DETERMINANTS OF TIRE IMPORTS IN ECUADOR

León Padilla and Ángela M. Díaz-Márquez

SUMMARY

End-of-Life Tires (ELTs) are a global problem due to their slow decomposition, the high costs of managing this waste, reverse logistics and the environmental impacts generated by different disposal methods. However, even though Ecuador adopted an Extended Producer Responsibility (EPR) model for the management of ELTs, the results in the first years have been poor. An important limitation for the management of ELTs in Ecuador is the characteristics of the tire market. Specifically, although the country produces and exports tires, only 30% of the total tires circulating in the country are locally produced, while 70% are imported from other countries. In this research we used an econometric model to find the factors that affect tire imports in Ecuador, considering that most of the supply is imported. Our findings show that economic growth and the number of imported vehicles maintain a positive relationship with the level of exports. On the other hand, the vehicle price index and the price of Chinese tire imports are variables that negatively influence the number of imported tires in Ecuador. These results can be useful for the development of policies that improve the results of the national model for the management of ELTs.

Introduction

Because of the overexploitation of natural resources, the planet is currently going through an environmental crisis (Moore, 2011). For this reason, it is necessary to move towards a sustainable economic system in which the production of goods and services is aligned with the conservation of natural resources and avoid greater environmental consequences in the future (Singh *et al*., 2012). In this context, the End-of-Life Tires (ELT), tires that are no longer used for car circulation or reuse, have become one of the main types of solid waste with a negative impact on environment. Annual global generation of tires is estimated at around 1.5 million tones (Czajczyńska *et al*., 2017). Worldwide, 800 million ELTs units are discarded annually (Sienkiewicz *et al*., 2012). According to the Global Industry Analyst Inc, on average, in developed countries, one tire per person is discarded each year; And by 2022, the global tire market is expected to reach 2.5 billion units. Furthermore, considering the growth of ELTs is linked to the increase in automobile production, ELTs also constitute an important part of vehicle waste at the end of its useful life. Therefore, ELT waste is a global environmental liability not only for poor countries but also for developed nations.

Despite substantial progress in waste management to make ELTs a valuable resource for energy and material applications, they remain a cause for concern, and much more so in developing economies (Cardona-Uribe *et al*., 2021). Although ELTs are classified as waste containing organic residue or as non-hazardous waste, ELTs are a global problem due to their slow decomposition, the high costs of handling these wastes, the reverse logistics (RL) and the environmental impacts that generate the different layout methods (Cecchin *et al*., 2019). Other drawbacks of tire waste are the large volume it requires in landfills; water retention leading to the proliferation of mosquitoes and the spread of diseases transmitted by these insects, such as dengue fever, which is a recurrent problem in developing countries; soil contamination; and surface and groundwater problems (Derakhshan *et al*., 2017a, 2017b). Furthermore, due to the chemical and biological resistance to degradation, ELTs cause negative environmental impacts from tire gasification (Oboirien and North, 2017).

KEYWORDS / Ecuador / End-of-Life Tires / Tire Imports /
Received: 04/27/2022. Modified: 09/03/2023. Accepted: 09/06/2023.

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FACTORES DETERMINANTES EN LA IMPORTACIÓN DE NEUMÁTICOS EN ECUADOR
León Padilla y Ángela M. Díaz-Márquez

