Trade Protection, Industrial Policy, and the Shaping of Local Preferences[⋆]

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Abstract

Spain adopted a strictly autarkic economic model at the outbreak of World War II. The Spanish automobile industrial policy was long-lived and characterized by a near prohibition of imports until Spain joined the European Union in 1986. This comprehensive long-term study of the Spanish automobile market covers four issues. First, we document the industrial policy that spurred the development of Spain's automobile manufacturing sector into the 5th largest automobile producer in the world. Second, we demonstrate how this policy limited consumer choice. Third, we identify pronounced regional and national home biases among Spaniards, revealing a preference for automobiles produced locally and domestically. Fourth, we estimate a rich equilibrium demand model to approximate the protection value of the long-lasting effect of industrial policy through changes in consumer preferences. Today, domestic automakers continue to enjoy a substantial advantage, equivalent to at least a 5.5% tariff, compared to a nominal import tariff into the European Union of 10.3%. An additional 3-5% import tariff is needed to avoid a 1% domestic share reduction due to weakening of home biased preferences.

Keywords: Industrial Policy, Domestic Market Advantage, Intranational Home Bias.

JEL Codes: F15, L13, L52, L62

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1 Introduction

The end of globalization and the rise of protectionism has given way to a renewed interest in long forgotten industrial policy as a mean to develop strategic economic sectors (Juhász, Lane and Rodrik, 2024). The Biden administration continued Trump's trade war with China despite its documented negative effects on prices and earnings of industrial workers (Fajgelbaum, Goldberg, Kennedy and Khandelwal, 2019). Passage of the *CHIPS and Science Act* in August of 2022 was America's stark response to supply chain disruptions after the Covid-19 pandemic, allocating a budget of $280bn in new funding for research and manufacturing of semiconductors in the United States with the explicit goal of countering China's dominance in this strategic industry.[1] Beyond the U.S., there is also renewed support for "pro-competitive" government interventions to achieve a variety of goals ranging from environmental sustainability to fairness.[2] The current policy shift acknowledges that there might be room for welfare improvements through an active industrial policy in non-competitive environments, if there are large potential dynamic economies of scale or significant consumer learning effects to be accounted for.

Academic economists frequently oppose these market interventions. This could perhaps explain why there are only a handful of empirical studies available that address the effectiveness of industrial policy. There are outstanding exceptions, though. The work of Choi and Levchenko (2023) evaluates the effect of loan guarantees to the Heavy and Chemical Industry in South Korea between 1973 and 1979 and show that a temporary policy intervention had long-lasting effects by relaxing firms' financial constraints and prompting productivity through learning-by-doing. Using more recent data, Jia Barwick, Kalouptsidi and Bin Zahur (2023) conclude that while the support of the Chinese government for production and investment decisions helped increasing China's worldwide shipbuilding market penetration, entry subsidies, comprising about 60% of the financial support of the program, were wasteful, as it mostly induced inefficient entry.

Although many economists remain skeptic towards industrial policy, the lack of empirical evidence might simply be a consequence of the pro-free trade policies followed in the past. It is difficult to conduct case-studies when Western economies did not engage in active industrial policy for decades.[3] Juhász et al. (2024) correctly point out that one of the difficulties to judge industrial policies is that they combine different elements, not always in a coherent manner, for very extended periods of time where many other economic variables may also change independently of the policy.

[1] See "Is Industrial Policy Making a Comeback?" at the *Council on Foreign Relations*, available at `https://www.cfr.org/backgrounder/industrial-policy-making-comeback`.

[2] The shift in policy is widespread among Western economies. See Mario Draghi's September 2024 report on "The Future of European Competitiveness" detailing the New Clean Industrial Deal to be adopted by the new EU Commission at `https://www.oecd-ilibrary.org/finance-and-investment/pro-competitive-industrial-policy_7c6b4708-en`, as well as the May 2024 OECD Competition Policy Paper "Pro-Competitive Industrial Policy" available at `https://doi.org/10.1787/7c6b4708-en`.

[3] For instance the works of both Goldberg, Juhász, Lane and Thurk (2024) and Jia Barwick, Kwon, Li, Wang and Zahur (2024) evaluate how innovative activity responds to incentives in areas where government intervention has been active recently: semiconductors and electric vehicles.

In this paper we do not measure the short term ability of a policy interventions to increasing some domestic production of strategic interest. Our goal is to address the potential of long-lasting effects associated to industrial policies if they affect consumer preferences. Thus, we conduct a retrospective study of the Spanish automobile industrial policy that originated in the little-known autarkic economic regime of the 1940s and implemented, one way or another, until Spain joined the European Union in 1986. This industrial policy explicitly ignored economic efficiency to favor investments aiming at some vague *national interest* objective linked to self-sufficiency. Although some aspects of this interventionist policy changed over time, the near prohibition of automobile imports was consistently enforced through stringent import quotas for nearly half a century. In addition, Spain offers a unique opportunity to evaluate both the short and long term effect of this industrial policy as Canarias (the Canary Islands) were always exempted from any import restriction as the archipelago always enjoyed a centuries-old free port regime. We use Canarias as a rarely available control to document "in real time" the differentiated consumption patterns induced by the Spanish industrial policy in order to assess some potential autarky-induced distortions.

Output. The success of an industrial policy is frequently measured solely by its ability to increase domestic production. From this perspective, the Spanish automobile industrial policy was a resounding success, growing at a remarkable 22% average annual rate between 1958 and 1972. This explosive growth transformed a backward agrarian economy into the fifth largest automobile manufacturer in the world in less than four decades. Today, Spain still produces nearly double the number of vehicles per capita than the United States.

This massive output growth might have occurred at a substantial expense in terms of economic efficiency, amounting up to 20% of total consumption according to Campos, Reggio and Timini (2023). Prohibiting automobile imports for decades led Spaniards to purchase expensive, obsolete, low quality, domestic vehicles compared to concurrent models available in Europe that could not be imported. An important question beyond the scope of this paper is whether a less protectionist approach could have allowed Spaniards a faster and less expensive access to mobility, therefore raising their standards of living more rapidly, and allowing a more productive allocation of scarce resources to other economic sectors. We find evidence supporting this latter view as Spaniards opted for non-Spanish automobiles whenever they had a chance. For instance, sales of models built in Europe grew rapidly after Spain joined the EU and was forced to liberalize trade with other European economies. This view is also supported by the different profile of automobile sold in Canarias, where the penetration of domestic vehicles only amounted to half the market share in the rest of the country while the industrial policy endured. Few years after joining the EU, the overall share of domestic brands in Spain was also halved.

Intranational Home Bias. Industrial policy has the potential for changing consumer preferences, a model primitive generally considered immune to policy choices. Coşar, Grieco, Li and Tintelnot (2018) argue that foreign direct investment policies leading to automakers' entry have the potential to influence local consumers' perception of the attributes of their choice alternatives to favor domestic brands. This opens the door for industrial policy changing consumer preferences and ultimately being responsible for which vehicles most residents purchase in the future, as manufacturers locate production in response to the economic environment that the industrial policy defines (Head and Mayer, 2019). Home bias, a generalized preference for products manufactured domestically or by domestic firms over similar imported alternatives, may reduce the purchase of imported alternatives (Atkin and Donaldson, 2015; Bronnenberg, Dhar and Dubé, 2009). If the change in preferences is permanent, as we document, it results in an effective protection of the domestic market that may well survive the phasing out of the industrial policy.

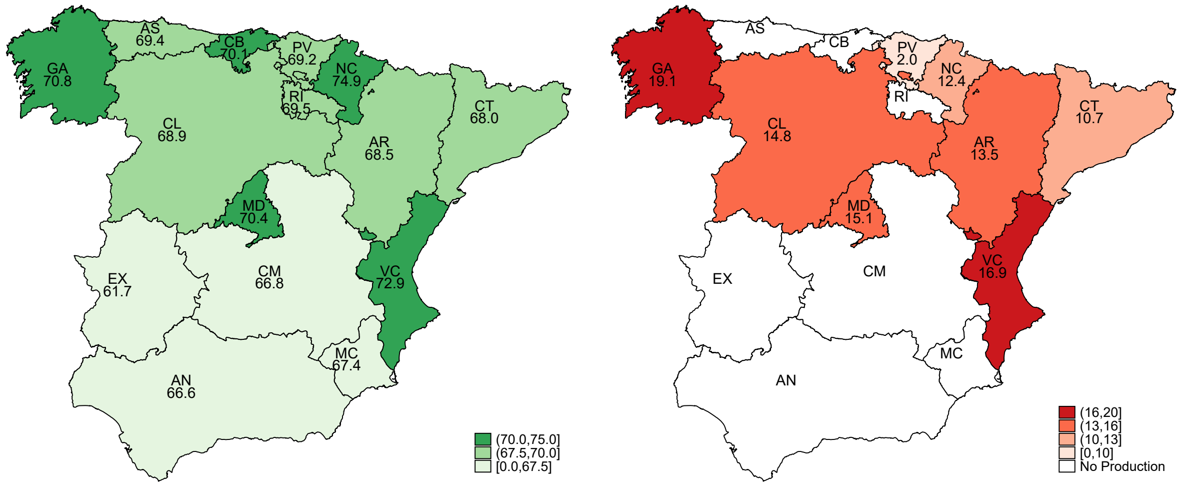
Instead, intranational home bias has rarely been addressed as economists mostly focus on identifying frictions occurring between countries (Anderson and van Wincoop, 2003; Balistreri and Hillberry, 2007; Engel and Rogers, 1996; McCallum, 1995). The Spanish automobile industry is particularly well suited to study intranational home bias as several automobile manufacturers entered the Spanish market between 1950 and 1990 in response to the incentives of the Spanish government and the nearly total prohibition of imports into the Spanish market until 1986, when Spain joined the EU. Spaniards not only favor brands with production facilities in Spain, regardless of their national origin, but they quickly develop a strong loyalty that favors the automobile brand assembled in their vicinity, thus leading to a substantial segmentation of the national market.

This regional market segmentation occurs despite the fact that automakers face common laws, culture, a common currency, and a single national industrial policy. Furthermore, automobile manufacturers follow a uniform national pricing across regions, a practice that might have its roots in the fact that automobile prices were regulated as late as 1980. Overall, this is possibly the closest institutionally and culturally homogeneous economic environment envisioned by Wolf (2000) to rule out most border frictions in favor of home bias. Contrary to Cao, Jia Barwick and Li (2021) we can rule out that the observed home bias is the result of hidden protectionist policies by regional policymakers. Unlike in China, Spanish regions have no role in the design of industrial policy and the Spanish market already had common institutions and uniform national rules when automobile firms first started opening their production plants in the 1950s. Today, automakers continue to operate under common rules as required by the EU's single-market directive.

