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The European Union Deforestation Regulation: The Impact on Argentina

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Abstract

We analyze the potential economic impacts in Argentina of the European Union Deforestation Regulation (EUDR), which as of January 2025 will prohibit the export to the European Union of certain raw materials and related products if they involve the use of deforested land. A dynamic computable general equilibrium model is used to simulate the impact of such regulation on the Argentine economy. The results suggest that the potential macroeconomic impacts are limited. As a consequence of the EUDR, between 2025 and 2030, GDP would be reduced by an average of 0.46% with respect to the baseline scenario. However, of greater magnitude is the potential environmental impact. Deforested hectares would be reduced by 6.64% and polluting gas emissions by 0.39%.

Keywords: Deforestation-free products, European Union, Argentina, exports, trade regulations.

JEL: C68, F13, F18, F4.

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1. Introduction

Deforestation is one of the main causes of climate change and biodiversity loss globally (IPBES, 2019; IPCC, 2023) and the conversion of forest areas to produce commodities has been identified as one of its most important determinants (Pendrill et al. 2022)[2]. In this context, restrictions on the consumption of products produced on deforested land emerge as a way to combat this phenomenon globally and fight against climate change.

As of January 2025, the European Union (EU)[3] will require a traceability system on certain raw materials and derived products identified as drivers of global deforestation. This policy, known as the European Union Deforestation Regulation (EUDR), is part of a broad package of measures included in the Green Deal, where the EU outlined the guidelines to achieve carbon neutrality by 2050 (CEI, 2023).[4]

The EUDR covers cattle, cocoa, coffee, oil palm, rubber, soybeans and timber and their products such as meat, chocolate, leather and paper. Such products may only be exported to the EU if they are supported by a due diligence process demonstrating that they have been produced following the legislation of the producing country and are "deforestation-free". The EUDR defines "deforestation-free" as those raw materials and products produced on land that did not undergo deforestation after December 31, 2020, and timber that has been harvested from forests without inducing forest degradation after December 31, 2020 (Drost et al., 2022; Stam, 2023; Calvo et al., 2024; Arias Mahiques et al., 2024).[5] The EUDR then prohibits even deforestation that was legally permitted under domestic regulations.

The potential economic impacts of the EUDR in Argentina are considerable. Using Comtrade data and the list of products covered by the regulation, Calvo et al. (2024) estimate that the EUDR would reach approximately 40% of the value of Argentina's exports of goods to the EU (about US$ 5 billion, 5% of total exports of goods), which is the second most important

[2] The products mainly associated with deforestation are beef, forestry products, palm oil, cereals and soybeans.
[3] Currently composed of 27 (twenty-seven) countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and Slovakia.
[4] Carbon neutrality implies achieving a net result of zero greenhouse gas emissions, that is, emitting the same number of gases that are absorbed in other ways.
[5] Deforestation refers to the removal of forests to use the land for productive activities. Meanwhile, forest degradation is a gradual process that decreases forest biomass, changing its composition or reducing the quality of its soil. Therefore, forest degradation is more difficult to measure and monitor and statistics are scarce (European Commission, 2021).

destination for Argentina's exports of goods. The main production chains affected are soybean and livestock, which account for 80% and 15% of the value of exports to the EU reached by the EUDR, respectively.

Given that a multiplicity of direct and indirect effects associated with this shock are expected, the need to use a general equilibrium approach to analyze them becomes evident. Computable general equilibrium (CGE) models, for example, allow us to capture the interdependencies between productive sectors and between economic agents, the role of prices in decision making and the macroeconomic constraints under which an economy usually operates. Thus, they allow capturing not only the direct impacts of a shock but also the indirect ones through the different linkages between factor markets and other economic sectors, as well as the ultimate consequences at the aggregate level in terms of GDP, trade balance, and fiscal results. CGE models, in particular, allow for a considerable disaggregation of the productive sectors and agents of the economy. They are a simulation tool: after being calibrated with real data, they allow to consistently simulate the effects of policy changes and other shocks.

In this sense, we use a CGE model to analyze the economic impact of the EUDR in Argentina. The results suggest that the potential macroeconomic impacts are limited. As a consequence of the EUDR, between 2025 and 2030, GDP would be reduced by an average of 0.46% with respect to the baseline scenario. However, of greater magnitude is the potential environmental impact. Deforested hectares would be reduced by 6.64% and emissions of polluting gases by 0.39%.

The remainder of this paper is as follows. In the next section, a literature review is carried out. Section 3 describes the CGE model used to simulate the impact of the EUDR on the Argentinean economy, which results are presented in Section 4. Section 5 performs a sensitivity analysis to evaluate the robustness of the results. Conclusions are included in Section 6.

2. Literature Review

This paper is linked to several strands of the literature. First, it is inserted within the vast literature that uses CGE models for the study of international trade (Scollay and Gilbert, 2000; Robinson and Thierfelder, 2002; Dixon et al., 2018) and in particular with those that analyze climate change issues (Boccanfuso et al., 2009; Buddelmeyer et al., 2012; Babatunde et al., 2017). More precisely, it is linked to those papers that study the consequences of international trade regulations that aim, among other things, to reduce deforestation, some of which are reviewed below. Studies that use alternative modeling tools to address issues relevant to this study, including partial equilibrium models, are also reviewed.

2.1 Policies against deforestation: similar to EUDR

Domestic and international policies to reduce deforestation have received considerable attention in the literature. Several of these investigations focus on the case of palm oil, which has become the most consumed vegetable oil globally and whose demand has been satisfied mainly by an expansion of the cultivated area at the expense of tropical forests. South Asia accounts for 84% of its global production (Leijten et al., 2023).

Jafari et al. (2017) use a static partial equilibrium model of the Indonesian palm oil sector to model moderate reductions in EU demand for palm oil due to sustainability issues. The authors simulate a 10% reduction in the price paid by the EU and find that impacts are small and some production is sent to other trading partners and the domestic market; deforestation is marginally reduced. However, the impacts are larger if the whole world simultaneously reduces its demand.

In a general equilibrium framework, Taheripour et al. (2019) use the GTAP model (Hertel, 1997) to evaluate different policies aimed at reducing deforestation associated with palm oil production in Indonesia and Malaysia. They simulate three policies over the period 2011-2016: a domestic production tax that limits palm oil production at its 2011 level; the above tax plus a domestic subsidy for forest area conservation at its 2011 level; and the above subsidy plus an international tariff on palm oil imports from Indonesia and Malaysia. The results suggest that while these policies reduce deforestation associated with palm oil in Indonesia and Malaysia, they may increase deforestation associated with other products and also deforestation in other parts of the world. There are significant costs in the wages of unskilled workers, as they are intensively employed in the agricultural sector. On the other hand, domestic regulations are less costly than external regulation because revenues are appropriated, in the latter case, by the main palm oil importing countries.

A very relevant precedent is the work of Busch et al. (2022), who use the GTAP[6] model to estimate the impact in Indonesia of European deforestation restrictions on palm oil cultivation between 2000 and 2015. The authors differentiate two varieties of palm oil: "high deforestation" and "low deforestation", depending on whether they were produced on land deforested after or before 2000, respectively. The restriction is introduced as a tariff imposed by Europe on imports of "high deforestation" palm oil large enough for the trade flow to be reduced by 99%.[7] Their simulations suggest that an 8.9% gap arises in the international price of the "low deforestation" variety of palm oil and Indonesia's exports of "low deforestation" palm oil to Europe increase by 31%, while half of the exports of "high deforestation" palm oil migrate to other regions and the domestic market. This translates into a 6.3% drop in production of the "high deforestation" variety and a 0.3% increase in the "low deforestation" variety. There are limited environmental impacts: a 1.6% decrease in deforested hectares and a 1.91% decrease in emissions associated with deforestation. The authors suggest that these results are associated with the low price-elasticity of palm oil supply and that palm oil is responsible for only 32% of deforestation in Indonesia. The authors thus suggest that demand-side constraints alone are insufficient to reduce deforestation and that other mechanisms such as direct financing of forest protection policies are needed.

Although CGE models are the most widely used tool to analyze shocks such as the one in this study, other types of models are also used. These models are more stylized and use less sectoral disaggregation (some models have a single sector). Porcher and Marek (2022), for example, use a model with less industry disaggregation and simulate different domestic policies to reduce deforestation in the Amazon. Hsiao (2021) studies the effect of domestic and international trade policies on palm oil trade using a choice equilibrium model. The authors calibrate the model with data for six aggregates of consumer countries EU, China, India, Indonesia, Malaysia, and the rest of the world and 2 producer countries (Indonesia and Malaysia) between 1988 and 2016. Their simulations suggest that imposing tariffs in an internationally coordinated manner can replicate the deforestation reductions achieved by a domestic tax, which is the first-best solution. Similarly, Dominguez-Iino (2023) models the agricultural sector and its use of the land factor (abstracting from the use of the rest of the productive factors) in Argentina and

[6] The model works with seven regions: Indonesia and Malaysia, the EU, the United States, the United States, China, Brazil, the rest of South America and the Rest of the World.
[7] The authors also sequentially simulate scenarios in which restrictions are implemented in other countries including China and the United States.

Brazil, with a special interest in the monopsonistic structure of part of the value chain and its implications for the implementation of policies aimed at reducing deforestation. The author finds that unilateral tariffs are ineffective because of trade diversion and because the non-competitive structure of the chain reduces the transmission of the signal to the point where deforestation occurs (upstream) and even more so when the environmental externality has high spatial heterogeneity. A command-and-control policy, such as conservation zones, may be more effective, although also more costly in terms of enforcement.

2.2 Other policies against deforestation: zero deforestation commitments and REDD mechanism

The spirit of the EUDR relates to several existing mechanisms for combating deforestation. These include, for example, zero deforestation commitments (ZDCs) made by the private sector to reduce or eliminate deforestation from their supply chains, and incentives provided under the Reduce Emissions from Deforestation and Forest Degradation mechanism (REDD), which provides for the transfer of resources to developing countries to compensate them for their efforts to reduce deforestation.[8]

Mosnier et al. (2017) study the implementation of ZDCs for the case of palm oil in Indonesia using a global partial equilibrium model. They find that these commitments can reduce deforestation by 25-28% and greenhouse gas emissions by 13-16%, relative to a no-policy scenario. More recently, Leijten et al. (2023) study the potential implementation of ZDCs at the global level for the case of palm oil using the GTAP model. ZDCs represent in the model a reduction in the supply of land available for expansion. The authors assume a stylized land supply curve and the constraint is implemented by moving the asymptote of this curve. Through simulations up to the year 2030, they find that, under full implementation and compliance with ZDCs in all economic sectors worldwide, global palm oil plantations would be 40% smaller, and 96 million hectares of forests would be saved than in the baseline scenario that assumes non-compliance with these commitments.

Resosudarmo et al. (2012) use a CGE model to study the potential impact of the REDD program in Indonesia. The simulations focus on reducing deforestation through declines in

[8] There is also the so-called REDD+ which extends the scope not only to reducing deforestation and forest degradation but also to conversation, sustainable forest management and enhancement of forest carbon stocks.

forest sector production. They find limited negative effects on GDP that are not offset by REDD program transfers. Babar and Kathmandu (2015) conduct a similar analysis for Nepal. Kuik (2014) uses the GTAP model to simulate different scenarios that consider constraints on the rate of deforestation in eight tropical forest regions. The author is particularly interested in estimating the leakage phenomenon, which occurs when a measure implemented in one place (or time) to reduce deforestation is partially offset by increased deforestation in another place (or time).

Overmars et al. (2014) use a variant of the GTAP model to simulate the protection of carbon-rich forest areas in developing countries to prevent them from being converted to productive land. They perform simulations for the period 2005-2030 in which the number of protected areas is sequentially increased by reducing the area of land available for agricultural expansion, starting with the most carbon-rich areas. Similar to Leijten et al. (2023), the authors assume a stylized land supply curve, which relates land supply to its price, and the constraint is implemented by moving the asymptote of this curve. They find that up to a maximum of 2.5 GT of carbon dioxide emissions could be avoided, but the opportunity costs in terms of GDP reduction can be large for some regions and can reach USD 60 per ton of carbon dioxide in South Asia. A similar analysis is performed by Tabeau et al. (2015) using another version of the GTAP model.

In Latin America, Brazil has received substantial attention given the importance of the conservation and restoration of the Amazon (one of the most biodiversity-rich ecosystems in the world), and the country's role as a major producer of agricultural commodities and one of the largest emitters of greenhouse gases. An extensive literature review can be found in Francisco and Gurgel (2020).

