DESIGNING PROCUREMENT MARKETS TO REDUCE GOVERNMENT SPENDING

MARCELO OLIVARES

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WHY STUDY PUBLIC PROCUREMENT?

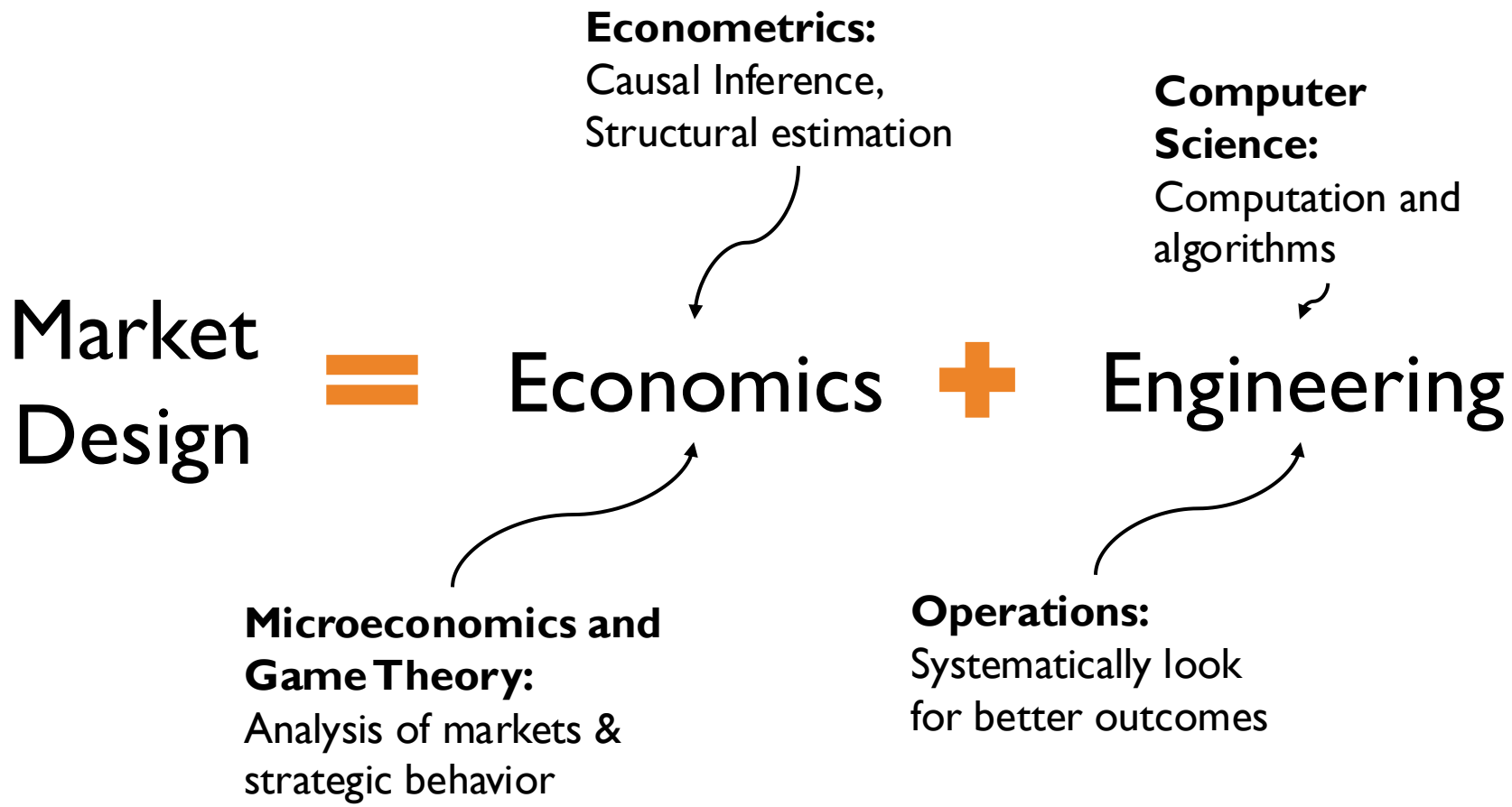
- Public procurement amounts $10 trillion (13-20%) of the World GDP (Source: WorldBank, OECD)
- Large inefficiencies in Public Procurement markets:
  - Corruption costs 10-25% of a public contract's overall value.
  - In Latin America, public procurement has lead to huge political scandals (see Netlfix series "The Mechanism").
- Procurement plays an important role in delivering public services to vulnerable populations:
  - School programs (food, books, supplies)
  - Healthcare: medical drugs and equipment to expand coverage of public health programs.
  - Small improvements can lead to large savings in government spending and increase coverage.
- Details in the design of the public market matter (Klemperer 2004):
  - Central Procurement Bodies play an important role: account for more than 10% of purchases in OECD countries, with saving in the order of 20-40%. (Dubois et al. 2021).
  - Multiple purchase mechanisms: need to decide which are more appropriate to satisfy different government needs (Dimitri et al 2006, Coviello et al 2018)

So what's the "science" behind public procurement?

If the government needs to buy something, just go and buy it!

MARKET DESIGN

Design rules of the markets to obtain better outcomes



CONDUCTING RESEARCH IN PUBLIC PROCUREMENT

Advantages

- Multidisciplinary:
  - Operations, Economics, Computer Science, Behavioral Sciences.
- Combines analytical modeling and empirical research.
- Public data facilitates access and replication.
- Can have a high cost-effectiveness when used in practice.

Challenges

- Political issues may generate resistance to change.
- Testing and pilot studies can take a long time.
- Government turnover can affect continuity of research projects.

Market-wide Field Experiments in Collaboration with the Government

PURCHASE MECHANISMS IN PUBLIC PROCUREMENT

Competition to enter the market
Low product variety
Complex purchase process

Competition within the market
High product variety
Simple purchase process

Procurement Auction	Framework Agreement	Open Marketplace
Single supplier	Few Suppliers / Many Suppliers	Free Entry
Fixed demand	Variable demand with allocation rules	Variable demand
Fixed price	Maximum price	Variable price

IMPROVING EFFICIENCY IN GOVERNMENT PROCUREMENT: COLLABORATION WITH CHILE'S CENTRAL PROCUREMENT BODY

Dirección ChileCompra

Central procurement body in Chile (5% of GDP)

Product catalogue

- Define product attributes
- Define procurement needs.

