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Conferencias 2023
Carbon Pricing, Productividad y Tarifas de electricidad

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FIEL

Enero 2024

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- Abril 18. “Carbon pricing en el uso de energía. América Latina y el Caribe y la Argentina. Situación y transición”. Universidad Torcuato Di Tella
- Agosto 17. “Productividad en la Argentina: Status quo, shocks y reformas”. XVIII Seminario Internacional del Boletín Techint.
- Septiembre 21. “Determinants of sectoral effective carbon rates on energy use”, British Institute of Energy Economics, Research Conference 2023, Oxford.
- Noviembre 23. “Electricity rate structure design”, LVIII Reunion Anual de la AAEP, UNCuyo Mendoza

Carbon pricing en el uso de energía. América Latina y el Caribe y la Argentina. Situación y transición

Fernando Navajas
FIEL

Seminario Fundación Torcuato Di Tella
"Condiciones habilitantes para la inversión en la transición a una sociedad baja en carbono en la Argentina"

Abril 18, 2023 UTDT

Effective Carbon Rates on Energy Use in Latin America and the Caribbean: Estimates and Directions for Reform

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Institutions for Development Sector

Fiscal Management Division

TECHNICAL NOTE Nº IDB-TN-2656

March 2023

Síntesis en el blog del BID Abril 12, 2023

https://blogs.iadb.org/gestion-fiscal/es/tasas-de-imposicion-a-las-emisiones-de-carbono/

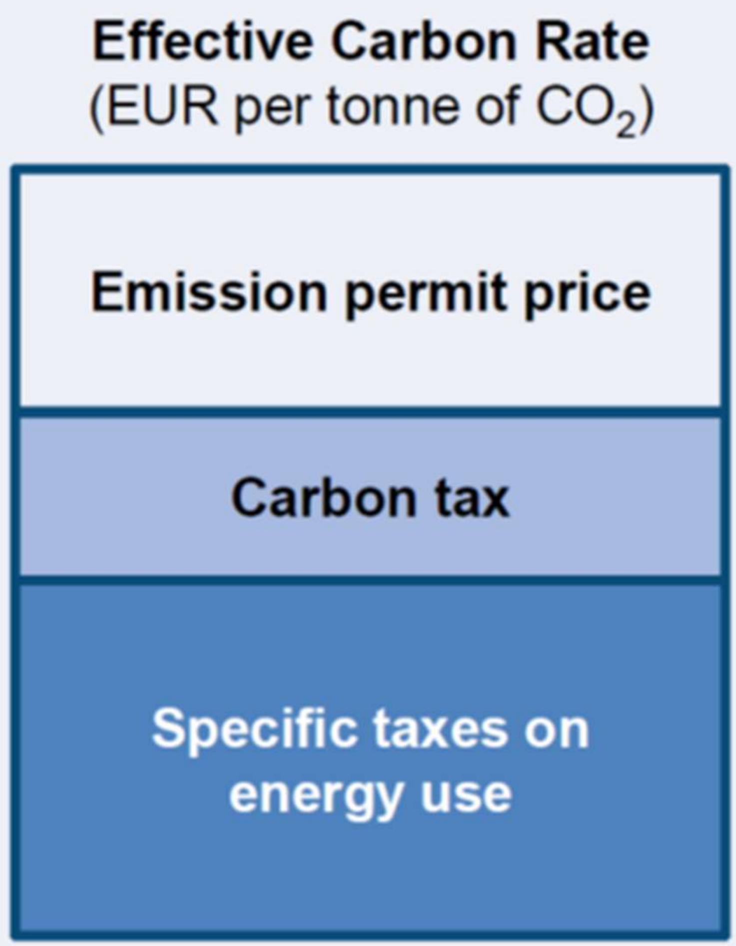
América Latina y Caribe necesita aumentar las tasas de imposición a las emisiones de carbono para mitigar el cambio climático

April 12, 2023 by Hildegart Ahumada - Santos Espina Mairal - Fernando Navajas - Alejandro Rasteletti — Deja un comentario

Para combatir el cambio climático, los países necesitan reducir dramáticamente sus emisiones de dióxido de carbono. Las políticas de fijación de precio de carbono pueden ayudar a alanzar este objetivo porque establecen un impuesto o tasa a los responsables de este tipo de emisiones, y tienen por lo tanto el potencial de contribuir para mitigar el calentamiento global.

ECR (Tasas Efectivas al Carbono)= Impuestos específicos (Excises)+ Impuestos al carbono+ Precios resultantes de sistemas de intercambio de emisiones (ETS)

Figure 1.1. Components of effective carbon rates



Metodología para estimación

- **Balances de energía**. Una matriz nxm B (bij) que expresa, en TJ, el uso de energía de m productos en n sectores.
- **Código impositivo**. Una matriz nxm T (tij) que expresa, en TJ, los impuestos sobre la energía, incluidos los impuestos especiales, los impuestos sobre el carbono y los precios del ETS, y permite captar exenciones. Los impuestos se expresan entonces como EU/TJ
- **Factores de conversión para emisiones**. Una matriz nxm E (eij) de emisiones de CO2 del uso de energía de m productos en n sectores, expresada en TJ/tCO2.
- **Agregación por productos y sectores.** Las tasas efectivas de carbono como una suma ponderada entre los productos $ECR_i = \sum_j w_{ij} b_{ij} e_{ij} t_{ij} \quad i = 1, \dots 6$ expresado en EU/tCO_2. La agregación sectorial para la OCDE es de 6 sectores.
- **Muestra resultante**. Cada país tiene 6 ECR sectoriales y un valor para toda la economía en una muestra de 66 países. Los promedios regionales no están ponderados.
- **Extensiones**. Estimaciones propias para 18 países de ALC, fuentes de la OCDE para el resto de los países. Incluimos subsidios.

ECR en LAC y Argentina

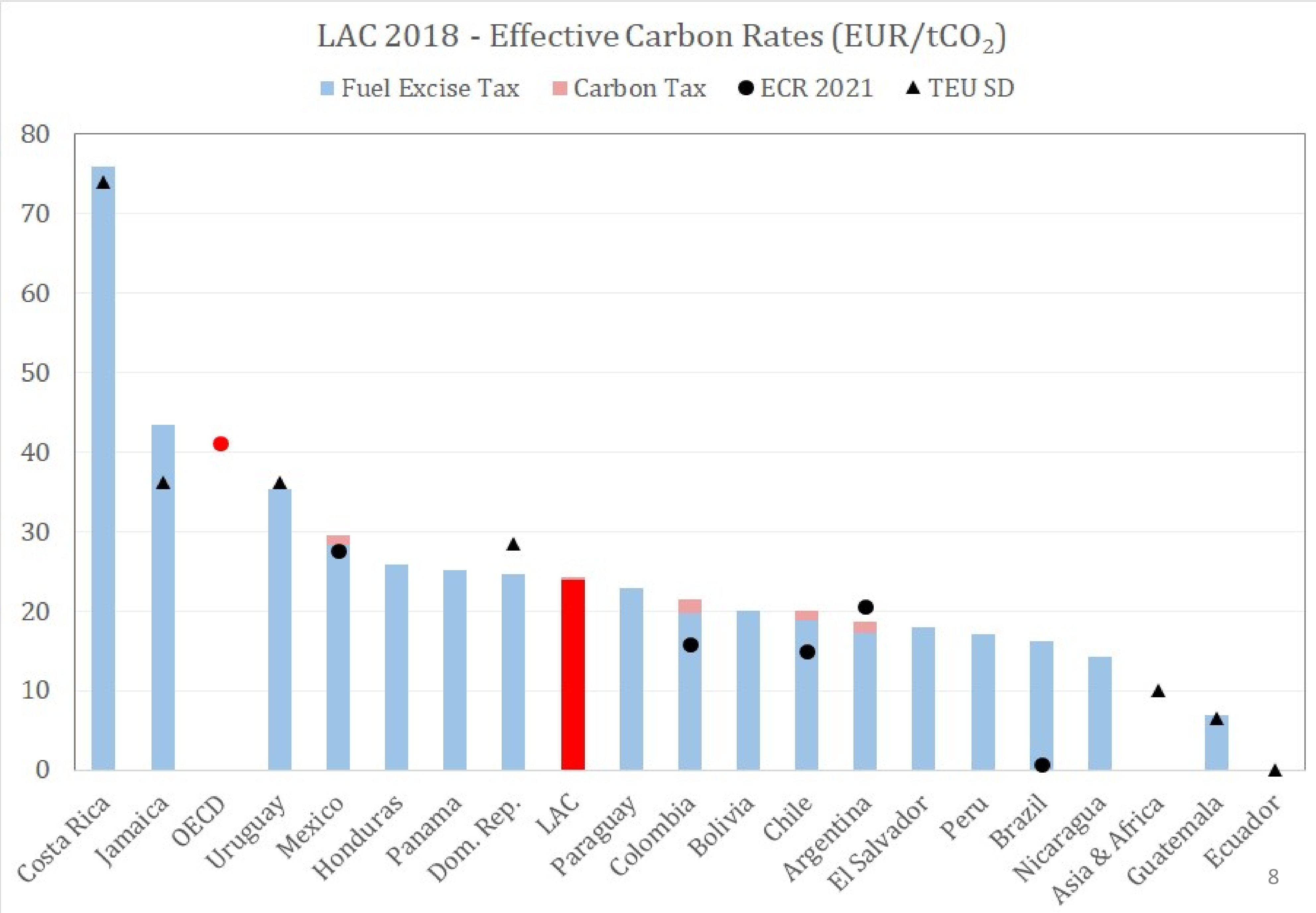
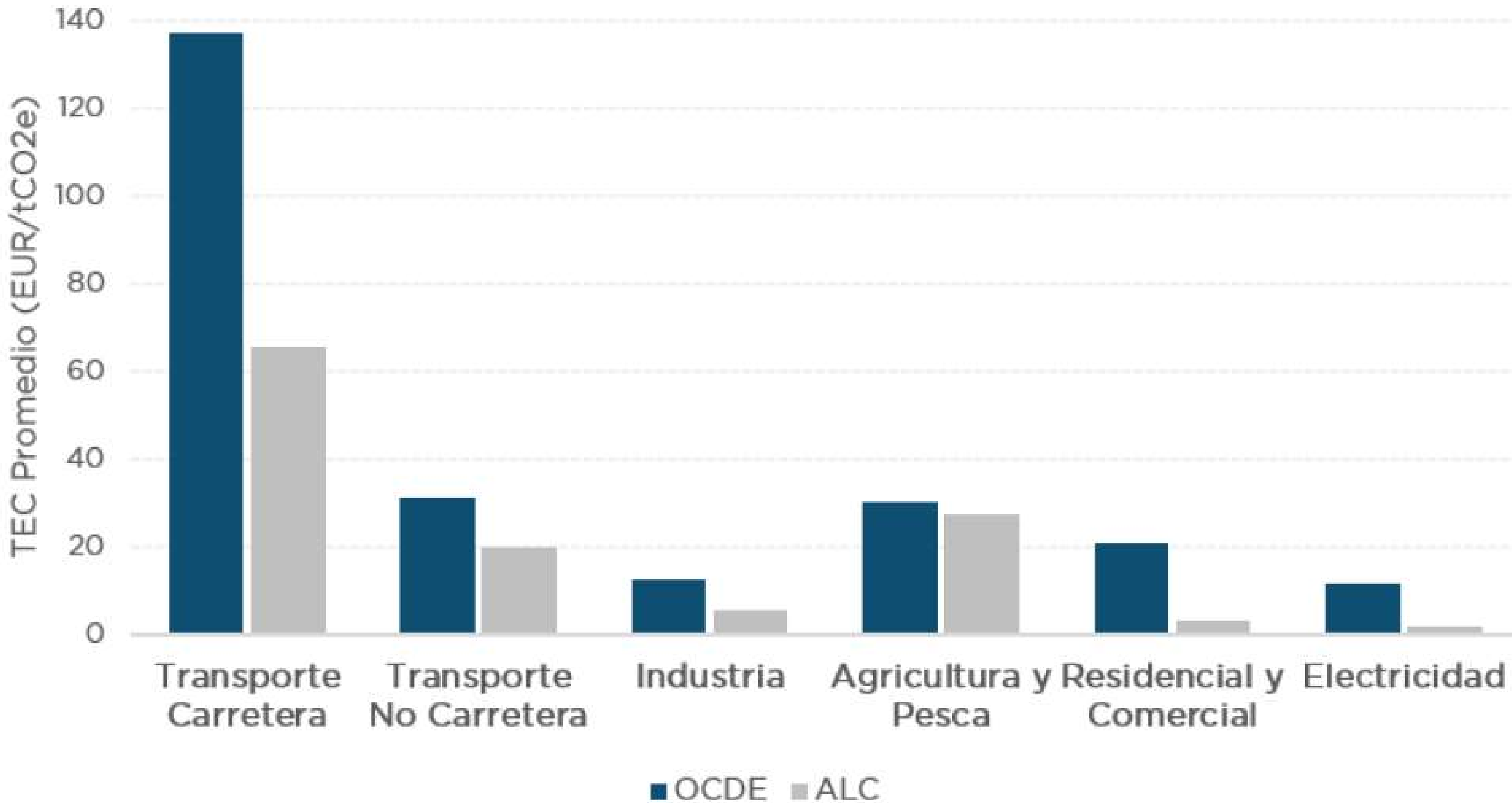


Figura 2: Tasas efectivas de carbono promedio, por sectores



Fuente: Ahumada et al. (2023).

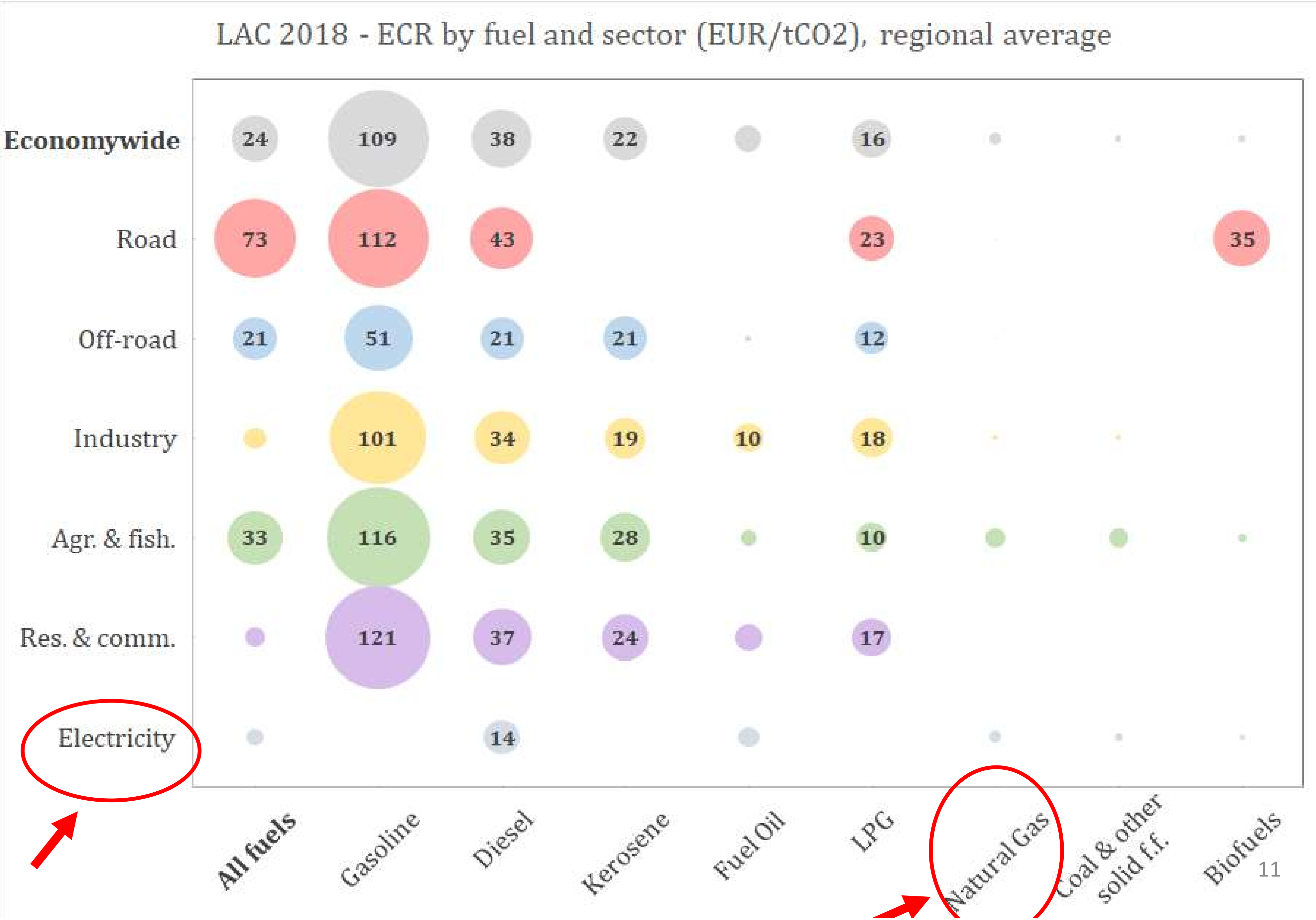
Nivel y estructura de ECR en LAC, 2018

unidades EUR-/ton CO2

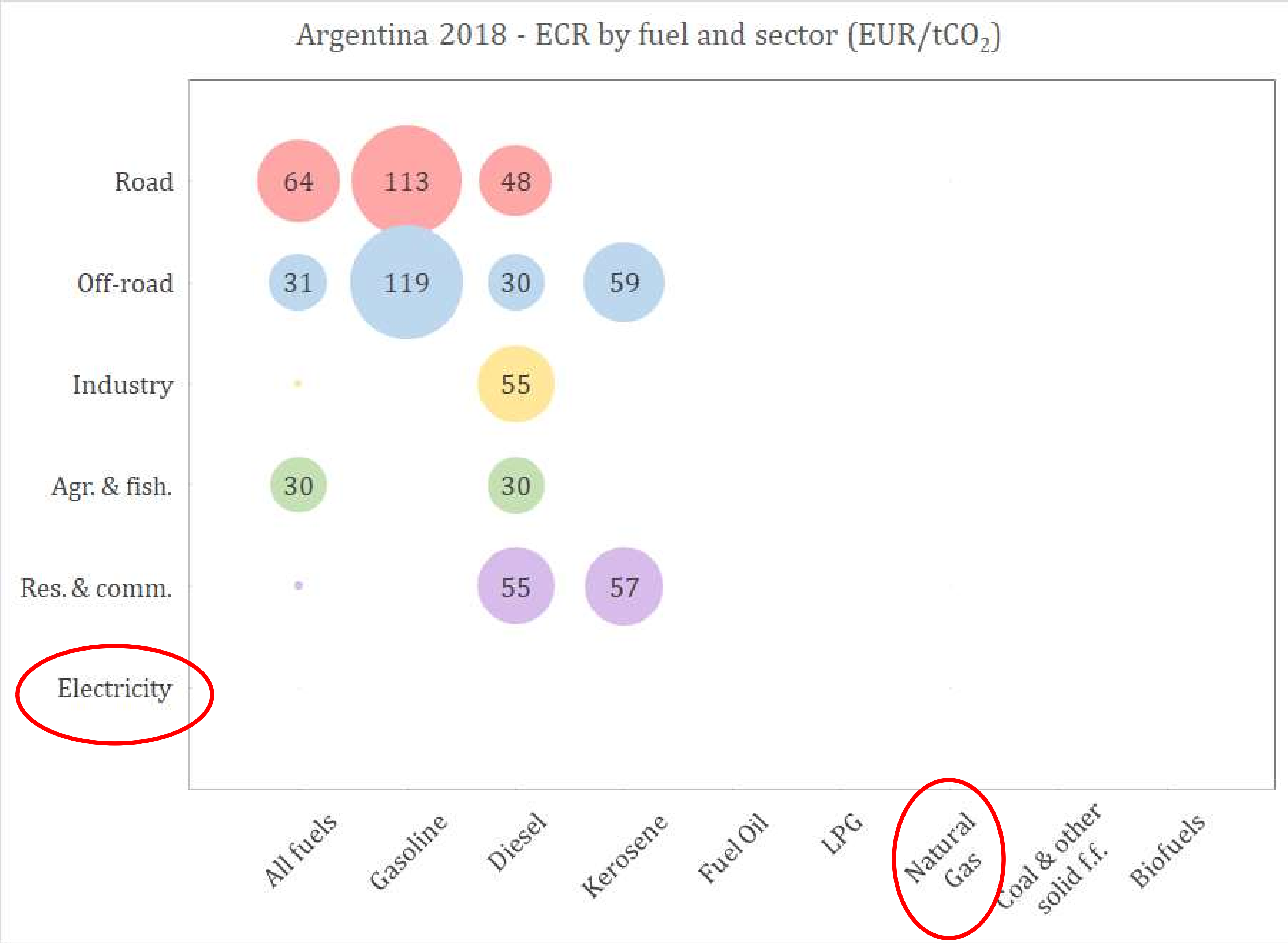
country	Fuel Excise Tax	Carbon Tax	**Effective Carbon Rate**	*Electricity Excise Tax*
Argentina	17.18	1.46	**18.64**	*4.39*
Bolivia	20.02	0.00	**20.02**	*4.95*
Brazil	16.24	0.00	**16.24**	*5.26*
Chile	18.77	1.24	**20.01**	*0.00*
Colombia	19.68	1.72	**21.39**	*0.00*
Costa Rica	75.93	0.00	**75.93**	*7.66*
Dom. Rep.	24.61	0.00	**24.61**	*0.00*
Ecuador	0.00	0.00	**0.00**	*12.59*
El Salvador	17.95	0.00	**17.95**	*0.00*
Guatemala	6.86	0.00	**6.86**	*3.75*
Honduras	25.91	0.00	**25.91**	*2.83*
Jamaica	43.34	0.00	**43.34**	*0.00*
Mexico	28.28	1.28	**29.57**	*0.00*
Nicaragua	14.28	0.00	**14.28**	*3.06*
Panama	25.07	0.00	**25.07**	*0.00*
Paraguay	22.83	0.00	**22.83**	*0.00*
Peru	17.09	0.00	**17.09**	*4.14*
Uruguay	35.35	0.00	**35.35**	*0.00*
LAC simple average	*23.85*	*0.32*	***24.17***	*2.70*

Source: own estimation based on country-level legislation and tax codes, and EIA World Energy Balances.