Leitão et al (2017) simulate different scenarios of ZDCs in Brazil between 2016 and 2030, reducing the expansion of the agricultural frontier. They find that macroeconomic impacts are limited, with a cumulative reduction of 0.6% of GDP by 2030. However, regions intensive in agricultural activities, as well as less skilled workers employed in such activities, may be considerably affected. Francisco and Gurgel (2020) simulate policies to stop illegal deforestation in Brazil using a global CGE model. The authors introduce the policy in the model as a tax of such a magnitude that it generates a reduction in the level of deforestation to preserve a given area. Their results suggest that these policies generate land use intensification practices, livestock production faces a drop of between 2.3% and 3.6% and GDP suffers negligible reductions (0.06%) even in aggressive deforestation reduction scenarios. The authors also find no evidence of significant deforestation leakage in the rest of the world. Carvalho et al. (2017) use a multi-region CGE model for Brazil to simulate domestic policies that limit deforestation. The policy is introduced by limiting the expansion of the land factor that can be used for productive purposes, to achieve zero deforestation in the Amazon. Their results suggest that the aggregate economic costs are small but some regions intensive in agricultural activities are particularly affected. Similar results are obtained by Ferreira-Filho et al. (2018).

2.3 EU Green Deal

Although recent, the study of the consequences of the measures contemplated in the EU's Green Deal has received considerable attention, especially the Carbon Border Adjustment Mechanism (CBAM). As its name suggests, it is a tax on the carbon content of EU imports, covering energy products, cement, fertilizers, steel, and aluminum. Several papers analyze the potential costs from a partial equilibrium perspective by measuring the exposure and/or vulnerability of exporting countries. Simola (2021) studies the potential costs of CBAM in the five countries with the highest exposure to European regulations (China, India, Russia, Turkey, and Ukraine) and finds that the potential economic effects are limited. Eicke et al. (2021) extend the analysis to the whole world and find that the economies with the highest risk exposure are in Africa. From a general equilibrium perspective, UNCTAD (2021) uses the GTAP model to estimate the global impacts of CBAM. The results are as expected: emissions from EU producers are reduced, carbon leakage decreases and trade patterns change in favor of those countries less intensive in emissions, which turn out to be the advanced countries. However, the impacts are limited: on average, exports from developing countries are reduced by 1.4 to 2.4%. Similar results are found by Chepeliev (2021) using the GTAP model and by Korpar et al. (2023) using a structural gravity model. Using a model for Argentina, Michelena (2023) finds that the effects are very small even in scenarios where the measure covers all products and activities.

The object of study of this paper, the EUDR, on the other hand, has received less attention in terms of quantitative analysis. Stam (2023) studies the impact of EUDR on the Brazilian soybean chain using a CGE model and simulations up to 2030. The author divides Brazil into different regions and simulates scenarios in which the costs of regulation are borne by certain regions. The authors introduce the shock as an increase in the soybean production tax rate (whose revenue is not recycled for a specific use). The incremental cost is determined at the regional level multiplying the share of soybean exports to the EU by 6%, which is the cost increase that emerged from a pilot test. In the scenario in which all regions suffer the shock, the results suggest limited negative impacts on GDP (0.003%) while greenhouse gas emissions are reduced by 0.05% in total and 0.1% from changes in land use. There is a shift in production towards other crops and livestock activities, but these do not compensate for the reduction in soybean production and exports. Calvo et al. (2024) use a static CGE model to assess the short-term impact of the EUDR in Argentina. The authors assume that Argentina cannot adapt and all products listed in the regulation cease to be exported to the EU. Specifically, they introduce the measure by exogenizing the quantities exported to generate falls in the value exported consistent with the share of value achieved by the EUDR according to international trade data. They find that GDP could fall by between 0.15 and 0.26% with negative effects on employment and real wages.

There is significant uncertainty regarding the costs of the EUDR due diligence process. As the report presented with the first EUDR proposal to the European Parliament states, these depend on the size and complexity of the value chain (European Commission, 2021). The report suggests that the most comparable system is that associated with the EU Timber Regulation, whose compliance required set-up costs of between US$5,000 and US$90,000 per importer and recurrent costs of between 0.29 and 4.3% of the value imported. Using these percentages, the report estimates that total annual compliance costs for importing companies can reach between 175 and 2,616 million euros per year (European Commission, 2021).

Drost et al. (2022) analyze the economic and legal implications of EUDR in the Indonesian palm oil sector. The authors estimate that compliance costs are relatively low and include the establishment of a traceability policy with internal and external audits, a due diligence framework, monitoring and verification systems, and certifications. In some scenarios, they also include the requirement for value chain separability, which the regulations do not require, but some analysts suggest is necessary. The authors estimate that compliance costs reach US$65 per ton of crude palm oil, while the additional cost of separation would be US$12 per ton. These costs would be between 2.5 and 3.5% of the value of Indonesia's palm oil exports to the EU.

3. General Equilibrium Model

This section describes the CGE model that will be used to analyze the isolated effect of the EUDR in Argentina. It is a dynamic-recursive real CGE model, which is a modified version of the standard model of the International Food Policy Research Institute (Lofgren et al., 2002) and the IEEM model of the Inter-American Development Bank (Banerjee and Cicowiez, 2019; Banerjee and Cicowiez, 2020; IDB, 2021). A small open economy is considered, where producers and consumers maximize profits and utility, respectively, in competitive markets.

Each productive sector is represented by a profit-maximizing activity. The value-added production technology is assumed to be a Cobb-Douglas function combining capital, labor, and land, while intermediate inputs are used in fixed proportions. Regarding factor markets, capital is assumed to be fully employed and sector-specific, while labor supply is exogenous and labor is perfectly mobile across sectors. Additionally, rigidities are introduced using a wage curve, which allows to account for the negative empirical relationship between the wage level and the unemployment rate (Blanchflower and Oswald, 1994). Then, the equilibrium in the labor market is determined by the intersection of labor demand and the wage curve. The modeling of the land factor is described in detail in Section 3.2.

In terms of institutions, we model households disaggregated by decile of per capita family income that receive income from the productive factors they own and transfers from the government and the rest of the world. This income is used to pay direct taxes, to save, to make transfers to other institutions, and to consume goods. Private consumption demand is derived from the maximization of a Cobb-Douglas utility function. The government collects through taxes on households, factors, activity, sales, and foreign trade, and receives transfers from the rest of the world. It then uses this revenue to purchase goods for consumption, invest, make transfers to households, and save. As already mentioned, a small economy is modeled, so that international prices are exogenous. As usual in the literature, following Armington (1969), imperfect substitution is assumed between goods that differ according to their origin, so that the demand for imports arises from a CES (Constant Elasticity of Substitution) function that combines domestic and imported goods. Meanwhile, the supply of exports is modeled from a CET (Constant Elasticity of Transformation) function, which reflects the fact that producers decide to allocate their production to the domestic market or to export it depending on relative prices.

The model is recursive-dynamic so that agents' expectations are myopic. The sources of dynamics are capital accumulation, labor force growth, and productivity change. Investment modifies the next period's capital stock, labor supply grows exogenously according to population projections, and land supply grows as a function of deforestation, as explained in Section 3.2.

The model requires the specification of closure rules for three macroeconomic balances: government, private savings and investment, and the balance of payments. In this regard, all simulations assume that: i) the government budget is balanced by changes in real domestic financing; ii) private investment is endogenously determined by the level of savings; and iii) savings from the rest of the world are exogenous (measured in foreign currency), so that the real exchange rate varies endogenously to match inflows and outflows of foreign exchange. The numeraire of the model is the consumer price index. Finally, an exogenous constant path of total factor productivity growth is assumed, while GDP is determined endogenously.

3.1 EUDR modeling

The EUDR prohibits the export to the EU of raw materials and products produced on deforested land after the cut-off date of December 2020.[9] Being a retrospective measure, today some decisions are sunk and the land factor can be divided into two types: deforested after December 2020 (deforested) and not deforested or deforested before January 2021 (not deforested). Production can be divided into analogous terms: that produced on non-deforested land will face an additional cost associated with the EUDR due diligence process if exported to the EU, while that produced on deforested land could only be sold to other destinations or in the domestic market (if there is a domestic demand for such products). Implicitly, the EUDR generates a regional differentiation of production in Argentina. Based on this premise, the methodology for introducing the EUDR is as follows. Since there is no information on land use change at a sufficiently disaggregated level in Argentina, the key assumption of the analysis is that production in "high deforestation" provinces is production using deforested land, and vice versa.

The objective then is to disaggregate the land factor into deforested and non-deforested land and land-demanding activities (crops, livestock, and forestry) and the products they produce (and consume) from deforested and non-deforested land.[10] Finally, we will also disaggregate

[9] We abstract from the ban on forest degradation, which is a more difficult process to measure and for which statistics are scarce (European Commission, 2021).
[10] A similar approach is used by Busch et al (2022), see Section 2.

industrial products that, although not produced by land-demanding activities, are produced by activities that use inputs whose production demands land (they demand land "indirectly"). The latter is important because the EUDR will require traceability throughout the chain. Each of these steps is detailed below.

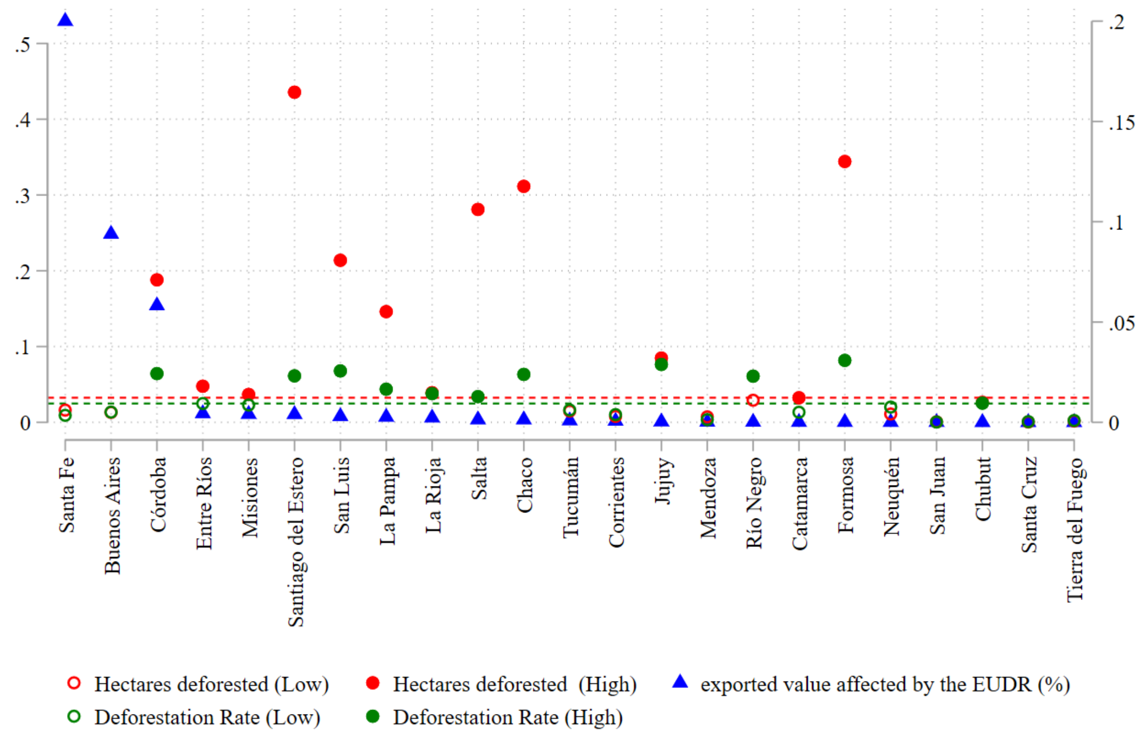
First, the Argentine provinces are classified into high- and low-deforestation using information from the National Forest Inventory for 2018-2021.[11] There is no clear and unique criterion to define "high-deforestation". A priori we could compare each province with the national median in terms of some measure of deforestation, which could be the number of hectares deforested or the deforestation rate (hectares deforested in terms of area). The provinces classified as high deforestation using one measure or the other are the same except for four cases. Both criteria coincide in identifying the provinces of Chaco, Córdoba, Formosa, Jujuy, La Pampa, La Rioja, Salta, San Luis, and Santiago del Estero as "high-deforestation". However, when using the number of deforested hectares, the provinces of Catamarca, Entre Ríos, and Misiones are also identified as "high-deforestation", while when using the deforestation rate, Chubut and Río Negro are added to the original list. While there is no a priori reason to choose one or the other, we consider that using the criterion of the number of deforested hectares is more cautious since the provinces of Entre Ríos and Misiones have a greater share in the national export value reached by the EUDR than Chubut and Río Negro (see Figure 1).

Then, we use information from the latest 2018 National Agricultural Census on land area used by activity in each province to divide production (and land factor use) of land-demanding activities (crops, livestock, and forestry) into production carried out in high- and low-deforestation provinces.[12] The implicit assumption is that production technology is the same in all provinces. Finally, industrial products that demand land "indirectly" are disaggregated using the main raw material distribution factors. For example, soybeans in the case of industrial soybean oil production.

[11] Specifically, information on "Loss of Forest Land and Other Forest Land" is used.