Design Procurement Mechanisms

- Generate competition among suppliers
- Lower administrative costs for CPB

Monitor Public Purchases

- Measure spending efficiency
- Align incentives of buyers

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Saving Millions in Government Procurement Through Data Science and Market Design

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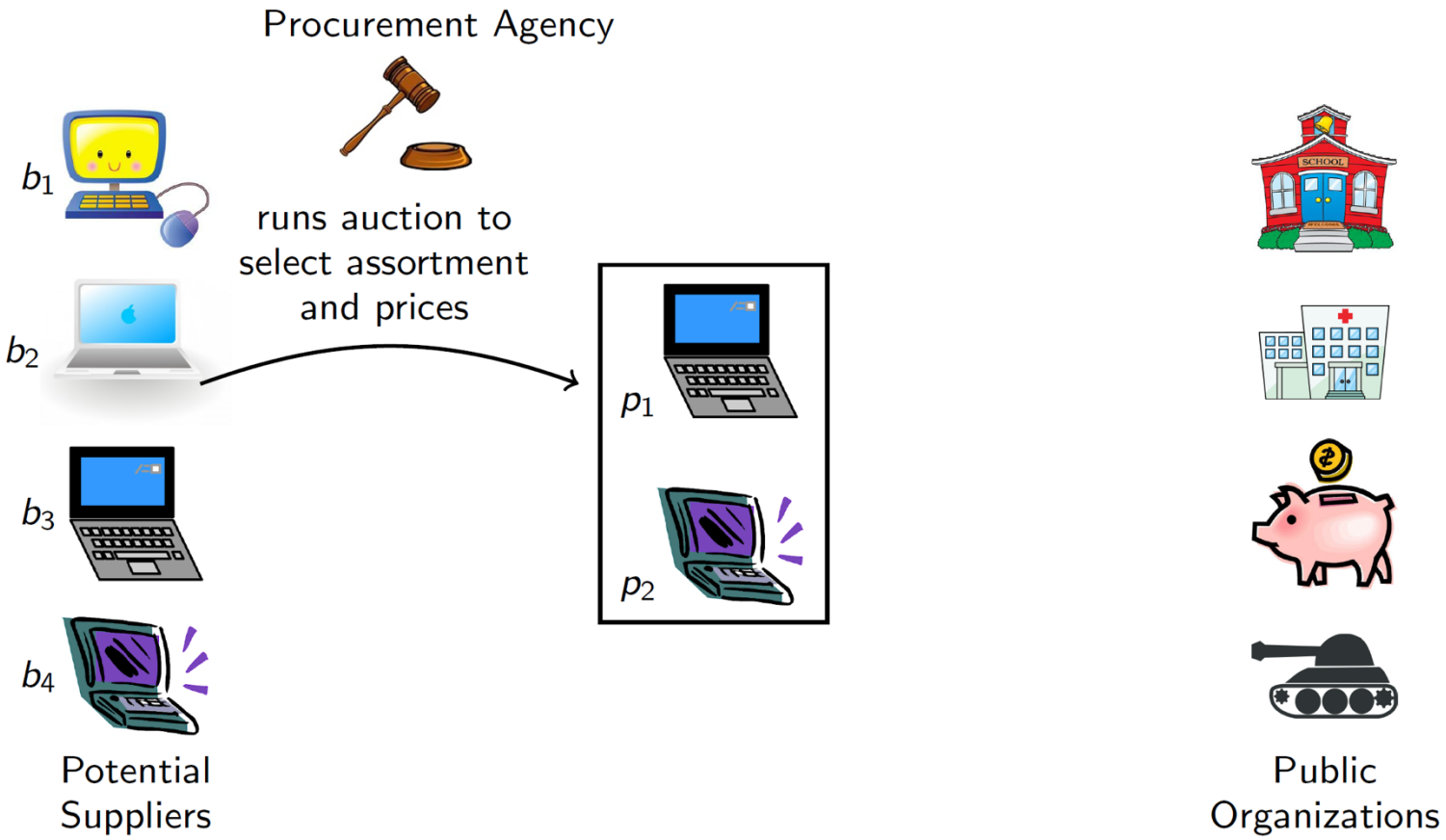
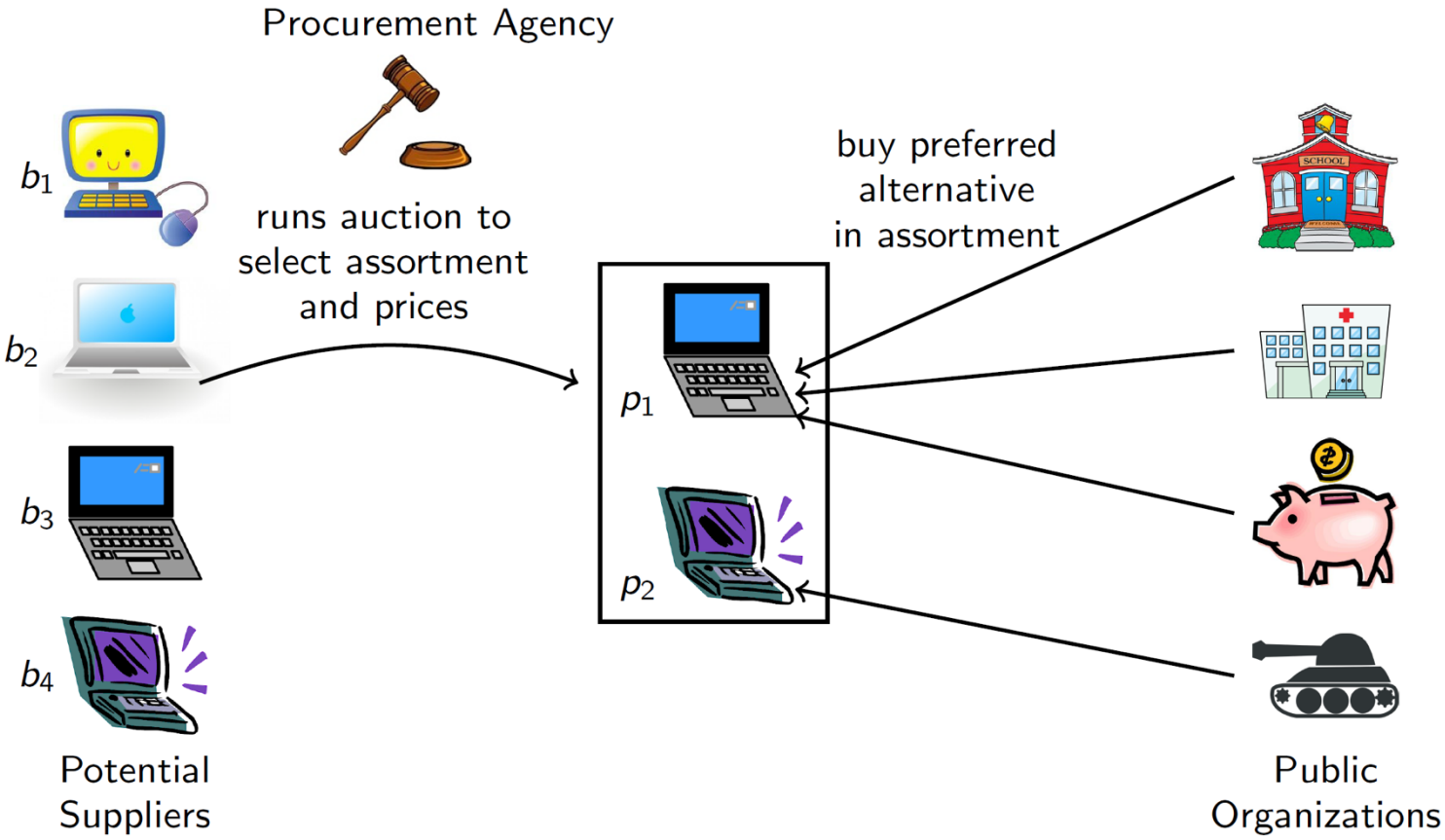
TWO-STAGE COMPETITION IN FRAMEWORK AGREEMENTS