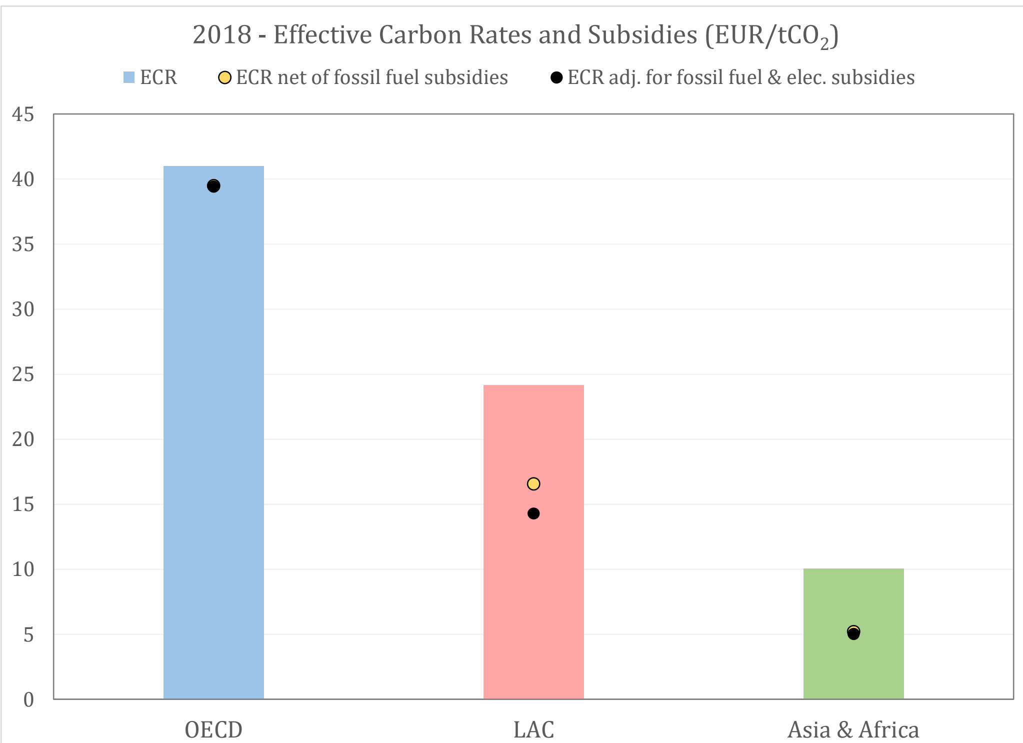
ECR en LAC: sesgo sectorial y por productos

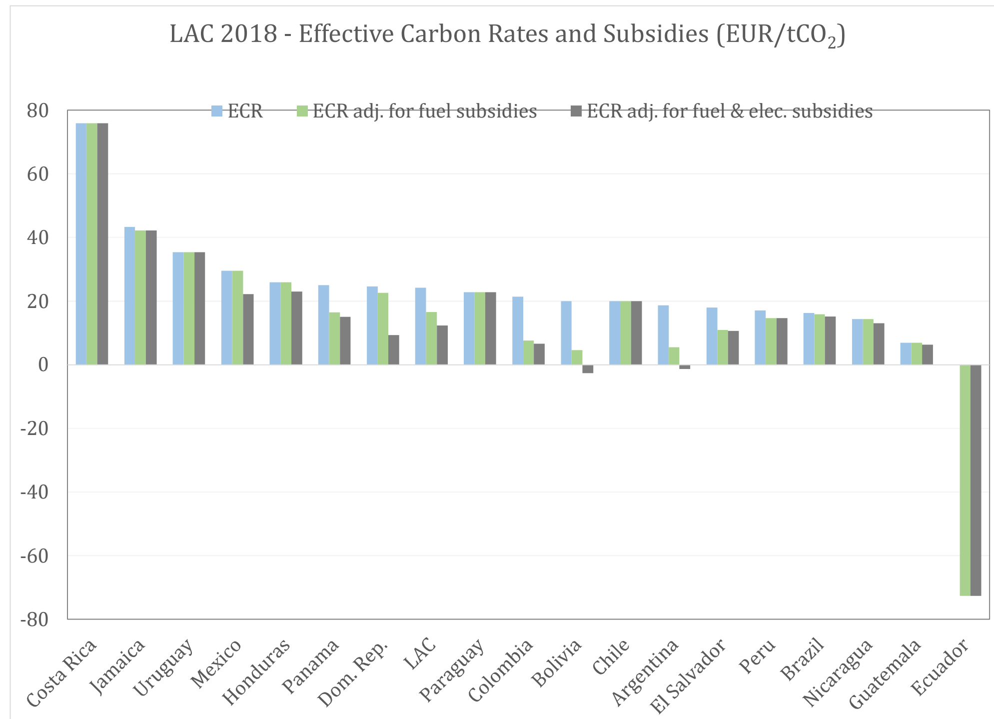


…y asi luce Argentina

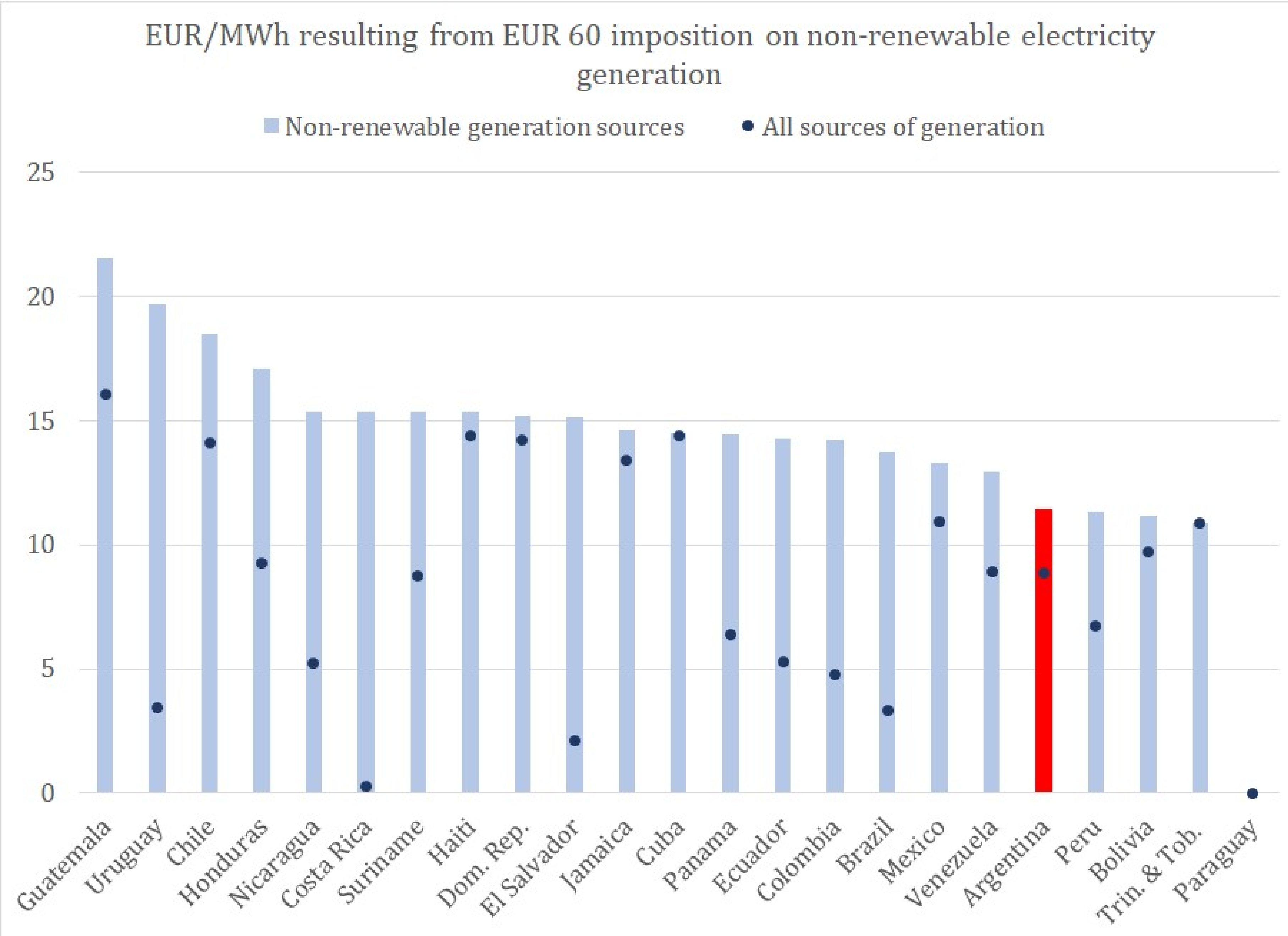


Cuando se incluyen los subsidios a la energía los resultados cambian…

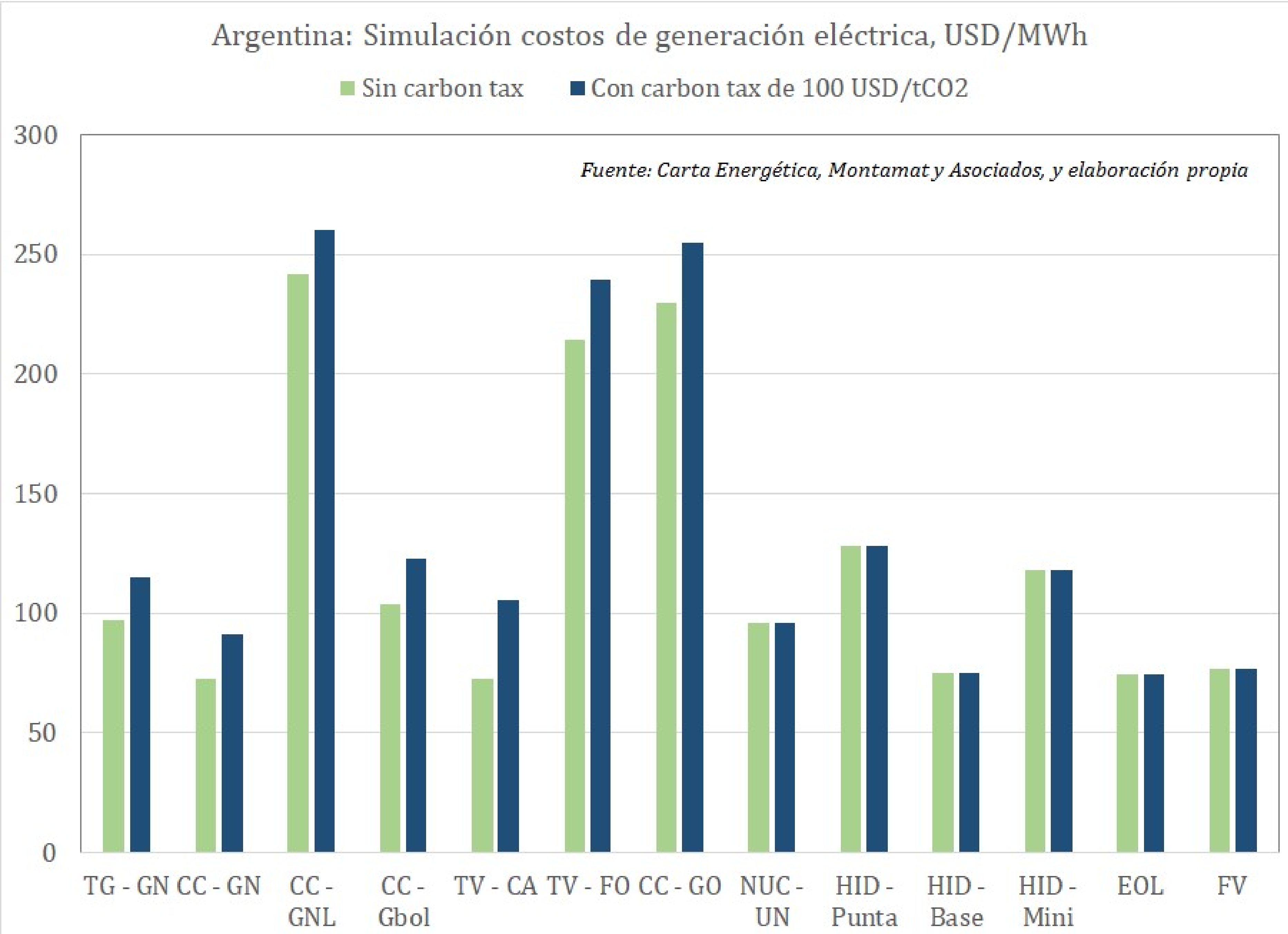




Impacto en el costo de la generación eléctrica



Por tipo de generación en la Argentina



Direcciones de reforma y transición

- Expandir la base del carbon pricing
- Elevar las tasas efectivas en sectores críticos en cuanto a emisiones.
- Reducir los subsidios a la energía, en particular a combustibles fósiles.
- Estudiar posibles mecanismos de sistemas de permisos de emisión en sectores críticos.
- Argentina.
  - Intersección gas natural / electricidad es campo crítico para extender imposición al carbono. Versus pensar en un ETS (como en piloto en Chile).
  - Reforma de los mecanismos de formación de precios del despacho eléctrico de modo que acomoden cuestiones de asequibilidad, frente a costos marginales altos.

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Productividad en la Argentina: Status quo, shocks y reformas

Fernando Navajas*

XVIII Seminario Internacional del Boletín Techint
Buenos Aires, jueves 17 de agosto de 2023

*Con aportes, comentarios y sugerencias de Hildegart Ahumada y Santos Espina Mairal.

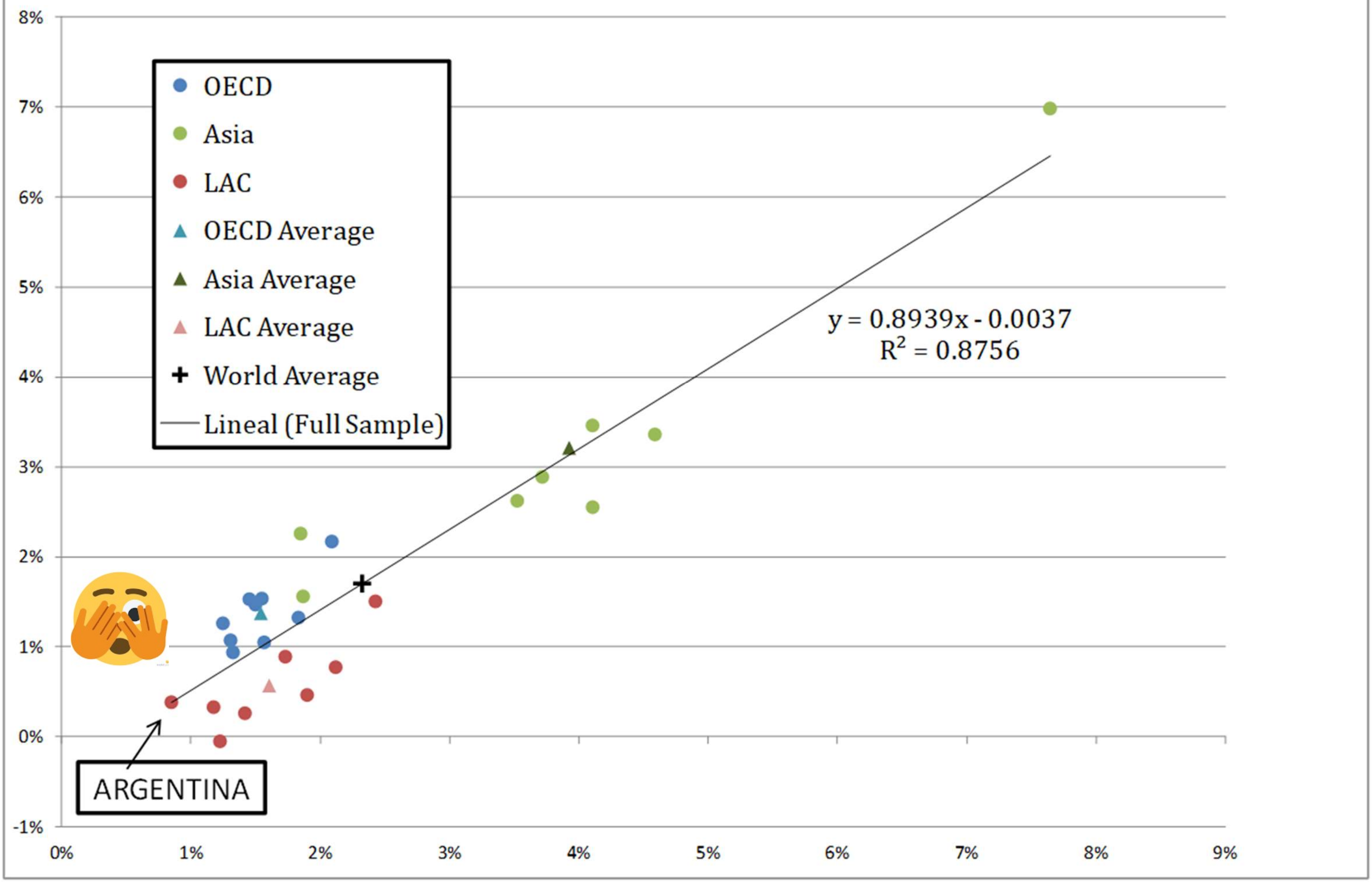
Status quo, shocks y reformas

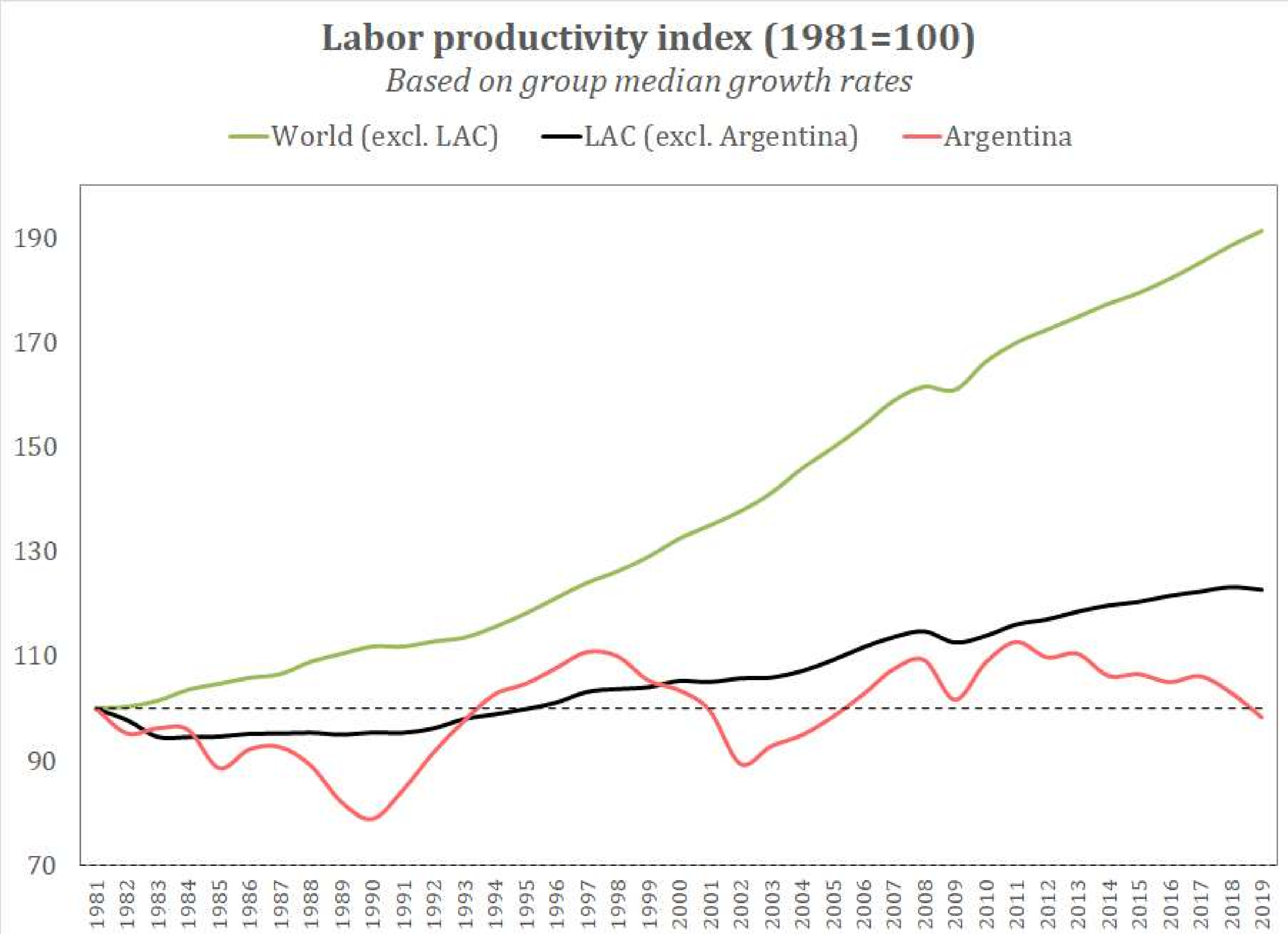
- La Argentina sufre un estancamiento largo de la productividad. Pero ahora hay sectores listos para dar un salto/shock importante, con VM a la cabeza.
- ¿Podrán esas mejoras sectoriales, sin otros cambios, revertir la tendencia de la productividad agregada?
- ¿Pueden lograrlo con "cuasi" cepo, tipos de cambio múltiples y débil consistencia macro-fiscal?
- ¿Se requiere que el salto se amplie a otros sectores y esté apoyado por reformas? ¿Pueden las reformas ayudar? ¿Cuáles?
- Dos (o más) modelos en pugna. Sin y con reformas o consistencia macro-fiscal. Senderos muy diferentes.

