

Do Public Goods Actually Reduce Inequality?

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Motivation

- ▶ Growing literature on measuring income and wealth inequality
- ▶ DINA: **D**istributional **N**ational **A**ccounts (Atkinson, Piketty, Saez 2011; Piketty, Saez, Zucman 2018, Bozio et al 2022...)
- ▶ Disposable income = Gross income – taxes paid + cash transfers received
- ▶ Our question: **what about public goods** (\approx in-kind transfers)?

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- ▶ Our question: **what about public goods** (\approx in-kind transfers)?
- ▶ So far:
 1. **Imputed** proportionally to disposable income
 2. **Lump-sum**
 3. If lump-sum, measured inequality is **halved** (Gethin 2024, Riedel-Stichnoth 2024)

Motivation

- ▶ Public goods are by definition meant to be “universal” (Samuelson, 1954)
- ▶ By design, they have a place-based component (Tiebout, 1956)
 - * Distance works as an implicit tax on household
 - * Political economy: pork vs barrel
 - * Urban economics: spatial location of amenities

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 - * Political economy: pork vs barrel
 - * Urban economics: spatial location of amenities
- ⇒ **RQ:** How does taking into account distance to public goods impact inequality measurement?

This paper

1. **We map amenities in Belgium for key “public goods”** (hospitals and schools)
 - * Measure **access** to public goods taking into account distance and congestion
 - * Finding: unequal (spatial) distribution of access to public goods

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2. **We check how access correlates with socio-economic variables**
 - * OLS regressions to check correlation with income controlling for geo factors
 - * Finding: robust positive correlation between access and income
 - * Rationalize findings with a model in which Govt maximizes utility from budget allocation

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3. DINA measure of inequality

- * DINA-compatible measure of inequality that takes **access** into account
- * Findings: increase in inequality

This paper

- ▶ This paper offers a new approach to measure the **redistributive impact of public goods**
- ▶ Beyond DINA, researchers used survey data to measure “consumption-side” (Verbist et al. 2012, Wagstaff et al. 2014, Riedel and Stichnoth 2022, Gethin 2024)
- ▶ We instead consider distance and locations of public goods → “supply-side”
 - * **Similar to price discrimination:** \neq access \Rightarrow heterogeneous consumer surplus
 - * In line with, e.g., micro evidence on educational or health outcomes (Falch et al. 2013; Eggerickx et al. 2018; Burgess et al. 2019; 2023; Renard et al. 2019; Case and Deaton 2021; Chetty’s MTO...)


The Accessibility Index: Enhanced 2-Step Floating Catchment Area

- ▶ We define access to each public good g in each location l
- ▶ **Challenge:** Each amenity serves multiple locations, and each location accesses multiple amenities → Inflation problem
 - * $\approx 20,000$ neighborhoods l ; g are located in locations m (still neighborhoods)

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 - * $\approx 20,000$ neighborhoods l ; g are located in locations m (still neighborhoods)
 - * Total population served by an amenity $g_m \implies N_m = \sum_l \sigma_{lm}^l n_l$
 - + σ_{lm}^l share of the citizens from location l who consume amenity m
 - * Service level of $g_m \implies L_m = \frac{g_m}{N_m}$
 - * Total access to amenities for each l :

$$A_l = \sum_m \sigma_{lm}^m L_m$$

E2SFCA
- ▶ σ_{lm}^m represents the share of amenity m consumed in location l , decreasing with distance

Dataset

1. Geolocation of schools and hospitals from Administrative data [▶ Schools](#); [▶ hospitals](#)
2. Socio-economic data: statistical sector level ($\approx 20,000$, for 581 municipalities), from STATBEL [▶ Summary Statistics](#)
3. Computation of travel distance matrix between each stat. sector and each amenity (e.g, $\approx 8,000$ schools)
4. Geographical controls from various sources (geo.be, NASA etc..)

Accessibility index: Hospital Beds

Access to hospitals beds

- ▶ $A.I.(hosp) \in [0; 8.06]$ beds/50K people
- ▶ Brussels & Flanders >> Wallonia
- ▶ Access matters for health outcomes