RESUMEN

Los neumáticos fuera de uso (NFU) son un problema mundial debido a su lenta descomposición, los altos costes de gestión de estos residuos, la logística inversa y los impactos ambientales generados por los diferentes métodos de eliminación. Sin embargo, a pesar de que Ecuador adoptó un modelo de Responsabilidad Extendida del Productor (REP) para la gestión de los NFU, los resultados en los primeros años han sido pobres. Una limitación importante para la gestión de los NFU en Ecuador son las características del mercado de neumáticos. Específicamente, aunque el país produce y exporta neumáticos, sólo el 30% del total de neumáticos que circulan en el país son de producción local, mientras que el 70% son importadas de otros países. En esta investigación utilizamos un modelo econométrico para encontrar los factores que afectan a la importación de neumáticos en Ecuador, teniendo en cuenta que la mayor parte de la oferta es importada. Nuestros resultados muestran que el crecimiento económico y el número de vehículos importados mantienen una relación positiva con el nivel de exportaciones. Por otro lado, el índice de precios de vehículos y el precio de importación de neumáticos chinos son variables que influyen negativamente en el número de neumáticos importados en Ecuador. Estos resultados pueden ser útiles para el desarrollo de políticas que mejoren los resultados del modelo nacional de gestión de los NFU.

DETERMINANTES DAS IMPORTAÇÕES DE PNEUS NO EQUADOR
León Padilla e Ángela M. Díaz-Márquez

RESUMO

Os pneus em fim de vida útil (ELTs) são um problema global devido à sua lenta decomposição, aos altos custos de gerenciamento desses resíduos, à logística reversa e aos impactos ambientais gerados pelos diferentes métodos de descarte. No entanto, embora o Equador tenha adotado um modelo de Responsabilidade Estendida do Produtor (EPR) para o gerenciamento de ELTs, os resultados nos primeiros anos foram ruins. Uma limitação importante para o gerenciamento de ELTs no Equador são as características do mercado de pneus. Especificamente, embora o país produza e exporte pneus, apenas 30% do total de pneus que circulam no país são produzidos localmente, enquanto 70% são importados de outros países. Nesta pesquisa, usamos um modelo econométrico para encontrar os fatores que afetam as importações de pneus no Equador, considerando que a maior parte do fornecimento é importada. Nossos resultados mostram que o crescimento econômico e o número de veículos importados mantêm uma relação positiva com o nível de exportações. Por outro lado, o índice de preços de veículos e o preço das importações de pneus chineses são variáveis que influenciam negativamente o número de pneus importados no Equador. Esses resultados podem ser úteis para o desenvolvimento de políticas que melhorem os resultados do modelo nacional para o gerenciamento de ELTs.

Within this context, several Latin America nations have begun to design policies for the treatment and management of ELTs through management plans and incentives for the creation of a production cycle for the treatment of these waste. Mostly, emerging economies have adopted the environmental policy of Extended Producer Responsibility (EPR), taking developed economies as the main reference. It should be noted that in the EPR system, the different actors involved in the production and supply chain (manufacturers, importers, distributors, and even local governments) share responsibility for the final destination of the post-consumer product. More precisely, Brazil, Chile, Colombia, Mexico and Uruguay have proposed EPR systems for different end-of-life products, including ELTs (Martínez, 2021). In Colombia, the EPR's governance model imposes financial and operational responsibilities on tire producers and importers (Park *et al*., 2018). Nevertheless, the Colombian model omits to encourage other actors in the product chain to fulfill their tasks and responsibilities. However, although tire collection has increased, one of the drawbacks of the EPR system in developing countries is that it does not promote recycling and energy recovery from ELTs. In addition, in developing countries, EPR policies tend to be adaptations of models designed for industrialized countries, where social, economic, technological, infrastructure, environmental conditions, and policy formulation are different (Akenji *et al*., 2011).