Datos y papers

- Extendemos a 1950-2022 la medición de productividad laboral en 9 sectores, de modo similar a la base del *Groningen Growth and Development Centre (GGDC)* (Trimmer *et al*, 2015).
- Antecedentes: simulaciones de shocks de productividad en infraestructura en Argentina (FIEL, 2019).
- Alternativa usando la data del modelo KLEMS, como Navajas *et al* (2021) para México, no está disponible para Argentina
- Base global KLEMS en Ahumada *et al* (2022) no está Argentina ahí, pero la usamos para simular shocks en Mineria.
- Discusión de efectos de reformas sobre productividad: base GGDC es usada en Konte *et al* (2022) junto a base de reformas de Prati *et al* (2013).

Figure 3.2. Labor Productivity (Y-Axis) & Value Added per Capita (X-Axis) Annual Growth Rates (%) for period 1971-2014





Labor productivity index (1981=100)
Based on group median growth rates
World (excl. LAC)
LAC (excl. Argentina)
Argentina
190
170
150
130
110
90
70
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
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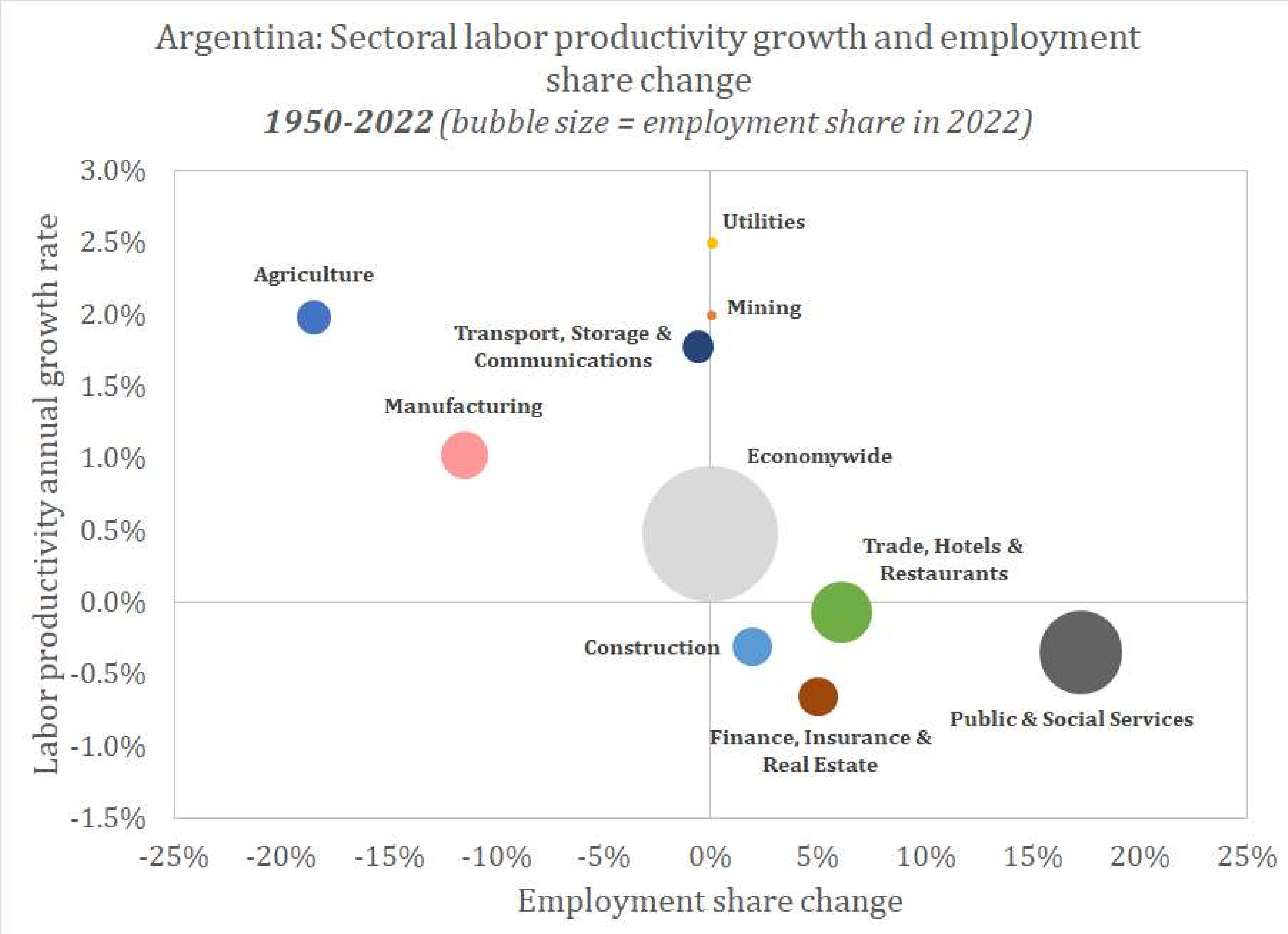
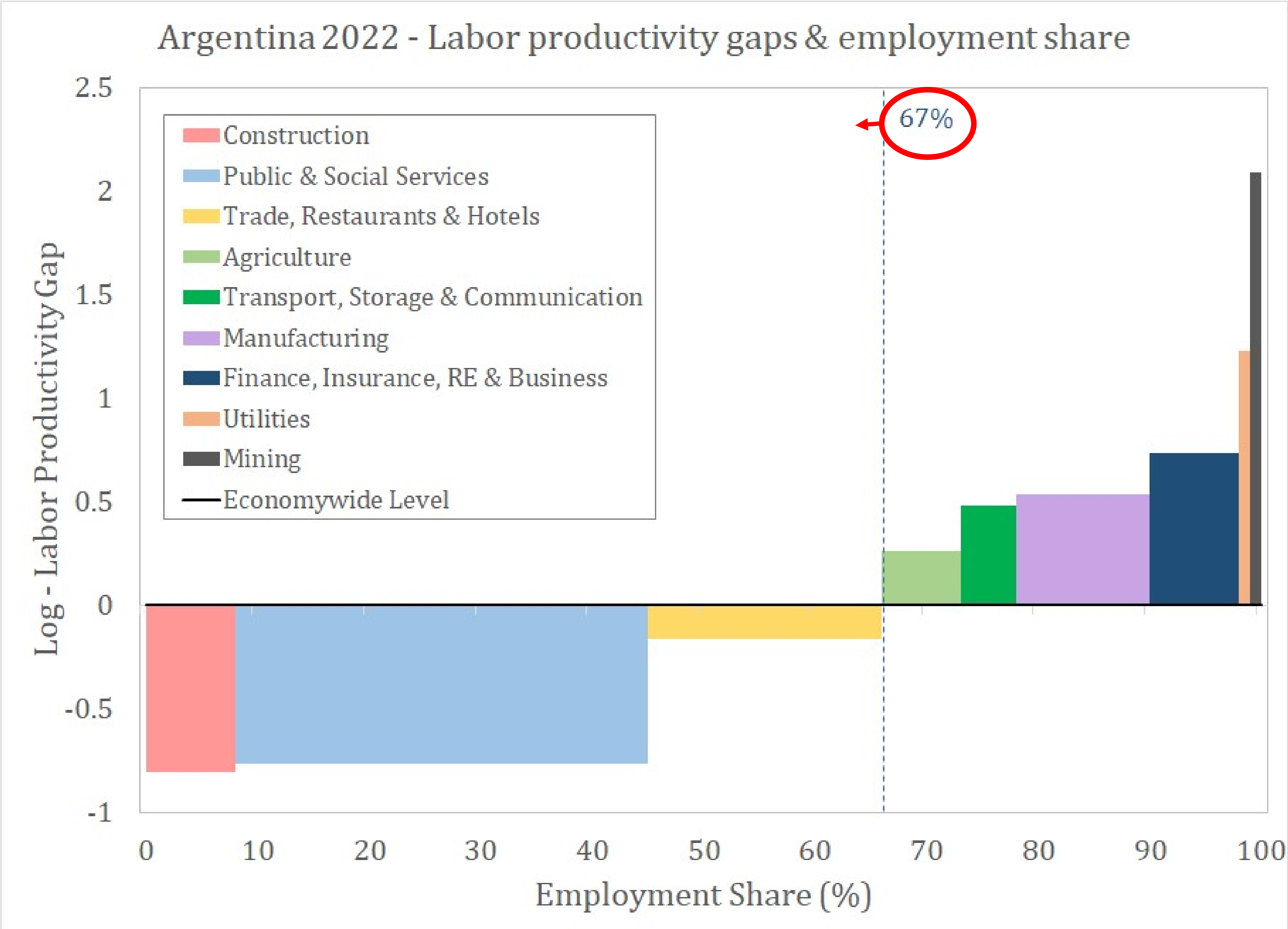
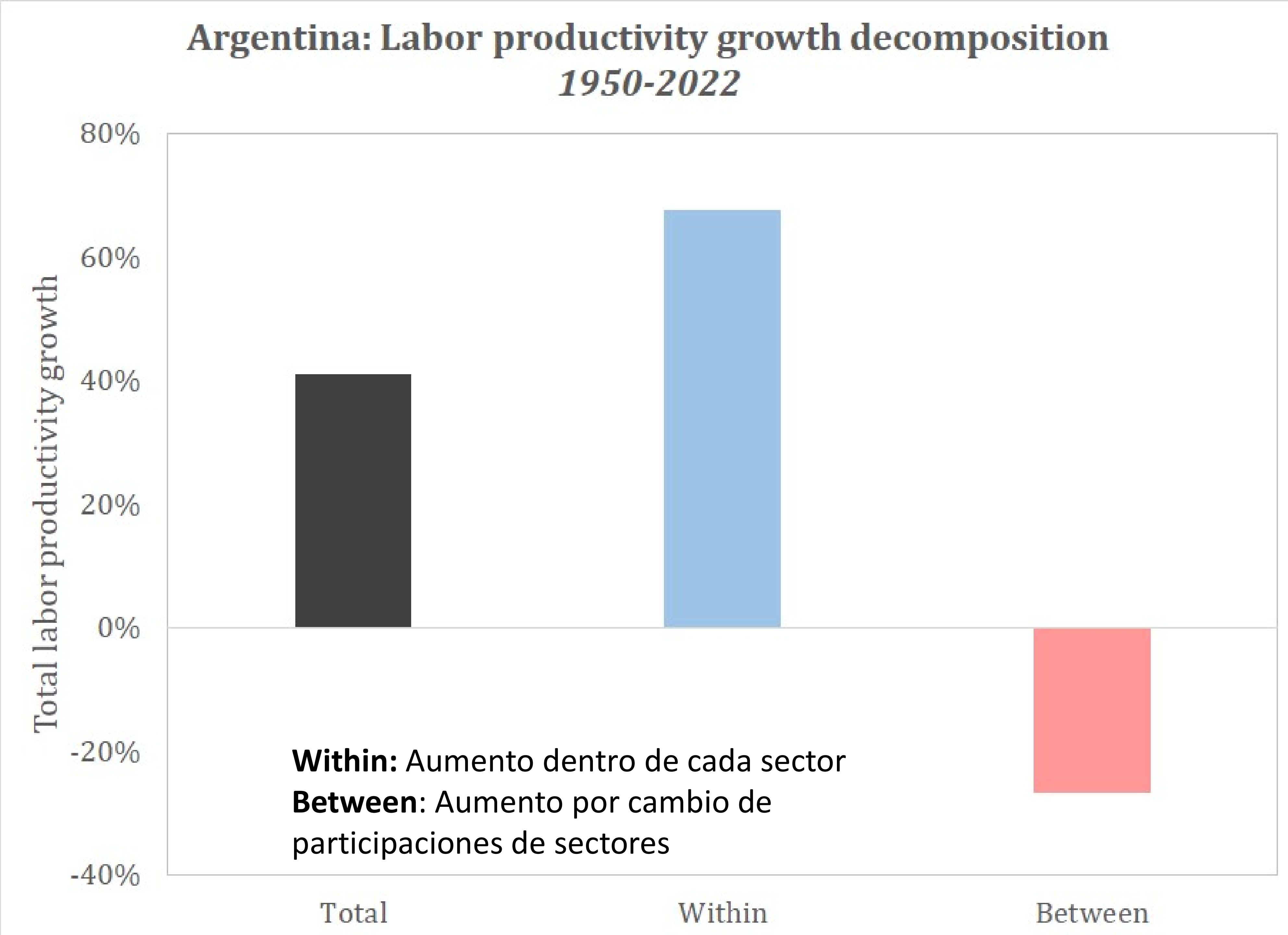
2014
2015
2016
2017
2018
2019

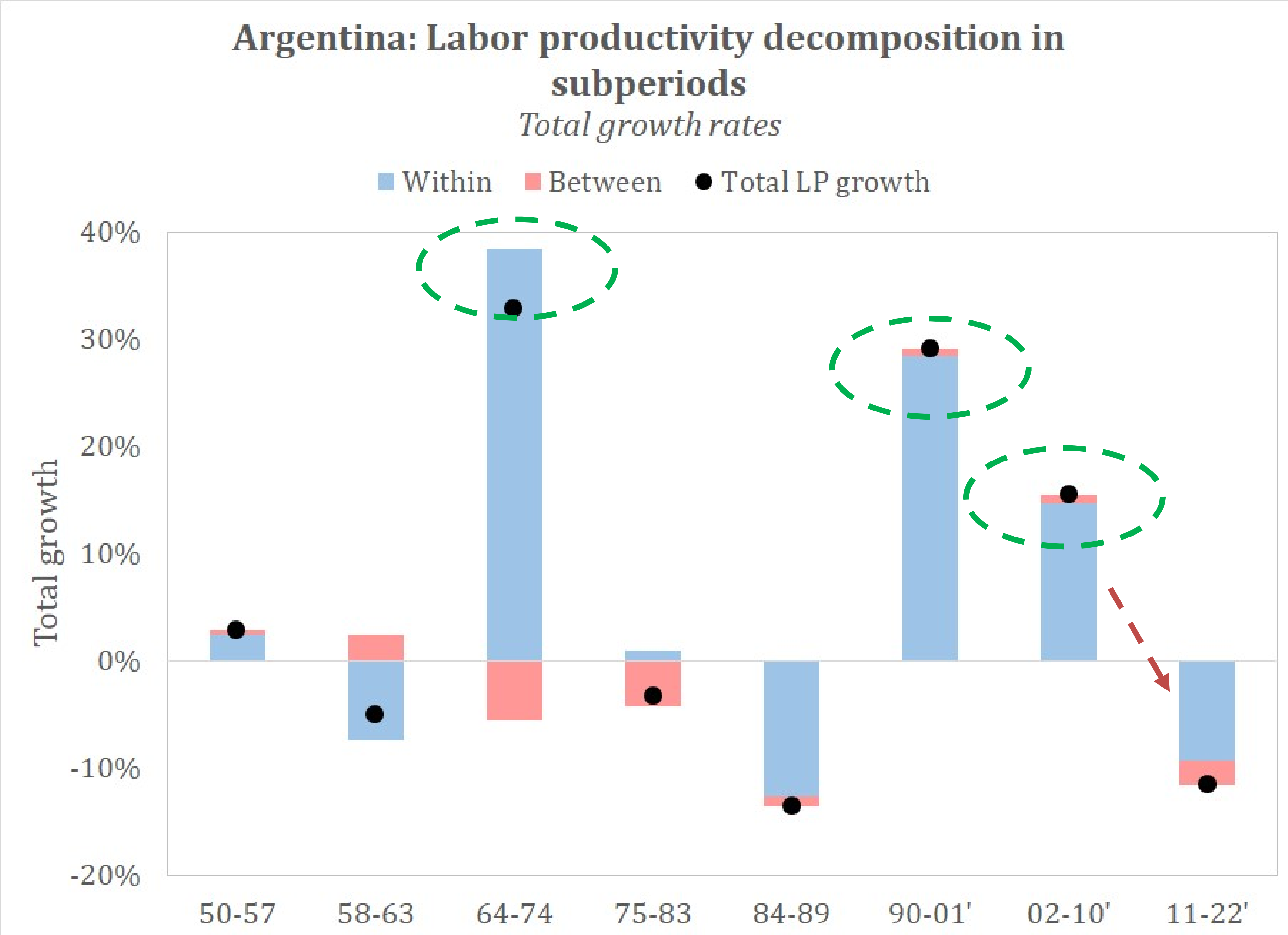


Argentina: Sectoral labor productivity growth and employment share change
1950-2022 (bubble size = employment share in 2022)
Labor productivity annual growth rate
Employment share change
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
-25%
-20%
-15%
-10%
-5%
0%
5%
10%
15%
20%
25%
Utilities
Agriculture
Mining
Transport, Storage & Communications
Manufacturing
Economywide
Trade, Hotels & Restaurants
Construction
Public & Social Services
Finance, Insurance & Real Estate

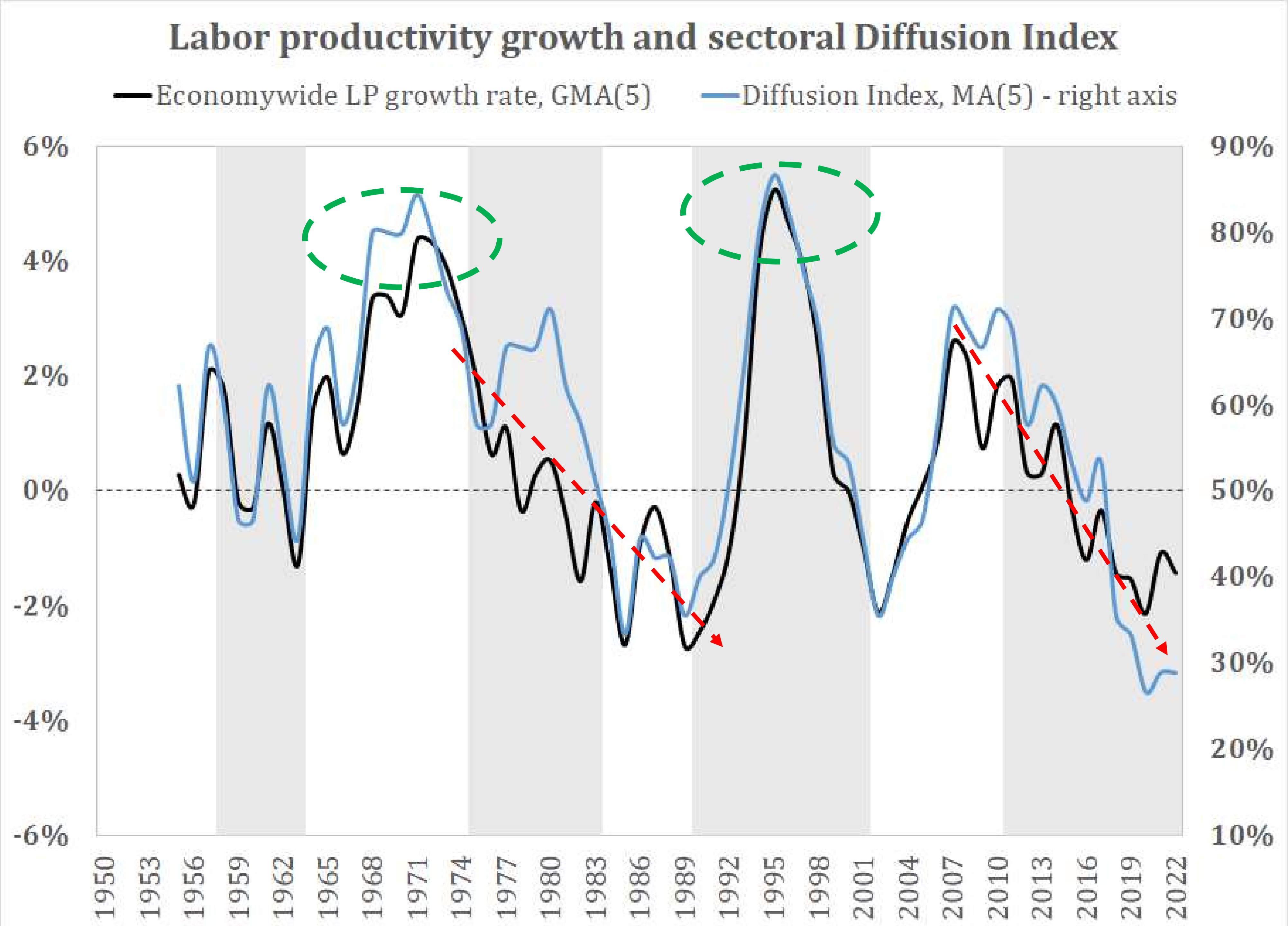

Argentina 2022 - Labor productivity gaps & employment share
Log - Labor Productivity Gap
Employment Share (%)
67%
Construction
Public & Social Services
Trade, Restaurants & Hotels
Agriculture
Transport, Storage & Communication
Manufacturing
Finance, Insurance, RE & Business
Utilities
Mining
Economywide Level
2.5
2
1.5
1
0.5
0
-0.5
-1
0
10
20
30
40
50
60
70
80
90
100



Argentina: Labor productivity growth decomposition
1950-2022
Total labor productivity growth
80%
60%
40%
20%
0%
-20%
-40%
Total
Within
Between
Within: Aumento dentro de cada sector
Between: Aumento por cambio de participaciones de sectores