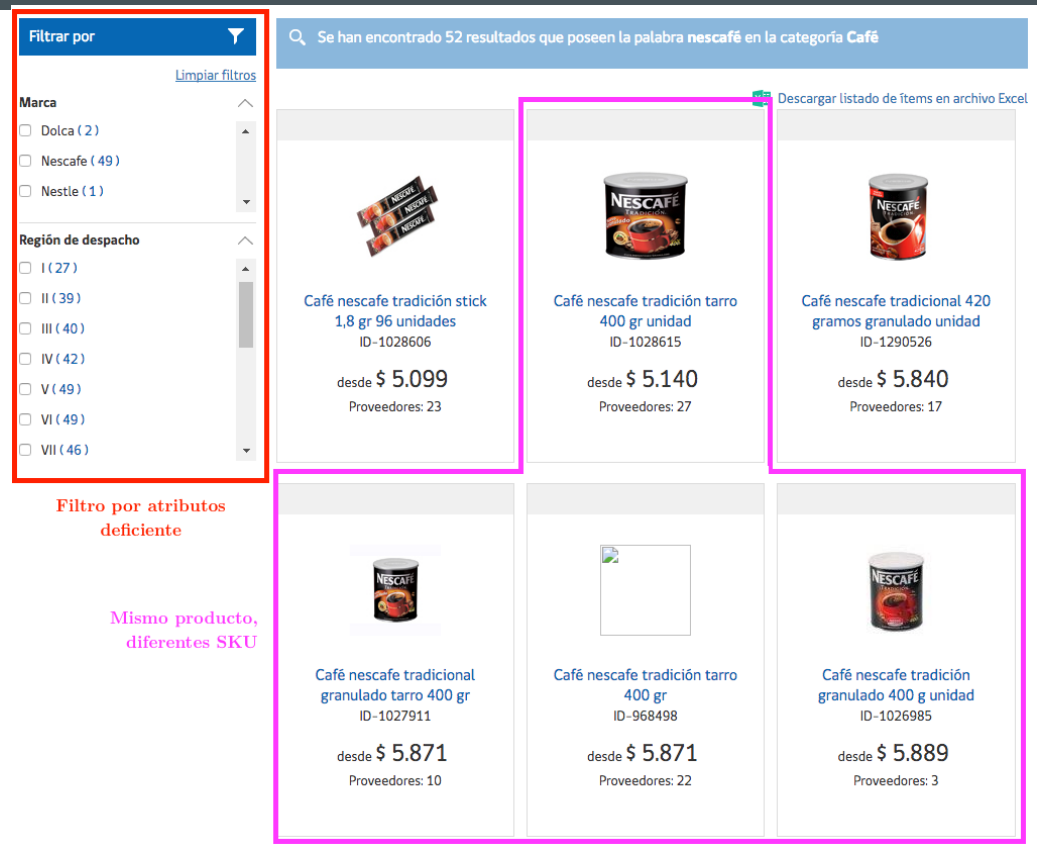
*Original slides from Daniela's job market talk (2014-2015)

TWO-STAGE COMPETITION IN FRAMEWORK AGREEMENTS



*Original slides from Daniela's job market talk (2014-2015)

LACK OF PRODUCT STANDARDIZATION LEADS TO LOW COMPETITION



- **Food Electronic Catalogue:** 8000 SKUs, $100 M in annual purchases.
- Attributes that characterize a product were not standardized.
- Difficult for buyers to search catalogue for lowest price

- High price dispersion.
- 80% of the bids were awarded.
- 60% of the auctions had a single bidder.

KEY MARKET DESIGN LEVER: COMPETITION WITHIN OR TO ENTER THE MARKET

The two stages of a FA:

FA Auction (first-price format):
- Decides FA assortment.
- Set ceiling prices (bids).

FA Operation: (a few years)
- Suppliers change (decrease) prices.
- Organizations buy as needed.

Effect of increasing competition in first stage is ambiguous:

Increasing competition **decreases (ceiling) prices**

Fewer suppliers **reduces price competition during the operation**

Theoretical work in stylized FA models* suggest that increasing competition at auction stage may reduce transaction prices and thus total spending.