In the case of Ecuador, until 2013 the logistics for managing ELTs were linear and some links in the chain of management of this waste were more powerful than others. The model for the management of ELTs in Ecuador was a sequential and linear model in which most of the pneumatic waste was generated mainly by imported tires. The only option for reusing used tires was through retreading (or remanufacturing) techniques, while most ELTs were incinerated or disposed of in open landfills (Cecchin *et al*., 2019). By 2013, Ecuador adopted an EPR policy for the management of ELTs and partially reduced the negative effects that the waste had on the environment. In 2015, the Ministry of the Environment, Water and Ecological Transition (MAATE) determined that importers and / or producers are the main entities responsible for the recovery of ELT. In addition, the MAATE established progressive and incremental goals for the recovery of tires waste in Ecuador. Also, under Ministerial Agreement 98, the requirements, procedures and environmental specifications for the preparation, application, and control of the Plan of the Integrated Management Program for Used Tires (PIMUT) were determined, which promotes reduction, reuse, recycling, and other forms of recovery to protect the environment (Ministerio del Ambiente, 2015). The principles of the plan were defined as: preventive, precautionary principle, polluter pays principle, correction at the source, environmental co-responsibility, cradle to the grave principle, strict liability for environmental damage, extended producer and/or importer responsibility (EPR), the best available technology or best available techniques (BAT), and proximity principle. Since the issuance of the PIMUT, the model for ELT management in Ecuador has changed dramatically. Tires considered waste could supply another production cycle in which powdered rubber was an input. However, the plan did not consider market forces, where the law of supply and demand can influence the plan itself, within its guidelines. According to Anzules-Falcones *et al*. (2021) in Quito, the capital of Ecuador, there are currently only 25 companies involved in the environmental management of used tires, 20 of which have environmental permits issued by MAATE, and only 4 are large companies. Specifically, although the volume of tire waste generated is substantially less in Ecuador, the recovery volume (38.9%) is also low compared to developed economies (Cecchin *et al*., 2019).

On the other hand, an important limitation for the management of ELTs in Ecuador is the characteristics of the tire market. According to data from the Central Bank of Ecuador, although the country produces and exports tires, only 30% of total tires that circulate in the country are produced locally, while 70% are imported from other countries. Campbell-Johnston *et al*. (2020) emphasized that a possible limitation to the management of ELTs in countries that import most of their tires is that it can hardly force large tire producers overseas to significantly change their design and production processes. Therefore, knowing the determinants of the level of tire imports in Ecuador is essential to establish possible policies for the management of ELTs. In this research, we used an econometric model to determine the main factors that affect the level of tire imports in Ecuador, considering that most of the tire supply is imported. The structure of this paper is as follows. In the second section, the main indicators of the tire market in Ecuador are revised. The third section integrates a model of tire import determinants in Ecuador. The fourth section discusses the main findings and results of the research. Finally, the main conclusions of the study are presented.

The tire market in Ecuador

According to information from the Central Bank of Ecuador (CBE), the value of the local supply of tires increased from USD 398 million in 2008 to USD 414 million in 2016. As shown in the Table I, most of the local supply corresponds to imported tires (approximately 70.3% between 2008 and 2016). Furthermore, in all years, except for 2016, the number of imported tires was greater than the local supply of tires. In other words, the national Ecuadorian statistics show a clear pattern, which is the dependence of the demand on imported tires.

As stated by the Association of Automotive Companies of Ecuador, the number of imported tires went from 1.15 million in 2004 to 3.32 million in 2019 (Figure 1). In the same vein, data from the CBE show that tire imports, both the quantity of tires imported by Ecuador, measured in metric tons (MT), and the FOB (Free on Board) that corresponds to the value of tire imports, have increased (Figure 2). Only between mid-2015 and mid-2017 did the value and quantity of imported tires register a drop. During this period, the Ecuadorian economy contracted because of the decrease in oil prices and the appreciation of the US dollar. On average, the FOB value of tire imports has grown annually by 5.9% while the quantity of imports has increased annually by 3.8%. Furthermore, Ecuador's tire imports come mainly from

