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Going backwards: Assessing the impact of NAFTA dissolution on Mexico[1]

Carmen Estrades[2]

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Introduction

During the US presidential campaign in 2016, one of Donald Trump's electoral promises was to renegotiate the North American Free Trade Agreement (NAFTA) among United States (US), Canada and Mexico. Six months after Trump assumed the presidency, the US Trade Representative (USTR) presented a document that summarizes the main objectives pursued by the US in the renegotiation of NAFTA. The text establishes objectives in terms of trade in goods, trade in services, public purchases, technical barriers to trade, labor and environmental standards, investment agreements, and intellectual property, among others. The main objective pursued by the US in the renegotiation, according to the text and to what was expressed in the first round of renegotiation started in August 2017, is to reduce the trade deficit of the country with NAFTA partners, as well as improving market access in Mexico and Canada of agricultural goods and industrial goods, taking into account the sensitivities of the United States in certain products. Likewise, the US has expressed its concern to update the regime of origin that governs the automotive sector, increasing the regional and national content.[3]

Up to April 2018, seven negotiation rounds took place. The achievements so far have been scarce, and the overall feeling is that renegotiation is not moving forward. The lack of agreement in key issues such as auto manufacturing and an expiration provision has contributed to the idea that NAFTA is under threat of being terminated.

After NAFTA came into force in 1994, it had a strong impact on its partners, in terms of trade, sectoral specialization, productivity, investment, and growth. Empirical evidence shows that the agreement increased exports from Mexico to the US, and provoked significant changes in Mexico's production structure: agricultural production fell and manufacturing production, concentrated in

[1] GTAP Conference paper

[2] Department of Economics, Universidad de la República (Uruguay). Consultant at the World Bank

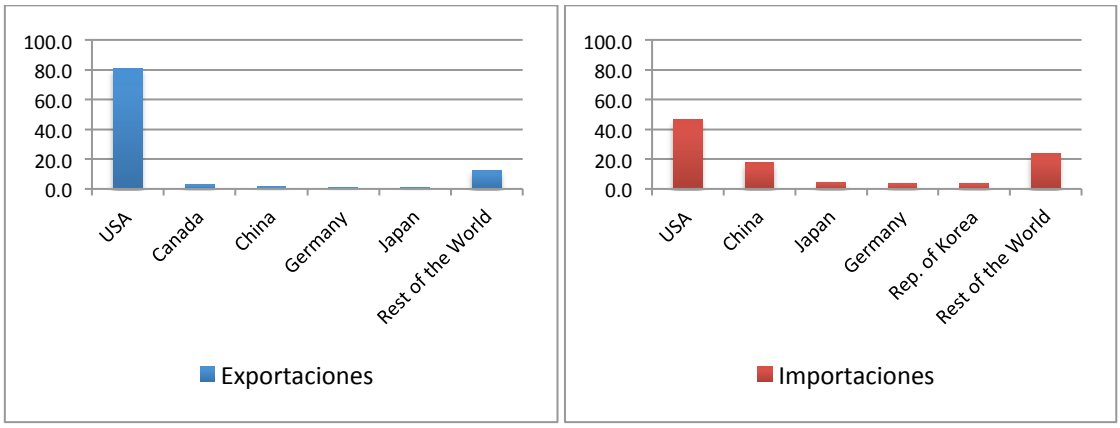
[3] https://ustr.gov/about-us/policy-offices/press-office/press-releases/2017/august/opening-statement-ustr-robert-0

maquiladoras, increased, which according to Kose et al. (2004) shows a vertical specialization in exports from Mexico. The impact on growth has been a matter of debate. While some papers indicate that NAFTA had a positive impact on the growth of the Mexican economy, through increased productivity and investment (Easterly et al., 2003; Kose et al., 2004), other works find that the long-term performance has not been good, and Mexico continues to show low levels of development (Velut 2011; Weisbrot et al., 2014) after 15 years of NAFTA. The long term growth rate for the Mexican economy in the last 15 years has been low: 2.6% annually, and poverty (50.6%) and inequality (48.2) remain high.

A termination of NAFTA could also have strong impacts on the Mexican economy. Currently, the Mexican economy is closely linked to the external sector: the value of exported goods constitutes one third of the GDP and FDI inflows 3.2% of GDP. The US represents Mexico's main trading partner, both in imports and exports (Figure 1). In 2016, 81% of Mexican exports of goods were destined to the US, while 46% of their imports originated in that country. Mexico exports to the US are concentrated in motor vehicles, electrical machinery and equipment, mineral fuels, and agricultural goods. The integration to the US economy, as described in Villareal (2017), took advantage of vertical supply specialization in sectors such as motor vehicles and electronic equipment. Trade in agricultural products is also significant among both countries: 79% of agricultural exports are destined to the US and 70% of agricultural imports are originated in the US. United States is also the main contributor to Foreign Direct Investment (FDI) inflows into Mexican economy, mainly in the manufacturing sector.

Despite being a NAFTA partner, Canada is not a major trading partner for Mexico. Even when it is the second recipient of Mexican exports, they represent only 2.8% of total exports. The main export products to Canada are also vehicles, machinery, and equipment. On the other hand, imports from Canada represent 2.5% of total imports, and Canada is not among the main five import providers for Mexico.

Figure 1. Share of Exports and Imports among Top Five Trading partners 2016



Source: Comtrade

Several studies analyze the potential impact of the dissolution of NAFTA on its members. Most of them apply a general equilibrium framework to capture the different linkages of NAFTA economies. Wamsley and Minor (2017) apply a global general equilibrium model, IESC, with a supply chain perspective, and find that production, investment and growth fall for the three members, but the impact is more pronounced for Mexico. Production falls mainly in sectors with the highest levels of vertical specialization across the bloc: motor vehicles and services sectors, meat, food, and textiles, chemicals and metals, wearing apparel, electronics and machinery. Ciuriak et al. (2017) also applied a CGE analysis to evaluate the impact of NAFTA lapsing. They also find a negative impact of this scenario, with a higher fall in GDP for Mexico.