Figure 1 uses local automobile registration in Spain between 2009 and 2015 to highlight the *regional* segmentation of the Spanish automobile market. About 69% of vehicles currently sold in Spain are manufactured either domestically or in Europe by an automaker with an assembly plant in Spain. Panel (a) shows sales of brands with a domestic manufacturing facility ranging from 62% in non-producing, low-income Extremadura to 75% in producing, high-income Navarra. Interestingly, the composition of domestic car purchases varies substantially across regions. Panel (b) clearly shows a preference for local brands: the 13.5% market share of GM in the region of Aragón, is 74% larger than the market share of GM in the rest of Spain, while FORD, the most extreme case, enjoys a local 16.9% market share in Valencia that more than doubles its the national market penetration.

Figure 1: Biased Preference for Domestic Vehicles (2009–2015)

(a) Market Shares of Domestic Brands (b) Market Shares of Regional Producers



Notes: Panel (a) illustrates the regional market penetration of brands with some domestic production in Spain while Panel (b) reports the market share of the brands with facilities in each producing regions for 2009-2015. Regions: Andalucía (AN), Aragón (AR), Asturias (AS), Cantabria (CB), Castilla y León (CL), Castilla-La Mancha (CM), Cataluña (CT), Extremadura (EX), Galicia (GA), Murcia (MC), Madrid (MD), Navarra (NC), País Vasco (PV), La Rioja (RI) and Valencia (VC).

This domestic market segmentation has not been documented in any other automobile market study that we are aware of. To our knowledge this is the first study documenting such a stark difference in sales of an industrial product across regions of a domestically integrated market. Both Verboven (1996) and Goldberg and Verboven (2001), as well as Coşar et al. (2018), addressed cross-country differences in demand for automobiles at different stages of the European integration. We therefore include brand preference effects in our equilibrium model to account for this acute preference for domestic brands, particularly those in the immediate vicinity and show that local preference arises immediately after automakers locate nearby.

Data. We construct two separate data sets to address issues related to the Spanish automobile industrial policy. First, we hand-coded the historical Spanish automobile registration data by province and automaker for years 1961-2015 to show that consumers quickly become loyal to products of the automobile brands with domestic manufacturing facilities. Using this data, we use reduced form regressions to document, for the first time, several important patterns regarding home bias: (*i*) it appears immediately after entry; (*ii*) it is permanent and stronger among early entrants; (*iii*) it survives trade liberalization; (*iv*) it is robust to inertia, and perhaps most shockingly (*v*) automobile preferences strongly favor the brand of the automaker producing in the immediate vicinity of consumers, an immediate intranational home bias effect sufficiently strong that effectively balkanize a supposedly integrated domestic market.

The second dataset includes provincial automobile registration data for 2009-2015 that we use to estimate an equilibrium oligopoly model where automakers set national uniform prices. The goal is to measure the economic magnitude of the trade distortion associated with the existence of home biased preferences in the long run, decades after the industrial policy ended. Measuring the welfare effect of home bias is challenging as customers appear happy to patronize the local brand today when they are free to purchase any other domestic or imported vehicle. Rather than measuring a questionable welfare loss, we compute the current shadow tariff equivalence of the estimated home biased preferences. Thus, for instance, while the official European import tax rate stands at 10.3%, we find that Spaniards acute preference for automobile brands manufactured in their own region amount to an equivalent 5.5% import tariff on automobile models from non-domestic firms. Furthermore, a 50% weakening of the loyalty for brands located in Spain requires up to a 3% tariff increase to compensate for each additional 1% market share lost to imports.

What could have happened if Spain had not developed its automobile industry? Would production have shifted to Europe? Would this have resulted in a more competitive European automobile market? Would Spaniards have been better off? Although fascinating, all these questions fall beyond the scope of the current paper. McAfee (1983) cautions against using counterfactual analysis to evaluate long historical episodes. Our paper does not build a dynamic model of European-wide entry decisions by different automakers. Our goal is to document for the first time how national and regional home bias arise using a rich automobile registration data within a unusual institutional framework where one of the regions gets excluded from the automobile import prohibition. We also document, for the first time, long term trade effects of local preferences shaped by a long defunct industrial policy.

For similar reasons we take the location of production facilities as given. Assuming plant location as exogenous is more reasonable approach than considering a static entry game where firms anticipate idiosyncratic local preferences when our analysis of the Spanish automobile market spans nearly seven decades under two very different political regimes. What could have happened if the Spanish government had convinced Henry Ford III to build his assembly plant in Madrid? The evidence presented in this paper suggest that residents of Valencia would have never developed their current preference for the FORD brand.

Organization. Section 2 presents a historical account of the development of the Spanish automobile industry within the context of a decades-old autarkic industrial policy. Section 3 shows that entry of a new firm triggers a rapid and long-lasting increase in sales at the national level, an increase that is significantly larger at the region where the new firm locates its assembly plant. Section 4 estimates an equilibrium, random coefficients, discrete choice, model of demand and supply for the Spanish automobile market where consumers might have possibly biased preferences for locally produced brands and firms price uniformly across Spain. We use counterfactual analysis in Section 5 to first quantify the additional sales of domestic brands and the reduction of imports, as well as to estimate of the shadow import tariffs mimicking the trade distortions induced by home biased preferences in a counterfactual environment without home biased preferences. Section 6 concludes. Additional documentation and results are reported in the Appendices.

2 The Spanish Automobile Industry

This section reviews the development of the Spanish automobile industry beginning with Franco's early autarkic regime. The analysis of industrial policy in Spain is interesting in itself since no other Western economy adopted such an extreme autarkic model for so long. The three pillars of the Spanish automobile industrial policy included the creation of a state-owned manufacturer, heavy-handed industry regulation, and near prohibition of imports. Over the decades, some of the regulations were softened or abandoned, except for the prohibition of imports, which was enforced until 1986, when Spain joined the EU. Because of this industrial policy, many manufacturers established in Spain, frequently supplying the fast-growing Spanish domestic market with models nearing the end of their life-cycle in other European countries. Later on, the small, fuel efficient models produced locally were introduced at the same time than in other European markets where they were exported. Overall, the Spanish automobile industry went from non-existing in the 1950s to become the fifth largest in the world in the 1990s. From 2002 on, Spain became the second largest automobile manufacturer in Europe, with thirteen assembly plants of ten automobile brands, comprising 8% of GDP and industrial employment, and exporting 87% of the 2.2 million units produced, i.e., about 11.5% of all Spanish exports.

2.1 Industrial Policy and the Development of the Spanish Automobile Industry

At the end of the 1930s, after a decade of stagnation during the Great Depression and three years of civil war, the Franco's regime adopted strongly isolationist and interventionist policies to rebuild the Spanish economy. The long decades of autarkic industrial policy originated in two pieces of legislation adopted right after the outbreak of WWII. The *Protection and Development of New Industries Act* of October, 1939, allowed the government to classify an industry as strategic for the *national interest*, offering administrative and financial advantages together with an iron-fist bureaucratic control. The second piece of legislation, the *Regulation and Industry Defense Act* of November, 1939, ranked industries according to their military importance, subjected entry of new firms to government approval, restricted foreign capital participation, required firms to use domestic inputs and limited their ability to import new technologies, all of which played a major role in the development of the Spanish automobile industry until Spain joined the European Union in 1986.[4]

The modern Spanish automobile industry has its origins in this statist industrial policy as implemented through the *Instituto Nacional de Industria* (*INI*), a state owned corporation founded in September, 1941, to foster the industrialization of Spain through state capital participation in any company deemed strategic for the success of the autarkic economic policy. SEAT was created in 1950 as a subsidiary of FIAT. *INI* owned 51% of SEAT's capital, or 300 million pesetas at the time,

[4] It is withing this legal framework that we deem the interaction between potential entrants and the Spanish government more important that any strategic consideration among automakers regarding if, when, and where to open an assembly plant in Spain, at least until 1986.

with 7% held by FIAT and 42% by local banks. SEAT imported parts from Italy and assembled them in Barcelona (Cataluña) where local versions of the Italian models were sold under license at astronomical prices. Soon after, other European manufacturers followed and entered the Spanish market with similar agreements with local entrepreneurs and Spanish banks, but without the direct involvement of *INI*.[5] They were attracted by a growing market, low-costs, and a relatively skilled and non-unionized labor force, despite foreign capital still being limited at 25%. Early entrant RENAULT located in Valladolid (Castilla y León) in 1951 and CITROËN in Vigo (Galicia) in 1957. Regardless of the national origin of each automaker, these three brands, SEAT, RENAULT, and CITROËN, define the "Core Spanish Brands" that entered well ahead of any other automaker, during the most interventionist phase of the Spanish industrial policy. Today, they still lead regional sales in their local markets, 14.8% and 19.1%, respectively, as shown in Figure 1(b).

In 1959 the autarkic model collapsed and Franco's government was forced to negotiate a drastic reform program with the International Monetary Fund and the World Bank to avoid default. Domestic sales amounted to only 38,000 vehicles that year. After the reforms, the Spanish GDP grew at an average yearly rate of 6.2% between 1958 and 1972. Automobile manufacturing outperformed any other industry and grew yearly at an astounding 21.7% average yearly rate over the same time period, mostly serving the domestic market and prompting the development of an important automobile component industry.[6]

From 1959 to 1985, despite a gradual liberalization of the economy, the Spanish automobile industry was still heavily regulated regarding capital control, prices, and minimum national production content. An important change in policy was the result of the Spanish government negotiating directly with Henry Ford III directly negotiating the conditions necessary to secure FORD's investment to build a large assembly plant in Spain. FORD formally announced building its factory in Valencia, one month after agreeing to lowering the required national components from 90% to 50% in November of 1972. It started production in 1976 (Catalán, 2006).

We consider FORD part of the group of "Early Entrants," those that decided to locate production in Spain under these more lax conditions, but early enough that the prospect of Spain could join the European Union remained uncertain. They also include PEUGEOT, which purchased the former Barreiros factory in Madrid in 1978 and OPEL, which closed a deal to built a factory in Zaragoza (Aragón) in 1979. "Late Entrants" such as NISSAN or VW, located in Spain when accession to the EU was imminent. Other smaller manufacturers that eventually left the Spanish market are grouped under the "Exiting Brands" label.

Table 1 reports the years when domestic brands sold vehicles in Spain (either produced or imported), their production location, and the average national and regional market share while producing in Spain. Thus, for instance, MERCEDES has been manufacturing car passengers in

[5] Visit `https://en.wikipedia.org/wiki/SEAT` for a summary description in English of the process leading to the creation of SEAT. For a much more detailed account in Spanish, see San Román (1995) and Catalán (2006).