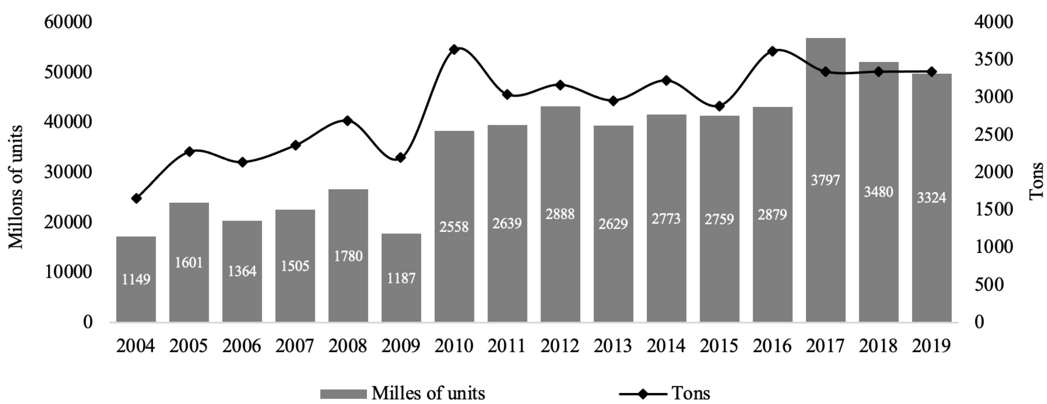

Figure 1. Units of tire imports and tons. Source: Association of Automotive Companies of Ecuador (AEADE).

TABLE I
LOCAL SUPPLY, EXPORTS, EXPORTS AND SHARE OF TIRES IN ECUADOR IN MILLIONS OF USD

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2008-2016
A. Imports	259,847	240,328	386,717	383,989	436,088	389,127	403,238	352,136	260,430	3,111,900
B. Local production	179,942	150,076	161,872	203,350	227,742	221,974	207,567	198,073	203,910	1,754,506
C. Exports	41,491	28,260	27,423	60,863	69,776	67,021	50,124	45,120	49,763	439,841
D. Local total supply (A+B-C)	398,298	362,144	521,166	526,476	594,054	544,080	560,681	505,089	414,577	4,426,565
Use of import tires	65.2%	66.4%	74.2%	72.9%	73.4%	71.5%	71.9%	69.7%	62.8%	70.3%
Use of local tires	34.8%	33.6%	25.8%	27.1%	26.6%	28.5%	28.1%	30.3%	37.2%	29.7%

Source: Central Bank of Ecuador.

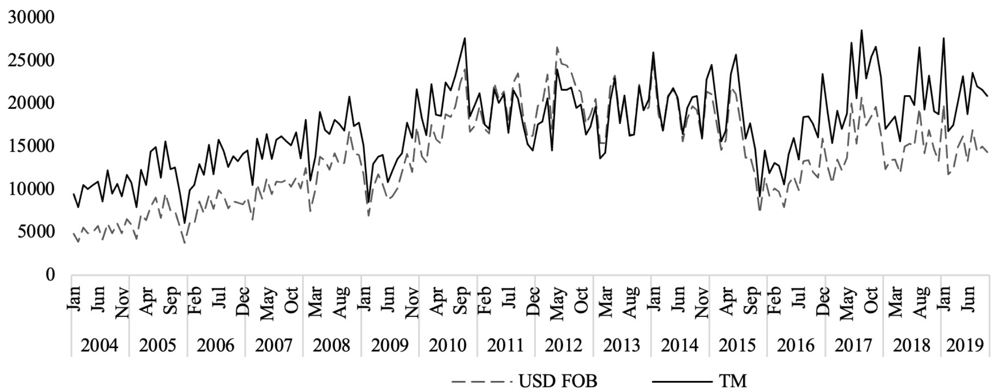

Figure 2. Tire imports in FOB values and metric tons. Source: Central Bank of Ecuador (BCE).

Asia and America (Figure 3). At the beginning of 2004, tire imports came mainly from Colombia. Nevertheless, in the following years, Chinese and Brazilian tires imports grew significantly, as Figure 4 shows. By 2019, approximately 50% of total tire imports came from Asian countries.

