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On the impacts of higher tobacco taxes in Argentina: a computable general equilibrium approach

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ABSTRACT

Objectives We analyse the employment effects of increasing tobacco taxation in Argentina by building a computable general equilibrium (CGE) model.

Methods In line with recent changes in tobacco taxation in the country, the CGE model simulates an increase in excise tax on cigarettes.

Results The results show that even a substantial increase in tobacco taxation induces a zero-net change in overall employment in the economy when the newly raised tax revenues are spent by the government on education, health or public infrastructure. Increased tobacco taxes may shift jobs from tobacco-related sectors to other sectors of the economy, but the overall impact on the total number of jobs is negligible.

Conclusions The widely documented positive effects of higher tobacco taxes (including a healthier population, more productive workers, savings from avoided costs of medical treatment for tobacco-related diseases, reductions in the number of new young smokers, among others) would far outweigh the nearly null effect of higher taxes on total net employment.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Governments can mitigate and even reverse any adverse employment effects of increased tobacco taxes by devoting the additional tax revenue to increase expenditure on social services and infrastructure.

WHAT THIS STUDY ADDS

⇒ Using a general equilibrium framework, this study shows that in Argentina a substantial increase in tobacco taxes induces a zero-net change in overall employment in the economy. Higher taxes may shift jobs from tobacco-related sectors to other sectors of the economy, but the overall impact on the total number of jobs is negligible.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ In addition to tax increases, accompanying policies to ease the transition to other activities of those negatively affected by higher taxes should be considered. A comprehensive policy package should include programmes to cover farmers' transition costs and training for displaced workers in alternative sectors.

INTRODUCTION

Vast worldwide evidence shows that tax increases that effectively increase tobacco products' retail price (RP) make them less affordable and generate large reductions in smoking prevalence and premature mortality.[1 2] However, this policy has been subject to two common objections. The first is that the increase in tobacco taxes tends to rely disproportionately on the poorest individuals, since less affluent smokers incur proportionately greater expenditures on cigarettes compared with more affluent smokers.[3] The second is that tobacco taxes may produce detrimental effects on employment in the tobacco sector and in the whole economy, since labour demand in the tobacco industry is a derived demand (ie, demand for a factor of production, such as labour or capital, that occurs as a result of the demand for a final good). Nevertheless, the effect of higher tobacco taxes on overall employment is not obvious since it depends on the reaction of consumers to higher taxes (ie, their demand price elasticities and the substitutability between tobacco products and other goods), the capability of workers to reallocate to other sectors and what the government does with the additional tax collection, among others. For instance, if the reallocation process of workers between sectors is not costly, and the government directs the additional tax collection to highly productive labour-intensive activities, the overall net effect of increased tobacco taxes on employment could be positive.

This paper contributes on the second objection with an empirical application for Argentina, a developing country in Latin America. This application becomes very interesting for two main reasons. First, in recent years tobacco taxes have been increased following international recommendations. WHO's guide on best practices recommends that total taxes on tobacco products should be at least 75% of the RP.[4] Along these lines, Argentina had increased the overall tax burden on tobacco products (ie, cigarettes) from 69% in 2014 to 76% in 2018.[5] Second, the first objection on the eventual regressivity of raising tobacco taxes has recently been questioned by Cruces *et al*.[6]

We build a computable general equilibrium (CGE) model of the Argentine economy focused on the tobacco sector. In line with recent changes to the tobacco taxation, we simulate a 15 percentage point increase in the internal tax on cigarettes. The tax is increased in 2021 and remains at this higher level from 2021 to 2025. This permanent tax shock allows to analyse short-term and long-term effects. Additionally, we simulate alternative scenarios in which the newly raised tax revenues return to the economy as higher public expenditure on education, health or public investment in infrastructure (ie, revenue recycling mechanisms).

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The results show that the tax increase raises the relative prices of cigarettes, reduces consumption by about 12% and induces a zero-net change in overall employment when the newly raised tax revenues are recycled by the government. Higher tobacco taxes may shift jobs from tobacco-related sectors to other sectors of the economy, but the overall impact on the total number of jobs is negligible.

To the best of our knowledge, this is the first comprehensive assessment of the impact of tobacco tax increases on employment for Argentina considering general equilibrium effects.

