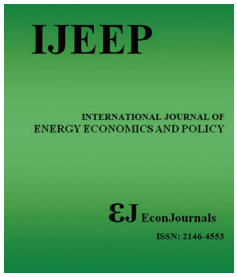

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Does Unemployment Affect Light Commercial Vehicle Emissions Intensity?

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ABSTRACT

This study investigates whether unemployment affects the share of greenhouse gas (GHG) emissions attributable to light commercial vehicles (LCV) in Greece over the period 2000-2023. While existing studies have primarily focused on economic growth, fuel prices, and environmental regulations as determinants of transport emissions, the role of labour market conditions has received little attention. Using annual data, the analysis employs ordinary least squares (OLS), a dynamic specification with a lagged dependent variable, and an Autoregressive Distributed Lag (ARDL) framework. The baseline model indicates no statistically significant relationship between unemployment and LCV emission share. However, once dynamic adjustment is considered, unemployment emerges as a significant determinant of LCV emission intensity. The ARDL bounds test further provides evidence of a stable long-run relationship between the variables. The results suggest that higher unemployment is associated with a larger contribution of LCV emissions to total road transport emissions, potentially reflecting reduced economic growth, slower fleet renewal, and prolonged use of older vehicles. The findings indicate that labour-market shocks can impact the decarbonization of the transport sector by affecting commercial vehicle replacement decisions. Furthermore, labour market conditions may have enduring environmental impacts.

Keywords: Unemployment, Greenhouse Gas Emissions, Light Commercial Vehicles, Fleet Renewal, ARDL, Greece
JEL Classifications: Q53, R41, J64, C22

1. INTRODUCTION

The transition towards low-carbon transport is commonly discussed in terms of technological innovation, fuel substitution and environmental regulation (IEA, 2023; European Commission, 2022). Public policies have largely focused on accelerating the adoption of cleaner vehicle technologies through financial incentives, emissions standards and investments in charging infrastructure. While these measures are essential, they implicitly assume that households and firms are able to replace existing vehicles whenever cleaner alternatives become available. However, vehicle replacement is also an investment decision that is constrained by macroeconomic conditions that influence investment decisions and access to capital (Sierzchula et al., 2014; Dijk et al., 2013) and this is more obvious in the case of LCV, where the vehicle is actually an asset and a tool of the firm.

Periods of economic distress may substantially slow the decarbonisation process by delaying fleet renewal (Fouquet, 2016; Timilsina and Shrestha, 2009). When unemployment rises and available income declines, firms face lower demand, tighter liquidity constraints and greater uncertainty regarding future investment. Under these conditions, businesses often postpone the replacement of productive assets, including commercial vehicle fleets. As a result, older and less efficient vehicles that use older technology remain in operation for longer periods, potentially slowing improvements in environmental performance even in the presence of increasingly ambitious climate policies.

This mechanism may be particularly relevant for light commercial vehicles (LCVs). Unlike passenger cars, LCVs represent productive capital rather than consumption goods (van Vliet et al., 2011; Fontaras et al., 2017). Their purchase is primarily

determined by business expectations and plans, economic conditions and operational requirements instead of household preferences, family needs and daily commuting. Consequently, labour-market conditions and especially unemployment may influence fleet renewal indirectly through its effects on firms' investment behaviour. Despite this plausible transmission mechanism, empirical evidence linking labour-market conditions to commercial vehicle emissions remains remarkably limited.

Greece provides an informative case for examining this relationship. The sovereign debt crisis generated one of the deepest and longest labour-market disruptions experienced by an advanced European economy (Matsaganis, 2013; Bank of Greece, 2014; European Automobile Manufacturers Association, 2016). Unemployment increased dramatically, business investment collapsed and registrations of new commercial vehicles declined sharply. As illustrated in Figure 1, the rise in unemployment during the Greek economic crisis coincided with a major decline in new LCV registrations. Subsequently, labour-market recovery was accompanied by a gradual rebound in LCV registrations.

Although previous studies have extensively documented the macroeconomic consequences of the crisis, considerably less attention has been devoted to its potential environmental implications, particularly regarding the evolution of commercial vehicle emissions.