In this paper, we also apply a general equilibrium model to assess the impact of NAFTA dissolution on Mexico, but our work differentiates from previous studies in several ways. Unlike previous evaluations, our work relies on a single country model for Mexico with an updated social accounting matrix, which represents the current situation in the production sector in Mexico. Indeed, previous studies use GTAP data, which the only available database for global CGE models but relies on old data for some countries, among them Mexico. The input-output structure on which GTAP database for Mexico is based relies on the 2003 release of input output tables by INEGI (Gonzalez-Mellado and Octaviano 2012).

Working with a single country CGE model also allows for detailed information on the labor market and for households disaggregation, which allows us to run microsimulations and estimate the impact on Mexico poverty and income distribution.

In the next section we present with detail the methodology we applied, including a section on how we built an updated Social Accounting Matrix for Mexico. Then, we present results and finally we draw some conclusions.

2. Methodology

We apply a single country, dyamic computable general equilibrium (CGE) model for Mexico. The proposed CGE model is LINKAGE, a model developed by the World Bank. The model is calibrated with a Social Accounting Matrix for Mexico of the year 2013, constructed from the latest Input-Output Tables published by INEGI.

The single country model is combined with a global computable general equilibrium model, MIRAGE, in order to obtain results from simulation scenarios with global impact. To combine both models, we follow Horridge and Zhai (2006).

In order to obtain results on welfare, poverty and income distribution, a non-parametric microsimulation model is applied, following Vos and Sánchez (2010).

2.1. LINKAGE model

To evaluate the impact of NAFTA dissolution on Mexico we use a recursive dynamic general equilibrium model, building upon the World Bank - LINKAGE model (Van der Mensbrugghe, 2005). The recursive dynamic approach consists of solving sequentially the model (one period at a time) with an update of the main macroeconomic variables at every period.

The production in all sectors takes place under constant returns to scale and perfect competition. Producers are assumed to maximize their profit by minimizing their cost of production. The production technology consists of a nested sequence of Constant Elasticity of Substitution (CES). At the top level, output is specified by a Leontief technology of the value added and the intermediate aggregates. The aggregate intermediate input is a Leontief function of the primary inputs. Value added is a CES function of an aggregated factor: the "capital skilled labor aggregate" and the "unskilled labor". The SAM distinguishes two types of labor distinguished by skill: unskilled labor and skilled labor. The "capital skilled labor aggregate" factor is itself obtained by a CES function of capital and skilled labor.

We assume perfect mobility of labor across the different sectors. Equilibrium is reached via a flexible wage rate, uniform across all sectors. However, we assume that capital is specific to each sector. Hence each activity pays an activity specific remuneration for capital. We assume unemployment in labor markets, incorporating a regime-switching behavior.

Imports are modeled using the Armington (1969) assumption, which states that demand for commodities is a function of their origin. Hence a CES aggregation function is used to take into account imperfect substitutability between imports and commodity sold domestically. The export side is treated in a symmetric fashion. Domestic output is allocated between domestic markets and exports via a Constant elasticity of transformation (CET) function.

Households receive income from factors of production and transfers from other institutions (enterprises, the government and the rest of the world). However they do not receive any direct payment from the gold companies since the government is the sole agent owning a share of the capital in this sector. Transfers from the rest of the world are fixed in foreign currency.

Households use their income to pay direct taxes, save, consume and make transfers to other institutions. The share of savings and direct taxes in household income is held constant. Households' consumption of the composite commodity is determined by a linear expenditure system (LES) demand function, derived from maximization of a Stone-Geary utility function.

The Government collects taxes (income taxes, indirect taxes on intermediate and final consumption, production taxes and tariffs) and receives transfers from other institutions. In the model, unless otherwise stated, all tax rates are fixed, so are the volumes of government current and investment spending as shares of real GDP. Hence government savings are flexible and adjust to clear the balance between revenues and spending. This is achieved through domestic and foreign borrowing.

Regarding the savings-investment balance, we assume a savings-driven closure, meaning that savings rates for all nongovernmental agents (households and firms) are fixed. Investment is flexible to ensure that the investment cost will be equal to the total savings value.

For the external balance, the current account (foreign savings) is fixed and equilibrium is achieved through adjustment of the real exchange rate.

The model has a recursive dynamic structure, meaning that there is no inter-temporal optimization by agents. Also this is mainly driven by computational convenience as the later models are pretty hard to solve. Hence, the model is solved as a sequence of static equilibria in each period. The dynamic of the economy is given by productive capital accumulation, exogenous labor supply growth and productivity changes.

Capital accumulation in each period is endogenous and given by the sum of depreciated capital stock inherited from the previous period and gross (new) investment as follows:

$$K_{i,t+1} = K_{i,t}(1-\delta) + \chi_i INVTOT_t$$

where δ is the annual depreciation rate of the capital, $INVTOT_t$ is the total investment in the current period (t), and χ_i is the share of each sector in total

capital in the initial year. The allocation of capital among sectors depends on the return to capital in each sector in the previous period.

Labor stock available in each period grows exogenously at the growth rate of the working age population (ages 15-64), obtained from United Nations Population Division forecasts. This rate for Mali is estimated at 3.17% on average annually.

$$LS_{t+1} = LS_t(1 + p)$$

Regarding productivity changes, the model assumes technical progress specific to sector and production factors. The change in productivity is derived by a combination of factors, but is also partially judgmental. First, agricultural productivity is assumed to be factor-neutral and exogenous, and is set to estimates from empirical studies (for example Martin and Mitra, 2001). Productivity in manufacturing and services is labor-augmenting, and a constant wedge is imposed between productivity growths in the two broad sectors with the assumption that productivity growth is higher in manufacturing than in services.

Data and calibration

Social accounting matrix (SAM) for 2013

We built a new Social Accounting Matrix (SAM) for Mexico, taking as a reference the Input Output (IO) Tables for 2013 published by INEGI (2017a). The information is complemented with other sources of information.

A SAM is a symmetric matrix that presents a picture of the economy in a given year, which includes the main economic transactions expressed in value. The SAM includes the different sectors of activity in the economy, the goods and services traded, the agents that carry out the economic transactions, and the saving and investment accounts of the economy. In the SAM, the columns represent the expenses of the sectors and agents, and the rows represent the revenues. It is necessary that the sum of income equals the sum of expenses, among which is included the savings of the agents.

