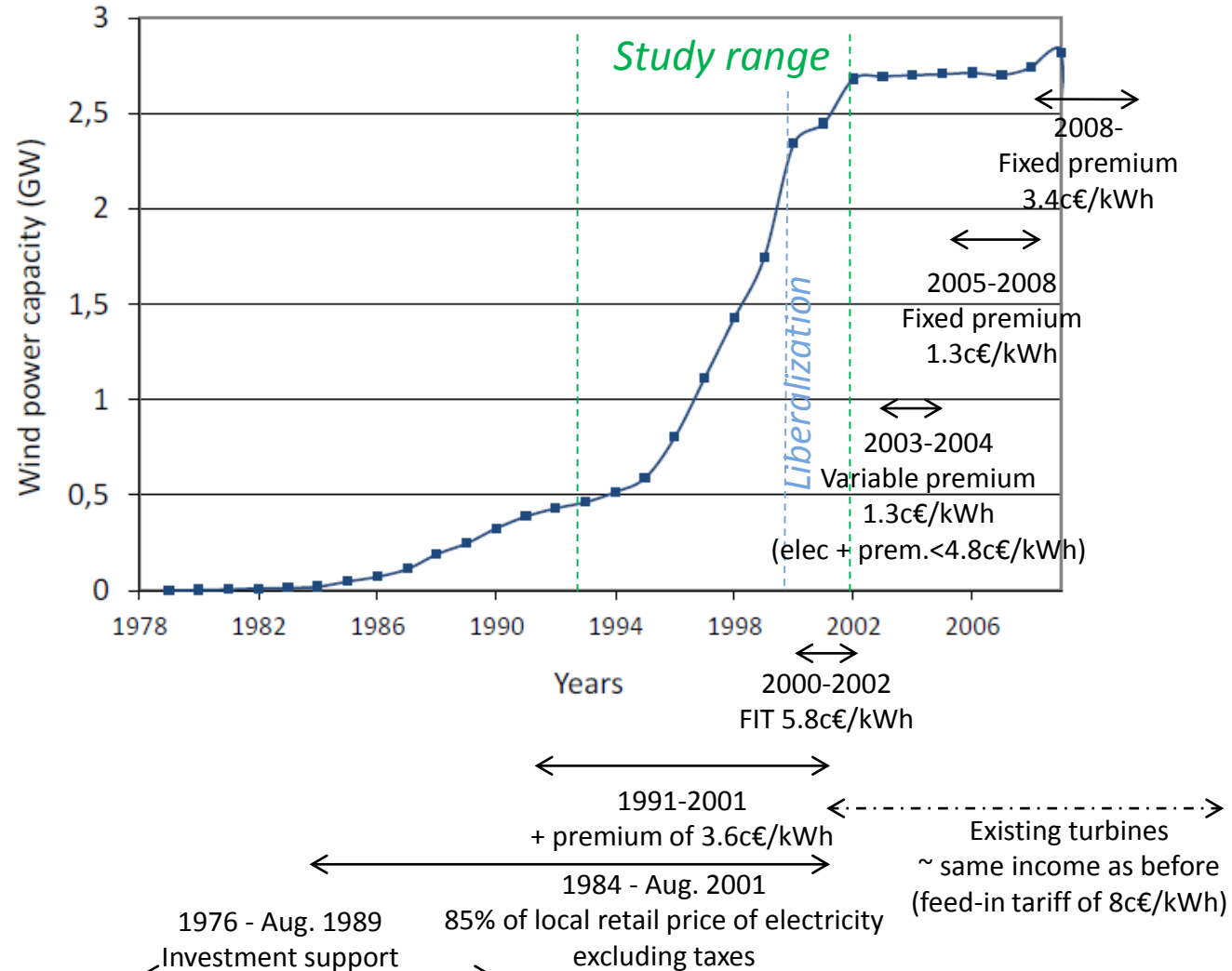
We take advantage of the long Danish experience of wind power support and detailed data to analyse the economic impact of new turbine installations at the municipal level:

- Income
- Municipal budget
- Sectoral employment

Background on wind power deployment in Denmark

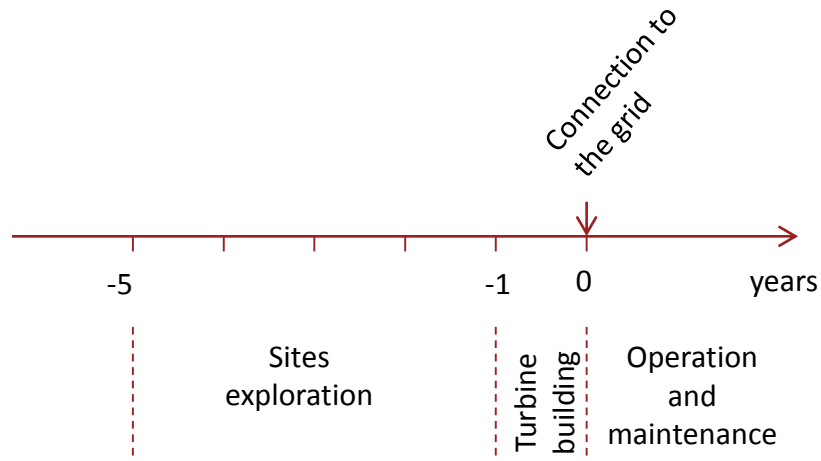


Background on wind power deployment in Denmark



Background on wind power deployment in Denmark

- 2/3 of the Danish wind power capacity is owned by individuals (e.g. farmers)
- The rest is owned by companies (e.g. Vattenfall)
- Process for building a wind turbine