Most empirical research examining transport-sector emissions has focused on variables such as economic growth, energy prices, technological progress, transport demand and environmental regulation (IEA, 2023; Creutzig et al., 2015). On the contrary, little attention has been given to labour-market conditions as a potential determinant of transport decarbonisation. Yet unemployment may influence emissions through economically meaningful channels, by affecting firms' capacity to replace vehicle fleets with modern more technologically advanced vehicles which use cleaner technologies. Ignoring this mechanism risks overlooking an important source of persistence in transport-sector emissions.

Against this background, this paper investigates whether unemployment is associated with the greenhouse gas emission share of light commercial vehicles over total road transport emissions in Greece during the period 2000-2023. Rather than treating unemployment simply as another macroeconomic indicator, the analysis interprets it as a proxy for investment constraints affecting LCV fleet renewal. To examine both short-run dynamics and long-run equilibrium relationships, the paper combines ordinary least squares estimation with a dynamic specification and an Autoregressive Distributed Lag (ARDL) framework (Pesaran et al., 2001; Gujarati and Porter, 2009).

The paper contributes to literature in three ways. First, it introduces labour-market conditions into the analysis of commercial vehicle emissions, an aspect that has received limited empirical attention (Creutzig et al., 2015). Second, it provides dynamic evidence on the relationship between unemployment and transport-sector environmental performance using annual Greek data spanning major economic disruptions. Third, it highlights the importance of integrating macroeconomic resilience into transport decarbonisation strategies by demonstrating that labour-market shocks may generate persistent environmental consequences through delayed fleet renewal.

2. LITERATURE REVIEW

The relationship between transport activity and greenhouse gas (GHG) emissions has been extensively examined in the environmental and transport economics literature. Most empirical studies identify economic growth, energy consumption, fuel prices, technological progress and environmental regulation as the principal determinants of transport-related emissions (Schipper et al., 2000; Ben Abdallah et al., 2013; Creutzig et al., 2015; Rasool et al., 2019; Dai et al., 2023). Improvements in vehicle technology, stricter emission standards and the transition towards alternative fuels have been recognised as the primary mechanisms through which transport systems can reduce their environmental footprint (European Environment Agency, 2024).

A growing body of research has also emphasised the importance of fleet renewal in achieving transport decarbonisation. Older vehicles generally exhibit lower fuel efficiency and higher pollutant emissions than newer models that comply with more stringent environmental standards (Dargay et al., 2007; Ghisolfi et al., 2022). Consequently, policies encouraging the replacement of ageing vehicle fleets have become a central component of European climate policy. The environmental benefits of fleet renewal, however, depend not only on technological availability but also on the economic capacity of firms and households to undertake new investment.

Investment decisions regarding commercial vehicles differ substantially from those concerning passenger cars. Light commercial vehicles constitute productive capital and are acquired primarily to support business activity rather than private consumption. Their replacement is therefore closely linked to firms' financial conditions, expectations regarding future demand and access to external finance. During periods of economic uncertainty, businesses frequently postpone capital replacement in order to preserve liquidity, thereby extending the operational life of existing vehicle fleets (Vesovic et al., 2022; Campello et al., 2010).

Despite the extensive literature on transport emissions and fleet renewal, comparatively little attention has been devoted to the role of labour-market conditions. Rising unemployment is typically associated with declining economic activity, reduced business investment and tighter financial constraints. These conditions may indirectly slow the adoption of cleaner vehicle technologies by delaying replacement decisions, particularly among small and medium-sized enterprises that rely heavily on light commercial vehicles. Nevertheless, unemployment has rarely been examined as a direct determinant of transport-sector environmental performance.

This study seeks to address this gap by investigating whether labour-market conditions and unemployment specifically, influence the greenhouse gas emission share of light commercial vehicles in Greece. Rather than viewing unemployment solely as

a macroeconomic indicator, the analysis interprets it as a proxy for investment constraints that may affect the pace of fleet renewal. By combining conventional regression techniques with a dynamic ARDL framework, the study contributes to the emerging literature linking macroeconomic instability with transport decarbonisation and environmental sustainability.