Table 1 presents the SAM macro for the year 2013, in which sectors, goods and services, and other accounts, such as value added, households and taxes are aggregated.

Table 1. Mexico Macro SAM 2013. In billion mexican pesos

	Activities	Goods and services	Value added	Firms	Households	Government	Rest of the world	Interests	Taxes	Saving-invest
Activities		27,643								
Goods and services	12,000				10,881	1,986	4,916			3,661
Value added	15,555									
Firms			6,045					18		
Households			9,510	3,718	138	1,350	285	-		
Government			-	9			654	-	3,370	
Rest of the world		5,067		1,062		307		264,167		
Interests				-	-	22	-			
Taxes	87	734		1,703	845					
Saving-invest				-	2,708	627,144	738,846			

Source: own elaboration

The primary source of information to build the SAM is IO tables for year 2013. IO tables provide information, valued at current basic prices, of intermediate and final use of 259 products. It also contains disaggregated data on value added by sector of activity, differentiation between labor remuneration (salaries, social contributions and other contributions), Taxes net of subsidies, and Gross Operating Surplus. In IO Tables, final demand is split in private consumption, government consumption, gross formation of fixed capital, variation of stocks, exports, and imports.

IO tables disaggregate sectors of activity according to North American Industry Classification System (NAICS) 2013. The 259 sectors / products included in the IO 2013 were added in 23 sectors / products for the SAM, presented in table 2, with the objective of identifying the most relevant sectors in terms of foreign trade, in total and with the US, in domestic production, and final consumption. Table A1 includes the conversion between NAICS and SAM classification.

Table 2. Sectoral aggregation

Sectors	Exports	Imports	Domestic production	Intermediate demand	Final demand
Agriculture	2.6	2.4	1.5	3.1	2.0
Livestock and forestry	0.3	0.2	1.4	2.9	0.8
Petroleum and gas extraction	11.1	0.0	3.7	4.2	0.0
Mining	1.1	0.5	1.6	2.4	0.0
Electricity, gas, water	0.1	0.0	1.6	2.8	0.6
Construction	0.0	0.0	7.6	1.6	0.1
Food, beverages and tobacco	3.7	4.1	7.0	4.0	19.9
Textiles and garments	2.2	2.9	1.2	1.9	2.8
Other manufactures	5.6	6.8	2.6	4.8	2.6
Oil and carbon products	1.7	7.1	3.5	8.1	2.8
Chemicals, fertilizers and pharmaceuticals	3.7	11.1	3.1	9.4	4.8
Plastic, rubber, glass, cement and other non- metallic minerals	2.8	4.6	1.8	5.5	1.3
Iron, steel and metallic products	7.4	9.2	3.2	9.5	0.7
Machinery and equipment	6.6	10.8	1.0	3.0	0.1
Computing, communication and electronic equipment	25.7	26.4	4.7	9.7	2.7
Motor vehicles and auto parts	24.7	10.5	6.7	6.2	5.5
Trade	0.00	0.0	12.2	0.0	0.0
Transport	0.1	0.8	5.9	1.2	5.6
Communication services	0.1	0.1	2.2	2.5	2.8
Financial and real estate services	0.8	1.5	10.1	4.9	18.7
Other private services	0.0	0.8	6.0	6.2	8.4
Business services	0.0	0.0	3.0	6.5	0.3
Public services	0.0	0.0	8.2	0.1	17.5

Source: SAM 2013

IO tables are expressed in basic prices, and the SAM is expressed at purchaser prices. Thus, we convert the information to purchaser prices using information from Supply and Use Tables from National Accounts for year 2013 (INEGI 2017b)[4].

The external sector accounts were opened to consider three trading partners: US, Canada and Rest of the World (ROW). The information to open the accounts of

[4] http://www.inegi.org.mx/est/contenidos/proyectos/cn/cou/default.aspx

imports and exports of goods was taken from Comtrade, while data from the OECD was used to open the service trade accounts.

In the case of trade in services, some difficulties arose, given that the data reported for Mexico do not coincide with the data reported for the US, that is, exports reported from the US to Mexico do not appear as imports from Mexico from the US. We took the data reported by the US of exports and total imports of services to and from Mexico, and estimate the weight of flows in the imports and exports of services reported by Mexico. This percentage was applied to open the trade data of SAM services by destination and origin. The same criterion was applied in the case of Canada.

Table 3 presents the data on exports and imports by trade partner, according to the SAM data.

Table 3. Exports and imports by SAM sector and trade partner. In million mexican pesos. 2013

Sectors	Exports			Imports		
	United States	Canada	Rest of the world	United States	Canada	Rest of the world
Agriculture	107,245	3,129	17,104	83,565	15,940	19,697
Livestock and forestry	9,480	63	3,350	9,954	150	2,288
Petroleum and gas extraction	392,995	10,398	142,474	0	0	1
Mining	22,230	2,105	28,997	17,544	1,053	8,473
Electricity, gas, water	3,389	0	1,272	1,020	0	13
Construction	0	0	0	0	0	0
Food, beverages and tobacco	128,526	3,189	48,501	147,043	8,080	54,106
Textiles and garments	90,523	1,799	14,000	58,332	2,506	84,169
Other manufactures	239,250	9,724	24,224	194,602	8,811	139,638
Oil and carbon products	74,024	134	11,700	292,406	822	64,702
Chemicals, fertilizers and pharmaceuticals	65,225	4,079	110,751	360,411	12,182	191,160
Plastic, rubber, glass, cement and other non-metallic minerals	104,626	2,888	27,744	133,674	7,423	94,129
Iron, steel and metallic products	250,654	11,131	101,447	257,345	19,304	190,803
Machinery and equipment	280,631	9,338	32,989	254,878	15,930	277,319
Computing, communication and electronic equipment	1,085,192	32,209	146,426	318,587	12,121	1,009,191
Motor vehicles and auto parts	987,516	37,258	187,394	286,885	21,233	222,611
Trade	0	0	0	0	0	0
Transport	3,367	30	3,969	12,819	128	27,629
Communication services	821	46	1,682	1,402	15	3,571
Financial and real estate services	11,770	344	25,278	31,626	1,151	44,734
Other private services	666	17	557	23,944	710	17,456
Business services	0	0	0	92	8	1,743
Public services	0	0	0	0	0	0

Source: SAM 2013

In the IO tables, imports reported include import duties. Given that in the SAM we are interested in including import duties separately, we estimate tariffs by sector and by commercial partner using data from MacMap for the year 2011. To do this, we first made a correspondence between GTAP sectors and sectors of the SAM, and we estimated tariff applied by SAM sector using simple average tariffs. As expected, given that the US and Canada receive preferential tariffs rates, the tariff rates applied by Mexico correspond mainly to the Rest of the World.