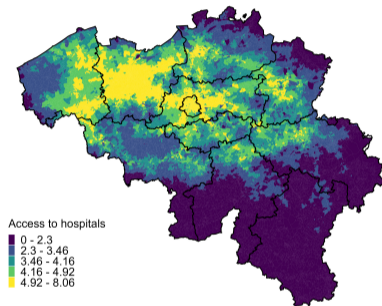


Figure : Accessibility to Healthcare

Accessibility index: Hospital Beds

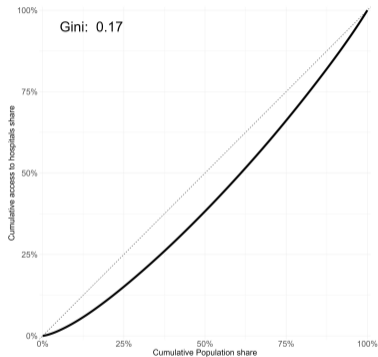


Figure : Lorenz Curve Accessibility to Healthcare

▶ Gini of income: 0.13

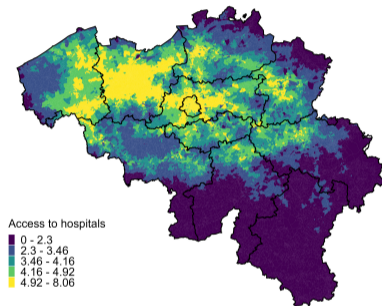


Figure : Accessibility to Healthcare

Accessibility index: Schools

Access to schools

- ▶ School access per pop'n aged 0-15:
 - * boosts lower-density areas
 - * depresses high-density areas
 - * $A.I. \in [0.49; 4.79]$ schools/1'000 pupils

- ▶ Flanders > Brussels >> Wallonia

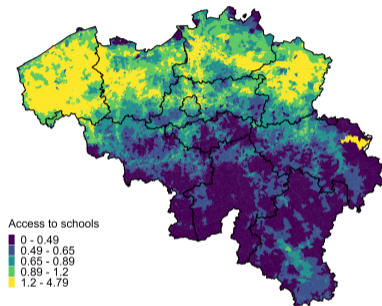


Figure : Accessibility to Education

Accessibility index: Schools

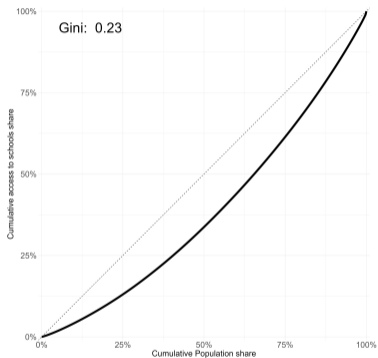


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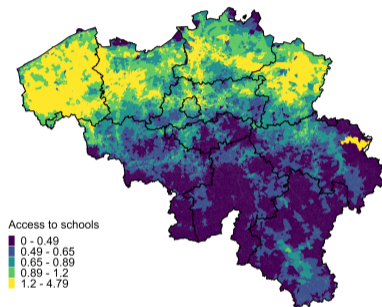


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Regressions

Dependent Variables:	Access to hospitals (log)		Access to schools (log)	
	(1)	(2)	(3)	(4)
Average income (log)	0.290 ^{***} (0.015)	0.370 ^{***} (0.011)	0.269 ^{***} (0.013)	0.276 ^{***} (0.013)
Population (log)	0.178 ^{***} (0.003)	0.072 ^{***} (0.003)	0.171 ^{***} (0.003)	0.109 ^{***} (0.003)
Dist. to core CBD		Yes		Yes
Age controls		Yes		Yes
Degree of Urb. FE		Yes		Yes
Observations	16,571	16,571	16,593	16,593
R ²	0.18131	0.56004	0.17258	0.30506

Model of Public Good Allocation

- ▶ Economy with multiple locations l where individuals consume:

- * **Private goods:** y_l & **Public goods:** g_l

- ▶ **Utility function:**

$$U(g_l, y_l) = (g_l^\eta + \omega \cdot y_l^\eta)^{\frac{1}{\eta}}, \quad \omega > 0$$

- ▶ **Elasticity of substitution:**

$$0 < \frac{1}{1 - \eta} < \infty$$

- * $\eta < 0 \rightarrow$ **complements**
 - * $\eta > 0 \rightarrow$ **substitutes**

Takeaways of the model

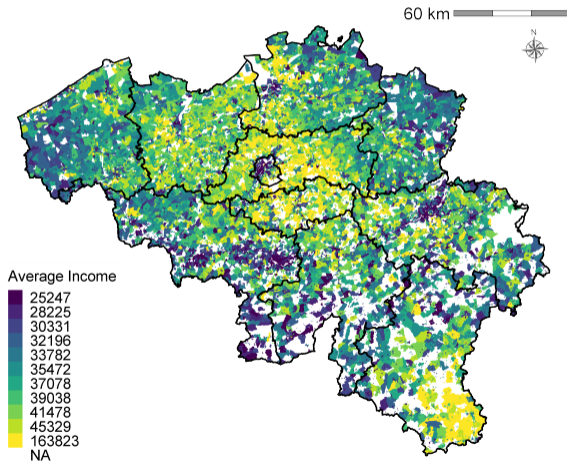
Proposition 1: In the absence of geographic externalities, all locations receive a strictly positive supply of public goods, strictly increasing in the population n_j and in the income y_j .

Proposition 2: If the catchment area of an amenity μ is a strict subset of the catchment area of another amenity m , then $g_\mu = 0$.

Proposition 3: For all the amenities m such that $g_m > 0$, once we account for the total population served by each amenity, the allocation is identical to the case of no geographic externalities.

