Impact of Financial Development on CO_2 Emissions: Panel Data Evidence from Iran's Economic Sectors

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ARTICLE INFO	ABSTRACT

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Introduction: The national trend indicates that various provinces of Iran have experienced attaining economic growth exclusive of parallel observing a boost in CO_2 emissions. It is clear that the effects of CO_2 emissions on health indicators such as death rate, infant mortality, and health expenditures have been ignored by policy makers over the past decades.

Methods: This study utilizes 1989-2016 panel data of the three economic sectors (agriculture, industry and services) of Iran to examine the effect of financial development on CO_2 emissions using Pooled Mean Group (PMG) and Mean Group (MG) Regression techniques for the first time in previous literature in Iran. The potential impact of government size and capital stock on CO_2 emissions is also analysed.

Results: According to empirical results, in the long-run, government size and capital stock increase CO_2 emissions, while financial development compact it. However, the results show these variables don't have statistically significant effect on CO_2 emissions in short-run.

Conclusion: The study opens up new policy insights to control the environment from degradation by financial development on economic sectors. It recommends that policy makers should realize the potentiality of the financial development in minimizing the CO_2 emissions. Therefore, the policy makers need to facilitate more financing at lower costs for investment in environmental projects.

Keywords: CO_2 emissions, financial development, government size, Iran's economic sectors, Pooled Mean Group (PMG) Regression

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Introduction

Over the past decades, Iran has been used fossil energy intensively for growth purposes in economic sectors such as agriculture, industry and services. This tends to important carbon dioxide (CO$_2$) emissions in almost all provinces of Iran. The greenhouse gases such as CO$_2$, and nitrous oxide (NO$_2$), usually come from economic activities such as energy-intensive industries, power plants, transportation, etc. For example, CO$_2$ emissions per capita increased from 4 metric tons in 1991 to 8.3 metric tons in 2014, implying almost 100% rise since 1991. It is clear that the effects of CO$_2$ emissions on health indicators such as death rate, infant mortality, and health expenditures has not been considered in economic growth process over the past decades. Therefore, since 2011, the quality of the environment has been a major concern for all provinces of Iran, and there has been a growing interest in the study of the relationship between CO$_2$ emissions, financial development and other societal and political factors.

This study examines the long- and short-run impacts of financial development and other control variables on CO$_2$ emissions using panel data of the three economic sectors of Iran such as agriculture, industry, and services. The domestic credit to private sector as a percentage of value added in each economic sector is used as alternate indicators of financial development. Previous studies have examined the long- and short-run impacts of financial development on CO$_2$ emissions in Iran by time series analysis [1, 2]. Further, other studies examined the impact of government size on the environmental quality as a public good and society welfare in the Caspian Sea countries (Iran, Turkmenistan, Kazakhstan, Russia, and Azerbaijan) [3]. The contribution of our study to the existing literature on the financial development and CO$_2$ emissions in Iran is to utilize panel data of the three economic sectors to examine the effect of financial development on CO$_2$ emissions.

The paper consists of the following sections; next section reviews existing literature; describes econometric modeling and estimation techniques; section 3 presents empirical results; section 4 focuses on discussion and the final section concludes the study.

Methods

There is large literature on the relationship between environmental quality and economic growth. For some pollutants such as CO$_2$ emissions, numerous scholarships find evidence of the "inverted-U shaped" link between economic growth and environmental quality (i. e., the pollution levels rise and then fall as income increases) known as the Environmental Kuznets Curve (EKC) [4-6]. However, there is limited evidence on the channels of financial development and environmental degradation [7-12]. According to the researches, involving in the practices of carbon trading activities, the presence of a well-functioning financial sector is essential as it is a device that offers the inducement to alleviate the emission of environmental harmful gases [8]. Also, as it was pointed out that improvement of the financial system prompts technological innovations (which act to propel productivity and hence economic growth) through risk sharing and easing capital mobilization [13].

Tamazian et al. argue that the financial development can play a remarkable role in the environmental performance [11]. Thus, greater financial sector development may facilitate more financing at lower costs, including for investment in environmental plans. Further, the financial development prepares with the motive and opportunity to use new technologies with clean and environment-friendly production processes [12].

Shahbaz et al. focus on the question whether financial development reduces CO$_2$ emissions or not in Malaysia. The empirical evidence indicates that financial development reduces CO$_2$ emissions [14].

