Productive Density and Distribution from an Input-Output Perspective: The Case of Argentina since the 1950s

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Context and motivation

Context and motivation:

- Long-run history of the conflictive relationship between trade balance (and BoP) constraints and productive structure (*'densidad productiva'*) in Latin America
- 'Competitiveness': issue related to relative price and distribution structure of the economy (at least, partially)
- Argentina since the 1950s: succession of 6 economic regimes

  (i) Import-substitution industrialisation (early 10950s)

  (ii) Structuralism (*'desarrollismo'*, late 1950s to mid 1970s)

  (iii) Economic Liberalisation (late 1970s - early 1980s)

  (iv) Debt-crisis inflationary economy (1980s)

  (v) Convertibility (1990s)

  (vi) Post-Convertibility (2000s)

Main contribution

- Brody (1970) type of *extended* Input-Output scheme based on the computation of ‘standard prices’ (Pasinetti, 1992) — rather than ‘standard proportions’ (Sraffa, 1960)
- Compute and analyse the structure of relative prices and distribution implied by a situation of balanced trade (for given quantities), to shed light on the *constraints* that productive structure pose on distributive possibilities
- Apply the framework to the case of Argentina from 1950s onwards

Structural expenditure and income accounting (I)

$$\mathbf{x} = \mathbf{X}\mathbf{e} + \mathbf{f} \qquad \text{(Expenditure)}$$

$$\mathbf{x}^T = \mathbf{e}^T\mathbf{X} + \mathbf{m}^T + \mathbf{w}^T + \boldsymbol{\pi}^T \qquad \text{(Income)}$$

$$\mathbf{X} = \mathbf{A}\widehat{\mathbf{x}} = [a_{ij}x_j] \qquad \text{(Intermediate inputs)}$$

$$\mathbf{w}^T = \mathbf{a}_w^T\widehat{\mathbf{x}} = [a_{wj}x_j] \qquad \text{(Industry wages)}$$

$$\mathbf{m}^T = \mathbf{a}_m^T\widehat{\mathbf{x}} = [a_{mj}x_j] \qquad \text{(Intermediate imports)}$$

$$\boldsymbol{\pi}^T = \mathbf{a}_\pi^T = [a_{\pi j}x_j] \qquad \text{(Surplus)}$$

$$\mathbf{f} = \mathbf{f}_{cw} + \mathbf{f}_e + \mathbf{f}_z \qquad \text{(Final demand)}$$

$$\mathbf{f}_{cw} = \boldsymbol{\theta}_c W, \quad \mathbf{f}_e = \boldsymbol{\theta}_e M \qquad \text{(Wage-consumption \& Exports)}$$

$$C = \mathbf{e}^T\mathbf{f}_c + M_c \qquad \text{(Agg. final consumption)}$$

$$\boldsymbol{\theta}_c = \mathbf{f}_c/C, \quad \theta_c^m = M_c/C \qquad \text{(Consumption structure)}$$

$$W = \mathbf{a}_w^T\mathbf{x} \qquad \text{(Wage bill)}$$

$$M = \mathbf{a}_m^T\mathbf{x} + \theta_c^m W + M_z \qquad \text{(Imports)}$$

Structural expenditure and income accounting (II)

Expenditure:

$$\begin{bmatrix} \mathbf{x} \\ W \\ M \end{bmatrix} = \begin{bmatrix} \mathbf{A} & \boldsymbol{\theta}_c & \boldsymbol{\theta}_e \\ \mathbf{a}_w^T & 0 & 0 \\ \mathbf{a}_m^T & \theta_c^m & 0 \end{bmatrix} \begin{bmatrix} \mathbf{x} \\ W \\ M \end{bmatrix} + \begin{bmatrix} \mathbf{f}_z \\ 0 \\ M_z \end{bmatrix}$$

Income:

$$\begin{bmatrix} \mathbf{e}^T & 1 & 1 \end{bmatrix} = \begin{bmatrix} \mathbf{e}^T & 1 & 1 \end{bmatrix} \begin{bmatrix} \mathbf{A} & \boldsymbol{\theta}_c & \boldsymbol{\theta}_e \\ \mathbf{a}_w^T & 0 & 0 \\ \mathbf{a}_m^T & \theta_c^m & 0 \end{bmatrix} + \begin{bmatrix} \mathbf{a}_\pi^T & 0 & (1 - \mathbf{e}^T \boldsymbol{\theta}_e) \end{bmatrix}$$

From structural price accounting to computable prices

Structural accounting:

$$\begin{bmatrix} \mathbf{e}^T & 1 & 1 \end{bmatrix} = \begin{bmatrix} \mathbf{e}^T & 1 & 1 \end{bmatrix} \begin{bmatrix} \mathbf{A} & \boldsymbol{\theta}_c & \boldsymbol{\theta}_e \\ \mathbf{a}_w^T & 0 & 0 \\ \mathbf{a}_m^T & \theta_c^m & 0 \end{bmatrix} + \begin{bmatrix} \mathbf{a}_\pi^T & 0 & (1 - \mathbf{e}^T \boldsymbol{\theta}_e) \end{bmatrix}$$