Geographical distribution of (taxable) income

How (re)distributive are public goods? Here: income across Belgium (Geog Gini = 0.13)



Imputation of STiKs combined with disposable income

- ▶ **Combine data on y_l with g_l^t**
- ▶ $GNP = C (\approx 50.7\%) + I (\approx 24\%) + G (\approx 24\%) + (X-M) (\approx -1.6\%)$
 - * In GNP data, HH income \approx consumption
- ▶ We rescale: $C = \sum_l n_l y_l = 0.507Y$ and $G = \sum_m \sum_l N_m A_l = 0.24Y$
- ▶ And compute the distribution of:

$$y_l^{ext'd} = y_l + A_l \times \frac{.24C}{.507G n_l}$$

Imputation of STiKs combined with disposable income

In-kind transfer	% of GDP
Healthcare	8.1
Education	6.1

Percentage of Belgian GDP allocated to healthcare and education (NBB data)

Imputation of STiKs combined with disposable income

- ▶ **Distribution of $y_I^{ext'd}$**
- ▶ In **red** we have *extended income* following the **equality** assumption
- ▶ In **blue** we have *extended income* following the **neutral** assumption
- ▶ In **green** we have *extended income* following our **geographical** approach

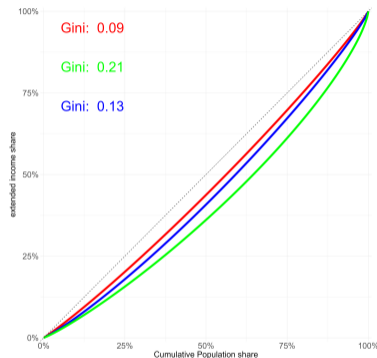


Figure Lorenz Curve, extended income

Conclusion

- ▶ Access to public goods is quite unequally distributed in Belgium
 - * Currently working on France
- ▶ We document a positive correlation between access and income at the neighbourhood level
- ▶ We provide a new measure of inequality considering the distribution of access
 - * Implicit costs of distance and congestion
- ▶ Income inequality increases when taking into account those two dimensions
 - * Better than “no public education” or “no public healthcare”...
 - * ... but definitely not egalitarian either

Thank You!

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Measurement from Geography literature

- ▶ Paez et al. (2019): M amenities and L locations (neighborhoods)
- ▶ Citizens can travel to locations: $L \times M$ problem
 - * Belgium: $L \approx 20,000$ (neighborhoods); 6710 schools, 186 hospitals...

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- ▶ Citizens can travel to locations: $L \times M$ problem
 - * Belgium: $L \approx 20,000$ (neighborhoods); 6710 schools, 186 hospitals...
- ▶ *Impedance matrix* (inverse of friction):

$W_{lm} = 1$ if l and m very close; $W_{lm} = 0$ if very far;

$W_{lm} \in (0, 1)$ and decreasing in distance in between

- ▶ Proba that individual in l goes to m : $\sigma_{lm}^l = \frac{W_{lm}}{\sum_{m'} W_{lm'}}$.
- ▶ Share of m used by individuals from l : $\sigma_{lm}^m = \frac{W_{lm}}{\sum_{l'} W_{l'm}}$

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- ▶ This implies:

$$\sum_m \sum_l N_m A_l = \sum_m \sum_l \sigma_{lm}^m g_m = \sum_m g_m \underbrace{\sum_l \sigma_{lm}^m}_{=1} = G.$$

Appendix: Location of Schools

Education: 6.710 (French/Dutch) schools

- ▶ Addresses on French and Dutch schools from Federation Wallonie-Bruxelles (FWB) and the Flemish and German Ministry of Education
- ▶ Pre-elementary, Primary and Secondary schools

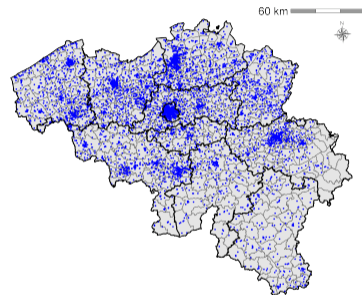


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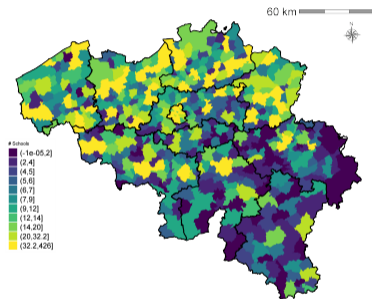


Figure : Number of schools per municipality in Belgium

Appendix: Location of Hospitals

Healthcare: 257 Hospitals (General, University and Psychiatric)

- ▶ General hospitals addresses from the Federal Public Service (FPS) Health, Food Chain Safety and Environment
- ▶ Majority of them have also emergency service and SMUR (\approx ambulances)
- ▶ We include the number of beds and functions provided