Table 4. Tariffs by sector and trade partner. In percentage

	United States	Canada	Rest of the world
Agriculture	0.3		11.8
Livestock and forestry	0.1	0.3	6.3
Petroleum and gas extraction			2.1
Mining			3.4
Electricity, gas, water			4.0
Food, beverages and tobacco	0.3	11.8	26.5
Textiles and garments			17.7
Other manufactures	0.3		8.4
Oil and carbon products			2.6
Chemicals, fertilizers and pharmaceuticals	0.2		4.6
Plastic, rubber, glass, cement and other non- metallic minerals			10.1
Iron, steel and metallic products			4.3
Machinery and equipment	0.1		4.8
Computing, communication and electronic equipment	0.2		0.7
Motor vehicles and auto parts			7.0

Source: SAM 2013 and MacMap 2011

We included eight categories of labor, according to the sex of the worker (male-female), the educational level (unskilled workers with primary or secondary education without finishing high school, and skilled workers with full secondary and higher education), and condition of formality (non-formal-formal). For the opening of the labor account, we took information from the Income and Expenditure Household Survey (ENGIH) 2016. The activities in relation of dependence and also the independent jobs were taken into account, and we consider both the main and secondary jobs. Table 5 shows the distribution of total labor remuneration in the eight categories, as well as the total labor supply. Women and informal and unskilled receive on average lower salaries.

Table 5. Wages and labor supply by labor category

	Employment	Unemployment rate	Wages	Average wage
Female unskilled informal labor	12.045.088	1.2	330.356	0,03
Female unskilled formal labor	2.688.989	3.1	149.790	0,06
Female skilled informal labor	3.911.765	4.4	235.588	0,06
Female skilled formal labor	5.267.665	2.7	688.279	0,13
Male unskilled informal labor	17.561.290	2.7	839.660	0,05
Male unskilled formal labor	5.524.754	6.1	434.651	0,08
Male skilled informal labor	5.137.652	4.8	777.455	0,15
Male skilled formal labor	6.782.440	3.6	1.087.072	0,16

Source: SAM 2013 and INEGI

We included 20 representative households in the SAM, categorized by income quintiles and by geographic location, taking the classification of the reports on regional economies published by the Bank of Mexico, in which four regions are identified: North, including Baja California, Chihuahua, Coahuila, Nuevo León, Sonora y Tamaulipas; Centre-north including Aguascalientes, Baja California Sur, Colima, Durango, Jalisco, Michoacán, Nayarit, San Luis Potosí, Sinaloa y Zacatecas; Center, considering Ciudad de México, Estado de México, Guanajuato, Hidalgo, Morelos, Puebla, Querétaro y Tlaxcala; and South, including Campeche, Chiapas, Guerrero, Oaxaca, Quintana Roo, Tabasco, Veracruz y Yucatán.[5]

To disaggregate households into 20 representative households, we used microdata from ENGIH 2016. In order to disaggregate expenditures for each household category, we built a correspondence between the 745 goods and services as reported in the ENIGH and the sectors of the SAM. Only monetary expenses were considered, together with other types of expenditures included in the SAM, such as transfers to other households. We distinguished between public and private health and education expenditures, considering the type of school the individual attends, as well as the type of institution that provides health care. We used an expansion factor to make the sample representative of the country.

Table 6 shows the distribution of consumption for each category of household in four goods and services. The poorest households from the first quintile in each region concentrate their spending to a greater extent on food and beverages and on energy, while households located in the highest quintiles spend more on manufactures and services.

[5] http://www.banxico.org.mx/publicaciones-y-discursos/publicaciones/informes-periodicos/reportes-sobre-las-economias-regionales/reportes-economias-regionales.html

Table 6. Households' expenditure by type of good and services

	Food and beverage	Energy	Manufactures	Services	Total
HH1-North	36.3	4.9	37.7	21.0	100.0
HH2-North	33.9	4.7	39.8	21.6	100.0
HH3- North	31.3	4.1	42.1	22.5	100.0
HH4- North	29.7	3.4	42.6	24.2	100.0
HH5- North	23.0	2.2	48.8	25.9	100.0
HH1-Center-North	40.3	5.6	31.3	22.9	100.0
HH2- Center-North	36.9	5.8	34.7	22.6	100.0
HH3- Center-North	33.8	4.9	37.6	23.8	100.0
HH4- Center-North	30.7	4.3	39.8	25.1	100.0
HH5- Center-North	24.8	3.1	45.3	26.8	100.0
HH1-Center	39.1	6.8	36.6	17.5	100.0
HH2-Center	38.0	6.9	37.0	18.1	100.0
HH3-Center	35.4	6.3	39.7	18.6	100.0
HH4-Center	34.2	5.6	40.4	19.9	100.0
HH5-Center	24.8	3.2	49.4	22.6	100.0
HH1-South	46.0	5.0	28.8	20.3	100.0
HH2- South	40.3	5.3	34.0	20.5	100.0
HH3- South	37.0	4.9	37.1	21.0	100.0
HH4- South	33.2	4.2	39.8	22.9	100.0
HH5- South	26.1	3.0	43.9	27.0	100.0

Source: SAM 2013

We also used the ENIGH 2016 to disaggregate the payment of direct taxes by household categories (Table 6.1). We assume informal jobs do not pay taxes. We consider formal workers those with a contract and whose employer has a tax receipt or accounting record. For this study, only the Income Tax (ISR) was considered as it is the main tax of the federal tax system that directly affects households' income. ISR was calculated for each individual in the survey, considering the tax structure of the personal ISR in 2016, which applies a tax rate, as well as a subsidy to employment. In general terms, the ISR regime for natural persons can be divided between those who receive income from salaries, professional activities and rents, business activities and interest. Regarding the exemptions in the salaried regime, the information contained in the ENIGH allows to approximate the exempt income that comes from bonuses, vacation premiums, profit sharing, overtime and other cash benefits in accordance with labor legislation. Since the income reported in the ENIGH is net income, to calculate the tax contribution per household category it was necessary to reconstruct the gross income.