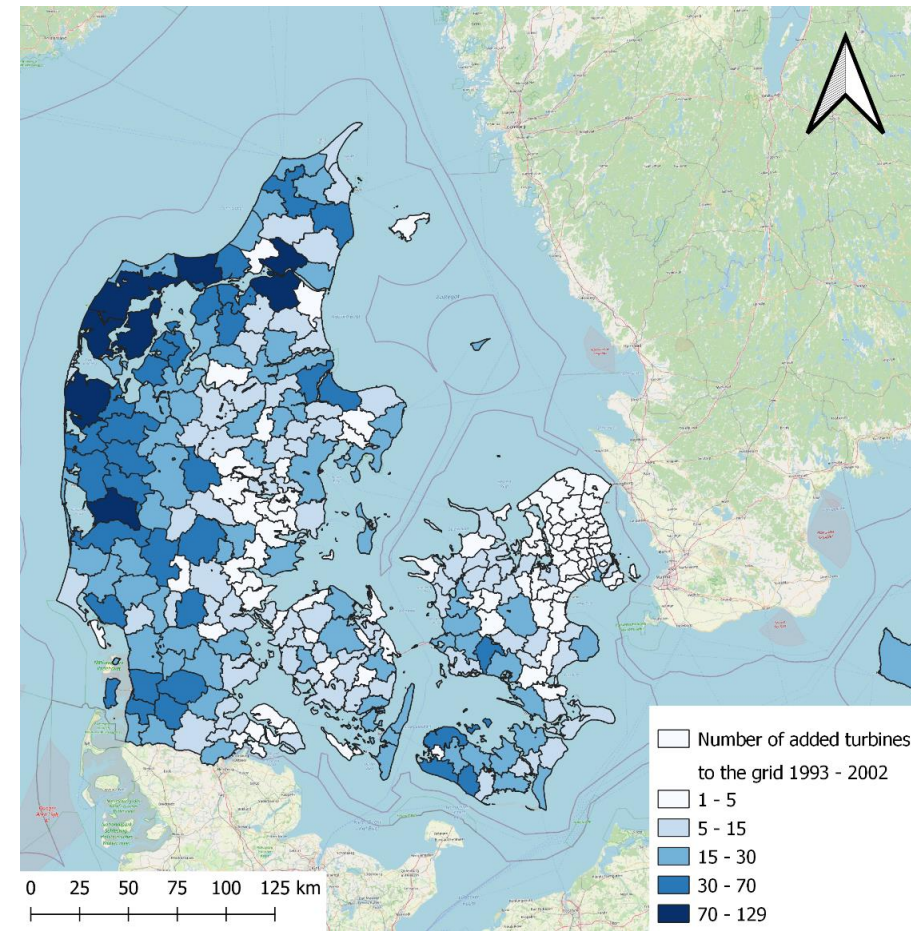


„In Europe average lead times for wind power projects range between 1.5 and 4.5 years“

(Pettersson et al., 2010)

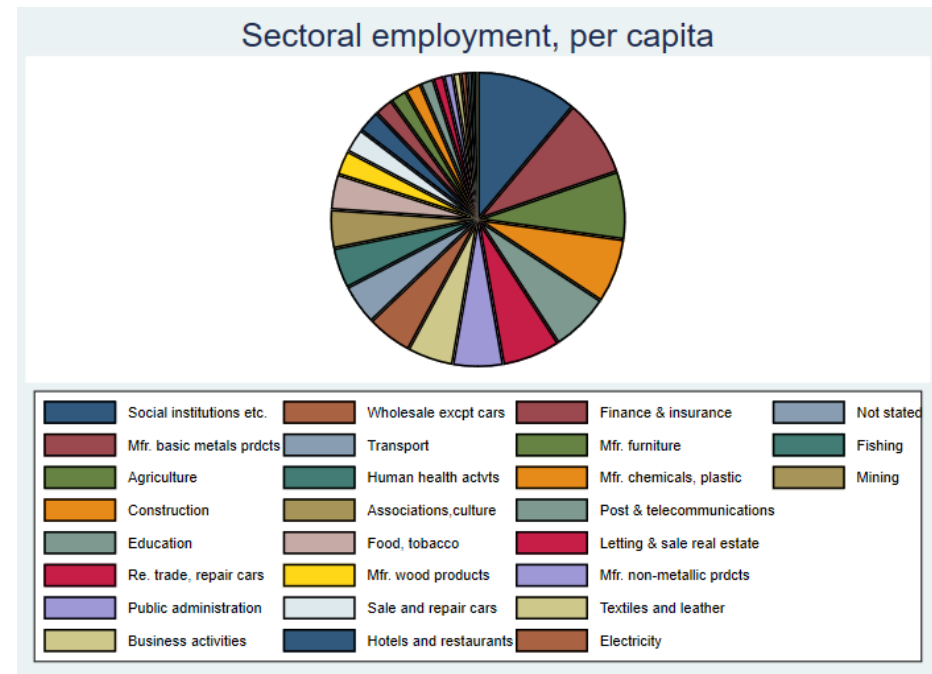
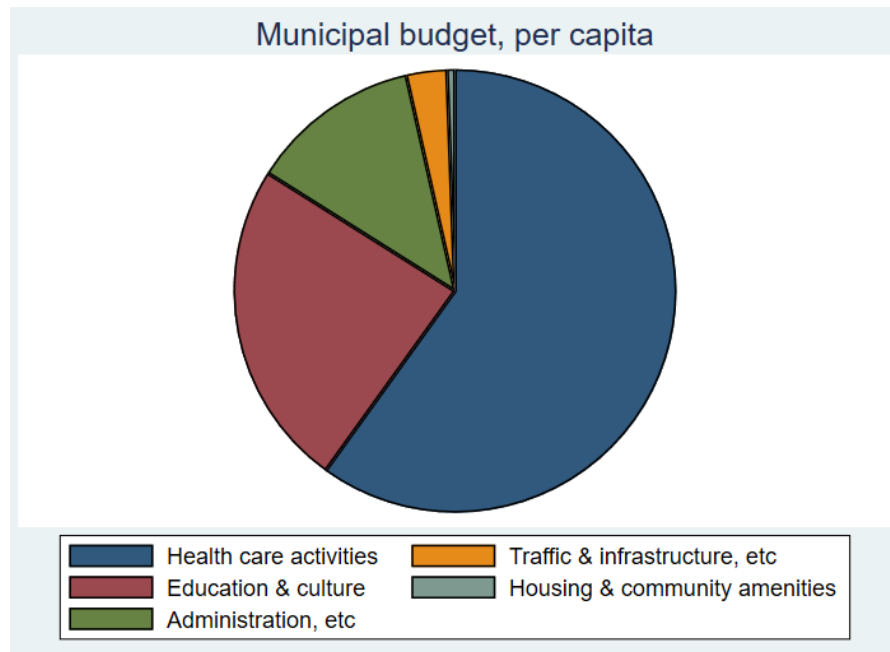
Data