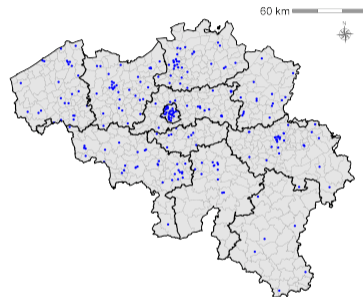


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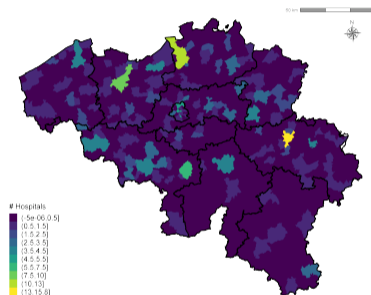


Figure : Number of hospitals per municipality in Belgium

Appendix: Location of Public Transport and Train Stations

- ▶ Public Transport: GTFS data (on Bus, Tram and Metro) from MVIB - STIB (Bruxelles), TEC (Wallonie) and De Lijn (Flanders) (74.369 stops)
- ▶ Railway Stations: Geolocation of train stations (568) from iRail project

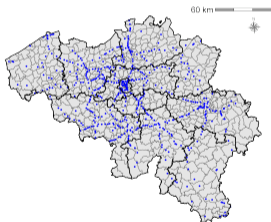


Figure : Location of train stations in Belgium

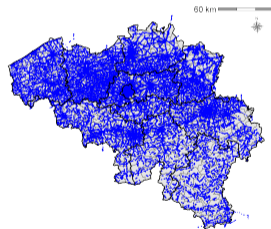


Figure : Location of public transport stops in Belgium



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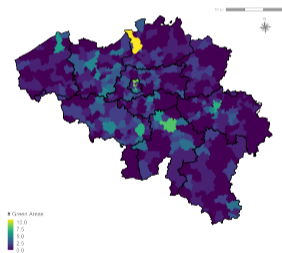


Figure : Number of train stations per municipality in Belgium

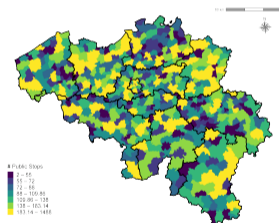


Figure : Number of public transport stops per municipality in Belgium



Appendix: Location of Highways Entrances

- ▶ Highways entrances: geolocation of highways networks from OSM
- ▶ We then select the point where OSM indicates the presence of an entrance (7.181 links)

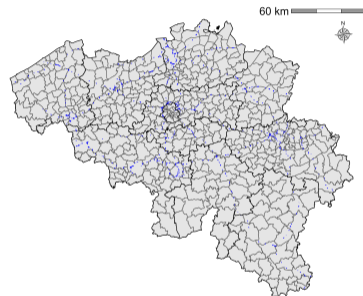


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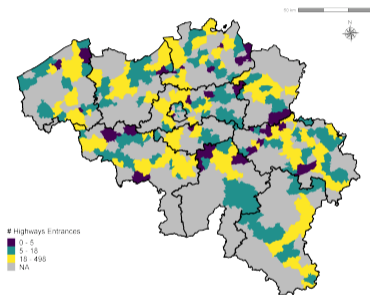


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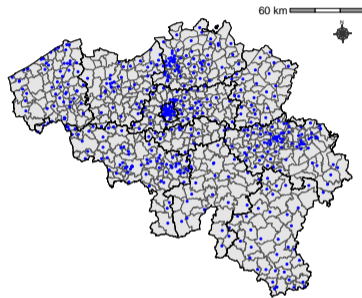


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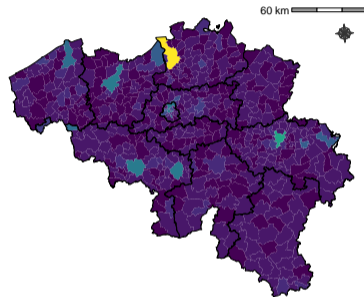


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Spatial Distribution of Income and Income inequality in Belgium

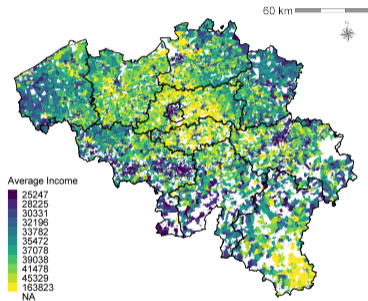


Figure : Average Net Taxable Income, statistical sector level (Belgium)

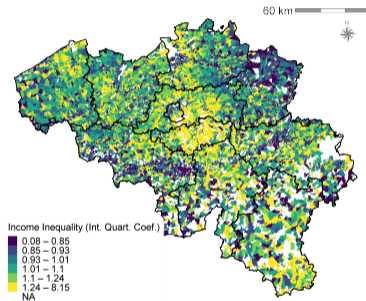


Figure : Income Inequality, statistical sector level (Belgium)