*Saban, D. and Weintraub, G. (2021), "Procurement mechanisms for assortments of differentiated products," *Oper. Research*
*Choi, J.O., Saban, D., Weintraub, G. (2022)., "The design of optimal pay-as-bid procurement mechanisms," *M&SOM*

MY FIRST EXPOSITION TO AI: CATALOGUE AUTOMATION USING SCALABLE NATURAL LANGUAGE PROCESSING (NLP)

External product catalogues

Walmart

freshdirect

Kroger

Unsupervised NLP (word2vec) to identify product categories and attributes

Dictionary of Categories & Attributes

Coffee: {ground/bean, decaf, brand, units, mass}
Oil: {Olive/Canola, brand, plastic/glass, units, volume}

Structured Catalogue for the FA with selected Standardized Products

Chilecompras Historical Transactional DB with unstructured products

Café nescafe tradicional 420 gramos granulado unidad

Classify new product entry based on existing categories and attributes

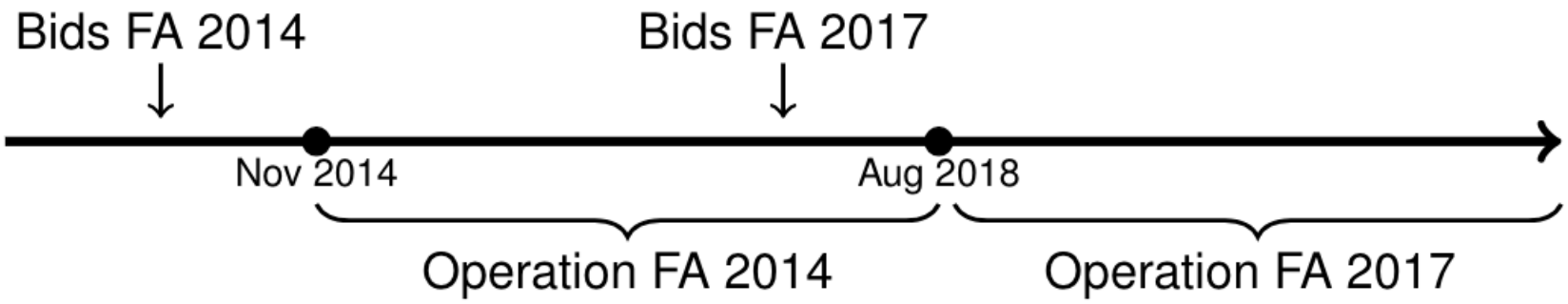
Low

Expert assesment + update dictionary

High confidence

Analysis of Public Market:
- Purchase volume
- Variety
- Cross-section of buyers

MEASURING THE IMPACT OF INCREASING COMPETITION IN THE AUCTION PHASE OF THE FRAMEWORK AGREEMENT



"Competitive" Treatment:	Old Design, Product A: Award 80% of bids	New Design, Product A: Award 20% of bids	$\Delta Price\ A$
Baseline Treatment:	Old Design, Product B: Award 80% of bids	New Design, Product B: Award 80% of bids	$\Delta Price\ B$

Results: Lowers transactions prices by 8%

Effect of Competition to enter the market $= \Delta Price\ A - \Delta Price\ B$

RESULTS

(1): Median submitted bids decreased by 14.1% for all auctions; no difference across treatments.

	Bids	
	Submitted	Awarded
	(1)	(2)
New	-0.141^{***}	-0.055^{***}
	(0.006)	(0.007)
New×Comp	-0.002	-0.081^{***}
	(0.010)	(0.013)
Observations	12,349	11,382
R^2	0.923	0.892
Adjusted R^2	0.920	0.887

Note: *p<0.1; **p<0.05; ***p<0.01

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(2): Competitive treatment reduced awarded bids in an additional 8.1%

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	Bids		*Prices*	
	Submitted	Awarded	Posted	Transaction
	(1)	(2)	(3)	(4)
New	-0.141^{***}	-0.055^{***}	-0.025^{***}	0.004^{***}
	(0.006)	(0.007)	(0.001)	(0.002)
New×Comp	-0.002	-0.081^{***}	-0.092^{***}	-0.082^{***}
	(0.010)	(0.013)	(0.001)	(0.002)
Observations	12,349	11,382	973,195	180,421
R^2	0.923	0.892	0.961	0.974
Adjusted R^2	0.920	0.887	0.961	0.974

Note: *p<0.1; **p<0.05; ***p<0.01

(3): Competitive treatment reduced posted prices and transaction prices in the order of 8-9%

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(3): Competitive treatment reduced posted prices and transaction prices in the order of 8-9%

US$12 million per year extrapolating to the entire Food FA.
The design was scaled to all FAs, with estimated savings of around US$ 74 million per year for the Chilean government.

IMPROVING EFFICIENCY IN GOVERNMENT PROCUREMENT: COLLABORATION WITH CHILE'S CENTRAL PROCUREMENT BODY

Dirección ChileCompra

Dirección de Presupuestos Gobierno de Chile

DIPRES Dirección de Presupuestos

DIPRES: Budget office of the Ministry of Finance

Product catalogue

- Define product attributes
- Define procurement needs.

