

Appendix 1. Structure of GEM-Core

GEM-Core is a dynamic computable general equilibrium (CGE) model designed for medium- and long-run policy analysis. GEM stands for General Equilibrium Model. GEM-Core is a core model in the sense that it can address the issues that typically are relevant for CGE analysis for developing countries, including fiscal space (with its spending, tax, and foreign aid aspects), public investment, social safety nets, trade, jobs, demography, poverty, and inequality.

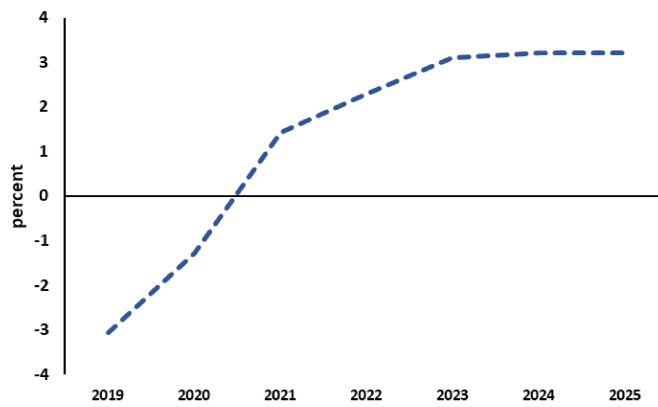
Technically, the model is made up of a set of simultaneous linear and non-linear equations. It is economy-wide, providing a comprehensive and consistent view of the economy, including linkages between disaggregated production sectors and the incomes they generate, households, the government, and the balance of payments. It is an appropriate tool for analyzing tax changes given the fact that it, in an integrated manner, captures household welfare, government budget, and differences between sectors in terms of household preferences, labor intensity, technological change, links to international trade and the domestic economy, and capital accumulation. In each period, the different agents (producers, households, government, and the nation in its dealings with the outside world) are subject to budget constraints: receipts and spending are fully accounted for and by construction equal (as they are in the real world). The decisions of each agent – for producers and households, the objective is to maximize profits and utility, respectively – are made subject to these budget constraints. For example, households set aside parts of their incomes to direct taxes and savings, allocating what is left to consumption with a utility-maximizing composition. For the nation, the real exchange rate adjusts to ensure that the external accounts are in balance. In GEM-Core, other options such as adjustments in foreign reserves or borrowing are possible but may not work in the long term. Wages, rents, and prices play a crucial role by clearing markets for factors and commodities (goods and services). For commodities that are traded internationally (exported and/or imported), domestic prices are influenced by international price developments. Given that Argentina is a small country, it is assumed that international markets demand and supply the country's exports and imports at given world prices. For this application, GEM-Core is modified to allow the assumption that the output of the tobacco leaf sector is exogenous and that exports are determined as a residual once domestic demand is satisfied. In this paper the words “tobacco” and “tobacco leaf” are used to refer to the output of the cultivation of tobacco. Therefore in case there

is an increase in the domestic price of tobacco products (for example, due to higher taxes on cigarettes) the resulting decrease in the domestic demand for tobacco leaf will be compensated one-to-one by an increase in exports of tobacco leaf.

Over time, production growth is determined by growth in factor employment and changes in total factor productivity (TFP). Growth in capital stocks is endogenous, depending on investment and depreciation. For other factors, the growth in employable stocks is exogenous. For labor and natural resources (with sector-specific factors for natural-resource-based sectors), the projected supplies in each time period are exogenous. For natural resources, they are closely linked to production projections. For labor, the projections reflect the evolution of the working age population and labor force participation rates. The unemployment rate for labor is endogenous. TFP growth is made up of two components, one that responds positively to growth in government infrastructure capital stocks and one that, unless otherwise noted, is exogenous.

Appendix 2. Supplemental Figures and Tables

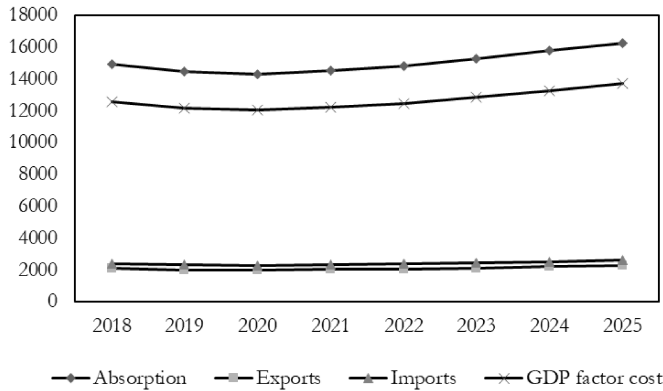
Figure A2.1 GDP growth rate (%), 2019–2025