Summary Statistics

	N	NUnique	Mean	SD	Min	Max
Average Net Taxable Income	16595	12503	35202.32	8417.47	7884	163823
Median Net Taxable Income	17575	11491	27117.82	5470.48	1677	83197
Area (km ²)	19794	19792	1.55	2.70	0.01	58.51
Income Inequality (Int. Coefficient)	17575	17571	1.05	0.25	0.08	8.15
People with > 65 years	19794	771	108.85	138.49	0.00	1805.00
People between 15 and 64 years	19794	1950	374.76	469.22	0.00	5475.00
People with < 15 years	19794	767	98.50	137.41	0.00	2506.00
Total Population	19794	2640	582.55	721.75	0.00	8254.00
Male Population	19781	1593	286.84	355.03	0	4212
Female Population	19781	1629	296.01	368.01	0	4356
Population Density (km ²)	19781	19287	1699.15	3278.40	0.00	46681.75
Degree of Urb.	19794	3	2.11	0.67	1	3
Num. of schools in 2 km	19794	150	10.49	20.31	0	155
Access to education	19794	19481	0.85	0.37	0.00	4.79
Access to healthcare	19794	7121	2.11	0.78	0.00	8.06
Access to public transport	19794	19398	116.41	827.07	0.00	60431.53

All the variables are collected at the statistical sector level.



1st step 2SFCA, Level of service

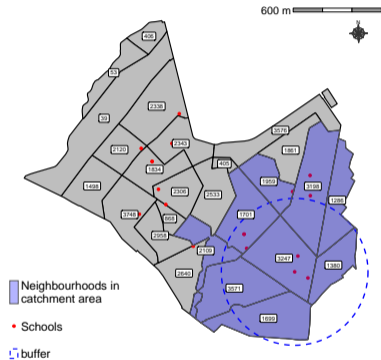


Figure : 1st step, amenity catchment area

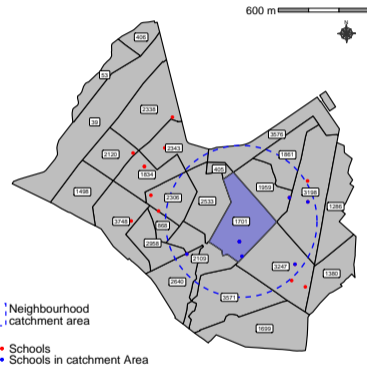


Figure : 2nd step, stat. sect. catchment area



Results from 2SFCA

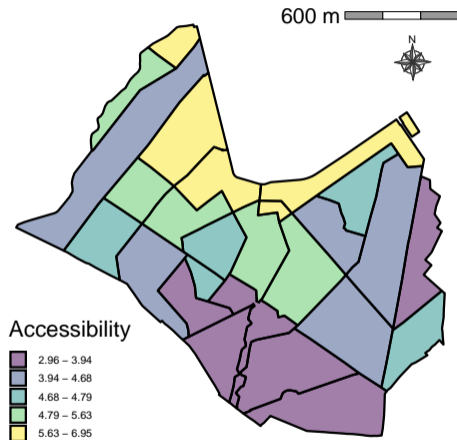


Figure Accessibility to schools, Saint-Gilles

Accessibility index: Public Transport (Bus, Tram, Subway...)

Very unequal public transport distribution

- ▶ Thick right tail: high concentration
- ▶ Cities & West Flanders: large A.I.
- ▶ 4th quintile: both in Wallonia and in Flanders
- ▶ Correlation with income is -0.12

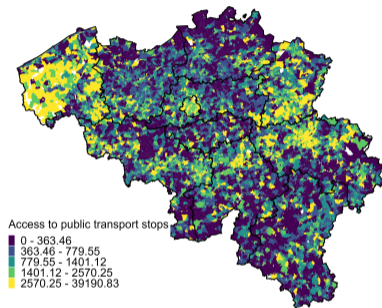


Figure : Accessibility to Public Transport

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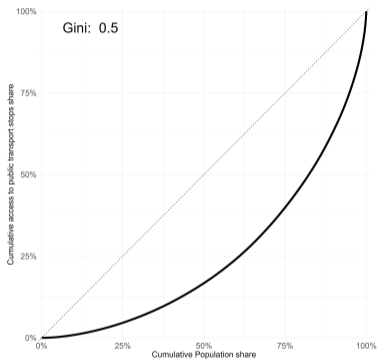


Figure : Lorenz Curve A.I.(Public Transport)

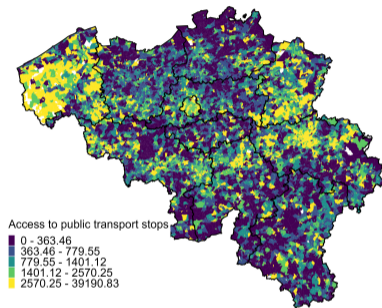


Figure : Accessibility to Public Transport

Accessibility index: Security (Police stations)

Quite a different picture for police stations

- ▶ 5th quintile prevalent in South-eastern Wallonia
- ▶ Brussels and much of Flanders in 4th quintile
- ▶ Correlation with income is again -0.12

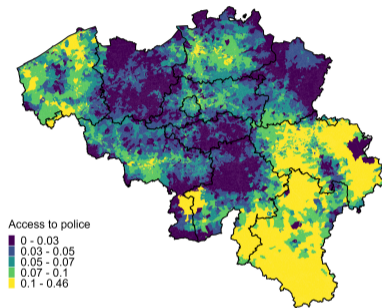


Figure : Accessibility to Security/Police

Accessibility index: Security (Police stations)