[6] See Pallarès–Barberà (1998), Tamames and Rueda (2005, §3.3.2), and Tortella and Núñez (2014, §12.3–12.4) for further institutional details.

Table 1: Domestic Brands: Production, Location, and Market Shares (1961–2015)

Manufacturers		Production		Avg. Market Share	
Group	Brands	Entry – Exit	Region	National	Regional
Core Spanish Brands					
VW	SEAT	1953 –	CT	25.24	27.94
PSA	CITROËN	1958 –	GA	8.33	9.89
RENAULT	RENAULT	1953 –	CL	19.28	25.51
Early Entrants					
FORD	FORD	1976 –	VC	10.72	12.02
PSA	PEUGEOT	1977 –	MD	8.23	8.66
DAIMLER	MERCEDES	1981 –	PV	2.42	1.67
GM	OPEL	1982 –	AR	10.06	16.85
Late Entrants					
NISSAN	NISSAN	1983 –	CT	2.54	3.49
VW	VW	1984 –	NC	7.44	9.45
SUZUKI	SUZUKI	1985 – 2001	AN	0.28	0.38
VW	AUDI	2011 –	CT	4.48	4.85
Exiting Brands					
SANTANA	SANTANA	1961 – 1970	AN	0.42	1.01
AUTHI	MG	1961 – 1972	NC	0.71	0.51
	AUSTIN, MORRIS	1963 – 1975	NC	3.40	7.29
BARREIROS	DODGE	1965 – 1971	MD	0.88	1.58
	SIMCA	1966 – 1980	MD	8.16	8.64
	CHRYSLER	1975 – 1981	MD	2.73	3.67
	TALBOT	1979 – 1987	MD	5.26	6.76

Notes: Years under the "Production" category indicate when automobiles of a particular brand were first/last produced in Spain, including the location of its assembly plant. The last two columns report the average national or regional market share of brands over their production period in Spain. The complete list of Spanish regions and their two-digit codes are available in Figure 1.

Vitoria (País Vasco) since 1981; and NISSAN in Barcelona since 1984. VW entered an agreement to produce some models in SEAT's plant in Navarra in 1984 but then quickly acquired a controlling stake in SEAT at the end of 1990. VW only begun producing locally some AUDI models much later, in 2011, in a former SEAT plant in Barcelona.[7] Table 1 indicates that FORD began producing in 1976 and therefore is considered a Spanish domestic brand for 40 years of our sample; it is located in Valencia and during these four decades had an average national market share of 10.72%, with a 12.02% average regional market share. We should stress that FORD vehicles were always sold in all Spanish regions, even during the first year of local production. This is common for surviving brands and we rule out that preference for a brand produced locally could be explained by the slow deployment of a network of dealerships across Spain.

[7] All the data used in sections 2 and 3 was collected from the Statistical Yearbooks of *Dirección General de Tráfico*, *DGT*, the Spanish Department of Motor Vehicles. See Appendix A.

Core brands, SEAT, RENAULT, and CITROËN, dominated the highly protected national market until 1986, with maximum national market shares of 60.25% (1961), 35.58% (1980), and 11.68% (1977), respectively. These brands, together with FORD, OPEL, and PEUGEOT, benefited from the Spanish industrial policy, as they manage to retain an important customer loyalty many decades after the policy ended and imports were no longer restricted. Several established brands eventually left the market after Spain's accession to the European Union. Perhaps the most remarkable cases are SIMCA and TALBOT, two brands built by BARREIROS in Madrid which, despite reaching a sizable share of the market, 14.65% (1966) and 10.60% (1981), could not cope in the long run with the competition from other European brands after the extreme import quotas were phased out. This likely amounts to evidence of inefficient entry prompted by the industrial policy.

2.2 Manufacturing Plant Location

We argue later in Section 3 that manufacturers develop a strong loyalty among residents in the region where they locate. Could firms anticipate this regional home bias effect and choose their location accordingly? Anecdotal evidence helps us rule out this hypothesis. Firm location was frequently the result of negotiations with *INE* and the Spanish government, particularly during the dictatorship, conditioning the location of manufacturers in the "Core Spanish Brands" and "Early Entrants" categories. The location of the smaller "Exiting Brands" obey to the previous existence of production facilities, skilled manual labor, or access to local financial institutions.

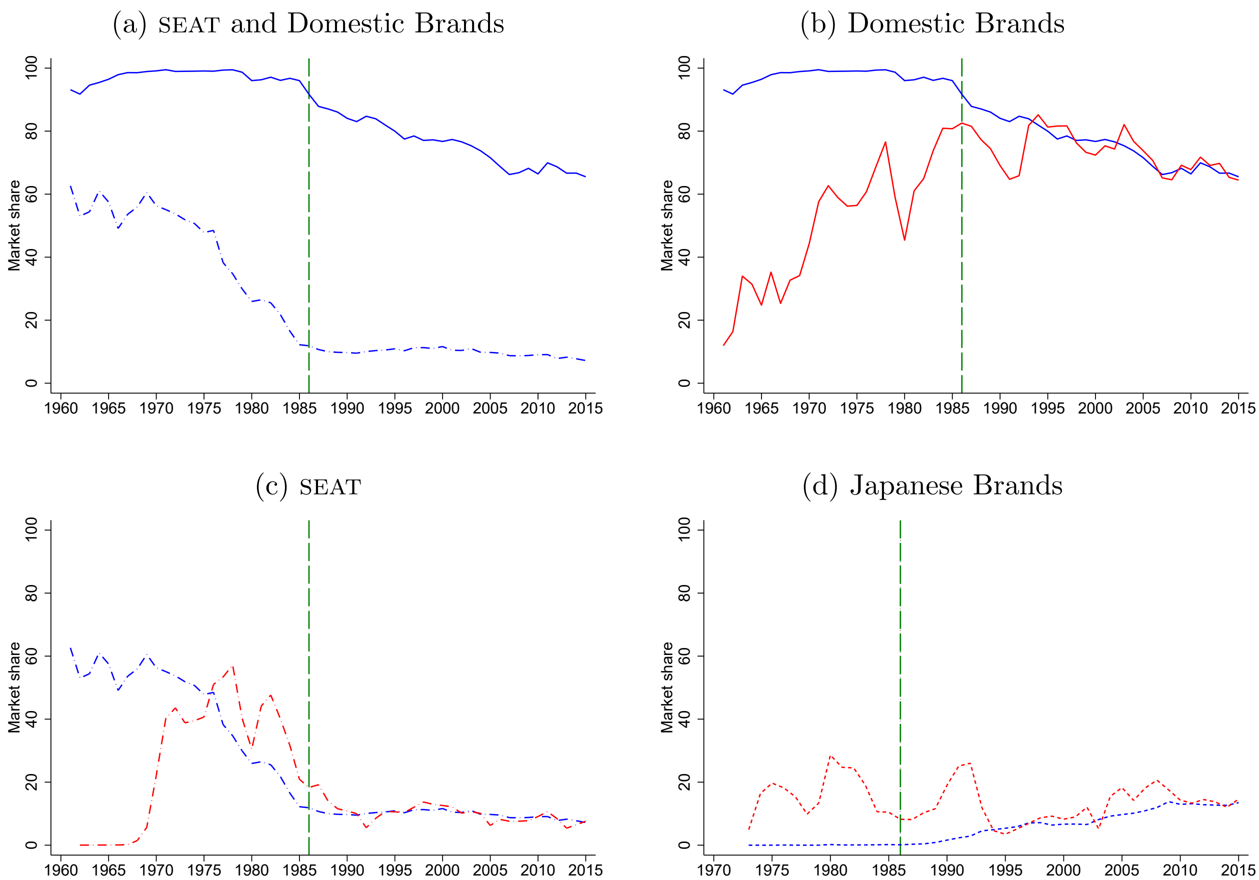
A couple of examples could be illustrative. The Spanish government wanted SEAT to locate near Madrid, the largest potential market (Pallarès–Barberà, 1998, p. 348), but *INI* chose to locate it in Barcelona due mostly to the reduced transportation cost of FIAT components from Turin and the preexisting industrial base there (San Román, 1995, p. 152). Many years later FORD located in Valencia, not so much because of any anticipated effect of local consumer loyalty, but rather for the proximity to the nearby port, key for a factory that exports around 70% of its production (Pallarès–Barberà, 1998, p. 354).[8]

2.3 Spanish Tariff Protection vs. Canarias' Free Ports

Spain delayed opening up its domestic market to Europe using tariffs and import quotas as a bargaining chip to ensure full EU membership and avoid a free trade association status (Guirao, 2021, §8). Tariff protection was so extreme that in 1978, the only year for which we have data, about 15,000 vehicles were imported in Spain, or less than 2% of total sales. But most of them,

[8] CITROËN is perhaps the best example to rule out any role of regional demand or strategic behavior among automakers when locating in Spain. The port city of Vigo in Galicia offered good communications, inexpensive land, skilled workers from the nearby shipyards, and financial aid from other government programs (García-Ruiz, 2001, p. 141). However, CITROËN was not even aware of these local conditions and intended to open its plan in Navarra, close to the French border. The local entrepreneur Félix Santamaría took the Director General of CITROËN on a surprise tour to Vigo when he was on its way to sign an agreement to locate in Navarra. See `https://www.vigoe.es/vigo/mas-vigo/la-fabrica-de-pamplona-que-acabo-en-vigo/`.

Figure 2: Evolution of Market Shares: Mainland vs. Canarias



Notes: Blue lines identify market shares in mainland Spain while red is associated to market shares in Canarias. The vertical dashed green line indicates Spain's accession to the EU. We include all brands with a Japanese parent company in Panel (d), regardless of whether they operate a factory in Europe (see Appendix A).

10,000 were sold in Canarias while 4,000 correspond to title transfers from returning migrants and diplomats or foreigners settling in Spain. Thus, the effective quota, with government permits issued to commercial importers did not exceed 1,000 units.[9] Trade protection only started to change in the 1980s. First, automobile prices stopped being regulated in February of 1980. Next, the stringent quotas were increased year after year. Once Spain joined the European Union in 1986, import tariffs on European manufactured vehicles were reduced until their elimination at the end of the transition period in December of 1992.

The effect of this trade liberalization is documented in Panel (a) of Figure 2. The decline of the market share of domestically produced vehicles (solid line) accelerates when Spain joined the European Union. Despite being dominant in the 1960s, SEAT's market share fell faster after 1976 (dashed blue line), when FORD began producing locally. Finally, SEAT's market share stabilizes at a lower level when VW acquires it at the same time that Spain joins the EU in 1986.