- Danish wind turbine register



Data

- Data on income, municipal budget and employment from Statistics Denmark



Data

- For each turbine built in Denmark, GIS matching to identify the municipality in which it is located.
- For each municipality and each year, we compute the “new revenues”: revenues from the electricity produced by the new turbines
 - 1984-2000: wind power producers were receiving 85% of the local retail price of electricity excluding taxes
 - + fixed premium 3.6 c€/kWh if connection between 1991 and 2000
 - For turbines connected between 2000 and 2002, wind power producers received a feed-in tariff of 5.8c€/kWh

Econometric model

$$\Delta Y = \beta_1 * NewRevenues(i, t - 1) + \beta_2 * NewRevenues(i, t - 2) + \beta_3 * NewRevenues(i, t - 3) + \alpha(i) + \omega(t) + \varepsilon(it)$$

↑

Outcome variable:

- Income
- Municipal budget
- Sectoral employment

↑

Revenues from turbines connected to the grid in municipality *i* in year *t-1*

↑

Year fixed effects

↑

Municipality fixed effects

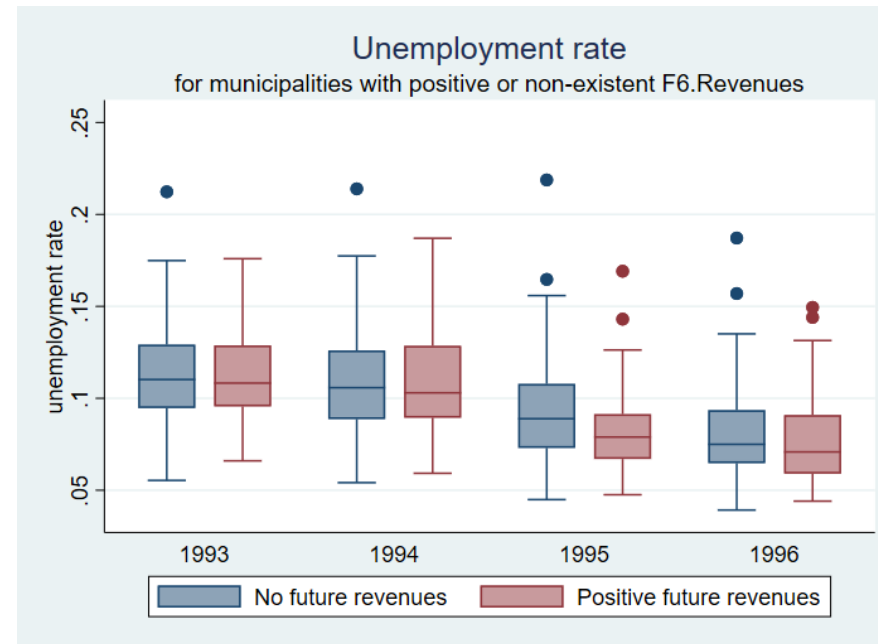
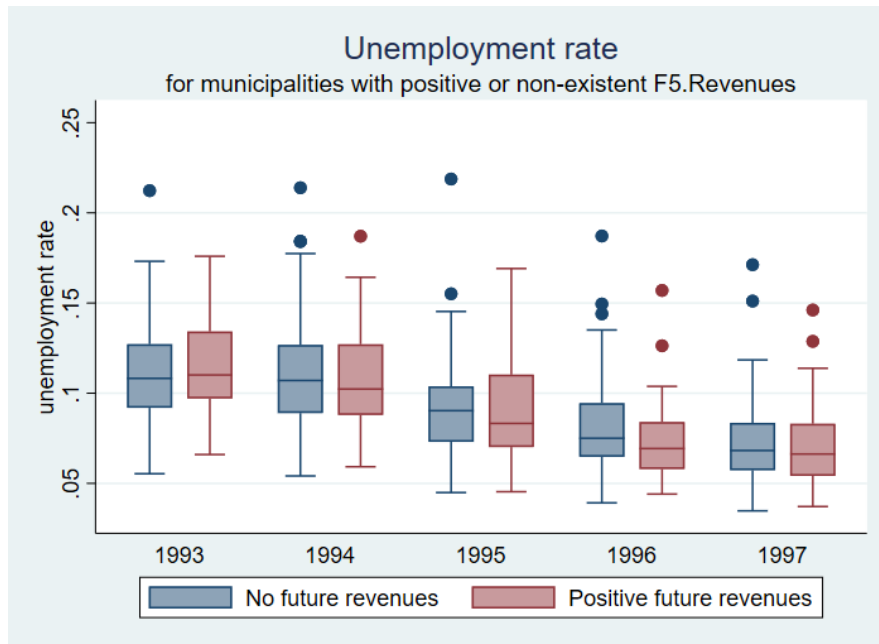
Econometric model