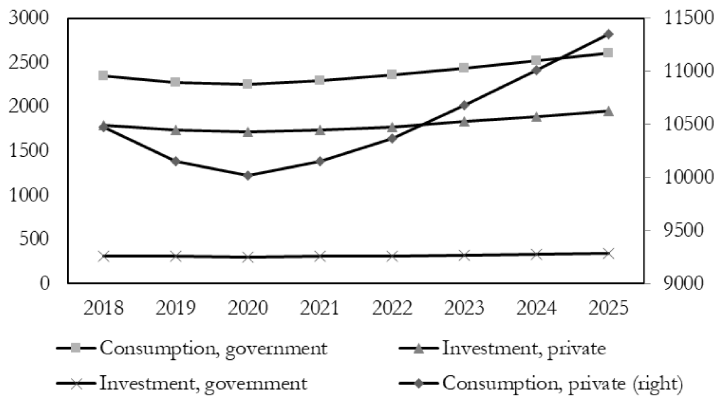
Source: Authors' calculations based on WEO-IMF and INDEC.

Figure A2.2 Baseline scenario: GDP, foreign trade, and domestic final demand aggregates (in billions of pesos), 2018

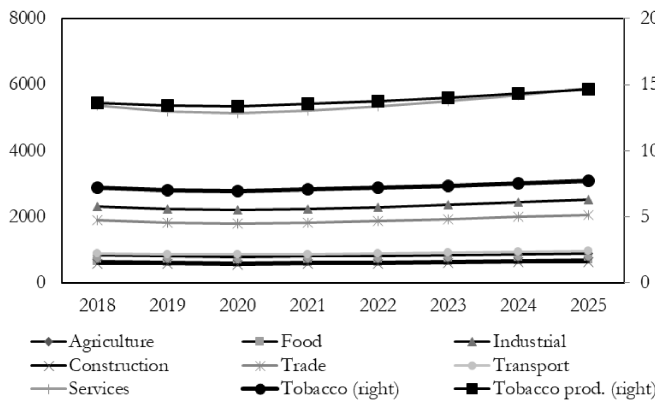
Panel A. Foreign trade, GDP, and absorption



Panel B. GDP composition, by aggregates

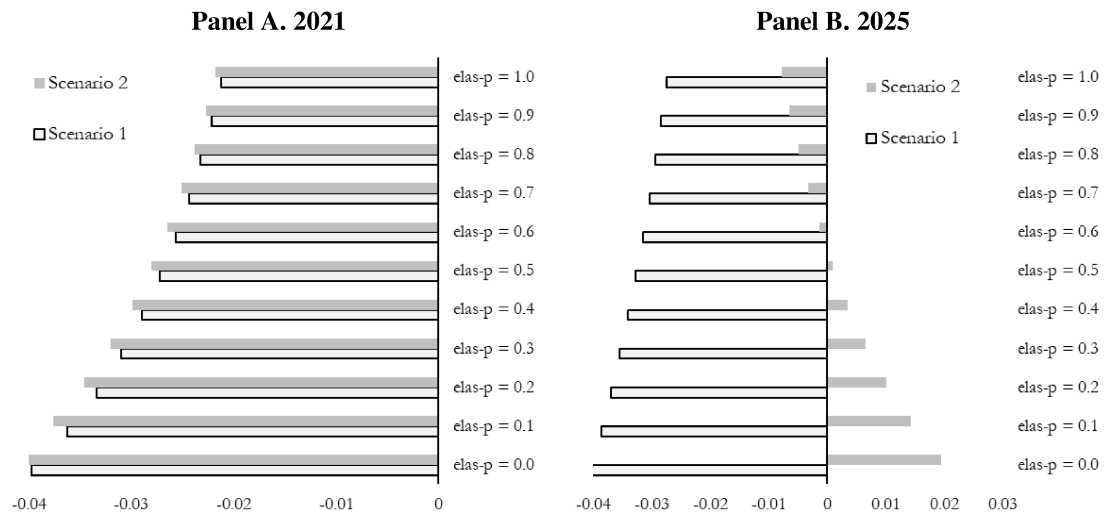


Panel C. GDP composition, by sectors



Source: Authors' calculations based on simulation results.

Figure A2.3 Sensitivity analysis of total employment by simulation in 2021 and 2025: Percentage level deviation from base



Source: Authors' calculations based on simulation results.

Table A2.1 Accounts in the social accounting matrix (SAM), disaggregation of GEM-Core Argentina, 2018

Category	Item
Sectors (activities and commodities)	Primary (10): <i>other crops, livestock and forestry; tobacco (7)*; fishing; mining</i> Manufacturing (17): <i>food and beverages; tobacco products; textiles; wearing apparel; leather; wood; paper; printing; refined pet products; chemical prod; rubber and plastic; non-met min prod; basic metals; metal prod; machinery and equipment; vehicles; other manufacturing.</i> Other industry (2): <i>electricity, gas and water; construction</i> Services (12): <i>trade; hotels and rest; transport and comm; financial ser; business ser and real estate; public administ; education, gov; education, non-gov; health, gov; health, non-gov; other services; domestic ser</i>
Factors (5)	Labor (3) ** Capital Land Natural resource, fishing Natural resource, mining
Institutions (4) ***	Households (10) Enterprises Government Rest of the World
Taxes (9)	Tax, social sec cont Tax, capital use (ganancias empresas) Tax, value added Tax, commodities Tax, FET Tax, direct (households) Tax, exports Tax, imports Tax, activities
Investment (2)	Investment, private Investment, government

*Tobacco is disaggregated between the seven producing provinces (Catamarca, Corrientes, Chaco, Jujuy, Misiones, Salta, and Tucumán).

