

# The Impact of Carbon Pricing On International Competitiveness In The Case of Azerbaijan

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## Research Article

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# Abstract

This article examines the impact of carbon pricing on international competitiveness for Azerbaijan, utilizing different cointegration methods such as, ARDLBT, CCR, DOLS, and FMOLS to the data spanning from 1998 to 2019. The results of the various cointegration approaches are in line with each other. The estimation results revealed that carbon pricing has a negative and significant impact on the international competitiveness in Azerbaijan. The study concludes that the Azerbaijani policymakers should implement carbon pricing measures (implicit) to decrease energy heavy industries as well as use more renewable energy in order to prevent higher pollution effects of fossil fuels.

## 1. Introduction

Environmental sustainability is one of the three dimensions of sustainable development. Today, environmental protection is one of the biggest problems for all countries. Seventh Millennium Development Goal is “ensuring environmental sustainability” that imposes specific responsibilities on government, institutions, societies, policymakers and individuals (UN 2015). Since these responsibilities are global priorities, many researches attempted to find economical and energy-efficient methods to meet Sustainable Development Goals (Delanka-Pedige et al. 2020).

Greenhouse gases produced by man-made activities, such as burning fossil fuels, absorb heat and create global warming, leading to changes in the climate system which results to the increase in global average temperature. Undebatable, this is one of the most pressing issues confronting humanity today. Since a result, global climate change is one of the most pressing policy problems of the century for all governments, as it jeopardizes society's well-being, complicates economic progress, and alters the natural environment. The United Nations Sustainable Development Summit in 2015 September noted in “Transforming our world: the 2030 agenda for sustainable development”, according to the 13<sup>th</sup> Sustainable Development Goal, “The global character of climate change necessitates the broadest feasible international collaboration aimed at accelerating global greenhouse gas emissions reductions and addressing adaptation to climate change's harmful effects” (UN 2015). Carbon dioxide takes significant part among other environmental pollutants. Based on the World Bank (2007), it is caused by the burning of fossil fuels and the production of cement, which account for over 60% of greenhouse gas emissions, which as a consequent cause the climate change (World Bank 2007). Carbon dioxide is created by the combustion of solid, liquid, and gas fuels, as well as gas flaring. Furthermore, the Intergovernmental Panel on Climate Change (IPCC) (2014) states that CO<sub>2</sub> emissions from fossil fuel combustion and industrial activities promoted approximately 78% of the rise in total greenhouse gases emission over the period of 1970-2010, with a similar percentage contribution during 2000-2010. In order to reach environmental sustainability around the world in terms of greenhouse gases, the Kyoto protocol was accepted in 1997 by many governments over the world, which puts commitment on developed countries to reduce emissions (Mikayilov et al. 2018).

The level of greenhouse gas emissions from developing economies has been sharply exceeding that of developed economies, which constituted approximately 50% of the world's overall CO<sub>2</sub> emissions in 2003. If the present level of energy consumption goes on, today's CO<sub>2</sub> trend is predicted to rise. It is the main reason that all policymakers should formulate effective policy actions in reducing CO<sub>2</sub> emissions. However, due to the differences between developed and developing economies and even distinctions between different economies within the same group, those policy measures will generally not be indistinguishable and should be analyzed for individual countries specifically, resource-rich developing countries. In terms of environmental deterioration, the important portion among the developing countries belongs to resource-rich (particularly oil-exporting economies). Because these economies have plentiful natural resources (such as oil, gas, and coal) at low/subsidized prices, a focus on economic growth may lead to the wasteful and unregulated exploitation of these resources, resulting in significant climate deterioration (Hasanaov et al. 2019). In this regard, the investigation of reducing CO<sub>2</sub> emissions for oil-rich countries gains particular importance.