- The impact of new revenues in a very small municipality is expected to have significantly different effect than in a large municipality.
 - > We follow Feyrer, Mansur and Sacerdoce (2016) and scale new revenues as well as the outcome variables by one year lagged employment

Econometric model

- Endogeneity ?

“the Danish planning system is vertically integrated, and involves a designation of areas for wind power purposes in the local plans, while the municipalities in Sweden must in some way assent to (i.e., plan for) the establishment of windmills at a certain location in order for the installation to actually take place.” (Pettersson et al., Renewable and Sustainable Energy Reviews, 2010)



Preliminary results

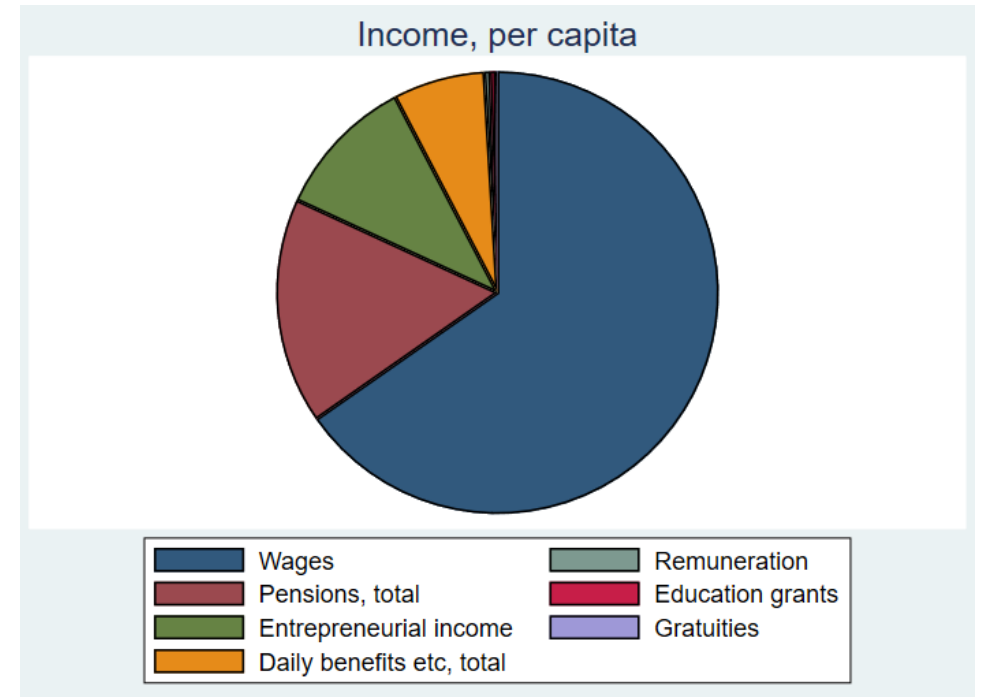
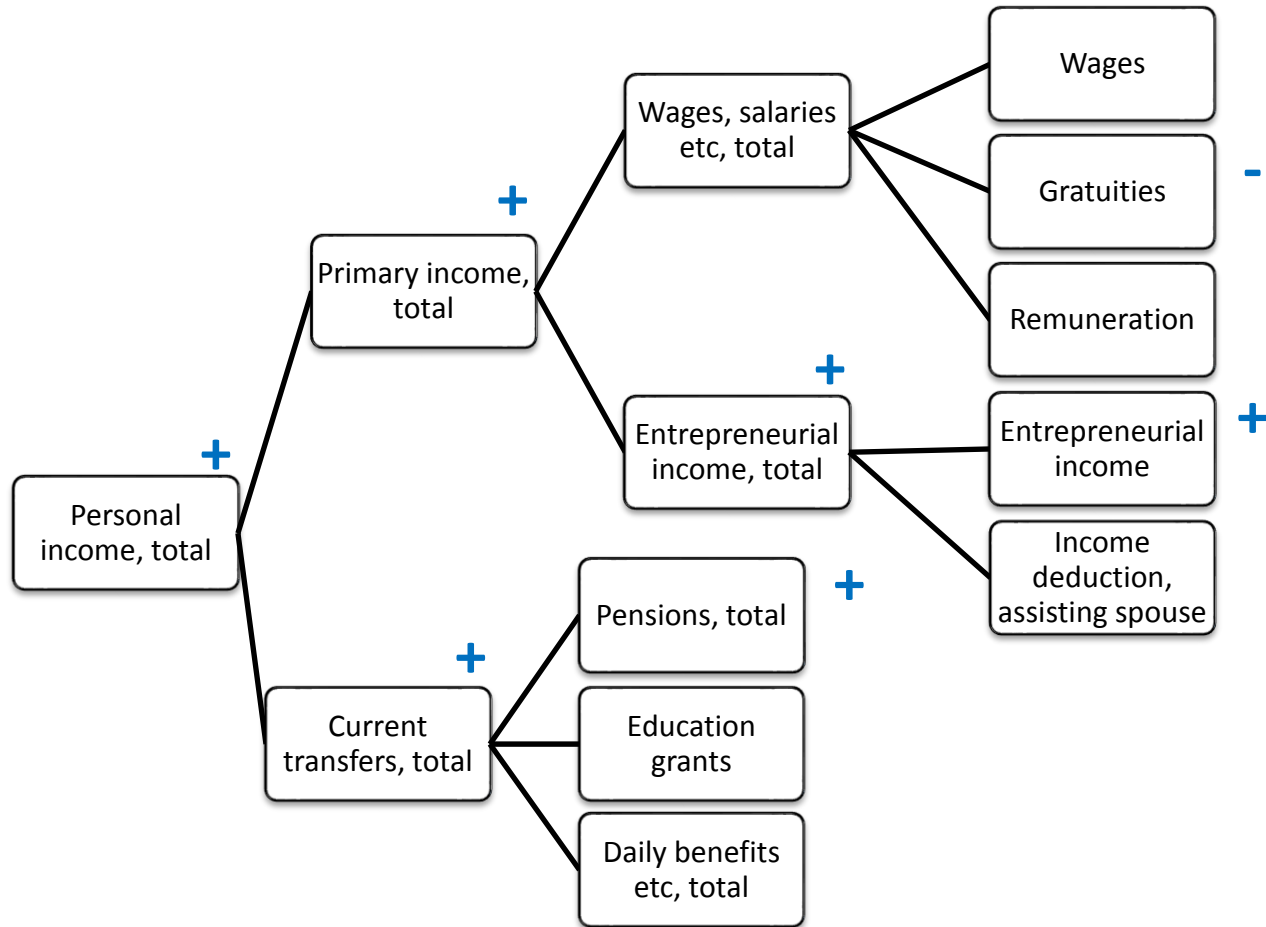
	Income, total	Primary income, total	Current transfers, total	Wages	Entrepreneurial income	Gratuities	Pensions, total