3. DATA AND METHODS

This study investigates the relationship between unemployment and the share of greenhouse gas (GHG) emissions attributed to light commercial vehicles (LCV) in Greece over the period 2000–2023. The dependent variable is the LCV emission share of total road transport emissions, calculated using annual greenhouse gas emission data. The unemployment rate serves as a proxy for labour-market conditions and the investment constraints that may delay fleet renewal. The analysis assumes that high unemployment influences fleet renewal primarily through investment postponement rather than through immediate changes in transport activity. The sample covers the pre-crisis period, the Greek sovereign debt crisis and the subsequent recovery, thereby capturing substantial variation in labour market conditions and transport-sector dynamics.

Data on unemployment are obtained from Hellenic Statistical Authority (ELSTAT), and transport emissions and energy-related indicators are compiled from Eurostat and the International Energy Agency (IEA). Table 1 presents the definitions and data sources of the variables used in empirical analysis. Table 2 reports the descriptive statistics for the main variables over the 2000–2023 sample period.

The empirical analysis was conducted in three stages. First, a baseline ordinary least squares (OLS) model was estimated to examine the relationship between the LCV emission share and unemployment.

$$LCV\ Share_t = \alpha + \beta Unemployement_t + \varepsilon_t \quad (1)$$

Second, a dynamic specification, including a lagged dependent variable, is estimated to account for persistence in emission patterns. Robust standard errors based on the Newey–West correction were employed to address potential autocorrelation and heteroscedasticity.

$$LCV\ Share_t = \alpha + \rho LCV\ Share_{t-1} + \beta Unemployement_t + \varepsilon_t \quad (2)$$

Third, this study uses an Autoregressive Distributed Lag (ARDL) framework to investigate both short-run dynamics and long-run equilibrium relationships.

$$LCV\ Share_t = \alpha + \sum_{i=1}^{p} \phi_i LCVShare_{t-i} + \sum_{j=0}^{q} \beta_j Unemployement_{t-j} + \varepsilon_t \quad (3)$$

The ARDL approach is particularly appropriate for this study because it performs well with relatively small samples and can accommodate variables integrated of order zero, I(0), and order one, I(1), provided that none is integrated of order two, I(2) (Pesaran and Shin, 1999; Pesaran et al., 2001). Stationarity is assessed using the Augmented Dickey–Fuller (ADF) test, while the existence of a long-run equilibrium relationship is examined using the ARDL bounds testing procedure. Once cointegration is confirmed, the long-run coefficients and the associated error-correction representation are estimated to evaluate both the long-run effects of unemployment and the speed at which deviations from equilibrium are corrected.

4. RESULTS

Table 3 presents the corresponding correlation matrix. The pairwise correlations provide preliminary evidence that unemployment is only weakly associated with the LCV emission share, suggesting that a static contemporaneous relationship may underestimate the effect of labour-market conditions. The strong negative association between GDP (data obtained from Hellenic Statistical Authority) and unemployment also highlights the importance of accounting for macroeconomic dynamics when interpreting the subsequent regression estimates.

The empirical results are presented progressively in three steps. The baseline OLS model examines the contemporaneous association between unemployment and the LCV emission share. A dynamic specification is subsequently estimated to account for persistence in emission patterns, while the ARDL framework evaluates whether a long-run equilibrium relationship exists between the variables.

Table 1: Definition of variables

Variable	Description	Source
LCV_GHG_share	Share of GHG emissions from LCV over total road transport emissions (%)	EUROSTAT
Unemployment	Annual unemployment rate (%)	Hellenic Statistical Authority

Table 2: Descriptive statistics

Variable	Mean	Standard deviation	Minimum	Maximum
LCV_GHG_share (%)	15.40	2.97	11.24	19.79
Unemployment (%)	15.51	6.49	7.80	27.80

The table reports descriptive statistics for the variables used in the empirical analysis. The sample consists of annual observations for Greece covering the period 2000-2023 (n=24)

Table 3: Correlation matrix, notes: pairwise correlation coefficients for the period 2000-2023

