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Article

Fiscal neutrality and adoption of hybrid vehicles: analysis of the vehicle registry in Nayarit, 2018-2024

Neutralidad fiscal y adopción de vehículos híbridos: análisis del padrón vehicular en Nayarit, 2018-2024

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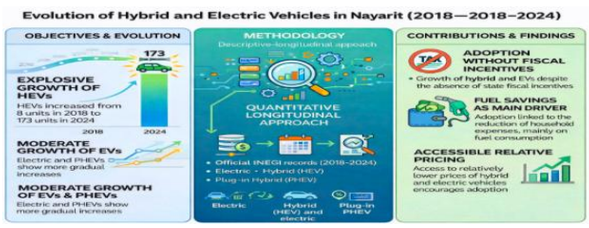
Abstract

The objective of this research is to analyze the evolution of hybrid and electric vehicle registration in the state of Nayarit during the period 2018–2024, in a context of absence of state tax incentives for their registration in the vehicle registry. The study adopts a quantitative approach with a descriptive-longitudinal design, using official information from the National Institute of Statistics and Geography [INEGI]. Three vehicle categories are analyzed: electric, conventional self-charging hybrids [HEVs], and plug-in hybrids [PHEVs], in relation to the growth of the total vehicle fleet. The results show a sustained increase in hybrid vehicles, especially HEVs, which will rise from 8 units in 2018 to 173 in 2024, while PHEVs and electric vehicles show more moderate increases. The evidence suggests that the adoption of these vehicles is not driven by tax incentives, but rather by economic factors associated with reduced fuel costs and greater relative affordability. It is concluded that tax neutrality has not limited their growth, but represents an opportunity to design tax instruments that accompany the vehicle transition without compromising tax revenue.



State tax policy, Hybrid vehicles, Vehicle registration Tax neutrality, Nayarit

Resumen

El objetivo de esta investigación es analizar la evolución del registro de vehículos híbridos y eléctricos en el estado de Nayarit durante el periodo 2018–2024, en un contexto de ausencia de incentivos fiscales estatales para su inscripción en el padrón vehicular. El estudio adopta un enfoque cuantitativo con diseño descriptivo-longitudinal, utilizando información oficial del Instituto Nacional de Estadística y Geografía [INEGI]. Se analizan tres categorías vehiculares: eléctricos, híbridos convencionales autorrecargables [HEV] e híbridos enchufables [PHEV], en relación con el crecimiento del parque vehicular total. Los resultados muestran un incremento sostenido de los vehículos híbridos, especialmente de los HEV, que pasan de 8 unidades en 2018 a 173 en 2024, mientras que los PHEV y eléctricos presentan aumentos más moderados. La evidencia sugiere que la adopción de estos vehículos no responde a estímulos fiscales, sino a factores económicos asociados a la reducción del gasto en combustible y a una mayor accesibilidad relativa en su precio. Se concluye que la neutralidad fiscal no ha limitado su crecimiento, pero representa una oportunidad para diseñar instrumentos fiscales que acompañen la transición vehicular sin comprometer la recaudación.

Política fiscal Estatal Vehículos híbridos Registro vehicular, Neutralidad fiscal; Nayarit

Area: Advocacy and attention to national problems

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Introduction

Over the last decade, the transition to vehicle technologies with a lower environmental impact has become a key public policy focus at various levels of government. Within this framework, hybrid combustion vehicles and electric vehicles have been promoted in various jurisdictions, whether through tax incentives, direct subsidies, or preferential registration schemes. However, empirical evidence on their adoption on a fiscally neutral scale, particularly at the subnational level, remains scarce, especially in a state with a limited tax collection structure, such as Nayarit.

More generally, state governments in Mexico are structurally torn between the need to strengthen their tax revenues and not reduce the revenue obtained from vehicle registration, and not only because it is an area that accounts for one-sixth of the total, 6.2% [CEFP, 2022; IMCO, 2021; Peredo, 2022]. In this context, the absence of explicit tax incentives for the registration of hybrid or electric vehicles in Nayarit suggests an appropriate approach to determining whether the adoption of these technologies is based exclusively on tax incentives or whether there are other economic reasons of a private nature.