As table 6 shows, payment of income taxes rely heavily on three household categories, richest quintile from North region, richest quintile from Center-North region, and richest quintile from Center region.

Table 7. Distribution of direct taxes paid by households. In percentage

HH1-North	0.2
HH2-North	0.7
HH3- North	2.0
HH4- North	4.4
HH5- North	19.0
HH1-Center-North	0.1
HH2- Center-North	0.7
HH3- Center-North	1.5
HH4- Center-North	3.4
HH5- Center-North	11.0
HH1-Center	0.3
HH2-Center	1.3
HH3-Center	2.7
HH4-Center	5.8
HH5-Center	34.9
HH1-South	0.2
HH2- South	0.5
HH3- South	1.1
HH4- South	2.3
HH5- South	7.9

Source: SAM 2013 and INEGI

The information of the ENGIH 2016 was also used to open the income of households by household category. To do this, we worked with the household income module by individual, to identify, in the case of income for work, the educational level of the individual, sex, and the formality status of the work. The information contained in the ENGIH also made it possible to open the capital factor income, public transfers (pension and retirement income), and remittances. Table 7 shows the weight of the different sources of income by household category. Households belonging to the lowest quintiles receive their income from labor, while the richest quintiles receive higher capital income.

Table 8. Income distribution by household category. In percentage

	Labor	Capital and dividends	Public transfers	Remittances	Private transfers	Total
HH1-North	62.0	18.9	9.6	7.1	2.4	100.0
HH2-North	62.3	18.0	12.2	5.8	1.8	100.0
HH3- North	65.4	17.9	10.8	4.4	1.4	100.0
HH4- North	57.0	26.2	12.8	2.8	1.3	100.0
HH5- North	15.1	79.7	4.5	0.3	0.3	100.0
HH1-Center-North	60.7	15.9	4.4	15.7	3.3	100.0
HH2- Center-North	55.7	23.7	7.5	11.0	2.1	100.0
HH3- Center-North	50.2	32.1	8.0	8.1	1.6	100.0
HH4- Center-North	44.8	37.3	10.6	6.0	1.3	100.0
HH5- Center-North	23.2	64.2	10.1	1.7	0.8	100.0
HH1-Center	74.0	13.3	4.6	5.4	2.7	100.0
HH2-Center	72.4	12.2	7.6	5.8	1.9	100.0
HH3-Center	59.8	23.7	10.1	4.8	1.5	100.0
HH4-Center	52.1	27.5	16.4	2.3	1.6	100.0
HH5-Center	25.7	61.9	11.1	0.5	0.8	100.0
HH1-South	65.7	18.7	3.9	7.4	4.3	100.0
HH2- South	58.8	25.5	6.6	6.8	2.4	100.0
HH3- South	58.6	23.9	9.9	5.5	2.1	100.0
HH4- South	45.0	35.5	14.7	3.2	1.5	100.0
HH5- South	26.9	56.8	14.2	1.1	0.9	100.0

Source: SAM 2013

2.2 MIRAGE model

In a single country model, it is not possible to simulate policy changes in other countries. Thus, in order to simulate the changes in trade policy that the dissolution of NAFTA brings about, we apply a global CGE model first in which the economies of all NAFTA partners are modeled explicitly, and then we communicate the results into the single country model. We apply MIRAGE, a global dynamic computable general equilibrium model developed in CEPII-IFPRI, and documented in Bchir et al (2002) and Decreux and Valin (2007).

The model is standard in terms of its main assumptions, which are in line with the assumptions of the single country model. It assumes perfect competition in all markets. A nested production function similar to LINKAGE is assumed, combining value added and intermediate goods under a Leontief hypothesis, a CES function combines intermediate goods and value-added is a constant elasticity of substitution (CES) function of unskilled labor, land, natural resources, and of a CES bundle of skilled labor and capital. This nesting implies less substitutability between capital and skilled labor than between these two and other factors. Unlike LINKAGE, in MIRAGE we assume full employment of factor endowments. Capital

supply is modified each period because of depreciation and investment. Growth rates of labor supply are fixed exogenously. Land supply is endogenous; it depends on the real remuneration of land.

Skilled labor is the only factor that is perfectly mobile. Installed capital is sector specific. New capital is allocated among sectors according to an investment function. Unskilled labor is imperfectly mobile between agricultural and nonagricultural sectors according to a constant elasticity of transformation (CET) function: unskilled labor's remuneration in agricultural activities is different to that in nonagricultural activities. This factor is distributed between these two series of sectors according to the ratio of remunerations.

In the external sector, real exchange rate is endogenous and adjusts in order to keep the ratio of current account balance to GDP fixed.

In the version of MIRAGE applied in this study, foreign direct investment (FDI) flows are modelled, following Bouet et al. (2012), and non-tariff barriers (BNA) are incorporated into the trade of goods and services, modeled as an "iceberg" cost. The data to calibrate BNAs are taken from Kee et al. (2009) for goods, and estimates based on gravity equations for services.[6]

Once the scenarios are simulated under MIRAGE, the changes in import prices and export prices and quantities are incorporated into the single country model. This approach, developed by Horridge and Zhai (2006), has been applied in several studies that combine the results of global models with single country models (many of them compiled in Hertel and Winters 2006). This approach takes changes in import prices in the global model and applies them to changes in import prices in the single country model, while in the case of exports we estimate the changes in the shift parameter FP of the export demand function:

Q= (FP/P)**ESUBM, with ESUBM being the elasticity of demand for exports, taken from GTAP model.