Shahbaz et al. examine the relationship between economic growth, energy consumption, financial development, trade openness and CO_2 emissions over the period of 1975Q1–2011Q4 in case of Indonesia. The empirical results show that economic growth and energy consumption increase CO_2 emissions, while trade openness and financial development reduce it [15].

Boutabba examines the long-run relationship between CO_2 emissions, financial development, economic growth, energy consumption, and trade openness in India. The results confirm that financial development has a long-run positive effect on CO_2 emissions, implying that financial development increases environmental degradation [16].

Abbasi and Riaz estimate the impact of economic and financial development on CO_2 emissions in a small emerging economy. The results confirm that financial variables played a role in emission mitigation only in the latter period where greater degree of liberalization and financial sector development occurred [17].

Shahzad et al. examine the long-run equilibrium relationship between CO_2 emissions, energy consumption, trade openness and financial development in Pakistan. The long-run results indicate that one percent increase in trade openness and financial development will increase CO_2 emissions by 0.247% and 0.165%, respectively [18].

Salahuddin et al. examine the impact of economic growth; electricity consumption, foreign direct investment (FDI), and financial development on CO_2 emissions in Kuwait. Findings show that economic growth, electricity consumption, and FDI stimulate CO_2 emissions in both long and short –run [19].

Xiong and Tu empirically examine the relationship between financial development and CO_2 emissions using the regional panel data in China from 1997 to 2011. The results show that financial development reduces CO_2 emissions in the developed regions, while increases emissions in the less developed regions [20].

Paramati et al. empirically examine the impact of stock market growth and Foreign Direct Investment (FDI) inflows on CO_2 emissions in a panel of the G20 countries. The long-run elasticities indicate that FDI and stock market growth significantly reduces CO_2 emissions in the developing and developed economies [21].

The aim of this paper is to determine the effects of financial development on CO_2 emissions for a panel of the three economic sectors of Iran. Following Paramati et al. Shahbaz et al. Tamazian et al. and Tamazian and Rao [11,12,14,21] the functional form of the model is:

$$CDE_{it} = f\ (GFCF_{it},\ GS_{it},\ FD_{it}) \tag{1}$$
$$\ln CDE_{it} = \beta 0 + \beta 1 \ln GFCF_{it} + \beta 2 \ln GS_{it} + \beta 3 \ln FD_{it} + \varepsilon_{it} \tag{2}$$

Where, CO_2 emissions (CDE) is a function of capital stock (GFCF), government size (GS), and financial development variables (FD). The model in Eq. (2), aims to address the impact of financial development on the CO_2 emissions by accounting other potential control variables in the model such as capital stock and government size.

Where *ln* denotes the natural logarithm; $I=1,\ldots,N$ for each economic sector in the panel, and $t=1,\ldots,T$ refers to the time period. The parameters $\beta 1$, $\beta 2$ and $\beta 3$ are the long-run elasticities of CO_2 emissions relative to capital stock, government size and financial development variables, respectively.

We considered all the economic sectors of the Iran except oil sector and we made use of annual data from 1989 to 2016 (28 observations for each cross-section). Thus, this study makes use of a balanced panel data set of the economic sectors of Iran. The sample economic sectors of the Iran are as follows: agriculture, industry and services. All data were obtained from the Central Bank of Iran (CBI 2017).

The measurement of the variables is as follows: CO_2 Emissions (CDE) is measured in per capita metric tons; capital stock represents the Gross Fixed Capital Formation (GFCF) as a

percentage of value added in each economic sectors and Government Size (GS) is the total government expenditures as a percentage of value added in each economic sectors. Financial Development (FD) proxies by domestic credit to private sector as a percentage of value added in each economic sector.

Results

This study rationalizes the case for the use of a panel Autoregressive Distributed Lag (ARDL) model based on the use of two alternative estimators: Mean Group estimator (MG) and Pooled Mean Group estimator (PMG). The MG estimator was developed by Pesaran and Smith and PMG estimator was introduced by Pesaran et al. [22] According to Pesaran et al. panel ARDL can be used even with variables with different orders of integration and irrespective of whether they are $I(0)$ or $I(1)$ or a mixture of the two[22]. However, this is an important advantage of the panel ARDL model, but, we test for the presence of unit roots to ensure that no series exceeds $I(1)$ order of integration.

