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DEVALUATION AND PUBLIC SERVICES: TRADE-OFFS AND REMEDIAL POLICIES. A CGE MODEL FOR ARGENTINA

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Abstract:
In a previous paper (Chisari, Estache y Romero, 1999) we explored the gains of the economy of the privatization process and of efficient regulation. This paper elaborates on the effects of the chaotic devaluation that followed a decade of Convertibility Law in Argentina. A the moment of the privatization tariffs were settled in US dollars. After the Peso devaluation, the authorities did not allow to maintain the tariffs in foreign currency to make them affordable for the poor. However, with this specification of tariffs the firms faced a scenario of non sustainability. Therefore, the Argentine government called for a renegotiation of pricing schemes. To assess different alternatives of tariffs, several policy-oriented simulations are performed in order to get insights on existing trade-offs: i) fixed tariffs: no pass-through of the devaluation to customers, which puts in danger the sustainability of the firms; ii) fully flexible tariffs: full pass-through, which puts in danger poor customer and the social interest of permanent connection the electricity, gas, water & sanitation and telecommunications access and use; iii) cross subsidies between rich and poor customers, to compensate for the losses of the firms; iv) reduction or postponements of investments in access, an inter-temporal cross-subsidy. Privatized sectors represent about 10% of GDP, and their workings affect competitiveness and efficiency of the rest of the economy, CGE modeling is a reasonable choice for this case. The model is a 26-sector, 10-decile structure for a small economy, updated for 1997, with a detailed description of financial relations and of the input-output linkages between privatized sectors.

Keywords: Computable General Equilibrium, Utilities regulation, Public Services.

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I. Introducción

The regulatory framework of Argentina was constructed under the implicit assumption of macroeconomic stability and sustainability. Therefore, the principles of efficiency were put as benchmarks for the design of concession contracts, for the deregulation of industries, as well as for establishing the landmarks of competition defence. Following those principles, cross subsidies were minimized (subject to obligation of service and universal service objectives) and price-cap mechanism were adopted as favourite policy for defining tariffs.

The privatisation process was successful in terms of expanding coverage, increasing productivity and reliability, and fostering investments.

But that implicit assumption on the macroeconomics has shown wrong. After ten years of currency board (the "Convertibility plan" that fixed a one-to-one parity between peso and dollar), the economy experienced a huge devaluation and a generalized default on financial contracts, both domestically and at the international level. What were the causes of this calamity? Uncontrolled public expenditure, overvalued exchange rate and incapacity to deal with the changing conditions of foreign capital markets, have been advanced as explanations.

Convertibility was also a basic setting or reference for contracts between private agents. Most transactions were implicitly expressed in dollars, giving certainty to an economy traditionally menaced by inflation. Moreover, under the Convertibility Law indexation of contracts was forbidden, as a means to break the inflationary inertia. This prohibition determined also the impossibility of including domestic price indexes as an adjustment mechanism in concession contracts (many included automatic adjustment with respect to the US RPI, a practice that seems was inefficient for the economy).

The devaluation increased abruptly costs for firms with debt obligations established in dollars terms and reduced the expected rate of return for shareholders.

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Within regulated industries, the clause of contracts that established tariffs fixed in dollars was not respected. Had it been, however, it is highly probable that customers arrears and delinquency would had put a market-limit to any instantaneous indexation. Therefore a reasonable guess is that some proportion of the real loss of tariffs is voluntary; nevertheless, tariffs have also fallen behind the retail price index, and an adjustment should be expected in the next future.

Political unrest has delayed the definition of a long run solution The government decided to fix tariffs in pesos (nominal) at the levels previous to devaluation, and initiated a cryptic process of negotiation between the concessionaires and the public sector. This process is still on going, with some temporary adjustments to overcome problems that could put in danger the provision of critical services.

Moreover, the rate of exchange has exhibited instability and this prevents the renegotiation of contracts. It seems difficult to define microeconomic conditions without a stable macroeconomic environment. But, on the other hand, privatised sectors represent an important proportion of GDP and they contribute critically to the process of formation of prices. Therefore, they are used implicitly (and politically) as an instrument to reach stability.

How shall we compute tariffs that simultaneously meet the requisites of being sustainable for firms, affordable for impoverished customers and efficient for the economy?

That is, there are two fundamental constraints to respect:

- *Sustainability* of the firms, financial in the short-run and economical in the long-run.
- *Affordability* of the service for customers.

These are the reference points we use in this paper to compute the solutions of the model. Many of those customers are "new poor customers", that suffered loss of their assets or are currently unemployed; most had been already integrated into the provision network of privatized sectors5.

In this paper we address that quest using a CGE model for Argentina. First of all, we present the main indicators of the evolution of privatised sectors in Argentina (Section II). Then we present the analytical model, emphasizing the treatment of "service obligation"; this condition is not only realistic, it also helps to by-pass possible technical problems due to non-convexities (Section III). We discuss the macroeconomic context and we simulate the short and medium term impacts of devaluation; next, we explore alternative policies for dealing with sustainability and affordability; we find that cross-subsidies among customers reveals as a more efficient solution than cross-subsidies between firms and customers (Section IV).

[5] Therefore though they received the contribution of the availability of the services, they lose their access to substitutes and are now under an implicit contract with the network, obliged to pay fixed connection charges.

II. Public Utilities Regulation.

In 1989, Argentina initiated a process of privatization of its infrastructure services that was at the forefront of the international experience. The breadth of the sectoral changes and their quick implementation did not initially reflect a dramatic concern for efficiency in the delivery of basic public services. They were driven instead by the need to alleviate the fiscal burden imposed by public utilities and the need to get the private sector involved in financing the increasingly pressing expansion requirements of these sectors. The concern for efficiency was a byproduct of the need to regulate the sector to avoid abuse by the private providers of activities with monopolistic features. But efficiency improvements coverage expansions and the increasing reliability, became one of the main successes of the privatization process.

Some degree of restructuring took place in each sector before the transfer to private operators. The following description is not encompassing but gives a sense of the major structural adjustment.