Changes in FP are estimated with the global model as follows:

fp= p + q/ESUBM

To calibrate MIRAGE model, we use the latest version of GTAP Database (9.1), and we work with four countries/regions: US, Mexico, Canada, and Rest of the World. We follow the same sectoral aggregation as in the SAM for Mexico, as shown in Table A1.

[6]http://www.miragemodel.eu/miragewiki/index.php/New_MIRAGE_version,_incorporating_NTBs_for_goods_and_services

2.3. Simulation scenarios

We built two scenarios that simulate the dissolution of NAFTA. In scenario NAFTA_diss, we simulate the increase in tariffs among NAFTA members to MFN levels. Then, in scenario NAFTA_diss_plus, we also simulate a fall in FDI inflows from the US to Mexico, and a 5% increase in NTB to services. We then simulate a policy response from Mexico, simulating a 50% reduction in applied tariffs to NAFTA partners and to the rest of the world.

2.4. Microsimulations

In order to obtain results on poverty and income distribution, we apply a top-down microsimulation strategy following Vos and Sanchez (2010). Results obtain through the LINKAGE are introduced in microsimulations as percentage variations of the initial level of the following variables: unemployment, formal employment rate, informal employment rate, wage by type of workers, average wage of the economy and average rate of return to capital. We used microdata from ENGIH 2016. Changes in labor market variables, assigned randomly and sequentially on individuals, allow obtaining their counterfactual income in each scenario simulated, and then calculating percentage variations of head-count poverty index, extreme poverty index and Gini coefficient, taking as reference the national poverty and extreme poverty lines, as defined by INEGI.

3. Results

In this section we first present results from the global model, MIRAGE, and then we focus on the impact of NAFTA dissolution on Mexico.

3.1. Impact on NAFTA members

The dissolution of NAFTA has a negative impact on all members, but Mexico is the country most hardly hit. The imposition of MFN tariffs in NAFTA brings about a 0.7% decline in real GDP in Mexico by 2025 and a 2.5% fall in GDP long-term growth rate. Trade is also reduced more for Mexico, with a 13% fall in exports and a 12% fall in imports by 2025. When we simulate a reduction in FDI flows and an increase in service trade barriers, the impact on Mexico is even stronger. GDP falls 1.2% by 2025, and the long term GDP growth rate is reduced 3.2%.

For the rest of NAFTA countries, the impact is much lower. GDP is not impacted for the US, in both scenarios, and for Canada, the reduction is much lower: 0.2% in both scenarios.

Table 9. Macroeconomic impact for NAFTA members. Percentage change with respect to BaU scenario, year 2025

	NAFTA_diss			Nafta_diss_plus		
	MEX	USA	CAN	MEX	USA	CAN
GDP	-0.7	0.0	-0.2	-1.2	0.0	-0.2
GDP growth rate 2018-2030	-2.5	-0.2	-0.6	-3.2	-0.1	-0.7
Welfare	-0.1	-0.1	-0.1	0.0	-0.1	-0.1
Real exchange rate	0.5	-0.3	-0.6	0.9	-0.4	-0.6
ToT	0.8	-0.3	-0.4	1.0	-0.4	-0.4
Real imports	-13.0	-2.5	-4.6	-13.2	-2.7	-4.8
Real exports	-12.4	-3.4	-4.4	-13.7	-3.3	-4.5

Source: MIRAGE results

In what follows, we will present results on the scenario NAFTA_diss_plus, considering a reduction in FDI flows and an increase in barriers to trade in services.

Trade flows within NAFTA fall significantly, mainly among US and Mexico and US and Canada, as table 10 shows. Exports from US to Mexico fall more than 72 billion US dollars by 2020, and exports from Mexico to US fall 52 billion dollars, in the scenario of NAFTA dissolution plus, which represents a 15% fall in export flows to the US in that year. Trade with the rest of the world, on the other hand, increases: Mexico and to a lower extent Canada divert imports from NAFTA to the rest of the world, while exports from US to Canada to the rest of the world increase. Mexico's exports to all destinations fall, and US imports from all origins are also reduced. As a consequence, the US reduces its trade deficit, while Mexico increases it.

Table 10. Impact on bilateral trade. In billion USD, year 2020

		Importer				
		Mexico	United States	Canada	Rest of the World	Total
Exporter	Mexico		-52,4	-3,6	-5,3	-61,2
	United States	-72,3		-25,9	21,3	-76,9
	Canada	-3,8	-29,1		6,8	-26,1
	Rest of the World	22,4	-0,8	1,6	-0,2	23,1
Total		-53,6	-82,3	-27,9	22,7	
Trade deficit		-7,6	5,5	1,8	0,3	

Source: MIRAGE results

Motor vehicles and parts, machinery, and computer and electronic equipment are the goods that are particularly affected by the fall in Mexico's exports. In relative terms, textiles and garments, food and beverages, and agricultural goods are the

most affected. In all these cases, the fall is linked to a decrease in exports to US, the main market for exports from Mexico.

On the other hand, Mexico imports are reduced in machinery, motor vehicles and parts, and chemicals; while in relative terms, the fall is more important for food and beverages, agricultural goods, and livestock and forestry, also from US. NAFTA dissolution has a strong negative impact on trade in vertically specialized sectors such as motor vehicles and parts, computer and electronic equipment, and machinery, reversing the value chains developed as consequence of the trade agreement.