Design Procurement Mechanisms

- Generate competition among suppliers
- Lower administrative costs for CPB

Monitor Public Purchases

- Measure spending efficiency
- Align incentives of buyers

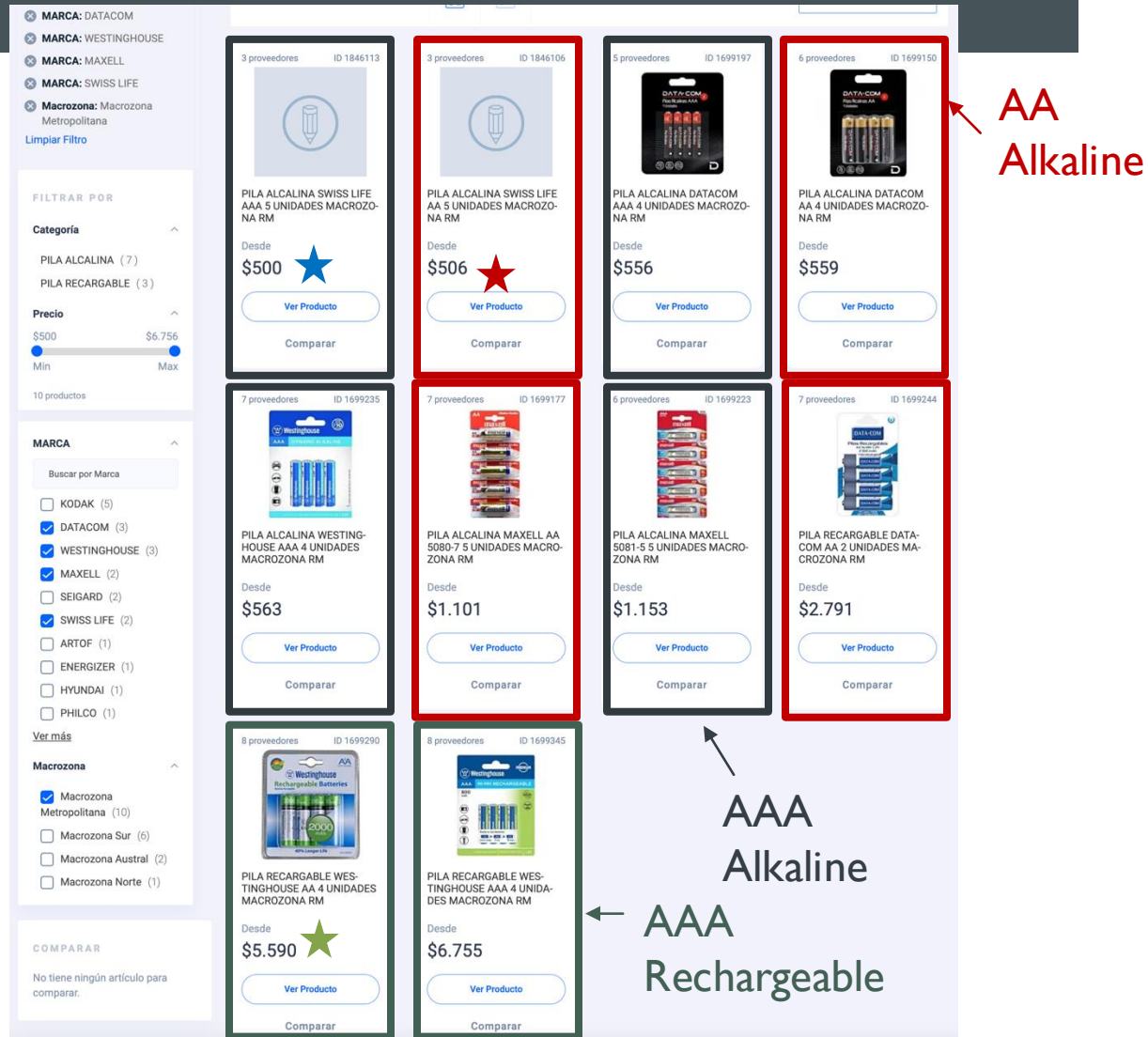
Pablo A. Celhay, Paul J. Gertler, Marcelo Olivares, and Raimundo Undurraga, (2024) "How Managers Can Use Purchaser Performance Information to Improve Procurement Efficiency," NBER Working Paper 32141, http://www.nber.org/papers/w32141

MONITORING OVER-SPENDING IN PUBLIC PURCHASES

- Products are grouped based on their attributes.
- Reference price:
  - Collect weekly posted prices
  - Choose lowest price as reference
- For each item in every transaction, calculate **Overprice** as:

$$Overprice = \frac{Transacted\ Price\ - Reference\ Price}{Reference\ Price}$$

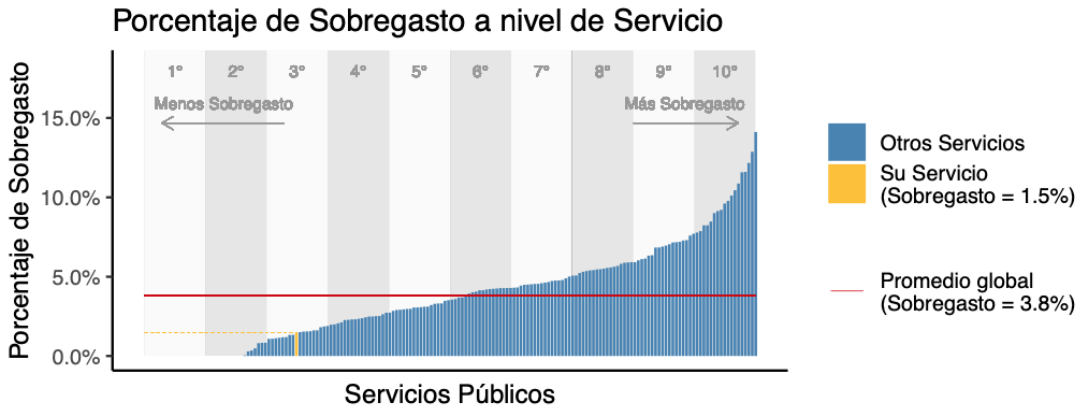
- Generated for product categories purchased by most organizations (office supplies and furniture, food, household, tools/hardware, computers, etc.)

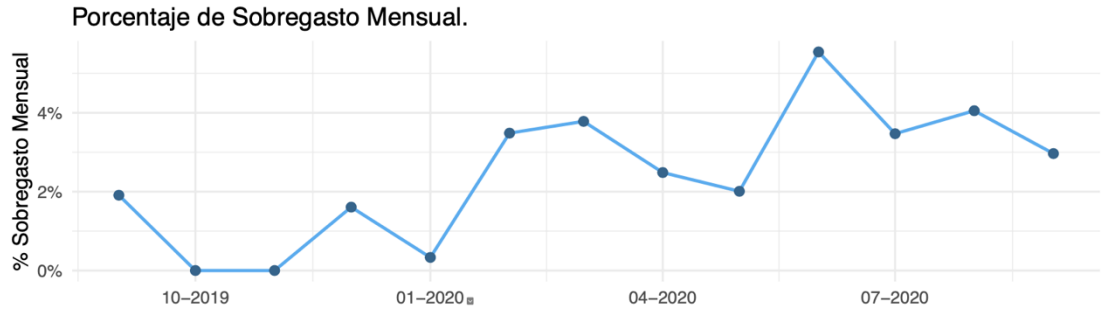


EXAMPLES OF MONTHLY REPORTS

Unit's performance info

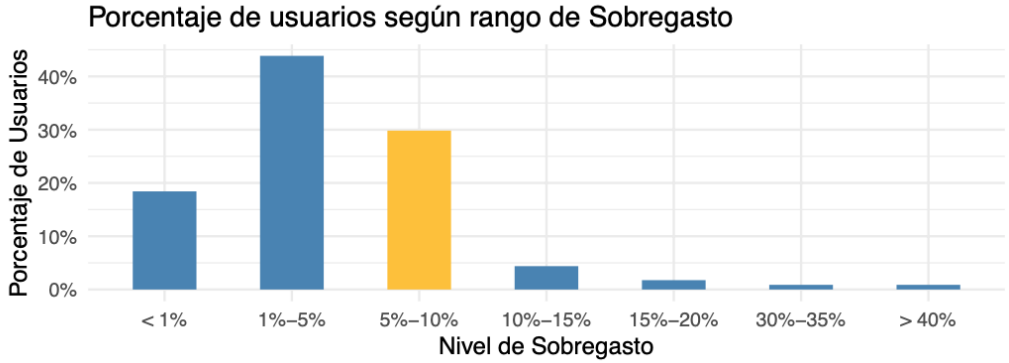
(184 government units)