The apparent contradiction between the lack of state tax benefits and the sustained growth in the number of hybrid vehicles in Nayarit is the central problem that this research will address. According to the literature, it is a proven fact that tax benefits are one of the determining factors in the adoption of clean technologies in consumer behavior. Thus, the central hypothesis of the research is as follows: the adoption of hybrid vehicles in Nayarit is not determined by state tax benefits, but by economic factors associated with fuel savings and greater relative affordability of these vehicles.

The added value of this research lies in its empirical-descriptive approach using official longitudinal data, which provides insight into the actual dynamics of vehicle registration, avoiding normative simulations or public policy assumptions. Therefore, unlike studies focused on incentive design, it analyzes a scenario of effective fiscal neutrality and provides evidence for the discussion on subnational tax policy and sustainable mobility in contexts of budgetary constraints.

Methodologically, the study adopts a quantitative approach based on a descriptive-longitudinal design, using information from official records of the National Institute of Statistics and Geography [INEGI, sf]. It reveals three vehicle categories: electric vehicles, self-charging hybrids [HEVs], and plug-in hybrids [PHEVs], as well as their relative evolution in terms of growth compared to the net increase in the total vehicle fleet in the state, which allows for contextualizing their real weight in the state mobility system.

This article is structured in five sections. The first section provides the contextual and regulatory framework for vehicle control and taxation in Nayarit. The second section describes the methodology and sources of information used. The third presents the results of the descriptive and longitudinal analysis of the vehicle registry. The fourth discusses the findings in light of the literature on fiscal neutrality and technology adoption. Finally, the fifth section presents the conclusions and suggests implications for the design of fiscal instruments that support the vehicle transition without affecting tax revenue.

Theoretical framework

The first section of the theoretical framework establishes the institutional and regulatory context of vehicle control and state taxation in Nayarit. In Mexico, the fiscal structure of the states is characterized by a high dependence on federal transfers and limited revenue-raising capacity. However, within non-federalized state revenues, vehicle control—fees paid for registration, renewal, and administrative procedures [CEFP, 2022; IMCO, 2021] has been a relatively stable and predictable source of public revenue. Thus, any change to the vehicle fee scheme, including exemptions or tax incentives, directly affects state financial sustainability.

From the perspective of fiscal federalism, subnational governments operate under structural constraints that limit their tax autonomy and restrict the implementation of differentiated environmental tax instruments [Oates, 1999; Boadway & Shah, 2012; OECD, 2021]. In Mexico, vehicle registration taxes constitute one of the few own-source revenue instruments available to state governments, representing a relevant but politically sensitive source of income [CEFP, 2022; IMCO, 2021].

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Under this institutional framework, tax and mobility legislation in the state of Nayarit does not provide specific fiscal benefits for hybrid or electric vehicles in the vehicle registry. A systematic review of state income laws for the period 2018–2024 confirms the existence of a uniform charging scheme applicable to the entire vehicle fleet [Gobierno del Estado de Nayarit, 2017; 2018; 2019; 2020; 2021; 2022; 2023].

This regulatory stability situates the state in a scenario of effective fiscal neutrality regarding vehicle technology and allows observed trends in registration to be interpreted as endogenous market responses rather than outcomes of discretionary fiscal policy.

Environmental fiscal theory establishes that taxation may serve as a corrective instrument to internalise negative externalities associated with fossil fuel consumption and vehicle emissions [Baumol & Oates, 1988]. Empirical evidence suggests that differentiated vehicle taxation, feebate systems, and registration incentives can significantly alter fleet composition and accelerate the adoption of low-emission technologies [Adamou et al., 2014; Van Dender, 2019]. Cross-country analyses further indicate that environmental vehicle taxes contribute to measurable reductions in CO_2 emissions when appropriately structured [Meireles et al., 2021].

However, recent research emphasizes that overlapping climate policies and regulatory standards may substitute or complement fiscal instruments [Perino et al., 2025; Jacobsen et al., 2023]. In certain cases, poorly designed incentives may generate strategic behavioral responses that undermine environmental effectiveness [Tanaka, 2020]. These findings highlight the importance of evaluating technological adoption in contexts where explicit fiscal incentives are absent.

Within this debate, the case of Nayarit constitutes a natural setting to examine whether hybrid vehicle diffusion can occur under conditions of fiscal neutrality. If adoption trends are sustained without tax exemptions or preferential treatment, this would suggest that private economic incentives such as fuel cost savings and relative acquisition prices play a decisive role in consumer decisions.