[12] There is an alternative source of information that indicates value-added at the production chain level (including primary and industrial links), by province. However, this information was discarded because it may introduce biases in the provincial distribution of the production of agricultural products when the primary and industrial links occur in different provinces. For example, in this database, the soybean chain in Chaco includes both primary and industrial production in that province. However, if part of the primary soybean production in Chaco is industrialized in Buenos Aires, the primary link is assigned to Chaco while the industrial link is assigned to Buenos Aires. In other words, the provincial value-added information overestimates the weight of the provinces where the product is industrialized. Thus, using this database to disaggregate primary production in Argentina would be erroneous.

Figure 1. Deforestation and share of export value affected by the EUDR, by province



Own elaboration based on Censo Agropecuario Nacional 2018, Sistema Nacional de Monitoreo de Bosques Nativos and CEP XXI[13]. The figure shows the proportion of the value affected by the EUDR explained by each province (left axis) and two deforestation measures on the right axis: hectares deforested between 2018 and 2021 (in millions) and the deforestation rate in the same period. The dotted lines correspond to the national median for each of the deforestation indicators. Filled dots indicate when a province is above the national median for the respective indicator. The provinces are ordered in decreasing order according to the proportion of the value affected by the EUDR explained by each province (left axis).

3.2 Land modelling

Land supply curves with constant price elasticity are introduced to endogenize the deforestation path and model the growth of land supply, as follows:

$$QDEFOR_{fland-defor,t} = QFS^{00}_{fland-defor}\left[\left(\frac{\frac{WFAVG_{fland-defor,t}}{CPI_t}}{\frac{WFAVG^{00}_{fland-defor}}{CPI^{00}}}\right)^{\mu_{fland-defor}} - 1\right] \tag{1}$$

[13] The CEP XXI database contains information on the provincial origin of exports (unfortunately, not the destination) but has similar limitations to the information on value added by production chains (see footnote 12). Provincial origin is a proxy of where the raw material was produced. In particular, in the case of Manufactures of Agricultural Origin (e.g., soybean oil and meal or deboned meat), the provincial origin data is not necessarily linked to the province where the raw material originated, but to the establishment where the product was manufactured.

where $fland - defor$={Crop land (deforested); Livestock land (deforested); Forestry land (deforested)}; $QDEFOR_{f,t}$ is the is the amount of land deforested for use as a productive factor f in the period t; QFS_f^{00} is the supply of land factor f in the base year; $WFAVG_{f,t}$ y $WFAVG_f^{00}$ are the average remuneration of the land factor f in period t and in the base year, respectively; CPI_t y CPI^{00} is the consumer price index in period t and in the base year, respectively; and μ_f is the supply price-elasticity of land factor f. Thus, equation (1) models the induced deforestation associated with the increase in the supply of the $fland - defor$ land factor as a function of the increase in its relative remuneration.

In the following period, this additional land is added to the initial offer of the next period:

$$QFINIT_{fland-defor,t} = QFS_{fland-defor,t-1} + QDEFOR_{fland-defor,t-1} \qquad (2)$$

where $QFINIT_{f,t}$ is factor f initial supply in period t; and $QFS_{f,t}$ is land factor f supply in period t.

The analogous equation for the non-deforested land factors is:

$$QFINIT_{fland-nodefor,t} = QFS_{fland-nodefor,t-1} \qquad (3)$$

where $fland - nodefor$={Crop land (not deforested); Livestock land (not deforested); Forestry land (not deforested)}. In both cases ($fland - nodefor$ and $fland - defor$), migration between land uses (crops, livestock or forestry) is then allowed according to their relative profitability (BID, 2021).[14] No migration of the land factor from uses using deforested land to non-deforested land and vice versa is allowed.

Total deforestation during the period t, $QDEFORTOT_t$, is:

$$QDEFORTOT_t = \sum_{fland-defor} QDEFOR_{fland-defor,t} \qquad (4)$$

which decreases the non-productive forest area, $QLAND_{fornprod,t}$, in the following period:

$$QLAND_{fornprod,t} = QLAND_{fornprod,t-1} - QDEFORTOT_{t-1} \qquad (5)$$

[14] The use of this migration module has the advantage over other ways of modeling land use change such as that using CET functions, in which they fail to maintain the balance in the physical land units (Taheripour et al., 2020).

In summary, while the supply of "non-deforested" land remains constant, deforestation reduces the non-productive forest area and increases the initial supply of the "deforested" type of land in the next period. Finally, unemployment of both land types is allowed for by functional forms analogous to the labor factor wage curves.

3.3 Calibration

The main source of information used to calibrate a CGE model is a Social Accounting Matrix (SAM), an accounting record of all economic transactions in an economy in a given period. Each account is represented by a row (income) and a column (expenditure). The row sum of each account is matched to the column sum of the same account, thus respecting the budgetary constraints of each agent and the sectoral and macroeconomic supply and demand balances.

We construct the SAM for Argentina 2019 following the methodology of Banerjee and Cicowiez (2021) and using the latest available version of the Supply and Use Tables provided by INDEC. Additionally, the rest of the world account is disaggregated into four main blocks using data on international trade flows: the EU and the Rest of the trading partners. Table 1 presents the macro-SAM associated with the SAM used in this work, with the disaggregations described in Sections 3.1 and 3.2. A description of the base year can be found in Appendix A.

The SAM information is complemented with elasticities and other behavioral parameters from the literature. In particular, our model requires values for i) the wage-unemployment elasticity; ii) the elasticities of substitution between domestic purchases and imports (Armington); iii) the elasticities of transformation between domestic sales and exports (CET); iv) the elasticity of transformation of exports between destinations; v) the price elasticity of land supply; vi) the unemployment elasticity of land. For this work, these inputs are obtained from the resources publicly provided by the Open-IEEM Project of the Inter-American Development Bank (IDB, 2021). The wage-unemployment elasticity is -0.1, and the Armington and CET elasticities are both in the range of 0.9-2 (see Table A1 in Appendix A). The price elasticity of land supply is calibrated so that the average deforestation rate in the baseline scenario is equal to the historical average between 2000 and 2019, which was 0.8% according to FAO.

The labor unemployment rate is obtained from ILOSTAT. Land endowments are obtained from FAOSTAT and the 2018 National Agricultural Census. Land unemployment rates are calculated using uncultivated suitable areas from the 2018 National Agricultural Census. Emissions of polluting gases, measured in million tons of carbon dioxide equivalent ($MtCO_2e$)

are obtained from the National Greenhouse Gas Inventory. A particular distinction is made between emissions associated with agriculture, livestock, forestry, and land use change (AFOLU). In the latter case, emissions are assigned to the corresponding activities (crops, livestock, or forestry) or to non-productive forest land (which can sequester carbon). In the case of "non-AFOLU" emissions, inventory emissions are allocated to product consumption (e.g., oil) and distributed among emitters (domestic activities or institutions) according to their consumption (intermediate or final) as derived from the SAM.

Population projections are obtained from the United Nations, while the INDEC's National Household Income Expenditure Survey is used to disaggregate households by deciles of per capita family income. GDP growth projections are obtained from the IMF WEO (April 2024).

Table 1. Macro-SAM: Argentina 2019 (% GDP)

	Non-deforesting activities	Deforesting activities	Other activities	Non-deforesting Products	Deforesting Products	Other Products	Margins	Not Deforested Land	Deforested Land	Other productive factors	Taxes	Households	Government	Rest of the World	Domestic Savings	External Savings	Investment	Total
Non-deforesting activities				5.4														5.4
Deforesting activities					5.7													5.7
Other activities				5.9	6.1	140.1												152.0
Non-deforesting Products	0.9	0.0	6.7									4.3	0.0	4.0			0.3	16.3
Deforesting Products	0.0	0.9	6.6									4.8	0.0	4.1			0.3	16.8
Other Products	2.1	2.2	59.7				18.7					57.1	16.4	9.7			13.6	179.5
Margins				2.6	2.9	13.2												18.7
Not Deforested Land	0.9																	0.9
Deforested Land		1.0																1.0
Other productive factors	1.4	1.5	80.4											1.4				84.8
Taxes	0.0	0.1	-1.4	1.5	1.5	13.1				7.3		6.3						28.4
Households								0.7	0.8	69.3			17.1	0.0				87.8
Government								0.1	0.1	3.1	28.4			0.3				32.0
Rest of the World				0.9	0.7	13.1		0.1	0.1	5.1			0.1					20.2
Domestic Savings												15.3	-1.7		2.3	0.6		16.5
External Savings														0.6				0.6
Investment															14.2			14.2
Total	5.4	5.7	152.0	16.3	16.8	179.5	18.7	0.9	1.0	84.8	28.4	87.8	32.0	20.2	16.5	0.6	14.2	680.6

Own Elaboration.

3.4 Scenarios

The baseline scenario simulates the Argentine economy between 2019 and 2030 assuming the absence of the EUDR. The shock scenario simulates the evolution of the economy in the same period but introduces the EUDR in two ways. On the one hand, as a reduction in the international price paid by the EU for products that were produced on deforested land or consumed intermediate inputs produced on deforested land, so that their quantity exported to the EU is approximately zero.[15] On the other hand, the export to the EU of products produced on non-deforested land will face an additional cost associated with the EUDR due diligence process. As reviewed in Section 2, there is significant uncertainty regarding the costs of this process. Based on estimates by the European Commission (2021), Drost et al. (2022) and Stam (2023), this incremental cost is introduced as an international price reduction of 6%.[16]

The intuition of the shock scenario is as follows. The EUDR reduces the price the EU pays for the products covered by the regulation. In the case of those produced on deforested land, the price reduction is such that the quantity exported becomes practically zero, while in the case of those produced on non-deforested land, it is a relatively minor price reduction, which allows for continued exports. In both cases, there is an incentive to divert production to other destinations or the domestic market (if there is domestic demand for such products). However, for reasonable values of the elasticities (of transformation between domestic sales and exports, and between export destinations), it is to be expected that the diversion of sales will not be able to compensate for the lost sales to the EU, so a fall in exports and production would be evident. In aggregate terms, the EUDR is expected to induce a reduction in production activities on deforested land and thus deforestation compared to the baseline scenario.

Table 2 shows the direct exposure to the EUDR through the share of EU exports and exports in the demand for each product. The most exposed products are residues from the extraction of vegetable oils, other industrial wastes, leather, palm oil (basic chemical products), oilseeds and oleaginous fruits, meat, and wood, among others.

[15] This procedure is similar to that used by Busch et al (2022), who introduce the ban on the "high deforestation" palm oil variety as a tariff in Europe high enough that imports are reduced by 99% (see Section 2).

[16] While this reduces the incentive to export these products to the European Union, it does not generate an increase in the cost of production. Given the production and marketing structure modeled in the CGE model, there is no obvious way to introduce a cost at the production level that is linked to exporting to a particular destination, as the decision is made to sell production in the domestic market or export it at another level.

The direct impact of the reduction in export revenues will be transmitted to the rest of the economy, for example, by inducing a depreciating tendency in the exchange rate, reducing the demand for and remuneration of productive factors, the income of the owners of such factors, government revenues, etc. The final impacts will depend, among other things, on the relevance of the sectors in intermediate demand, in the markets of productive factors, and the level of activity.

Table 2. Direct EUDR exposure, by product

	EU in exports (%)	Exports in Demand (%)
Animal and vegetable oils and fats	2.55	35.10
Live animals	9.27	0.29
Cocoa, chocolate and confectionery	1.39	4.19
Wooden boxes and containers, cooperage products	8.22	0.26
Meat and meat products	23.04	24.84
Leather and other leather articles	21.84	46.10
Crops of drinking plants and spices	12.39	1.31
Waste or scrap	46.43	30.09
Newspapers, magazines and periodicals	1.14	0.47
Prefabricated buildings	0.01	5.72
Record books, stationery, paper or cardboard	0.99	0.12
Wood	0.75	10.20
Wood and other forestry products	52.55	6.50
Advertising material and other printed matter	3.21	0.74
Furniture	2.06	0.96
Tires and other rubber products	2.35	8.50
Works and carpentry pieces for construction	1.16	0.41
Other animal products	28.31	4.78
Other wood, cork and braidable materials products	15.60	0.74
Pulp, paper and cardboard	0.49	5.24
Food products n.e.c.	1.55	6.58
Printed products (except advertising)	10.79	3.14
Miscellaneous basic chemicals	16.13	48.52
Basic Organic Chemicals	23.30	8.10
Residues from the extraction of vegetable fats; oilseed meals	29.92	85.05
Oilseeds and fruits	35.74	26.07

Own elaboration. For simplicity, the table shows the products without disaggregating between deforested and non-deforested land, since the percentage of exports to the EU and the percentage of exports in total demand are equal.

4. Results

Table 3 shows the results in terms of production, domestic sales, exports and imports, for the products covered by the measure and which are produced on deforested land, so that their export to the EU is prohibited. For all these products production falls, but particularly for oilseeds and oleaginous fruits, food crops, timber, and other forestry products, which face substantial reductions in exports and fail to be absorbed by domestic sales or to other destinations. On the other hand, in cases where production is biased towards the domestic market, either for intermediate or final consumption (Table B4), domestic sales contribute to absorbing the shock. This is the case for leather and its derivatives, chemical products, meat, and oilseeds and oleaginous fruits. Among these, there are also cases in which exports to other destinations also grow, although they account for a small part of the demand. Examples of the latter are advertising material, carpentry pieces, newspapers and magazines, registry books, furniture, among others.