Computable prices:

$$\begin{bmatrix} \mathbf{p}^T & p_w & p_m \end{bmatrix} = \begin{bmatrix} \mathbf{p}^T & p_w & p_m \end{bmatrix} \begin{bmatrix} \mathbf{A} & \boldsymbol{\theta}_c & \boldsymbol{\theta}_e \\ \mathbf{a}_w^T & 0 & 0 \\ \mathbf{a}_m^T & \theta_c^m & 0 \end{bmatrix} + $$
$$+ r \begin{bmatrix} \mathbf{p}^T & p_w & p_m \end{bmatrix} \begin{bmatrix} \mathbf{A} & \mathbf{0} & \mathbf{0} \\ \mathbf{a}_w^T & 0 & 0 \\ \mathbf{a}_m^T & 0 & 0 \end{bmatrix}$$

Computable prices: Interpretation

Developing the partitioned-matrix formulation:

$$\mathbf{p}^T = (1+r)(\mathbf{p}^T\mathbf{A} + p_w\mathbf{a}_w^T + p_m\mathbf{a}_m^T) \qquad \text{(Comm. prices)}$$

$$p_w = \mathbf{p}^T\boldsymbol{\theta}_c + p_m\theta_c^m \qquad \text{(Wage-labour monetary unit price)}$$

$$p_m = \mathbf{p}^T\boldsymbol{\theta}_e \qquad \text{(Balanced foreign trade import price)}$$

Computable prices: solution

An eigensystem: $\mathbf{v}^T \neq \mathbf{0}^T$ such that:

$$\lambda \mathbf{v}^T = \mathbf{v}^T \mathbf{M}$$

Our system is:

$$\frac{1}{r} \left[\begin{array}{ccc} \mathbf{p}^T & p_w & p_m \end{array} \right] =$$

$$= \left[\begin{array}{ccc} \mathbf{p}^T & p_w & p_m \end{array} \right] \left(\left[\begin{array}{ccc} \mathbf{A} & \mathbf{0} & \mathbf{0} \\ \mathbf{a}_w^T & 0 & 0 \\ \mathbf{a}_m^T & 0 & 0 \end{array} \right] \left[\begin{array}{ccc} \mathbf{I} - \mathbf{A} & -\boldsymbol{\theta}_c & -\boldsymbol{\theta}_e \\ -\mathbf{a}_w^T & 1 & 0 \\ -\mathbf{a}_m^T & -\theta_c^m & 1 \end{array} \right]^{-1} \right)$$

We can compute its solution:

$$(r, \left[\begin{array}{ccc} \mathbf{p}^T & p_w & p_m \end{array} \right])$$

Computable prices: normalisation

Sum of all statistical unit-prices:

$$\begin{bmatrix} \mathbf{e}^T & 1 & 1 \end{bmatrix} \begin{bmatrix} \mathbf{e} \\ 1 \\ 1 \end{bmatrix} = \mathbf{e}^T\mathbf{e} + 1 + 1 = n + 2$$

Then, we want:

$$\begin{bmatrix} \mathbf{p}^T & p_w & p_m \end{bmatrix} \begin{bmatrix} \mathbf{e} \\ 1 \\ 1 \end{bmatrix} = \mathbf{p}^T\mathbf{e} + p_w + p_m = n + 2$$

Thereby adopting:

$$\frac{\mathbf{p}^T\mathbf{e} + p_w + p_m}{n + 2} = 1$$

as the normalisation condition for the eigenproblem

Examples in a 2 × 2 economy

	1	2	C	E	$Oth.$	x
1	10	5	1	2	1	19
2	5	15	2	4	0	26
m	1	3	1	0	0	
w	2	1				
π	1	2				
x	19	26				45

$$BoT = E - M = 6 - 5 = 1 > 0$$

$r = 3/(35 + 3 + 4) = 0.071$ (mark-up)

	obs.	comp.	surplus
p_1	1.000	0.954	0.052
p_2	1.000	0.931	0.076
p_w	1.000	0.986	0.000
p_m	1.000	1.127	-0.200
r	0.071	0.048	

BoT surplus: $\uparrow p_m, \downarrow p_w, \downarrow r$

	1	2	C	E	$Oth.$	x
1	10	5	1	2	1	19
2	5	15	2	4	0	26
m	1	3	1	0	2	
w	2	1				
π	1	2				
x	19	26				45

$$BoT = E - M = 6 - 7 = -1 < 0$$

$r = 3/(35 + 3 + 4) = 0.071$ (mark-up)

	obs.	comp.	surplus
p_1	1.000	1.078	0.052
p_2	1.000	1.023	0.076
p_w	1.000	1.004	0.000
p_m	1.000	0.893	0.142
r	0.071	0.089	