The basic goal of sustainable development is to reduce total emissions while maintaining high levels of economic development (Mikayilov et al. 2018). There, the carbon pricing policies would be more effective in reducing CO<sub>2</sub> emissions. The implementation of carbon prices policies can raise the cost of production and could negatively influence the competitiveness of energy intensive industries. In the literature, competitiveness has been widely discussed during the last decades. Krugman (1995) defined competitiveness as the equivalent of productivity. However, he states that competitiveness is a “wrong and dangerous definition” if it is implemented at the international level. Fagerberg (1988) stated international competitiveness as an ability to achieve central economic policy goals, particularly economic growth and higher employment, without running into balance-of-payments problems. Wignaraja (2003) defined competitiveness as the ability of an economy to produce what meet the test of international competition while increasing real GDP. In addition, Aiginger (2006) and Kao (2008) described competitiveness as the skill to create welfare, the relative ability of an economy to produce and preserve an atmosphere in which firms can compete so that the level of wealth can be developed. The authors also recommend that each comprehensive valuation of competitiveness should cover an outcome estimation and a process assessment, on one hand, and must be compared to other similar economies, conversely.

There are many researches examining the impact of carbon pricing on international competitiveness. The previous researchers use various proxies like, employment, productivity, output, innovation, inflation, exchange rate, investment for international competitiveness. Among these researchers, Saddler et al. (2006) in the case of Australia, Pearce and McKibbin (2007), Rivers (2010) in the case of Canada, Mafizur (2011) in the case of Australia, Grottera et al. (2015) in the case of G20 countries revealed a negative impact from carbon pricing to international competitiveness. In addition, some studies such as, Reinaud (2008), Bassi et al. (2009) for USA, Branger and Quirion (2014), Silva et al. (2016) for Brazil, Carbone and Rivers (2017), Dechezlepre and Sato (2017), Rentschler et al. (2017) for Saudi Arabia, Pradhana et al. (2017) for India reached the similar results. Also, In the case of U.K., Kneller and Manderson (2012) revealed a negative correlation whereas, Zhao (2011) demonstrates a statistically significant negative impact from carbon taxes to the international competitiveness of energy-intensive sectors. On the other hand, Dissou and Eyland (2011), Timilsina et al. (2013), Sbroiavacca et al. (2016), Santos et al. (2018) conclude the positive impact of carbon pricing on competitiveness. Additionally, Rivers and Schaufele (2014) reached that there is no persuasive link. Moreover, the insignificant relationship were revealed by Zhang and Baranzini (2004), Bataille et al. (2009), Clarke and Waschik (2012), Beale et al. (2015), Aldy and Pizer (2015).

From the literature, the implementation of the Emission Trading System (ETS) and carbon taxation as carbon pricing measures (explicit) may not be as successful in transition economies and oil rich countries, due to the lack of socio-economic institutions, infrastructure, and regulatory frameworks. For this reason, the better way is to consider implicit carbon price policies. Empirical studies indicate that the implicit measures of carbon pricing (increasing the energy prices or removing fossil fuel energy incentives) are more suitable for developing economies and easier to apply as compared with explicit measures (ETS, carbon taxation and so on). Due to associated infrastructure, the latter requires market establishments and legislation (Aldy and Stavins 2012; Klenert et al. 2018; Hasanov et al. 2020).

In developing countries (particularly resource-rich), reforming energy prices as an implicit carbon price measures might be implemented. The profit margins in some sectors cannot be preserved at previous levels with the removal of fossil fuel incentives. In developing countries, macro-econometric studies devoted to carbon pricing policies-international competitiveness nexus are necessary to measure the role of energy price mechanisms precisely and reliably. Also, it is needed to formulate mitigation policies that diminish any loss in competitiveness from the removal of fossil fuel incentives. (Hasanov et al. 2020).

