On the Interaction between Trade Liberalization of Environmental Goods and Services and the Factor markets when reducing CO2 Emissions: A CGE evaluation for Argentina, Brazil and Chile
FIRST DRAFT - DO NOT QUOTE

M. Priscila Ramos[a,c], Omar O. Chisari[a,b]

[a] *Universidad Argentina de la Empresa, Lima 717, Ciudad Autónoma de Buenos Aires, Argentina*
[b] *Consejo Nacional de Investigaciones Científicas y Técnicas - Godoy Cruz 2290 (C1425FQB) Ciudad Autónoma de Buenos Aires, Argentina*
[c] *Centre d'Etudes Prospectives et d'Information Internationale - 113, rue de Grenelle (75007) Paris, France*

Abstract

The 2001 Doha Declaration singled out trade liberalization of Environmental Goods and Services (EGS) as a way to achieve sustainable development by creating a triple-win situation for trade, development, and the environment. We use CGE models to evaluate the consequences of tariffs eliminations on EGS for three upper-middle income Latin American countries (Argentina, Brazil and Chile), under different assumptions of the functioning of the labor market (full employment, constant nominal wages and constant real wages with unemployment) and also on different degrees of capital mobility. Our main results show that there is a trade-off between the labor market workings and the impact on carbon emissions through tariffs elimination on EGS, without a unique pattern of behavior when adding greater capital mobility. Following Brock and Taylor [1], we also decompose the reductions in carbon emissions in three effects: scale, composition and intensity. We find that mitigation of climate change through the tariff cuts on EGS mainly comes from changes in the scale effect rather than from the composition effect, leading also to a less carbon intensive economies (Argentina and Brazil).

Keywords: trade liberalization, labor market, CGE modeling, CO2 emissions

Preprint submitted to the 2016 Arnoldshain Seminar - Córdoba, Arg. September 12, 2016

1. Introduction

Since the stagnation of the multilateral negotiations to liberalize trade on Environmental Goods and Services (EGS) in July 2014, the original purposes of these negotiations, set in the 2001 Doha Ministerial Declaration,[1] have been redirected towards the plurilateral arena.

A small group of WTO members (currently 17 countries of the G20)[2] has ratified the need for progresses to get an Environmental Goods Agreement (EGA), not only because of the improvement in the trade diversification but particularly due to the potential positive consequences in environmental terms (i.e., climate change). These 17 countries account for a large proportion of the global trade in environmental goods, thus it is expected that their tariff cuts on EGS will impact on their world prices.

Moreover, this group of countries has decided to use the list approach. This approach consists of identifying sets of products, based on the Harmonized System (HS), to be considered as EGS. Even when it is an easy approach for implementation of trade liberalization (tariff cuts and the elimination of non-tariff measures), it is rigid as approach and entails the risk of dual or multiple uses of EGS, depending on their level of definition in the HS. The 17 countries have initially agreed on the Asia-Pacific Economic Cooperation (APEC) list of EGS [3] as the starting point; however, the possibility of adding new products remains open, especially those related to the improvement of energy efficiency and other new technological products and services that could arise in the market as a consequence of this first step in the EGA Vossenaar [3].

The modalities for tariffs cuts on those EGS will take into account the differences of development across the countries concerned, and thus they will apply a Special and Differentiated Treatment (SDT) for developing countries, allowing for progressive tariffs elimination and a reduced tariff cut on sensitive products as exceptions.

While the plurilateral opening of the EGS markets in these 17 countries will be extended to all WTO members on the basis of the Most Favored

[1] See World Trade Organization (WTO) Doha Ministerial Declaration, 20 November 2001 (WT/MIN(01)/DEC/1, paragraph 31), available at: `http://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_e.htm`

[2] Australia, China, Costa Rica, the European Union, Hong Kong, Iceland, Israel, Japan, Korea, New Zealand, Norway, Singapore, Switzerland, Chinese Taipei, Turkey and the United States.

[3] The APEC list concerns 54 non-agricultural products which directly and positively contribute to green growth and sustainable development objectives Vossenaar [2]

Nation principle, the EGA may generate certain effects of trade diversion, as well as limiting potential gains for trade, welfare and the environment compared with the multilateral liberalization.