L.New Revenues	1.416** (0.558)	0.892* (0.465)	0.290*** (0.108)	0.0409 (0.187)	0.887** (0.415)	-0.120* (0.0679)	0.229*** (0.0827)
L2.New Revenues	0.157 (0.427)	0.239 (0.347)	0.0933 (0.154)	0.278 (0.323)	0.105 (0.204)	-0.0330 (0.0357)	-0.0115 (0.108)
L3.New Revenues	0.226 (0.476)	0.308 (0.427)	-0.0374 (0.107)	0.433 (0.379)	-0.00997 (0.347)	0.0223 (0.0212)	0.0561 (0.115)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.000994*** (0.0000393)	0.000150*** (0.0000359)	0.000793*** (0.0000112)	0.00119*** (0.0000250)	-0.000345*** (0.0000237)	-8.72e-08 (0.000000879)	0.000418*** (0.00000743)
No. of obs.	1750	1750	1750	1250	1500	1750	1750
N_g	250	250	250	250	250	250	250
g_max	7	7	7	5	6	7	7
g_min	7	7	7	5	6	7	7
R-square	0.297	0.426	0.914	0.147	0.410	0.264	0.584
R-square <i>ajdusted</i>	0.293	0.423	0.913	0.142	0.407	0.260	0.581
F-Test	75.94	126.4	1436.7	23.95	60.30	77.74	195.9
F-Test <i>p – value</i>	2.72e-66	1.40e-87	4.64e-209	8.31e-25	5.36e-54	3.26e-67	1.34e-107
sigma_e	0.000625	0.000557	0.000167	0.000402	0.000311	0.0000585	0.000111