A model of tire import determinants in Ecuador

Consequently, considering the hegemony of tire imports in the total local supply in Ecuador, was developed an econometric model to determine the main factors that influence tire imports. Knowledge of these factors would allow policy makers to establish strategies aimed at improving the management of ELTs. As is well known, the amount of imports is related to the economic activity of an economy since a proportion of the national income is destined to the purchase of goods produced abroad (Blanchard and Johnson, 2017). Carree and Thurik (2000) developed a model in which the output of tires is explained by using the number of motor vehicles, the quality of tires (and roads), and the price index of tires. Furthermore, Carree and Thurik (2000) argue that the replacement demand of tires depends on the number of motor vehicles already on the road and that the replacement of tires is negatively affected by the price of tires. Thus, the higher the price of tires, the longer drivers will wait to replace them. Smith (1981) found that the level of tire imports is largely conditioned by the degree of economic activity. Using a simple equation demand, Jovanovic and Macdonald (1994) demonstrated that the tire demand was inelastic in the United States between 1910 and 1973. To estimate the effects of prices and income on tire sales, Ochmann (2002) integrated the number of vehicles registered in a calendar year, the taxes for new tires, the consumer price index for all items, personal income, the population, and the national tire replacement costs for the fiscal year. In addition to the number of vehicles, the growth in the demanded quantity of tires also affects the rolling resistance of tires (Haikal Sitepu *et al*., 2020; Zhang *et al*., 2016). The number of tires replaced for each vehicle depends on the distance traveled, the driving style, the weather conditions, the road surface and others (Nowakowski and Król, 2021). Finally, the increase in the demand for tires depends on the level of income, but also on the price policy due to the scarcity of raw materials, imports, taxes, public policies, road conditions and consumer behavior, among other socioeconomic factors (Chang,

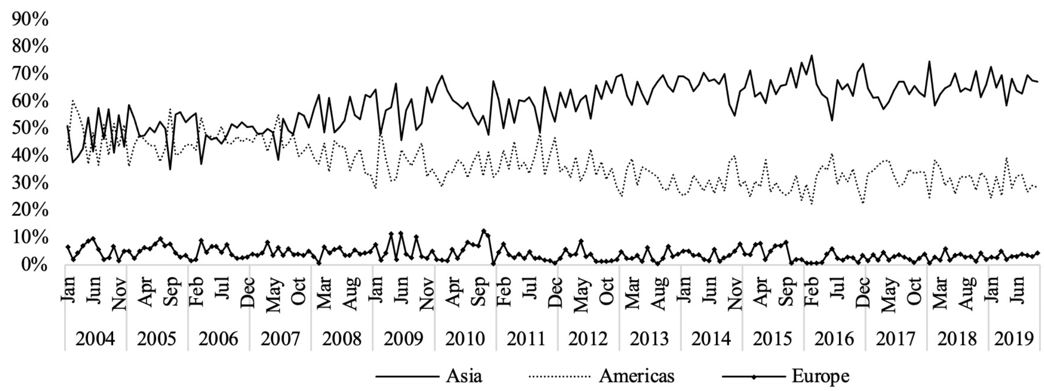

Figure 3. Imports of tires in FOB values by continent of origin. Source: Central Bank of Ecuador (BCE).

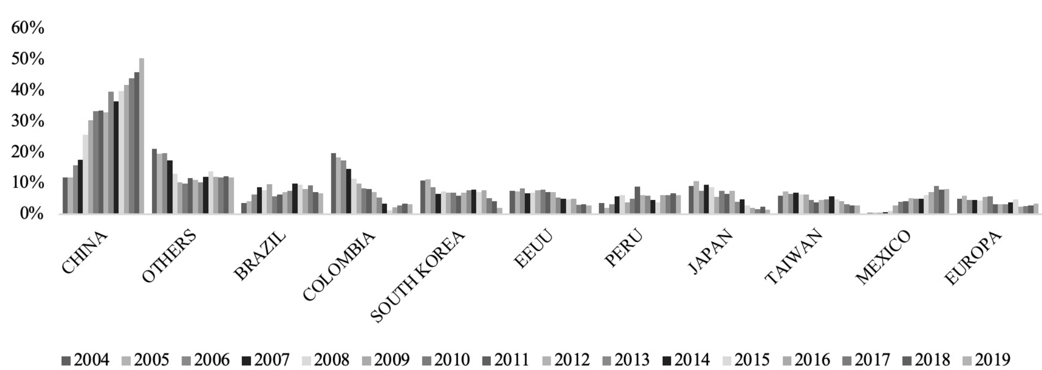

Figure 4. Tire imports by country of origin. Source: Central Bank of Ecuador (BCE).