Even though, Argentina, Brazil and Chile have been proposed different approaches to liberalize EGS trade under the multilateral framework,[4] they do not actively participate (at least so far) of the current plurilateral negotiations for an EGA. Consequently, some questions arise for these three Latin American countries: which could be the impact on trade, welfare and the carbon emissions in Argentina, Brazil and Chile in this context where the liberalization of the large part of the EGS could change the international prices?, what if Argentina, Brazil and Chile decide to join the current 17 countries of the G20 in this commercial and environmental challenge?. Thus, we seek to demonstrate that the potential benefits/costs that these three Latin American countries could get in terms of trade, welfare and environmental would be initially limited by their passivity in this plurilateral trade EGA. Moreover, tariff on EGS are already low in the 17 countries engaged in this EGA, the products included in the current EGS lists are not mainly produced and export by Latin American countries and finally, those results could be sensitively different depending on the labor market modeling (full employment versus the presence of some rigidity of wages) and on the degree of mobility of capital across sectors. In this paper, we will focus on the latter modeling assumptions to evaluate costs and benefits of the EGA for Argentina, Brazil and Chile.

Our objective is addressed using a mono-country and multi-sector Computable General Equilibrium (CGE) model for each of the three Latin American countries. We simulate two main scenarios: the first one with an small increase of the EGS world prices as a consequence of the EGA implementation by the 17 countries currently engaged; and the second one, adds tariff cuts on EGS in Argentina, Brazil and Chile, assuming that they have decided to take this commitment for trade and the environment.

[4]Brazil proposes that each country suggest its own commitments in bilateral negotiations through its request-offer approach. Argentina suggested the integrated approach that combines elements of the environmental project from India and the list approaches to identify categories of environmental projects that include lists of eligible EGS. These approaches are criticized because they are more difficult to implement, as the liberalization of EGS would depend on a unilateral decision of the national authority, and because they do not offer predictable and permanent liberalization. Finally, Chile has jointly proposed with Mexico the combined approach that suggests a SDT for developing countries in the form of differentiated EGS lists, and more flexibility in implementing tariff cuts (lower cuts and longer phase-out periods).

The paper is organized as follows. Section 2 presents the main models assumptions and describes the scenarios to be simulated. Section 3 discusses the results of the EGA with and without the active participation of Argentina, Brazil and Chile in the EGS tariff cuts. Then, we comment the relation between the change in carbon emissions when the EGA is implemented under different conditions of the labor market functioning (full employment and constant nominal wages in terms of the foreign currency) and a greater level of capital mobility across sectors in each country. Finally, section 4 provides policy relevant conclusions and discusses future improvement in this research.

2. The Methodological Approach

In order to simulate the impact of the implementation of the EGA for Argentina, Brazil and Chile we use mono-country multi-sector CGE models for each of them, which have been developed by Chisari and Miller [4]. The assumptions of the models are similar but they differ on the Social Accounting Matrix (2006 for Argentina and Chile, and 2008 for Brazil) and some key parameter (e.g., percentage of mobile capital) that characterize each of the economies and serve to calibrate the models Chisari et al. [5].

Next subsections present the main assumptions of the CGE models and those to run the EGA scenarios.

2.1. Assumptions of the models

The demand side is modeled assuming two representative households (poor and rich), a government and the rest of the world.

Households consume goods and services domestic and imported, invest and buy/sell bonds in a constant proportion of their income (Cobb-Douglas). Their incomes are composed by labor and capital remunerations and transfers received from the government. In order to choose the optimal proportion of the consumption of final goods and services, households maximized their utilities which are nested production functions, where EGS imported products and 'dirty' domestic goods are highly substitute (CES with an elasticity of substitution of 5).

The government also consumes, invests and makes transfers to households also in a constant proportion (Cobb-Douglas), financing those expenses mainly with its tax collection, and debt in a lower proportion. In this sense the modeling of the government behavior is neutral because each dollar received by the government is always spent in the same way.

The equivalent variation is the measure used to evaluate the change in the level of the agents' utility when prices of goods, services and factors' change.

We additionally assume that these economies are small with respect of the international market, which is particularly true for the case of EGS markets.

The rest of the world buys domestic exports and sells imports in addition to making transaction in the financial market and collecting dividends from investment. In the benchmark situation the value of exports equalizes the value of imports (trade balances in equilibrium).

On the supply side, each sector combines intermediate consumption and value added in a fixed proportion (Leontief). The intermediate consumption assumes that imported EGS are substitutes to domestic 'dirty' inputs such as in the final consumption of households (CES with an elasticity of substitution of 5). Value added is a Cobb-Douglas production function of labor and capital.