Variable	LCV emission share	GDP	Diesel price	Unemployment
LCV emission share	1.000			
GDP	−0.580	1.000		
Diesel price	0.359	−0.225	1.000	
Unemployment	0.287	−0.738	0.442	1.000

The baseline OLS estimates are presented in Table 4. The unemployment coefficient is positive but statistically insignificant, indicating that changes in unemployment do not appear to have an immediate effect on the LCV emission share. This suggests that the environmental consequences of labour market conditions may not materialize concurrently. To account for persistence in emission patterns, a dynamic specification, including the lagged dependent variable, is estimated and the estimates of the are presented in Table 4 as well. The lagged emission share is strongly significant, confirming substantial inertia in the evolution of transport sector emissions. Once this dynamic adjustment is considered, unemployment emerges as a positive and statistically significant determinant of the LCV emission intensity and the estimated coefficient of 0.97 implies that a 1%-point increase in unemployment is associated with approximately a 0.10%-point increase in the LCV emission share after accounting for dynamic persistence. The result remains robust when Newey–West standard errors are employed, indicating that the relationship is not driven by autocorrelation or by heteroscedasticity.

Table 5 reports the ARDL estimates and the associated cointegration tests. The bounds testing procedure provides evidence of a stable, long-run relationship between unemployment and the LCV emission share. The finding supports the hypothesis that labour-market deterioration (unemployment) delays commercial vehicle replacement, thereby increasing the relative contribution of older LCVs to total transport-sector emissions, implying that higher unemployment is associated with a larger share of LCV emissions in total road transport emissions as time progresses.

Table 4: Baseline and dynamic estimates, dependent variable: LCV_GHG_share

Variables	(1) OLS	(2) Dynamic model
Unemployment	0.131	0.097**
	(0.650)	(0.016)
lag_share		0.946***
		(<0.001)
Constant	0.134***	0.020
	(0.001)	(0.098)
Observations	24	23
R^2	0.082	0.893

Column "(1) OLS" reports baseline OLS estimates. Column "(2) Dynamic model" reports the dynamic specification including the lagged dependent variable. Newey–west corrected P-values are reported in parentheses. ** P<0.05, *** P<0.01

Table 5: ARDL cointegration and long-run results

Panel A: Bounds test for cointegration			
Statistic	**Value**	**P-value**	
Bounds F-statistic	7.623	0.012	
Panel B: Long-run estimates			
Variable	**Coefficient**	**Standard error**	**P-value**
Unemployment	0.533	0.238	0.037
Panel C: Error-correction representation (UECM)			
Variable	**Coefficient**	**Standard error**	**P-value**
ECM	−0.233	0.106	0.040
*Observations=23			

The bounds test rejects the null hypothesis of no long-run relationship. The long-run coefficient indicates that higher unemployment is associated with a larger share of greenhouse gas emissions attributable to light commercial vehicles. The negative and statistically significant error-correction term confirms convergence towards the long-run equilibrium

The findings indicate that unemployment affects transport sector emissions primarily through dynamic and long-run mechanisms. The results suggest that unemployment affects the composition of transport emissions rather than their level. While aggregate transport activity may decline during economic downturns, reduced fleet renewal appears to increase the relative contribution of older light-commercial vehicles to total transport sector emissions.