Employee's performance info

(8400 government employees)



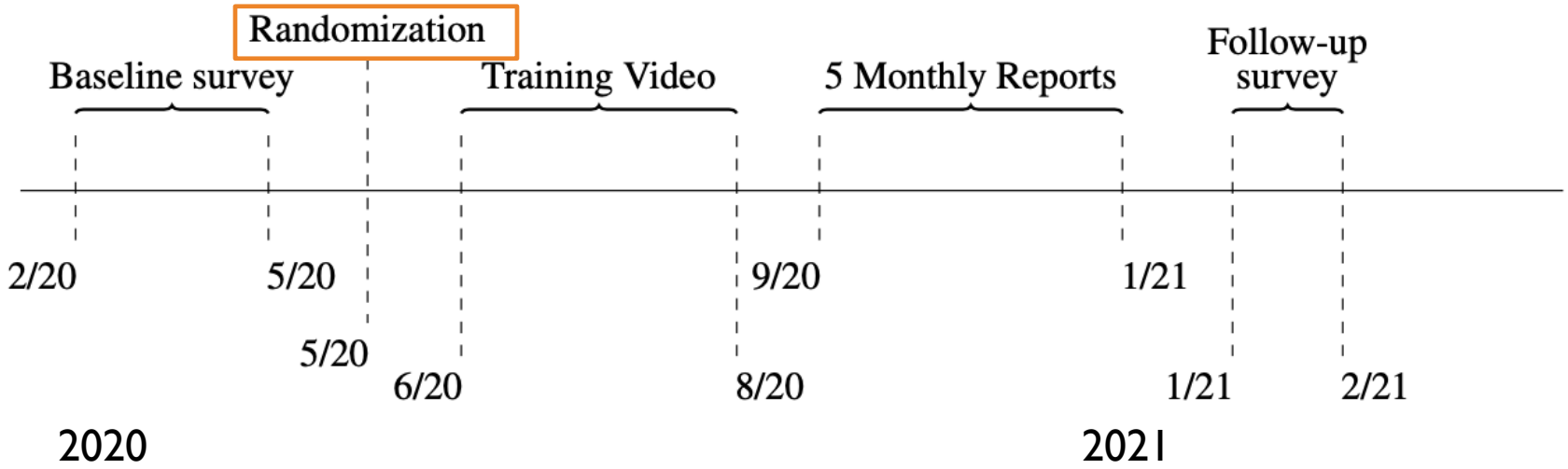
Dirección de Presupuestos
Gobierno de Chile

DIPRES
Dirección de Presupuestos

Public Budget Office, Ministry of Finance

IMPLEMENTATION OF FIELD EXPERIMENT

Treatment (# services)	Manager intervention	Employee intervention
I. Private Treatment (61 units) *Intrinsic motivation*	Training Info on unit's performance	Training Info on unit's performance Info on individual performance
II. Public Treatment (62 units) *Intrinsic + Extrinsic motivation*	Training Info on unit's performance Detailed info on employees' individual performance	Training Info on unit's performance Info on individual performance "Your boss is watching this report"



MAIN RESULTS: PUBLIC TREATMENT (BUT NOT PRIVATE) REDUCES OVERSPENDING

	% of Purchases in CM	Overprice	Log(Quantity)	Log(# P.O.)
	(1)	(2)	(3)	(4)
Treat: Public	-0.012	-0.021***	0.139	0.051
	(0.018)	(0.007)	(0.105)	(0.080)
Treat: Private	0.007	0.005	-0.033	0.115
	(0.017)	(0.005)	(0.101)	(0.074)
Control mean	0.552	0.087	3.42	1.54
N Observations	2,402	134,151	134,151	2,402
N Buyers	2,402	2,402	2,402	2,402
N Agencies	160	160	160	160
p-value H_0: Public=Private	0.249	0.000	0.233	0.422

$17 Million (aprox) per year considering comparable product categories.

Note: All regressions control for baseline outcome and include stratification groups (randomization) fixed effects. Models (2) and (3) include product's category and calendar month fixed effects. Standard errors clustered at the organization level are shown in parentheses.

CHANGES IN THE PROCUREMENT LAW (APPROVED BY THE CHILEAN SENATE IN JUNE 2023)

Dirección ChileCompra

DIRECCIÓN DE COMPRAS Y CONTRATACIÓN PÚBLICA

APRUEBA NUEVAS POLÍTICAS Y CONDICIONES DE USO DEL SISTEMA DE INFORMACIÓN DE COMPRAS PÚBLICAS Y REGISTRO DE PROVEEDORES

RESOLUCIÓN EXENTA N° 585 -B

A/B Testing Methodologies

The DCCP can conduct studies based on the implementation of A/B Testing methodologies in the Framework Agreements that are defined, in fulfillment of its duty to create value and bring more efficiency to public procurement processes. The purpose of carrying out these experimental activities is to identify behavior patterns of the users of the public procurement platform (suppliers and buyers). For this, it may segment the users and expose each group ("A" and "B") to different visual configurations on the electronic platform, such as special graphic designs, product card visualization, changing the location of filters, words, and messages, among other aspects of the A/B Testing investigative methodology.

Framework Agreement (Convenio Marco)
This purchasing procedure is only applicable for the acquisition of products and/or services in areas with the following characteristics:

- *standardized*
- *cross-sectional*
- *and frequently used by the organizations in the Public Market.*

Given the above, in order to properly manage the aforementioned Framework Agreements, this Directorate may regulate the various requests that can be made to the awarded suppliers, such as the inclusion of new products within the Catalog, the modification of commercial conditions, among others, in line with the principles of efficiency and effectiveness that govern administrative activity.