1. Electricity

The restructuring of the sector began in 1991 with the transfer of most public enterprises under federal control to the private sector, the reorganization of the institutions of the sector and the introduction of a new regulatory framework. The three stages of production in the sector—generation, transmission and distribution—were vertically disintegrated and different regulatory criteria where adopted for each activity. Generation became competitive, and transmission and distribution became regulated private monopolies. The regulation of the tariff and of the quality of the distribution and transmission services is particularly detailed in the new regulatory framework to ensure that the final users enjoy the benefits of competition in the generation sector. The regulatory mechanism is essentially and RPI-x where the productivity gains x will be adjusted after 5 years. The commercialization of energy has enables big consumers to buy directly energy from the generators, paying for the use of the network

2. Gas.

Gas restructuring took place at the end of 1991 when the transport and distribution activities were separated into two transporters and eight regional distribution concessions. Its production activities are included in the Mining sector of the National Accounts. It provides the major input for the privatized companies and sales are concluded at an unregulated price. However, since the other activities are controlled by local monopolies, as in electricity, a good regulation of tariff and quality was needed and was introduced with the reform. The regulatory mechanism is essentially an RPI-x where the productivity gains x will be adjusted after 5 years.

3. Water.

While few provincial privatizations in the water sector have occured, the largest and the best documented is the privatization that transferred the responsibility for water and

sanitation service in the Buenos Aires Metropolitan Area to Aguas Argentina in May 1993. Competition was achieved through a bidding process and the resulting concession contract has become the main regulatory instrument available to the regulators. It stipulates service obligation, investment requirements and quality standards monitored by the national sector regulator. The tariff adjustments are based on a cost plus rule. It is clear that the analysis of sector performance is based on the information for a single company but since this company involves about 30% of Argentina's population and its regulation is serving as a model for most of the others, it still seems reasonable to model this privatization experience as well.

4. Telecommunications.

The transfer of the telecoms company to private operators was concluded in November 1990. It was in fact the first infrastructure service concessioned. The service is now provided by two companies. Their tariffs are regulated and service and quality obligations detailed in their concession contracts. The regulatory mechanism is essentially an RPI-x where the productivity gains x will be adjusted after 5 years A temporary exclusiveness to operate basic services expired in 1997, but a three-year extension (admitted in the regulation) was given because several benchmark indicators were fulfilled. Since 1998 the government put forward the "telecommunication liberalization plan" in order to gain competition in the sector. Interconnection rules were established so as to avoid exercise of market power. Universal service requirement were also established

The Price-Cap mechanism was adopted for most privatized sectors under regulation, with their obvious specific characteristics, and tariff review processes every five or ten years. Regulatory agencies were created both at the national and at the provincial levels, controlling quality and investments. Service obligation was established for all of this sectors and Universal Service was also a basic objective in some (e.g. Water and Sanitation). Table II-1 below shows the main features of public utilities regulation in Argentina.

Table II-1: Main features of Utilities' Reform

	Water (Buenos Aires)	**Electricity Distribution and Transport (National)**	**Natural Gas**	**Telecomm**
Legal framework	Law 23.696	Law 24.065	Law 24.076	Several Decrees
Re-organization	None	Vertical and horizontal separation	Vertical and horizontal separation	Geographical separation. Deregulation
Tariff regulation	Cost Plus	Price cap with RPI-X	Price cap with RPI-X	Price cap with RPI-X
Quality standards	Product Quality (Purity)	Product, service and commercial quality	Product, service and commercial quality	Product, service and commercial quality
Investment	Approved Plan	None	Obligatory Plan	None

Source: Own elaboration

Table II-2 shows some of the main performance indicators for selected years. Notice the improvement in all the indicators of production, investment, quality and labor productivity.

Table II-2: Argentina's Utilities: Performance indicators for selected years (Index 1993=100)

Indicators*	1994	1997	2000
Electricity			
Total Sales	113	143	164
Spot Prices ($/HWh)	115	76	89
Power Installed (MW)	110	130	139
Average time of interruption per client**	35	37	30
Labor Productivity (connections / employees)	126	170	196
Natural Gas			
Production (Millions of m^3)	97	100	120
Customers	104	114	125
Legal Tariff (big users)	110	110	110
Large Users Restrictions (winter, MM m3/dia)	10	11	5
Labor Productivity (connections / employees)	94	115	124
Water and Sanitation			
Water production (mill. m3/day)	112	112	138
Population Served – Water	104	130	134
Implicit Tariff	113	113	120
Water Network extensions (Km)	103	120	121
Labor Productivity – (Water production / employees)	102	120	229
Telecommunications			
Lines in service	118	170	178
Legal Average tariffs	100	96	77
Percentage of network digitalization	53	90	100
Quality index (days waiting for repairs)	81	56	59
Labor Productivity (lines in service / employees)	126	258	380

Source: CEER (2001)

Table II-3 shows the evolution of access in Electricity, Gas, Telecommunications and Water and Sanitation. There were also fast gains of efficiency and productivity which contributed significantly to the economy (see Chisari *et al.*, 1999).

Table II-3: Evolution of access in public utilities. (percentage in the households that have access)

	Gas		Water		Electricity		Telephone	
	85/86	**96/97**	**85/86**	**96/97**	**85/86**	**96/97**	**85/86**	**96/97**
Poorest	21.98	46.44	10.26	46.44	65.20	98.98	18.32	22.81
Richest	90.94	99.18	63.02	96.33	99.25	100	82.26	92.86
Average	63.29	83.45	40.43	76.57	89.91	99.78	50.41	67.22

Source: Ennis and Pinto (2002)

All the figures show an impressive improvement in the main sectoral indicators. An important flow of future investments is required to maintain these successful results. However, the impact of the profound Argentina´s macroeconomic crisis on infrastructure sectors could offset the achievements.

III. The Structure of the Analytical Model

The basic data for the model are obtained from a social accounting matrix (SAM) constructed for 1997 which isolates every utility from the other accounts.[6] It is consistent with national accounts for 1997.