[9] See *Liberalización de las importaciones de turismos en España (I): Antecedentes, and (II): El Plan Sahagún* in `https://www.documentosdelmotor.com` and sources cited therein.

For historical reasons, Canarias was excluded from the application of this harsh trade protection and thus it could import vehicles that were not available anywhere else in Spain. This is due to a very different taxation of trade going back centuries. Autarky was less stringent in Canarias, and for the automobile industry in particular, it resembled free trade.[10]

This singular behavior of the automobile market in Canarias responds to the existence of a free port fiscal regime, and it is therefore exogenous to idiosyncratic local preferences for automobiles. This exception makes the study of the Spanish case particularly interesting as we can give a causal interpretation to the estimated difference in valuation of domestic automobiles between Canarias and the rest of Spain. Thus, Canarians purchased a sizeable share of Japanese vehicles decades ahead of any other European market. The other panels of Figure 2 compare the evolution of the regional automobile market in the Canarias and the rest of Spain to highlight how a closer-to-free-trade environment led to a dramatically different automobile market configuration.

Panel (b) shows that the share of domestic vehicles sold in Canarias and the rest of Spain only converged after the complete phasing out of import tariffs on European cars in 1993. Canarias certainly mimics mainland Spain during the Great Recession, between 2009–2015, the long-term equilibrium period that we use to conduct our counterfactual analysis after estimating a structural model later in Section 4. Canarias is thus a good control group that could show how the Spanish automobile market would have behaved without the draconian import restrictions of the autarkic industrial policy.

The last two panels show that purchasing habits in Canarias and the rest of Spain converged across several very different market segments such as SEAT and Japanese brands. Japanese brands have always been far more popular in the Canarias than the rest of Spain. Panel (d) shows that market shares of Japanese brands converged after 1992, right when the transition period to the Spanish accession to the EU ended and Spanish tariffs were finally lowered to the common European rate of 10.3%. As for SEAT, its market penetration shows a similar trend in mainland Spain and Canarias starting in 1976 and became indistinguishable after 1992, compounding the effect of trade liberalization with the quality improvement of SEAT models after this automaker was acquired by VW in 1986.

[10] The differentiated insular tax and trade regime has deep historical roots going back to 1487, with the annexation of Canarias by the Crown of Castille. To favor new population settlements, the crown essentially exempted its inhabitants from income and wealth taxation and left the insular administration to tax the local economy to cover its needs. This regime survived one way or another until 1852 when, in a major reform, Canarians began to be taxed for their income and wealth and contribute to the growing size of the state administration. In exchange, the islanders got (almost) free ports, excluding them from the prohibitive national import tax adopted in 1820 and 1826 to deal with reconstruction after the War of Independence (1808–1814), the successive defaults of the crown, and the loss of the American Colonies (Fontana, 2002). Trade at the Canary Islands was taxed much less by local authorities to fund their own administration. In practice, this regime established a foreign entity from a taxation point of view to avoid that imports entered Spain taking advantage of the insular exception to protectionism. The Francoist regime initially canceled these free ports until the collapse of its autarkic policy in 1959, but later restored them in a more modern fashion in 1972 to promote the insular economy, more dependent from foreign trade than the rest of Spain. Spain's treaty of accession to the European Union recognized this fiscal singularity and left Canarias' economic activity outside the borders of the EU. See Solbes, Castillo and Quintana (2023) for a very detailed account of the evolution of this insular taxation system.

3 Automaker Entry and the Shaping of Domestic Preferences

Industrial policies may have very long-lasting effects. It is remarkable that sixty years after the government chose to locate SEAT in Barcelona, the only genuinely Spanish automaker is still the leading sales brand in Cataluña with a 10.7% regional market share. Dealer networks of domestic brands cover all the regional markets immediately after firms begin domestic production. Thus, we discarded that the availability of a dealership network could explain excessive regional market shares of local manufacturers in Table 1. Another commonly suggested explanation for this biased preference hints at the existence of employee discounts. It is difficult, however, to conceive that a workforce below 11,000 in a region with more than 7.5 million inhabitants could be responsible for SEAT's 1.7% excess market share in Cataluña relative to its national average market penetration in years 2009–2015, i.e., nearly seventy years after SEAT started manufacturing vehicles in Barcelona. The same can be said about FORD, OPEL, CITROËN, RENAULT, and VW, all of which have a regional excess market share over national market penetration much larger than SEAT in Cataluña, as shown in Figure 1(b).

National and Regional Preference Bias. To conduct the econometric analysis of this section, we hand-coded yearly sales by automaker and province between 1961 and 2015 as reported in the Statistical Yearbooks of *Dirección General de Tráfico, DGT*. This produced an unbalanced panel of 25,124 region-year-automaker observations. Table 2 presents the estimates of some variation of the following model:

$$\ln(s_{jrt}) = \alpha + \beta_{\mathrm{NHB}}\, \mathbb{1}[j \in g(t)] + \beta_{\mathrm{HBReg}}\, \mathbb{1}[r = r_i] + \beta_{\mathrm{RHB}}\, \mathbb{1}[j \in g(t)] + \phi_j + \delta_t + \rho_r + \varepsilon_{jrt}\,, \qquad (1)$$

where s_{jrt} is the market share of all automobile models of brand j, sold in region r at time t between 1961 and 2015.[11] During this long time-span, several firms entered the Spanish market. After evaluating different alternatives we distinguish four types of automakers, mostly defined by how early they entered the Spanish market. They include "Core Spanish," "Early Entrants," "Late Entrants," and "Exiting" firms, all of which defines groups $g(t)$. Table 1 lists the brands of each group. We also distinguish two types of consumer home bias: "national" (NHB) captures the loyalty towards brands with at least one assembly plant in Spain while "regional" (REG) is the additional preference for the brand produced locally. We also include an indicator to capture the differentiated valuation of domestic vehicles by residents in Canarias and other regions, $r_i = \{$Baleares, Canarias, Murcia$\}$, to assess the validity of Canarias as control group. In addition we also include several fixed effects: (up to) 43 firms, 54 years, and 16 regions. The reference group are imported vehicles, i.e., European or Asian brands without assembly facilities in Spain at time t. This reference group changes when there is an entry or exit of domestic manufacturers.

[11] Automobile attributes are not available because this long historical dataset does not report sales by model but rather aggregated by automaker. We thus control for firm fixed effects but cannot address the heterogeneity of product portfolio of each automaker with product fixed effects.

Table 2: National and Regional Preference for Local Brands

	Model 1	Model 2	Model 3	Model 4
CONSTANT	-5.8516***	-5.8511***	-5.8513***	-5.9742***
	(0.0883)	(0.0883)	(0.0883)	(0.0951)
NHB-CORE	4.2719***	4.2699***	4.2709***	
	(0.0670)	(0.0671)	(0.0672)	
NHB-EARLY	2.2646***	2.2625***	2.2635***	
	(0.0489)	(0.0491)	(0.0492)	
NHB-LATE	1.5109***	1.5089***	1.5098***	
	(0.0609)	(0.0611)	(0.0611)	
NHB-EXIT	4.1259***	4.1238***	4.1249***	
	(0.0850)	(0.0852)	(0.0851)	
H.B. CANARIAS	-1.2641***	-1.2620***	-1.2630***	-1.2609***
	(0.0830)	(0.0831)	(0.0831)	(0.0837)
H.B. BALEARES		0.03078		
		(0.0716)		
H.B. MURCIA			0.01596	
			(0.0693)	
RHB-CORE	0.2524***	0.2539***	0.2531***	0.2595***
	(0.0869)	(0.0869)	(0.0869)	(0.0871)
RHB-EARLY	0.2267***	0.2282***	0.2275***	0.2367***
	(0.0684)	(0.0685)	(0.0685)	(0.0679)
RHB-LATE	0.1683	0.1698	0.1691	0.1713*
	(0.1082)	(0.1082)	(0.1083)	(0.0923)
RHB-EXIT	0.2219	0.2233	0.2226	0.2201
	(0.2146)	(0.2146)	(0.2146)	(0.2110)
Leads/Lags (5/5)				✓
Adj. R^2	0.6702	0.6702	0.6702	0.6756

OLS estimates using a sample of 25,124 region-year-automaker observations. The endogenous variable is the log of the regional market share of sales of all models of each automaker. The sample period spans from 1961 and 2015 and all models include 54-year, 42-firms, and 16-region fixed effects. Absolute value, heteroskedastic-consistent, standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively.

Table 2 evaluates the effects of automakers' entry decisions on regional market shares of automobile brands. Models 1-3 report the estimates of the average national home bias effects by type of entrant and Models 4-6 repeats the analysis allowing for a transition phase. Results show that entry of an automobile manufacturer increases its market share in Spain substantially. National home bias estimates are quite different for each type of entrant in Model 4, once we take into account firm, year, and region fixed effects. Results show that national home bias is more important for core brands and early entrants, i.e., , those who started operating in Spain well ahead of trade liberalization. Late entrants had to compete immediately with imports as they entered the Spanish market right before the accession to the EU. Spaniards are still loyal to these new domestic brands but to a lesser degree than those who had been operating for decades. In any case, results show that entry of an automobile manufacturer increases its market share in Spain substantially.

Table 2 also report separate estimates of regional home bias effects for each type of domestic automobile manufacturer (RHB-CORE, RHB-EARLY, RHB-LATE, RHB-EXIT). These regional effects are significant for the early entrants that remain in the market, and smaller and marginally significant for late entrants in more competitive environments.

The home bias estimate is particularly strong for firm that eventually exited the market. We could think that if some brands are more effective at developing national or regional loyalty, or offer a set of products better aligned with local preferences, then they should both be more likely to enter and less likely to exit with the EU. That is precisely what happens in equilibrium for the core Spanish brands and the early entrants. Then, NHB-EXIT=1 possibly identifies the effect of inefficient entry due to the industrial policy. All automakers at the bottom of Table1 include many early manufacturers that could only operate in an extremely protected market, but that eventually left either before or immediately after Spain joined the EU, as they were no longer competitive. They are all small manufacturers that fail to achieve economies of scale despite their strong customer base, as for instance BARREIROS.

Canarias. We documented in Section 2 that Canarias had access to imports, unlike the rest of Spain. This offers the possibility of using the archipelago as an effective control group later on to evaluate the effect of trade liberalization. Other than its peculiar taxation regime, Canarias is no different to the rest of the country. Consumption patterns are similar and the islands have shared the same institutions and legal framework with Spain for centuries. This is confirmed in our data as automobile consumption in Canarias and the rest of Spain converges after joining the European Union, e.g., see Panel (b) of Figure 2.