It will be the DCCP (Dirección ChileCompra, or ChileCompra Directorate in English) who determines, for each framework agreement, the frequency of request submissions and/or the maximum number of goods or services to be included in each of them.

Translated by ChatGPT 4.0

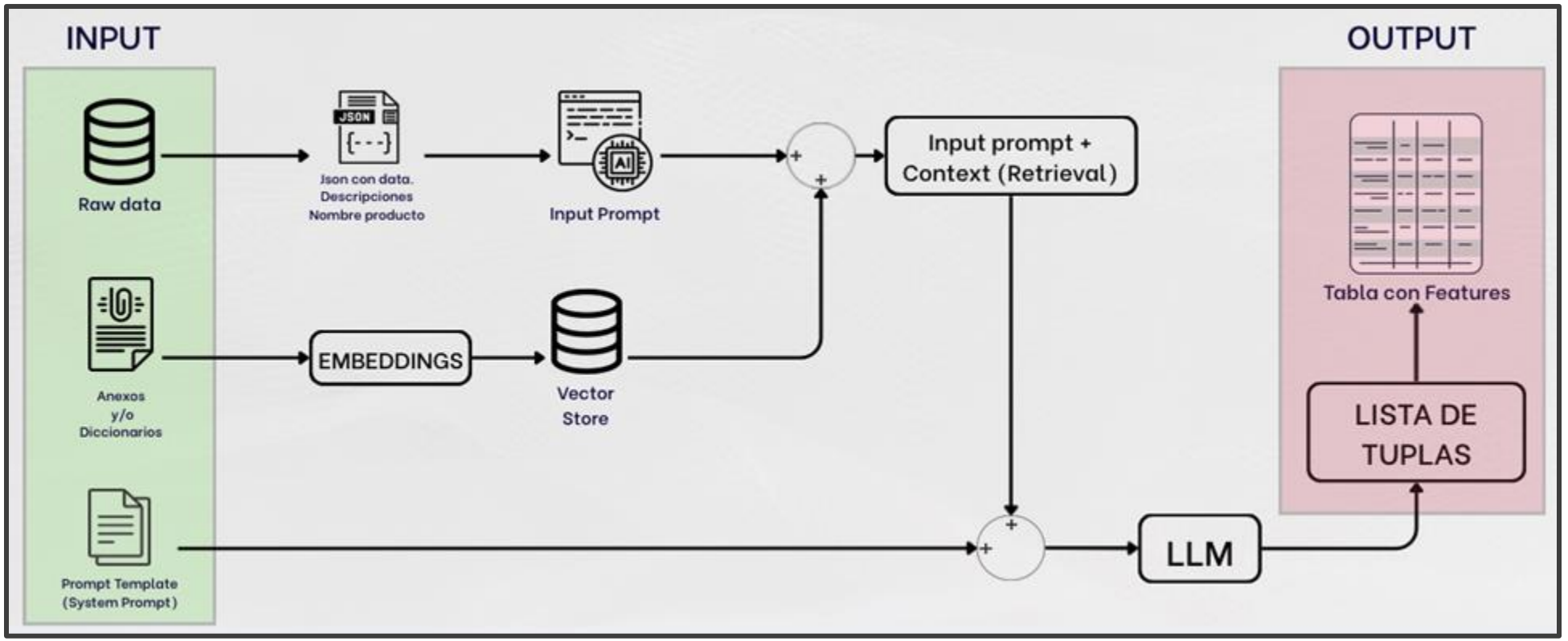
ONGOING RESEARCH WITH STUDENTS
USING LLMS FOR ATTRIBUTE IDENTIFICATION FROM UNSTRUCTURED PROCUREMENT DATA

Campos de texto

Código ONU	Producto / Servicio	Cant.	Medida	Esp. Comprador	Esp. Proveedor	Precio Unit.	Desc.	Cargos	Total Unit.	Valor Total
12162201	Ácido ascórbico	30	Unidad	Línea N°128 Mirtazapina 15 mg comprimidos	0056-48-1 MIRTAVITAE 15 mg Mirtazapina, REG ISP: F-26958 CAJA X 30 COMPRIMIDOS RECUBIERTOS 30-04-2027. Productos Bioequivalentes BE con flete incluido, despacho hasta 48 hrs. hábiles posteriores a recepción conforme de orden de compra, monto mínimo de fac	$ 9.000,00	$ 0,00	$ 0,00	$ 270.000	$ 270.000

Archivos Adjuntos

Eduardo Moya
Ingenieria Electrica & Master Data Science
FCFM, U de Chile



Accuracy in attribute detection

	Medicamentos	**Computadores**
Licitación	0.953	0.838
Compra Ágil	0.872	0.873

RCT (AB TESTING) TO EVALUATE THE IMPACT OF HIDING SELLER'S INFO

with Rodrigo Guerra (DSI Uchile) R. Undurraga (UChile) y P. Zannoco (UC Davis)

7 proveedores ID 2227922

LAPTOP HP PROBOOK 445 WINDOWS 11 PRO AMD RYZEN 3 7330U 8 GB 512 GB GAMA 1

Design A

PRODATA SPA	Máximo 30 días hábiles Despacho cobertura nacional	US$463
COMERCIALIZADORA SP DIGITAL SPA	Máximo 30 días hábiles Despacho cobertura nacional	US$463,98
TIC SERVICES SPA	Máximo 30 días hábiles Despacho cobertura nacional	US$463,99
RICOH CHILE S.A	Máximo 30 días hábiles Despacho cobertura nacional	US$464,00
TECHNOSYSTEMS CHILE SPA	Máximo 30 días hábiles Despacho cobertura nacional	US$467,00
BOOKCOMPUTER COMERCIALIZADORA SPA	Máximo 30 días hábiles Despacho cobertura nacional	US$475,00