Table 3. Results by product, selected cases (average % deviation with respect to baseline, 2025-2030)

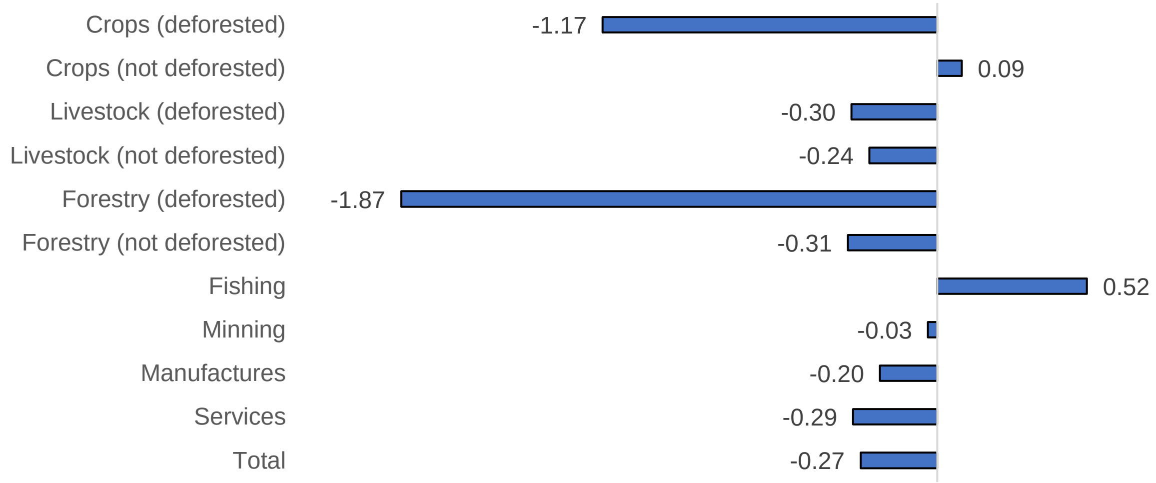
	Productio n	Domesti c Sales	Export s	Import s
Animal and vegetable oils and fats (deforested)	-0.20	-0.35	-0.50	-1.18
Live animals (deforested)	-0.30	-0.29	-5.80	-0.36
Cocoa, chocolate and confectionery (deforested)	-0.20	-0.28	1.03	-0.91
Wooden boxes and containers, cooperage products (deforested)	-0.20	-0.19	-4.73	-0.64
Meat and meat products (deforested)	-0.20	0.95	-9.52	-2.15
Leather and other leather articles (deforested)	-0.20	1.90	-7.50	-2.36
Crops of drinking plants and spices (deforested)	-1.17	-1.05	-11.97	2.86
Waste or waste (deforested)	-0.20	0.65	-21.24	-11.91
Newspapers, magazines and periodicals (deforested)	-0.20	-0.21	1.60	-1.03
Prefabricated buildings (deforested)	-0.20	-0.48	1.59	-2.20
Record books, stationery, paper or cardboard (deforested)	-0.20	-0.20	1.44	-1.92
Wood (deforested)	-0.20	-0.24	-0.02	-0.37
Wood and other forestry products (deforested)	-1.63	0.11	-33.83	-2.23
Advertising material and other printed matter (deforested)	-0.20	-0.23	2.55	-2.65
Furniture (deforested)	-0.20	-0.22	0.81	-1.44
Tires and other rubber products (deforested)	-0.20	-0.19	-0.84	-0.70
Works and carpentry pieces for construction (deforested)	-0.20	-0.21	2.17	-1.91
Other animal products (deforested)	-0.27	0.03	-12.50	-4.31
Other products made of wood, cork and braidable materials (deforested)	-0.20	-0.17	-7.96	-1.78
Pulp, paper and cardboard (deforested)	-0.20	-0.25	0.47	-0.66
Food products n.e.c. (deforested)	-0.20	-0.29	0.47	-1.07
Printed products (except advertising) (deforested)	-0.20	-0.13	-4.56	-0.96
Various basic chemicals (deforested)	-0.20	1.21	-5.35	-2.50
Basic organic chemicals (deforested)	-0.20	0.92	-12.19	-1.21
Residues from the extraction of vegetable fats; oilseed meals (deforested)	-0.20	-0.19	-8.35	0.00
Oilseeds and fruits (deforested)	-1.11	0.68	-15.93	-7.08

Own elaboration.

These results are reflected at the level of productive sectors (Figure 2). Those that suffer the most are the deforested land activities of crops and forestry, whose value-added falls by an average of 1.17% and 1.87%, respectively. Livestock production, for example, of live animals and meat, falls, but to a lesser extent, so the livestock sector on deforested land falls relatively less (-0.30%), similar to the fall of the same sector on non-deforested land (-0.24%). The non-deforested land crops sector expands marginally (0.09%), increasing the production of oilseeds and oleaginous fruits, and drinkable plant crops. The non-deforested land forestry sector falls by 0.31%, due to lower production of timber and related products. [17]

This translates into important effects on the land market, as shown in Figure 3. The demand for deforested land decreases for forestry (-2.46%) and crops (-1.11%), while it increases marginally for livestock (0.04%). In contrast, non-deforested land use grows for crops (0.31%), while it contracts for livestock (-0.12%) and forestry (-0.02%).

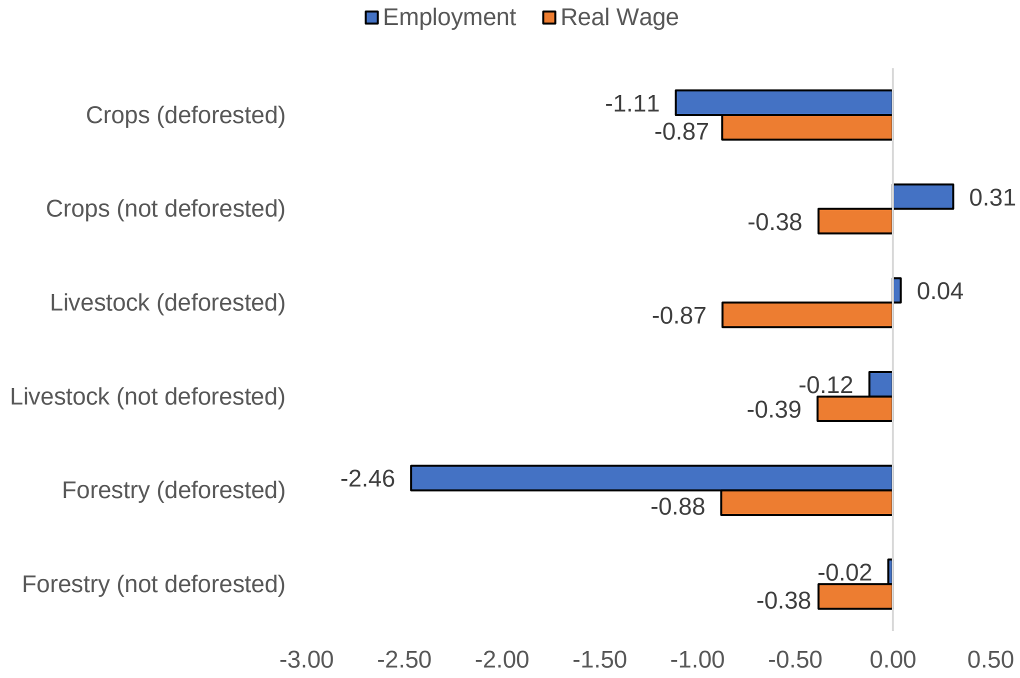
Figure 2. Results Value-added, by activity (average % deviation from baseline, 2025-2030)



Own elaboration.

[17] As for the rest of the sectors, the adjustment of the trade balance associated with the EUDR shock depreciates the exchange rate, boosting exports (in the case of fishing) but also making imported inputs more expensive, which are relevant for sectors such as mining, manufacturing, and services. Overall, value added fell 0.27%.

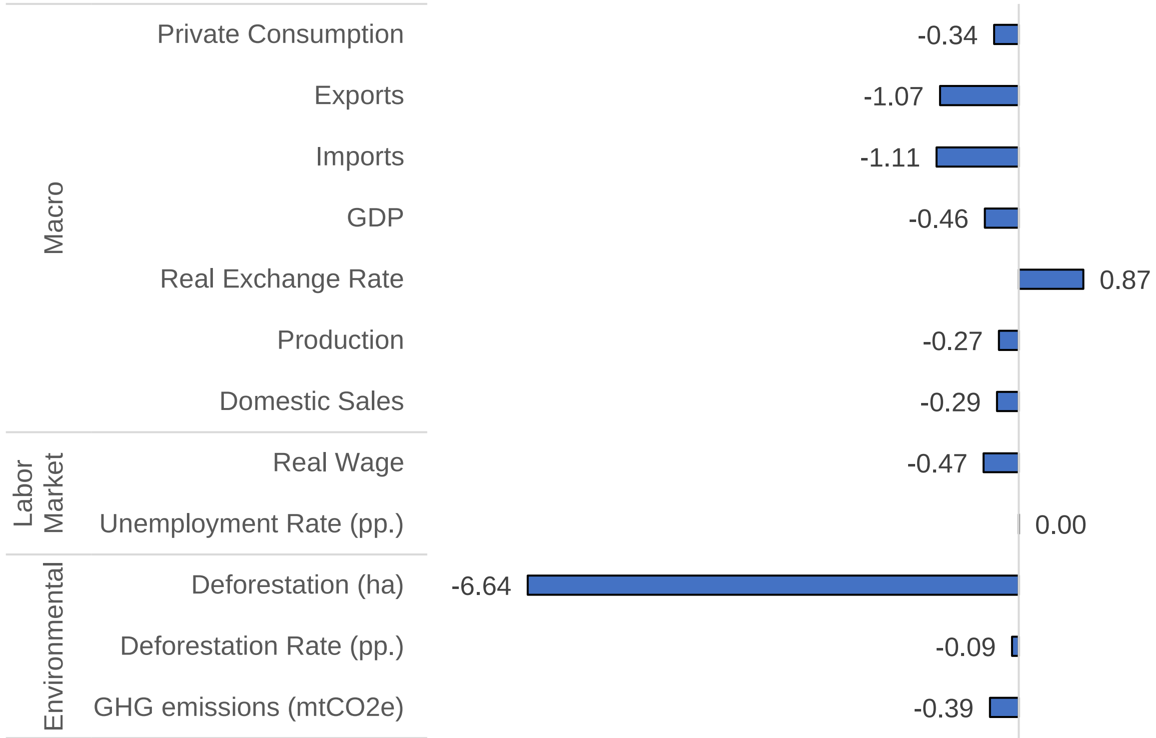
Figure 3. Land Use Results (average % deviation from baseline, 2025-2030)



Own elaboration.

The sectoral impacts discussed above have, in turn, consequences on the labor market and the income of the owners of the productive factors, which are the households. Figure 4 summarizes the main macroeconomic, labor market, and environmental results. Given that the sectors most affected by the EUDR account for a low proportion of labor demand (see Table B3), the impacts on the labor market are limited. Real wages fall by 0.47%, which helps explain a reduction in private consumption of 0.34%. As expected, the reduction in exports to the EU is not offset by sales to other destinations, so total exports are reduced by an average of 1.07%. This is associated with a real exchange rate 0.87% higher than in the base scenario, which adds up to a negative shock for those sectors that import inputs. In effect, imports fall 1.11%. GDP is reduced by 0.46% on average.

