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Investigating the Relationship between Economic Growth, Traffic Volume and Environmental Stress in Iran: A Decoupling Approach

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EXTENDED ABSTRACT
INTRODUCTION

One of the requirements of economic growth is the development of the transport sector and its related services. But the transportation development, in addition to the positive economic effects, has an undeniable impact on the pollutants emission. Now the question is "what should be done to reduce carbon dioxide emissions in the transport sector so that economic development is not Disrupted". Decoupling carbon dioxide emissions from economic growth in the transport sector is the key to providing a practical solution to achieve low-carbon economic development.

The decoupling concept refers to conditions in which economic growth increases but environmental Stress decreases over the same period. The Organization for Economic Co-operation and Development (OECD) was the first organization which developed decoupling concept (OECD, 2000). Then Vehmas et al. (2003) described different aspects of decoupling and Tapio (2005) presented a elasticity-based decoupling model. Subsequently, the decoupling of carbon dioxide emissions from economic growth Was considered by many researchers (e.g., Loo & Banister, 2016; Zhang, 2018; Riti et al., 2017; Wu et al., 2018; Wang et al., 2018). But in this field no study has been done in Iran so far. Therefore, this study is going to investigate this issue in Iran to contribute to identifying appropriate measures to achieve decarbonization in the transport sector.

METHODOLOGY

Many decomposition techniques are used to decompose the CO2 emissions changes into various driving factors, such as Structural Decomposition Analysis (SDA) and Index Decomposition Analysis (IDA). However, nowadays decoupling analysis is a novel concept that requires less data and calculation, and provides more details on the relationship between economic growth and carbon emissions. There are three approaches to do decoupling analysis: OECD, Vehmas et al. (2003) and Tapio (2005). The OECD approach has several disadvantages, such as inaccurate measurement and

unclear criteria that caused to develop this method by Vihmas et al. (2003) and finally Tapio(2005) by modifying the classification of Vehmas et al. (2003) improved their method. To doing so, Tapio (2005) at first changed the six possible linking and de-linking states introduced by Vehmas et al. (2003) to eight possible logic states; Second, he introduced the concept of negative decoupling, and third, he defined specific intervals for the environmental stress elasticity of economic growth, and he specified each decoupling and linking states more accurate. Accordingly, in this paper, we use the Tapio approach to investigate the decoupling of environmental stress from economic growth (Tapio, 2005). A summary of this approach is given in Table (1).

Table 1. Degrees of the coupling and decoupling process based on Tapio(2005) approach
Source: Researcher Conclusion Based on Tapio(2005) Classification

Degrees of the linking and decoupling	ΔVOL		ΔGDP		$\%\Delta VOL/\%\Delta GDP$
	< 0	> 0	< 0	> 0	
Weak decoupling		*		*	*[0-0.8]*
Weak negative decoupling	*		*		*[0-0.8]*
Strong decoupling	*			*	$\%\Delta VOL/\%\Delta GDP < 0$
Strong negative decoupling		*	*		$\%\Delta VOL/\%\Delta GDP < 0$
Expansive negative decoupling		*		*	$\%\Delta VOL/\%\Delta GDP > 1.2$
Recessive decoupling	*		*		$\%\Delta VOL/\%\Delta GDP > 1.2$
Expansive coupling		*		*	*[0.8-1.2]*
Recessive coupling	*		*		*[0.8-1.2]*

The Research data have been extracted from the Statistical Center of Iran and the Iran energy balance sheets during the period 2000-2018. The period is seleted so that it covers the ten years before and after the implementation of the targeted subsidies law, because changes in energy prices in this period can affect the activities of the transport sector, energy consumption and carbon dioxide emissions. The variables of this research include the value added of the sub-sectors of the transport (road, rail, air and sea transport), non–oil real GDP , the total volume of freight and passenger in the transport sector and its sub-sectors and the amount of carbon dioxide emissions of transport sector and its sub-sectors.

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FINDINGS

The Decoupling results of freight and passenger transport from economic growth and carbon dioxide emissions are given in Tables (2) and (3), respectively. In these tables the symbols TG, TP, GDP and CO2 are used to represent freight transport, passenger transport, GDP and carbon dioxide emissions, respectively.