BoT deficit: $\downarrow p_m, \uparrow p_w, \uparrow r$

Dataset characteristics: Argentina (1953-2011)

Table: Input-Output matrices for Argentina since the 1950s

(all matrices in current AR$, distinguishing between domestically produced and imported commodities)

Period	Year	Dimension	Source	Prices	GVA disag.
1950-1958	1953	23×23	BCRA	Purchaser	Wages & Salaries
1959-1965	1963	23×23	BCRA	Purchaser	Wages & Salaries
1966-1974	1973	56×56	BCRA	Purchaser	Comp. Employees
1983-1991	1984	220×220	BID-SP	Producer	-
1991-2001	1997	124×124	INDEC	Basic	Comp. Employees
2002-2007	2004	95×95	Own est.	Basic	Comp. Employees
2008-2011	2011	95×95	Own est.	Basic	Comp. Employees

Argentina's Input-Output matrix: 1953

Cuadro 5

ARGENTINA: TRANSACCIONES INTERSECTORIALES DE BIENES Y SERVICIOS

(Miles de pesos argentinos)

Origen \ Destino	Agricultura	Ganadería	Yacimientos, canteras y minas	Alimentos, bebidas y otros productos de frigoríficos	Tabaco	Productos textiles	Confecciones
	1	2	3	4	5	6	7
1. Agricultura	633 963	1 275 095	-	4 912 725	170 985	517 949	347
2. Ganadería	-	-	-	4 641 934	-	280 578	125
3. Yacimientos, canteras y minas	-	-	3 000	16 816	-	602	172
4. Alimentos, bebidas y otros productos de frigoríficos	-	-	-	2 715 786	3 457	33 282	5 798
5. Tabaco	-	-	-	-	64 750	-	-
6. Productos textiles	227 607	-	-	21 925	-	2 740 813	2 232 795
7. Confecciones	531 083	19 063	2 000	88 252	-	22 039	76 878
8. Madera y otros productos forestales	87 142	69 542	3 384	154 564	599	-	5 389
9. Papel, cartón e imprenta	-	-	4 384	252 154	73 574	43 750	36 763
10. Productos químicos	77 939	81 997	12 389	259 189	19 705	532 792	6 990
11. Combustibles, lubricantes y otros derivados del petróleo	267 759	42 065	54 248	397 595	2 655	79 151	4 784

Industry Classification

Industry Classification: 1953, 1973, 1997, 2011		
cod_IP	Description	Label
IP_01	Agriculture	01_AGRIC
IP_02	Animal production	02_ANIM
IP_03	Mining	03_MIN
IP_04	Food processing	04_FOOD
IP_05	Tobacco	05_TOBAC
IP_06	Textiles & apparel	06_TEXT
IP_07	Leather & products	07_LEATH
IP_08	Wood & Forestry Products	08_WOOD
IP_09	Paper products & publishing	09_PAPER
IP_10	Chemicals	10_CHEM
IP_11	Petrochemical	11_PETRO
IP_12	Rubber & Plastics	12_RUBPL
IP_13	Mineral products	13_MINPR
IP_14	Metal products	14_METAL
IP_15	Vehicles & Mech. Mach.	15_MMACH
IP_16	Electrical Machinery	16_EMACH
IP_17	Other manufacturing	17_OMANU
IP_18	Utilities	18_UTIL
IP_19	Construction	19_CONST
IP_20	Transport, Comm. & Trade	20_TRCOTR
IP_21	Prof. & Social Services	21_SERV

Computable prices for Argentina (1953-2011)