There are a variety of panel unit root tests, which include Levin et al. (LLC), Im et al. (IPS), Maddala and Wu [23-25]. The results in Table 1 point out that the hypothesis levels of all variables under study contain a unit root accepted at the 5% significant level. When these tests are applied on the first differences of those variables, the reported results display that the unit root hypothesis is rejected. So, the ARDL methodology can be used in order to estimate the model.

Table 1. Panel unit root test results

Test Statistic	LLC	IPS	ADF	PP(Fisher)
A:Level				
L CDE	-0.6461	-0.3003	9.5180	8.2156
L GFCF	1.1065	3.0111	0.6174	1.0849
L GS	-2.4937***	-0.6261	6.5106	5.8941
L DCP	-0.3051	-0.3657	3.3043	2.2731
B: First Differences				
DL CDE	-4.9908***	-5.5810***	35.7509***	119.326***
DL GFCF	-5.3129***	-7.4195***	47.9358***	63.2517***
DL GS	-7.4671***	-7.4474***	47.2491***	49.9463***
DL DCP	-3.8546***	-3.0371***	20.1847***	19.6223***

Note: *, **, *** indicate 10%, 5% and 1% significance levels respectively. All test Statistics are estimated by Adding an intercept to the models.
Source: Author's estimations.

Besides the order of integration of the variables another important issue is that ARDL lag structure should be determined by some consistent information criterion. According to the Schwartz Bayesian criterion, we impose the following lag structure (1,1,1,1) for the CO₂ emissions, capital stock, government size, and financial development respectively. (The test results are available upon request). Table 2 reports the results of PMG and MG estimation along with the Hausman h-test to measure the efficiency and consistency among them.

Table 2. Results from PMG and MG estimation for model

Explanatory Variables	PMG		MG	
	long-run	Short-run	long-run	Short-run
GFCF	0.2922***		0.1923***	
GS	0.274***		0.2385**	
DCP	-0.3287***		-0.1317	
Error-Correction		-0.1772**		-0.3596***
D GFCF		-0.0512		0.0059
D GS		-0.0140		-0.0377
D DCP		-0.0585		-0.1995
Intercept		1.5158**		3.4890***
Economic sectors	3		3	
Observation	75		75	
Hausman test		3.31[a]		
p-Value		0.1912		

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively
a PMG is more efficient estimation than MG under null hypothesis
Source: Author's estimations.

Discussion

The results indicate that financial development (FD) has a negative and significant impact on CO_2 emissions in the long-run according to the PMG estimator. But it has insignificant impact on CO_2 emissions according to the MG estimator in the long-run. Furthermore, PMG and MG estimators suggest negative and insignificant coefficient in the short-run. The validity of the long-run homogeneity restriction across countries, and hence the efficiency of the PMG estimator over the MG estimator, is examined by the Hausman test. According to the results of the Hausman test accepts the null hypothesis of the homogeneity restriction on the regressors in the long-run, which indicates that PMG is a more efficient estimator than MG.

Conclusion

This study examines the impact of financial development with capital stock and government size on CO_2 emissions in the period of 1989-2016 for the three economic sectors of Iran. The panel ARDL methodology is used to examine long-run relationship among the variables and short-run dynamics are checked by applying error correction method. The effects of financial development and other potential control variables in the model such as capital stock and government size on CO_2 emissions are examined through the PMG and MG estimators.

The results show that financial development has a statistically significant negative effect on CO_2 emissions in the long-run. This implies that domestic credit to private sector a percentage of value added in each economic sector subscriptions reduces the CO_2 emissions in Iran. This supports previous studies such as Shahbaz et al. in case of Malaysia[14]. But, the estimated coefficients on short-run show that financial development has not a statistically significant negative effect on CO_2 emissions in Iran. This study recommends that policy makers should realize the potentiality of the financial development in minimizing the CO_2 emissions. Therefore, the policy makers need to facilitate more financing at lower costs for investment in environmental projects.

Moreover, results show that the relationship between government size and CO_2 emissions is positive, so government size has negative relationship with air quality. The relationship between government size and air quality indicates government has an incorrect effect on the externalities of market operations. Further, government has a negative impact on supply a

public good namely air quality. This has not supported previous studies such as Jafari Samimi in case of Caspian Sea countries. This may tend to suggest cutbacks in government size especially by reducing economic activities.

For future research, a possible extension of our analysis could be the assessment of the effect of stock markets indexes on CO$_2$ emissions for the three economic sectors of Iran.

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Conflict of Interest

No conflict of interest was reported by the authors.

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