Table III-1: Sectors participation on GDP and Household expenditure structure

Sectors	Household consumption (Richest)	Household consumption (Poorest)	GDP (at buyer prices)
Agriculture	0.97	2.25	5.72
Gas – Extraction	0.00	0.00	0.38
Petroleum	0.03	0.04	2.12
Food, Beverages and Tobacco	11.70	27.01	4.31
Textiles and Leather	3.74	3.72	1.83
Products of wood, Paper and cardboard; Editing	2.26	1.06	2.22
Chemical and Petrochemical Products	4.14	7.68	3.52
Mineral Prod.; Home & office appliances; Other Ind.	2.02	1.04	1.19
Basic Metallic Industries; Metallic Products	0.14	0.07	1.42
Capital Goods; Parts of Capital Goods	0.58	0.30	1.28
Transport Machinery	2.84	0.59	1.29
Construction	0.00	0.00	5.97
Commerce, Restaurants and hotels	22.44	19.63	14.55
Electricity - Transport and Distribution	0.83	2.50	0.89
Electricity - Generation	0.00	0.00	0.42
Gas – Transport and Distribution	0.41	1.24	0.32
Water and Sanitation	0.34	1.03	0.35
Transport	3.97	7.46	5.79
Communications	2.84	1.33	2.19
Financial and Insurance Services	4.88	0.53	3.89
Companies Services; Real Estate	13.59	15.94	17.75
Public Administration	0.18	0.20	6.65
Education	2.71	1.00	4.74
Health	6.76	1.37	3.91
Social Services; Entertainment	12.59	4.01	7.28
Total	100.00	100.00	100.00

Source: Own elaboration based on INDEC

It may be helpful to summarize here the most critical assumptions we had to make in regards to data. First, the matrix of intermediate purchases is based on the 1997 data (INDEC, 2001). Second, the distribution of the factor income across income groups is based on the distribution observed in Argentina in 1997 (Altimir y Beccaria - 1999:).

[6] This section follows Chisari, Estache and Romero (1999). Another version of the model without detailed infrastructure accounts was presented in Chisari and Romero (1996).

Finally, the distribution of the consumption basket per type of goods and services is based on the 1996 household consumption survey. In both the input and output matrix and the household consumption, consistency for consumption and production with the national accounts data was obtained by relying on the RAS method. As for the government distribution between goods and services, data is available for 1997 for the national and provincial governments. Municipal expenditures are assumed to be distributed in the same proportion as the average for the two other government levels.

The model identifies 26 domestic production sectors, 11 for goods and 15 for services. In addition to the usual activities under services, the SAM identifies electricity generation, electricity distribution, gas, water and communications as separate sectors. Three factors of productions are accounted for: labor, physical capital and financial capital. Labor and financial capital are mobile across sectors while physical capital is sector specific. Domestic consumer groups are divided into 10 income classes, a government, and there is only one foreign consumer and one foreign producer. The small open economy assumption is relied on, implying that Argentina is a price taker in the international markets.

1. Consumers

The representative consumer of income group h has a utility function:

$$[1] \qquad U^h = U^h [c^d(h), c^m(h), I^d(h), L_h, B(h), C_r],$$

It is modeled as a Cobb-Douglas between all goods. The preferences of domestic agents are assumed to follow an Armington specification, which implies no perfect substitutability in preferences between domestic and imported goods.[7]

Expenditures are distributed as follows:

- domestic consumption goods c^d , and investments I^d at price p
- leisure L_h at price w
- imported goods c^m at prices p_m,
- "bonds" services B at prices p_b, and
- goods and services of public utilities firms represented by an index C_r and their prices are represented by r_C,

Equation [2] gives the budget constraint for income group h:

$$[2] \qquad (1+t_i)[pI^d(h) + pc^d(h)] + (1+t_m)p_m c^m(h) + (1+t_{ir})\, r_C\,(h)\, C_r(h) + p_b B(h) + w\, L_h =$$

[7] Although not necessary to ensure that the economy does not end up specializing, by assumption, the capital installed in the tradeable sectors cannot be reallocated

$$= wS(h) + \theta(h)(r_pK_{po} + r_pK_{pxo} + N^p + N^{px}) +$$
$$+ \theta_r(h)\,(r_rK_{ro} + N^r)]\,(1-t_d) + p_bB^o(h) + p_R\,R^o.$$

Every household pays indirect taxes at rates t_i and t_{ir}, depending on the good or service, and direct taxes t_d and taxes on imports t_m. Its income sources are labor income S at salary w, and capital K_{po} in private firms remunerated at rate r_p; revenue from profits on domestic sales N^p and sales abroad N^{px} and revenue from participation in the privatized firm N^r in proportion to shares owned, indicated as θ_r; θ_r also represents the participation of the income group in each sector specific capital r_pK_p, r_pK_{pxo} and r_rK_r. In the scenario in which capital is specific, the profit rates enter fully r_p or r_r **.** B^o represents holdings of private sector bonds. The initial "holdings are negative if the consumption group is a net debtor in the benchmark simulation. Households also get public sector transfers represented as the purchase by the government of a service with an inelastic supply, R^o at price p_R.

2. Private firms

The private firms are those which are not public utilities. They produce goods and services intended for intermediate and final consumption as well as for export and investment. This differentiation is needed to be able to account properly for the differences in the tax treatment of the various destinations (for instance, exporters do not pay the VAT and benefit from discounts on their gross income tax). There is no technological differentiation across these sectors.

Exporters of goods are price-takers abroad and exports of services are price inelastic (i.e. they are constant). Non-tradable prices are determined as solution variables and adjust with factor income until markets are in equilibrium.

The profit function for a private firm can thus be written as:

$$[3]\quad N^p = [p - ap_b - \alpha_{pE}(zr_E+(1-z)r_C) - f(1+t_i) - f_m(1+t_m)p_m]Q^p - wL_p(1+t_{v1}) - r_pK_p(1+t_{v2}),$$

and for exporters, it can be adjusted as:

$$[4]\quad N^{px} = [p_x - ap_b - \alpha_p(zr_E+(1-z)r_C) - f(1+t_i) - f_m(1+t_m)p_m]X^p - (wL_{px} + r_pK_{px}).$$

where parameter **a** is the credit requirements per unit of output, while α_p represents the quantity of services provided by the regulated company to obtain a unit of output. Moreover, **1-z** indicates the share of privatized services requirements per unit of output purchased through distribution companies at price r_C, while **z** is the share purchased on the wholesale market at prices r_E. Purchases of electricity in the wholesale market correspond to generation, purchases on the retail market correspond to distribution.