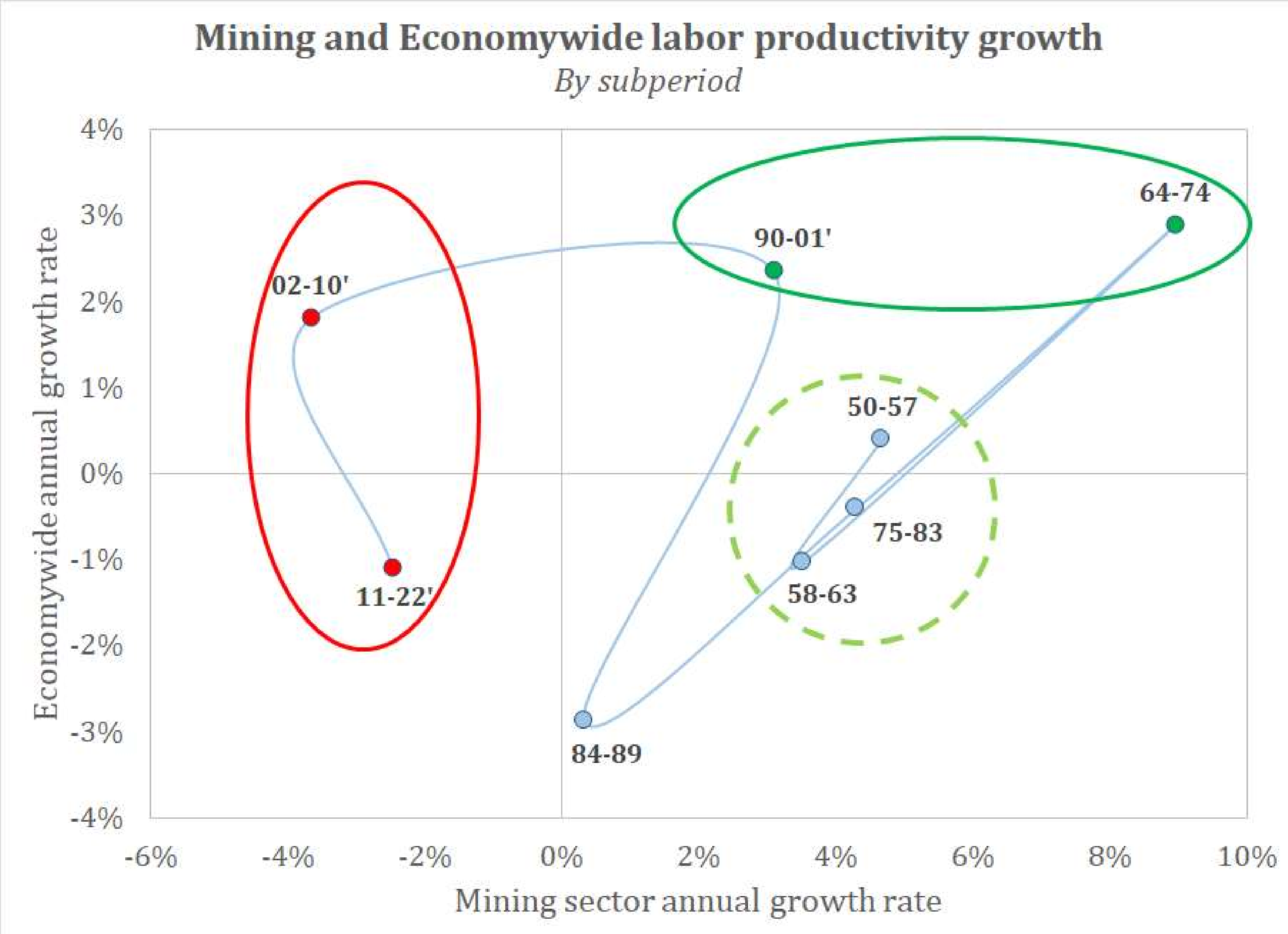
Argentina: Labor productivity decomposition in subperiods
Total growth rates
Within
Between
Total LP growth
Total growth
40%
30%
20%
10%
0%
-10%
-20%
50-57
58-63
64-74
75-83
84-89
90-01'
02-10'
11-22'

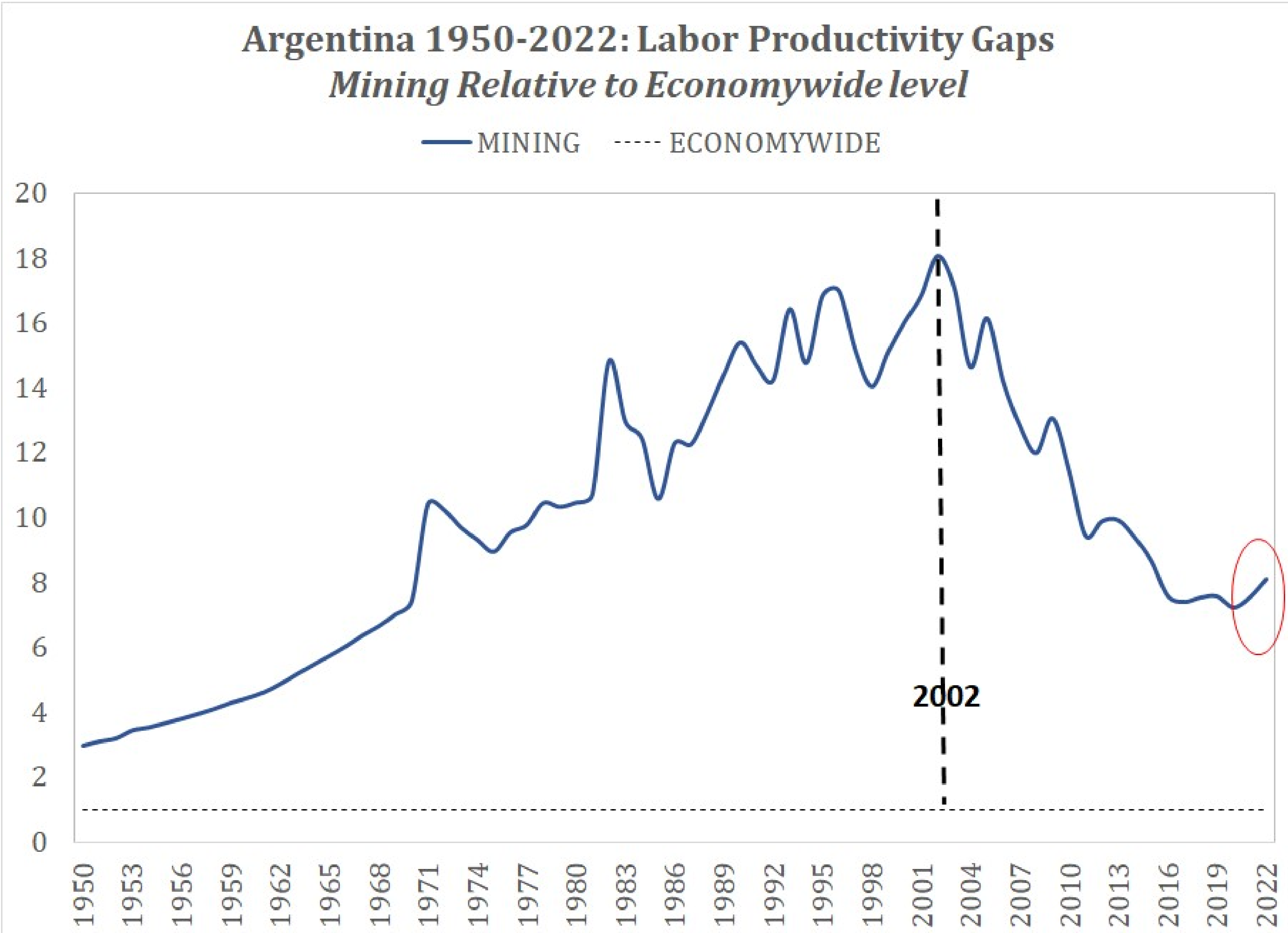


Labor productivity growth and sectoral Diffusion Index
Economywide LP growth rate, GMA(5)
Diffusion Index, MA(5) - right axis
6%
4%
2%
0%
-2%
-4%
-6%
90%
80%
70%
60%
50%
40%
30%
20%
10%
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010
2013
2016
2019
2022

Shock en Minería¨y productividad agregada

- Crecimiento de productividad de la minería con tendencia firme hasta 2002, que se rompe en las últimas dos décadas y ahora renace con vigor.
- Hay tres sub-períodos distintivos según el acople o desacople de la productividad de minería con la productividad agregada.
  - No existe spillover automático, si otros sectores no acompañan. Evidencia de 1950-63 y 1975-83.
  - Subperíodo 1964-74 (minería 9%, economía 3% anual). Relación 3 a 1.
- Algunos países de la base global KLEMS muestran relación entre productividad de minería y economía. Relación de 3 a 1 posible, pero no es robusto.

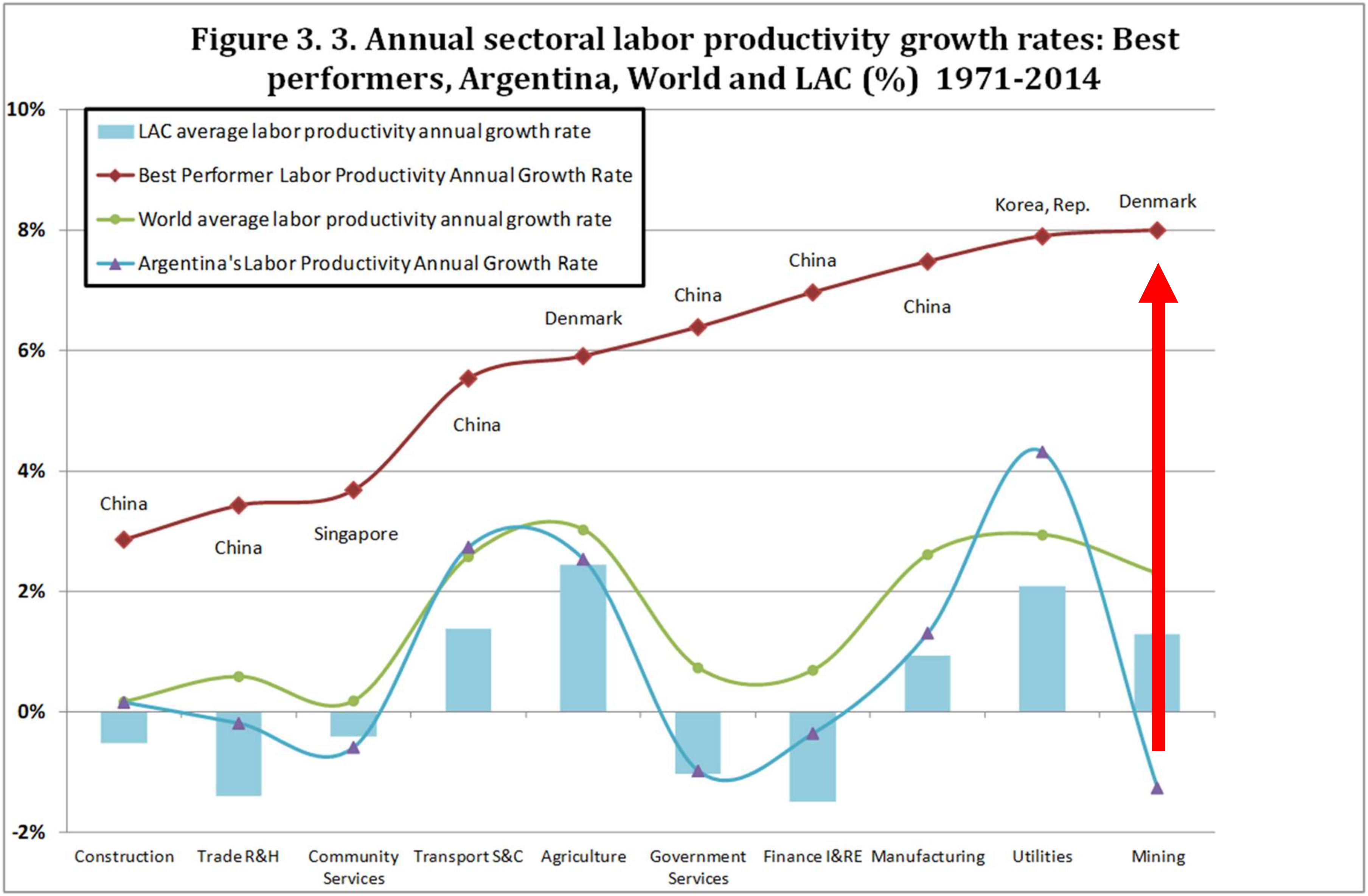

Mining and Economywide labor productivity growth
By subperiod
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
Economywide annual growth rate
-6%
-4%
-2%
0%
2%
4%
6%
8%
10%
Mining sector annual growth rate
64-74
90-01'
02-10'
50-57
75-83
58-63
11-22'
84-89



F. Navajas (2006), “Energo-Crunch Argentino 2002-20XX”, http://www.fiel.org/publicaciones/Documentos/DOC89.pdf

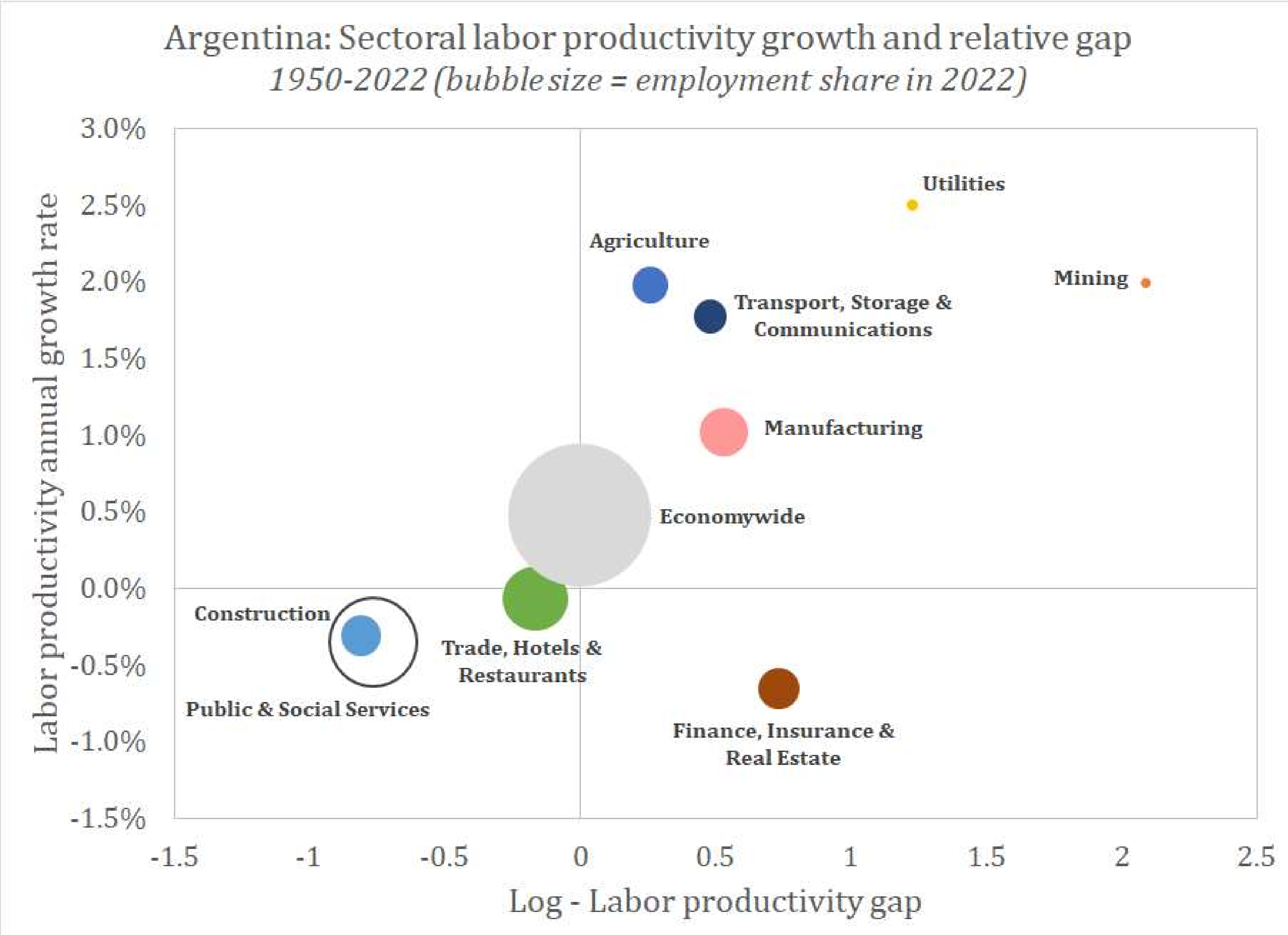
Shocks plausibles de productividad sectorial en Argentina

Un shock de productividad del 9% anual en minería, si acontece, supera el mejor registro de la base de datos global de GGDC.

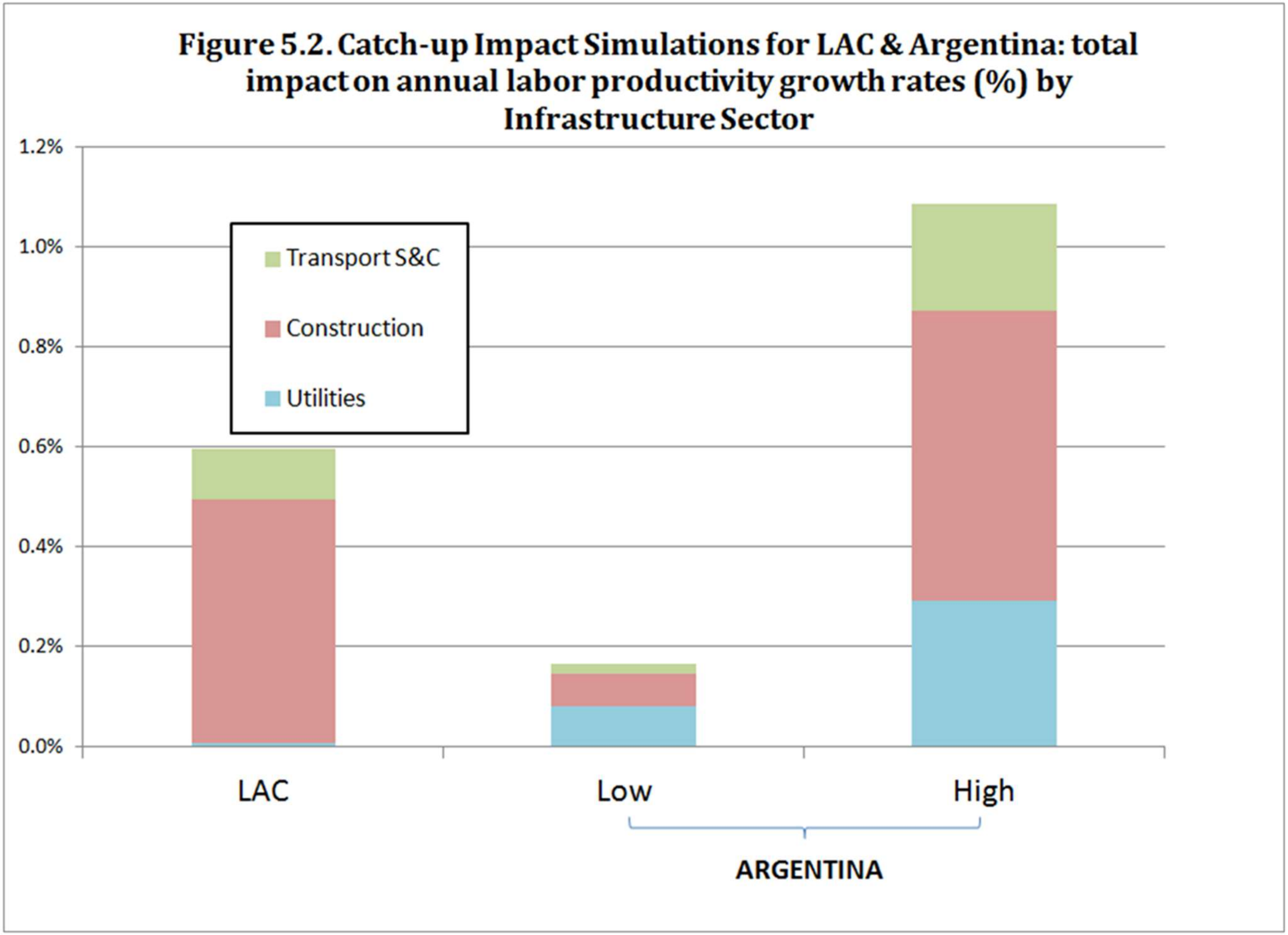


Reformas y productividad

- Más allá de Minería existen otros 4 sectores de alto nivel (brecha) y crecimiento de productividad que dependen de reformas en el comercio (agricultura, industria) y en el mercado de bienes y servicios (EGA y TCS). Los restantes, en servicios, dependen de reforma laboral y del estado (gasto público).
- Konte *et al* (2022) estudian los efectos de reformas entre 1985-2005 en comercio (aranceles y apertura en cuenta corriente), en mercados de productos (reformas regulatorias en telecoms y electricidad) y en el sector financiero (incluida la cuenta capital del BP).
- Es el único paper que yo conozca que mide efectos de las reformas en la base GGDC, y obtiene resultados.


Argentina: Sectoral labor productivity growth and relative gap
1950-2022 (bubble size = employment share in 2022)
Labor productivity annual growth rate
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
Utilities
Agriculture
Mining
Transport, Storage & Communications
Manufacturing
Economywide
Construction
Trade, Hotels & Restaurants
Public & Social Services
Finance, Insurance & Real Estate
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
Log - Labor productivity gap

Shock de Productividad en Infraestructura: hasta 1% de crecimiento anual



FIEL (2019), "Productivity Growth and Infrastructure Related Sectors: The case of Argentina", June. http://www.fiel.org/publicaciones/Novedades/NEWS_1690308003529.pdf

Reformas y productividad (2)

- Resultados en Konte *et al* (2022): Las reformas impulsan la tasa de crecimiento de la productividad ("within"), con efectos de largo plazo de 36% para protección arancelaria, 70% para apertura en cuenta corriente (anti "cepo") y 55% para la liberalización financiera, con cuenta capital sin efecto.
- Des-intervención en telecoms y electricidad tiene también efectos positivos sobre tasa de crecimiento, pero no pueden estimar efectos de largo plazo.
- Impactos de un índice de flexibilidad laboral del país da lugar a efectos poco nítidos, pero que los autores interpretan que indican que ayudan en la reasignación de empleo entre sectores.