2008; Ferrer, 1997). With these considerations, a model was designed to establish the determinants of tire imports into Ecuador. Therefore, the proposed model is given by (Eq. 1):

$$\ln ImportTires_t = \beta_0 + \beta_1\ lpibproxy_t + \beta_2 ImpVehicles_t + \beta_3\ IndPriVehicles_t + \beta_4 PriceOthers_t + \beta_5 PriceColombia_t + \beta_6 PriceBrazil_t + \beta_7 PriceChina_t + \beta_8 RER_t + u_t \quad (1)$$

where the logarithm of the number of imported tires (*ImportTires*$_t$) is determined by an industrial activity proxy variable (*lpibproxy*), the number of imported vehicles (*ImpVehicles*$_t$), a vehicle price index (*IndPriVehicles*$_t$), the value of Colombian tire imports (*PriceColombia*$_t$), the value of Brazilian tire imports (*PriceBrazil*$_t$), the value of Chinese tire imports (*PriceChina*$_t$), the value of tire imports from other countries (*PriceOthers*$_t$), the real exchange rate (*RER*$_t$), and an error term (u_t).

The sample is composed of a time series with monthly data from January 2005 to September 2019. All data were obtained from the Central Bank of Ecuador database except for the vehicle price index and the industrial activity variable, which were obtained from the National Institute of Statistics and Census (INEC). The variables of the number of imported tires, production proxy and number of imported vehicles are in logarithms. In addition, to avoid unitary root problems, we applied the first difference to all variables except for the quantity of imported vehicles because it did not lend itself to this problem. We use two estimation techniques to guarantee the robustness of the results. The first consists of a Prais-Winsten and Cochrane-Orcutt regression model (Cochrane and Orcutt, 1949; Prais and Winsten, 1954). For the second estimation method, we use an ARMA model of order one for the autoregressive component and for the moving average.

The results (Table II and III) showed that economic activity and the number of imported vehicles maintain a positive relationship with the level of exports. As expected, the vehicle price index has a negative relationship with the quantity of imported tires according to the results of the second estimation method. Furthermore, an important result is that in all models, the price of Chinese tire imports is statistically significant and inversely related to the total amount of tire imports in Ecuador. In other words, a reduction in the price per ton of Chinese tires would be related to an increase in the quantity of imported tires to Ecuador. Moreover, models (8a) and (9a) showed that the price of tires from Brazil is also correlated to the quantity of tires imported into Ecuador. However, considering the sign of the coefficient, it is possible to infer a degree of substitution between Brazilian and Chinese tires. Although these results could be considered expected, their relevance lies in that they can be used to establish strategies to improve the discrete results of ELT management in Ecuador. These strategies are discussed below.

Discussion

The number of tires demanded in Ecuador is expected to increase in the coming years. Data compiled by the National Institute of Statistics and Censuses (INEC) show that the number of registered vehicles in Ecuador grew by more than 1.4 million vehicles between 2008 and 2018. In 2018, the number of vehicle units exceeded 2.4 million. In addition, an increase in the number of cars is expected in the coming years. Between 2007 and 2019, the average annual vehicle sales were USD 111,052 (AEADE). Therefore, it is necessary that in the coming years, the management of ELTs improves substantially. Nevertheless, it is important to consider that due to the global crisis of COVID-19 and its consequential economic slowdown, in the short and medium