5. DISCUSSION

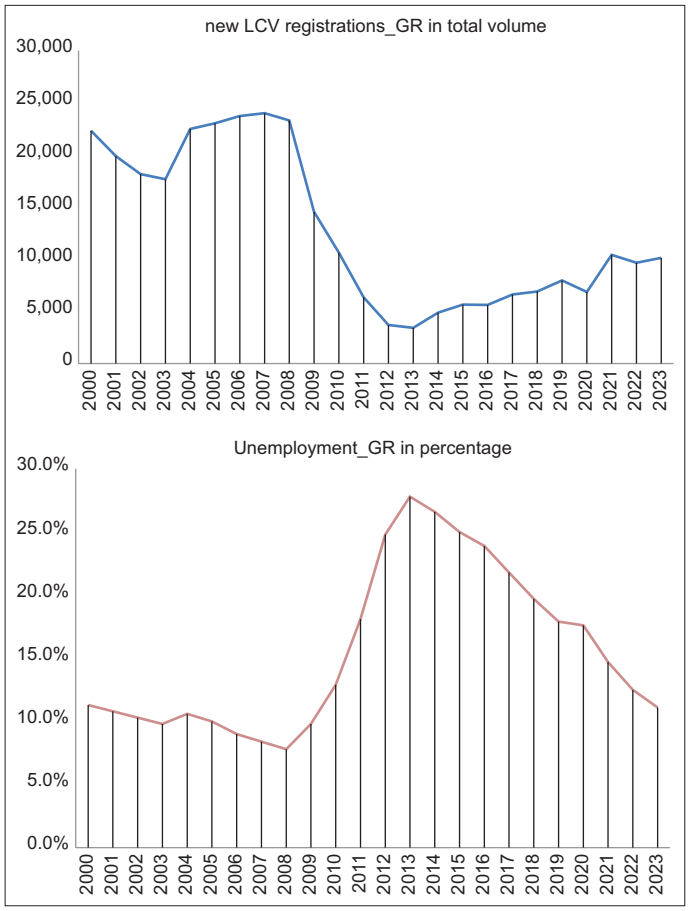
This study examined the relationship between unemployment and the share of greenhouse gas emissions attributable to light commercial vehicles in Greece over the period 2000-2023, covering major economic events including the sovereign debt crisis, the COVID-19 pandemic and the subsequent recovery. While the baseline OLS specification did not identify a statistically significant contemporaneous relationship, the results changed substantially once dynamic adjustment and long-run equilibrium relationships were considered. This finding highlights the importance of adopting dynamic econometric approaches when investigating the environmental implications of macroeconomic conditions.

The empirical findings indicate that unemployment is positively associated with the LCV GHG emission share in the long run. More specifically, the ARDL estimates suggest that periods of elevated unemployment are accompanied by a larger contribution of light commercial vehicle emissions to total road transport emissions. These results are consistent with the hypothesis that adverse labour-market conditions delay investment decisions, including the replacement of ageing commercial vehicles, thereby extending the operational life of older, less fuel-efficient and more polluting fleets. This interpretation is consistent with the fleet-replacement literature, which shows that capital and budget constraints can restrict or postpone vehicle replacement decisions (Karabakal et al., 1994).

The findings are also consistent with the broader literature on investment under uncertainty, which argues that firms tend to postpone irreversible investment decisions during periods of heightened macroeconomic instability (Dixit and Pindyck, 1994; Campello et al., 2010). The acquisition of new light commercial vehicles represents a capital investment that depends on business expectations, financing conditions and anticipated demand. Consequently, rising unemployment may reduce firms' willingness and ability to modernise their vehicle fleets. Rather than generating an immediate increase in transport emissions, labour-market deterioration appears to influence the composition of the vehicle fleet, producing gradual but persistent environmental effects through slower fleet renewal.

The results further support the concepts of capital adjustment and fleet ageing. Commercial vehicle fleets evolve gradually because replacement occurs over several years rather than instantaneously. Temporary economic shocks may therefore generate environmental consequences that persist well beyond the duration of the initial downturn. This adjustment mechanism is

Figure 1: Inverse evolution of new light commercial vehicle registrations and unemployment in Greece (2000-2023). Official Data Sources: AMVIR available at: https://seaa.gr/and Hellenic Statistical Authority available at: https://www.statistics.gr/



reflected in the strong persistence of the lagged dependent variable and the statistically significant long-run equilibrium relationship identified by the ARDL model. These findings suggest that the environmental consequences of labour-market shocks should be viewed as cumulative processes rather than immediate responses to changing economic conditions.

More broadly, the results are consistent with the notion of economic hysteresis, whereby temporary labour-market disruptions produce persistent economic and environmental consequences through delayed capital renewal. In the present context, prolonged unemployment may continue to affect transport-sector environmental performance long after economic activity has recovered because older commercial vehicles remain in service for extended periods. Transport decarbonisation should therefore be viewed not only as a technological or regulatory challenge, but also as a process that depends on macroeconomic stability and firms' investment capacity.