Table 2. Reformsand Aggregate Labor Productivity Growth

Dependent variable: LnProd(t)-LnProd(t−1)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Trade reforms										
Tariffs(t−1)	0.024**									
	(0.011)									
Current account(t−1)		0.028**								
		(0.013)								
Product market reforms										
Agriculture(t−1)			0.005							
			(0.009)							
Network(t−1)				0.019**						
				(0.008)						
Financial sector reforms										
Domestic finance(t−1)					0.022**					
					(0.009)					
Banking(t−1)						0.020**				
						(0.009)				
Securities(t−1)							0.022***			
							(0.008)			
Capital(t−1)								0.014		
								(0.010)		
Capital resident(t−1)									0.007	
									(0.009)	
Capital nonresident(t−1)										0.013
										(0.008)
LnProd(t−1)	−0.066***	−0.040**	−0.032	−0.024	−0.040***	−0.039***	−0.040***	−0.037**	−0.036**	−0.036**
	(0.015)	(0.018)	(0.019)	(0.016)	(0.012)	(0.012)	(0.013)	(0.016)	(0.017)	(0.016)
Constant	0.661***	0.393**	0.326	0.242	0.400***	0.395***	0.401***	0.373**	0.367**	0.367**
	(0.146)	(0.178)	(0.199)	(0.164)	(0.122)	(0.121)	(0.136)	(0.166)	(0.172)	(0.167)
Observations	1,025	1,075	1,034	1,051	913	913	913	1,075	1,075	1,075
No. of countries	34	32	31	31	28	28	28	32	32	32
R-squared	0.193	0.161	0.163	0.128	0.152	0.152	0.154	0.154	0.152	0.154

Source: Authors' calculation.

Note: Robust standard errors cluster within countries in parentheses. All the estimations include country fixed-effects and period dummies. ***$p<0.01$, **$p<0.05$, *$p<0.1$.

Reformas y productividad (3)

- Resultados en Konte *et al* (2022) tienen en mi opinión varios problemas.
  - No surgen de los efectos de las reformas sobre los sectores, sino explican el agregado. No sabemos qué reformas impactan en qué sectores. Esto sugiere que las estimaciones de una estrategia bottom up fracasarían.
  - Estrategia de estimar efectos de reformas tomadas de a una. Argumento de colinealidad no luce suficiente, se requiere saber cómo actúan en conjunto. ¿Cómo interpretar los efectos cuantitativos? ¿Se suman?
  - Cruce de efectos de reformas con grado de flexibilización laboral luce dudoso. Reformas en telecoms y electricidad llevan a efectos estructurales en otros sectores en ambientes laborales flexibles. Raro, excepto que incluya transporte

Conclusión: Status quo, shocks y respuestas

- Luce difícil que un boom en minería por sí solo, y sin reformas macro-fiscales, pueda dar lugar a una suba sostenible de una productividad tan estancada.
- Necesitamos un "combo" para poder hacer un growth case (Navajas, 2019) con saltos además en Agricultura, Industria, Infraestructura y Servicios. Pero eso implica reformas.
- Resultados de efectos de reformas son discutibles, pero útiles para Argentina dado rol de apertura y cepo.
  - *"Cepo-mata-productividad"* es un resultado robusto.
- Pero no se sale del cepo sólo con shock de productividad sectorial. Reforma de cuenta corriente depende de consistencia macro-fiscal.

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Determinants of sectoral effective carbon rates on energy use

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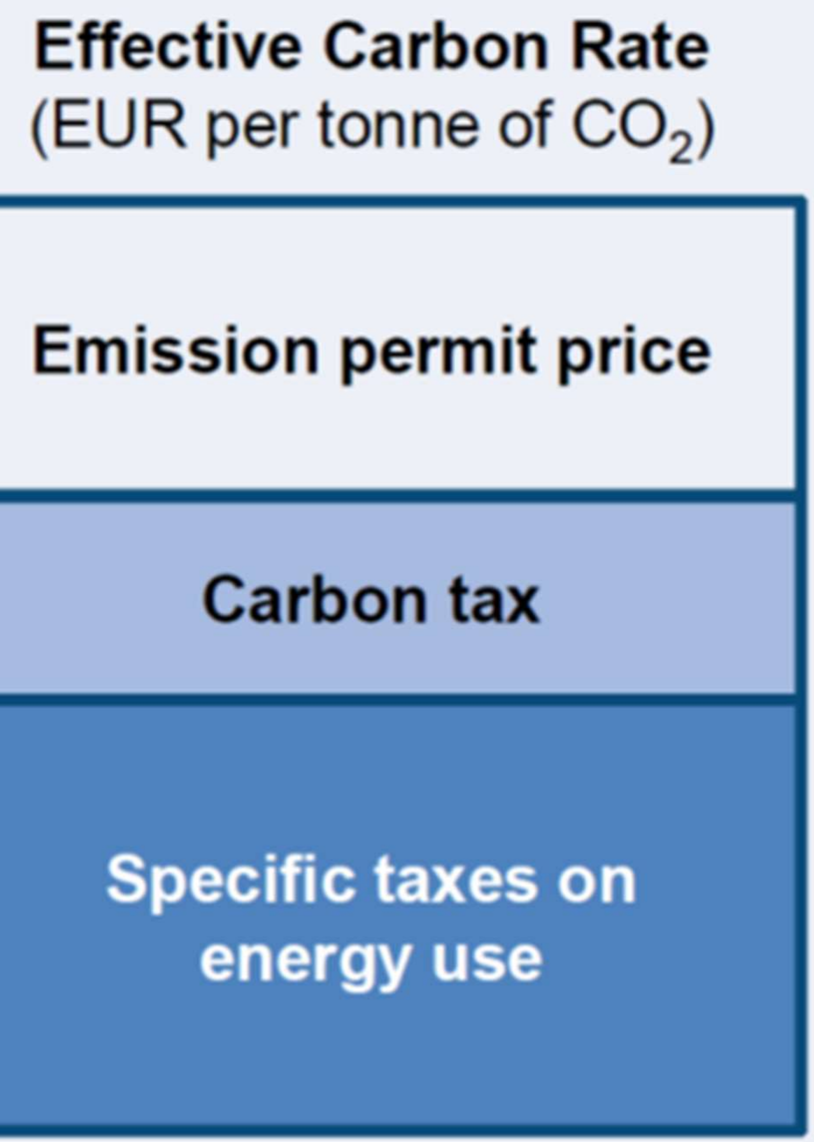
BIEE RESEARCH CONFERENCE 2023

Worcester College, Oxford, September 21, 2023

ECR= Excises+Carbon Taxes+ETS prices

Figure 1.1. Components of effective carbon rates



Related literature

- OECD reports ECR (OECD-ECR, 2019, 2021) as well as papers using their data. We extend to LAC following IEA (2021) energy balances, emission conversion factors and adding bottom up sectoral energy use taxes for each country in LAC.
- OECD-ECR (2021) states the bias towards road transport in the measurement. We make this observation more accurate for LAC and prepare global sample to model determinants.
- Environmentally-related energy excise taxation (Barde and Bratheen, 2005; Navajas et al, 2012; Conte Grand et al, 2022). Excises here are one part, albeit important, of ECR.
- Models that explain observed tax structures in more positive terms and explain observed biases (in general terms, Becker, 1983 and Kanbur and Myles, 1992; applied to energy environmentally related taxes, Navajas *et al*, 2012; applied to fossil fuels taxes and subsides, Mahdavi *et al*, 2022).

Related literature

- Papers on the structural determinants of carbon pricing in general (Carraro and Favero, 2009; Faure, 2020)
- Literature on the effects of energy subsidies on effective energy and carbon prices (Parry *et al*, 2021)
- Reports by OECD (OECD-ECR, 2021, chapter 2) and background academic papers (e.g. Sen and Vollebergh, 2018; Martin, Muûls and Wagner, 2016) on ECR and energy consumption and emissions
- Paper by Ahumada et al (2023) provides the database.

Inter-American Development Bank

Effective Carbon Rates on Energy Use in Latin America and the Caribbean: Estimates and Directions for Reform

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TECHNICAL NOTE Nº IDB-TN-2656

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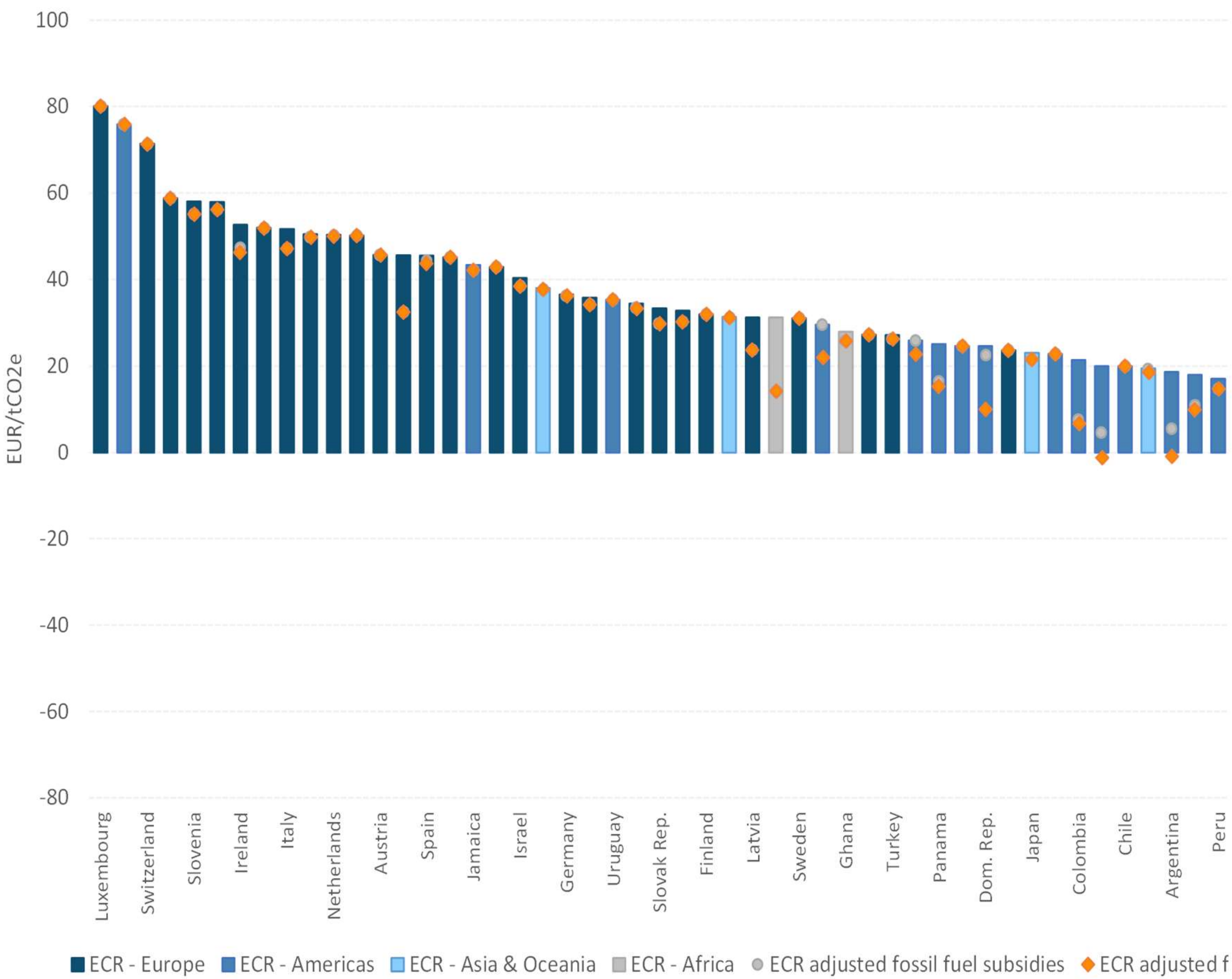
ECR: Measurement and estimation

- *Energy balances*. An nxm matrix **B** (b_{ij}) expressing, in TJ, energy use of m products across n sectors.
- *Tax code*. An nxm matrix **T** (t_{ij}) expresing, in TJ, energy taxes including excises, carbon taxes and ETS prices and allowing for exemptions. Taxes are then expressend as EU/TJ
- *Conversion factors for emissions*. An nxm matrix **E** (e_{ij}) of CO2 emissions from energy use of m products across n sectors, expressed in TJ/tCO_2.
- By aggregation of the products and sectors we express effective carbon rates as a weighted sum across products $ECR_i = \sum_j w_{ij} b_{ij} e_{ij} t_{ij} \quad i = 1, \ldots 6$ expressed in EU/tCO_2. Sectoral aggregation for OECD is 6 sectors.
- Each country has 6 sectoral ECR and an economywide value in our sample of 66 countries. Regional averages are unweighted.
  - Own estimates for 18 LAC countries, OECD sources for the rest

Economy wide estimates of ECR

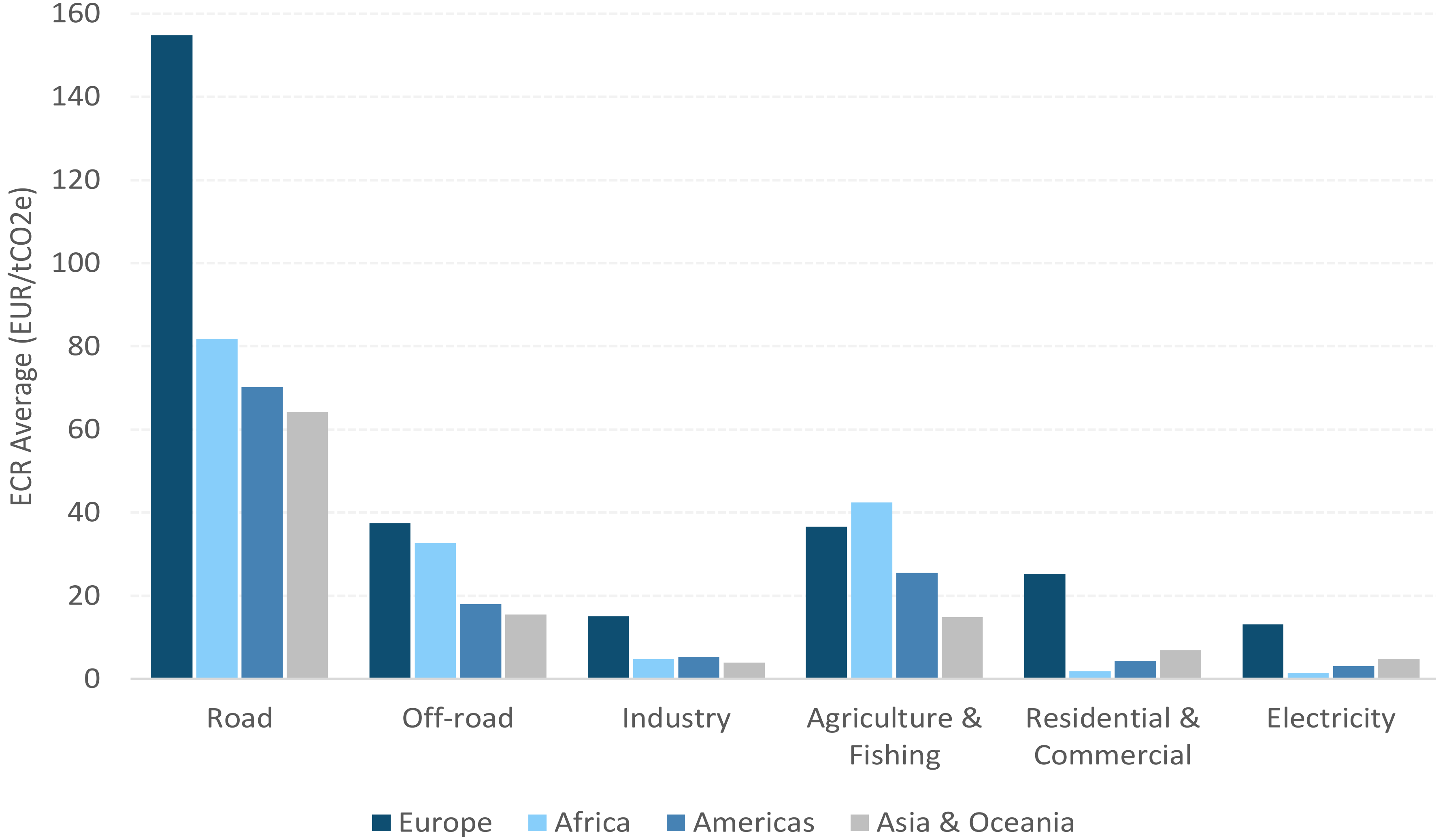
Figure 1: Effective Carbon Rates, 2018



FN1

Sectoral differences

Figure 2: Effective Carbon Rates in Regions, by Sector



Source: Authors' estimations for LAC countries. For other countries, see OECD (2021a, 2021b).