TABLE II
TECHNIQUE 1 RESULTS

	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	(7a)	(8a)	(9a)
β_0	8.262***	6.760***	6.739***	6.739***	6.779***	6.779***	6.835***	6.928***	6.974***
	(185.292)	(10.340)	(10.015)	(10.015)	(10.144)	(10.144)	(9.312)	(9.408)	(9.525)
dlpibproxy	0.895***	0.888***	0.930***	0.930***	0.904***	0.904***	1.121***	1.039***	1.015***
	(3.737)	(3.723)	(4.087)	(4.087)	(3.834)	(3.834)	(4.282)	(3.899)	(3.744)
ImpVehicles		0.157**	0.159**	0.159**	0.155**	0.155**	0.149**	0.139*	0.134*
		(2.332)	(2.296)	(2.296)	(2.252)	(2.252)	(1.979)	(1.845)	(1.789)
dIndPriVehicles			-0.028	-0.028	-0.028	-0.028	-0.031	-0.032*	-0.031
			(-1.501)	(-1.501)	(-1.516)	(-1.516)	(-1.612)	(-1.657)	(-1.631)
dPriceOthers					-0.066	-0.066	-0.058	-0.057	-0.058
					(-1.324)	(-1.324)	(-1.128)	(-1.124)	(-1.142)
dPriceColombia							0.001	-0.000	0.002
							(0.043)	(-0.002)	(0.076)
dpriceBrazil								0.030*	0.033*
								(1.772)	(1.932)
dRER									0.008
									(1.209)
dPriceChina	-0.166***	-0.168***	-0.164***	-0.164***	-0.159***	-0.159***	-0.183***	-0.176***	-0.177***
	(-3.348)	(-3.346)	(-3.188)	(-3.188)	(-3.047)	(-3.047)	(-3.433)	(-3.225)	(-3.239)
Observations	175	175	174	174	174	174	165	165	165
Adj. R^2	0.0842	0.110	0.127	0.127	0.131	0.131	0.151	0.158	0.158

Note: t-statistic is reported in parentheses and the significance levels are denoted as follows: *** p<0.01, ** p<0.05 and * p<0.1. Source: Authors' calculations.

TABLE III
TECHNIQUE 2 RESULTS

	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)	(7b)	(8b)	(9b)
β_0	8.222***	6.697***	6.648***	6.648***	6.686***	6.686***	6.589***	6.693***	6.719***
	(84.201)	(12.364)	(13.101)	(13.101)	(13.007)	(13.007)	(12.270)	(12.214)	(12.167)
dlpibproxy	0.914**	0.907**	0.948***	0.948***	0.930***	0.930***	1.138***	1.050***	1.041***
	(2.552)	(2.514)	(2.767)	(2.767)	(2.764)	(2.764)	(3.119)	(2.878)	(2.893)
ImpVehicles		0.160***	0.167***	0.167***	0.163***	0.163***	0.174***	0.163***	0.160***
		(2.735)	(3.051)	(3.051)	(2.949)	(2.949)	(3.000)	(2.762)	(2.702)
dIndPriVehicles			-0.035**	-0.035**	-0.035**	-0.035**	-0.035**	-0.035**	-0.034**
			(-2.501)	(-2.501)	(-2.343)	(-2.343)	(-2.316)	(-2.339)	(-2.244)
dPriceOthers					-0.054	-0.054	-0.043	-0.042	-0.041
					(-0.906)	(-0.906)	(-0.690)	(-0.677)	(-0.667)
dPriceColombia							-0.003	-0.003	-0.001
							(-0.123)	(-0.118)	(-0.060)
dpriceBrazil								0.033	0.035
								(1.202)	(1.270)
dRER									0.006
									(0.613)
dPriceChina	-0.172**	-0.174**	-0.182**	-0.182**	-0.178**	-0.178**	-0.197***	-0.191***	-0.190***
	(-2.185)	(-2.181)	(-2.443)	(-2.443)	(-2.397)	(-2.397)	(-2.597)	(-2.605)	(-2.602)
AR(1)	0.927***	0.925***	0.913***	0.913***	0.912***	0.912***	0.913***	0.912***	0.911***
	(27.421)	(25.230)	(20.068)	(20.068)	(20.076)	(20.076)	(19.587)	(19.689)	(19.657)
MA(1)	-0.476***	-0.508***	-0.500***	-0.500***	-0.496***	-0.496***	-0.497***	-0.486***	-0.483***
	(-4.870)	(-4.921)	(-4.641)	(-4.641)	(-4.607)	(-4.607)	(-4.513)	(-4.475)	(-4.451)
Observations	176	176	175	175	175	175	169	169	169