The decoupling results of passenger and freight transport from economic growth in Table (2) show that the increase in energy prices in the early years of targeted subsidies law implementation (2010-2014) has led to a strong decoupling of freight and passenger transport growth from economic growth, this means that despite the positive economic growth, the growth of transport has been negative. But the affectability level of passenger transport has been significantly greater than freight transport. After that, the decoupling state in the freight transport sector has changed to a expansive negative decoupling, while in the passenger transport sector, there is still a strong decoupling.

Table 2. Decoupling of transport volume growth from economic growth
Source: Research Findings

Decoupling of passenger transport volume growth from economic growth				
Period	(ΔTP)	(ΔGDP)	%ΔTP/%ΔGDP	Decoupling State
2000-2004	2.04	29.64	0.07	Weak decoupling
2005-2009	23.68	25.74	0.92	Expansive coupling
2010-2014	-15.17	2.28	-6.66	Strong decoupling
2015-2018	-10.16	13.97	-0.73	Strong decoupling
Decoupling of freight transport volume growth from economic growth				
Period	(ΔTG)	(ΔGDP)	%ΔTG/%ΔGDP	Decoupling State
2000-2004	42.37	29.64	1.43	Expansive negative decoupling
2005-2009	22.61	25.74	0.88	Expansive coupling
2010-2014	-7.06	2.28	-3.10	Strong decoupling
2015-2018	21.13	13.97	1.51	Expansive negative decoupling

Table 3. Decoupling of transport volume growth from co2 emission
Source: Research Findings

Decoupling of passenger transport volume growth from CO2 emission				
Period	(ΔTP)	(ΔCO2)	%ΔCO2/%ΔTP	Decoupling State
2000-2004	2.04	27.25	13.34	Expansive negative decoupling
2005-2009	23.68	27.29	1.15	Expansive coupling
2010-2014	-15.17	12.19	-0.80	Strong negative decoupling
2015-2018	-10.16	3.92	-0.39	Strong negative decoupling

Decoupling of freight transport volume growth from CO2 emission				
Period	(ΔTG)	(ΔCO2)	%ΔCO2/%ΔTG	Decoupling State
2000-2004	42.37	27.25	0.64	Weak decoupling
2005-2009	22.61	27.29	1.21	Expansive negative decoupling
2010-2014	-7.06	12.19	-1.73	Strong negative decoupling
2015-2018	21.13	3.92	0.19	Weak decoupling

Based on Table (3) which shows the decoupling state of freight and passenger transport from carbon dioxide emissions, we can say that the increase in the energy price in the period 2010-2014 has led to

Significant reductions in passenger and freight transport, But ,although the carbon dioxide emission growth has decreased compared to the previous period, it is still positive. Therefore, the carbon dioxide emission growth has occurred along with the reduction of passenger and freight transport, reveals the need for complementary policies implementation. In 2015-2018 period, although the freight transport sector is still affected by the implementation of this law, but this effect is not observed in the passenger transport sector.

CONCLUSION

Based on the results, Although the reform of energy prices in 2010, is caused to change the relationship between economic growth and traffic volume from an expansive coupling (economic growth with increase in traffic volume) to a Strong decoupling (economic growth with decrease in traffic volume), but due to the lack of a Strong decoupling between traffic volume and carbon emissions, energy price reform has not reduced carbon emissions. Therefore, low carbon development in the transport sector does not achieved only by energy prices reform and requires the implementation of appropriate energy efficiency policies and using related technologies to reducing carbon emissions. Based on the findings of this study, the following suggestions are recommended to define appropriate carbon reduction strategies for the transport sector, First, the energy prices of the transport sector should be corrected. Second, ban traffic of high-carbon vehicles while promoting new technologies and energy sources proportionate with modern transportation. Third, improving transport infrastructure, especially road transport, should be on the agenda. Fourth, the share of non-road transport (rail, air and sea), especially rail transport in the freight transport sector, should be substantially strengthened so that a large volume of goods can be moved with less energy consumption and less pollution.

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