Diapositiva 46

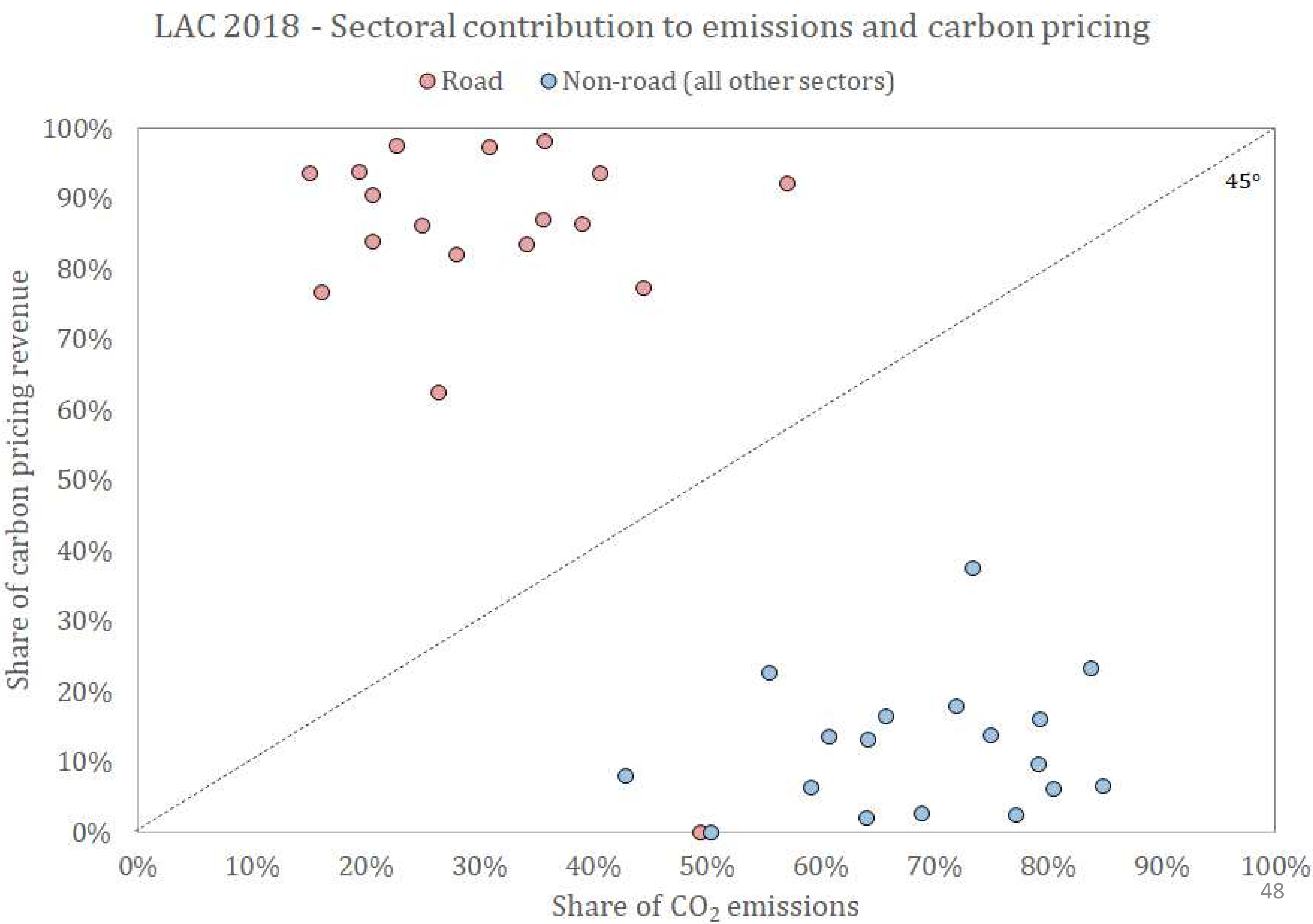
FN1 Fernando Navajas, 9/3/2023

Level and structure of ECR for LAC, 2018

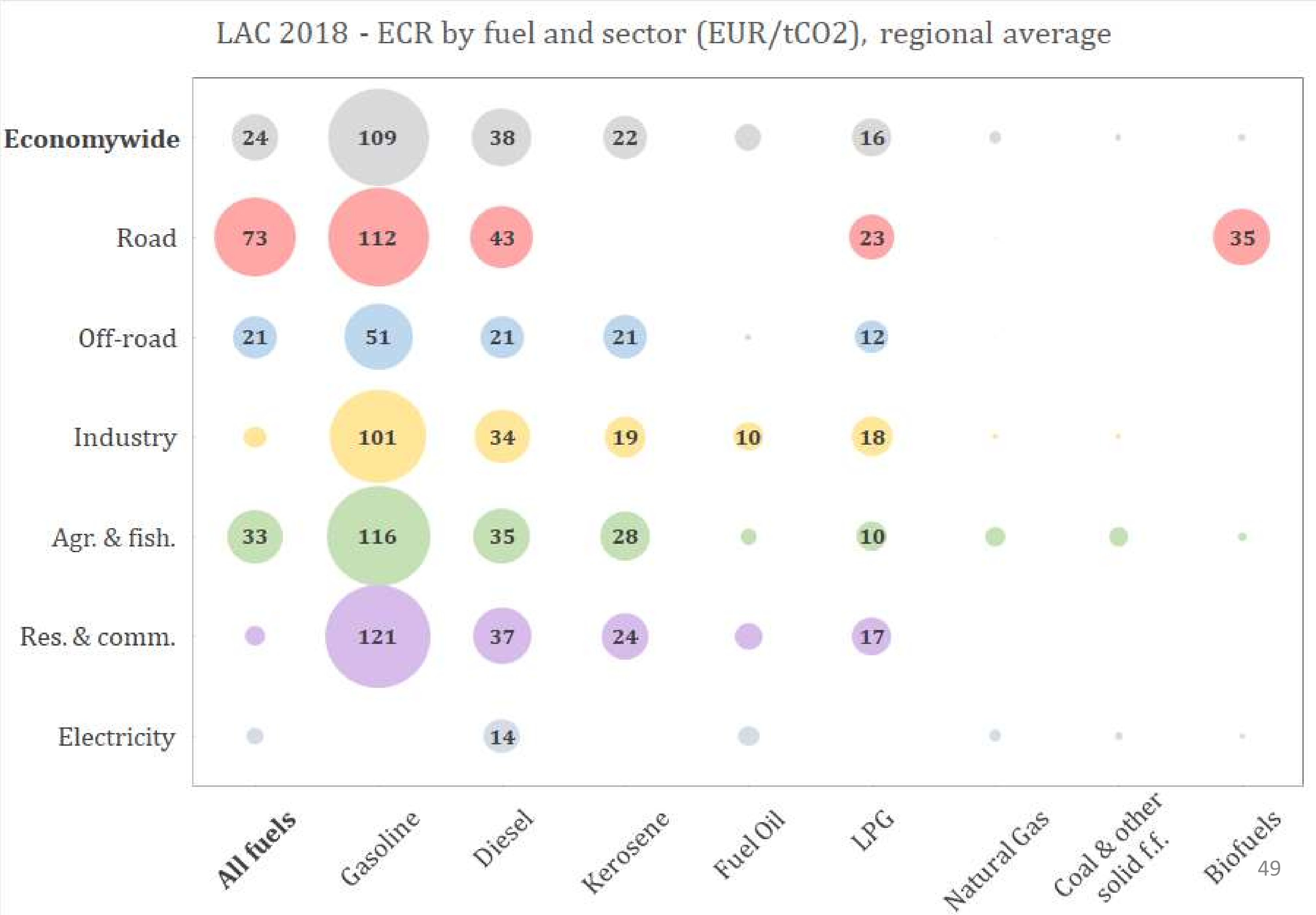
country	Fuel Excise Tax	Carbon Tax	**Effective Carbon Rate**	*Electricity Excise Tax*
Argentina	17.18	1.46	**18.64**	*4.39*
Bolivia	20.02	0.00	**20.02**	*4.95*
Brazil	16.24	0.00	**16.24**	*5.26*
Chile	18.77	1.24	**20.01**	*0.00*
Colombia	19.68	1.72	**21.39**	*0.00*
Costa Rica	75.93	0.00	**75.93**	*7.66*
Dom. Rep.	24.61	0.00	**24.61**	*0.00*
Ecuador	0.00	0.00	**0.00**	*12.59*
El Salvador	17.95	0.00	**17.95**	*0.00*
Guatemala	6.86	0.00	**6.86**	*3.75*
Honduras	25.91	0.00	**25.91**	*2.83*
Jamaica	43.34	0.00	**43.34**	*0.00*
Mexico	28.28	1.28	**29.57**	*0.00*
Nicaragua	14.28	0.00	**14.28**	*3.06*
Panama	25.07	0.00	**25.07**	*0.00*
Paraguay	22.83	0.00	**22.83**	*0.00*
Peru	17.09	0.00	**17.09**	*4.14*
Uruguay	35.35	0.00	**35.35**	*0.00*
LAC simple average	*23.85*	*0.32*	***24.17***	*2.70*

Source: own estimation based on country-level legislation and tax codes, and EIA World Energy Balances.

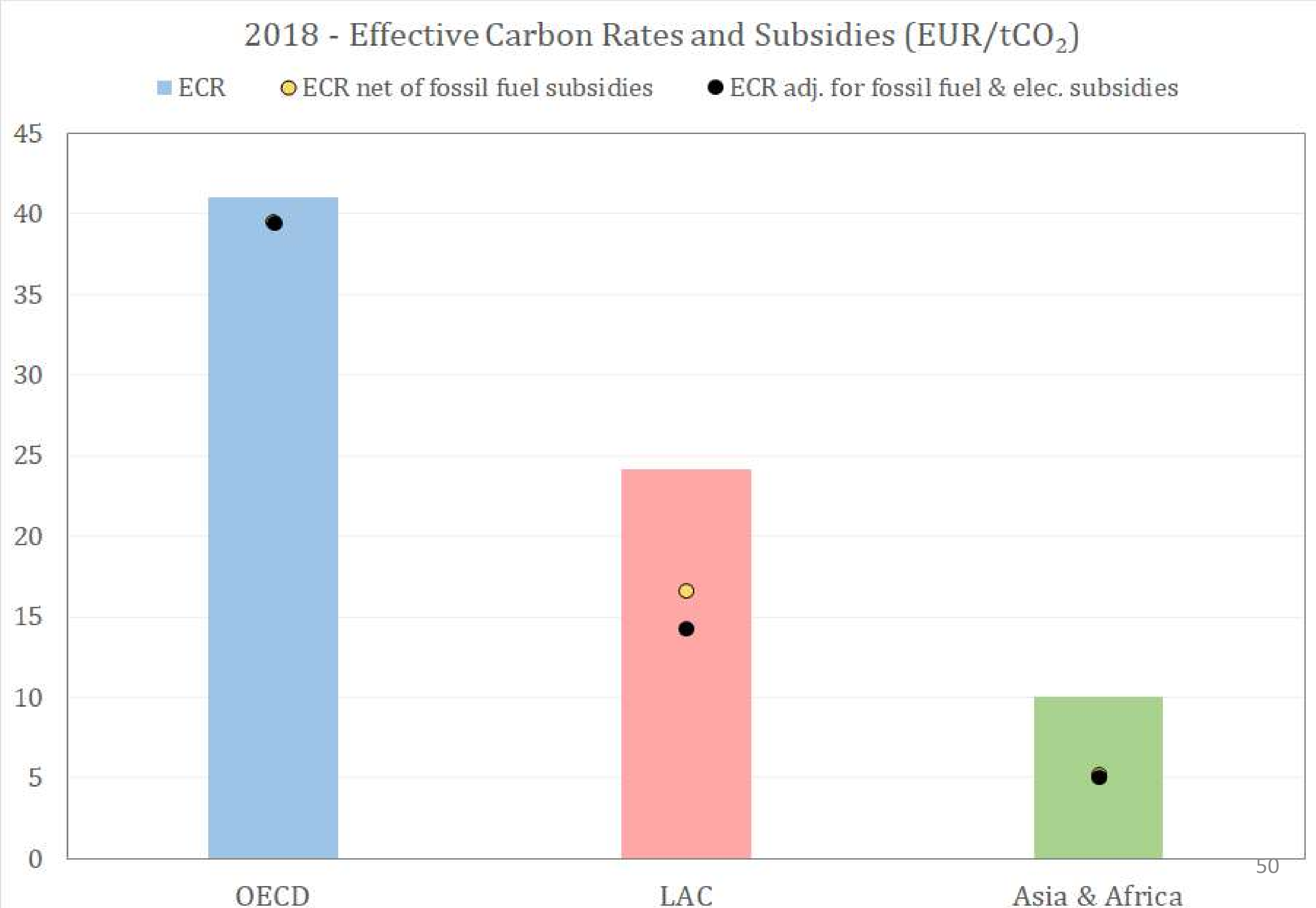
Sectoral bias of ECR: Road Transport vs Others



Sectoral and products bias of ECR



Adjusted ERC, for energy subsidies



Econometric modelling of ECR determinants

- Separate 3 models: Economy wide, Road Transport and Rest of sectors. First two models are cross section n=66, third is a panel of n=5x66.
- ECR and adjusted (for subsidies) as explained variable against a set of structural, economic and institutional variables. To handle many potential variables, an automatic algorithm (Autometrics, see Doornik, 2009 and Hendry and Doornik, 2014) helped us select the relevant determinants.
  - Uses a tree search to discard paths rejected as reductions of the initial unrestricted model based on ordered squared t-statistics, given a p-value provided by the researcher and providing misspecifications tests.
  - Allows obtaining more robust estimations by selecting the observations

Data and variables definition

- Broad group of candidate explanatory variables was compiled from various sources. These include standard income-level measures as GDP per capita (*gdp*), and indicators that intend to proxy fiscal revenue needs. Among them a proxy of the marginal cost of public funds (*mcf*) defined from optimal indirect taxation formulae (Navajas *et al*, 2012) :

$$mcf = \frac{1 + VAT}{1 + 0.1\,VAT} \qquad (2)$$

- Three blocks of explanatory variables related to governance and institutions; infrastructure quality indicators and geographical indicators

Data and variables definition

Variable group	Variable name	Description
Carbon pricing variables	**ecr**	Effective Carbon Rate (EUR/tCO2) in 2018. ECR includes fuel excises, carbon tax, and marginal permit price for ETS systems, in case these instruments are operative. Data drawn from ECR 2021 was replaced from TEU 2019 uniquely for the Road sector in the particular cases where the sectoral ECR saturated the 120 benchmark.
	ets	Dummy variable coded =1 if Emission Trading System was operative in 2018, excluding subnational systems (as for the case of USA, Canada, Japan, China).
	carbon	Dummy variable coded =1 if Carbon Tax was operative in 2018, excluding subnational systems (USA).
	subsidy_fuel	Fossil fuel subsidies (EUR/tCO2) in 2018. LAC country data is from FIEL (2020). TEU SD countries have fuel subsidy data from OECD TEU SD, but do not have electricity subsidy data, so the latter are filled with zero-values. The remainder of the countries in the document have fuel subsidy data from OECD Inventory of Support Measures for Fossil Fuels, taking into acount uniquely Budgetary Transfers, because Tax Expenditures should already be accounted for under TEU methodology. Electricity-based support measures are taken as Electricity subsidies (see below).
	subsidy_elec	Electricity subsidies (EUR/tCO2) in 2018. Same sources as above.
	adj_ecr	Effective Carbon Rate net of Fuel Subsidies (EUR/tCO2)
	adj_ecr_elec	Effective Carbon Rate net of Fuel Subsidies and adjusted for Electricity subsidies (EUR/tCO2). This estimate is done assuming a cost structure where 90% are explained by variable costs, and considering that subsidies on electricity increase the demand for fossil fuels to the extent that electricity generation is fossil-fuel based. Thus, ECR net of fossil fuel subsidies is hereby adjusted by substracting **subsidy_elec** multiplied by 0.9 and by the share of electricity generated using fossil fuels (**1-renew_elec**).
Variable group	**Variable name**	**Description**
Control variables	**gdp**	GDP per capita, 2018, PPP (constant 2017 international $)
	emission	CO2 emissions, 2018 (kg per PPP $ of GDP)
	emission_transport	Transport sector share in CO2 emissions from enery use. Keep in mind this sectoral definition encompasses Road and Off-Road transport, and takes into account emissions excluding biofuel combustion, and thus is not directly comparable with our approach.
	oil	Oil rents, 2018 (% of GDP)
	net_exporter	Dummy coded =1 if country is a net energy exporter
	renew_energy	Renewable energy consumption, 2018 (% of total final energy consumption)
	renew_elec	Renewable electricity output, 2015 (% of total electricity output)
	energy_use	Energy use (kg of oil equivalent) per $1000 GDP, 2014 (constant 2017 PPP).
	dist_loss	Electric power transmission and distribution losses (% of output), 2014
	polity	Polity Index, 2018 (10 is full democracy, -10 full autocracy)
	regqual	Normalized estimate based on a standard distribution (ranges from aprox -2.5 to 2.5). Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. 2018.
	mcf	Marginal Cost of public Funds, proxied as (1+VAT)/(1+0.1*VAT). VAT data was sourced from PWC. For USA, State-level Sales & Use tax rates were weighted by total energy consumption shares for 2018 from EIA.
	debt	Gross Government Debt (% of GDP), 2018
	deficit_prim_5	General government primary net lending/borrowing (% of GDP), 2014-2018 avg
	pop_density	Population density, 2018 (people per sq. km of land area)
	latitude	Latitude value of capital city
	elevation_span	Elevation span (distance in m from lowest to highest point)
	road_quality	Road quality index, 2017-2018 edition (1 = extremely underdeveloped—among the worst in the world; 7 = extensive and efficient—among the best in the world])
	road_density	km of road per sq. km
	road_paved	Percentage of roads paved (%)
	transport_infr	Logistics performance index: Quality of trade and transport-related infrastructure (1=low to 5=high). Nicaragua was completed due to missing data using the OLS best fit prediction based on its road_quality value, given that the correlation coefficient between both variables is 0.77.
	vehicles	Motor vehicles per 1000 people (2014)

Summary of econometric results

- A simple automatic selection of explanatory variables lead to a simplified picture: ECR main determinants selected at the economy-wide level are basically three, GDP, marginal cost of funds and the presence of ETS.
  - The first two come (as expected) from ECR determinants in the road transport sector while the third (ETS) come from its effects in the rest of sectors.
- Other structural and institutional elements play an auxiliary or secondary role, while most physical or geography variables in our large dataset are not selected.
- The effect of ETS on economy wide ECR is significant (7%). Absence of a similar effect from carbon taxes show that they are probably associated with compensatory effects in excises.
- LAC as a region is not captured as having a different model nor does it interact with individual variable effects. The only test for differences in LAC versus OECD is shown in the role of ETS, since these are not operative in LAC.

Table 1. Regression results for selected economywide models

Explanatory variables \ Dependent variable	ECR	ECR-F	ECR-F-E
Log (GDP per capita)	6.08**	6.80**	6.28**
	(2.08)	(2.01)	(2.14)
ETS	11.0**	12.5**	16.1***
	(4.09)	(3.94)	(4.21)
MCPF	104**	87.3*	73.8*
	(35.08)	(33.81)	(36.14)
CRI	57.2***	59.9***	62.4***
	(10.04)	(9.65)	(10.31)
SWIT + LUX	37.8***	37.7***	37.2***
	(7.81)	(7.50)	(8.02)
JAM		29.8**	32.1**
		(9.61)	(10.27)
EGYP		-35.9***	-33.7**
		(9.60)	(10.26)
ECU		-84.0***	-82.0***
		(9.63)	(10.29)
Constant	-157***	-149**	-131**
	(45.02)	(43.46)	(46.45)
Adjusted R^2	0.726	0.839	0.827
Observations	66	66	66

Note: ECR stands for the standard effective carbon rate, ECR-F corresponds to ECR adjusted for fuel subsidies, and ECR-F-E corresponds to ECR adjusted for both fuel and electricity subsidies. Standard errors are shown in parenthesis. * means p-value <0.05, ** p-value <0.01, and *** p-value <0.001.

Table 2. Regression results for road transport

Explanatory variables \ Dependent variable	ECR
Log (GDP per capita)	19.0**
	(6.33)
Oil	-6.24*
	(2.51)
Elevation Span	-0.005*
	(0.003)
MCPF	559***
	(125.90)
Population Density	0.147***
	(0.04)
Constant	-725***
	(147.40)
Adjusted R^2	0.571
Observations	66

Note: ECR stands for the standard effective carbon rate for the road-transport sector. Standard errors are shown in parenthesis. * means p-value <0.05, ** p-value <0.01, and *** p-value <0.001.

Table 3. Regression results for pooling of other sectors

Explanatory variables \ Dependent variable	ECR
Agriculture & Fishing Sector	-349***
	(71.44)
ETS	7.15**
	(2.41)
ETS * Agriculture & Fishing Sector	-23.5**
	(8.48)
MCPF * Agriculture & Fishing Sector	327***
	(65.64)
Baltic * Off-Road Sector	90.7***
	(1.93)
Latitude	0.100**
	(0.035)
SWI * Off-Road Sector	91.1***
	(1.55)
CRI * Agriculture & Fishing Sector	64.9***
	(4.62)
Constant	7.09***
	(1.26)
Adjusted R^2	0.419
Observations	330

Note: ECR stands for the standard effective carbon rate for the road-transport sector. Baltic dummy includes Estonia, Latvia and Lithuania. Robust standard errors are shown in parenthesis. * means p-value <0.05, ** p-value <0.01, and *** p-value <0.001.

Table 4. Regression results for cross section of other sectors

Note: ECR stands for the standard effective carbon rate for the road-transport sector. Baltic dummy includes Estonia, Latvia and Lithuania. Standard errors are shown in parenthesis. * means p-value <0.05, ** p-value <0.01, and ** p-value <0.001.

Sector	**Off-road**	**Industry**	**Agriculture & fisheries**	**Residential & commercial**	**Electricity**
Explanatory variables \ Dependent variable	**ECR**	**ECR**	**ECR**	**ECR**	**ECR**
ETS	9.41	7.37***		16.7***	10.4***
	(5.15)	(1.56)		(2.84)	(0.72)
MCPF			257***		
			(59.57)		
latitude		0.054*			
		(0.03)			
Baltic	85.2***				
	(12.02)				
SWIT	84.6***			46.5***	
	(20.05)			(11.34)	
JAM+UGA	78.4***				
	(14.30)				
DMK		16.9***			
		(4.68)			
NOR		24.0***			
		(4.69)			
SLOV		20.2***			
		(4.67)			
JAM		18.6***	82.3***		
		(4.66)	(21.54)		
CRI			72.1**		
			(21.62)		
UGA			91.1***		
			(21.51)		
TUR			85.8***		
			(21.51)		
NETH				84.7***	
				(11.34)	
ISR				48.3***	
				(11.29)	
ICE+KOR+SWIT+ UK+CRI+JAM					17.0***
					(1.24)
Constant	16.0***	3.36***	-271***	3.27	1.33***
	3.32	0.79	68.71	1.86	0.48
Adjusted R^2	0.612	0.721	0.510	0.678	0.877
Observations	66	66	66	66	66

Final comments

- Economy-wide ECR across countries are explained by GDP, the marginal cost of public funds and the existence or not of an ETS mechanism.
  - The first two variables drive the equation for road transport ECR while ETS significance comes from the panel estimate for the (poorly taxed) rest of sectors.
- The quantitative contribution of ETS to economy-wide ECR is significant (countries with ETS have on average 7% higher ECR) and shows that the introduction of ETS does not carry a compensatory adjustment of other components of ECR, mainly excises.
  - The result that there is no "carbon pricing crowding out" (if we are allowed to use the term) after the introduction of ETS is a significant result.
- The same cannot be said in the case of carbon taxes, according to our results, probably do to the fact that carbon pricing results may come with compensatory adjustments in excises in road transport fuels.

Final comments

- Three main explanatory variables, from a very large list of potential determinants, as consistent determinants of ECR. These are GDP per capita, the marginal cost of public funds, and having a nationwide ETS in operation.
  - The first two variables lead to an increase in the economywide ECR through their effects on the road transport sector.
- The significance of having a nationwide ETS in operation comes from the electricity, industry and commercial and residential sector.
  - The quantitative contribution of having an ETS to the economywide ECR is significant in magnitude, suggesting that the introduction of an ETS does not carry a compensatory adjustment of other components of ECR (e.g. excises taxes), that nullifies its effects on carbon pricing.
- This contrasts with the effect of having carbon taxes, which is not selected as a ECR determinant, probably due to policy substitution or design deficiencies.
- Policy implications on the direction of reform from 3 margins: Instruments, energy products and sectors. Country specific: It

Electricity rate structure design

Fernando Navajas

Noviembre 23, 2023

LVIII Reunion Anual de la AAEP

FCE UNCuyo Mendoza

TECHNICAL NOTE Nº IDB-TN-2766

Electricity Rate Structure Design in Latin America: Where Do We Stand? Where Should We Go?

Fernando Navajas

Inter-American Development Bank
Energy Division

August 2023

Contents of talk today

1. Current is third wave in utility pricing theory
2. Basic ingredients of third wave
3. Implications: wholesale market pricing
4. Utility rate consensus on ….?
5. Increasing block pricing: theory vs. evidence
6. Scope of rate design innovation
7. Coordination across regulatory jurisdictions in Argentina
8. Where will we go? Two polar paths

1. Current is third wave in utility pricing theory

- First wave was post IIWW with a de facto equivalence between optimal indirect and utility pricing principles due to vertically integrated public monopolies.
  - Marginal cost pricing, Ramsey Pricing, peak /off peak, two part tariffs etc. Many contributors and debates here.
- Second wave is adaptation to efficient/incentive regulation
  - Cost of service approach to utility pricing (e.g. Wollak, 2008) and use previous advances on price structures (Brown and Sibley, 1986) but perfecting (specially non linear) pricing mechanisms and accounting for informational asymmetries (Laffont and Tirole, 1993; Wilson, 1993). Dynamic pricing advances.
- Third wave is now on going and not yet completed, conceptually speaking. It stems from the energy transition process and the fundamental changes in the structure of costs, cost fluctuations due to intermittency generation, decentralization, new customer categories, use of information technologies (digitalization), storage.