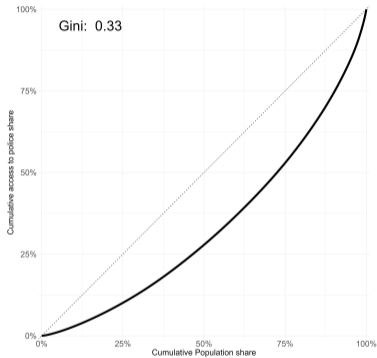


Figure : Lorenz Curve A.I.(Police)

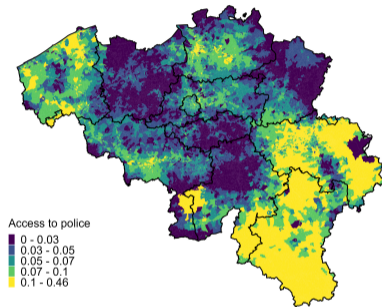


Figure : Accessibility to Security/Police

DINA vs Geography

► DINA → Govt. Consumption distributed:

- * Neutral: Gini remains the same
- * **Max equality**: Gini decreases to 0.09

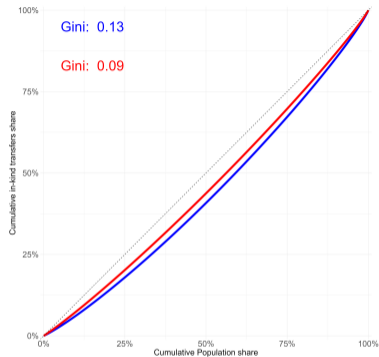


Figure : Lorenz Curve, Average Taxable Income and **Extended Income** (gov. spending distributed in an egalitarian way)

DINA vs Geography

► DINA → Govt. Consumption distributed:

- * Neutral: Gini remains the same
- * **Max equality**: Gini decreases to 0.09

- * Geography → Govt. Consumption distributed:
 - + **Schools accessibility** → Gini rises to 0.209 when we impute G as school AI (60.7% increase) ◀

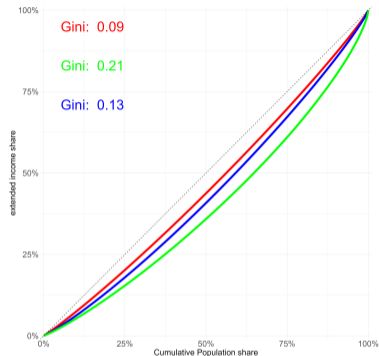


Figure : Lorenz curve **Extended Income (gov. spending distributed like schools)**

DINA vs Geography

► DINA → Govt. Consumption distributed:

- * Neutral: Gini remains the same
- * **Max equality**: Gini decreases to 0.09
- * Geography → Govt. Consumption distributed:
 - + **Hospitals accessibility** → Gini rises to 0.207 when we impute G as hospital AI (59.2% increase)

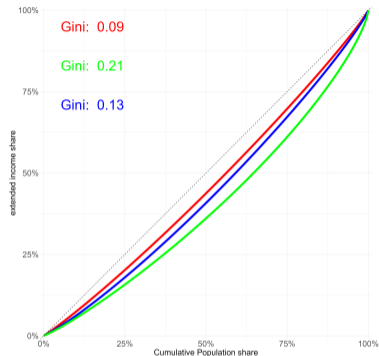


Figure : Lorenz curve **Extended Income (gov. spending distributed like hospitals)**

DINA vs Geography

► DINA → Govt. Consumption distributed:

- * Neutral: Gini remains the same
- * **Max equality**: Gini decreases to 0.09
 - + **Public transport accessibility** → Gini rises to 0.26 (= doubles) when G = transport AI

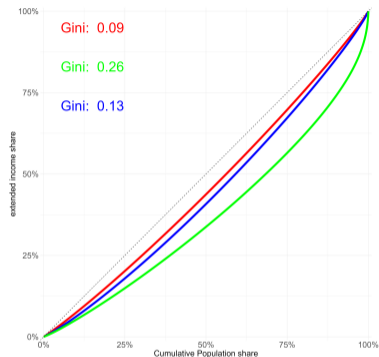


Figure : Lorenz curve **Extended Income** (gov. spending distributed like public transport stops)

DINA vs Geography

► DINA → Govt. Consumption distributed:

- * Neutral: Gini remains the same
- * **Max equality:** Gini decreases to 0.09
 - + **Police stations accessibility** → Gini rises to 0.24 (85% increase) when $G =$ police AI