THE TOBACCO SECTOR AND TOBACCO TAXATION IN ARGENTINA

Tobacco sector

Tobacco growing is concentrated in seven provinces: Jujuy (with 36% of total production in 2018), Misiones (29%), Salta (25%), Tucumán (7%), Catamarca (1%), Corrientes (1%) and Chaco (1%). Around 19 170 producers were registered in 2016. The production of cigarettes is carried out predominantly outside of the growing area, basically in the province of Buenos Aires.[7]

In 2018, the gross production value (GPV) of tobacco cultivation represented 0.5% of agricultural crops and 0.03% of total GPV. Primary production is mainly oriented to the manufacture of cigarettes for the domestic market and the manufacture of raw tobacco for exports. In the 2006–2018 period, the planted area reached 60 571 hectares and the average production was 125 000 tons of the varieties Virginia (61%), Burley (36%) and Criollas (3%). Despite the technological change that prevails in agriculture, tobacco primary production continues to be labour intensive. Based on technical relationships, and considering a 180-day tobacco production cycle, it was estimated that tobacco production required 23 500 jobs.

Cigarette manufacturing (ie, industrial production) is oriented to the domestic market and strongly dominated by two companies which account for 89% of cigarette sales in the country: Philip Morris International Argentina and British American Tobacco. In 2018, the industrial stage represented 0.7% of the total manufacturing industry and 0.2% of total GPV. The physical volume index of the production of tobacco products, after having reached its historical maximum in 2012, shows a sustained decline in line with the slowdown in domestic demand in recent years. In 2018, sales of cigarettes were 1.740 billion packs of 20 sticks.

Tobacco taxation

The tax structure on cigarette consumption in Argentina is very complex.[6 8] Federal taxes affecting cigarettes are four ad valorem taxes: (1) the additional emergency tax (Impuesto Adicional de Emergencia (IAE)), with a rate of 7% over the RP; (2) the value-added tax (VAT) with a rate of 21%; (3) the special tobacco fund (Fondo Especial del Tabaco (FET)) with a rate of 8.35%; and (4) the internal tax (IT), with an ad valorem rate of 70%. The tax base of each one is different. For example, IT is applied over RP excluding IAE, VAT and FET. VAT's base is RP excluding IAE, IT and FET. Finally, FET is applied over RP excluding IAE and VAT. One additional tax is levied at the subnational level: the turnover tax with an ad valorem rate that varies depending on the province. Tobacco tax collection was approximately US$1.9 billion in 2020 and represents approximately 2% of total tax collection (0.5% of gross domestic product (GDP)).

Since 2016, tobacco taxation has undergone several reforms in Argentina. In May 2016, the ad valorem rate of the IT was raised from 60% to 75% (Decree 626/2016). In December 2017, a new reform set the IT rate at 70% and a minimum tax was established (Law 27430). With this tax structure on cigarettes, 76.6% corresponds to taxes when considering the price of the most sold brand, being the IT, the one that explains a greater share of the tax burden (54.5%). In this paper, we simulate a 15 percentage point increase in the internal tax on cigarettes, in line with the observed increase during May 2016.

METHODS AND DATA

The CGE model used in this paper is based on GEM-Core (General Equilibrium Model-Core), which draws on Lofgren *et al*.[9–11] GEM-Core is a CGE model designed for country-level analysis of medium-term and long-term development policies (see online supplemental appendix 1 for more details).

GEM-Core is calibrated to the last available 2018 social accounting matrix (SAM) and other data for Argentina. To build this SAM for Argentina, we follow a top-down approach as described in Round and Reinert and Roland-Holst.[12 13] The SAM includes 42 activities/commodities including tobacco sector by tobacco products; 7 factors (3 labour, capital, land, 2 other natural resources); 10 representative households (smokers and non-smokers, specialised in different sources of income); and other institutions (enterprises, government and the rest of the world). Table A2.1 in online supplemental appendix 2 shows the accounts in the SAM, which determine the disaggregation of the model. While all simulations were conducted using the complete level of sectoral disaggregation, for the sake of brevity, all figures and tables in the main text aggregate the SAM data to nine activities and commodities and five factors (ie, three labour, capital and natural resources).

The main sources of information for building the SAM are 2018 national accounts data with sectoral disaggregation, international trade (ie, exports and imports), the balance of payments, government data (ie, revenues and expenditures) and household income and spending data. This information is complemented with the 2004 supply and uses tables, which are the latest available for Argentina. Additionally, a 2018 SAM documented in Michelena is also used.[14] To enable household-level impacts to be estimated, households are disaggregated using Argentina's Household Income and Expenditure Survey for 2004 and 2005. Most of the data were obtained from the National Institute of Statistics and Census of Argentina (INDEC). Besides, other sources of information are the Ministry of Economy of Argentina and the International Monetary Fund (IMF) Balance of Payments Statistics.