The inter-industrial transactions in these simplified expressions are represented by a coefficient f for national goods and f_m for imported intermediate inputs. These requirements are proportional to total production Q^p ,and to exports X^p respectively. Privatized goods and services are also proportional to output.

Remuneration r_p includes total payments to capital and hence amortization. This means that the savings and investment decisions are taken by households in the model. The

tax t_{v1} corresponds to the VAT and to the labor taxes collected at the firm level while t_{v2} corresponds to similar taxes on capital. For the sake of simplicity, the taxes on labor and capital levied on exports are not included here, even if in the model this is done more accurately.

The product is obtained by combining intermediate inputs and value added in fixed proportions. The value added itself is obtained by combining labor and capital inputs in a CES production:

[5] $VA_p = F(L_p,K_p) = [b_1 L_p^{\ k} + b_2 K_p^{\ k}]^{1/k}$,

where k is the elasticity of substitution of labor and capital while the b_i are distribution parameters used in the calibration of the model.

For exports, the value added function is similar:

[6] $VA_{px} = F(L_{px},K_{px})$.

More generally, the product of sector j, QT_{pj}, is obtained from a fixed coefficient function (Leontief) between intermediate consumption and value added:

[7] $QT_{pj} = \text{mín } \{Q_{1j}/a_{1j},..., Q_{nj}/a_{nj}, Va_{pj}/av_j\}$

where Q_{ij} is the quantity consumed of good i for producing j.

3. Public utilities

The regulated firms sell to the domestic market mostly. With the exception of some differentiation due to regulation, service obligations or to taxes according to their final users, each utility sector is assumed to sell a single product.

[8] $N^r = r_C Q_C + r_E Q_E + r_G Q_G - [a^r p_b + i_r + \alpha_r (z r_E + (1-z) r_C)$

$+ f(1+t_i) + f_m (1+t_m) p_m](Q_C+Q_E+Q_G) - wL_r(1+t_{v1}) - r_r K_r(1+t_{v2})$,

where Q_C is the quantity of product sold to households at a unit price r_C, Q_E corresponds to the goods and services sold to the firms at price r_E y the index G is used for the public sector wherever a distinction is relevant. This also allows a differentiation of tariffs into retail, wholesale or commercial and residential as necessary. i_r represents investment requirements per unit of output.

It is important to note that all outputs are limited by capacity and transmission constraints incorporated through the value added function. The product of the sector is also based on a fixed proportions production function:

[9] $Q_{ri} = \text{mín } \{Q_{1i}/a_{1i},...,Q_{ni}/a_{ni}, Va_{ri}/av_{ri}\}$,

where a_{ji} is the input requeriment of j by firm i.

The value added function in the regulated sector are assumed to be Cobb-Douglas.

[10] $VA_{ri} = A\, L_{ri}^{\ a}\, K_{ri}^{\ 1-a}$,

where A is a constant. The installed capital of the firm was taken as given:

[11] $K_{ri} = K^o_{ri}$,

Though it is natural to think that the production function of that sector should exhibit some economies of scale or sub-additivity, we will assume that there are not non-convexities once specific capital is installed. This is a simplification with obvious theoretical costs, but it also contributes to concentrate our effort in determining the impact of regulatory mechanisms[8]. The main focus of the paper is in the short run, and when capital is installed the regulated sector is ex-post receiving a rent that compensates the initial investment.

4. Government

The government maximizes a social welfare **y** including current collective goods H produced with goods and services purchased G and G_r, employment L_g, bonds B_g (which can be sold domestically or internationally), pension services R, and a proxy for future collective goods I_g, public investment:

$$[12]\quad y = y[H(G,G_r,L_g),\ B_g,\ R,\ I_g].$$

The function y(.) is a Cobb-Douglas and H(.) is a Leontief in G, L_g and G_r which includes all the public utilities services in fixed proportions. Pensions, bonds services, investments, and current operative expenses are a constant proportion of total government income in this model.

The government faces a budget constraint given by:

$$[13]\quad t_i[f(pQ + p_xX) + pI^d + pc^d] + t_{v1}\, w(L_p) + t_{v2}\,(r_pK_p + r_r K_r) + t_m p_m f_m(Q+X) + t_m p_m c^m + t_d(wL + w_gS_g + rK^o + N^r + N^p - pI^d) + p_bB_g^{\,o} = p(G + I_g) + r_G\, G_r + w_gL_g + p_bB_g + p_RR$$

5. Rest of the World.

The foreign consumer has a Cobb-Douglas utility function:

$$[14]\quad u^F = u^F(M^c,\ X^c,\ B_x);$$

subject to the following constraints,

$$[15]\quad p_mM - z^*V^d = 0,$$

for imports M, produced with a single factor V^d at price z^*,

$$[16]\quad p_x\, X^s - z^*V^x = 0,$$

for exports X, where V^x is the quantity of the foreign factor needed to produce X^s, a perfect substitute to Argentina's exports.

This foreign consumer faces the following budget constraint:

$$[17]\quad p_xX^c + p_mM^c + p_bB_x = p_bB_x^{\,o} + z^*(V^d + V^x) + {}^*\,(r_rK_{ro} + N^r)\ ,$$

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[8] Dierker et al (1985) present an analysis of the existence of equilibrium when there are special pricing rules.

i.e. his revenue comes from payments to V-from its share of capital in the privatized sector- and from bonds and his expenditures are X^c in the exports markets and M^c in the imports markets.

Equation [18] sets the export prices at the international level:

[18] $p_x X^a - pX = 0$.

Considering that A_m and A_x are the foreign technological parameters, [19] y [20] determine a linear transformation curve abroad and fixes the relative prices faced by Argentina:

[19] $M = V^d/A_m$,

[20] $X^s = V^x/A_x$.