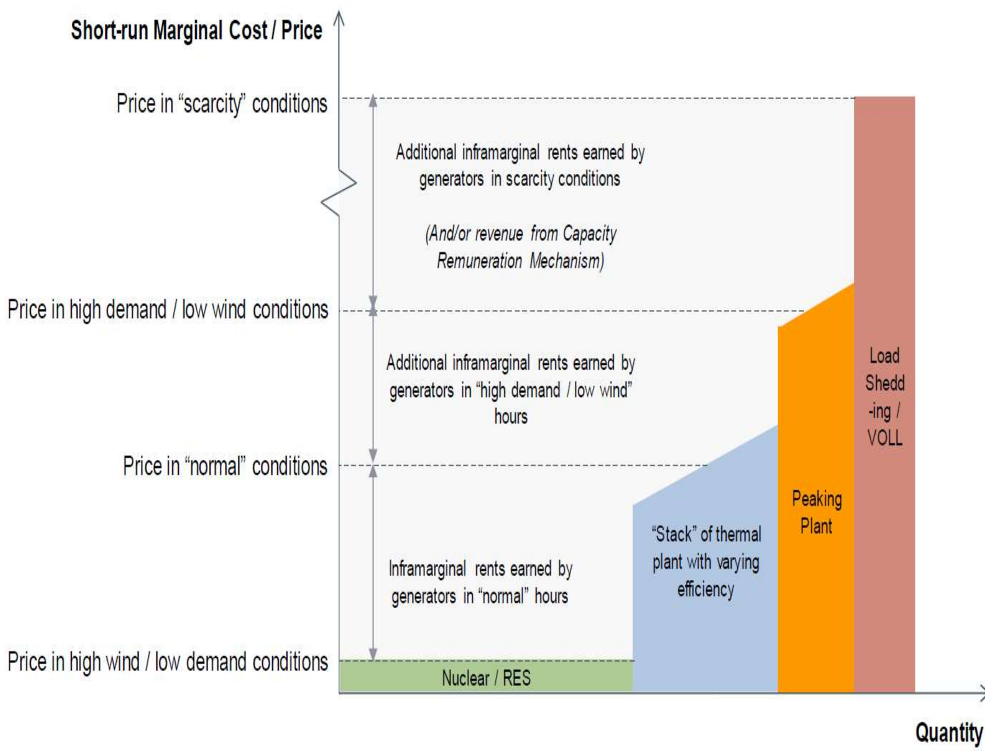
2. Basic ingredients of third wave

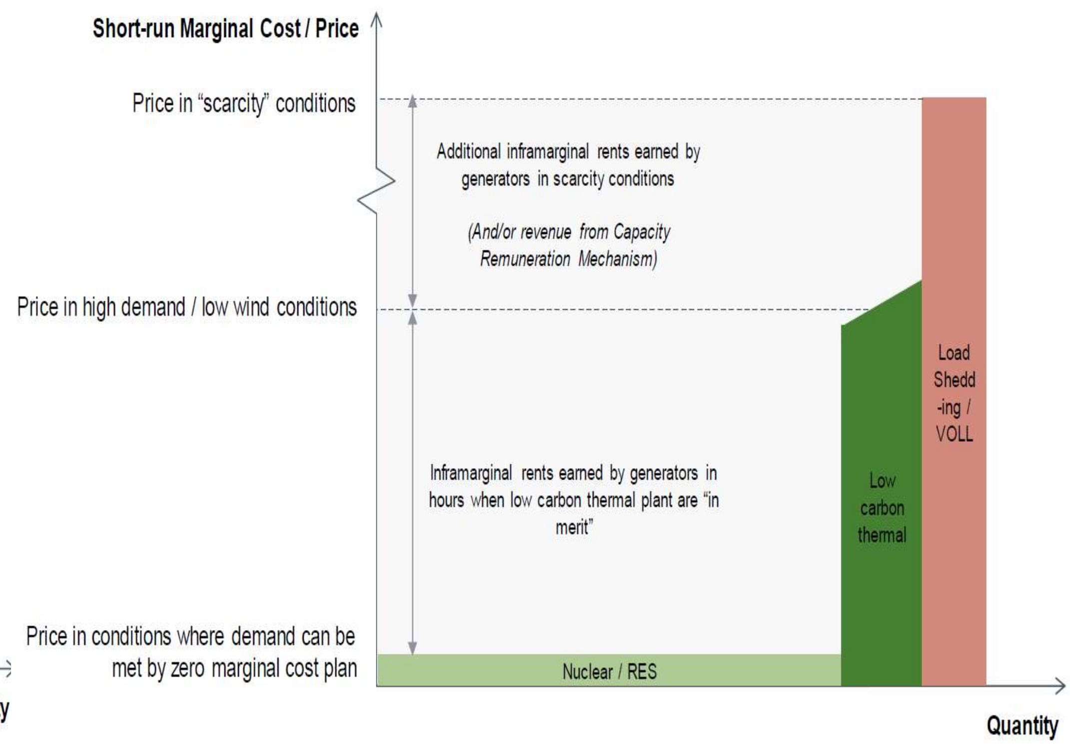
1. Marginal costs signal converges on average to low values, c↓
2. Fixed cost and capacity charges scale up due to network importance, F↑
3. Significant space and time variations of marginal cost signal due to intermitentcy and network congestion
4. Decentralization /distributed resources, exchanges with prosumers
5. Digitalization allows real time metering
6. Customer grouping (clustering) and self selection more important
7. Storage under way
8. Relative pricing of subsititutes (natural gas, gasoline) critical to acommodate socially efficient prices

Energy transition to accomodate climate change, with technological change (new products and processes, cost shifts), reorganization, affordability concerns. Price vs non-price (regulatory) instruments interact

3. Implications of third wave: wholesale markets (WM)

- Key issue in WM is whether and how to preserve marginal cost pricing, given volatility and (associated) cuasi rents allocation. EU case dilemma most prominent since 2022. PPA versus Contracts-for-Differences (CfD) versus other segmented solutions.
- Division among scholars divided on the i) way out of MCP to full PPA with a short term signal for demand, ii) preservation of mixed PPA and CfD, iii) segmentation of renewables and natural gas generation, iv) preservation of MCP to put more emphasis on extreme scarcity pricing.
  - Consensus of economic scholars in EU stays around ii) (CEPR, 2023);
  - Big consulting firms in EU looking at i) as preferred by investors (NERA, 2023);
  - Some engineering and energy systems scholars behind iii) (Grubb *et al* 2023);
  - US economic scholars more in favor of iv) to use marginal price signals to avoid distorting socially efficient pricing (Borenstein and Bushnell, 2021 might be here although with a balanced view).


Short-run Marginal Cost / Price
Price in "scarcity" conditions
Additional inframarginal rents earned by generators in scarcity conditions
(And/or revenue from Capacity Remuneration Mechanism)
Price in high demand / low wind conditions
Additional inframarginal rents earned by generators in "high demand / low wind" hours
Price in "normal" conditions
Inframarginal rents earned by generators in "normal" hours
"Stack" of thermal plant with varying efficiency
Peaking Plant
Load Shedd -ing / VOLL
Price in high wind / low demand conditions
Nuclear / RES
Quantity


Short-run Marginal Cost / Price
Price in "scarcity" conditions
Additional inframarginal rents earned by generators in scarcity conditions
(And/or revenue from Capacity Remuneration Mechanism)
Price in high demand / low wind conditions
Inframarginal rents earned by generators in hours when low carbon thermal plant are "in merit"
Low carbon thermal
Load Shedd -ing / VOLL
Price in conditions where demand can be met by zero marginal cost plan
Nuclear / RES
Quantity

4. Utility rate design consensus on….?

- **First**, marginal prices should be set close to social marginal costs and reflect scarcity values that can only be achieved through TOU pricing, not through fixed capacity charges.
- **Second**, it should not depend on quantity consumed, i.e. should be rather uniform.
- **Third**, fixed charges play an increasing role in financing fixed, common or policy costs, i.e. infrastructure services should not be charged to volumetric components.
- **Fourth**, taxes and other charges should not exacerbate the bias towards volumetric end user pricing. Rather they should collaborate on financing fixed costs and help compensating for equity impacts of reform.

Utility rate decomposition: Energy, capacity, lump-sum

Table 1

Percentage Allocation of Components of Electricity Charges

selected EU countries

Member State	Energy (%)	Power (%)	Lump-sum (%)	Year
Belgium (Brussels)	82	0	18	2020
Belgium (Flanders)	85-90	10 15	<1	2020
Belgium (Wallonia)	95	0	5	2020
Bulgaria	75	25	0	2019
Croatia	84.8	15.2	0	2019
Cyprus	100	0	0	2020
Czech Republic	51	49	0	2018
Denmark	95	0	5	2019
Estonia	81	NA	NA	2018
France	70	16	14	2019
Greece	82	18	0	2020
Hungary	77	20	3	2019
Ireland	68	9	23	2019/20
Italy	0	95	5	2020
Latvia	68	32	0	2020
Lithuania	100	0	0	2020
Luxembourg	59	16	25	2020

Correspondence tariff elements/cost categories

Table: DSO costs

	Present cost			Future cost
Cost categories	**Short-run marginal costs**	**Customer specific costs**	**Residual (sunk) costs**	**Long-run marginal costs**
Description	Network losses and variable payment related to DSR	Metering and data processing	Other costs for coverage according to the regulation	Cost for increasing capacity (wire and non-wire option)
Preferred tariff design	Marginal pricing (Energy Time of Use)	Cost-based (Fixed)	Cost-based (capacity, Fixed)	Semi-marginal pricing (Energy Time of Use, capacity peak pricing)

CEER (2020)

5. Block increasing pricing: theory

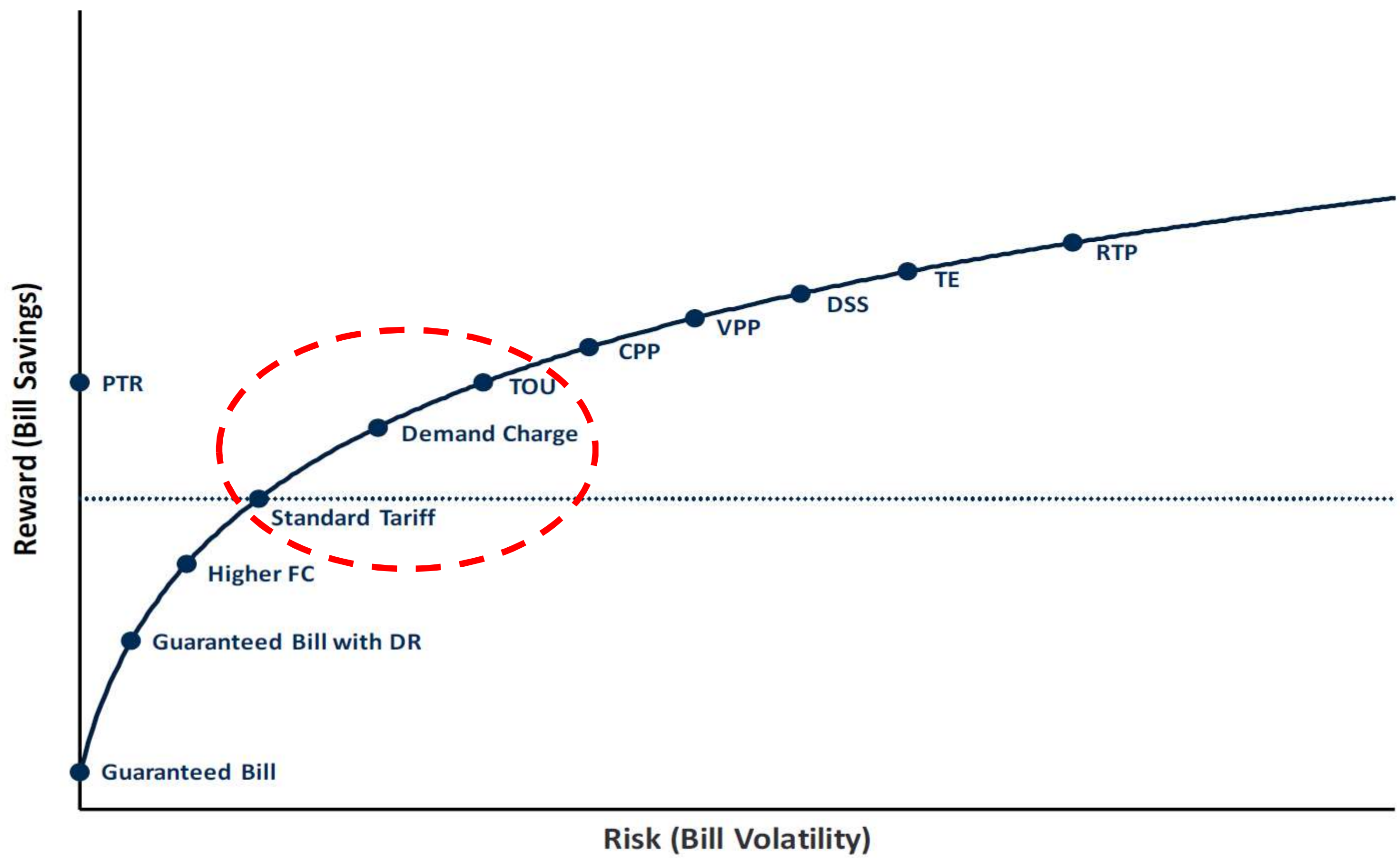
- In practice, increasing blocks are chosen presumably to pursue "progressive" or "conservationist" objectives.
- However, increasing blocks require particular assumptions (missing instruments) to arise in theory and are dominated by the trilogy of a two part tariff with a capacity charge with heterogenous fixed charges. They do a better job in terms of cost recovery, cost reflectivity and affordability.
  - Evidence in electricity consumption patterns show that Engel Curves are conditional on household characteristics that make consumption across households much uniform than previously believed (Komives *et al*, 2005) and thus the "power" of multiblock schemes to redistribute is low (Navajas, 2009).
  - Conservationist objectives or scarcity (capacity) signals cannot be properly addressed by increasing blocks of tariff outlays with frequencies of metering and billing that do not correspond or reflect those costs across time.
- Difficulty to process multi block pricing: Critique on non-linear tariffs (Ito 2014; Ito and Zhang, 2020; Shaffer, 2020) and the problem of behavioral responses or limited rationality/rate illiteracy (see also Lavandeira *et al*, 2022; which also affects to two part tariff reform.

5. Block increasing pricing: evidence

- Evidence from the US (Borenstein and Bushnell, 2021) shows that in some states blocks are either decreasing or increasing but the size or magnitude (of price variation across blocks) is rather small.
- Evidence for LAC is mixed. Brazil, Chile and Colombia do not display block pricing. Colombia is fully volumetric (fixed charge is zero). However it is rather pervasive in many countries such as Argentina, Bolivia, Costa Rica, El Salvador, Mexico, Paraguay and Uruguay. This includes block pricing of volumetric components and in some cases (Argentina, Bolivia, El Salvador, Peru and Uruguay) of differentiated fixed charges.
- Empirical evidence.
  - Navajas and Porto (1990) modeled a multiple part cuasi optimal tariff and found that the observed range of prices across blocks (10 to 1 or more !) were unjustified from a distributional characteristics (of blocks) approach. Urbiztondo *et al (*2020) found a range of fixed charges of electricity tariff in EDENOR Argentina that varied from more tan 1 US dollar (monthly) to more tan 50 dollars. Borenstein and Bushnell, 2021) shows fixed charge in the US distribute close to an average of about 10 dollars. Other papers for the US have measured and criticized the distributional power of these schemes (Borenstein 2010; Borenstein and Davis, 2010 and others).

6. Scope of rate design innovation

Utilities are beginning to offer choices of tariffs to customers



Faruqui and Tang (2021)

DOMESTIC BEST PRACTICES

North America Overview

According to 2019 EIA Form-861, **365 U.S. utilities offer at least one form of time-varying rate** to residential customers

- 335 offer Time-of-Use (TOU)
- 31 offer Critical Peak Pricing (CPP)
- 13 offer Peak Time Rebate (PTR)
- 6 offer Variable Peak Pricing (VPP)
- 9 offer Real-Time Pricing (RTP)

Altogether, **6 million customers** (or 4.5% of all residential customers) are enrolled on one of these time-varying rates.

Faruqui and Tang (2021)

INTERNATIONAL BEST PRACTICES

Progress in South America

Traditionally, Brazil offers two TOU tariff, blue and green and started to transition all residential customers to white tariff on an opt-in basis in 2018.

- Customers in Brazil purchase energy either through bilateral contracts or through regulated prices, which are based on supply-contract auctions.
- Blue and green rate design all include an energy component and a demand component
- The White divides the day into three periods – peak, intermediate, and off-peak – with peak/off-peak price ratio between 2 to 2.5, depending on the utility.
- Only about 48,000 customers are on the White

Faruqui and Tang (2021)

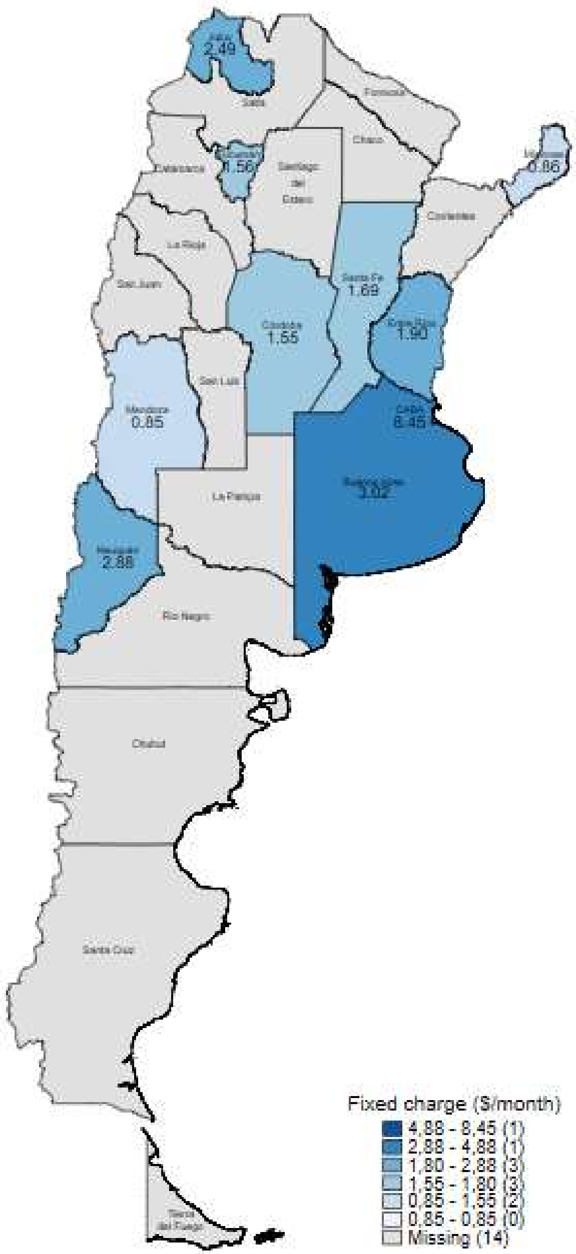
7. Coordination issues

- There is an additional coordination issue across jurisdictions, even within a fully interconnected electricity system. They may have different "regulatory constitutions" (including public enterprises) and of course Independence concerning provincial and municipal taxes.
  – Inefficiencies may arise because pricing departs from social marginal costs across jurisdictions (Borenstein and Bushnell, 2021) or because subnational taxes interfere with efficient signals.
- We address this issue. We study pricing and tax heterogeneity and a coordination scheme of "tariff format" across regulatory jurisdictions in a wholly interconnected electricity system like Argentina.

Database

- We measure the residential tariff structure of ten distributions areas of Argentina
  - which account for more than 75% of electricity consumed by households, for 2018, based on The DSOs Association (ADEERA) database.
- 2018 is our benchmark because is a stable recent year,
  - Electricity subsidies where at the lowest levels in years (FIEL, 2020) and debts or arrears between distribution companies were also relatively low (compared to nowadays).
  - Is the year of the last National Household Expenditure Survey (ENGHo). Microdata allow to allocate consumed

Sample size: 10 DSO across 10 provinces



Distribución de usuarios de acuerdo a consumo y distribuidora

			ADEERA	ENGH
Empresa	Provincia	Área [km2]	Usuarios Res nº	Usuarios Res nº
1		2		
EDENOR	GBA	4,637	2,620,458	1,027,027
EDESUR	CAP.FED.	3,304	2,227,060	3,380,355
EPESF	Santa Fe	133,696	1,180,926	914,126
EPEC	Córdoba	165,321	956,061	1,020,371
EDEMSA	Mendoza	109,908	375,953	450,840
ENERSA	Entre Ríos	56,287	326,404	359,363
EDET	Tucumán	22,524	470,853	336,739
EMSA	Misiones	16,206	193,939	248,279
EPEN	Neuquén	90,878	77,564	169,257
EJESA	Jujuy	53,219	193,429	162,023
TOTALES (10 seleccionados)		**655,980**	**8,622,647**	**8,068,380**

Argentina: Utility rate structure status quo

	Utility/Province	Argentina: Utility Rate Residential Structure 2018 in US dollars										
		Fixed Charge					Variable Charge					
		Uniform	No uniform				Uniform			No uniforme		
			N° blocks	Min	Max	Ratio Max/Min		N° blocks	Free block*	Min	Max	Ratio Max/Min
1	EDENOR (CABA)		9	1.07	50.43	47.26		9	No	0.068	0.087	1.28
2	EDESUR (GBA)		9	1.14	50.16	43.95		9	No	0.068	0.095	1.40
3	EPE (Santa Fé)	1.69	1					4	No	0.090	0.177	1.96
4	EPEC (Córdoba)		4	1.29	2.61	2.02		4	No	0.100	0.188	1.89
5	EDEMSA (Mendoza)		3	0.34	4.31	12.64		3	No	0.104	0.117	1.12
6	ENERSA (Entre Ríos)	1.90	1					4	No	0.093	0.169	1.82
7	EDET (Tucumán)		5	1.04	4.28	4.13		5	No	0.077	0.102	1.33
8	EMSA (Misiones)		7	0.54	1.41	2.60		7	No	0.074	0.110	1.48
9	EPEN (Neuquén)		7	1.60	22.53	14.09		7	No	0.122	0.095	0.78
10	EJESA (Jujuy)	2.49	1					2	No	0.090	0.112	1.24

Source: Navajas and Olguin (2022), own calculation based on ADEERA

Blocks for fixed charges oscillate between up to 9 blocks, with Max/Min ratios from 1 to 47. Blocks for variable charges go from 3 to 9 with a milder escalation; ratio of 1.96

Argentina: Provincial Taxes on electricity

		Argentina: Provincial Taxes					
		No Taxes	Ad-Valorem				Specific
	Utility/Province		Uniforme	Non uniform			Uniform
				Min	Max	Diferencia	
1	EDENOR (CABA)	**X**					
2	EDESUR (GBA)		0.64%				
3	EPE (Santa Fé)		1.50%				0.10 $/month
4	EPEC (Córdoba)			0.50%	2.00%	4.00	
5	EDEMSA (Mendoza)		12.59%				
6	ENERSA (Entre Ríos)			0.00%	11.00%		
7	EDET (Tucumán)		1.50%				
8	EMSA (Misiones)		1.50%				
9	EPEN (Neuquén)	**X**					
10	EJESA (Jujuy)		1.50%				

Source: Navajas and Olguin (2022), own calculation based on ADEERA

Taxes at the provincial level are absent in two cases, and mostly ad-valorem and uniform for the rest, with rates that go from 0.6% (of the bill) to 12.6%.