Conventional hybrid vehicles [HEVs] may exhibit comparative advantages over fully electric vehicles [EVs] and plug-in hybrids [PHEVs] in subnational markets characterized by limited charging infrastructure. Their technological autonomy and lower infrastructure dependency reduce adoption barriers, particularly in middle-income regions. In such contexts, diffusion patterns may reflect relative cost-efficiency rather than policy-driven incentives. This situation has been found in several examples of sustainable development, with gradual and selective technology adoption processes.

INEGI [sf] administrative records provide consistent and comparable information on the evolution of the vehicle fleet by technological category, enabling a longitudinal assessment of registration dynamics. The use of official administrative data strengthens the descriptive validity of the analysis and allows the identification of structural trends in technology adoption within a fiscally neutral regulatory environment. State-level vehicle registration studies have demonstrated the value of these records for evaluating policies related to mobility and tax collection [Gómez Álvarez & Maldonado Bernal, 2023].

In the absence of differentiated tax treatment, fiscal neutrality operates as a benchmark condition against which the effectiveness of environmental taxation can be implicitly assessed. If technological adoption progresses without fiscal intervention, this may indicate that price signals embedded in fuel markets and technological learning curves are sufficient to induce transition dynamics, reducing the necessity of subnational fiscal subsidies

From a theoretical standpoint, this body of literature supports the central hypothesis of the study: that the growth of hybrid and electric vehicles in Nayarit has occurred independently of state-level fiscal incentives and is primarily driven by market-based economic factors associated with operating cost efficiency.

This hypothesis is consistent with scenarios of fiscal neutrality in subnational governments facing limited revenue flexibility and institutional constraints on environmental tax innovation.

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Methodology

In general terms, the research adopts a quantitative, descriptive-longitudinal design aimed at documenting the temporal evolution of vehicle registrations by technological category under conditions of fiscal neutrality. The use of administrative records as primary data sources is consistent with empirical traditions in applied public finance, where official registries provide reliable measures of behavioral and fiscal outcomes.

In this sense, the unit of analysis refers to annual vehicle registrations in the state of Nayarit, disaggregated by type of vehicle technology. The analysis period covers 2018 to 2024, so that the results allow for the identification of technological adoption in the medium term, considering a stable institutional regulatory framework for vehicle control.

Supporting information sources.

Secondary information from the official administrative records of the National Institute of Statistics and Geography [INEGI, sf] is used to conduct this study. In particular, two databases have been created:
1. Register of vehicles by technology: Electric vehicles [EV]; Plug-in hybrid vehicles [PHEV]; and Conventional or self-charging hybrid vehicles [HEVs]
2. Total vehicle fleet in the state of Nayarit, in order to contextualize the relative expansion of alternative technologies in the state mobility system.

Variables and analysis strategy

The variables analyzed are:

1. Annual number of registered vehicles by type of technology [EV, PHEV, and HEV].
2. Size of the total registered vehicle fleet per year.
3. Temporal evolution and absolute growth of each technological category.

The analytical strategy is strictly descriptive, based on:

- Temporal comparison of records,
- Identification of growth patterns,
- Analysis of the relative share of each technology within the total vehicle fleet.

No econometric techniques or causal models are applied, as the objective of the study is to empirically document the observed dynamics, without attributing direct effects to specific fiscal instruments, in accordance with the fiscal neutrality approach outlined in the theoretical framework [OECD, 2021; López-Santana & Rocco, 2021].

Results

The results are as follows:

Box 1

Table 1

Evolution of vehicle registration by type of technology

Year	Electric Vehicles	PHEV	HEV
2018	1	0	8
2019	0	0	11
2020	0	2	27
2021	0	0	64
2022	16	1	108
2023	28	7	106
2024	64	12	173

Source: INEGI [sf]

In contrast, conventional hybrid vehicles show sustained growth throughout the period observed. In 2018, there were 8 units registered, rising to 173 by 2024. This is one of the fastest growth rates.

In second place are electric vehicles, although their growth has been slower and more moderate. There were no registrations during the first three years, but by 2022 the number had risen to 16, marking an upward trend that will reach 64 in 2024.

However, it continues to be the lowest proportion of the total number of vehicles with alternative technologies.

Finally, plug-in hybrid vehicles are registered at a lower level throughout the period, closing 2018-2021 with zero to one and registering a marginal number in 2022. They gradually rise to 12 in 2024.