Data related to factor stocks and several elasticities (production, consumption and trade) are also used to calibrate the model. For capital depreciation rates we follow Agénor *et al* and assume 4.5% and 3.5% for private and public capital, respectively.[15] Unemployment figures draw from the Center of Distributive, Labor and Social Studies while population projections were obtained from the 2019 United Nations World Population Prospects. Regarding specific data on the tobacco sector, information about the GPV, value added and employment draws from the Under-Secretary for Microeconomic Programming.[7] The GPV of tobacco cultivation in 2018 was $7.065 billion Argentine pesos and the GPV of tobacco products was $40.972 billion Argentine pesos. Tobacco exports were $3.488 billion for tobacco production and $509 million for tobacco products. Imports were $376 million and $1.092 billion, respectively. Employment in tobacco cultivation was 23 500 jobs while in tobacco manufacturing was 5900 jobs. Thus, given that total employment comprises 20 554 552 jobs, tobacco-related jobs in

Table 1 Sectoral structure of Argentina's economy in 2018

	Value added	Employment	Exports	Imports
Agriculture	6.67	6.56	11.98	3.50
Tobacco primary	0.06	0.11	0.17	0.02
Food	5.16	3.64	19.42	1.76
Industrial	18.40	8.78	26.57	67.82
Tobacco production	0.11	0.03	0.02	0.04
Construction	4.70	8.34	0.00	0.00
Trade	15.05	17.23	14.36	0.34
Transport	7.18	5.80	9.19	6.95
Services	42.68	49.50	18.27	19.56
Total	100	100	100	100

Select information contained in the SAM. In percentage.
Food includes fishing.
Source: Authors' calculations based on 2018 Argentina SAM.
SAM, social accounting matrix.

primary activity represent about 0.11% and those of manufacturing activity represent 0.03%.

In addition, the calibration of the GEM-Core requires (exogenous) supply and demand elasticities. Based on Cicowiez, Sadoulet and de Janvry, Dimaranan and Muhammad *et al*, we define this value as follows: the value-added elasticities of substitution are in the range of 0.20–0.95, the Armington and Constant-Elasticity-of-Transformation (CET) elasticities are both in the range of 0.9–2.0 and the own price elasticities for household consumption demand are in the range of 0.4–1.0.[16–19] Most importantly, we calibrate GEM-Core Argentina under the assumption that the own price elasticity of tobacco product consumption is 0.6, as reported in Cruces *et al*.[6]

Table 1 describes the sectoral structure of Argentina's economy, for 2018, in terms of the distribution of value added, employment, exports and imports. It can be observed that tobacco-related activities (growing or primary production and manufacturing of tobacco products) represent a small share of the Argentine economy. Table 2 covers the structure of sectoral factor demand. Labour use intensity in primary tobacco production is approximately 50%, while capital intensity is 40%. On the other hand, tobacco manufacturing is highly capital intensive (75%).

Finally, effective tax rates on commodities, excluding trade taxes, were 5.8% of total supply value for tobacco production and 62.6% of total supply value for tobacco products. It is worth noting that this is not the overall tax burden; this is the ratio between excise tax collection and total supply value (ie, domestic production sold in the domestic market and imports). It is important to show this tax rate because this is what is increased in the simulation below. In order to approximate the observed raise in the ad valorem rate of the internal tobacco tax in May 2016, this is increased from 62.6% up to 77.6%, which represents a substantial increase in tobacco taxation. Here, it is important to note that tobacco products initially present a high effective tax burden, which is critical when simulating a tax increase on this commodity, given the relationship between the level of the tax rate and the deadweight burden. By comparison, excise taxes account for about 44% of the RP of cigarettes in the USA.[20]