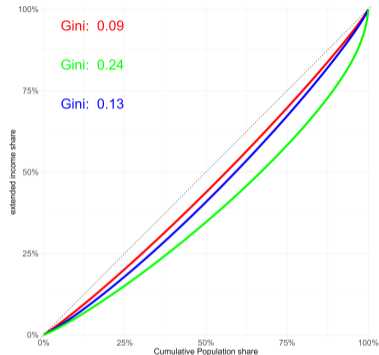


Figure : Lorenz curve **Extended Income** (gov. spending distributed like police stations)

Regressions: Access to Police stations (A_i)

	Police (ai) 1	Police (ai) 2	Police (ai) 3	Police (ai) 3	Police (ai) 1 (w)	Police (ai) 2 (w)	Police (ai) 3 (w)	Police (ai) 4 (w)
(Intercept)	-1.630*** (0.091)	-1.553*** (0.094)	-1.457*** (0.094)	-1.925*** (0.093)	-2.357*** (0.092)	-2.113*** (0.099)	-2.141*** (0.099)	-2.368*** (0.097)
Log Avg Income	-0.387*** (0.023)	-0.434*** (0.028)	-0.441*** (0.028)	-0.283*** (0.028)	-0.272*** (0.022)	-0.404*** (0.029)	-0.394*** (0.029)	-0.221*** (0.029)
Log pop. density	0.024*** (0.003)	0.025*** (0.003)	0.043*** (0.003)	0.040*** (0.003)	0.063*** (0.004)	0.062*** (0.004)	0.054*** (0.004)	0.049*** (0.004)
Inc. Ineq.		0.0008** (0.0003)	0.0009*** (0.0003)	0.0003 (0.0003)		0.002*** (0.0003)	0.002*** (0.0003)	0.0008** (0.0003)
URB. FE				Y				Y
Num.Obs.	16583	16583	16583	16583	16583	16583	16583	16583
R2	0.025	0.026	0.034	0.068	0.049	0.052	0.053	0.086

Regressions: Access to Transport (A_i)

	Transport (ai) 1	Transport (ai) 2	Transport (ai) 3	Transport (ai) 4	Transport (ai) 5	Transport (ai) 6	Transport (ai) 7	Transport (ai) 8
(Intercept)	8.908*** (0.136)	8.900*** (0.141)	9.418*** (0.144)	8.883*** (0.137)	9.698*** (0.131)	10.062*** (0.139)	10.547*** (0.139)	9.587*** (0.130)
Log Avg Income	-0.904*** (0.034)	-0.899*** (0.042)	-0.845*** (0.041)	-0.716*** (0.035)	-1.061*** (0.029)	-1.270*** (0.040)	-1.073*** (0.040)	-0.788*** (0.030)
Log Pop.	0.122*** (0.008)	0.122*** (0.008)	0.074*** (0.008)	0.083*** (0.008)	0.086*** (0.008)	0.085*** (0.008)	0.004 (0.009)	0.012 (0.009)
Inc. Ineq.		-0.00008 (0.0004)	-0.0003 (0.0004)			0.004*** (0.0005)	0.002*** (0.0005)	
Degree of Urb			-0.191*** (0.013)				-0.260*** (0.012)	
URB. FE				Y				Y
Num.Obs.	16373	16373	16373	16373	16373	16373	16373	16373
R2	0.061	0.061	0.074	0.093	0.098	0.102	0.127	0.154

Regressions: Log Number of Hospital beds (*Hosp*)

	#Hosp (OLS) 1	#Hosp (OLS) 2	#Hosp (OLS) 3	#Hosp (OLS) 4	#Hosp (WLS) 5	#Hosp (WLS) 6	#Hosp (WLS) 7	#Hosp (WLS) 8
(Intercept)	-0.905*** (0.116)	-0.641*** (0.119)	0.964*** (0.098)	0.375*** (0.095)	-0.199+ (0.117)	0.509*** (0.143)	1.433*** (0.121)	0.607*** (0.106)
Log Avg Income	0.656*** (0.029)	0.492*** (0.034)	0.655*** (0.029)	0.703*** (0.024)	0.412*** (0.027)	0.006 (0.051)	0.376*** (0.040)	0.612*** (0.025)
Log Pop.	0.312*** (0.006)	0.316*** (0.006)	0.169*** (0.005)	0.160*** (0.005)	0.335*** (0.007)	0.335*** (0.007)	0.181*** (0.007)	0.174*** (0.007)
Inc. Ineq.		0.003*** (0.0003)	0.002*** (0.0003)			0.007*** (0.0007)	0.004*** (0.0005)	
Degree of Urb			-0.585*** (0.009)				-0.491*** (0.011)	
URB. FE				Y				Y
Num.Obs.	16571	16571	16571	16571	16571	16571	16571	16571
R2	0.175	0.180	0.367	0.372	0.166	0.188	0.344	0.337