The modeling of the labor market assumes a positive unemployment rate due to constant wages in real terms, i.e. wages are indexed to the price of the consumption basket of the poor household. Later, this assumption will be modified to evaluate the sensitivity of the results under full employment and also under unemployment but due to fixed nominal wages in terms of the foreign currency.

Two types of capital are available in the model, fixed and mobile. Fixed capital is installed in each sector as a specific resource and the mobile capital is allocated across sector according to the rate of return in each of them. Concerning capital mobility across sector we initially assume that a low proportion of capital is mobile (i.e., 12.5% in Argentina, 15.4% in Brazil and 10% in Chile). Then, this assumption will be modified increasing the percentage of the mobile capital (half of all capital) in each of the economies.

Closures of the model assume: a saving-driven investment, endogenous exchange rate given the equilibrium of the current account, endogenous unemployment rate given a constant real wage, and for the rest of goods, services and factors markets clear under perfect competition conditions. The *numeraire* in model is the remuneration of the foreign production factor. In this way the system fills the basic properties of Walrasian model.

The CGE models are numerically solved using the interface GAMS/MPSGE where the problem is programmed as a Mixed Complementarity Approach (MCP).

In order to measure the environmental impact of the simulated scenarios, we follow, such as in Chisari and Miller [4], the taxonomy developed by

Brock and Taylor [1]. These authors identify three channels to explain the change in carbon emissions: 1) the *scale effect* when the scale of the activity can increase or reduce when some policy (in this case a trade policy) is implemented; 2) the *composition effect* when the sectors' value-added structure changes due to the implemented policy; and 3) the *intensity effect* when the coefficients of emissions per unit of output change, when adopting an alternative technology.

2.2. Scenarios

We simulate two possible scenarios of the plurilateral trade liberalization on EGS.

The first one considers the increase in world prices of EGS as a consequence of the tariff reduction on these products in the 17 countries which are negotiating the EGA and which concentrate more than 70% of the EGS trade in the world. Since the tariffs on EGS are currently low in the concerning countries, we assume a shock of 5% in the EGS international price.

The second scenario assumes that all countries, including Argentina, Brazil and Chile, are part of the plurilateral EGA. Consequently, we add tariffs elimination on EGS in these three Latin American countries to the previous increase in the world price of EGS.

According to the sectors details in the SAMs of each country and based on the contribution of each sector in the global carbon emissions, we assume that EGS exclusively industrial goods, such as those including in the APEC list. However, we know that our sectors aggregation does not allow for a fine detail in order to isolate completely 'clean' products from those which pollutes, thus the industrial sector is not excluded as carbon emitter as a whole. Nevertheless, our assumption based on real data is that primary goods (agricultural, mineral) and fossil fuel energy products are relative more pollutant compared to manufactures (EGS).

Finally, it is important to note that those shocks affects relative prices between domestic and foreign goods, affecting the household consumption decisions, the purchasing of capital goods for investment and the intermediate consumption of firms, as well production and export decisions of domestic sectors.

3. Results of the EGA scenarios

We analyze the results of the two EGA scenarios, with (EGA 20) and without (EGA 17) the active participation of Argentina, Brazil and Chile on tariff cuts in EGS. Even though we present some selected and aggregated

indicators, more detailed information at the sector level (level of activity, intermediate consumption, etc.), at the factor level or for poor/rich households, is available and can be provided upon request.

3.1. EGA 17 versus EGA 20: main results

The increase in the international world prices of EGS as a consequence of the tariff cuts in the 17 countries concerned by the plurilateral EGS negotiation (EGA 17) increases the real trade and the GDP in the three Latin American countries. These results reduces the unemployment rate and increase households welfare particularly due to the improvement in capital profits (Table 1, columns EGA 17).

Unfortunately, carbon emissions increase in all the three countries; however, the results in terms of the scale and composition effects are not the same for all of them. While the scale effect and the composition effects go in opposite sense in Argentina and Brazil, in Chile one effect intensifies the other. The scale effect in Argentina and Brazil shows a reduction in terms of total carbon emissions, since the trade liberalization of EGS reduces the production of carbon-intensive sectors, when assuming no possibility of inputs substitution. This result is coherent with the change in the Kutznets index of emissions that shows both economies become less carbon-intensive as a whole. Nonetheless, the composition effect is stronger and does not follow the scale one, leading to an increase in national carbon emissions. The possibility to substitute inputs in the intermediate consumption and final goods and services in the households final consumption shows that a greater level of income due to trade liberalization is also spent in primary goods (e.g., fossil fuel energy and meat) which are relatively more harmful to the climate change.