Azerbaijan is one of the most oil-rich countries yet gifted with abundant renewable energy resources, making it a special case for this study. In Azerbaijan, the total air pollutant emissions were 620 thousand tons in 2002. It was almost doubled and reached to 1122.0 thousand tons in 2019. The total air pollutant emissions increased by 80,9 %, with an average 4.06 % annual growth rate during 2002-2019 (SSCA 2021a). From the economic dimension of the development, Azerbaijan

economy has been demonstrating a considerable economic growth since 2006. Over the period 1996-2019, Azerbaijani GDP increased by 29.9 times, from 2733 million manats in 1996 to 81681 million manats in 2019 (SSCA 2020). Economic growth in turn, as other wings of sustainability, might cause negative impacts on environment through different channels. A deteriorated environment and environmental resources have negative consequences for individuals, society, and nature. To maintain the balance of development factors, or to create sustainable development, resources must be used in an ecologically acceptable manner.

Considering the above-mentioned facts, it is necessary to evaluate the impact of carbon pricing policies on international competitiveness in Azerbaijani case employing time-series econometric methods. Therefore, the purpose of the current article is to investigate the impact of carbon price measure (implicit) on international competitiveness in the Republic of Azerbaijan by employing different cointegration methods such as ARDBT, CCR, DOLS, FMOLS. The main contribution of the study is that it is only one time series analysis investigating the impact of carbon pricing policy (implicit) on international competitiveness in the case of Azerbaijan which can be useful for Azerbaijani policymakers to conduct policy regulations for reducing the CO<sub>2</sub> emissions. In addition, the study can encourage researchers to conduct the same study for the countries similar to Azerbaijan.

## 2. Model And Data

### 2.1. Data

This article uses annual data between 1998-2019 for empirical estimation of relationship between carbon pricing and international competitiveness. The international competitiveness is dependent variable which proxied by real exchange rate. Carbon pricing is expressed by the average real weighted end-use price of oil product (oilpp) and domestic crude oil prices (coilp) in this study. All variables are in logarithmic form.

**Real Exchange Rate (RER)** is measured as the value of foreign currency in terms of domestic currency, hence a rise in RER indicates that the domestic currency has appreciated, which is computed as follow:

$$RER = E_t \times (P/P^*)$$

Where,  $E_t$  is the Nominal Exchange Rate of domestic country;  $P$  is Consumer Price Index of Azerbaijan while,  $P^*$  is the Consumer Price Index of U.S. The Consumer Price Index data of both countries have been retrieved from World Bank (WB 2021a). Also, the data of Nominal Exchange Rate is collected from World Bank (WB 2021b).

**The average weighted real end-use price of oil product (oilpp)** is calculated as an average of exogenous, measured end-use prices of diesel and gasoline, weighted by the proportions such as  $q_{oilpp,t} = \sum_{i=1}^2 (q_{i,t} * D_{i,t-1} / \sum_i D_{i,t-1})$ , where  $q_{oilpp,t}$  is the average real weighted end-use price of oil product at year  $t$ ,  $D_{i,t-1}$  shows the final consumption in quantities for diesel ( $i=1$ ) and gasoline ( $i=2$ ), (all expressed in thousands ton) and where,  $q_{i,t}$  is the weighted price, at year  $t$ , of diesel ( $i=1$ ) and gasoline ( $i=2$ ), (both proxied by real dollars/liter). The diesel and gasoline use data are obtained from The State Statistical Committee of the Republic of Azerbaijan (SSCA, 2021b) whereas, prices of diesel and gasoline are retrieved from Tariff (price) Council of the Azerbaijan Republic (TCAR 2021).

**Domestic crude oil price (coilp)** is proxied by manats per tons of oil equivalent (TOE). This data collected from Tariff (price) Council of the Azerbaijan Republic (TCAR 2021).

### 2.2. Methodology

The impact of carbon pricing on international competitiveness is analyzed by employing the cointegration techniques in this article. The steps of the empirical assessment are as follows: To verify for non-stationarity of variables, the unit root test is applied first. The unit root tests of Augmented Dickey Fuller (Dickey and Fuller, 1981, ADF) are utilized to determine if variables are stationary or not.