Regressions: Log Number of Schools

	(OLS) 1	(OLS) 2	(OLS) 3	(OLS) 4	(WLS) 5	(WLS) 6	(WLS) 7	(WLS) 8
(Intercept)	0.420** (0.129)	0.548*** (0.137)	2.666*** (0.108)	2.029*** (0.099)	0.948*** (0.146)	1.603*** (0.164)	2.889*** (0.137)	1.974*** (0.125)
Log Avg Income	0.596*** (0.032)	0.516*** (0.042)	0.726*** (0.033)	0.684*** (0.025)	0.320*** (0.035)	-0.055 (0.055)	0.458*** (0.041)	0.617*** (0.030)
Log Pop.	0.438*** (0.007)	0.440*** (0.007)	0.246*** (0.006)	0.241*** (0.006)	0.505*** (0.009)	0.504*** (0.008)	0.291*** (0.008)	0.287*** (0.008)
Inc. Ineq.		0.001*** (0.0004)	0.0004 (0.0003)			0.007*** (0.0007)	0.003*** (0.0004)	
Degree of Urb			-0.766*** (0.009)				-0.681*** (0.011)	
URB. FE				Y				Y
Num.Obs.	16593	16593	16593	16593	16593	16593	16593	16593
R2	0.246	0.247	0.494	0.499	0.257	0.270	0.472	0.470

Literature 1: On Political Economy

► Impact of different redistribution policies

- * Myerson (1993); Coate and Morris 1995; Persson et al. (2000); Persson and Tabellini (2000, 2003); Lizzeri and Persico (2001, 2004, 2005)

► Targetable public services: **pork-barrel spending**

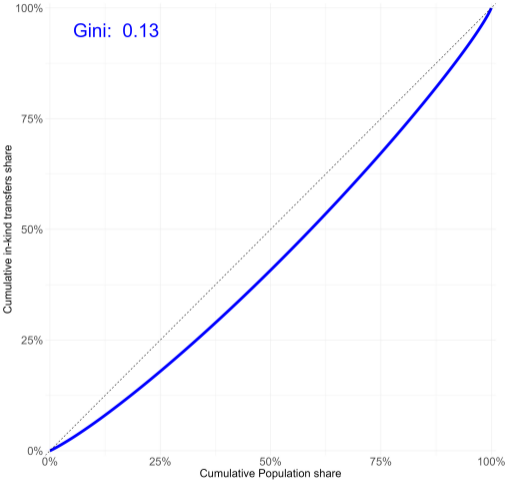
- * Lizzeri and Persico (2004); Coate and Morris (1995); Persson et al. (2000), Milesi-Ferretti et al. (2002)

Health outcomes and Access to Hospitals

Dependent Variables:	% Screening		Diabetes	
	(1)	(2)	(3)	(4)
Access to hospitals (log)	0.016*** (0.003)	- 0.002 (0.004)	- 0.101*** (0.006)	- 0.086*** (0.007)
Population (log)	0.028*** (0.001)	0.041*** (0.002)	- 0.064*** (0.003)	- 0.079*** (0.003)
Average income (log)		0.107*** (0.005)		- 0.502*** (0.010)
Dist. to core CBD		Yes		Yes
Age controls:		Yes		Yes
Degree of Urb. FE		Yes		Yes
Observations	7,000	6,781	12,862	12,590
R ²	0.09277	0.18534	0.08687	0.44049



Lorenz Curve of Average Income (by stat. sector)



Literature 2: On Inequality

► Inequality measure: National Accounts

- * DINA: Piketty and Saez (2003); Piketty, Saez and Zucman (2018); Bruil (2018); Saez and Zucman (2020); Christl et al. (2020); **Chatterjee, Czajka and Gethin (2023)**; **Chancel et al. (2021)**; Bozio et al. (2022), **Gethin (2024)**
- * EGDNA: Fesseau and Mattonetti (2013), Zwijnenburg et al. (2017)

► Extended income from Survey data

- * Smeeding et al. (1993); Evandrou et al. (1993); Garfinkel et al. (2006); Aaberge and Langoren (2006); Maricaal et al. (2008); Paulus et al. (2010); Aaberge et al. (2010, 2019); Verbist and Forster (2012, 2019); Andreou (2014); Figari and Paulus (2015); Lustig (2018), Aaberge et al. (2017)

Literature 3: Access to Public services

- ▶ Methodologies for Floating Catchment Areas (Geography literature)
 - * Radke and Mu (2000); Luo and Wang (2003); Delameter (2013); **Paez et al. (2019)**

- ▶ Specialized Literature:
 - * **Education:** Kirby (1979); Parsons et al. (2020); Tigre et al. (2016); Dickerson and McIntosh (2010); Flach et al. (2012); Burgess et al. (2019); Burgess et al. (2023), Pennerstorfer and Pennerstorfer (2019)
 - * **Healthcare:** Ingram et al. (1978), Oliveira et al. (2015), Higgs (2019), Paez et al. (2019), Lindo et al. (2019), Myers (2021), Irlacher et al. (2023)
 - * **Transportation:** Martin and Van Ommeren (2016), Anderson (2014), Chen and Whalley (2012), Gu et al. (2021)

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- Verbist, Gerlinde, Michael Förster, and Maria Vaalavuo (2012) “The impact of publicly provided services on the distribution of resources: Review of new results and methods.”
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