The change in the relative prices motivates the increase in the domestic production and exports in the industrial sector, while they fall in the primary and energy ones. However, it is noteworthy that the industrial sector is not a completely 'clean' sector because of the composition of its intermediate consumption (even if some of 'dirty' inputs are substitutes to 'clean' one), and consequently the growth of the production of this sector also generates carbon emissions.

Now, if Argentina, Brazil and Chile also decide to eliminate tariff on EGS imports (EGA 20), the gains in terms of GDP, trade and households' welfare become greater. This improvement in the level of national activity also reduce even more the unemployment rate when assuming indexed wages (Table 1, columns EGA 20). Nevertheless, the indicator of total emissions deteriorates on all the three countries, particularly explained by a greater

composition effect. In Argentina and Brazil, the scale effect is even smaller and does not compensate the composition one, while in Chile, as in the previous scenario, the scale and the compositions effects go in the same direction increasing total carbon emissions. Even though, the increase in total emissions is greater in all the three countries, Argentina and Brazil become less carbon-intensive economies, which is not true for Chile under the EGA 20.

In short we can say that, even when the implementation of the EGA (either EGA 17 or EGA 20) increases total carbon emissions while reducing unemployment in the three Latin American economies, solely in Argentina and Brazil these trade liberalization scenarios of EGS allow reducing their carbon intensity.

Table 1: Macroeconomic and Environmental impacts of EGA

	Argentina		Brazil		Chile	
	EGA 17	EGA 20	EGA 17	EGA 20	EGA 17	EGA 20
GDP	2.75	3.29	2.15	2.62	0.55	0.65
Exports	6.96	7.91	10.25	11.84	7.65	8.19
Imports	8.02	9.26	9.49	10.94	10.75	11.62
Households' Welfare	3.15	4.02	2.22	2.84	1.53	2.08
Unemployment (av. rate)	9.12	8.82	5.35	4.59	5.26	5.12
CO2 Emissions	0.84	1.12	0.99	1.31	7.06	7.50
Scale effect	*-0.92*	*-0.75*	*-1.07*	*-0.57*	*2.00*	*2.24*
Composition effect	*1.78*	*1.89*	*2.09*	*1.89*	*4.96*	*5.14*
Kutznetz index of CO2 Emissions	-1.86	-2.10	-1.13	-1.28	6.48	6.81

Note: In the Baseline the unemployment rates are 10.2 in Argentina, 7.78 in Brazil and Chile 5.96, according to the calibration data taken for each country. 'EGA 17' denotes the scenario of EGS trade liberalization in the 17 countries of the current plurilateral negotiations and the 'EGA 20' considers also

3.2. EGA under different labor market conditions

In order to analyze the role of the labor market closures, we will compare previous results of EGA scenarios to those when full employment is assumed (inelastic labor supply) and when wages are downwards inflexible in terms of the foreign currency (Table 2).

When full employment is assumed, the same EGA simulations lead to a lower increase in the level of activity and also in terms of total carbon emissions. In the cases of Argentina and Brazil, the reduction of emission due to the scale effect becomes greater compared to the situation with constant real wages (perfect elastic labor supply); however, it does not compensate

the increase in emissions due to the composition effect, which is also greater. Carbon intensity of these two economies also falls but less than under the previous labor market assumption. For Chile, the situation is quite worst because its GDP slightly fall while carbon emissions still increase. When full employment is assumed, the EGA (either 17 or 20) is not enough as a mean to boost the economy towards a 'greener' functioning.

Now, when assuming positive unemployment due to inflexible nominal wages in terms of tradeable goods, the increase in GDP, trade, households' welfare (due to even greater capital profits) and also the total carbon emission is even larger in all three Latin American economies. In this particular case the reaction of trade is relatively greater than under other labor market assumptions because when nominal wages are inflexible, the costs of producing domestically are lower due to tariff elimination on EGS (EGA 20). Moreover, a greater trade and GDP push emissions up due to both the scale and the composition effects. Nonetheless, in Argentina and Brazil there is still a greater reduction in the carbon intensity indicator (Kutznets index variation). The latter is not true for Chile once again.

It is noteworthy the relevance of the appropriate modeling for labor market and the rule of indexation of wages in developing countries, such as our three illustration cases, in order to get the real environmental and economic costs or benefits due to policy changes (in this case a trade agreement).