Then, to evaluate the cointegration link between variables, the Bounds Testing method is employed (Pesaran et al, 2001). The Bounds Testing Approach to Autoregressive Distributed Lagged (ARDLBT, Pesaran et al. 2001; Pesaran and Shin 1999) approach is applied for this purpose. As a result, one of the primary advantages of ARDL is that it is more resilient and performs better than alternative methods when dealing with small sample sizes, as is the case in this study. Also, the CCR, DOLS and FMOLS are applied for robustness check.

The aforementioned approaches are not covered in depth in this article to save space and avoid overloading the readers with econometric terminology. Dickey and Fuller (1981), Phillips and Hansen (1990), Hansen (1992a, b), Park (1992), and Stock and Watson (1993), Pesaran et al. (2001), Pesaran and Shin (1999), and others provide detailed information on these tests and models.

### 3. Empirical Results

To assess the model variables' stationarity, the ADF and PP tests were used first. Table 1 shows the outcomes of the tests. The findings of ADF and PP's unit-root tests show that RER, oilpp and coilp are non-stationary at I(0) but stationary at I(1). As a result, we may infer that our variables are non-stationary in terms of levels but stationary in terms of first differences, allowing us to test for cointegration.

Table 1  
Results of ADF unit root tests

Variable	Panel A:		Panel B:		Result
	Level		1st difference		
	<i>k</i>	Actual value (p-value)	<i>k</i>	Actual value (p-value)	
<i>RER</i>	2	1.858 (0.999)	1	-3.381 (0.025)	I(1)
<i>oilpp</i>	0	-1.586 (0.470)	2	-4.073 (0.006)	I(1)
<i>coilp</i>	2	-0.159 (0.927)	1	-4.161 (0.005)	I(1)
Notes: Maximum lag order is two and optimal lag order ( <i>k</i> ) is determined using the Schwarz criteria;					

For cointegration relationship, The Bounds Testing Approach, Engle-Granger and Phillips-Ouliaris tests are applied and results are depicted in the Table 2. The z-statistics and tau-statistics of Engle-Granger and Phillips-Ouliaris tests reject the "Series are not cointegrated" null hypothesis. In addition, the Bounds cointegration test findings approve existence of long-run cointegration relationship between variables.

Table 2  
The Results of Cointegration tests

	Engle-Granger	Phillips-Ouliaris	Bounds Cointegration
<b>Tau-statistic</b>	<b>-8.5979</b> <b>(0.00)</b>	<b>-7.9191</b> <b>(0.00)</b>	<b>F<sub>w</sub> 19.65</b> <b>Critical Values</b>
<b>z-statistic</b>	<b>-28.7215</b> <b>(0.00)</b>	<b>-30.4385</b> <b>(0.00)</b>	<b>10%3.43 4.47</b> <b>5%4.26 5.47</b> <b>1%6.18 7.87</b>
Notes: P-values are in parenthesis. F <sub>w</sub> refers to F-statistics for Bounds Cointegration test; the critical values for the Bounds test are based on Narayan's (2005) critical values;			

As a result, using ARDL method, the long-run influence of carbon pricing on international competitiveness can be estimated after confirming the presence of cointegration links among the variables. Table 3 summarizes the findings of ARDL. The residuals of the evaluated specifications successfully meet Gauss-Markov criteria, according to residual diagnostics tests. Furthermore, the model's misspecification test findings revealed no misspecification issues. To end, we also utilize use the CCR, DOLS and FMOLS techniques to obtained more robust results. Table 3 summarizes the findings of CCR, DOLS and FMOLS techniques.