6. Labor Market

Constraint [21] describes the imbalance in the labor market and in the model is replaced by equation [22] determining the salary in the economy:

[21] $L_p + L_{px} + L_r + L_h + L_g \leq S$,

[22] $w = b\, w^*$,

Parameter **b** is calibrated for the equilibrium salary in the economy, so that the initial unemployment rate is equal to the observed unemployment rate; this value of **b** is then kept constant throughout the counterfactual exercises.

7. Investment Goods Industries.

Investment goods industries were divided into two main categories: those providing capital goods for private firms and those that construct specific capital for each one of the privatized utilities (electricity, gas, water and telecommunication). This procedure allows the recognition of the differential impact of investment schedules established by the regulatory contracts.

8. The Market for "Bonds".

The financial market is highly simplified in this model. As already mentioned, there are fixed requirements of credit per unit of output in each production sector, including recently privatized utilities. Additionally, domestic consumers can be separated into net debtors (tipically the poorest income brackets, to meet their demand for durable goods) and net creditors (the richest income bracket); the rest of the world was considered a net creditor too for the benchmark. In terms of the bonds market, debtors were represented as issuers and creditors as subscribers. Therefore for domestic families and for the foreign consumers, bonds were introduced in the model giving them initial endowments but also introducing preferences for bond holdings as arguments in their utility functions.

The market for bonds is therefore represented as:

[24] $B(h) + Bg + Bx + a(Qp + Xp + Ip) + ar\,(QC + QE + QG) =$

= Bo(h) + Bog + Box.

The information on sectoral and personal net financial positions was obtained from monetary authorities and estimated using purchases of durables goods and total capital holdings.

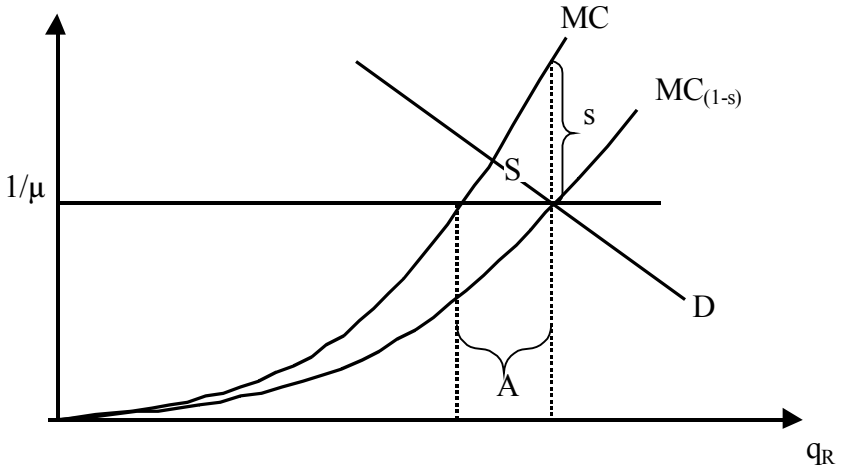
The domestic bonds market adjusts to the internal credit disequilibria of the families and of the government and to Argentina's disequilibrium with the rest of the world. The benchmark simulation of the model includes both a positive unemployment level and a commercial deficit. This implies that in addition to a disequilibrium in the labor market, the rest of the world is financing consumption and domestic investment. The implications for the bond market is an increase in the demand for bonds issued by domestic agents and purchased by foreigners.

9. How does the mechanisms of Price-Cap and Cost-Plus work in this setting?

To make the model as realistic as possible, it is important to model the fact that contracts with private operators generally specify explicit large service obligations because the services they deliver are often perceived as essential to the well being of the poorest. In our model, service obligation is interpreted as the passive adjustment of services supply to demand in the regulated sector.

Most regulatory regimes establish explicitly this obligation in the contract, and its violation has not only direct economic costs but also hinders on the reputation of the firm. Service obligation increases costs to the firm (real and expected) and is compensated with the tariff and, very often, with the commitment by the regulator of protecting incumbents by legally blocking the entry of new competitors. A temporary "no entry" condition is, in fact, a second important characteristics of modern infrastructure reforms, which guarantees a return on assets, when perceived commercial risk levels could be aggravated by the concern for entry and become a participation constraint for the private sector.

Graph 1: Subsidy to cover marginal costs



Under Service Obligation hypothesis the price-cap or the rate-of-return regulation can be interpreted as special mark-up rules that are in fact taxes for which the revenue accrues

to (or is extracted from) the owners of the firms. Namely, when there is an increase in costs (see graph 1), we assume that a subsidy is paid by the shareholders of the firm in order to maintain the prices fixed. With this strategy, existence of equilibrium can be shown using the proofs already available for the standard general equilibrium models with taxes.

Assume that the market price for the regulated firm were r_C and that this level were below the price-cap benchmark, given by $1/\mu$, then the tax rate will be determined by:

$$t = (1/\mu\ r_C) - 1.$$

That is, we introduce an artificial tax system whose claimant is not the government, but the shareholders of the regulated firm.

If, instead of a benchmark for price we have a benchmark for the rate of return on assets, the tax function is adjusted endogenously again; the tax rate will be determined using the equation:

$$(t\ r_C\ Q_r + N^r) = z^* K_R$$

which means that total dividends to shareholders (left hand of the equation) match exactly normal rate of return abroad (right hand), z^*.

These equations are added to the general equilibrium system, so that we have one more equation and one more unknown, the tax rate.

The proof of existence of equilibrium in this case could become an issue. Fortunately, Shoven and Whalley (1973) have already given a proof of existence for a general case when the claimant of the mark – up revenue is the government. The natural requirement is that the mark-up function be homogenous of degree zero with respect to prices –see Ginsburgh and Keyzer (1997), for a summary of the approach.Our rules for determining the tax rate fulfil this condition.The tax could be negative if the market price is above the reference level $1/\mu$, or if the rate of return on assets, N^r/K_R is higher than z^*.

IV. Simulations of alternatives for renegotiating tariffs

As we already mentioned there are two focal points for renegotiation of tariffs. On the one hand, the affordability of the service to the customer, and on the other hand, the sustainability of the firm. Of course, tariffs should respond basically to efficiency in the long run, but at present, failing to fulfil one of those could put in danger the privatization process as well as the continuity of the service provision (accompanied by political, sanitary and social distress).