Figure 4. Summary of macro, labor and environmental results (average deviation from baseline, 2025-2030)

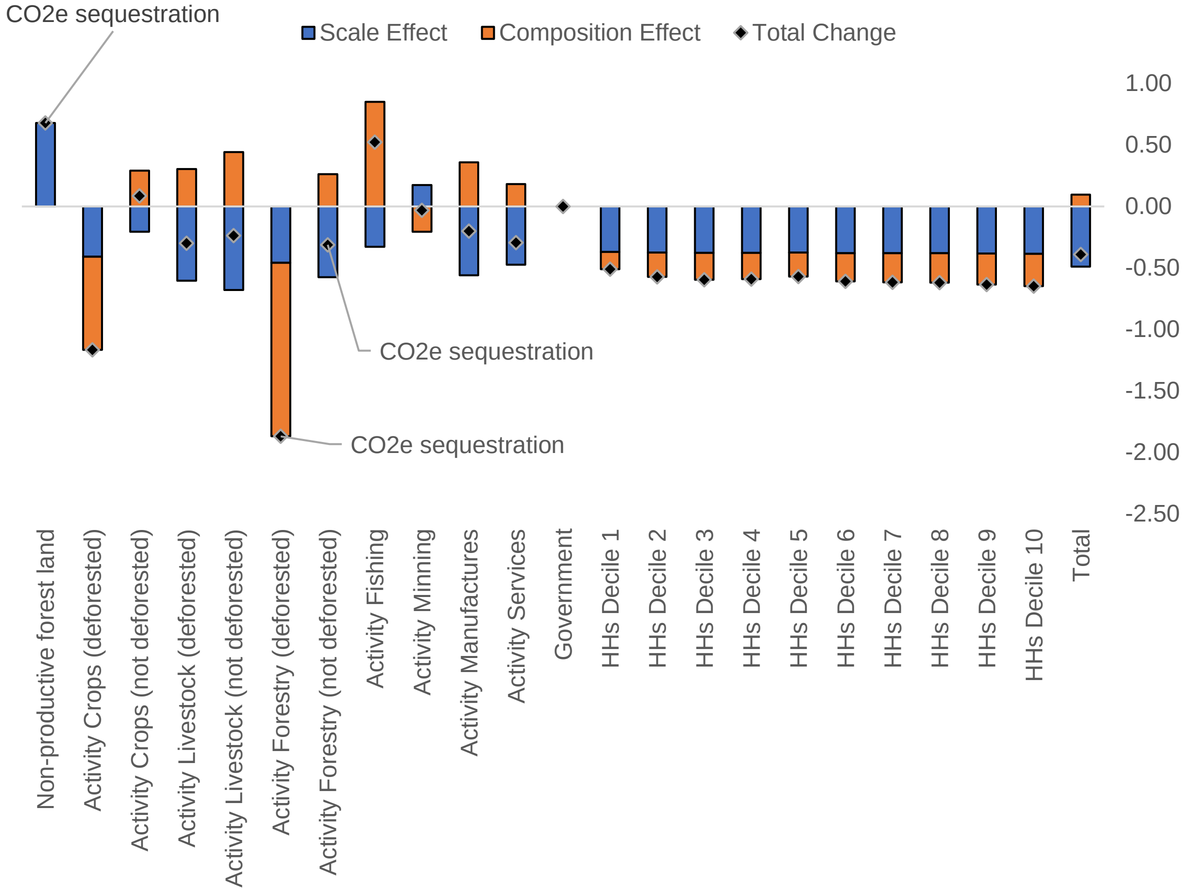


Own Elaboration. The figure shows the average percentage deviation (unless otherwise noted) from the baseline scenario (without EUDR) for key indicators.

The decrease in the demand for deforested land translates into a reduction in deforested hectares by an average of 6.64%, with the deforestation rate 0.09 percentage points lower. Meanwhile, emissions of polluting gases are reduced by an average of 0.39% with respect to the base scenario, due to a scale effect that reduces emissions by 0.49% offsetting a composition effect of 0.1% (Figure 5).[18] In cases involving an emitter that captures CO2, such as non-productive forest land, a positive total change represents an increase in sequestration (a greater reduction in emissions), and vice versa for a negative total change, as in this case for forestry activities. The scale effect is negative for all emitters, whether due to decreases in activity or final or intermediate consumption. On the other hand, the composition effect refers to the share of the emitter among the consumers of emitting factors. It is positive, for example, for fishing activity, whose value-added expands, while it is negative for forestry activity on deforested land, which contracts (see Figure 2).

[18] See Appendix D for a description of the decomposition method.

Figure 5. Pollutant gas emissions, by emitter (average % deviation from baseline, 2025-2030)



Own elaboration. See Appendix D for a description of the decomposition method.

5. Sensitivity Analysis

The sensitivity of the results is evaluated by modifying the assumptions regarding the magnitude of key parameters in our analysis. The elasticities to be modified are important to analyze the degree of adjustment of the production most exposed to the EUDR, which are agricultural activities and derived products. In this sense, the two important parts of the problem are the changes in land use and the flexibility to modify the destination of sales. For this reason, the sensitivity analysis is carried out by modifying: (i) the elasticity of land supply; (ii) the elasticity of the land wage curve; (iii) the elasticities of transformation between domestic sales and between exports; and (iv) the elasticities of transformation of exports between different destinations. The value of the elasticities is modified in a range between +/-50%, as shown in Table 3.

Table 3. Parameters for sensitivity analysis

ID	Description	EUDR Shock Scenario (Section 4)	Variation
S1	Deforested Land Supply Curve (LO)	0.033	- 50%
S2	Deforested Land Supply Curve (UP)	0.033	+ 50%
S3	Land Wage Curve (LO)	-0.066	- 50%
S4	Land Wage Curve (UP)	-0.066	+ 50%
S5	Transformation between domestic sales and exports (LO)	Table A1	- 50%
S6	Transformation between domestic sales and exports (UP)	Table A1	+ 50%
S7	Transformation between exports to different destinations (LO)	Table A1*2	- 50%
S8	Transformation between exports to different destinations (UP)	Table A1*2	+ 50%

Own Elaboration.

The results are shown in Table 4, including a column with the results presented in Section 4, for comparison. In general terms, no major variations are found in terms of macroeconomic outcomes, value-added, and distributional impacts. However, there are important changes in environmental outcomes and land use changes. The lower the absolute value of the land supply elasticity (S1 vs. S2), the greater the reduction in deforested hectares and pollutant gas emissions, which is associated with larger declines in deforested land use. Something similar occurs for the elasticity of the land wage curve (S3 vs S4). What happens in this case is that it is easier to use non-deforested land that is unemployed. Also, the use of deforested land falls less, whose supply is less dependent on deforestation.

Changes in the magnitudes of the elasticities of transformation elasticities between domestic sales and between exports; and the elasticities of transformation of exports between different destinations mainly generate changes in macroeconomic, sectoral, and distributional outcomes. The more difficult it is to transform exports into domestic sales (S5 vs. S6), the smaller the fall in exports to the EU and the diversion to other destinations, and the larger the real depreciation required to adjust the trade balance. GDP and real wages fall more, which is explained by the fact that the manufacturing sector expands less and the services sector contracts more. Something similar happens the more difficult it is to divert exports to other destinations (S7 vs. S8) although the required adjustment in the real exchange rate is even greater.

Table 4. Sensitivity Analysis Results (average % deviation from baseline, 2025-2030)

Macroeconomic Results									
GDP	-0.46	-0.48	-0.44	-0.44	-0.48	-0.61	-0.37	-0.63	-0.36
Exports	-1.07	-1.10	-1.03	-1.03	-1.10	-1.10	-0.93	-1.33	-0.83
European Union	-22.41	-22.41	-22.41	-22.40	-22.42	-18.51	-24.16	-18.64	-24.10
Rest	3.88	3.83	3.92	3.91	3.84	2.93	4.46	2.68	4.56
Imports	-1.11	-1.15	-1.08	-1.08	-1.14	-1.37	-0.96	-1.58	-0.87
Production	-0.27	-0.29	-0.25	-0.24	-0.29	-0.38	-0.21	-0.39	-0.21
Domestic Sales	-0.29	-0.32	-0.28	-0.27	-0.32	-0.44	-0.22	-0.42	-0.23
Real Exchange Rate	0.87	0.89	0.86	0.87	0.88	1.09	0.74	1.23	0.68
Value-Added Results									
Crops (deforested)	-1.17	-1.41	-0.96	-1.08	-1.27	-1.18	-1.09	-1.87	-0.83
Crops (not deforested)	0.09	0.10	0.07	0.12	0.03	0.61	-0.26	0.26	0.00
Livestock (deforested)	-0.30	-0.36	-0.25	-0.26	-0.34	-0.46	-0.22	-0.45	-0.23
Livestock (not deforested)	-0.24	-0.26	-0.22	-0.21	-0.26	-0.38	-0.17	-0.34	-0.19
Forestry (deforested)	-1.87	-2.01	-1.75	-1.81	-1.93	-1.92	-1.77	-2.71	-1.40
Forestry (not deforested)	-0.31	-0.31	-0.32	-0.28	-0.35	-0.21	-0.42	-0.30	-0.32
Fishing	0.52	0.53	0.52	0.53	0.52	0.63	0.45	0.73	0.41
Mining	-0.03	-0.03	-0.03	-0.01	-0.04	-0.10	-0.01	-0.06	-0.02
Manufactures	-0.20	-0.22	-0.18	-0.17	-0.22	-0.38	-0.11	-0.30	-0.15
Services	-0.29	-0.31	-0.28	-0.27	-0.31	-0.41	-0.23	-0.42	-0.23
Total	-0.27	-0.29	-0.25	-0.24	-0.29	-0.38	-0.21	-0.39	-0.21
Labor Market									
Real Wage	-0.47	-0.50	-0.46	-0.45	-0.50	-0.65	-0.38	-0.68	-0.37
Unemployment Rate (pp.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Environmental									
Deforestation (ha)	-6.64	-48.73	28.06	-10.34	-2.53	-8.17	-5.67	-10.26	-4.89
Deforestation Rate (pp.)	-0.09	-0.64	0.38	-0.14	-0.04	-0.11	-0.08	-0.14	-0.07
GHG emissions (mtCO2e)	-0.39	-0.49	-0.30	-0.38	-0.41	-0.53	-0.32	-0.57	-0.30
Land Use									
Crops (deforested)	-1.11	-2.00	-0.33	-0.78	-1.48	-1.01	-1.08	-1.81	-0.78
Crops (not deforested)	0.31	0.34	0.28	0.42	0.12	0.98	-0.11	0.58	0.17
Livestock (deforested)	0.04	-0.60	0.60	0.34	-0.27	-0.08	0.09	0.08	0.02
Livestock (not deforested)	-0.12	-0.13	-0.11	-0.05	-0.23	-0.37	0.03	-0.22	-0.07
Forestry (deforested)	-2.46	-3.68	-1.40	-2.05	-2.95	-2.33	-2.42	-3.51	-1.86
Forestry (not deforested)	-0.02	0.02	-0.07	0.12	-0.28	0.14	-0.15	0.16	-0.11

Own elaboration. S1= Deforested Land Supply Curve (LO); S2 = Deforested Land Supply Curve (UP); S3 = Land Wage Curve (LO); S4 = Land Wage Curve (UP); S5 = Transformation between domestic sales and exports (LO); S6 = Transformation between domestic sales and exports (UP); S7 = Transformation between exports to different destinations (LO); S8 = Transformation between exports to different destinations (UP). See descriptions in Table 3.

6. Conclusions

Restrictions on the consumption of products associated with deforestation appear as a way to combat deforestation globally and fight climate change. As of January 2025, the EU will prohibit the export to the EU of certain products if they involve the use of deforested land. This regulation covers cattle, cocoa, coffee, oil palm, rubber, soybeans, and timber and related products such as meat, chocolate, leather, and paper.

By using a computable general equilibrium model, this paper simulated this shock in Argentina to estimate its potential impacts. The results suggest that the macroeconomic impacts are limited. As a consequence of the EU regulation, between 2025 and 2030, GDP would be reduced by an average of 0.46% with respect to the baseline scenario. However, of greater magnitude is the potential environmental impact. Deforested hectares would be reduced by 6.64% and emissions of polluting gases by 0.39%. These results depend on the modeling and data used. However, the main findings are robust, in particular, concerning their qualitative interpretation so that they account for the direction and range of magnitude of the effects, which are necessary as a basis for policy decisions aimed at mitigating the adverse effects.

Our study is not without limitations. International prices are assumed to be exogenous and we do not consider changes as a consequence of the introduction of the EU regulation in the international market of the products achieved. As mentioned, we abstract from the part of the EU regulation that prohibits forest degradation, which is a more difficult process to measure and for which statistics are scarce (European Commission, 2021). We also abstract from considerations about the presence of segments of value chains with monopolistic competition that may reduce the effectiveness of this type of regulation (Dominguez-Iino, 2023). These are potential future research agendas.

Similar regulations are under discussion in other countries of great relevance in the international market, such as the United States (Drost et al., 2022). Reducing deforestation is essential in the fight against climate change and Argentina should transform the challenges posed by these new regulations into opportunities to consolidate its position in international markets, comply with its environmental commitments, and improve practices in the agricultural sector, which is key to the climate transition and the country's development.