In Table 2 we include a dummy variable to identify the differential valuation of domestic brands in Canarias. We also included the same dummy for Baleares (the Balearic Islands) in Models 2 and 5, as well as Murcia in Models 3 and 6. Baleares and Canarias share not only an insularity reality, but in both cases, tourism is the most important activity and they are the regions with the highest population density of the country. Murcia is the region with the most similar income per capita to Canarias. However, none of the estimates for these other regions depart from the national average home bias favoring domestic products. Thus, we conclude that the differentiated behavior of Canarias residents amounts to a reasonable control group capturing the induced effect of trade restrictions by the Spanish automobile industrial policy.

The loyalty of Canarians towards domestic brands is always significantly negative, reducing the average market share advantage a minimum of 30%, an amount similar to the advantage of later entrants. The reason was Canarians access to imports. Despite being a much poorer region than the affluent markets of Madrid and Barcelona, Canarias concentrated most Spanish imports of all foreign brands, including Japanese cars before 1986, when Spain joined the European Union. This result should at the very least question the wisdom of *INI*'s industrial policy. Yes, it might have turned Spain into a large automobile manufacturing producer, but what was built domestically could not compete with imported alternatives, and if given a chance, as Canarians can attest, most consumers preferred better or less expensive imported vehicles.

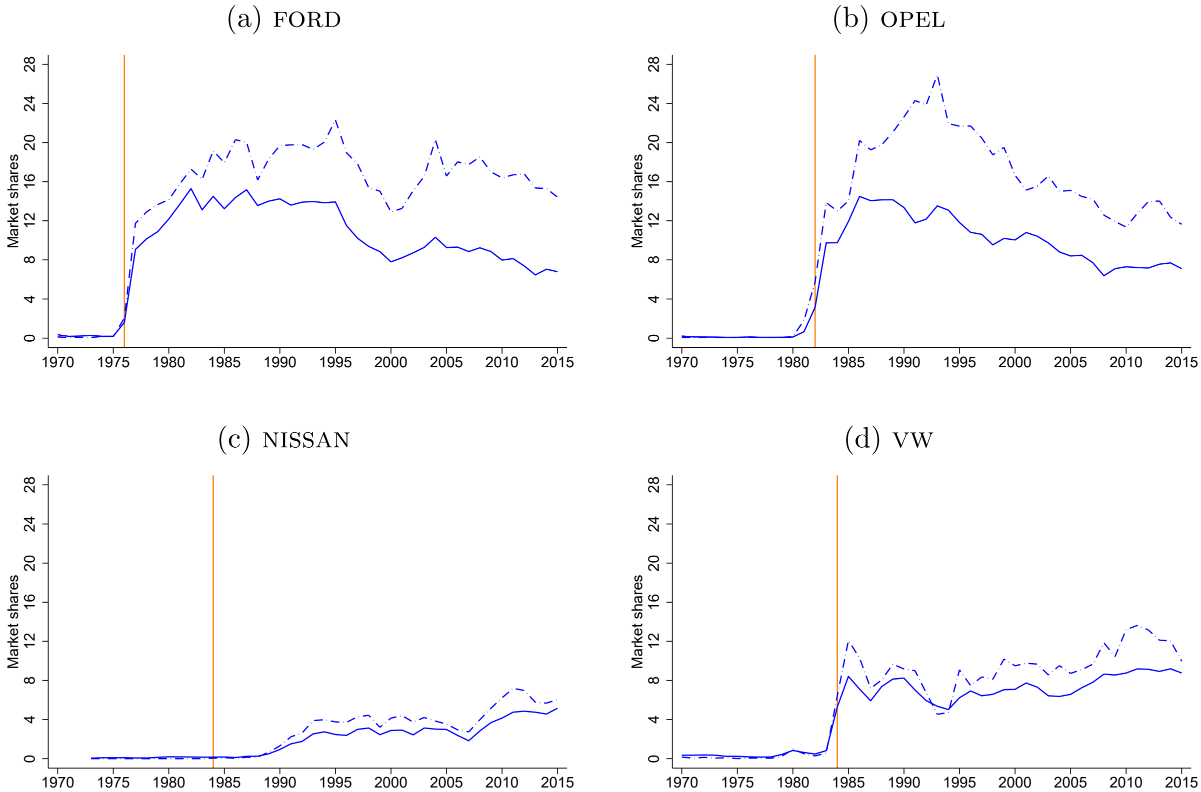
Immediate and Persistent Home Bias Effect. Models 4-6 evaluate the dynamic treatment effects of Laporte and Windmeijer (2005), allowing for a transition phase of plus/minus five years from/to the year of entry of each automaker. Table 2 only reports the estimates of the main parameters while Table D.3 in Appendix D reports these dynamic treatment estimates for Model 4. National home bias effects are qualitatively similar when we allow for a dynamic adjustment associated to a automaker's entry. The long-term national home bias increases for all firms currently producing vehicles in Spain. There is a significant and quite stable premium for the core and early brands who entered the Spanish market between 1950 and 1982 that amounts to about 10% of the market share increase due to national home bias.

The estimates of Table 2 and Table D.3 show that all automakers benefit from locating in Spain. There is little or no anticipation among late entrants and firms that eventually left the market. Demand reacts rather quickly to entry for all entrants, somewhat overreacting in the first two or three of years to settle at a slightly lower (but positive) level afterwards. Late entrants continue to increase their brand recognition as times goes by. The positive national home bias effect is thus sudden and permanent for all entrants. It is remarkable that all those firms that entered the market before 1982 show home bias effects that are much larger, nearly double, than those of late entrants NISSAN, VW, SUZUKI, and AUDI.

Figure 3 illustrates these results for particular automakers. The top row shows the dramatic increase in sales following the entry of the last two large automakers before 1982. Both FORD and OPEL decided to build large factories well before Spain joined the European Union. They both had to deal with the Spanish Goverment and all the national origin component regulations of a long-lasting industrial policy. But they also benefited from a highly protected domestic market. In both cases, previous sales (imports) were almost non-existing. Domestic sales grew overnight after entry and declined slowly over the next decades. Note that the reduction of import tariffs during the transition period of 1986 and 1992 did not affect their domestic market presence significantly. It is also worth highlighting the substantial and permanent additional market penetration of these two automakers in their regional home markets (dashed lines).

The bottom row presents the case of late entrants, NISSAN and VW. NISSAN mostly produced the large "Patrol" SUV, and after 1986 other models built in the U.K. Its market penetration was much smaller than those of FORD or OPEL, but managed to sell a few more vehicles in Cataluña, where it built them. VW, on the other hand, entered quickly in Spain after acquiring SEAT (not included in VW's market share of this figure) in 1986. The production of the popular VW "Polo" in Navarra led to a fast increase in sales, also exceeded by regional buyers.

Figure 3: Entry and Local Preferences



Notes: Domestic market share (solid line) and regional market share (dashed line) before and after firms opened their production facilities.

Inertia. Empirical research in development and industrial organization highlights the role of culture as an important intangible trade barrier. Habit formation may explain home biased preferences for consumer products, and particularly food, with taste developing in the early years of consumers' lives (Atkin, 2013; Dubois, Griffith and Nevo, 2014). As for automobiles, Anderson, Kellogg, Langer and Sallee (2015) have documented the intergenerational transmission of preferences for automobile brands: sons and daughters tend to be loyal to the brand favored by their parents; and Severen and van Benthem (2022) show how the price of gasoline for individuals aged 15-18 affects their driven miles later in life.

The first three columns of Table 3 (and more more in detail in Table D.4 in Appendix D) aim at addressing the validity of our results in the presence of some state dependence. Our conclusions are limited by the fact that our data is aggregate and thus, we cannot really discern whether this inertia effect is the result of intergenerational transmission of preferences, habit formation, formative experiences, or simply a response that might combine them with consumer learning spillovers, fashion, product life cycle, or many other reasons. For instance, consumers might purchase the local brand out of a warm glow feeling, or perhaps because they perceive that popular models

Table 3: Changing Preferences: Learning and Trade Liberalization

	Model 1.I	Model 1.II	Model 1.III	Model 1.C	Model 1.E
CONSTANT	-7.2778***	-6.8836***	-6.8562***	-6.2571***	-5.6353***
	(0.1279)	(0.1325)	(0.1317)	(0.1028)	(0.0724)
NHB-CORE	3.5023***	3.3305***	3.3520***	3.0573***	2.9365***
	(0.0646)	(0.0557)	(0.0556)	(0.0528)	(0.0349)
NHB-EARLY	1.7421***	2.2230***	2.2328***	1.8025***	3.0041***
	(0.1134)	(0.1154)	(0.1161)	(0.2345)	(0.0352)
NHB-LATE	1.1329***	1.2963***	1.3365***	0.6818***	0.07859
	(0.0756)	(0.0711)	(0.0713)	(0.0781)	(0.0583)
NHB-EXIT	4.6244***	5.0597***	6.3148***	1.3350***	
	(0.2086)	(0.4468)	(0.2310)	(0.2922)	
H.B. CANARIAS	-0.6014***	-0.2109***	-0.1732**	-0.2478***	0.1994***
	(0.0817)	(0.0722)	(0.0732)	(0.0753)	(0.0643)
RHB-CORE	0.3377***	0.2259***	0.2559***	0.3327***	0.3051***
	(0.0891)	(0.0685)	(0.0672)	(0.0682)	(0.0436)
RHB-EARLY	0.2304***	0.2030***	0.2193***	0.2153***	0.3094***
	(0.0615)	(0.0591)	(0.0586)	(0.0574)	(0.0476)
RHB-LATE	0.1487	0.1760**	0.1375	0.1215	0.1741***
	(0.1064)	(0.0831)	(0.0856)	(0.1043)	(0.0441)
RHB-EXIT	0.1240	-0.6935	-0.07362	-0.03614	
	(0.5053)	(1.3305)	(1.0567)	(0.4580)	
PAST DOMESTIC SALES		0.0036***	0.0029***		
		(0.0004)	(0.0004)		
PAST IMPORTS		0.0316***	0.0301***		
		(0.0018)	(0.0017)		
Lagged Years Windows	[0]	[4–9]	[5–10]		
Starting Year	1975	1975	1975	1980	1992
Observations	20,835	17,228	16,791	19,419	14,143
Adj. R^2	0.6825	0.7241	0.7305	0.6983	0.7571

The endogenous variable is the log of the regional yearly market share of sales of all models. For models 1.II-1.III, "Past Domestic Sales" and "Past Imports" are the cumulative regional sales of vehicles of brands with domestic production and imports, respectively, for the window of past years indicated at the bottom of the table. Samples for Models 1.c-1.e begin at different starting years to capture the change in preferences following Spain accession to the European Union. All regressions include firm, year, and region fixed effects. Absolute value, heteroskedastic-consistent, standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively.

might be more reliable or a better value proposition. We can measure the effect of home bias and state dependence but cannot identify the channel leading to these effects using only aggregate data.