In fact, the economy is facing the problem of defining tariffs accepting some degree of inefficiency, just to overcome the present disequilibrium. From that point of view, some solutions that are ruled out under normal conditions can be accepted temporarily. That is why we included cross-subsidies as one alternative solution. Under equilibrium conditions, cross-subsidies are minimized because they distort relative prices and therefore reduce efficiency; however, they can be left as the only alternative when the contributory capacity of some deciles is clearly below the required tariffs.

We have focused our analysis in two cross-subsidies schemes. The first one is a subsidy to poor customers financed by rich customers, that is a transfer within the sector

between customers. The second one, is a transfer from firms that use the regulated goods as inputs (say electricity for manufactures) to poor customers; this will increase costs of firms, reduce exports and production, as well as employment for the poor (say in manufacture) but the net effect is not well determined on an a priori basis. That is an example of why the CGE is useful.

We have not considered a subsidy to firms from the public sector. The reason is clear: the government is under default and the tax system is unable to generate the fiscal revenue necessary to fulfil normal obligations; therefore, there is not a feasible way of transferring resources from tax payers to poor customers (except for the inflationary tax which is in contradiction with long-run objectives).

The third possible mechanism we explore is a temporary reduction of capital expenditure of firms, reducing investments to the minimum level necessary to guarantee the continuity of provision. This is implicitly a cross-subsidy from future customers to present poor customers.

The fourth policy is to sustain the rate of return of regulated sectors, adjusting tariffs, at their initial level in real domestic terms.

We will try to see which of those proposed solutions is the least costly for the economy.

Our benchmark for the model is 1997, some years before the devaluation of 2001. That year is chosen because information on input-output relations was available from a national wide survey and because in 1997 the economy was not experiencing significant disequilibria.

We discuss two basic solutions. Under the label of "Firms Absorb" we include exercises that imply that privatized firms cannot adjust tariffs nominally after the devaluation and henceforth suffer important real losses; sustainability is not guaranteed under those conditions. Instead, when we admit the firms adjust freely their tariffs, the so called "Users Absorb" scenario, we put in danger the affordability of the tariffs for poor customers. This is a conceptual experiment, since we assume that the resulting tariffs will mimic the workings of a competitive solution. The implicit assumption is that the well known non-convexities (e.g. economies of scale) are not present and that the firms are regulated so that the tariffs coincide with the ones that a competitive world will determine.

The set of solutions includes also two alternative critical policies for debt renegotiation. An important cost driver for privatized firms is the financial cost of debt; Table IV-1 shows an estimate of the participation of obligations in dollars in the capital structure of privatized sectors. Had the financial obligations been mandatory in a dollar-basis most of the firms would had already gone bankrupt.

Table IV-1: Obligations in Dollars

Group	Electricity	Gas	Water	Telecomm
As a proportion of total capital (%)	37	36	57	41

Source: Own elaboration

We consider two alternative "solutions". The first one is to assume that obligations must be honored in the currency they were originally established. The second possibility is that debt received the same treatment as shareholders capital, and therefore it is passive to the regulatory review process and its rate of return was the same the owners of capital were able to reach. Tariffs included a component of "country-risk" that compensated shareholders of the risk of investing in Argentina (a state of nature that has shown true ex post). Debt did not necessarily followed that rule and in several cases it had an explicit guarantee from parent companies abroad[9]; we consider therefore the net return on own capital, including implicit subsidies the domestic firms receive from their shareholders for fulfilling their service obligations.

Table IV-2 and Table IV-3 present the main results of our simulations[10]. The first column shows the results of the model, to be compared with observed actual changes.

We evaluated three alternative comparative statics changes to replicate the economy sudden shock triggered by the devaluation:

- A tax of 65% in every financial transaction, destroying the revenue afterwards.
- A generalized loss of total factor productivity of 8%.
- A tax on exports of 60%. The revenue is given as a windfall to domestic agents, in order to capture the wealth effect. The method takes into account that the response of exports to relative price is slow.

The third one, approximates better the observed changes of the economy.

We have chosen some indicators that could give a good idea of the workings of the economy after the devaluation. As of 2002: Rate of Unemployment: 21.5% ; change in GDP: -11% (year); primary goods GDP: –2.7%, manufactures GDP: –10.6%; Services GDP: –10.5%)

Table IV-2 corresponds to the case of passive adjustment of debt of privatised firms; that is, debt receives the same treatment as shareholders' assets. The balance sheet costs of devaluation are not therefore transferred to customers, and foreign creditors experience a reduction in the real value of the debt.

[9] This is a relevant issue according to a recent paper by Ehrhardt and Irwin (2003).

[10] All changes are in pesos.

Table IV-2: Simulation Results. Scenario with default.

Indicator	Firms Absorb First Year	Firms Absorb (FA)	Users Absorb (UA)	FA and investments reductions	UA with cross-subsidies intra-households	UA with cross-subsidies firms-households	Rate of Return
Activity Level							
GDP	-11.0	-6.0	-6.2	-5.5	-6.2	-6.2	-6.5
Primary Goods	2.3	4.2	4.3	4.3	4.3	4.2	4.4
Manufactured Goods	-18.1	-10.7	-10.4	-9.9	-10.4	-10.6	-10.2
Services	-11.2	-6.2	-6.8	-5.9	-6.8	-6.8	-7.4
Exports	-5.2	4.7	5.5	5.1	5.5	5.5	6.1
Welfare (% change)							
Poorest	-15.1	-8.6	-9.2	-7.8	-7.7	-7.8	-9.9
Richest	-9.1	-3.2	-3.2	-1.6	-3.3	-3.3	-3.6
Average	-15.8	-9.1	-9.7	-8.2	-9.6	-9.6	-10.5
% Shift in Share of expenditure on Public Services							
Poorest (Base year: 11.3%)	0.2	-3.8	-1.3	-4.4	-6.2	-6.2	0.7
Richest (Base year: 7.3%)	-12.4	-16.3	-16.0	-17.4	-15.8	-15.9	-15.8
Average (Base year: 10.0%)	-9.8	-13.5	-13.0	-14.5	-12.8	-12.9	-12.6
Labor Market							
Rate of Unemployment	25.0	18.8	18.9	18.0	18.9	19.0	19.0
Rate of Return							
Economy (average)	-27.4	-26.0	-26.2	-15.1	-16.2	-16.4	-16.4
Electricity	-58.9	-84.6	-29.4	-13.2	-29.4	-28.3	0
Gas	-113.5	-138.2	-43.7	-20.1	-43.7	-42.1	0
Water and Sanitation	-45.8	-73.1	-17.9	-7.3	-17.9	-17.3	0
Communications	-73.0	-61.0	-38.6	-17.7	-38.6	-38.5	0
Prices							
RPI	22.2	28.3	29.6	28.5	29.6	29.6	32.1
Electricity	0	0	25.5	0	25.5	25.8	46.0
Gas	0	0	25.4	0	25.4	25.7	41.9
Water and Sanitation	0	0	13.0	0	13.0	13.1	17.2
Communications	0	0	19.1	0	19.1	19.1	81.8