Table 11. Impact on Mexico trade flows by commodity. Year 2020

Sector	Exports		Imports	
	Million USD	Percentage change	Million USD	Percentage change
Motor vehicles and parts	-15988	-15,5	-9467	-18,7
Machinery	-12847	-13,8	-10894	-12,9
Computer and electronic equipment	-7337	-9,6	-3075	-7,7
Metals	-5061	-13,0	-5913	-16,7
Chemicals	-4571	-15,0	-7738	-11,6
Food and beverages	-4392	-27,0	-4999	-30,0
Agriculture	-2827	-23,4	-3768	-27,0
Textiles and garments	-2633	-39,6	-1903	-14,1
Other manufactures	-2448	-17,2	-2339	-14,2
Crude oil and gas	-1149	-2,7	282	4,6
Refined oil and carbon	-896	-9,8	-3309	-9,9
Transport	-394	-3,4	-8	-0,1
Financial services	-267	-4,4	8	0,2
Business services	-113	-4,6	1	0,0
Livestock and forestry	-72	-5,4	-184	-23,7
Other private services	-71	-2,0	47	1,6
Trade	-62	-4,1	-33	-1,3
Construction	-37	-2,5	-3	-2,1
Communication servies	-35	-3,7	0	-0,1
Public services	-16	-1,5	-55	-1,2
Electricity, gas, water	-15	-7,6	8	2,3
Mining	-4	-0,1	-273	-7,8

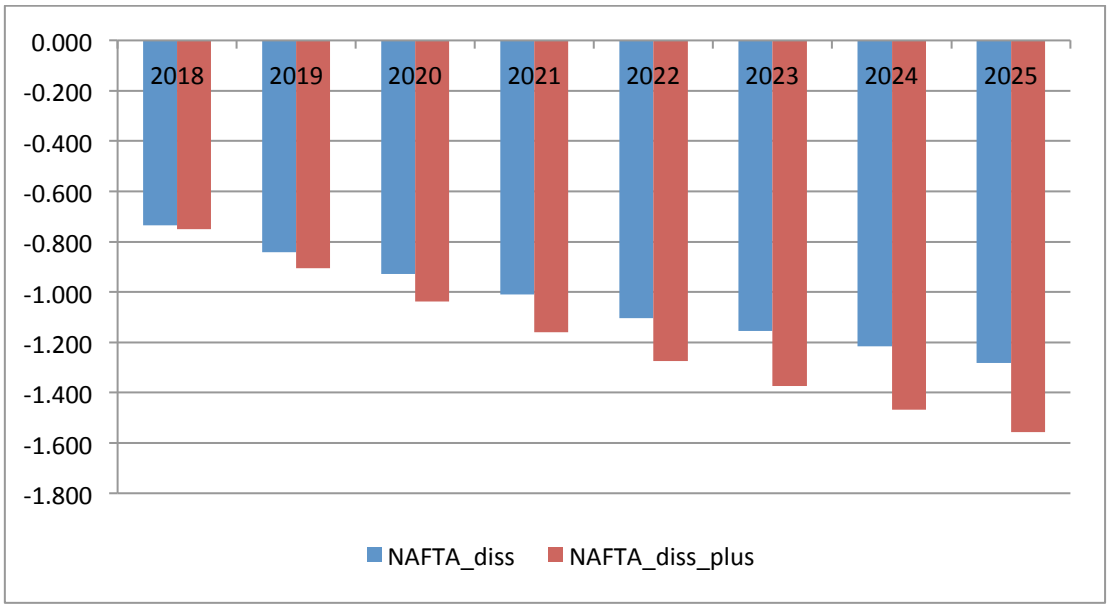
Source: MIRAGE results

3.2. Impact on Mexico

In this subsection we present results from LINKAGE model. For some variables, we find distinctive results with respect to MIRAGE results, because in the single country model we are working with some specifications not included in the global

model, such as unemployment in the labor market, segmented labor markets, and updated input-output production data. For these reasons, with LINKAGE we find a stronger impact on Mexico GDP, with a 1.3% fall with respect to BaU in the NAFTA_diss scenario and a 1.6% fall in NAFTA_diss_plus scenario by year 2025, as figure 2 shows.

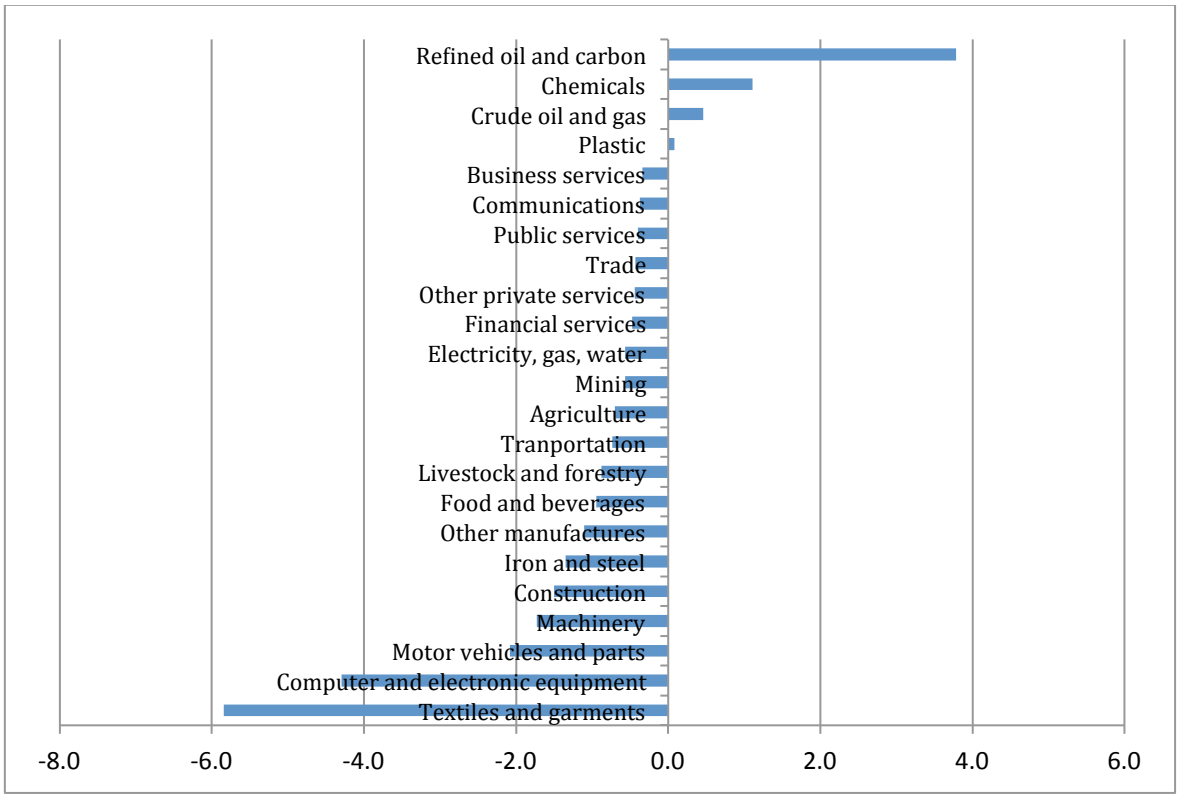
Figure 2. Impact on real GDP, 2018-2025. Percentage change with respect to BaU