SIMULATIONS

The economy-wide analysis is based on the results of several scenarios. First, we simulate the baseline scenario, which represents a business-as-usual (BaU) projection without policy changes. We use the BaU as a benchmark for comparisons. It runs from 2018 (ie, the base year) to 2025. Under this scenario, the annual growth rates for real GDP at factor cost are exogenous. Specifically, we impose the observed growth rates in real GDP at factor cost for the year 2019 and an average growth rate of 2.0% during 2020–2025 (see figures A2.1 and A2.2 in online supplemental appendix 2). For 2019, we use estimates from INDEC. For 2020–2025, estimates are based on the IMF World Economic Outlook. Household spending on tobacco in the baseline scenario is a function of the GDP growth rate. Thus, we do not impose an exogenous path for tobacco prevalence or sales. However, given how we calibrate the linear expenditure system that we use to model household consumption, the growth rate for tobacco (real) spending is less than the growth rate of GDP (ie, the expenditure elasticity for tobacco consumption is less than 1). In fact, the base 2021–2025 average growth rates for overall household consumption per capita and household consumption per capita of tobacco are 1.6% and 0.9%, respectively. Therefore, our baseline assumption is consistent with a constant prevalence of tobacco combined with an increase in the (real) spending per capita on tobacco.

Second, we simulate a shock of a 15 percentage point increase in the internal tax (IT) on cigarettes, in line with the recent experience in Argentina. Specifically, the effective tax rate on tobacco products rises from 62.6% to 77.6%. The tax is increased in

Table 2 Structure of sectoral factor use, by sectors in 2018

	Labour, edu primary	Labour, edu secondary	Labour, edu tertiary	Capital	Natural resources	Total
Agriculture	18.58	3.66	2.21	37.73	37.82	100
Tobacco primary	37.50	7.39	4.47	39.31	11.33	100
Food	30.75	13.49	3.86	48.11	3.80	100
Industrial	24.57	12.86	4.25	49.97	8.35	100
Tobacco production	15.30	7.00	1.93	75.77	0.00	100
Construction	37.08	9.40	5.59	47.93	0.00	100
Trade	19.39	20.97	7.12	52.51	0.00	100
Transport	23.56	19.25	9.68	47.51	0.00	100
Services	19.15	21.65	22.87	36.33	0.00	100
Total	21.91	17.54	12.92	43.37	4.26	100

In percentage.
Food includes fishing; edu indicates educational level.
Source: Authors' calculations based on 2018 Argentina SAM.
SAM, social accounting matrix.

2021 and remains at the new tax rate up to 2025. Thus, it is a permanent shock that allows to analyse short-term and long-term effects. As remarked by Jha *et al*, this type of shock is like a pendulum that swings through all markets until it reaches its stationary position again. The swing could normally take 3–5 years to reach a new equilibrium.[21] Here, we simulate two alternative revenue recycling mechanisms: (1) the government increases spending on education and health (scenario 1); and (2) the government increases spending on public infrastructure investment with a high marginal product of capital (scenario 2).

In the non-baseline scenarios, the main transmission mechanisms are as follows. In all cases, higher tobacco taxation increases the relative price of tobacco products. Thus, tobacco consumption decreases. Therefore, production and employment in the tobacco sector also decrease. This is the gross impact on tobacco employment. In the estimates below, we present the net impact on tobacco employment that results once the indirect or general equilibrium effects are also considered. In a sense, the gross impact on employment is akin to a partial equilibrium estimate in as much as it assumes that no other impacts occur through (indirect) changes in the commodity and factor markets. In other words, this is the gross impact on employment where the disposable income that was previously spent on cigarettes, that would normally be spent on something else, and the newly raised tax revenue are not returned to the economy. This would be equivalent to calculating estimates of the employment impact of tax increases by assuming that a job permanently disappears from the economy rather than being reallocated to other sectors. However, consumers can substitute consumption and, through the input-output linkages, other sectors in the economy might be positively affected. That is, demand for other products increases, as do production and employment in those sectors. This is the net impact on employment, where the income previously spent on tobacco and the newly raised tax revenues return to the economy by allowing consumers and the government to spend them on alternative goods and services according to pre-existing spending patterns.[20] This net impact is reported in the next section.