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Box 2

Table 2

Growth of the total vehicle fleet in Nayarit

Year	Vehicle owner
2018	449,029
2019	475,446
2020	494,810
2021	519,899
2022	542,623
2023	556,713
2024	578,284

Source: INEGI [sf]

Likewise, the total registered vehicle fleet in Nayarit shows sustained growth over the six years. While a total of 449,029 vehicles were registered in 2018, this figure increased steadily by 2024 to reach 578,284 vehicles, representing an absolute increase of 129,255 units over the period. Contrasting this increase with that of electric and hybrid vehicles reveals that, although relative growth within their segment is significant, their relative weight in the total remains small.

By 2024, hybrid and electric vehicles jointly represented less than 0.05% of the total registered fleet, indicating that despite high relative growth rates within their segment, their structural weight in the state vehicle stock remains marginal.

With regard to comparative dynamics under fiscal neutrality, the first occurs in the preeminence of conventional hybrid vehicles over electric and plug-in hybrid vehicles. This phenomenon is striking and consistent with the literature, which establishes that the absence of direct tax incentives means that households adopt technologies that provide them with an immediate economic benefit, such as fuel savings or lower operating costs, without the need for a public infrastructure structure.

Furthermore, the growth of these technologies has occurred without any changes to the vehicle control fee structure, suggesting that the adoption process has occurred without observable modifications to the state vehicle fee structure.

From the perspective of state public finances, the above results show that fiscal neutrality regarding vehicle control has not been a barrier to the gradual introduction of cleaner technologies.

The empirical evidence is consistent with the central hypothesis: hybrid and electric vehicles in Nayarit, which have experienced accelerated growth trajectory, have not done so because of state tax incentives but have acted mainly because of private economic factors, in an environment of subnational fiscal symmetry.

Discussion of Results

The descriptive-longitudinal evidence indicates that the expansion of hybrid vehicle registration in Nayarit occurred under conditions of effective fiscal neutrality, characterized by the absence of differentiated vehicle control fees during the period 2018–2024. The observed growth trajectory is consistent with the central hypothesis that technological adoption in this case does not appear to have been directly associated with differentiated state-level tax incentives, but rather is consistent with market-based economic considerations.

Although the absolute number of hybrid and electric vehicles remains small relative to the total fleet, their relative growth rate exceeded the overall expansion of the vehicle registry. This pattern suggests an accelerated diffusion process within the alternative technology segment. However, given the descriptive nature of the design, these findings should be interpreted as consistent with a market-driven adoption dynamic rather than as causal evidence of fiscal irrelevance.

From the standpoint of environmental fiscal theory, taxation is typically justified as a corrective mechanism for internalizing transport-related externalities [Baumol & Oates, 1988]. Empirical studies have shown that differentiated vehicle taxation schemes—such as feebates can significantly modify fleet composition [Adamou et al., 2014], while environmental vehicle taxes are associated with measurable emission reductions when appropriately designed [Meireles et al., 2021].

Evidence from Latin America further illustrates the fiscal trade-offs involved in incentive-based transition strategies. In Uruguay, Lavalleja and Scalese [2019] estimate that tax incentives promoting electric vehicle adoption would generate measurable revenue losses under different market penetration scenarios, potentially reaching significant fiscal magnitudes in long-term projections.

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Similarly, Urrutia-Mosquera and Fábrega [2021], in the Chilean case, find that VAT exemptions and purchase-related fiscal incentives substantially increase the probability of adopting low-emission vehicles, implying an explicit renunciation of indirect tax revenues per transaction. These findings contrast with the Nayarit case, where technological diffusion occurred without differentiated fiscal treatment, thereby avoiding direct short-term revenue trade-offs

In contrast, the Nayarit case provides evidence of technological diffusion without explicit fiscal differentiation, offering a complementary perspective to policy driven transition models.

Recent literature also emphasizes that regulatory standards and overlapping climate policies may substitute for direct fiscal instruments [Perino et al., 2025; Jacobsen et al., 2023]. In a federal system characterized by vertical fiscal imbalance and limited tax autonomy at the subnational level [Oates, 1999; Boadway & Shah, 2012], discretionary environmental tax design may entail non-trivial fiscal risk. Under these conditions, maintaining uniform vehicle control fees can be interpreted as a revenue-stabilizing strategy consistent with intergovernmental fiscal constraints. The neutrality observed in Nayarit therefore appears aligned with a broader pattern of subnational fiscal prudence in systems characterized by vertical fiscal imbalances.