Model 1.I of Table 3 estimates the equivalent of Model 1 in Table 2 but for the 1975-2015 sample, so that we can account for the effect of past sales. Models 1.II and 1.III repeat this estimation including the past market shares of domestic brands and imports for different lagged windows (that are indicated at the bottom). For instance, Model 1.II conditions on sales of the previous 4 to 9 years. The estimates of these past shares are always very small but always significant. Results show that consumers respond more to vehicles sold recently rather than in the distant past. The effect is more important for past sales of imports than past sales of domestic brands.

Qualitative results of other estimates of interest remain unchanged, although for some of them, accounting for past sales affects their size. The national home bias of surviving brands increases and the regional effect of "core" brands before 1986 does not change at all. Instead, the loyalty towards brands that exited the market is much larger once we account for past sales. Canarians' dislike for Spanish brands is milder once we control for inertia. Imports in Canarias varied wildly from year to year depending on the number of direct import agreements with foreign manufacturers and thus, their dislike for Spanish brands diminishes once we account for recent past imports. See the ups and downs of the imports of Japanese vehicles in Canarias in Figure 2(d).

Trade Liberalization. We have mentioned repeatedly the dramatic transformation of the Spanish automobile market after Spain joined the European Union. Within seven years, Spain went from essentially forbidding imports to abolishing quotas and applying the common European import tariff of 10.3%. Imports soared, although a substantial share of the market remained captive to brands with production facilities in Spain. This rapid change in trade regulation allows us to evaluate how trade liberalization affected Spaniard's loyalty towards domestic brands.

The last two columns of Table 3 (and more in detail in Table D.5 of Appendix D) repeats the estimation of Model 1 of Table 2 from different starting years up to 2015 to highlight how demand changed over this long period. The most meaningful comparison is between Model 1.c for years 1980-2015 and Model 1.e for years 1992-2015, starting around the time of negotiations to joint the EU and at the end of the transitory accession period, respectively. The national home bias premium of core Spanish brands weakens slightly while loyalty for early entrants increase substantially and disappears for late entrants. A plausible interpretation is that SEAT, RENAULT, and CITROËN, suffered from the increased variety suddenly available to Spaniards. They still kept a very loyal customer base that NISSAN and VW had little time to develop. The big winners, FORD, OPEL, PEUGEOT, and MERCEDES, had time to build a loyal customer base and could now offer a much larger set of models built in other European countries through their established distribution networks without facing any import constraints.

Regional loyalty follows a similar pattern, remaining stable for "core" brands and improving for early entrants. Canarians end up having a positive view of domestic brands by the beginning of the century, once the automobile market in mainland Spain has become more similar to the insular counterpart, e.g., Figure 2(b), as former European imports become domestic brands.

Summary. We show that brand loyalty can credibly be traced back to the automobile industrial policy enforced between 1950 and 1985. It arises quickly after entry, its effects are permanent, and survive decades after the industrial policy ended. This acute preference for domestic vehicles may thus become an important trade barrier even decades after liberalizing trade. Our remaining task is to measure the the protection value of these biased preferences in the very long run equilibrium. For this we turn to the estimation of a structural model of the Spanish automobile industry.

4 An Equilibrium Oligopoly Model with Local Brand Loyalty

In this section we estimate a standard, multiproduct, oligopoly equilibrium model of demand and supply for horizontally differentiated automobiles along the lines of Berry, Levinsohn and Pakes (1995) (BLP hereafter) and Berry, Levinsohn and Pakes (1999). The model allows for consumer's heterogeneous preference and price responses to vary with income. Our specification uncovers consumers' average valuation of automobiles as related to their geographical origin. We begin with a description of our data for the sample period 2009-2015.

4.1 Automobile Registration Data (2009 – 2015)

Unlike the historical database used in the previous section, the database used here provides detailed information on sales, prices, and characteristics of car models. Data sources and selection criteria of automobile models included in the sample are extensively discussed in Appendix B. Our sample focuses on the fifteen regions of mainland Spain from 2009 to 2015, to avoid dealing with the increased transportation costs of insularity of Baleares and Canarias plus the separate taxation system of the latter. This time frame coincides with the Great Recession, not only a period of major economic stress, but also when a significant transformation of the automobile was under way. This results in a consumer choice set that changes significantly over the years, which facilitates the robust estimation of a discrete choice model of demand.

Table 4 presents two snapshots of the composition of the Spanish automobile market. SMALL, COMPACT, and LARGE vehicles lost market share to tiny CITY cars, and even more in favor of SUVs, including off-road and cross-overs, which in just seven years increased their market penetration, from 6.8% to 17.4%. The market share of DIESEL vehicles decreased for the first time since the early 1990s by 6% to 67.5% by 2015. DIESEL penetration still exceeds 70% of sales for all segments except the smaller CITY and SMALL. Sale of SUV and domestically produced vehicles are the fastest growing among gasoline models.[12]

The SHARE column of Table 4 confirms that Spaniards favor vehicles from brands with domestic manufacturing facilities decades after the industrial policy ended. It is followed by traditional European brands, Asian automobiles assembled in Europe, and lastly imports from outside the European Union. The preference for Spanish brands weakens over this period, as already documented in Panel (b) in Figure 2), shifting away from domestic brands in favor of other EU and EURASIAN imports. This is mostly the result of the strong growth in the SUV segment. Table 4 also indicates that prices remain quite stable with some important exceptions. Average prices in the CITY segment increased by 29% in response to a shift in preferences, while the price of SUVs decreased by 17%, due mostly the smallest SUV models. Imports from the European Union

[12] Reynaert (2021) argues that the growth of the SUV segment is the result of the two-tier European emission standards that led automakers to produce larger vehicles to minimize emission abatement costs. The increase of sales of SUVs in Spain is also partly the result of excluding expensive MINIVAN models from the 2011-2017 *cash for clunkers* program known as *PIVE* (Laborda and Moral, 2019).

Table 4: Automobile Characteristics by Segment and Geographic Origin

	SHARE		PRICE		DIESEL		HPW		KPE		CO_2	
	2009	2015	2009	2015	2009	2015	2009	2015	2009	2015	2009	2015
Segment												
CITY	3.30	6.24	11.33	14.70	11.72	26.28	0.79	0.76	19.32	18.40	115.49	113.26
SMALL	26.80	23.66	15.26	15.99	52.60	40.56	0.76	0.80	19.69	20.30	128.42	107.73
COMPACT	32.71	26.57	21.96	22.67	77.89	72.81	0.85	0.91	20.14	21.90	132.89	108.01
LARGE	14.22	10.05	30.80	31.58	92.26	96.87	0.95	0.96	18.19	21.98	150.71	112.56
MINIVAN	16.14	16.10	24.66	24.66	84.59	76.82	0.79	0.84	17.88	20.50	152.30	117.29
SUV	6.82	17.38	34.75	28.50	96.88	85.12	0.88	0.88	15.07	18.50	185.33	131.60
Origin												
SPAIN	70.95	67.23	21.55	22.96	76.36	68.82	0.80	0.87	19.40	21.11	138.25	111.12
EU	14.22	16.81	26.99	22.31	71.97	68.51	0.93	0.87	18.98	19.97	139.42	117.18
EURASIAN	10.30	13.45	22.25	22.13	61.70	58.47	0.86	0.82	17.63	18.51	147.21	123.81
NON-EU	4.53	2.51	21.18	26.14	56.92	72.87	0.86	0.95	15.95	18.28	160.84	130.07
ALL MODELS	100.00	100.00	22.38	22.82	73.35	67.48	0.83	0.86	19.00	20.49	140.36	114.32

Notes: SHARE and DIESEL are the average percent market penetration over total sales in Spain. PRICE is denominated in thousands of 2011 euros and includes value-added taxes and import tariffs. All other variables are also sales weighted averages: HPW is the ratio of horsepower per ton of weight; KPE measures the economic cost of driving as kilometers per 2011 euros; and CO_2 measures g/km emissions.

became more competitive, with a 17% price reduction for EU vehicles. All this is consistent with our characterization of the realignment of preferences both in favor of ultra-small CITY and SUVs, as well as in favor of European imports.

Most segments become more powerful as measured by HPW, particularly for SPAIN and NON-EU origin. Note the substantial improvement in fuel efficiency of SUVs, about 27% in just seven years, due again to the increased sales of the smaller models of this segment. EURASIAN vehicles are about 8% more fuel efficient than other traditional European brands, whether they are from domestic brands (with a local production facility) or imported from the European Union. Asian imports from outside the Europe are still the most fuel efficient vehicles, about 22% more efficient than any European automaker. Although diesel engines are still dominant, there is already a significant reduction of their sales across almost all market segments ahead of the more stringent European regulation after the *Dieselgate* scandal in 2015.[13] The overall result of this increase in fuel efficiency is an average 18% reduction in emissions across all market segments, irrespective of vehicle's origin.

Table 5 documents the regional preferences for different domestic brands (AUDI, FORD, MERCEDES, NISSAN, OPEL, PSA, RENAULT, SEAT, and VW). This table reports national and regional market shares of all current brands with a production facility in Spain, as well as the share of their sales in Spain that are locally produced. Thus, for instance, FORD has an average market penetration in Spain of 7.99%, with 7.80% consisting of vehicles manufactured in Valencia, i.e., 97.62% of its total sales in Spain. FORD's market presence in Valencia is much more important,

[13] Miravete, Moral and Thurk (2018) document how the lax European emission standards on Nox prompted a fast transformation of the European automobile market in favor of locally produced diesel engines that acted as an effective entry barrier against Asian and American manufacturers with little expertise on this technology.