RESULTS

Table 3 reports simulated changes in key macroeconomic variables within each scenario in response to the IT increase. As expected, the increase in the relative price of tobacco products results in a decrease in cigarette consumption and increases tax revenues. Overall, household consumption decreases by about 12.7% in 2021 (see Tobacco consumption, in units, in table 3). This reduction represents approximately 218 million 20-stick

Table 3 Key macroeconomic variable CGE estimation: baseline and simulated scenarios

	Base			Scenario 1		Scenario 2	
	2018	2021	2025	2021	2025	2021	2025
Value added (billion pesos)							
Overall economy	12 552.916	12 184.934	13 684.996	12 183.778	13 681.667	12 182.637	13 703.952
Tobacco	7.230	7.051	7.757	7.050	7.755	7.049	7.760
Tobacco production	13.636	13.526	14.627	11.887	12.575	11.887	12.788
Production (billion pesos)							
Overall economy	23 549.314	22 848.856	25 647.202	22 843.786	25 637.481	22 843.869	25 682.219
Tobacco	7.065	6.890	7.580	6.890	7.580	6.890	7.580
Tobacco production	40.972	40.642	43.949	35.717	37.785	35.716	38.425
Exports (billion pesos)							
Overall economy	2070.968	2011.091	2250.374	2009.923	2248.617	2010.225	2253.898
Tobacco	3.488	3.349	3.744	3.905	4.421	3.904	4.209
Tobacco production	0.509	0.488	0.554	0.496	0.524	0.497	0.562
Imports (billion pesos)							
Overall economy	2398.260	2320.101	2592.001	2319.519	2591.013	2319.780	2595.201
Tobacco	0.376	0.383	0.403	0.438	0.453	0.437	0.312
Tobacco production	1.092	1.120	1.152	0.849	0.898	0.847	0.865
Tax revenues (billion pesos)							
Overall economy	4290.679	4158.019	4652.885	4186.353	4678.646	4181.972	4682.835
Tobacco	69.754	70.976	74.442	113.919	120.707	114.001	119.603
Private consumption							
Overall economy exp. (billion pesos)	10 478.527	10 149.630	11 351.159	10 105.187	11 280.112	10 094.573	11 502.520
Tobacco expenditure (billion pesos)	141.554	443.616	1240.906	538.574	1476.468	538.504	1498.150
Tobacco quantity (billion units)	1.740	1.728	1.865	1.509	1.596	1.509	1.620
Tobacco price (pesos per stick)	81.367	256.720	665.415	356.841	924.927	356.841	924.927
Employment (in thousands)							
Overall economy	20 554 552	20 876 027	21 991 225	20 869 989	21 983 743	20 869 790	21 992 013
Tobacco	23 507	24 064	24 435	24 061	24 436	24 061	24 328
Tobacco production	5908	6525	6110	6157	5806	6157	5807

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.
Source: Authors' calculations based on simulation results.
CGE, computable general equilibrium.

cigarette packs in the short term (1.509 billion packs in scenario 2 vs 1.728 billion in BaU, by 2021). To put this in context, around 150 million packs of cigarettes are monthly consumed in Argentina. To assess the relevance of general equilibrium effects, we develop a simple partial equilibrium model to simulate the same shock (see online supplemental appendix 3). In this alternative model, the overall decrease in cigarette consumption is 16.4%; that is, the general equilibrium adjustments imply that the decrease in cigarette consumption is reduced by 3.7 percentage points. The average price per stick increases by approximately 39%, after the tax change (see Tobacco price, pesos per stick, 356.84 in scenario 1 vs 256.72 in BaU). As a result of the changes in prices and quantities, households spend 21.4% more on cigarettes (see Tobacco expenditure, billions of nominal pesos, 538.57 in scenario 1 vs 443.61 in BaU). Finally, regarding tobacco tax collection, it can be observed that revenues increase in all scenarios by around 60% (eg, from $70.97 billion to $113.91 billion in the short term of scenario 1). This increase in public revenues, which also considers collection from the IT, takes place both in the short term and in the long term. Overall tax collection increases by around 0.7%.

For the sake of brevity, and given the focus of this paper, we concentrate now on changes in employment. In tobacco growing (Tobacco, in table 3), given the assumption of constant output with exports determined as a residual once domestic demand is satisfied, employment shows small changes; it falls by 0.01% in the short term and by 0.4% (around 108 jobs) in the long term under scenario 2. This reduction is negligible and does not impact overall agricultural production. In tobacco manufacturing production (Tobacco production, in table 3), the reduction in employment is approximately 5.6% (5.0%) in the short (long) term.

