

AN ANALYSIS OF NAFTA'S ECONOMIC RELATIONS: emphasis on energy commodities

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Authors: Ébio José Vitor Junior
Rosemarie Bröker Bone



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Goals

NAFTA (*North American Free Trade Agreement*)

Energy consumption by country

Commodities consumption and trade – Oil, Natural Gas and Coal

Evolution of energy commercial flows within NAFTA

Relationship between economy and energy

Conclusions and final remarks



Why NAFTA?

Due to the **difference** between the **socioeconomic profiles** of members and their role as **important players** in the **global energy scenario**.

- **Analyse** the **consumption of fossil fuels (Oil, Natural Gas and Coal)** of NAFTA's members;
- **Evaluate** the **energy trade** among NAFTA's members and external players in order to determine whether there is an energy self-sufficiency within NAFTA;
- **Correlate** the primary energy consumption with macroeconomic variables and CO₂ emissions:
 - **Annual GDP growth;**
 - **Unemployment rate;**
 - **Inflation rate;**
 - **Trade balance.**



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NAFTA (*North American Free Trade Agreement*)

The Agreement

- Context (post-World War II): economical **cooperation** amongst countries, **facilitation** of transnational trade by creating custom benefits and free movement of capital;
- **North American Free Trade Agreement**: formed by three countries — United States, Canada and Mexico.
- Came into force in January, 1994;
- Removal of trade barriers, such as tariffs and import rates;
- NAFTA's creation: politic and economical reasons during the 80's — U.S. strategy to strengthen its economy;



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Energy consumption – U.S.

- Largest producer of energy commodities → 13% of global production
- Oil and gas combined are responsible for almost 70% of U.S. energy consumption
- Coal production and consumption are facing a several decline in the past years

However, coal remains as the third most important energy resource

- Largest producer of biofuels → 43.5 % of global production

Promulgation of laws that established a minimum volume of renewables in the composition of transportation fuels → Energy Policy Act (2005) and Energy Independence and Security Act (2007)

- Barack Obama government: Climate Action Plan — set policies and measures to reduce the emissions of GHG, prepare the country for climate change impacts and lead international efforts in tackling global warming.
- Withdrawn from Paris Agreement (2017): weakening the engagement against climate change



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- Vast territory and resources → Diversified energy portfolio
- Expressive oil and gas segment
- Third largest proven hydrocarbon reserves
- Sixth largest producer of oil and second largest hydropower producer
- Primary energy consumption: Oil (30.6%), Natural Gas (27.3%) and Hydropower (26.6%)
- Government has been committed to invest in innovative technologies to reduce environmental impacts from economic activities
- Reduce in 30% the emissions of GHG by 2030
- Regulation of the use of coal in power generation → environmental laws
- Investment in Carbon Capture and Storage (CCS) technology



Energy consumption - Mexico

- Strong dependency from fossil fuels → 87.6% of primary energy consumption came from oil, natural gas and coal
- Position amongst major producers has weakened in the last decade:
 - **Lack of investment in E&P and corruption at PEMEX (*Petroleos Mexicanos*) → led to decline of mature fields recovery and incapacity of new discoveries**
 - **Decline of 21% in proven reserves between 2014 and 2015**
 - **Increasing natural gas imports**
 - **Lack of refining capacity → net importer of oil products**
 - **High costs in electricity generation**
- Energy reforms (2015):
 - **Redesign the existing institutions and create new ones**
 - **Open the oil and gas sector for foreign companies**
 - **Strengthen the role of regulatory bodies**
- One of the leaders in integrating goals and policymaking to counter climate change:
 - **Second country to pass a law that stipulates a 30% reduction of GHG by 2020**
 - **Development of a National Energy Efficiency Policy Strategy to reduce the carbon intensity in the economy**



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Commodities consumption and trade

UNITED STATES

Natural Gas

Exports:

Mexico (56.4%)
Canada (25.6%)
South Korea (5.1%)

Imports:

Canada (97.1%)
Trinidad & Tobago (2.8%)
Norway (0.1%)

Crude oil and products

Exports:

Canada (17.7%)
Mexico (16.7%)
Netherlands (5.0%)

Imports:

Canada (37.6%)
Saudi Arabia (11.0%)
Venezuela (7.9%)

Coal

Exports:

Netherlands (11.1%)
South Korea (10.3%)
India (9.6%)

Importações:

Colombia (83.6%)
Canada (10.0%)
Indonesia (6.3%)

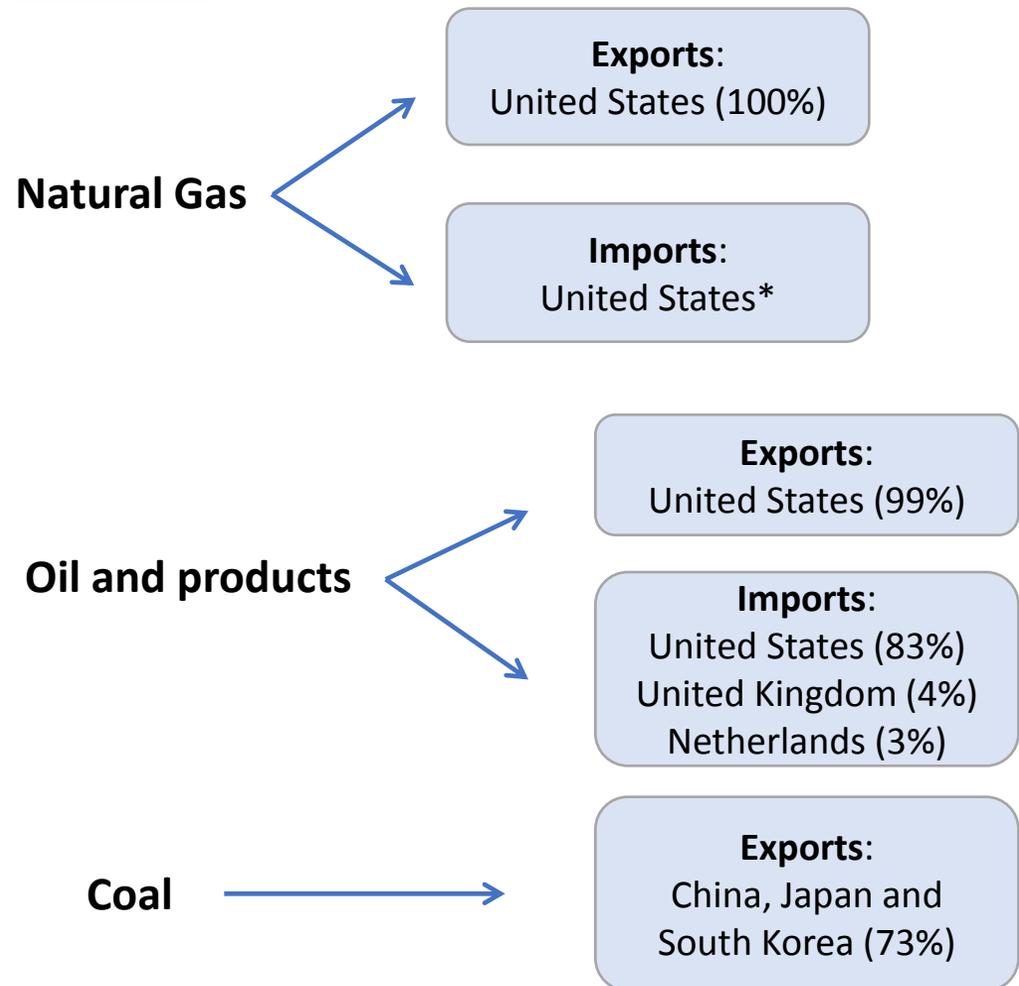
Sources: **U.S. Energy Information Administration**
International Energy Agency