Source: Own Elaboration

Table IV-3 shows the opposite case. Debt payments are fully indexed in dollar terms and therefore the cost of devaluation must be faced by domestic customers and the shareholders of the firms.

Table IV-3: Simulation Results. Scenario without default

Indicator	Firms Absorb First Year	Firms Absorb (FA)	Users Absorb (UA)	FA and investments reductions	UA with cross-subsidies intra-households	UA with cross-subsidies firms-households	Rate of Return
Activity Level							
GDP	-11.0	-11.9	-12.5	-11.8	-12.5	-12.7	-12.6
Primary Goods	2.3	1.7	1.7	1.8	1.7	1.7	1.7
Manufactured Goods	-18.1	-16.3	-16.1	-15.3	-16.1	-16.6	-16.1
Services	-11.2	-13.0	-13.9	-13.1	-13.9	-14.1	-14.1
Exports	-5.2	10.0	10.4	10.8	10.4	10.1	10.4
Welfare (% change)							
Poorest	-15.1	-18.0	-19.1	-17.5	-16.4	-16.8	-19.4
Richest	-9.1	-11.2	-11.5	-9.6	-11.8	-12.0	-11.7
Average	-15.8	-18.7	-19.7	-18.7	-19.2	-19.6	-20.3
% Shift in Share of expenditure on Public Services							
Poorest (Base year: 11.3%)	0.2	4.32	9.4	4.7	0	0	11.4
Richest (Base year: 7.3%)	-12.4	-170.0	-9.3	-11.6	-7.8	-8.7	-8.8
Average (Base year: 10.0%)	-9.8	-6.3	-5.7	-8.1	-4.3	-5.2	-5.1
Labor Market							
Rate of Unemployment	25.0	26.4	26.5	25.8	26.5	26.8	26.5
Rate of Return							
Economy (average)	-27.4	-30.8	-31.0	-30.0	-31.0	-31.7	-24.0
Electricity	-58.9	-115.0	-22.6	-16.1	-22.6	-20.8	0
Gas	-113.5	-154.9	-24.4	-14.2	-24.4	-22.8	0
Water and Sanitation	-45.8	-155.0	-15.0	-7.5	-15.0	-13.6	0
Communications	-73.0	-110.2	-26.8	-22.1	-26.8	-26.5	0
Prices							
RPI	22.2	25.3	28.7	26.8	28.7	28.6	30.5
Electricity	0	0	45.8	12.2	45.8	46.8	64.9
Gas	0	0	37.5	0	37.5	38.0	48.0
Water and Sanitation	0	0	38.4	0	38.4	38.8	44.3
Communications	0	0	61.5	34.9	61.5	61.6	103.5

Source: Own Elaboration

The first scenario was calibrated to represent the change in the main indicators of the economy, after one year of the initial devaluation. The observed fall of GDP was 11%; the rate of unemployment rose to 25% and exports (in terms of quantities) fell 5.2%. Welfare of domestic agents (measured by the Equivalent Variation) are affected mainly by the rate of unemployment increase as well as by the increase in prices and of the cost of debt in dollar terms.

The second scenario addresses the on-going renegotiation process. The model was calibrated to represent the observed increase in the GDP for the second year (5%), under the assumption of default and no increase in tariffs. Exports grow 10% (4% with respect to benchmark).

In each case we compute several alternatives for tariffs adjustment and policies. The first possibility is that tariffs were fixed in nominal peso terms, and therefore, shareholders had to cover the deficit of privatised firms. This is presented under the heading of "Firms Absorb". On the opposite side, "Users Absorb" mimics the workings of an flexible price economy, where tariffs adjust freely to the new conditions. The implicit assumption is that the privatised sectors can be represented analytically as neoclassical firms (this is a non realistic assumption but helps to put points of reference for the discussion). Then we consider three alternatives for policy.

Finally, we consider a case when all debts are honored in the original currency, GDP falls an additional 1% and welfare losses are doubled.

"FA-Investments" corresponds to a "Firms Absorb" sub-case. Current investments are considered an input requirement of the production function, and they are reduced eliminating access and expansion expenditures. Only maintenance is left as a minimum investment level.

Table IV-4 presents the percentage of reduction needed to avoid tariffs increases.

Table IV-4: Investment reductions

Group	Electricity	Gas	Water	Telecomm
with default	79%	63%	27%	86%
without default	100%	90%	88%	100%

Source: Own elaboration

Here we can see that in the case without default in electricity and telecomm sectors the investment reduction is not enough to avoid price increases. We can also see that this remedy generates the lower welfare loss for consumers. However, as we have already stated, this can be interpreted as a cross-subsidy from future customers whose welfare is not considered in a static general equilibrium model, so the welfare loss is underestimated. Nevertheless this simulation shows that this policy (that assures *Sustainability* of the firms) might be tempting in the short run. Moreover it will alleviate pressures on the trade balance since imports represent a high proportion of total investments.