Changes in total employment are negative in the short term, regardless of the simulated scenario, although small in magnitude (around 0.03%). In the long term, changes in total employment are negative for scenario 1 and positive for scenario 2. Again, in both cases, these changes are negligible. The negative changes in the tobacco sector are greatly reduced or even cancelled out when the government recycles revenues by increasing spending on education and health or highly productive public investment. As can be appreciated in table A2.2 in online supplemental appendix 2, in scenario 1 the services sector that includes health and education presents an increase in employment of around 0.04%. In scenario 2, since the government recycles revenues through public investment, employment in the construction sector expands by about 0.3%. In this scenario 2, the gains in employment in other sectors more than compensate the losses in the tobacco sector in the long term. For instance, the reduction in total employment is 0.03% (6237 jobs out of a total of 20.8 million jobs) in the short term, while in the long term a net employment increase of 787 jobs is estimated. This is close to a zero-net change in employment, as it represents a 0.004% increase in jobs that would not have existed without the tax. Similarly, a nearly zero-net change in employment can be observed in scenario 1.

We conduct several sensitivity analyses for these simulations. First, a piecemeal sensitivity analysis is performed with respect to the price elasticity of demand for tobacco products. Specifically, we re-estimate the scenarios under alternative assumptions for the price elasticity of demand for tobacco products; we consider elasticities in the range of 0–1. Figure A2.3 in online supplemental appendix 2 shows the percentage point change in total employment under alternative values for the own price elasticity of tobacco products demand; all other elasticities are kept at their central values (see table A2.3 in online supplemental appendix 2). Trivially, all non-base scenarios in this case promote the production of sectors that are more labour intensive than tobacco products. Interestingly, CGE studies do not usually test the sensitivity of their results to the factor composition of sectoral value added. Second, we also repeat the simulations under the extreme assumption that the production of tobacco products does not require labour. Finally, we perform systematic sensitivity analyses with respect to all model elasticity values. The main results still hold after all these robustness checks.

It is important to note that these results are in line with previous empirical evidence for other countries. Our paper is closely related to Huesca *et al*'s paper which, using a general equilibrium model, evaluates the effects of increasing tobacco taxation on employment in Mexico.[22] The results indicate that the loss of tobacco-related jobs represents 0.1% of total employment. Moreover, this minimal loss of employment could be compensated for if the government recycles newly raised revenues in some specific sectors, such as, for example, health. Saleem and Iqbal quantify the changes in employment resulting from raising tobacco taxes in Pakistan and show that employment multipliers for the cigarette industry have small magnitudes indicating minimal impact on the economy.[23] Similar to our paper, Saleem and Iqbal conclude that reduction in tobacco demand will lead to initial losses to the economy but there will be considerable gains in employment due to redistribution of tobacco expenditures. In the same line, Jha *et al* use a full-fledged global CGE model to analyse the case of Tanzania and indicate that a 30% reduction in prevalence could lead to employment losses of about 20.8% in tobacco and 7.8% in the tobacco products sector.[21] However, when compensated by increases in other sectors the overall decline in employment is only 0.5%.

Finally, our results are related to those that emerge from the analysis of raising other health taxes on goods such as alcohol or sugar-sweetened beverages (SSB). For example, Wada *et al* analyse the net impact of two hypothetical alcohol tax increases on employment in the USA and show that, although gross employment falls, both taxes on alcoholic beverages increase net employment when new tax revenues are allocated to general expenditures.[20] Powell *et al* assess the impact of SSB taxes on net employment in Illinois and California and find that employment within the beverage industry declines but is offset by new employment in the non-beverage industry and government sectors.[24]

DISCUSSION

We contribute to the debate of detrimental effect of tobacco taxes on employment. For this purpose, we build a CGE model of the Argentine economy focused on the tobacco sector. We documented that a substantial 15 percentage point increase in tobacco taxation in Argentina can generate a net increase in employment if the newly raised tax revenues are recycled by the government on employment-intensive public infrastructure. Furthermore, while tax increases may reduce employment in the tobacco sector these losses are nearly zero in net terms for the whole economy, even in worst-case scenario assumptions. Increased tobacco taxes may shift jobs from tobacco-related sectors to other sectors of the economy, but the overall impact on the total number of jobs is negligible.

These conclusions indicate that substantial increases in tobacco taxes can even increase aggregate employment in the medium term. Additionally, governments can mitigate and even reverse any adverse employment effects of increased tobacco taxes by devoting the additional tax revenue to increase expenditure on social services and infrastructure. The widely documented positive effects of higher tobacco taxes (including a healthier

population, more productive workers, savings from avoided costs of medical treatment for tobacco-related diseases, reductions in the number of new young smokers, among others)[25] would far outweigh the nearly null effect of higher taxes on total net employment.