Table 2: Impacts of the EGA under different functioning of the labor market

	Full Employment						Constant Nominal Wages					
	Argentina		Brazil		Chile		Argentina		Brazil		Chile	
	EGA 17	EGA 20	EGA 17	EGA 20	EGA 17	EGA 20	EGA 17	EGA 20	EGA 17	EGA 20	EGA 17	EGA 20
GDP	1.13	1.16	0.81	0.87	-0.59	-0.70	8.70	9.66	5.03	5.09	3.67	3.90
Exports	8.35	9.00	8.38	9.36	3.31	3.52	13.42	14.84	14.30	15.35	11.06	11.75
Imports	10.09	11.08	7.78	8.69	4.87	5.35	14.56	16.30	13.17	14.14	14.10	15.14
Households' Welfare	1.35	1.69	0.92	1.14	0.39	0.71	8.75	10.04	5.01	5.23	4.57	5.27
Unemployment (av. rate)							5.89	5.34	0.00	0.00	3.35	3.11
CO2 Emissions	0.32	0.37	0.33	0.44	3.15	3.31	3.86	4.35	2.41	2.53	9.29	9.83
Scale effect	*-2.81*	*-3.07*	*-2.28*	*-2.17*	*0.98*	*1.03*	*2.47*	*2.91*	*2.23*	*2.33*	*4.64*	*5.03*
Composition effect	*3.22*	*3.55*	*2.67*	*2.67*	*2.14*	*2.26*	*1.36*	*1.40*	*0.17*	*0.19*	*4.44*	*4.58*
Kutznets index of CO2 Emissions	-0.81	-0.78	-0.47	-0.42	3.76	4.04	-4.45	-4.84	-2.50	-2.44	5.42	5.71

Note: The full employment scenario assumes an inelastic labor supply and the constant nominal wage assumption is in terms of the foreign currency (*numeraire*). 'EGA 17' denotes the scenario of EGS trade liberalization in the 17 countries of the current plurilateral negotiations and the 'EGA 20' considers also

3.3. EGA under different capital mobility across sectors

Coming back to the original assumption for labor market functioning (constant real wages), we evaluate the sensitivity of the results when capital mobility is greater across sectors in each of the three Latin American economies (Table 3).

In the case of Argentina, a more flexible allocation of capital across sector improves both macroeconomic and environmental indicators. While GDP, trade and households' welfare increase even more when capital mobility increase, the unemployment rate, the total carbon emissions (the scale effect more than compensates the composition one) and the carbon-intensity indicator fall. This appears as the best situation for the whole Argentinean economy when an EGA is signed. However, the real situation of Argentina does not show that half of capital is mobile across sectors, but less of that.

Conversely, in Brazil and Chile, greater capital mobility reallocates capital in sectors which are carbon-intensive. Thus, while macroeconomic indicators improve, climate change one deteriorates compared to a lower capital mobility situation.

In short we can say that, such as for labor market conditions, capital mobility across sectors (and even internationally not presented here) are also key assumptions when evaluating the implementation of new policies.

Table 3: Impacts of the EGA under a greater capital inter-sector mobility

	Argentina		Brazil		Chile	
	EGA 17	EGA 20	EGA 17	EGA 20	EGA 17	EGA 20
GDP	3.85	4.40	2.40	2.95	1.90	2.11
Exports	9.71	10.76	12.71	14.67	12.14	13.32
Imports	11.26	12.63	11.95	13.76	16.91	18.71
Households' Welfare	4.22	5.15	2.48	3.18	2.98	3.68
Unemployment (av. rate)	8.60	8.29	5.04	4.18	2.33	2.12
CO2 Emissions	-3.06	-2.50	1.83	2.45	9.57	10.05
Scale effect	*-4.94*	*-5.28*	*-0.16*	*0.64*	*4.11*	*4.32*
Composition effect	*1.97*	*2.93*	*1.99*	*1.80*	*5.24*	*5.49*
Kutznets index of CO2 Emissions	-6.65	-6.61	-0.56	-0.49	7.52	7.77

Note: Half of capital in each economy is mobile across sector. 'EGA 17' denotes the scenario of EGS trade liberalization in the 17 countries of the current plurilateral negotiations and the 'EGA 20' considers also

Sometimes, policies are designed for some countries and under some particular functioning assumptions of the factors markets which are not necessarily reproduced in every economy of the world Böhringer and Rutherford [6], Li et al. [7], Böhringer et al. [8]. Here, we have evaluated two possible

situations to three Latin American countries facing the EGA plurilateral negotiations. Even when these are all developing countries, their differences in terms of production structure and the characteristics of the factor markets (e.g., full employment versus unemployment; labor differentiation across skills Jagger et al. [9]) allow highlighting the effectiveness (or ineffectiveness) of this trade scenario to seek multiple commercial, development and environmental objectives.