**Labor is disaggregated into three categories according to skill level.

***The institutional capital accounts are for domestic non-government (aggregate of households), government, and rest of the world.

Source: Authors' own elaboration.

Table A2.2 Change in employment by sector. In percentage with respect to the baseline scenario

	Population in base year 2018 ('000)	Scenario 1		Scenario 2	
		2021	2025	2021	2025
Agriculture	1349.251	-0.045	-0.058	-0.049	-0.024
Tobacco Primary	23.507	-0.010	0.002	-0.012	-0.440
Food	747.265	-0.037	-0.042	-0.048	0.048
Industrial	1804.221	-0.107	-0.115	-0.068	0.028
Tobacco Production	5.908	-5.641	-4.965	-5.647	-4.959
Construction	1714.465	-0.184	-0.175	0.291	0.282
Trade	3541.884	-0.090	-0.095	-0.059	-0.049
Transport	1192.839	-0.066	-0.075	-0.072	0.023
Services	10175.212	0.043	0.036	-0.054	-0.027
Total	20554.552	-0.029	-0.034	-0.030	0.004

Source: Authors' calculations based on simulation results. Note: The short term indicates effects for 2021 while the long term indicates effects for 2025. Alternative scenarios for newly raised tax revenues: Scenario 1) the government increases spending on education and health; Scenario 2) the government increases spending on public infrastructure investment with high marginal product of capital.

Table A2.3 Elasticities

	VA	Armington	CET	elas-p
Other crops, livestock and forestry	0.250	2.000	2.000	-0.988
Tobacco	0.250	2.000	2.000	-0.400
Fishing	0.200	2.000	2.000	-1.000
Mining	0.200	2.000	2.000	-1.000
Food and beverages	0.900	1.500	1.500	-0.988
Tobacco products	0.900	1.500	1.500	-0.400
Textiles	0.900	1.500	1.500	-1.000
Wearing apparel	0.900	1.500	1.500	-1.000
Leather	0.900	1.500	1.500	-1.000
Wood	0.900	1.500	1.500	-1.000
Paper	0.900	1.500	1.500	-1.000
Printing	0.900	1.500	1.500	-1.000
Refined pet products	0.900	1.500	1.500	-1.000
Chemical products	0.900	1.500	1.500	-1.000
Rubber and plastic	0.900	1.500	1.500	-1.000
Non metallic minerals products	0.900	1.500	1.500	-1.000
Basic metals	0.900	1.500	1.500	-1.000
Metal products	0.900	1.500	1.500	-1.000
Machinery and equipment	0.900	1.500	1.500	-1.000
Vehicles	0.900	1.500	1.500	-1.000
Other manufacturing	0.900	1.500	1.500	-1.000
Recycling	0.900	0.800	0.800	-1.000
Electricity, gas, and water	0.900	0.800	0.800	-0.450
Construction	0.900	0.800	0.800	-1.000
Trade	0.900	0.800	0.800	-1.000
Hotels and restaurants	0.900	0.800	0.800	-1.000
Transport and communications	0.900	0.800	0.800	-1.000
Financial services	0.900	0.800	0.800	-1.000
Business services and real estate	0.900	0.800	0.800	-1.000
Public administration	0.900	0.800	0.800	-1.000
Public education	0.900	0.800	0.800	-1.000
Private education	0.900	0.800	0.800	-1.000
Public health	0.900	0.800	0.800	-1.000
Private health	0.900	0.800	0.800	-1.000
Other services	0.900	0.800	0.800	-1.000
Domestic services	0.900	0.800	0.800	-1.000

Source: Authors' calculations.

Appendix 3. Partial Equilibrium Model

Mathematically, a relatively simple partial equilibrium model is developed with the following two equations:

$$pqs_c = PQD_c(1 - tq_c)$$
$$QH_{c,h} = \gamma_{c,h} + \frac{\beta_{c,h}}{PQD_c} \left(eh_h - \sum_{c' \in C} PQD_{c'} \cdot \gamma_{c',h} \right)$$

where PQD_c is the (endogenous) demand price of commodity c , pqs_c is the supply price of commodity c , tq_c is the tax rate on commodity c , $QH_{c,h}$ is the (endogenous) quantity consumed of commodity c by household h and eh_h is the household consumption expenditure. In this model, we impose the ubiquitous partial equilibrium assumption that consumers (households) bear the entire burden of the tax. To allow a meaningful comparison, we calibrated this model using the same dataset that is used to calibrate GEM-Core Argentina. Note that this reduction of around 16 percent in tobacco consumption is in line with that found in the partial equilibrium simulation of CEDLAS.^[28]