Design B

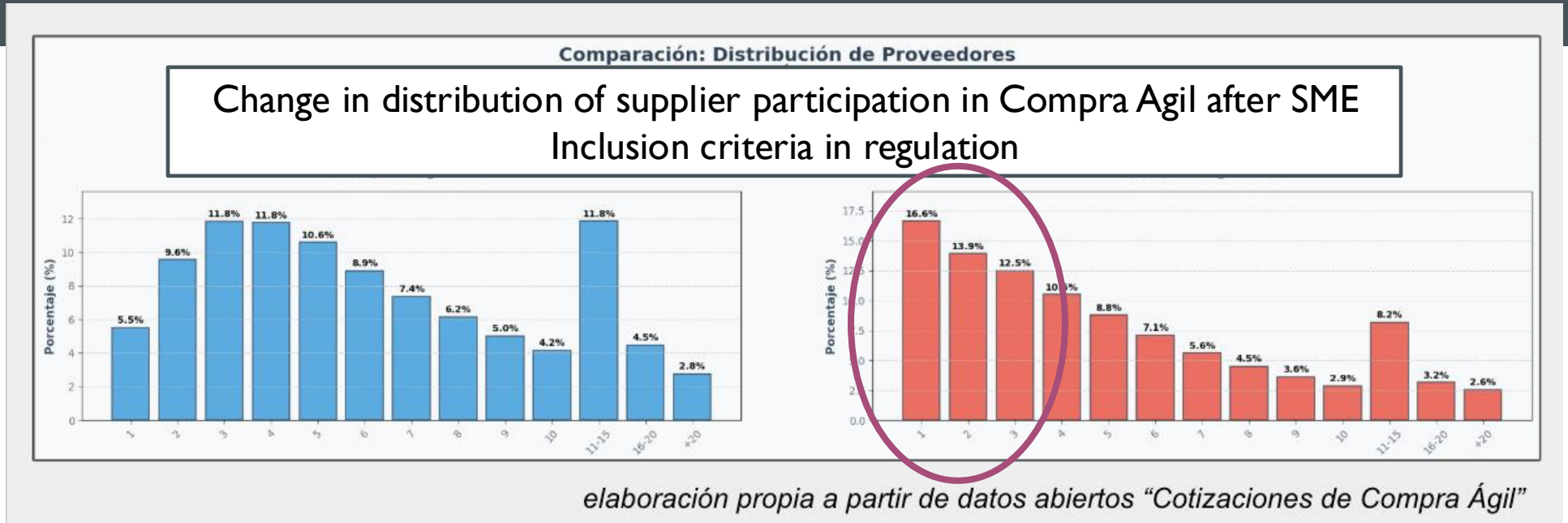
Seller 1	Máximo 30 días hábiles Despacho cobertura nacional	US$463,98
Seller 2	Máximo 30 días hábiles Despacho cobertura nacional	US$463,98
Seller 3	Máximo 30 días hábiles Despacho cobertura nacional	US$463,99
Seller 4	Máximo 30 días hábiles Despacho cobertura nacional	US$464,00
Seller 5	Máximo 30 días hábiles Despacho cobertura nacional	US$467,00
Seller 6	Máximo 30 días hábiles Despacho cobertura nacional	US$475,00

GENDER AND SMALL ENTERPRISE INCLUSION IN PUBLIC PROCUREMENT

with Rodrigo Guerra (DSI Uchile) , Ana Maria Montoya (UAI) & Josefa Aguirre (PUC Econ)

- New law establishes priority rules for local Small and Medium Enterprises (PyMEs) and Women businesses, on small purchases (Compra Agil) .
- Two possible effects:
  - Lower competition in Compra Agil channel, **increasing in prices.**
  - As these smaller business develop, they move up competing for larger purchases (Auctions, Framework Agreements), generating more competition and **lower prices** in these channels.
- Other effects: Promote local development, increase participation of women in the labor force.
- Project is funded by DIPRES, "Evaluacion de Impacto" initiative.

ENHANCING MATCHING EFFICIENCY IN PUBLIC PROCUREMENT WITH AI-BASED ASSISTANCE

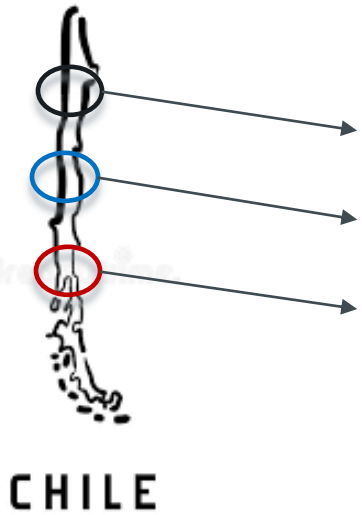


Buyers specify requirement and submits RFQ

Notebook de marca reconocida, preferentemente HP o similar, con procesador Intel Core i3 o equivalente, memoria RAM suficiente para tareas administrativas y almacenamiento sólido de alta capacidad. Pantalla de tamaño medio (alrededor de 14 pulgadas) y sistema operativo Windows actualizado.

Suppliers search among hundreds of RFQs that match their products & to submits bid

ENHANCING MATCHING EFFICIENCY IN PUBLIC PROCUREMENT WITH AI-BASED ASSISTANCE



Clustered RCT

No intervention

Buyer side intervention

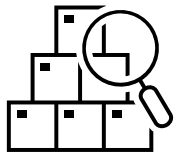
Buyer & Supplier intervention

Measure impact on:

- Purchase price
- Supplier participation
- SME participation and growth
- User satisfaction (surveys)

Buyers specify requirement to AI assistant

"Tipo": "Notebook",
"Marca": "HP","Lenovo","Acer"
"Procesador": "Intel Core i3-1115G4",
"Memoria RAM": "8 GB",
"Pantalla": "14.0\"",
"Tipo de Almacenamiento": "SSD",
"Capacidad de Almacenamiento": "512 GB",
"Chip Gráfico": "Intel UHD Graphics",
"Sistema Operativo": "Windows 11 Home"



Suppliers receives alerts of RFQ that match their inventory

DATA-DRIVEN PUBLIC PROCUREMENT IN PRACTICE:

- Making impact through Market Design in the developing world through cost-efficient interventions.
  - Ongoing collaboration between government and academia (>10 yrs)
  - Need for evidence-based policy aligns the objectives between science and practice.
- Design details matter:
  - Product standardization enables more competition and tighter monitoring.
  - Design of purchasing mechanisms needs to account for procurement needs.
  - Monitoring and Incentive mechanisms can be adapted to different organization depending on their characteristics.
- Innovation in the public sector:
  - Learning-by doing through pilot studies.
  - Knowledge transfer from research field-experiments to the adoption of new management practices and regulation.
  - Scaling to other countries in Latin America: Peru, Paraguay and Nueva Leon (Mexico).

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