4. Final remarks

Given the unsuccessful multilateral trade liberalization of EGS as part of the Doha Round, a small group of 17 WTO members have decided to turn this trade negotiation to the plurilateral arena. Even when all WTO members would benefit from their unilateral tariff cuts on EGS, we were interested to know in which sense the economic and environmental situation of Argentina, Brazil and Chile would change if they do (or not) actively participate of these EGA. Even more, we compare the EGA scenarios under different factors (labor and capital) market assumptions.

Main results on EGA suggest that the trade liberalization of EGS by the 17 WTO countries (excluding Argentina, Brazil and Chile) could also positively impact on trade, GDP and employment in these three Latin American economies. However, in terms of carbon emissions the only encouraging results is the decrease in the carbon-intensity indicator for Brazil and Argentina exclusively. Moreover, if Argentina, Brazil and Chile decide to liberalize trade on EGS, the lower level of tariff on EGS could slightly intensify the previous gains/losses in both economic and environmental terms.

Nevertheless, it is important to note that labor market modeling and capital mobility matter when evaluating the real costs or benefits of policies. Concerning labor market conditions we have found that under full employment both macroeconomic indicators and carbon emissions also increase but in a lower proportion. Conversely, downwards inflexible wages in terms of the foreign currency reduce domestic production costs, increasing positive impacts on trade and GDP, but intensifying negative consequences for climate change (both scale and composition effects explain total carbon emission increase in the three countries). Then, the increase in the capital mobility across sectors in each economies, displays opposite patterns of results. While in Argentina greater capital mobility allows factors reallocation to less-carbon intensive sector decreasing emissions, in Brazil and Chile, the allocation of capital moves towards carbon-intensive sectors. Consequently,

the design of a policy seeking environmental, trade and development objectives has not necessarily the same results in every country. Even when countries display the same degree of development, the own characteristics of the production structure and the rigidity/flexibility of factors markets functioning may lead to different results, solving or becoming worst the initial macroeconomic and environmental situation.

More aspects of modeling (e.g., technological transmission and change, trade and carbon emissions data at a more detailed level for a better modeling in substitution effects and environmental impacts [10]) and multipurpose policy design should be improved to reach a better evaluation of trade, development and climate change impacts of current international negotiations for developing countries such as those presented in this paper.

References

[1] W. A. Brock, M. S. Taylor, Economic growth and the environment: a review of theory and empirics, Handbook of economic growth 1 (2005) 1749–1821.

[2] R. Vossenaar, The APEC List of Environmental Goods, An analysis of the Outcome and Expected Impact. Geneva: International Centre for Trade and Sustainable Development (2013).

[3] R. Vossenaar, Identifying Products with Climate and Development Benefits for an Environmental Goods Agreement, Environment (2014).

[4] O. O. Chisari, S. J. Miller, CGE Modeling: The Relevance of Alternative Structural Specifications for the Evaluation of Carbon Taxes' Impact and for the Integrated Assessment of Climate Change Effects: Simulations for Economies of Latin America and the Caribbean, Technical Report, Inter-American Development Bank, 2015.

[5] O. O. Chisari, J. Maquieyra, S. Miller, Manual sobre modelos de equilibrio general computado para economías de LAC con énfasis en el análisis económico del cambio climático, Nota Técnica IDB-TN 445 (2012).

[6] C. Böhringer, T. F. Rutherford, Transition towards a low carbon economy: A computable general equilibrium analysis for Poland, Energy Policy 55 (2013) 16–26.

[7] A. Li, Z. Zhang, A. Zhang, Why are there large differences in performances when the same carbon emission reductions are achieved in different countries?, Journal of Cleaner Production 103 (2015) 309–318.

[8] C. Böhringer, T. F. Rutherford, D. G. Tarr, N. Turdyeva, Market Structure and the Environmental Implications of Trade Liberalization: Russia's Accession to the World Trade Organization, Review of International Economics 23 (2015) 897–923.

[9] N. Jagger, T. Foxon, A. Gouldson, Skills constraints and the low carbon transition, Climate policy 13 (2013) 43–57.

[10] G. Allan, P. McGregor, K. Swales, Greening regional development: employment in low-carbon and renewable energy activities, Regional Studies (2016) 1–11.