Naturally, some caveats on the analysis should be made. First, we do not incorporate the health benefits of controlling tobacco such as lower medical expenses, longer life expectancy and more time for income-generating activities.[26–28] These benefits are crucial for analysing the effects of higher tobacco taxation on inequality and economic efficiency. For instance, fewer smokers result in more productive workers and—very important for the case of Argentina, given its public-private health system—savings in the treatment of tobacco-related diseases. In this context, our results can be interpreted as a lower bound, and the actual effect of higher taxes on overall employment could certainly be positive. Further research should include the positive effects of tobacco taxation into the CGE model to gauge its indirect employment effects against the direct impacts of increased taxation.

Second, we simulate a substantial tax increase which, given the high initial tax burden on tobacco in Argentina, could generate a disproportionately high deadweight loss. In other countries facing initial lower taxes on tobacco, the deadweight loss of raising taxes should be lower and the effect on employment could be positive and larger than for the case of Argentina. In addition, we do not analyse this tax increase along with other tobacco control measures that are relevant in Argentina, such as the Law 26687, implemented in 2011, which regulates the advertising, promotion and consumption of products made with tobacco. Third, we do not attempt to calculate any productivity increase that might arise, for example, by an improvement of soil quality that may have deteriorated due to the toxicity of tobacco. In reality, there would be an increase in yields and productivity, which in turn means the effects would be more positive than our predictions.

Based on our findings, some policy recommendations can be suggested. First, given the displacements generated by higher taxes in the tobacco growing sector, smart design of rural development programmes can help cover farmers' transition costs. Additional revenues from higher taxation could be used to finance these costs. Second, to cope with employment reduction in tobacco manufacturing, training displaced workers in alternative sectors as well as in alternative forms of employment becomes crucial. Third, some of the increased tax revenue could be directed to alternative cultivation through agricultural extension services, training for services and other forms of industrial production. Fourth, when designing tax policies for the sector, policy makers should consider issues related to efficiency and look at the effects of policies on income distribution, tax collection and tax administration.

Our findings can be used to debate public policies aimed at discouraging the consumption of tobacco and other goods that produce negative externalities. In any case, policy makers should be clear about the main objective of tobacco taxes: the public health goal of tobacco tax increases is to reduce tobacco consumption and its negative consequences.

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Contributors GC and JP conceptualised the study. MC conducted the statistical analysis and interpreted the findings. GC, JP and GF wrote the article. GC is the guarantor of the study.

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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.

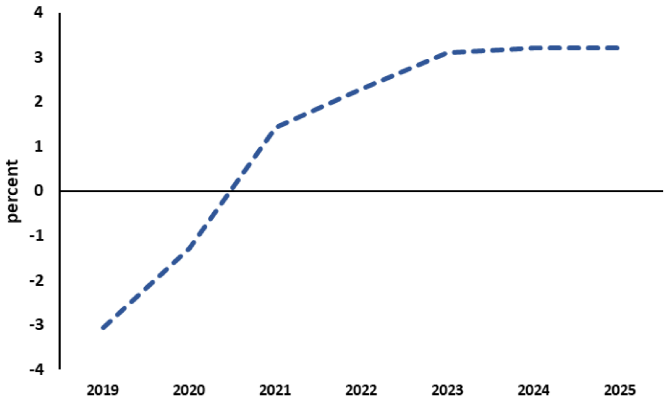
Technically, the model is made up of a set of simultaneous linear and non-linear equations. It is economy-wide, providing a comprehensive and consistent view of the economy, including linkages between disaggregated production sectors and the incomes they generate, households, the government, and the 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

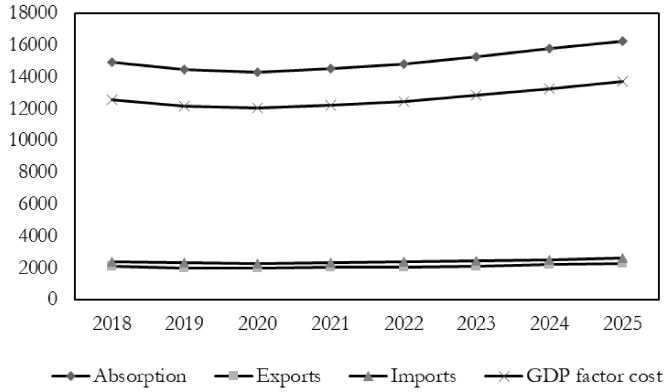
Figure A2.1 GDP growth rate (%), 2019–2025