Table 5: **Regional Market Shares of Domestic Manufacturers (2009–2015)**

Local Market	Region	AUDI	FORD	MERCEDES	NISSAN	OPEL	PSA	RENAULT	SEAT	VW
Andalucía	AN	4.11	7.72	2.60	4.74	6.84	16.72	7.69	8.72	8.85
Aragón	**AR**	3.97	7.04	2.64	5.77	**13.51**	16.37	6.91	6.36	7.30
Asturias	AS	4.36	7.38	2.63	5.33	7.64	17.52	10.36	8.35	7.50
Cantabria	CB	4.69	8.44	2.30	4.15	6.52	19.81	9.42	8.65	7.79
Castilla y León	**CL**	4.74	6.73	2.66	**4.96**	7.61	14.54	**14.79**	7.41	7.29
Castilla-La Mancha	CM	3.86	5.39	3.22	3.86	6.45	25.14	6.68	6.90	6.69
Cataluña	**CT**	**4.90**	7.13	2.50	**6.65**	7.06	14.54	7.29	**10.74**	8.66
Extremadura	EX	4.15	6.27	2.10	5.67	8.64	15.04	7.36	6.68	7.36
Galicia	**GA**	5.14	7.92	3.00	3.43	7.02	**19.08**	9.54	9.12	8.51
Murcia	MC	5.10	7.89	3.55	5.04	5.49	17.62	7.11	8.14	9.07
Madrid	**MD**	4.91	5.81	2.98	3.72	8.34	**15.95**	9.48	10.47	10.07
Navarra	**NC**	4.10	8.65	1.91	4.41	9.09	20.65	8.27	6.85	**12.45**
País Vasco	**PV**	5.00	8.72	**2.02**	5.01	9.36	16.48	9.98	5.86	8.53
La Rioja	RI	3.73	7.88	2.74	4.88	8.31	21.15	8.62	6.61	6.78
Valencia	**VC**	3.39	**16.89**	2.68	6.26	7.41	15.67	6.07	6.97	8.51
SPAIN (mainland)		4.55	7.99	2.74	4.87	7.75	15.71	8.50	9.06	8.95
Local Production		0.51	7.80	0.15	0.22	3.20	8.81	6.76	8.75	2.30
In %		11.21	97.62	5.47	4.52	41.29	56.08	79.53	96.58	25.70

Notes: Percent regional market share of all automobile models branded by the local automaker over 2009–2015. Blue bold numbers identify market shares of producing regions. Bold region labels identify regions with an assembly facility of the highlighted brand. Local Production is the domestic market share of locally assembled vehicles for each brand produced in Spain and "In %" reports the percentage of all domestic sales of a brand that are produced in Spain. For AUDI this includes only years 2011–2015. Region denotes the two-character ISO 3166-2 abbreviation for the autonomous communities of Spain defining each Local Market for the present study.

with a 16.89% regional market share. Only PSA in Galicia shows a larger regional market presence. However, PSA's market share in Galicia is much closer to the national average of 15.71%. Note that PSA imports nearly half of its sales in Spain.

MSI Consulting facilitated automobile prices. We estimate our model accounting for the fact that automobiles are sold at the same listed price across Spain.[14] Average price disparities across provinces are fully explained by income differences, with drivers in higher income markets such as Madrid or Barcelona, selecting more frequently the most expensive trims of each model. Since we define consumer choices at the *model name*-fuel type combination, using the national average model price helps identify the price-income interaction and differences in regional penetration the sources of home bias.

4.2 Demographics

We collected detailed local demographic information from the Spanish Statistical Agency (*Instituto Nacional de Estadística, INE*). Data include *per capita* total disposable household INCOME of the previous year measured in 2011 euros); AGE of the head of the household, CHILDREN (an indicator identifying households with a dependent minor); and an indicator identifying if the head

[14] We have tested this hypotheses using province average paid prices by vehicle using 2014 and 2015 data from the Spanish Tax Agency (*Agencia Estatal de Administración Tributaria*), *AEAT*. We report out detailed results in Appendix C.

Table 6: Demographics – 2009-2015

REGION		HOUSEHOLDS	INCOME	COLLEGE	AGE	CHILDREN
AN	(Andalucía)	1,542	17,861	34.8	50.7	40.6
AR	(Aragón)	332	20,510	33.9	51.2	39.0
AS	(Asturias)	260	19,498	34.4	52.0	30.4
CB	(Cantabria)	141	18,709	33.6	51.6	35.4
CL	(Castilla y León)	587	19,198	33.4	51.3	33.8
CM	(Castilla-La Mancha)	414	17,892	29.1	49.4	40.1
CT	(Cataluña)	1,800	21,350	36.3	49.4	37.8
EX	(Extremadura)	191	16,680	28.3	51.0	39.5
GA	(Galicia)	604	18,076	34.4	51.6	34.7
MC	(Murcia)	268	16,871	25.8	49.7	41.8
MD	(Madrid)	1,555	22,342	45.3	49.8	37.6
NC	(Navarra)	167	22,584	38.7	49.8	41.2
PV	(País Vasco)	568	24,346	44.8	50.1	37.3
RI	(La Rioja)	81	19,276	34.5	51.0	33.7
VC	(Valencia)	1,094	18,362	30.7	49.3	38.6
SPAIN	(Mainland Spain)	9,598	19,970	36.2	50.9	37.9

Notes: REGION identifies autonomous communities of Spain defining regional markets for the present study (bold indicates an automobile producing region). HOUSEHOLDS reports the number of households (in thousandss) in each region while INCOME is the average *per capita* GDP for the 2009–2015 period in 2011 euros. The last three columns report the percentage of households heads with a COLLEGE degree; the average AGE of the head of the household; and the percentage of households with CHILDREN (a dependent under 18 years of age).

of the household completed a COLLEGE degree. The Survey on Living Conditions (*Encuesta de Condiciones de Vida, INE*) also provides representative socioeconomic information for each region that we report in Table 6.

Madrid, País Vasco, Navarra and Cataluña, are the wealthiest markets, a pattern closely matching the level of college education, e.g., País Vasco has an income *per capita* 41% higher than Extramadura. The north-west corner has the oldest population and regions along the Mediterranean coasts the youngest. The average population age in Asturias is nearly three years older on average than in Valencia. The share of households with children overlaps with regions with younger average age and higher incomes. This variation of demographics across automobile manufacturing regions helps us better isolate intranational home bias from income and other demographics.

The Great Recession hit hard on *per capita* income, when Spanish unemployment increased from 8% in 2007 to over 26% in 2013, which is strongly aligned with automobile sales. This strong variation of income over the cycle helps us identify the effect of income on automobile demand. To address market participation in the estimation, we use 1,000 draws per region-year for the *relevant market*, i.e., the population likely to purchase a new car from the set of households with a head in the $(18, 70]$ age range. They include only households reporting that they can afford buying a new vehicle, even if they do not purchase any, and anybody exceeding the "Extreme poverty" threshold (40% of the median *per capita* income). In addition, we follow Nair, Chintagunta and Dubé (2004) and exclude households that bought a new car in the past two years from the set of potential buyers given the low likelihood of replacement in such a short period of time.

4.3 A Discrete Choice Model of Demand with Home Biased Preferences

Consumer i in market region r and period t obtains the following indirect utility from buying a model-engine type vehicle $j \in \mathcal{J}_{rt}$:

$$\begin{aligned} & u_{ijrt} = x_{jt}\beta_i^* + \alpha \times \frac{p_{jt}}{y_{it}} + \xi_{jrt} + \epsilon_{ijrt}\,, \\ & \text{where } \; i = 1, \ldots, M_{rt}; \quad j = 1, \ldots, J_{rt}; \quad r = 1, \ldots, 15; \quad t = 2009, ..., 2015\,. \end{aligned} \tag{2}$$

Note that a consumer's payoff depends on the set of automobile attributes summarized by a vector of K observable vehicle time-invariant characteristics x_{jt} common across all regional markets r, with the set of choices varying over time as models enter and exit all regional markets simultaneously. The price of product j at time t, p_{jt}, is also common across regions as automakers follow a uniform national pricing strategy as documented in Appendix C.

We include the following observable atributes in the mean utility: a measure of automobile performance (horsepower divided by weight, HPW), fuel economy (kilometers per euro, KPE) and its interaction with fuel engine type (KPE × DIESEL), a linear diesel trend (TREND × DIESEL) to account for the increasing driving restrictions on diesel vehicles and changing fuel preferences on fuel type in Europe around this period. We also include segment fixed effects for CITY, COMPACT, LARGE, MINIVAN, and SUV. For the latter category we also include a time interaction (SUV × TREND) to capture the documented large increase in market share during this time.

Some other attributes that we denote by ξ_{jrt} are unobservable to the econometrician. They could include features such as reliability, expected economic depreciation, a fashionable vehicle design or anything else that consumers value and firms might account for when pricing their models. Loyalty to a brand fits this description, and we distinguish a domestic brand-specific consumer premium plus regional home bias effects to capture the idiosyncratic preference for locally assembled vehicles:

$$\xi_{jrt} = \left(\zeta_{jr}^m + \zeta_{jr}^b + \zeta_{jr}^d + \zeta_{jr}^a\right) + \zeta_{rt} + \nu_{jrt}, \tag{3}$$

where ζ_{rt} includes a total of 104 region-year demand dummies to account the different local evolution of the relevant market (outside option) and ε_{jrt} is a random model-region-year attribute. We also include a set of indicators to capture an average effect across automakers of a geographic origin of vehicles sold in region r. Thus ζ_{jr}^m = REGHBMODEL indicates that the chosen automobile model is manufactured in the region where consumer lives; ζ_{jr}^m = REGHBBRAND, whether model j is produced somewhere else by an automaker with a local production facility (imported from the EU); ζ_{jr}^d indicates whether the vehicle is produced somewhere else in Spain by any of the nine domestic brands;[15] and ζ_{jr}^a if it is a model imported from outside the European Union, NON-EU (most likely from Asia). These home bias parameters capture the valuation of a particular model

[15] They include AUDI, FORD, MERCEDES, NISSAN, OPEL, PSA, RENAULT, SEAT, and VW. We distinguish the three brands of the VW group, (AUDI, SEAT, VW) but instead pool together CITROËN and PEUGEOT into PSA. The reason is that in the latter case, PSA assembles vehicles of both brands in both, its Galicia and Madrid facilities.

beyond observable product characteristics relative to European imports, such as BMW or FIAT. Table B.2 in Appendix B) reports all automobile models by automaker and vehicle segment grouped by type geographical origin. Other non-observable characteristics are captured by ν_{jrt}.

Drivers are most surely not be aware of which specific automobile models are assembled at the local plant. However, it might be likely that manufacturers produce locally those models more closely aligned with local preferences. For instance, nearly all sales of FORD and SEAT in Spain are locally produced, 97.6% and 96.6%, respectively. At the other end, MERCEDES and NISSAN sell less than 1% of local production in Spain, e.g., see the bottom rows of Table 5). The mere presence of an assembly plant might increase demand for all models of a brand, regardless of whether they are produced locally or imported. Thus, we distinguish among locally assembled models and others sold by the local manufacturer to separate the model-specific home bias from the spill-over of goodwill to other models of the same local brand but assembled elsewhere.