The study also extends the existing literature by introducing labour-market conditions as an indirect determinant of transport-sector environmental performance. Previous research has primarily examined the effects of economic growth, fuel prices, technological progress and environmental regulation on transport emissions, whereas considerably less attention has been devoted to the role of unemployment. The present findings suggest that labour-market conditions may influence transport decarbonisation indirectly through their impact on fleet renewal decisions, thereby providing an additional explanation for the persistence of transport-related emissions during periods of economic distress.

Several limitations should be acknowledged. First, the analysis is confined to Greece, and the findings may therefore not be fully generalisable to countries with different labour-market characteristics or transport systems. Second, the relatively small annual sample limits the complexity of the econometric specifications that can be estimated reliably. Third, unemployment is employed as a proxy for investment constraints rather than as a direct measure of firms' fleet replacement behaviour. Future research could investigate this mechanism using firm-level data, cross-country panel datasets or direct indicators of commercial vehicle replacement decisions.

Overall, the findings indicate that labour-market conditions should be recognised as an integral component of transport decarbonisation strategies. Policies supporting commercial fleet renewal during periods of economic distress may simultaneously strengthen economic resilience and accelerate the transition towards lower transport-sector greenhouse gas emissions. Consequently, employment policy and environmental policy should be viewed as complementary rather than independent policy domains.

6. CONCLUSION

This paper examined whether labour-market shocks, as reflected by unemployment, influence the decarbonisation of the light commercial vehicle (LCV) fleet in Greece. Using the share of greenhouse gas (GHG) emissions attributable to LCVs within total road transport emissions as an indicator of fleet renewal, the study employed ordinary least squares (OLS), a dynamic specification and an Autoregressive Distributed Lag (ARDL) framework to investigate both short-run and long-run relationships. The results indicate that unemployment exerts a positive and statistically significant long-run effect on the LCV GHG emission share, suggesting that labour-market deterioration delays fleet renewal and slows transport decarbonisation.

The study contributes to the literature by identifying labour-market conditions as an indirect determinant of transport decarbonisation. By demonstrating that unemployment may delay fleet renewal and increase the relative contribution of light commercial vehicles to total road transport greenhouse gas emissions, the analysis extends the existing literature beyond its traditional focus on economic growth, fuel prices and environmental regulation. The findings also have important policy implications, suggesting that macroeconomic conditions should be considered alongside technological and regulatory measures when designing policies aimed at accelerating fleet renewal, promoting light commercial vehicle electrification and supporting the transition towards a low-carbon transport system. Policies that facilitate investment in newer commercial vehicles during periods of economic distress

may therefore contribute simultaneously to economic resilience and improved environmental performance.

Despite its contributions, the study is subject to certain limitations. First, the empirical analysis is based on annual data, which limits the ability to capture short-term fluctuations in labour-market conditions and transport activity. Second, the analysis focuses exclusively on Greece, and the findings may therefore not be directly comparable to countries with different economic structures or transport systems. Finally, unemployment is employed as a proxy for investment constraints rather than as a direct measure of fleet renewal decisions. Future research could extend the analysis using cross-country panel data, firm-level information or direct indicators of vehicle replacement to further investigate the mechanisms through which labour-market conditions influence transport decarbonisation.

REFERENCES

Bank of Greece. (2014), Monetary Policy 2013-2014. Athens: Bank of Greece. Available from: https://www.bankofgreece.gr/Publications/NomPol20132014_en.pdf

Ben Abdallah, K., Belloumi, M., De Wolf, D. (2013), Indicators for sustainable energy development: A multivariate cointegration and causality analysis from Tunisian road transport sector. Renewable and Sustainable Energy Reviews, 25, 34-43.

Campello, M., Graham, J.R., Harvey, C.R. (2010), The real effects of financial constraints: Evidence from a financial crisis. Journal of Financial Economics, 97(3), 470-487.