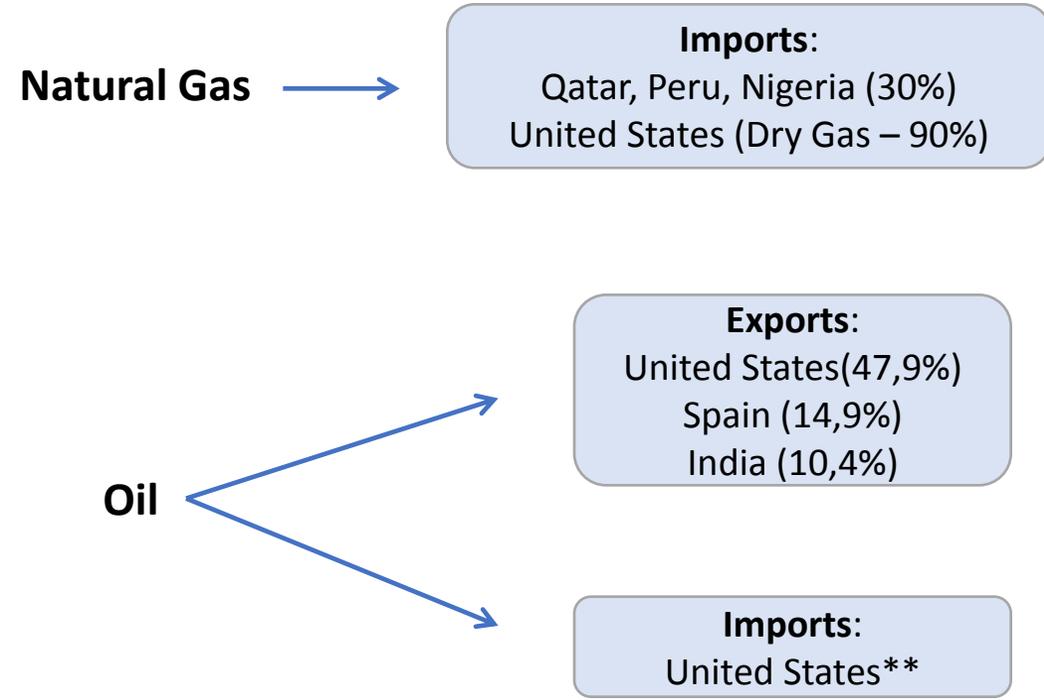
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Commodities consumption and trade

CANADA



MEXICO



Sources: International Energy Agency
World Energy Council
Secretaría de Energía



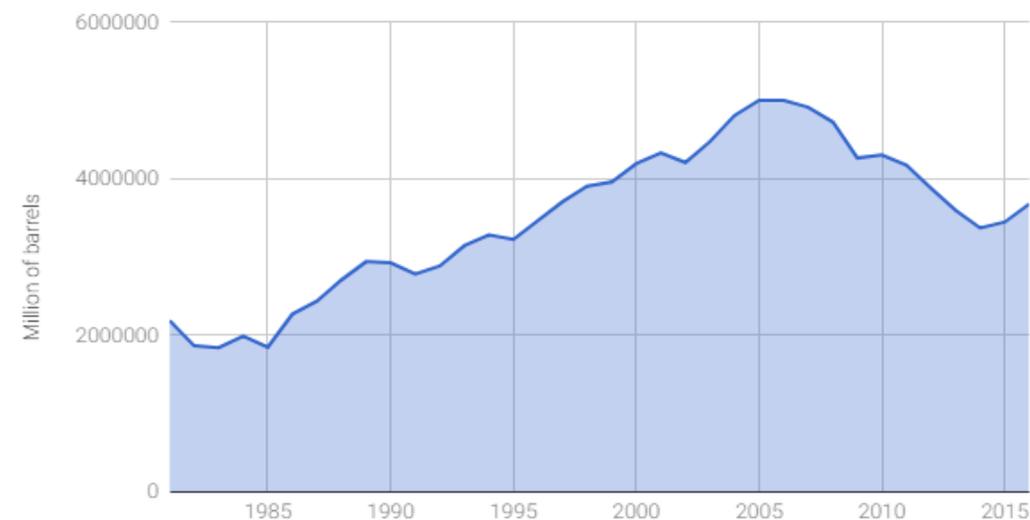
Evolution of energy commercial flows within NAFTA

U.S. crude oil and products imports

1994		2000	
Country	Share (%)	Country	Share (%)
Saudi Arabia	15.6	Canada	15.7
Venezuela	14.8	Saudi Arabia	13.7
Canada	14.1	Venezuela	13.5
Mexico	10.9	Mexico	12.0
Nigeria	7.1	Nigeria	7.8

2008		2016	
Country	Share (%)	Country	Share (%)
Canada	19.3	Canada	37.6
Saudi Arabia	11.8	Saudi Arabia	11.0
Mexico	10.1	Venezuela	7.9
Venezuela	9.2	Mexico	6.7
Nigeria	7.7	Colombia	4.8

Crude oil and products imports (USA)