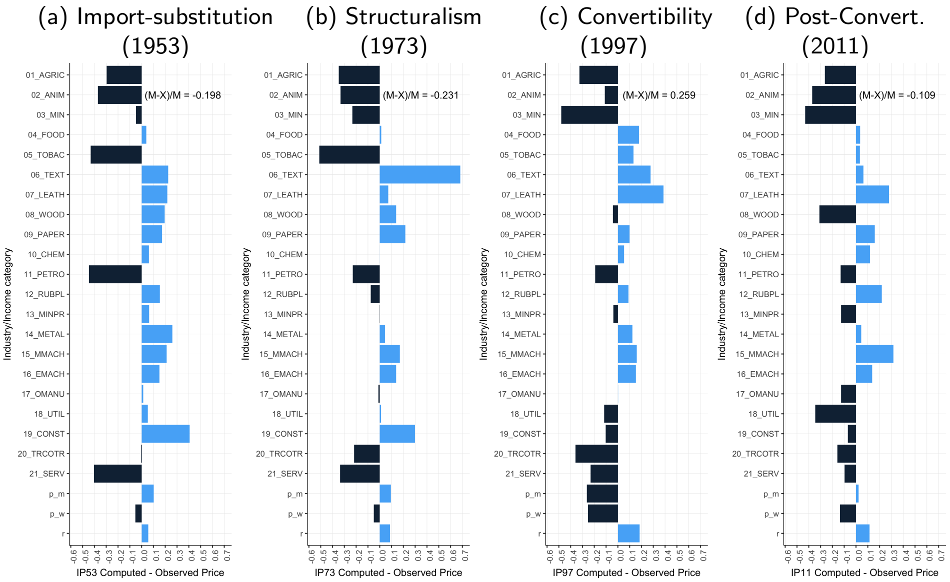
	IP53			IP73			IP97			IP11		
Industry	obs.	comp.	surplus	obs.	comp.	surplus	obs.	comp.	surplus	obs.	comp.	surplus
01_AGRIC	1.000	0.703	0.520	1.000	0.653	0.447	1.000	0.674	0.486	1.000	0.737	0.439
02_ANIM	1.000	0.629	0.540	1.000	0.668	0.504	1.000	0.889	0.347	1.000	0.628	0.493
03_MIN	1.000	0.952	0.345	1.000	0.769	0.447	1.000	0.519	0.583	1.000	0.569	0.556
04_FOOD	1.000	1.040	0.179	1.000	1.013	0.122	1.000	1.180	0.162	1.000	1.035	0.175
05_TOBAC	1.000	0.569	0.587	1.000	0.488	0.572	1.000	1.133	0.174	1.000	1.033	0.230
06_TEXT	1.000	1.225	0.220	1.000	1.683	0.098	1.000	1.276	0.229	1.000	1.062	0.319
07_LEATH	1.000	1.218	0.237	1.000	1.071	0.206	1.000	1.386	0.242	1.000	1.280	0.151
08_WOOD	1.000	1.196	0.247	1.000	1.140	0.180	1.000	0.958	0.283	1.000	0.690	0.485
09_PAPER	1.000	1.174	0.249	1.000	1.217	0.150	1.000	1.098	0.240	1.000	1.159	0.226
10_CHEM	1.000	1.063	0.291	1.000	1.001	0.260	1.000	1.052	0.225	1.000	1.119	0.229
11_PETRO	1.000	0.554	0.627	1.000	0.772	0.375	1.000	0.808	0.132	1.000	0.869	0.207
12_RUBPL	1.000	1.154	0.266	1.000	0.924	0.302	1.000	1.090	0.261	1.000	1.218	0.210
13_MINPR	1.000	1.064	0.271	1.000	0.998	0.239	1.000	0.961	0.273	1.000	0.874	0.308
14_METAL	1.000	1.261	0.204	1.000	1.045	0.208	1.000	1.123	0.223	1.000	1.044	0.281
15_MMACH	1.000	1.213	0.222	1.000	1.171	0.188	1.000	1.160	0.202	1.000	1.317	0.120
16_EMACH	1.000	1.150	0.272	1.000	1.139	0.173	1.000	1.153	0.214	1.000	1.137	0.233
17_OMANU	1.000	1.013	0.332	1.000	0.988	0.225	1.000	1.001	0.312	1.000	0.874	0.378
18_UTIL	1.000	1.052	0.286	1.000	1.011	0.265	1.000	0.885	0.282	1.000	0.655	0.445
19_CONST	1.000	1.408	0.105	1.000	1.298	0.105	1.000	0.897	0.396	1.000	0.930	0.289
20_TRCOTR	1.000	0.995	0.308	1.000	0.783	0.448	1.000	0.641	0.476	1.000	0.842	0.372
21_SERV	1.000	0.597	0.593	1.000	0.665	0.535	1.000	0.769	0.411	1.000	0.904	0.315
p_w	1.000	0.946	0.000	1.000	0.950	0.000	1.000	0.747	0.000	1.000	0.865	0.000
p_m	1.000	1.103	-0.198	1.000	1.094	-0.231	1.000	0.737	0.259	1.000	1.022	-0.109
r	0.484	0.511	0.000	0.441	0.479	0.000	0.568	0.672	0.000	0.459	0.511	0.000

References: Obs.: observed in actual data, Comp.: computed. Shaded cell indicates (M-X)/M

01_AGRIC to 21_SERV industries, p_w: price of a monetary unit of wage labour, p_m: price of a monetary unit of imports

r: mark-up on circulating capital and labour costs.

Model-implied changes in relative prices



Model-implied changes in income categories

(a) Import-substitution (1953) (M-X)/M = -0.198

(b) Structuralism (1973) (M-X)/M = -0.231

(c) Convertibility (1997) (M-X)/M = -0.259

(d) Post-Convert. (2011) (M-X)/M = -0.109