Creutzig, F., Roy, J., Lamb, W.F., Azevedo, I.M.L., Bruines, J., Dalkmann, H., Edelenbosch, O.Y., Geels, F.W., Grubler, A., Hepburn, C., Hertwich, E.G., Khosla, R., Mattauch, L., Minx, J.C., Ramakrishnan, A., Rao, N.D., Steinberger, J.K., Tavoni, M., ürge-Vorsatz, D., Weber, E.U. (2015), Transport: A roadblock to climate change mitigation? Science, 350(6263), 911-912.

Dai, J., Alvarado, R., Ali, S., Ahmed, Z., Meo, M.S. (2023), Transport infrastructure, economic growth, and transport CO_2 emissions nexus: Does green energy consumption in the transport sector matter? Environmental Science and Pollution Research, 30, 40094-40106.

Dijk, M., Orsato, R.J., Kemp, R. (2013), The emergence of an electric mobility trajectory. Energy Policy, 52, 135-145.

Dixit, A.K., Pindyck, R.S. (1994), Investment under Uncertainty. Princeton, NJ: Princeton University Press. DOI: https://doi.org/10.1515/9781400830176.

European Automobile Manufacturers' Association (ACEA). (2016), 2015 Motor Vehicle Registrations in Europe, by Country. Brussels: ACEA. Available from: https://www.acea.auto/figure/2015-motor-vehicle-registrations-in-europe-by-country/

European Commission. (2022), Leading the Green Transition. Brussels: European Commission. Available from: https://commission.europa.eu/strategy-and-policy/state-union/state-union-2022/leading-green-transition_en

European Environment Agency. (2024), Greenhouse Gas Emissions from Transport. Copenhagen: European Environment Agency.

Eurostat. (2024), Unemployment Statistics Database. Luxembourg: European Commission.

Fontaras, G., Zacharof, N.G., Ciuffo, B. (2017), Fuel consumption and CO2 emissions from passenger cars in Europe – Laboratory versus real-world emissions. Progress in Energy and Combustion Science, 60, 97-131.

Fouquet, R. (2016), Path dependence in energy systems and economic development. Nature Energy, 1, 16098.

Ghisolfi, V., Tavasszy, L.A., Correia, G.H.A., Chaves, G.L.D., Ribeiro, G.M. (2022), Freight transport decarbonization: A systematic literature review of system dynamics models. Sustainability, 14(6), 3625.

Gujarati, D.N., Porter, D.C. (2009), Basic Econometrics. 5th ed. New York: McGraw-Hill/Irwin.

International Energy Agency (IEA). (2023), The Role of E-fuels in Decarbonising Transport. Paris: International Energy Agency.

Karabakal, N., Lohmann, J.R., Bean, J.C. (1994), Parallel replacement under capital rationing constraints. Management Science, 40(3), 305-319.

Matsaganis, M. (2013), The Greek Crisis: Social Impact and Policy Responses. Berlin: Friedrich Ebert Stiftung.

Pesaran, M.H., Shin, Y. (1999), An autoregressive distributed lag modelling approach to cointegration analysis. In: Strom, S., editor. Econometrics and Economic Theory in the 20th Century. Cambridge: Cambridge University Press. p371-413.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Rasool, Y., Zaidi, S.A.H., Zafar, M.W. (2019), Determinants of carbon emissions in Pakistan's transport sector: The role of road infrastructure, energy consumption and oil prices. Environmental Science and Pollution Research, 26, 33280-33290.

Schipper, L., Marie-Lilliu, C., Gorham, R. (2000), Flexing the Link between Transport and Greenhouse Gas Emissions: A Path for the World Bank. Paris: International Energy Agency.

Sierzchula, W., Bakker, S., Maat, K., van Wee, B. (2014), The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy, 68, 183-194.

Timilsina, G.R., Shrestha, A. (2009), Transport sector CO_2 emissions growth in Asia: Underlying factors and policy options. Energy Policy, 37(11), 4523-4539.

van Vliet, O., Brouwer, A.S., Kuramochi, T., van den Broek, M., Faaij, A. (2011), Energy use, cost and CO2 emissions of electric cars. Journal of Power Sources, 196(4), 2298-2310.