Evolution of energy commercial flows within NAFTA

U.S. crude oil and products exports

1994		2000	
Country	Share (%)	Country	Share (%)
Mexico	13.2	Mexico	33.8
Virgin Islands	9.7	Canada	10.4
Canada	8.3	Japan	8.5
Japan	7.8	Netherlands	3.9
Singapore	7.2	Spain	3.7

Country	Share (%)	Country	Share (%)
Mexico	18.5	Canada	17.7
Canada	14.6	Mexico	16.7
Netherlands	7.2	Netherlands	5.0
Chile	4.6	Brazil	4.9
Singapore	4.3	Japan	4.7





Relationship between economy and energy

Pearson Correlation

$$\hat{\rho}_{X,Y} = \frac{\sum_{i=1}^n x_i y_i - n\bar{X}\bar{Y}}{n\hat{\sigma}_X\hat{\sigma}_Y} = \frac{\sum_{i=1}^n (x_i - \bar{X})(y_i - \bar{Y})}{n\hat{\sigma}_X\hat{\sigma}_Y}$$

if $0.00 < |\rho| < 0.30$, there is a weak linear correlation;

if $0.30 < |\rho| < 0.60$, there is a moderate linear correlation;

if $0.60 < |\rho| < 0.90$, there is a strong linear correlation;

if $0.90 < |\rho| < 1.00$, there is a very strong linear correlation.

	Primary Energy Consumption
Annual GDP growth	+
Unemployment rate	-
Inflation rate	+
Trade balance	-
CO2 emissions	+



Expected correlations



Relationship between economy and energy

Results

	Primary Energy Consumption (USA)
Annual GDP growth (USA)	0.527697
Unemployment rate (USA)	-0.628496
Inflation rate (USA)	0.595332
Trade balance (USA)	-0.799376
CO ₂ emissions (USA)	0.832353

	Primary Energy Consumption (Canada)
Annual GDP growth (Canada)	0.14764
Unemployment rate (Canada)	-0.432247
Inflation rate (Canada)	-0.234289
Trade balance (Canada)	-0.529995
CO ₂ emissions (Canada)	-0.04895

	Primary Energy Consumption (Mexico)
Annual GDP growth (Mexico)	0.287952
Unemployment rate (Mexico)	0.803414
Inflation rate (Mexico)	-0.719554
Trade balance (Mexico)	-0.77832
CO ₂ emissions (Mexico)	0.992932

	Primary Energy Consumption (NAFTA)
Annual GDP growth (NAFTA)	0.532637
Unemployment rate (NAFTA)	-0.434067
Inflation rate (NAFTA)	0.089463
Trade balance (NAFTA)	-0.621284
CO ₂ emissions (NAFTA)	0.527631



Conclusions

- Despite of the social and economic disparities between them, the members of NAFTA converge when it comes to their respective importance in the energy scenario — vast abundance of natural resources and diverse trading partners.
- The development of the natural gas industry became a key element in the North American energy sector due to the high productive indexes on the part of USA and Canada, that demonstrate an indissoluble partnership in respect to the supply of their internal markets.
- Canada has the U.S. as its main energy commodities trading partner. Thus, the major challenge of the country lies in the diversification of the market beyond North America — investments in transportation infrastructure.
- Mexico is also hugely dependent of U.S. exports of crude oil and products due to the gradual production drop in the last years associated to a deficient refining capacity. However, to meet its crescent demand of natural gas, Mexico counts on Peru, Qatar and Nigeria as external partners.



- The analysis of energy commodities flows within NAFTA lead to the conclusion that there is no self-sufficiency between its members yet, especially due to the U.S. dependency from OPEC-members. However, such dependency has been gradually reduced since NAFTA's implementation.
- Regarding the exports, the United States has been increasing the volume of oil and products exported since 1994. While Canada is continuously increasing its share on those exports, Mexico has been reducing. Nevertheless, the volume exported to Mexico reached a peak in 2016. It might suggest that the U.S. has diversifying even more its oil receiving markets, which current encompass Netherlands, Brazil and Japan as important partners.
- The findings presented in this work were partially confirmed from the correlations – using the Pearson Correlation. For the U.S., correlations were stronger, mainly regarding Primary Energy Consumption versus Trade Balance and CO₂ emissions. For Canada, none of the obtained correlations were considered as strong. For Mexico, in instance, there is an almost perfect and positive correlation between Primary Energy Consumption and CO₂ Emissions. Regarding NAFTA, those correlations were, in average, moderate.

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THANK YOU!



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