Table 3  
Long-run coefficients from the different methods

Methods	<i>oilpp</i>	<i>coilp</i>
	Coefficients (P-values)	Coefficients (P-values)
ARDL	-0.11 (0.002)	-0.87 (0.000)
CCR	-0.12 (0.000)	-0.87 (0.000)
DOLS	-0.10 (0.024)	-0.79 (0.000)
FMOLS	-0.12 (0.000)	-0.87 (0.000)
The tests results of Residuals Diagnostics and Mis-specification for ARDL: $\chi^2_{SC}=0.79 [0.67]$ $\chi^2_{HETR}=2.45[0.48]$ $JB_N=2.98 [0.22]$ $F_{FF}=1.91 [0.39]$		
<b>Notes:</b> RERt is dependent variable; $\chi^2_{HETR}$ and $\chi^2_{SC}$ , refer to Chi-squared statistics which reject presence of heteroscedasticity and serial correlation problems in the residuals, accordingly; $F_{FF}$ and $JB_N$ refer to F-statistic and Jarque-Bera to test the null hypotheses of no functional mis-specification and normal distribution, accordingly;		

As shown in Table 3. the findings of estimation revealed that there is a negative and statistically significant effect from the average real weighted end-use price of oil product at to international competitiveness at 1 % level. The results designate that a 1% increase in oilpp, reduce international competitiveness by 0.11%. Furthermore, the estimation findings show that at the 1% level, domestic crude oil price has a negative and statistically significant influence on international competitiveness in Azerbaijan. Findings of current study coincide with the economic theory and the findings of Saddler et al. (2006) in the case of Australia, Pearce and McKibbin (2007), Rivers (2010) in the case of Canada, Mafizur (2011) in the case of Australia, Grottera et al. (2015) in the case of G20 countries, Bassi et al. (2009) for USA, Silva et al. (2016) for Brazil, Rentschler et al. (2017) for Saudi Arabia, Pradhana et al. (2017) for India. From a theoretical perspective, the

reached a negative impact of carbon pricing expressed by the average real weighted end-use price of oil product and domestic crude oil price indicate that an increase in the carbon price (increase the prices of energy products) will increase firms' production costs and cause lower production, subsequently reduce their international competitiveness.

## 4. Conclusions

The link between carbon pricing policies (implicit) and international competitiveness is investigated in this study. The different cointegration tests (ARDLBT, CCR, DOLS and FMOLS) are utilized to assess the long-term relationship between the variables for this goal. Our findings show that there is a cointegration relationship between the variables for Azerbaijan. The estimation results indicate that the average real weighted end-use price of oil product and domestic crude oil prices have a statistically significant and negative influence on international competitiveness proxied by real exchange rate.

The obtained negative impact of carbon pricing, measured by the average real weighted end-use price of oil product and domestic crude oil price mean that the implicit measures of carbon pricing policies (increase the prices of energy products) can boost production costs and hinder the competitiveness of energy-intensive sectors in Azerbaijan. According to the results of this study, Azerbaijan should apply a slow energy price reform (removing incentives for fossil fuel energy or raising the prices of energy products) to reduce CO<sub>2</sub> emission. A steady increase in domestic energy prices to bring them up to worldwide benchmark levels, so increasing government budget revenues and making the economy and society more energy efficient. Also, the results of this study and many previous empirical studies stated that there is a trade-off between carbon pricing and competitiveness for oil-rich developing economies (such as Azerbaijan). Therefore, an effective trade-off is needed. For this reason, policy makers should apply the best trade-off policy option considering characteristics of Azerbaijan. Such means will reduce CO<sub>2</sub> emissions while the competitiveness of Azerbaijan will not be negatively influenced. In addition, the revenues getting from carbon pricing policies (raising the prices of energy products) should be returned to sectors to help them move smoothly to energy-efficient technologies and renewable energy sources. As a result, the industries cut carbon emissions without lowering production levels and harming their competitiveness. This idea may largely be executed by encouraging industries to invest in energy-efficient technologies and easing the transition to renewable energy sources. Moreover, Azerbaijani policy makers should ensure support packages to industries and household for minimizing the negative consequences of price rises as well as retaining international competitiveness of Azerbaijan. This would also raise the public acceptability of carbon pricing in Azerbaijan.

## Declarations

**Ethical Approval:** "Not applicable"

**Consent to Participate:** "Not applicable"

**Consent to Publish:** "Not applicable"

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