Moreover, research warns that poorly designed tax incentives may generate strategic behavioral distortions [Tanaka, 2020]. The absence of preferential treatment in the Nayarit vehicle registry eliminates reduces the likelihood of strategic behavioral distortions associated with preferential fiscal treatment. The predominance of conventional hybrid vehicles [HEVs] over fully electric vehicles [EVs] and plug-in hybrids [PHEVs] is consistent with this interpretation, as HEVs present lower infrastructure dependency and reduced entry barriers in subnational markets.

From a public finance perspective, maintaining a uniform vehicle control scheme preserves revenue stability, a relevant consideration in Mexican states where own-source revenues remain structurally limited [CEFP, 2022; IMCO, 2021; Cabral et al., 2021; Del Castillo & Cabral, 2024].

The findings suggest that fiscal neutrality did not prevent gradual technological diffusion, indicating compatibility between revenue stability and incremental transition dynamics.

Overall, the results contribute empirical evidence to the debate on environmental fiscal policy by documenting a case in which technological diffusion occurred under conditions of subnational fiscal neutrality.

Unlike incentive-based schemes documented in other Latin American contexts—where accelerated adoption has been accompanied by measurable fiscal trade-offs [Lavalleja & Scalese, 2019; Urrutia-Mosquera & Fábrega, 2021], the Nayarit case illustrates a transition path that preserved revenue stability while allowing gradual market-driven adoption.

The findings neither refute the theoretical justification for corrective environmental taxation nor demonstrate fiscal irrelevance; rather, they indicate that incremental diffusion dynamics may unfold even in the absence of differentiated tax instruments. Within the limits of a descriptive design, the evidence supports the interpretation of a technologically gradual transition compatible with subnational revenue sustainability under institutional constraints.

Conclusions

This descriptive and longitudinal analysis of the vehicle registry in the state of Nayarit indicates that the adoption of hybrid technologies occurred under conditions of effective fiscal neutrality during the period 2018–2024.

The evidence suggests that the absence of differentiated vehicle control fees did not prevent sustained growth in hybrid registrations, particularly among conventional hybrid vehicles [HEVs].

Within the limitations of a descriptive design, the findings are consistent with a market driven adoption dynamic rather than with incentive-induced behavioral change. No direct association can be established between state-level fiscal instruments and the observed technological transition.

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From a subnational public finance perspective, the study underscores the importance of maintaining revenue stability in contexts characterized by limited tax autonomy and structural dependence on own-source revenues. The Nayarit case illustrates that fiscal neutrality may be compatible with gradual technological diffusion under specific institutional constraints, although it does not allow conclusions regarding the optimality of such a policy stance from an environmental efficiency perspective.

The predominance of HEVs relative to EVs and PHEVs reinforces the interpretation that entry costs, fuel savings, and infrastructure dependency constitute central determinants of adoption in subnational markets.

Methodologically, the use of official administrative records and a longitudinal descriptive approach strengthens internal consistency while deliberately avoiding causal overreach. The contribution of this study lies in documenting an empirically observable pattern of technological diffusion within a fiscally neutral subnational framework, thereby enriching the comparative discussion on environmental fiscal policy in decentralized systems.

Declarations

Conflict of interest

The authors declare that they have no conflict of interest. They have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

Author contribution

Gómez-Álvarez, Ricardo: Idea and conceptualisation, Literature review, Review and adjustments, Oversight and final validation.

Maldonado-Bernal, Ignacio and Castro-Castañeda, Carlos Felipe: Methodology and Application of the analysis.

Ortega-Fernandez, Francisco Jesús: Drafting, Proofreading and referencing

Availability of data and materials

Given the nature of the research, the data collected were available.

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Abbreviations

CEFP = Centro de Estudios de Finanzas Públicas
EV = Electric vehicles
HEV = Hybrid Electric Vehicles [self-charging]
IMCO = Instituto Mexicano para la Competitividad
INEGI = Instituto Nacional de Estadística y Geografía
OECD = Organisation for Economic Cooperation and Development
PHEVs = Plug-in Hybrid Electric Vehicles

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