Standard errors in parentheses

sigma_e: sd of residuals (overall error term) ei

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Preliminary results



Preliminary results

	Municipal budget, total	Health	Education and culture	Administration	Traffic and Infrastructure	House amenities	Public utilities
L.New Revenues	0.163 (0.139)	0.0675 (0.131)	-0.00851 (0.0302)	0.0535** (0.0212)	0.0818 (0.0901)	0.0203 (0.0416)	-0.0712 (0.0678)
L2.New Revenues	0.168* (0.0856)	0.125 (0.0892)	0.0513* (0.0276)	0.00191 (0.0249)	0.00204 (0.0194)	-0.0157 (0.0267)	-0.0104 (0.0281)
L3.New Revenues	-0.148 (0.133)	-0.00861 (0.105)	-0.0199 (0.0385)	-0.0155 (0.0248)	0.0349 (0.0220)	-0.0142 (0.0279)	-0.112** (0.0471)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.000469*** (0.0000233)	0.000321*** (0.0000112)	0.0000835*** (0.00000440)	0.0000473*** (0.00000357)	0.00000231 (0.00000184)	0.00000565*** (0.00000214)	-0.00000538* (0.00000288)
No. of obs.	1750	1750	1750	1750	1750	1750	1750
N_g	250	250	250	250	250	250	250
g_max	7	7	7	7	7	7	7
g_min	7	7	7	7	7	7	7
R-square	0.427	0.493	0.330	0.0874	0.332	0.448	0.705
R-square <i>adjusted</i>	0.424	0.490	0.327	0.0827	0.329	0.445	0.703
F-Test	162.7	128.6	89.11	22.11	37.95	126.5	145.6
F-Test <i>p - value</i>	6.09e-99	2.42e-88	1.06e-72	2.08e-27	6.01e-42	1.36e-87	6.64e-94
sigma_e	0.000228	0.000154	0.0000650	0.0000489	0.0000283	0.0000551	0.0000440