Source: LINKAGE results

The negative impact on growth is explained by a fall in production in the sectors that are hit by the fall in exports to the US: textiles and garments, computer and electronic equipment, motor vehicles and parts, machinery, and other manufactures, as shown in Figure 3. On the other hand, some sectors expand, such as oil production, chemicals and metals. This is explained by the fact that imports of these goods fall, and domestic production in Mexico expands to compensate for this decrease.

Figure 3. Mexico: Impact on production by sector. Scenario NAFTA_diss_plus. Percentage change with respect to BaU scenario, year 2025



Source: LINKAGE results

The fall in production in export oriented sectors affect labor demand, which falls significantly among those sectors. As we are considering segmentation in labor markets, there is a distinctive impact on the different type of workers. The most affected sectors employ mainly unskilled and female labor, for which employment and wages fall. On the other hand, the increase in labor demand from the oil sector attenuates the negative impact on male labor demand. This is reflected in changes in wages, as table 12 shows.

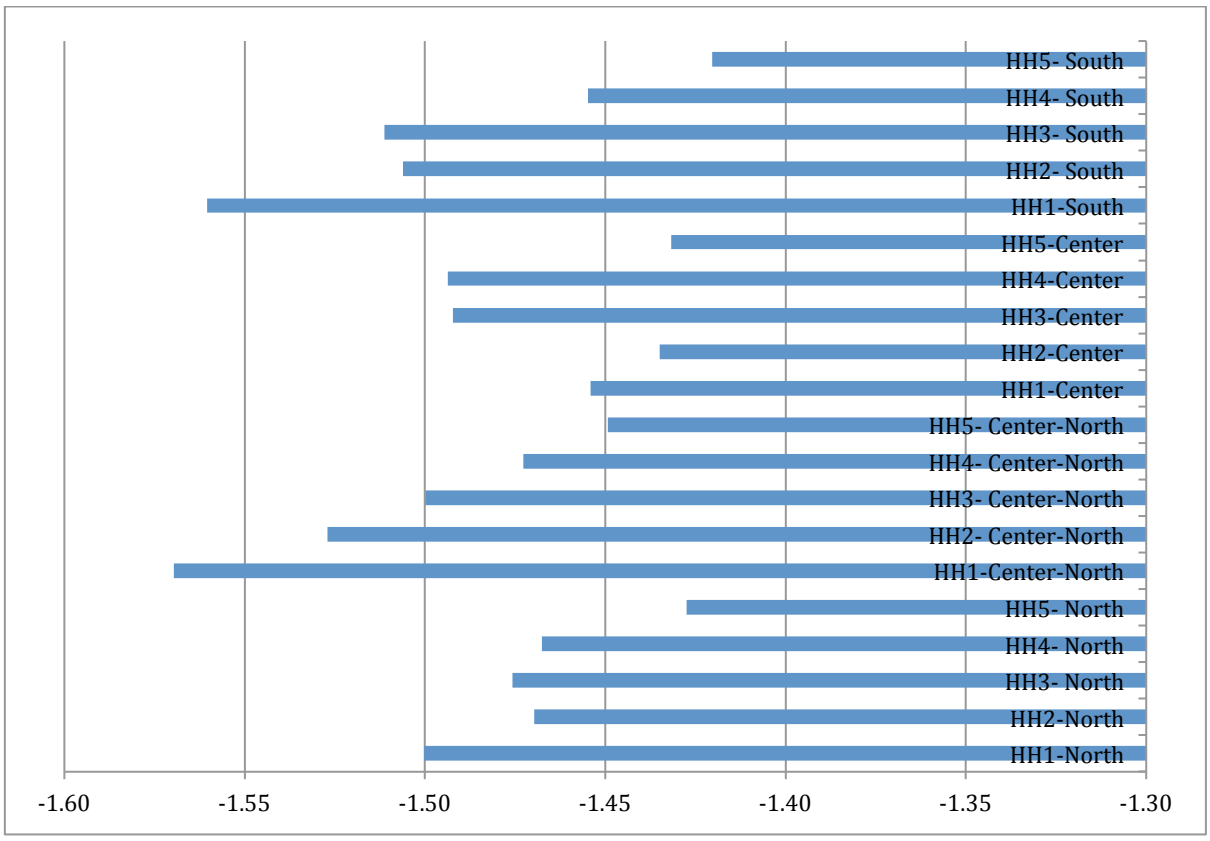
Table 12. Employment and wage by labor category. Scenario NAFTA_diss_plus. Percentage change with respect to BaU scenario, year 2025

	Employment	Wage
Male skilled informal labor	-0,03	-1,41
Male skilled formal labor	0,02	-1,96
Male unskilled informal labor	-0,03	-1,83
Male skilled formal labor	-2,13	-4,82
Female skilled informal labor	-0,09	-1,52
Female skilled formal labor	-0,04	-1,74
Female unskilled informal labor	-1,27	-3,39
Female skilled formal labor	-2,20	-5,13

Source: LINKAGE results

Poor households are negatively affected. Income falls among all types of households, but the decrease is deeper for households in the first quintiles of income and for households located in the center and south regions of the country.

Figure 4. Mexico: Impact on income by representative household. Scenario NAFTA_diss_plus. Percentage change with respect to BaU scenario, year 2025



Source: LINKAGE results

Microsimulation results

To be included

Concluding remarks

To be included

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