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Appendix A. International Trade Elasticities

Table A1. International Trade Elasticities

	Armington	CET
Animal and vegetable oils and fats (deforested)	1.50	1.50
Animal and vegetable oils and fats (not deforested)	1.50	1.50
Live animals (deforested)	2.00	2.00
Live animals (not deforested)	2.00	2.00
Sugar (deforested)	2.00	2.00
Sugar (not deforested)	2.00	2.00
Wooden boxes and containers, cooperage products (deforested)	1.50	1.50
Wooden boxes and containers, cooperage products (not deforested)	1.50	1.50
Meat and meat products (deforested)	1.50	1.50
Meat and meat products (not deforested)	1.50	1.50
Cereals (deforested)	2.00	2.00
Cereals (not deforested)	2.00	2.00
Cocoa, chocolate and confectionery (deforested)	1.50	1.50
Cocoa, chocolate and confectionery (not deforested)	1.50	1.50
Leather and other leather articles (deforested)	1.50	1.50
Leather and other leather goods (not deforested)	1.50	1.50
Waste or waste (deforested)	0.90	0.90
Waste or waste (not deforested)	0.90	0.90
Newspapers, magazines and periodicals (deforested)	1.50	1.50
Newspapers, magazines and periodicals (not deforested)	1.50	1.50
Prefabricated buildings (deforested)	1.50	1.50
Prefabricated buildings (not deforested)	1.50	1.50
Crops of drinking plants and spices (deforested)	2.00	2.00
Crops of drinking plants and spices (not deforested)	2.00	2.00
Live plants, flowers and seeds (deforested)	2.00	2.00
Live plants, flowers and seeds (not deforested)	2.00	2.00
Fruits and nuts (deforested)	2.00	2.00
Fruits and nuts (not deforested)	2.00	2.00
Residues from the extraction of vegetable fats; oilseed meals (deforested)	1.50	1.50
Residues from the extraction of vegetable fats; oilseed meals (not deforested)	1.50	1.50
Legumes (deforested)	2.00	2.00
Legumes (not deforested)	2.00	2.00
Printed products (except advertising) (deforested)	1.50	1.50
Printed products (except advertising) (not deforested)	1.50	1.50
Record books, stationery, paper or cardboard (deforested)	1.50	1.50
Record books, stationery, paper or cardboard (not deforested)	1.50	1.50
Wood (deforested)	1.50	1.50
Wood (not deforested)	1.50	1.50
Works and carpentry pieces for construction (deforested)	1.50	1.50
Works and carpentry pieces for construction (not deforested)	1.50	1.50
Furniture (deforested)	1.50	1.50
Furniture (not deforested)	1.50	1.50

Oilseeds and fruits (deforested)	2.00	2.00
Oil seeds and fruits (not deforested)	2.00	2.00
Other manufactures	1.50	1.50
Other agricultural products	2.00	2.00
Food products n.e.c. (deforested)	1.50	1.50
Food products n.e.c. (not deforested)	1.50	1.50
Other animal products (deforested)	2.00	2.00
Other animal products (not deforested)	2.00	2.00
Advertising material and other printed matter (deforested)	1.50	1.50
Advertising material and other printed matter (not deforested)	1.50	1.50
Other products made of wood, cork and braidable materials (deforested)	1.50	1.50
Other products made of wood, cork and braidable materials (not deforested)	1.50	1.50
Various basic chemicals (deforested)	1.50	1.50
Various basic chemicals (not deforested)	1.50	1.50
Unprocessed vegetable materials n.e.c. (deforested)	2.00	2.00
Unprocessed vegetable materials n.e.c. (not deforested)	2.00	2.00
Pulp, paper and cardboard (deforested)	1.50	1.50
Pulp, paper and cardboard (not deforested)	1.50	1.50
Tires and other rubber products (deforested)	1.50	1.50
Tires and other rubber products (not deforested)	1.50	1.50
Basic organic chemicals (deforested)	1.50	1.50
Basic organic chemicals (not deforested)	1.50	1.50
Services related to agriculture, hunting, forestry and fishing (deforested)	2.00	2.00
Services related to agriculture, hunting, forestry and fishing (not deforested)	2.00	2.00
Wood and other forestry products (deforested)	2.00	2.00
Wood and other forestry products (not deforested)	2.00	2.00
Services	0.90	0.90
Raw tobacco (deforested)	2.00	2.00
Raw tobacco (not deforested)	2.00	2.00

Own elaboration.

Appendix B. Base-Year Description

This section describes the Argentine economy in the base year used for the calibration (2019) by collecting information on the GDP structure, the balance of payments, the government budget, the income structure of institutions, and different sectoral indicators.

With respect to the structure of GDP, Table B1 shows that absorption represents 96.78% of GDP, and the Argentine economy consumed less than it produced, so it had a trade surplus of 3.2% of GDP. Consumption is broken down into private and public, which represent 66.13% and 16.44% of GDP, respectively, while investment in fixed capital is 14.2% of GDP.

On the other hand, foreign exchange income in the balance of payments represents 20.21% of GDP. In terms of GDP, Argentina exported 17.93%, had income from remittances and transfers to the government of 0.01% and 0.31%, respectively, and received income from productive factors of 1.41%. The EU accounts for 18.65% and 20.60% of exports and imports, respectively. Regarding foreign exchange outflows, imports accounted for 14.71% of GDP, and payments for the use of productive factors for 5.37% of GDP.

In 2019, taxes were collected for an amount net of subsidies equivalent to 31.64% of GDP, of which 42.6% corresponds to product taxes (13.49% of GDP), 33.4% to factor taxes (10. 55% of GDP), 20% to direct taxes (6.34% of GDP), 5.8% to export taxes (1.84% of GDP), 0.76% to import taxes (0.76% of GDP), and -4.2% to activity taxes. The government also received transfers from abroad for 0.31% of GDP. On the expenditure side, as a percentage of GDP, public consumption is 16.45% and domestic transfers 17.06%. Finally, the government borrowed 1.68% of GDP.

Table B1. Base year description. Structure of GDP, Balance of Payments and Government Budget. In nominal terms (billions of pesos) and as a percentage of GDP.

	Nominal	% GDP
GDP Components		
Absorption	20.86	96.78
Private Consumption	14.26	66.13
Gov. Consumption	3.54	16.44
Investment	3.06	14.20
Changes in inventories	0.00	0.01
Exports	3.87	17.93
European Union	0.72	3.34
Resto	3.14	14.59
Imports	3.17	14.71
European Union	0.65	3.03
Resto	2.52	11.68
GDP	21.56	100.00
Indirect Taxes	3.18	14.75
Balance of Payments		
Exports	3.87	17.93
Inflow HHs Transfers	0.00	0.01
Inflow Gov. Transfers	0.07	0.31
Inflow Factorial Payments	0.30	1.41
RoW Savings	0.12	0.55
Total Inflows	4.36	20.21
Imports	3.17	14.71
Outflow Gov Transfers	0.03	0.13
Outflow Factorial Payments	1.16	5.37
Total Outflows	4.36	20.21
Government Budget		
Direct Income Taxes	1.37	6.34
Direct Factor Taxes	2.28	10.55
Activity Taxes	-0.29	-1.34
Product Taxes	2.91	13.49
Import Taxes	0.16	0.76
Export Taxes	0.40	1.84
Row Transfers	0.07	0.31
Total Gov Incomes	6.89	31.95
Consumption	3.54	16.44
Domestic Transfers	3.68	17.06
RoW Transfers	0.03	0.13
Public Savings	-0.36	-1.68
Total Gov Expenditure	6.89	31.95

Source: own elaboration based on SAM 2019.

As shown in Table B2, household income is composed of factor income from labor (41.37%) and capital (39.19%), transfers from the government (19.43%), and from the rest of the world (0.01%). Government income is 88.94% tax income, 10.1% capital income, and 0.96% transfers from the rest of the world. Income from the rest of the world is mainly given by payments to imports (72.79%), followed by payments to capital (26.4%), government transfers (0.62%), and payments to labor (0.19%).

Table B2. The revenue structure of the institutions

	Households	Government	Rest of the World (RoW)
Total Taxes	0.00	88.94	0.00
Gov. Transfers	19.43	0.00	0.62
RoW Transfers	0.01	0.96	0.00
Imports	0.00	0.00	72.79
Labor	41.37	0.00	0.19
Capital	39.19	10.10	26.40
Total	100.00	100.00	100.00

Source: own elaboration based on SAM 2019.

The sectoral structure is shown in Table B3 including shares in value-added, production, wage bill, exports and imports, as well as separating domestic supply between exports and domestic sales, and domestic demand between imports and domestic production. For example, the product "Cereals (deforested)" represents 5.72% of total exports (60.95% of its production), but only 0.75% in terms of value added. Services are the main creators of value added (75.78%) and have a substantial share in the total wage bill (82.25%). Meanwhile, other manufacturing has the highest share in total imports (59.53%), and one of the highest shares in their consumption (26.05%).

On the other hand, Table B4 reports the structure of sectoral demand, which is mainly given by intermediate consumption (37.25%) and private consumption (31.11%). Several products allocate a high proportion of their production to intermediate consumption: among them wooden boxes and containers, carpentry parts, wood products, and live animals, among others. Cereals are those with the highest demand biased towards the external market since exports represent 62.7% of its sales. On the other hand, prefabricated buildings allocate a high proportion of their sales to investment (90.13%).

Table B3. Productive Structure (%). Base year

	VAshr	PRDshr	EMPshr	EXPshr	EXP_OUTshr	IMPshr	IMP_DEMshr
Animal and vegetable oils and fats (deforested)	0.37	0.63	0.26	2.96	31.14	0.09	1.95
Animal and vegetable oils and fats (not deforested)	0.37	0.62	0.26	2.92	31.14	0.09	1.95
Live animals (deforested)	0.75	0.82	0.87	0.02	0.27	0.02	0.25
Live animals (not deforested)	0.66	0.72	0.76	0.02	0.27	0.02	0.25
Sugar (deforested)	0.05	0.07	0.04	0.05	5.61	0.00	0.52
Sugar (not deforested)	0.07	0.11	0.06	0.08	5.61	0.01	0.52
Wooden boxes and containers, cooperage products (deforested)	0.01	0.02	0.01	0.00	0.26	0.01	6.31
Wooden boxes and containers, cooperage products (not deforested)	0.01	0.01	0.01	0.00	0.26	0.01	6.31
Meat and meat products (deforested)	0.46	0.77	0.32	2.79	25.21	0.15	2.37
Meat and meat products (not deforested)	0.40	0.67	0.28	2.43	25.21	0.13	2.37
Cereals (deforested)	0.74	0.94	0.86	5.69	60.80	0.02	0.52
Cereals (not deforested)	0.75	0.95	0.87	5.73	60.80	0.02	0.52
Cocoa, chocolate and confectionery (deforested)	0.05	0.08	0.04	0.07	4.84	0.11	11.42
Cocoa, chocolate and confectionery (not deforested)	0.08	0.13	0.06	0.11	4.84	0.17	11.42
Leather and other leather articles (deforested)	0.03	0.06	0.02	0.38	56.22	0.10	31.71
Leather and other leather goods (not deforested)	0.03	0.05	0.02	0.33	56.22	0.09	31.71
Waste or waste (deforested)	0.08	0.14	0.06	0.52	28.01	0.07	6.34
Waste or waste (not deforested)	0.01	0.01	0.00	0.03	28.01	0.00	6.34
Newspapers, magazines and periodicals (deforested)	0.03	0.05	0.02	0.00	0.46	0.01	1.31
Newspapers, magazines and periodicals (not deforested)	0.03	0.04	0.02	0.00	0.46	0.01	1.31
Prefabricated buildings (deforested)	0.00	0.00	0.00	0.01	12.48	0.04	57.00
Prefabricated buildings (not deforested)	0.00	0.00	0.00	0.00	12.48	0.04	57.00
Crops of drinking plants and spices (deforested)	0.02	0.02	0.02	0.00	1.65	0.06	20.15
Crops of drinking plants and spices (not deforested)	0.01	0.01	0.01	0.00	1.65	0.04	20.15
Live plants, flowers and seeds (deforested)	0.01	0.01	0.01	0.00	2.70	0.01	8.03
Live plants, flowers and seeds (not deforested)	0.05	0.05	0.05	0.02	2.70	0.05	8.03
Fruits and nuts (deforested)	0.03	0.03	0.03	0.21	22.46	0.09	25.19
Fruits and nuts (not deforested)	0.10	0.13	0.12	0.82	22.46	0.36	25.19
Residues from the extraction of vegetable fats; oilseed meals (deforested)	0.29	0.49	0.20	5.65	78.23	0.00	0.00