Note: t-statistic is reported in parentheses and the significance levels are denoted as follows: *** $p<0.01$, ** $p<0.05$ and * $p<0.1$. Source: Authors' calculations.

term, the demand for tires will probably decrease. According to Association of Automotive Companies of Ecuador (AEADE), accumulated vehicle sales between January and July 2020 fell by 47% compared to the same period in 2019.

In addition, in Ecuador, where approximately 70% of new tires are imported, the imposition of an import duty on tires can be a complementary tool to an EPR system, with the aim of recovering and reprocessing ELTs. Gupt and Sahay (2015) demonstrated that the financial responsibility of producers, dealers (or importers) and separate collection and recycling agencies contributed significantly to the success of extended producer responsibility-based environmental policies. Furthermore, Mangmeechai (2017) argues that ELT management is driven by economic incentives for tire collectors and tire recycling industries. However, according to the author, the percentage of treated ELTs cannot reach 100% due to the costs related to the collection system. Therefore, it is imperative to enact a policy that allows financing the collection of ELTs in Ecuador, considering that this is one of the most sensitive points for a circular economy system.

Finally, statistics show that in recent years, the quantity of imported Chinese tires has increased considerably. Although in 2004 most of the tires were imported from Colombia, in 2019m the main country of origin was China. Furthermore, all econometric models showed that the price of Chinese tire imports is statistically significant and inversely related to the total quantity of imported tires in Ecuador. Consequently, a reduction in the price per ton of Chinese tires would be related to an increase in the quantity of tires imported to Ecuador. Although these results may be expected, their relevance lies in the fact that they can be used to establish strategies to improve the discrete results of ELT management in Ecuador. Considering that the quality of tires is one of the main determinants of tire demand (Carree and Thurik, 2000; Haikal Sitepu *et al*., 2020; Zhang *et al*., 2016), future research should focus on studying the quality of tires according to the country of origin and establish whether the substitution of Chinese tires for tires produced in other countries would generate a greater amount of ELT waste in the long term despite their lower price. Campbell-Johnston *et al*. (2020) empathized that a possible limitation to the management of ELTs in countries that import most of their tires is that it can hardly force large tire producers overseas to significantly change their design and production processes. Therefore, if a market that stimulates the practice of circular economy in this sector is consolidated, it is important to create policies that encourage the importation of higher-quality tires.

Conclusion

Ecuador adopted in 2013 an EPR policy for ELT to reduce the negative effects that these residues have on the environment. However, although the plan represents a significant advance in Ecuador's waste management system, one of the main challenges is the excessive dependence on imported tires. Specifically, although the country produces and exports tires, only 30% of total tires that circulate in the country are produced locally, while 70% are imported from other countries. Therefore, knowing the determinants of the level of tire imports in Ecuador is essential to establish possible policies for the management of ELTs. The econometric models showed that the price of Chinese tire imports is statistically significant and inversely related to the total quantity of imported tires in Ecuador. Although these results may be expected, their relevance lies in the fact that they can be used to establish strategies to improve the discrete results of ELT management in Ecuador. Considering that the quality of tires is one of the main determinants of tire demand, future research should focus on studying the quality of tires according to the country of origin and establish whether the substitution of Chinese tires for tires produced in other countries would generate a greater amount of ELT waste in the long term despite their lower price. In this sense, if a market that encourages circular economy practice in this sector is consolidated, it is important to create policies that encourage the importation of higher-quality tires.

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