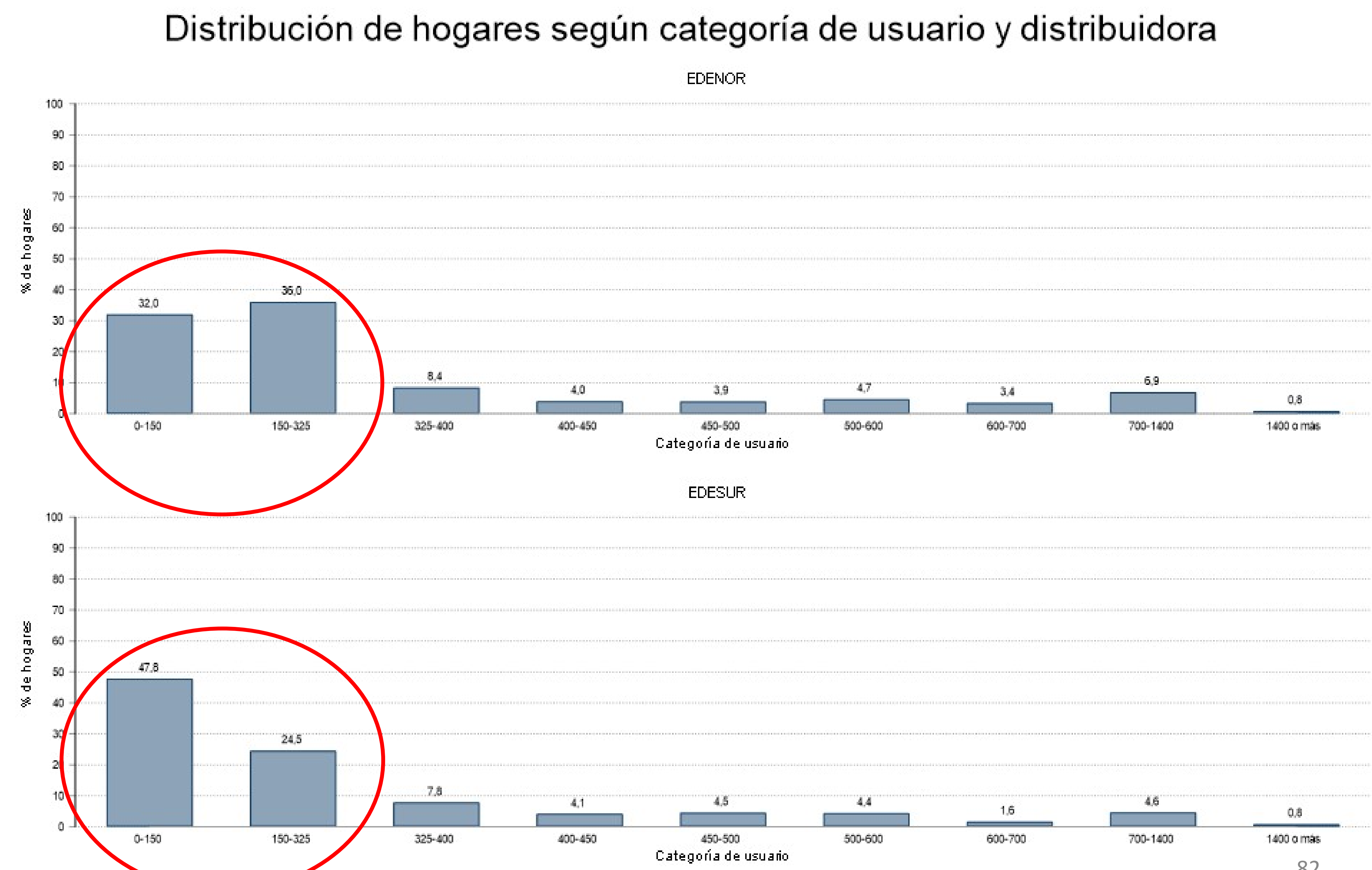
Argentina: Municipal Taxes on electricity

		Argentina: Municipal Taxes				
		No Tax	Ad-Valorem			
	Utility/Province		Uniform	No uniform $/month		
				Min	Max	Ratio Max/Min
1	EDENOR (CABA)		6.38%			
2	EDESUR (GBA)		6.42%			
3	EPE (Santa Fé)		8.40%	1.49	24.68	16.56
4	EPEC (Córdoba)		10.00%			
5	EDEMSA (Mendoza)			3.15	5.37	1.70
6	ENERSA (Entre Ríos)		24.70%			
7	EDET (Tucumán)		15.00%			
8	EMSA (Misiones)			0.10	0.23	2.29
9	EPEN (Neuquén)		4.50%			
10	EJESA (Jujuy)		6.00%	4.64	7.56	1.63

Source: Navajas and Olguin (2022), own calculation based on ADEERA

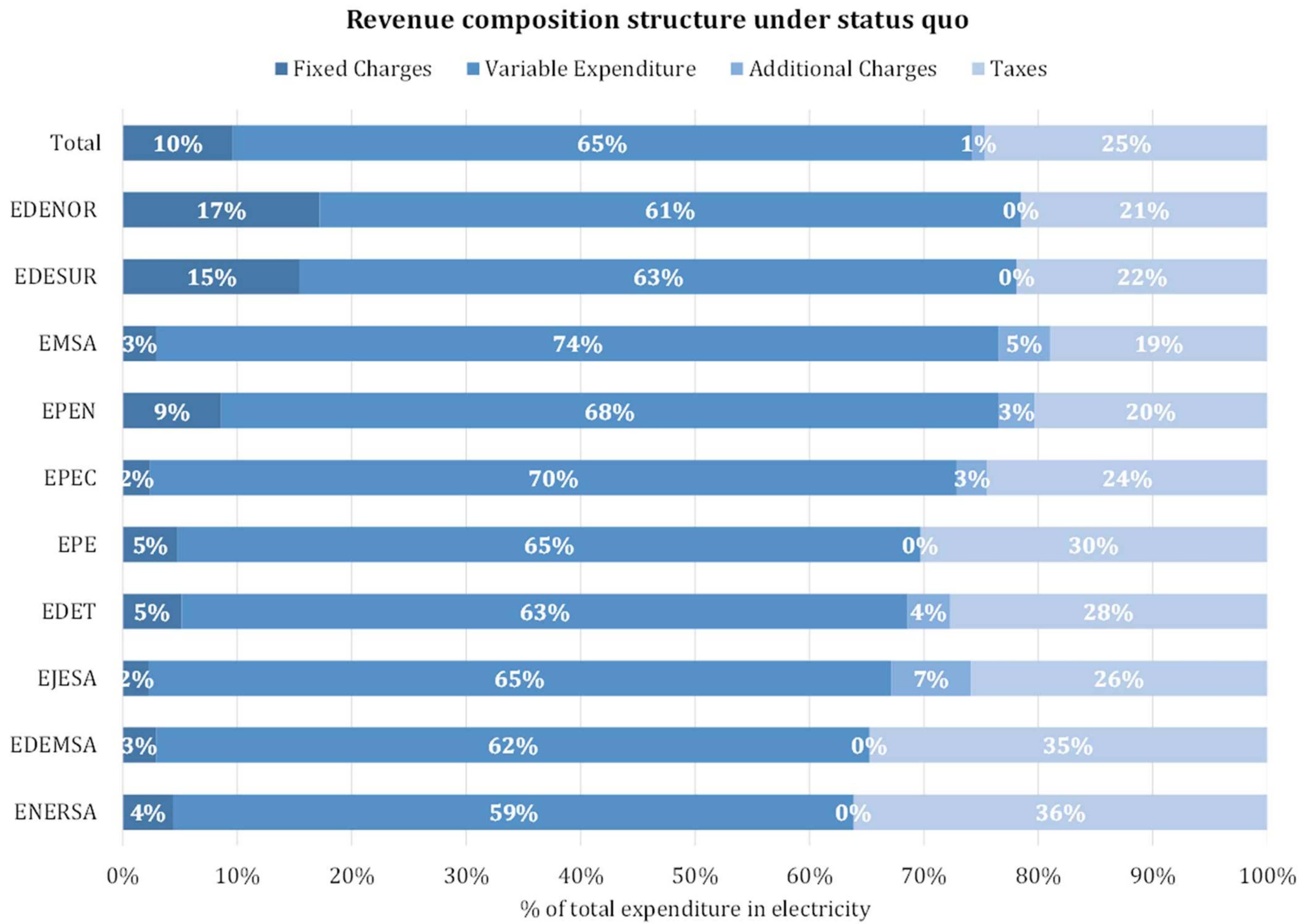
Taxes at the municipal level have also mostly ad-valorem components that have a uniform format oscillating between 4.5% and 24.7%, with 4 out of 10 utilities facing a specific format with increasing blocks.

Household distribution across increasing block tariffs



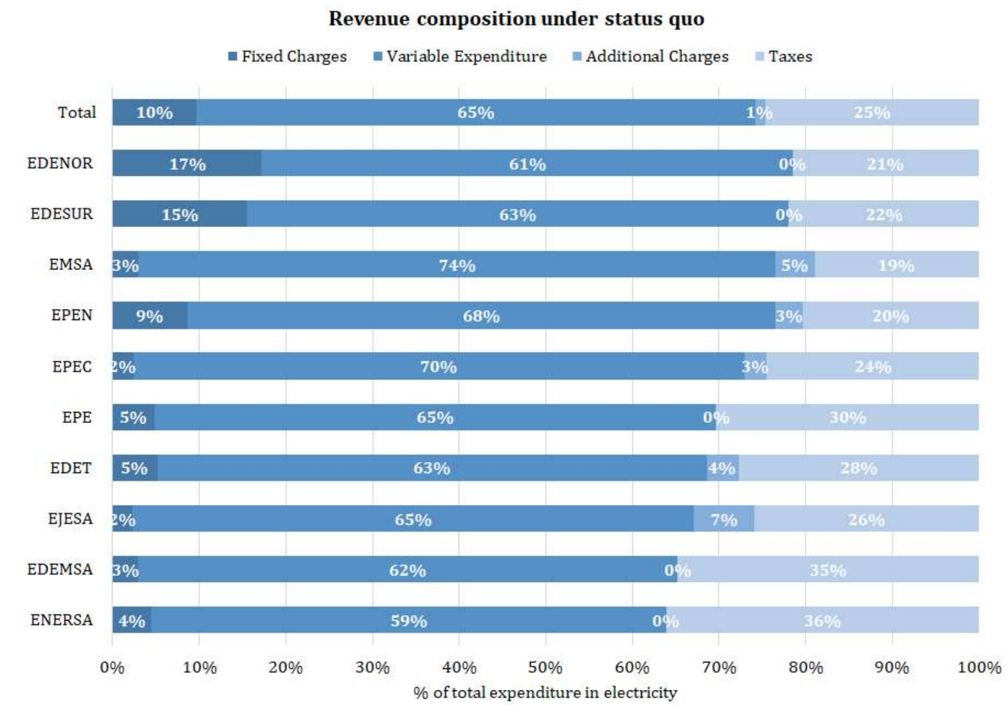
Fuente: Elaboración propia en base a datos de ENGHo 17-18 y ADEERA.

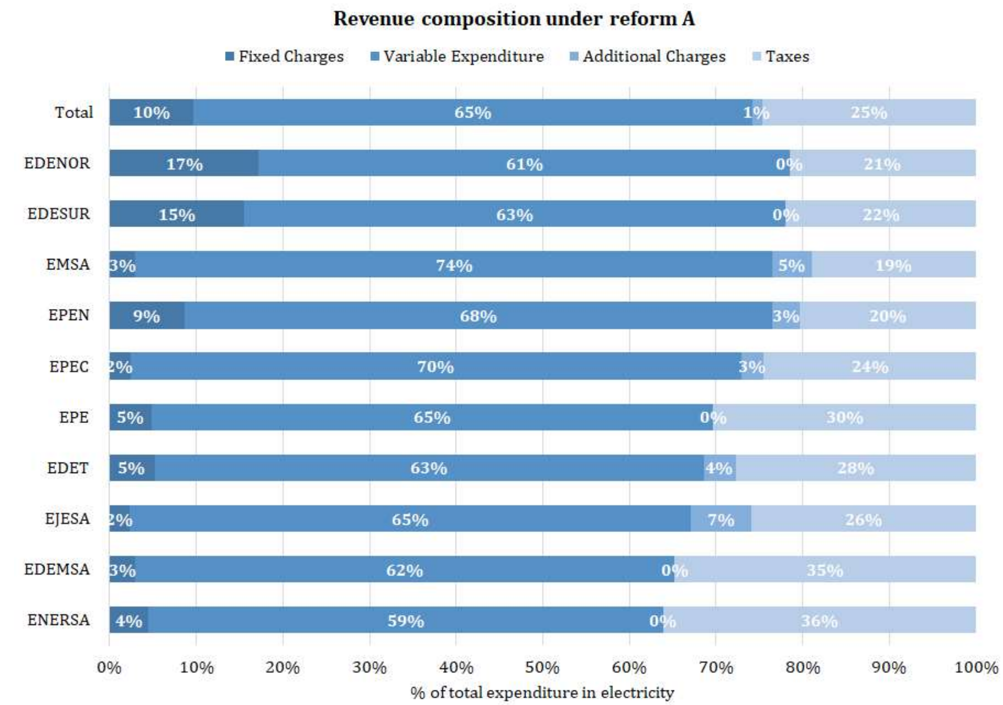
Pricing /revenue+tax structure: status quo

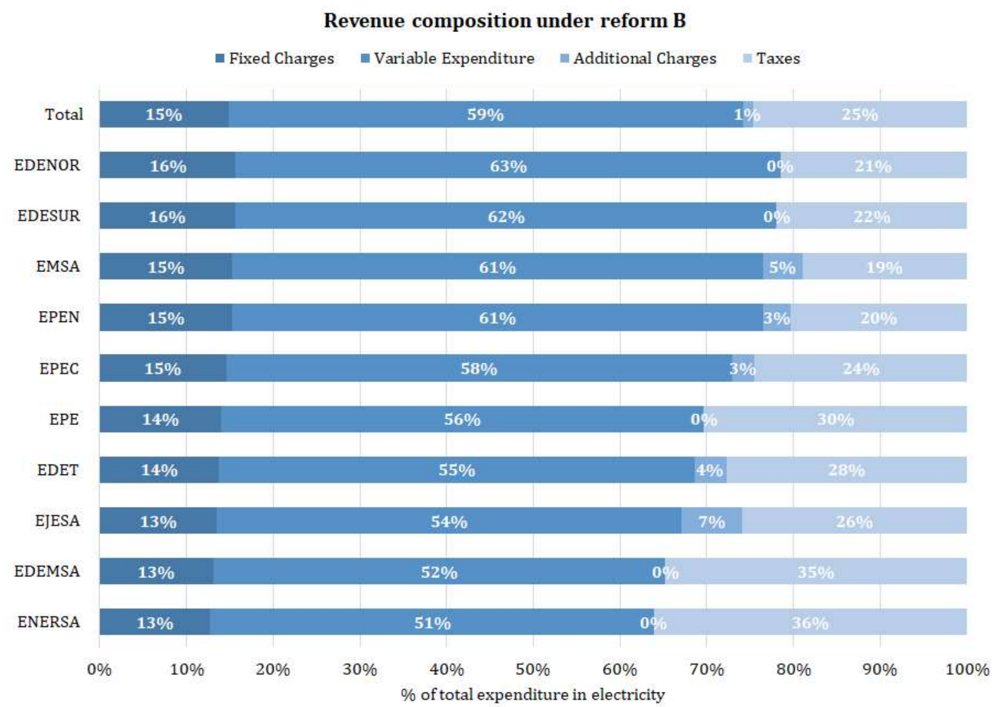


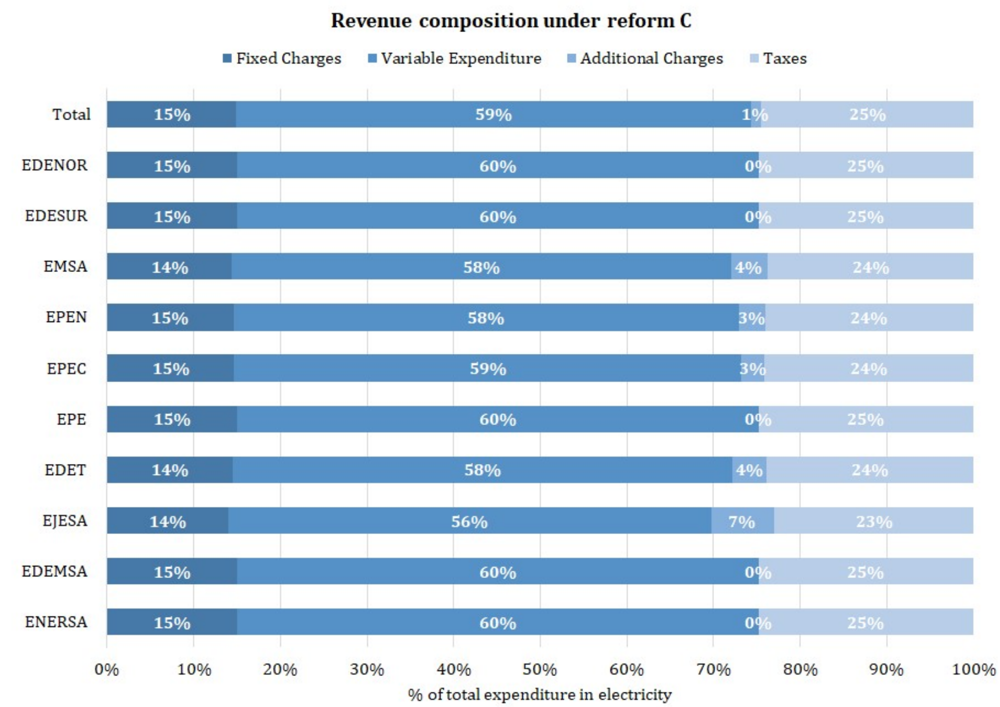
Three coordination reform exercises

- They are basically a reform of the tariff structure format, an increase in the share of fixed charges and a ceiling on the share of taxes.
- They must account for revenue neutrality for utilities and also for subnational jurisdiction, in the latter case involving a distribution share mechanism.
- Also, lump sum transfers across households are required is able to account for the impacts or incidence across household deciles.
- **Reform A:** Move to two part tariff format keeping revenue and tax structure


Revenue composition under status quo
Fixed Charges
Variable Expenditure
Additional Charges
Taxes
Total 10% 65% 1% 25%
EDENOR 17% 61% 0% 21%
EDESUR 15% 63% 0% 22%
EMSA 3% 74% 5% 19%
EPEN 9% 68% 3% 20%
EPEC 2% 70% 3% 24%
EPE 5% 65% 0% 30%
EDET 5% 63% 4% 28%
EJESA 2% 65% 7% 26%
EDEMSA 3% 62% 0% 35%
ENERSA 4% 59% 0% 36%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
% of total expenditure in electricity


Revenue composition under reform A
Fixed Charges
Variable Expenditure
Additional Charges
Taxes
Total 10% 65% 1% 25%
EDENOR 17% 61% 0% 21%
EDESUR 15% 63% 0% 22%
EMSA 3% 74% 5% 19%
EPEN 9% 68% 3% 20%
EPEC 2% 70% 3% 24%
EPE 5% 65% 0% 30%
EDET 5% 63% 4% 28%
EJESA 2% 65% 7% 26%
EDEMSA 3% 62% 0% 35%
ENERSA 4% 59% 0% 36%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
% of total expenditure in electricity


Revenue composition under reform B
Fixed Charges
Variable Expenditure
Additional Charges
Taxes
Total 15% 59% 1% 25%
EDENOR 16% 63% 0% 21%
EDESUR 16% 62% 0% 22%
EMSA 15% 61% 5% 19%
EPEN 15% 61% 3% 20%
EPEC 15% 58% 3% 24%
EPE 14% 56% 0% 30%
EDET 14% 55% 4% 28%
EJESA 13% 54% 7% 26%
EDEMSA 13% 52% 0% 35%
ENERSA 13% 51% 0% 36%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
% of total expenditure in electricity


Revenue composition under reform C
Fixed Charges
Variable Expenditure
Additional Charges
Taxes
Total 15% 59% 1% 25%
EDENOR 15% 60% 0% 25%
EDESUR 15% 60% 0% 25%
EMSA 14% 58% 4% 24%
EPEN 15% 58% 3% 24%
EPEC 15% 59% 3% 24%
EPE 15% 60% 0% 25%
EDET 14% 58% 4% 24%
EJESA 14% 56% 7% 23%
EDEMSA 15% 60% 0% 25%
ENERSA 15% 60% 0% 25%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
% of total expenditure in electricity

8. Where will we go? Two polar paths

“signal-efficiency model”

- *c*ompetitive wholesale market;
- incentive regulation 2.0
- Pervasive smart metering;
- two-part tariffs+ capacity charge+ packages+ new tariff clusters;
- social marginal cost pricing;
- time of use;
- Lump sum fiscal subsidies to solve affordability.

”cross-subsidy model”

- Segmented wholesale market
- basic incentive regulation;
- Restricted metering
- block pricing with differentiated blocks + restricted capacity charge
- average cost pricing;
- restricted time of use;
- Subsidies fundamentally embedded in pricing.