"UA- Households" and "UA-Firms" represent two sub-cases of "Users Absorb". The first one computes cross-subsidies within the Household Sector, having the objective of compensating Poor Customers with reduced tariffs that are covered with increased tariff to the Richest Families. The initial level of consumption of the Poorest Families is considered a minimum consumption for every household. The same benchmark is used for "UA-Firms", but in this case the deficit of the Poorest is covered with a relative increase in tariffs to all producers in the economy.

Taxes and subsidies are presented in Table IV-4.

Table IV-5: Taxes and subsidies

Indicator	UA with cross-subsidies 1				UA with cross-subsidies 2			
With default	**T**	**E**	**G**	**W**	**T**	**E**	**G**	**W**
Decil								
1°	-36.2	-42.6	-42.5	-29.0	-36.2	-43.2	-42.8	-29.5
2°	-	-23.7	-23.5	-5.5	-	-24.1	-23.9	-5.9
3°	-	-2.4	-2.4	-	-	-3.1	-2.7	-
4°	-	-	-	-	-	-	-	-
5°-10°	0.4	3.8	3.3	1.4	-	-	-	-
Firms	-	-	-	-	0.7	2.7	4.4	3.4
Without default								
Decil								
1°	-71	-63.5	-59	-60	-71	-64.5	-59.8	-60
2°	-45.5	-51.5	-46	-47	-46	-52.5	-46	-47
3°	-	-38	-30	-31	-2.0	-39.2	-32	-32
4°	-	-29.5	-20	-21	-	-30.5	-20.5	-21.5
5°	-	-13.5	-0.5	-2	-	-15	-0.5	-2
6°	-	-1.3	-	-	-	-2.9	-	-
7°	-	-	-	-	-	-	-	-
8°-10°	3.6	26.7	14.5	15.5	-	-	-	-
Firms	-	-	-	-	3.4	9.9	11.9	20.5

Source: Own Elaboration

The cost of the subsidies is about 150 millions of pesos (u$s 50 millions) in the default case and 530 millions (u$s 177 millions) when debts are honored. Although there is no significant difference in the amount of money required if we finance the subsidies using taxes on rich consumers or taxes on firms, the welfare impact is not neutral: if we use taxes on firms, there is an extra welfare cost of 280 millions pesos (u$s 93 millons) in the case with default, and of 1150 millions pesos (u$s 383 millons) in the case without default. In other words, the additional welfare cost of cross subsidizing with a higher tariff on firms, measured as a proportion on the original household expenditure on public utilities, is 2.7% in the case with default and 11.1%.when debt is fully honored in foreign currency.

The last column shows the results of adjusting tariff to keep the rate of return of privatised sectors at its initial level in constant Pesos. Although we have shown that Price-Cap mechanism was adopted for most privatized sectors, this simulation is performed as a reference for discussion. Prices must increase far more than in Users Absorb case, (i.e.: in electricity sector the tariff is almost twice the level than in User Absorb case) and consumers are clearly much worse in terms of welfare.

V. Conclusions

This paper presents a computational exercise designed to study the unpleasant alternatives of policy for the privatised sectors in Argentina, after the catastrophic devaluation in 2001.

There are two basic constraints to take into account: *sustainability* of firms and *affordability* of tariffs for customers.

The main findings of the paper are:

- The short-run impact of the devaluation is a generalized loss of welfare. In the long-run positive effects can be expected.
- Affordability and sustainability will be much more difficult to achieve when debt of the firms is not renegotiated and must be honoured in the original currency. Moreover, tariffs will increase in relative terms to the RPI.
- Temporary investment reductions is not enough for sustainability, though it could be a policy preferred by customers. It is a tempting policy, because it transfers costs to customers in the future and reduces pressures on the trade balance.
- Cross-subsidies among customers help to guarantee firms sustainability and affordability for the Poor. This is the policy that minimizes welfare losses given the social objective of sustaining access and consumption of basic services for the Poor.
- The alternative of cross-subsidising from production sectors involves a significant extra welfare loss compared to intra-household cross-subsidies scheme.

VI. References

Altimir, O. y L. Beccaria (1999): "Distribución del Ingreso en la Argentina", Serie Reformas Económicas No. 40. CEPAL. Santiago de Chile.

CEER, (2001), *Las empresas privadas de Servicio Público en la Argentina: Análisis de su Contribución a la Competitividad del País*. Centro de Estudios Económicos de la Regulación (CEER). Buenos Aires, Argentina.

Chisari, O. y C. Romero, (1996), "Distribucion del ingreso, asignacion de recursos y shocks Macroeconomicos," Serie Financiamento del Desarollo #36, CEPAL, United Nations.

Chisari O.O., A. Estache and C. Romero (1999), "Winners and Losers of Privatization and Regulation of Utilities: Lesson from a General Equilibrium Model of Argentina", *The World Bank Economic Review*, May, Vol.13, no.2, pp.357-378.

Dierker E., R. Guesnerie and W. Neuefeind (1985), "General Equilibrium When Some Firms Follow Special Pricing Rules", *Econometrica*, Vol.53, No.6, pp.1369-1393, November.

Ehrhardt D. and T. Irwin (2003), "The Problem of leverage, high – powered regulation and implicit guarantees in private infrastructure projects", Mimeo.

Ennis H. and S. Pinto (2002) "Privatization and Income Distribution in Argentina", Mimeo.

Ginsburgh V. and M. Keyzer (1997), *The Structure of Applied General Equilibrium Models*, (Cambridge MA: The MIT Press).

INDEC. (2001), *Matriz insumo Producto Argentina 1997*, Ministerio de Economía. Buenos Aires, Argentina.

Santiere J.J., J. C. Gomez Sabaini and D.A. Rossignolo (2000), *"Impacto de los Impuestos sobre la Distribución del Ingreso en la Argentina en 1997"*. Estudio preparado para la Subsecretaría de Programación Económica y Regional en el marco del Proyecto 3958 AR- FOSIP- Banco Mundial. Buenos Aires, Febrero de 2000.

Shoven J.B. and J. Whalley (1973), "General Equilibrium With Taxes: A Computational Procedure and an Existence Proof", *The Review of Economic Studies*, Vol. 40, Issue 4 (October), 475-489.