Residues from the extraction of vegetable fats; oilseed meals (not deforested)	0.28	0.48	0.20	5.59	78.23	0.00	0.00
Legumes (deforested)	0.17	0.21	0.19	0.69	10.52	0.04	2.14
Legumes (not deforested)	0.04	0.05	0.04	0.15	10.52	0.01	2.14
Printed products (except advertising) (deforested)	0.02	0.04	0.02	0.02	3.64	0.09	17.45
Printed products (except advertising) (not deforested)	0.02	0.03	0.01	0.02	3.64	0.08	17.45
Record books, stationery, paper or cardboard (deforested)	0.04	0.07	0.03	0.00	0.10	0.01	0.69
Record books, stationery, paper or cardboard (not deforested)	0.04	0.06	0.03	0.00	0.10	0.00	0.69
Wood (deforested)	0.04	0.07	0.03	0.09	10.12	0.04	5.33
Wood (not deforested)	0.04	0.06	0.03	0.08	10.12	0.03	5.33
Works and carpentry pieces for construction (deforested)	0.01	0.02	0.01	0.00	0.25	0.00	2.50
Works and carpentry pieces for construction (not deforested)	0.01	0.02	0.01	0.00	0.25	0.00	2.50
Furniture (deforested)	0.08	0.13	0.06	0.02	1.10	0.19	12.41
Furniture (not deforested)	0.07	0.12	0.05	0.02	1.10	0.16	12.41
Oilseeds and fruits (deforested)	0.74	0.94	0.84	2.72	21.37	1.11	11.89
Oil seeds and fruits (not deforested)	0.73	0.93	0.83	2.69	21.37	1.10	11.89
Other manufactures	10.74	18.03	7.69	30.81	13.65	59.53	26.05
Other agricultural products	3.50	2.91	0.44	6.06	21.00	3.64	12.86
Food products n.e.c. (deforested)	0.16	0.27	0.11	0.29	7.63	0.24	8.40
Food products n.e.c. (not deforested)	0.16	0.27	0.11	0.29	7.63	0.24	8.40
Other animal products (deforested)	0.23	0.28	0.24	0.17	4.58	0.01	0.49
Other animal products (not deforested)	0.20	0.25	0.21	0.14	4.58	0.01	0.49
Advertising material and other printed matter (deforested)	0.02	0.04	0.02	0.00	0.59	0.01	1.67
Advertising material and other printed matter (not deforested)	0.02	0.04	0.02	0.00	0.59	0.01	1.67
Other products made of wood, cork and braidable materials (deforested)	0.03	0.05	0.02	0.00	0.76	0.04	6.71
Other products made of wood, cork and braidable materials (not deforested)	0.03	0.05	0.02	0.00	0.76	0.03	6.71
Various basic chemicals (deforested)	0.00	0.01	0.00	0.04	57.43	0.02	37.64
Various basic chemicals (not deforested)	0.02	0.03	0.01	0.17	57.43	0.07	37.64
Unprocessed vegetable materials n.e.c. (deforested)	0.06	0.08	0.07	0.04	5.06	0.02	2.85
Unprocessed vegetable materials n.e.c. (not deforested)	0.06	0.08	0.07	0.04	5.06	0.02	2.85
Pulp, paper and cardboard (deforested)	0.22	0.37	0.15	0.29	6.12	0.73	16.65
Pulp, paper and cardboard (not deforested)	0.19	0.32	0.13	0.25	6.12	0.63	16.65

Tires and other rubber products (deforested)	0.08	0.14	0.06	0.18	11.83	0.60	32.73
Tires and other rubber products (not deforested)	0.07	0.12	0.05	0.16	11.83	0.52	32.73
Basic organic chemicals (deforested)	0.04	0.06	0.03	0.10	15.56	0.60	52.60
Basic organic chemicals (not deforested)	0.14	0.24	0.10	0.40	15.56	2.36	52.60
Services related to agriculture, hunting, forestry and fishing (deforested)	0.18	0.22	0.20	0.02	1.13	0.00	0.00
Services related to agriculture, hunting, forestry and fishing (not deforested)	0.18	0.22	0.20	0.02	1.13	0.00	0.00
Wood and other forestry products (deforested)	0.04	0.04	0.05	0.03	7.54	0.05	12.84
Wood and other forestry products (not deforested)	0.04	0.03	0.04	0.02	7.54	0.05	12.84
Services	75.78	64.97	82.25	17.46	2.90	25.86	3.57
Raw tobacco (deforested)	0.02	0.02	0.02	0.01	3.00	0.01	3.61
Raw tobacco (not deforested)	0.00	0.00	0.00	0.00	3.00	0.00	3.61
Total	100.00	100.00	100.00	100.00	8.45	100.00	10.27

Source: own elaboration based on SAM 2019. Notes: VAshr = share in total value added; PRDshr = share in total gross value added; EMPshr = share in total wage bill; EXPshr = share in total exports; EXP-OUTshr = share of exports in production; IMPshr = share of total imports; IMP-DEPshr = share of imports in consumption.

Table B4. Demand Structure (%). Base year

	Intermediate Consumption	Margins	Private Consumption	Gov Consumption	Investments	Change in inventories	Exports	Total Demand
Animal and vegetable oils and fats (deforested)	16.25	0.00	49.52	0.00	0.00	-0.87	35.10	100.00
Animal and vegetable oils and fats (not deforested)	16.25	0.00	49.52	0.00	0.00	-0.87	35.10	100.00
Live animals (deforested)	87.58	0.00	5.55	0.00	3.10	3.48	0.29	100.00
Live animals (not deforested)	87.58	0.00	5.55	0.00	3.10	3.48	0.29	100.00
Sugar (deforested)	43.86	0.00	49.90	0.00	0.00	0.95	5.28	100.00
Sugar (not deforested)	43.86	0.00	49.90	0.00	0.00	0.95	5.28	100.00
Wooden boxes and containers, cooperage products (deforested)	98.40	0.00	1.84	0.00	0.00	-0.50	0.26	100.00
Wooden boxes and containers, cooperage products (not deforested)	98.40	0.00	1.84	0.00	0.00	-0.50	0.26	100.00
Meat and meat products (deforested)	16.51	0.00	58.40	0.00	0.00	0.25	24.84	100.00
Meat and meat products (not deforested)	16.51	0.00	58.40	0.00	0.00	0.25	24.84	100.00
Cereals (deforested)	28.21	0.00	0.79	0.00	0.00	8.32	62.67	100.00
Cereals (not deforested)	28.21	0.00	0.79	0.00	0.00	8.32	62.67	100.00
Cocoa, chocolate and confectionery (deforested)	16.61	0.00	79.47	0.00	0.00	-0.26	4.19	100.00
Cocoa, chocolate and confectionery (not deforested)	16.61	0.00	79.47	0.00	0.00	-0.26	4.19	100.00
Leather and other leather articles (deforested)	18.23	0.00	34.00	0.00	0.00	1.67	46.10	100.00
Leather and other leather goods (not deforested)	18.23	0.00	34.00	0.00	0.00	1.67	46.10	100.00
Waste or waste (deforested)	70.12	0.00	0.00	0.00	0.00	-0.21	30.09	100.00
Waste or waste (not deforested)	70.12	0.00	0.00	0.00	0.00	-0.21	30.09	100.00
Newspapers, magazines and periodicals (deforested)	10.51	0.00	89.07	0.00	0.00	-0.06	0.47	100.00
Newspapers, magazines and periodicals (not deforested)	10.51	0.00	89.07	0.00	0.00	-0.06	0.47	100.00
Prefabricated buildings (deforested)	3.73	0.00	0.00	0.00	90.13	0.42	5.72	100.00
Prefabricated buildings (not deforested)	3.73	0.00	0.00	0.00	90.13	0.42	5.72	100.00
Crops of drinking plants and spices (deforested)	97.21	0.00	1.39	0.00	0.00	0.08	1.31	100.00
Crops of drinking plants and spices (not deforested)	97.21	0.00	1.39	0.00	0.00	0.08	1.31	100.00
Live plants, flowers and seeds (deforested)	63.35	0.00	30.45	0.00	0.00	3.36	2.84	100.00
Live plants, flowers and seeds (not deforested)	63.35	0.00	30.45	0.00	0.00	3.36	2.84	100.00
Fruits and nuts (deforested)	43.48	0.00	37.16	0.00	0.00	-0.95	20.31	100.00

Fruits and nuts (not deforested)	43.48	0.00	37.16	0.00	0.00	-0.95	20.31	100.00
Residues from the extraction of vegetable fats; oilseed meals (deforested)	14.60	0.00	0.00	0.00	0.00	0.36	85.05	100.00
Residues from the extraction of vegetable fats; oilseed meals (not deforested)	14.60	0.00	0.00	0.00	0.00	0.36	85.05	100.00
Legumes (deforested)	14.03	0.00	72.70	0.00	0.00	2.14	11.13	100.00
Legumes (not deforested)	14.03	0.00	72.70	0.00	0.00	2.14	11.13	100.00
Printed products (except advertising) (deforested)	28.29	0.00	68.89	0.02	0.14	-0.48	3.14	100.00
Printed products (except advertising) (not deforested)	28.29	0.00	68.89	0.02	0.14	-0.48	3.14	100.00
Record books, stationery, paper or cardboard (deforested)	85.85	0.00	14.36	0.00	0.00	-0.33	0.12	100.00
Record books, stationery, paper or cardboard (not deforested)	85.85	0.00	14.36	0.00	0.00	-0.33	0.12	100.00
Wood (deforested)	88.65	0.00	1.21	0.00	0.00	-0.06	10.20	100.00
Wood (not deforested)	88.65	0.00	1.21	0.00	0.00	-0.06	10.20	100.00
Works and carpentry pieces for construction (deforested)	91.47	0.00	8.80	0.00	0.00	-0.68	0.41	100.00
Works and carpentry pieces for construction (not deforested)	91.47	0.00	8.80	0.00	0.00	-0.68	0.41	100.00
Furniture (deforested)	23.00	0.00	62.47	0.00	13.99	-0.42	0.96	100.00
Furniture (not deforested)	23.00	0.00	62.47	0.00	13.99	-0.42	0.96	100.00
Oilseeds and fruits (deforested)	73.55	0.00	0.00	0.00	0.00	0.38	26.07	100.00
Oil seeds and fruits (not deforested)	73.55	0.00	0.00	0.00	0.00	0.38	26.07	100.00
Other manufactures	43.07	0.00	37.76	0.95	9.11	-0.60	9.71	100.00
Other agricultural products	74.55	0.00	7.23	0.00	0.00	-0.61	18.83	100.00
Food products n.e.c. (deforested)	10.57	0.00	81.87	1.12	0.00	-0.13	6.58	100.00
Food products n.e.c. (not deforested)	10.57	0.00	81.87	1.12	0.00	-0.13	6.58	100.00
Other animal products (deforested)	80.93	0.00	14.13	0.00	0.00	0.16	4.78	100.00
Other animal products (not deforested)	80.93	0.00	14.13	0.00	0.00	0.16	4.78	100.00
Advertising material and other printed matter (deforested)	97.19	0.00	2.27	0.00	0.00	-0.20	0.74	100.00
Advertising material and other printed matter (not deforested)	97.19	0.00	2.27	0.00	0.00	-0.20	0.74	100.00
Other products made of wood, cork and braidable materials (deforested)	94.58	0.00	5.01	0.00	0.00	-0.33	0.74	100.00
Other products made of wood, cork and braidable materials (not deforested)	94.58	0.00	5.01	0.00	0.00	-0.33	0.74	100.00
Various basic chemicals (deforested)	51.41	0.00	0.00	0.00	0.00	0.07	48.52	100.00
Various basic chemicals (not deforested)	51.41	0.00	0.00	0.00	0.00	0.07	48.52	100.00
Unprocessed vegetable materials n.e.c. (deforested)	93.16	0.00	1.16	0.00	0.00	0.46	5.22	100.00

Unprocessed vegetable materials n.e.c. (not deforested)	93.16	0.00	1.16	0.00	0.00	0.46	5.22	100.00
Pulp, paper and cardboard (deforested)	73.83	0.00	21.30	0.00	0.00	-0.37	5.24	100.00
Pulp, paper and cardboard (not deforested)	73.83	0.00	21.30	0.00	0.00	-0.37	5.24	100.00
Tires and other rubber products (deforested)	81.47	0.00	10.57	0.00	0.00	-0.53	8.50	100.00
Tires and other rubber products (not deforested)	81.47	0.00	10.57	0.00	0.00	-0.53	8.50	100.00
Basic organic chemicals (deforested)	91.69	0.00	0.00	0.00	0.00	0.21	8.10	100.00
Basic organic chemicals (not deforested)	91.69	0.00	0.00	0.00	0.00	0.21	8.10	100.00
Services related to agriculture, hunting, forestry and fishing (deforested)	98.78	0.00	0.00	0.00	0.00	0.00	1.22	100.00
Services related to agriculture, hunting, forestry and fishing (not deforested)	98.78	0.00	0.00	0.00	0.00	0.00	1.22	100.00
Wood and other forestry products (deforested)	71.59	0.00	22.03	0.00	0.00	-0.12	6.50	100.00
Wood and other forestry products (not deforested)	71.59	0.00	22.03	0.00	0.00	-0.12	6.50	100.00
Services	30.10	15.99	30.09	13.60	7.53	0.00	2.68	100.00
Raw tobacco (deforested)	82.64	0.00	0.00	0.00	0.00	13.17	4.19	100.00
Raw tobacco (not deforested)	82.64	0.00	0.00	0.00	0.00	13.17	4.19	100.00
Total	37.25	8.79	31.11	7.74	6.68	0.01	8.44	100.00

Source: own elaboration based on SAM 2019.

The factor composition of value added or intensity of factor use is presented in Table B5. The only sector that is relatively more labor intensive is services (56.48%), while the rest are relatively capital intensive.

Table B5. Factor Composition of Value Added (%). Base year

	Capital	Labor	Deforested Land	Not Deforested Land	Total
Crops (deforested)	34.90	26.01	39.09		100.00
Crops (not deforested)	34.90	26.01		39.09	100.00
Livestock (deforested)	35.21	26.07	38.72		100.00
Livestock (not deforested)	35.21	26.07		38.72	100.00
Forestry (deforested)	61.66	26.06	12.27		100.00
Forestry (not deforested)	61.66	26.06		12.27	100.00
Fishing	62.60	37.40			100.00
Mining	75.72	24.28			100.00
Manufactures	53.79	46.21			100.00
Services	43.91	56.09			100.00

Source: own elaboration based on SAM 2019.