Standard errors in parentheses

sigma_e: sd of residuals (overall error term) ei

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Preliminary results

	Employment, total	Manufctr food	Manufctr textiles	Social institutions	Manufctr chemicals	Associations, culture	Manufctr of wood prod
L.New Revenues	6.541 (11.29)	3.677* (2.126)	4.663* (2.682)	6.659** (2.876)	-2.055 (1.362)	-3.591 (2.614)	2.297 (1.451)
L2.New Revenues	14.46* (7.498)	0.225 (2.246)	5.183 (3.503)	4.528 (3.467)	2.102* (1.258)	4.585* (2.361)	2.501 (1.763)
L3.New Revenues	-0.835 (11.60)	4.819** (2.289)	6.503 (4.391)	-0.413 (3.300)	1.588 (1.317)	0.377 (2.079)	2.675* (1.520)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.0152*** (0.000911)	-0.000300* (0.000180)	-0.00172*** (0.000507)	-0.00229*** (0.000275)	0.0000449 (0.000125)	-0.000280 (0.000206)	-0.000755*** (0.000174)
No. of obs.	1750	1750	1750	1750	1750	1750	1750
N_g	250	250	250	250	250	250	250
g_max	7	7	7	7	7	7	7
g_min	7	7	7	7	7	7	7
R-square	0.202	0.0434	0.0395	0.323	0.0223	0.0339	0.0468
R-square <i>ajdusted</i>	0.198	0.0384	0.0345	0.319	0.0173	0.0289	0.0418
F-Test	66.12	7.337	5.416	79.01	4.238	6.291	9.413
F-Test <i>p – value</i>	5.79e-61	1.77e-09	0.000000874	7.42e-68	0.0000399	5.10e-08	2.59e-12
sigma_e	0.0164	0.00360	0.00307	0.00486	0.00268	0.00303	0.00287

Standard errors in parentheses

sigma_e: sd of residuals (overall error term) ei

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Preliminary results

	Wholesale	Public admin	Agriculture	Fishing	Mining	Manufctr mineral prod	Manufctr metal
L.New Revenues	-2.262 (2.439)	-1.637 (1.896)	4.195 (3.730)	-1.077 (0.767)	0.277 (0.346)	-2.111 (3.361)	3.386 (5.731)
L2.New Revenues	-2.687 (3.413)	1.630 (1.798)	-4.935* (2.577)	0.673 (0.580)	0.538 (0.353)	-1.631 (1.163)	3.745 (3.858)
L3.New Revenues	-6.912** (3.383)	4.257** (1.897)	-1.392 (2.190)	-1.288 (1.152)	0.588 (0.467)	-2.220 (1.400)	4.593 (3.295)
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0000907 (0.000434)	-0.00131*** (0.000167)	-0.00162*** (0.000218)	-0.000138*** (0.0000397)	0.000232*** (0.0000594)	-0.000229* (0.000130)	-0.00319*** (0.000323)
No. of obs.	1750	1750	1750	1750	1750	1750	1750
N_g	250	250	250	250	250	250	250
g_max	7	7	7	7	7	7	7
g_min	7	7	7	7	7	7	7
R-squar	0.0384	0.345	0.0745	0.0326	0.0276	0.0700	0.123
R-square <i>ajdusted</i>	0.0334	0.342	0.0697	0.0275	0.0225	0.0652	0.118
F-Test	12.68	65.70	12.81	3.821	5.620	9.665	16.02
F-Test <i>p – value</i>	1.44e-16	9.97e-61	9.93e-17	0.000153	0.000000450	1.19e-12	1.22e-20
sigma_e	0.00427	0.00335	0.00334	0.000912	0.000975	0.00273	0.00624

Standard errors in parentheses

sigma_e: sd of residuals (overall error term) ei

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Thank you for your attention!

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