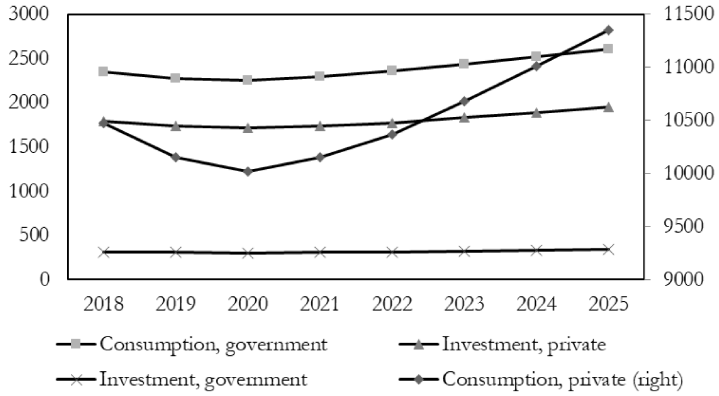
Source: Authors' calculations based on WEO-IMF and INDEC.

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

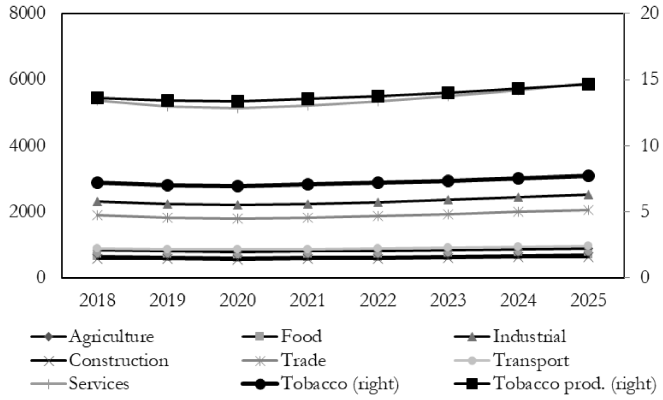
Panel A. Foreign trade, GDP, and absorption



Panel B. GDP composition, by aggregates

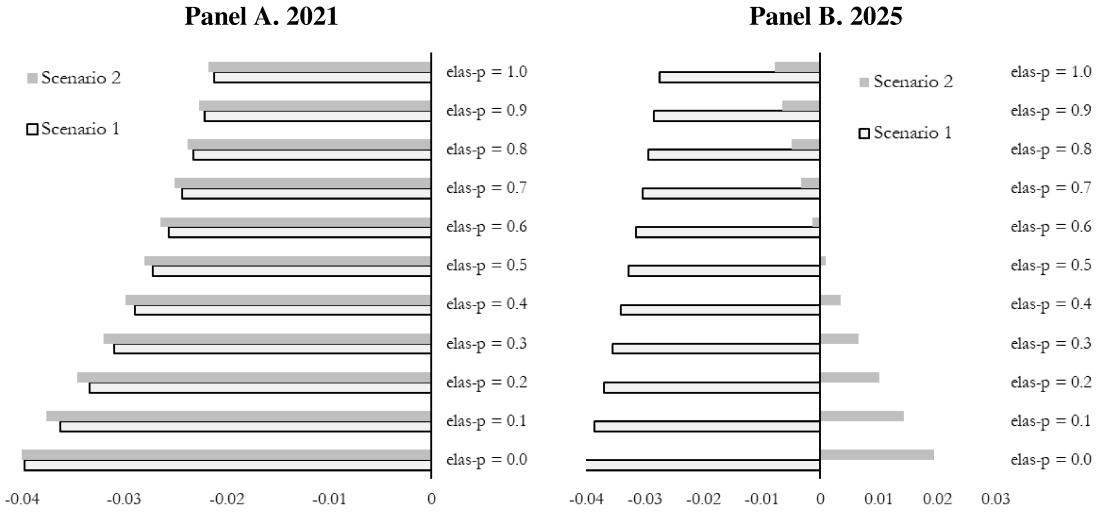


Panel C. GDP composition, by sectors



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): *other crops, livestock and forestry; tobacco (7)*; fishing; mining.* Manufacturing (17): *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.* Other industry (2): *electricity, gas and water; construction* Services (12): *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*
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 metalic 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 servicesand 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:

$$pqs_c = PQD_c(1 - tq_c)$$

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

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]