In 2019, Argentina emitted 365.89 million tons of greenhouse gases. The composition by emitter is presented in Table B6.

Table B6. Emissions by emitter (millions of tons of carbon dioxide equivalent)

	Base	% total
Non-productive forest land	-10.64	-2.91
Activity Crops (deforested)	20.67	5.65
Activity Crops (not deforested)	19.84	5.42
Activity Livestock (deforested)	66.25	18.11
Activity Livestock (not deforested)	59.66	16.31
Activity Forestry (deforested)	-0.57	-0.16
Activity Forestry (not deforested)	-0.59	-0.16
Activity Fishing	1.13	0.31
Activity Mining	2.28	0.62
Activity Manufactures	40.82	11.16
Activity Services	80.99	22.13
Government	1.54	0.42
HHs Decile 1	3.93	1.07
HHs Decile 2	5.62	1.54
HHs Decile 3	6.14	1.68
HHs Decile 4	6.89	1.88
HHs Decile 5	6.59	1.80
HHs Decile 6	7.90	2.16
HHs Decile 7	9.87	2.70
HHs Decile 8	10.78	2.95
HHs Decile 9	11.04	3.02
HHs Decile 10	15.77	4.31
Total	365.89	100.00

Source: own elaboration based on SAM 2019.

Appendix C. Additional Results

Table C1. Results by product (average % deviation with respect to baseline, 2025-2030)

	Production	Domestic Sales	Exports	Imports
Animal and vegetable oils and fats (deforested)	-0.20	-0.35	-0.50	-1.18
Animal and vegetable oils and fats (not deforested)	-0.20	-0.47	0.38	-1.06
Live animals (deforested)	-0.30	-0.29	-5.80	-0.36
Live animals (not deforested)	-0.24	-0.24	0.34	-1.86
Sugar (deforested)	-0.46	-0.51	0.37	-0.62
Sugar (not deforested)	-0.12	-0.24	2.04	-1.35
Wooden boxes and containers, cooperage products (deforested)	-0.20	-0.19	-4.73	-0.64
Wooden boxes and containers, cooperage products (not deforested)	-0.20	-0.20	-0.45	-0.56
Meat and meat products (deforested)	-0.20	0.95	-9.52	-2.15
Meat and meat products (not deforested)	-0.20	-0.09	-0.72	-1.25
Cereals (deforested)	-1.17	-0.33	-1.73	1.09
Cereals (not deforested)	0.09	-0.14	0.24	-0.52
Cocoa, chocolate and confectionery (deforested)	-0.20	-0.28	1.03	-0.91
Cocoa, chocolate and confectionery (not deforested)	-0.20	-0.30	1.63	-0.90
Leather and other leather articles (deforested)	-0.20	1.90	-7.50	-2.36
Leather and other leather goods (not deforested)	-0.20	0.05	-0.53	-1.18
Waste or waste (deforested)	-0.20	0.65	-21.24	-11.91
Waste or waste (not deforested)	-0.20	-0.07	-0.67	-2.06
Newspapers, magazines and periodicals (deforested)	-0.20	-0.21	1.60	-1.03
Newspapers, magazines and periodicals (not deforested)	-0.20	-0.21	2.14	-1.03
Prefabricated buildings (deforested)	-0.20	-0.48	1.59	-2.20
Prefabricated buildings (not deforested)	-0.20	-0.48	1.60	-2.20
Crops of drinking plants and spices (deforested)	-1.17	-1.05	-11.97	2.86
Crops of drinking plants and spices (not deforested)	0.09	0.09	0.03	-1.25
Live plants, flowers and seeds (deforested)	-0.63	-0.64	-0.17	-0.77
Live plants, flowers and seeds (not deforested)	-0.21	-0.24	1.07	-1.07
Fruits and nuts (deforested)	-1.09	-1.06	-1.21	0.49
Fruits and nuts (not deforested)	0.06	-0.53	2.34	-0.23
Residues from the extraction of vegetable fats; oilseed meals (deforested)	-0.20	-0.19	-8.35	0.00
Residues from the extraction of vegetable fats; oilseed meals (not deforested)	-0.20	-0.19	-0.36	0.00
Legumes (deforested)	-1.17	-1.14	-1.37	0.47
Legumes (not deforested)	0.09	-0.35	4.66	-0.63
Printed products (except advertising) (deforested)	-0.20	-0.13	-4.56	-0.96
Printed products (except advertising) (not deforested)	-0.20	-0.23	0.35	-0.90
Record books, stationery, paper or cardboard (deforested)	-0.20	-0.20	1.44	-1.92
Record books, stationery, paper or cardboard (not deforested)	-0.20	-0.20	1.95	-1.92
Wood (deforested)	-0.20	-0.24	-0.02	-0.37
Wood (not deforested)	-0.20	-0.25	0.21	-0.27
Works and carpentry pieces for construction (deforested)	-0.20	-0.21	2.17	-1.91

Works and carpentry pieces for construction (not deforested)	-0.20	-0.21	2.73	-1.90
Furniture (deforested)	-0.20	-0.22	0.81	-1.44
Furniture (not deforested)	-0.20	-0.22	1.82	-1.43
Oilseeds and fruits (deforested)	-1.11	0.68	-15.93	-7.08
Oil seeds and fruits (not deforested)	0.07	0.22	-0.74	-2.93
Other manufactures	-0.20	-0.37	0.83	-0.99
Other agricultural products	0.03	-0.18	0.69	-0.93
Food products n.e.c. (deforested)	-0.20	-0.29	0.47	-1.07
Food products n.e.c. (not deforested)	-0.20	-0.31	1.16	-1.06
Other animal products (deforested)	-0.27	0.03	-12.50	-4.31
Other animal products (not deforested)	-0.22	-0.18	-1.52	-1.95
Advertising material and other printed matter (deforested)	-0.20	-0.23	2.55	-2.65
Advertising material and other printed matter (not deforested)	-0.20	-0.23	3.91	-2.52
Other products made of wood, cork and braidable materials (deforested)	-0.20	-0.17	-7.96	-1.78
Other products made of wood, cork and braidable materials (not deforested)	-0.20	-0.20	-0.02	-1.47
Various basic chemicals (deforested)	-0.20	1.21	-5.35	-2.50
Various basic chemicals (not deforested)	-0.20	0.09	-0.50	-0.68
Unprocessed vegetable materials n.e.c. (deforested)	-1.17	-0.78	-12.64	12.69
Unprocessed vegetable materials n.e.c. (not deforested)	0.09	-0.03	4.79	-4.63
Pulp, paper and cardboard (deforested)	-0.20	-0.25	0.47	-0.66
Pulp, paper and cardboard (not deforested)	-0.20	-0.26	0.68	-0.64
Tires and other rubber products (deforested)	-0.20	-0.19	-0.84	-0.70
Tires and other rubber products (not deforested)	-0.20	-0.25	0.15	-0.60
Basic organic chemicals (deforested)	-0.20	0.92	-12.19	-1.21
Basic organic chemicals (not deforested)	-0.20	0.03	-1.58	-0.42
Services related to agriculture, hunting, forestry and fishing (deforested)	-1.19	-1.11	-9.03	0.00
Services related to agriculture, hunting, forestry and fishing (not deforested)	0.07	0.06	1.16	0.00
Wood and other forestry products (deforested)	-1.63	0.11	-33.83	-2.23
Wood and other forestry products (not deforested)	-0.30	0.01	-4.23	-1.87
Services	-0.29	-0.31	0.57	-1.18
Raw tobacco (deforested)	-1.17	-0.91	-16.07	16.94
Raw tobacco (not deforested)	0.09	0.03	4.37	-4.10

Own Elaboration.

Appendix D. Greenhouse gas emissions change decomposition method

To account for changes in greenhouse gas emissions, we implemented a decomposition procedure based on McMillan and Rodrik (2011). The change in emissions with respect to the baseline scenario is decomposed into two: (a) a scale effect: the change in emissions associated with changes in pollutant consumption; and (b) the composition effect: the change in emissions associated with movements in pollutant consumption among emitters.

To do this, we first distinguish AFOLU (Agriculture, Forestry and Other Land Use) emissions from the rest, the "non-AFOLU" emissions. The latter is explained by the intermediate and final consumption of certain products, while "AFOLU" emissions are linked to the level of activity in the crop, forestry and livestock sectors and to the hectares of non-productive forest area (carbon sequestration).

In the case of "non-AFOLU" emissions, we define total emissions for period t in scenario sim, $emitot_{noAFOLU,t,sim}$ as follows:

$$\begin{aligned} emitot_{noAFOLU,t,sim} &= \sum_{emi}\sum_{c} emitot_{noAFOLU,emi,c,t,sim} \\ &= \sum_{emi}\sum_{c} emifac_{emi,c} Q_{emi,c,t,sim} \\ &= \sum_{c} Q_{c,t,sim} \sum_{emi} emifac_{emi,c} wgth_{emit,c,t,sim} \end{aligned} \tag{6}$$

where $emit(\in EMIT)$ are the emitters (activities, households, government); $emitot_{noAFOLU,emi,c,t,sim}$ are the emissions of emitter emi associated with the consumption of product c; $emifac_{emi,c}$ are the emissions of emitter emi per consumption unit of product c; $Q_{emi,c,t,sim}$ is the consumption of product c by emitter emi; $Q_{c,t,sim} = \sum_{emi} Q_{emi,c,t,sim}$ is the total consumption of product c by all emitters $EMIT$; and $wgth_{emit,c,t,sim} = \frac{Q_{emi,c,t,sim}}{\sum_{emi} Q_{emi,c,t,sim}} = \frac{Q_{emi,c,t,sim}}{Q_{c,t,sim}}$ is the share of emmiter emi in the consumption of product c. Defining analogously for the base scenario, we have that:

$$\begin{aligned} emitot_{noAFOLU,t,sim} - emitot_{noAFOLU,t,base} \\ = \sum_{c}\left(Q_{c,t,sim} - Q_{c,t,base}\right)\sum_{emi} wgth_{emit,c,t,base}emifac_{emi,c} \\ + \sum_{c} Q_{c,t,sim}\sum_{emi} emifac_{emi,c}\big(wgth_{emit,c,t,sim} \\ - wgth_{emit,c,t,base}\big)\end{aligned}$$	(7)

The first term on the right-hand side of equation (7) corresponds to the scale effect, while the second term corresponds to the composition effect, for the case of "non-AFOLU" emissions.

In the case of "AFOLU" emissions, we define the total emissions for period t t in scenario sim, $emitot_{AFOLU,t,sim}$ as follows:

$$\begin{aligned} emitot_{AFOLU,t,sim} &= \sum_{a} emitot_{AFOLU,a,t,sim} + emitot_{fornprod,AFOLU} \\ &= \sum_{a} emifac_{a,AFOLU}QA_{a,t,sim} + emifac_{fornprod,AFOLU}QLAND_{fornprod} \\ &= \sum_{ap\in EMI} QA_{ap,t,sim} \sum_{a\in EMI} emifac_{a,AFOLU}wgth_{a,AFOLU,t,sim} \\ &+ emifac_{fornprod,AFOLU}QLAND_{fornprod}\end{aligned}$$	(8)

where $emitot_{AFOLU,a,c,t,sim}$ are the AFOLU emissions of activity a; $emitot_{fornprod,AFOLU}$ are the AFOLU emissions per hectare of non-productive forest land (carbon sequestration);

$emifac_{a,AFOLU}$ are the AFOLU emissions per unit of production of activity a; $emifac_{fornprod,AFOLU}$ are the AFOLU emissions per hectare of non-productive forest land; $QLAND_{fornprod}$ is the number of hectares of non-productive forest land; $QA_{a,t,sim}$ is the production level of activity a; and $wgth_{a,AFOLU,t,sim} = \frac{QA_{a,t,sim}}{\sum_{ap\in EMI} QA_{ap,t,sim}}$ is the share of activity a in the total production of activities that emit AFOLU emissions. Defining analogously for the base scenario, we have that:

$$
\begin{aligned}
&emitot_{AFOLU,t,sim} - emitot_{AFOLU,t,base} \\
&\quad = \Bigg[\sum_{a\in EMI} \left(QA_{a,t,sim} - QA_{a,t,base}\right) \sum_{emi} wgth_{a,AFOLU,t,base}\, emifac_{a,AFOLU} \\
&\quad + emifac_{fornprod,AFOLU}\, QLAND_{fornprod}\Bigg] \\
&\quad + \Bigg[\sum_{a} QA_{a,t,sim} \sum_{emi} emifac_{emi,AFOLU} \big(wgth_{a,AFOLU,t,sim} \\
&\quad - wgth_{a,AFOLU,t,base}\big)\Bigg]
\end{aligned} \qquad (9)
$$

The first term on the right-hand side of equation (9) corresponds to the scale effect, while the second term corresponds to the composition effect, in the case of "AFOLU" emissions.