Price-income interaction in (2) assumes that high income are less responsive to prices than low income households, a common assumption in the literature since Berry et al. (1999). We also allow for idiosyncratic preferences over automobile characteristics to be correlated with demographics, D_{irt}, in addition to purely random tastes over product characteristics, η_{irt}, to ensure flexible price substitutions patterns across products and overcome the Independence of Irrelevant Alternatives (IIA) propriety of the logit model. Demographic heterogeneity across regions and the different automobile purchase patterns across regions and time facilitate the identification and estimation of these nonlinear parameters of the model. Then the random coefficient for the "k" observed characteristic is specified as:

$$\beta_i^{*(k)} = \beta^{(k)} + \Pi D_{irt} + \Sigma\, \eta_{irt}\,, \qquad \eta_{irt} \sim N(0, I_n)\,, \tag{4}$$

where Π is a $K \times d$ matrix of coefficients that measures the effect of heterogeneity in households taste of demographic characteristics "d" regarding the k observable, time-invariant, vehicle characteristic. Demographics include the household head's AGE; whether he/she has a COLLEGE degree; and if the household members include any number of minors (CHILDREN). They are interacted with indicators of whether the car model is inexpensive (CHEAP), i.e., below the mean price for its segment-fuel-region-year; if it is among the largest, most expensive models available (LUXURY); or if it runs on DIESEL.

The last term in equation (4) are zero-mean, multivariate normally distributed idiosyncratic individual preferences on other non-observable vehicle attributes. The matrix Σ captures the covariance of unobserved individual preferences for product attributes. In practice, it is a diagonal matrix with elements, σ_k^2, are the variance of unobserved preferences on the observed vehicle attributes.

Lastly, ϵ_{irjt} in equation (2) denotes the idiosyncratic unobserved preferences of consumer i for product j in market r in period t, which is assumed i.i.d. multivariate type I extreme value distributed across all available products $\mathcal{J}_{rt}$ in each market. This stochastic specification leads to the well-known mixed-logit choice probabilities for each household:

$$s_{ijrt} = \frac{\exp\left[\delta_{jrt} + \mu_{ijrt}\right]}{1 + \sum\limits_{k \in J_{rt}} \exp\left[\delta_{krt} + \mu_{ikrt}\right]}\,, \tag{5}$$

where δ_{jrt} comprises the deterministic (observable and unobservable) elements of households' preferences and μ_{ijrt} their idiosyncratic components:

$$\delta_{rj} = x_{jt}\beta_i + \xi_{jrt}\,, \tag{6a}$$

$$\mu_{irjt} = \alpha \times \frac{p_{jt}}{y_{irt}} + x_{jt} \times \left(\Pi D_{irt} + \Sigma\ \eta_{irt}\right). \tag{6b}$$

Integrating across individual with respect to the empirical distribution of income and other demographics, $F_{rt}\left(y_{irt}, D_{irt}, \eta_{irt}\right)$, we obtain the market share prediction of the model for product j in region r in year t, that is:

$$s_{jrt} = \int \frac{\exp\left[\delta_{jrt} + \mu_{ijrt}(y_{irt}, D_{irt}, \eta_{irt})\right]}{1 + \sum\limits_{k \in \mathcal{J}_{rt}} \exp\left[\delta_{krt} + \mu_{ikrt}(y_{irt}, D_{irt}, \eta_{irt})\right]} dF_{rt}\left(y_{irt}, D_{irt}, \eta_{irt}\right). \tag{7}$$

The outside option, s_{0rt} varies by region and year. We define the relevant market, M_{rt}, as the number of households in each region r and year t making more than 40% of the median *per capita* income that has not purchased a new vehicle in the past two years, and where the age of the household head falls in the $(18, 70]$ range. See Appendix B for further details.

4.3.1 Pricing Strategy for Multiproduct Firms

Multiproduct automobile manufacturers first decide the location where they assemble each model. A model of entry and pricing is beyond the scope of the present analysis. As we have argued before, location of assembly plants, described in Appendix **??**, is assumed exogenous. This is not a restrictive assumption for the short 2009-2015 period used for the estimation of the present equilibrium model.

Only those models produced outside the EU pay a 10.3% import duty. Tax rate τ includes this 0.103 duty rate for non-European imports and zero for European assembled models, plus a 21% national value added tax and a regional emission tax detailed in Table C.1 in Appendix C. Thus, each automobile manufacturer f competes in the Spanish market by choosing non-cooperatively the set of pre-tax prices p_j^{pre} of all automobile models in their portfolio $\mathcal{J}^f$ to maximize profits accounting both for own price effect and cross-product substitution, as well as the strength of the local preferences for the firms' product offering. We thus write Bertrand-Nash equilibrium pre-tariff prices as a nonlinear function of the product characteristics (x), market shares $s_j(x, p, \xi; \theta)$, retail prices (p), and markups (omitting subindex t to ease notation):

$$p_j^{pre} = mc_j + \Delta_j^{-1}(p, x, \xi; \theta) s_{jt}(p, x, \xi; \theta) \,, \tag{8}$$

where $\theta = (\alpha, \beta, \gamma, \Sigma)$ and $p_j = p_j^{pre} \times (1 + \tau_j)$. The vector of equilibrium markups combines market shares $s_j(\cdot)$ and the ownership matrix $[\Delta_{ab}(\cdot)] = \left[\frac{\partial s_a(\cdot)}{\partial p_b} \frac{\partial p_b}{\partial p_b^{pre}}\right]$ for any $\{a, b\} \in \mathcal{J}^f g$ (the models of all automakers in a group) and [0] otherwise, so that firms internalize the cross-price effects among products of the same group.

4.3.2 Marginal Costs

As in Berry et al. (1999), we do not observe global sales of each manufacturer but rather only their sales in the Spanish market. Thus, we assume a constant return to scale technology where marginal costs mc_{jt} depend on some observed automobile attributes. Thus:

$$\log mc_{jt} = W_{jt}\gamma + \omega_{jt} \,, \tag{9}$$

where W includes manufacturing group indicators and year fixed effects, as well as some segment dummies (COMPACT, LUXURY, AFFORDABLE-LARGE). Marginal costs also depend on an index, SPI, of steel and rubber prices and salaries that we interact with the logs of HP and WEIGHT, respectively to account the larger amount of inputs necessary to build more powerful and heavier cars. We also include a DIESEL dummy and the log of CO_2, as manufacturing more efficient vehicles is likely to be more costly. In addition, we introduce dummies variables to control for cost similitude among firms. For instance, we account for firms that belong to a group or alliance. We also assume a common cost shift for independent brands operating in same country, e.g., HONDA, LAND ROVER and TOYOTA in the U.K. Finally, productivity ω_{jt} includes all cost components unknown to the econometrician.

4.4 Estimation

We jointly estimate demand and supply simultaneously. Identification of all parameters improves when we include cost shifters as instruments based on costs introduces an important improvement in the identification of demand. The vector of demand-side structural error is defined as $\varepsilon^D(\theta) = \nu$ and the supply-side structural error as $\varepsilon^S(\theta) = \omega$, where $\theta = [\beta, \Sigma, \Pi, \gamma]$ is the complete parameter vector to estimate.

For demand, we use the nested fixed point algorithm of Berry (1994), connecting the predicted purchase probabilities of the model to the observed market shares data for any given value of θ, to solve for the mean utilities $\delta(\theta)$. The demand-side structural error, $\varepsilon^D(\theta)$, results from the differenc between the observed and the model's predicted market share predicted by the model in equation (7): $\varepsilon^D_{jrt}(\theta) = S_{jrt} - s_{jrt}(\theta)$. To construct the predicted aggregate shares we average the purchase probabilities (7) across household demographics via Monte Carlo integration using 1,000 Halton draws of households for each region-year market.[16] We simulate demographic characteristics (income, age, education and children) from yearly regional census data to account for changes in the demographic characteristics distribution across markets and time.

Purely random coefficients driven by idiosyncratic preferences over automobile characteristics add up to relax the restrictive substitution patterns associated to the Independence of Irrelevant Alternatives feature of the logit model. We considered a large number of random coefficients and explored alternative specifications. In the end we included random coefficients for CITY segment and LUXURY vehicles (expensive models in the LARGE, MINIVAN, SUV, and small SUV segments), in addition to regions of origin where vehicles are manufactured.

For supply, we use the observed prices, ownership structure, taxes, and tariff rates and predicted aggregate shares to solve for the implied markups $\Delta_{jt}^{-1}(\cdot)s_{jt}(\cdot)$ in equation (8) and generate marginal costs as a function of the parameter guess, assuming a pure strategy Bertrand-Nash equilibrium. The supply-side structural error $\varepsilon^S(\theta)$ then follows from expression (9).

We assume that the set of available vehicles is exogenous so that structural errors are orthogonal to product characteristics, i.e., $E[\omega|Z] = 0$ and $E[\nu|X] = 0$, that together, they define the vector of demand and supply-side structural errors, $g(\theta)$. We use product characteristics and socio-demographic information of households to construct moment conditions for demand, HD, and supply HS. From this matrix $H = \left(\begin{smallmatrix} HD & 0 \\ 0 & HS \end{smallmatrix}\right)$, we obtain a positive definite weighting matrix $W = [H^{'}H]^{-1}$, to obtain demand and supply estimates by minimizing the generalized method of moments (GMM) objective function:

$$\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \; \left\{ g(\theta)' HWH' g(\theta) \right\}. \tag{10}$$

We use the standard two-step procedure for obtaining GMM estimates. We first assume homoscedastic errors and compute initial parameter estimates. Given these estimates, we solve equation (10) and use the resulting structural errors $(\varepsilon^D, \varepsilon^S)$ to update the weight matrix W, so that it represents a consistent estimate of $E[H^{'}gg'H]$.[17]

4.4.1 Instruments

The exogeneity of X and W_{jt} is enough to build the instruments ZD and ZS for β and γ, respectively.[18] Mean utility vector β is identified by variation between market shares and observable

[16] In each region, consumer income is drawn from the empirical income distribution of the previous year. Thus, income variance is flexible across years so that for any given year it is not correlated with the marginal utility of consumption (Andrews, Gentzkow and Shapiro, 2017).

[17] We employ the Interior/Direct algorithm Knitro to solve the optimization problem. In the BLP contraction mapping solving for ξ_{jr} we use a nested-fixed point algorithm with a convergence threshold equal to 1e-14. The contraction mapping is computed in parallel per market-year. We further use several different initial conditions to increase the likelihood of achieving a global minimum to this minimization problem (Knittel and Metaxoglou, 2014).

[18] See the discussion on instruments in Gandhi and Houde (2021).

product characteristics after controlling for brand, segment, market and year. The identification of γ follows from variation in observable product characteristics and implied marginal costs where the latter depends also on variation in price, market shares and the ownership pattern via the price coefficient α, plus the shocks related to inputs costs such as salaries and row material prices.

Prices are endogenous. In addition to product characteristics, automaker's product portfolio are considered exogenous (predetermined by previous investment decisions) during the short times span of our sample. We follow *BLP* and Bresnahan, Stern and Trajtenberg (1997) build "BLP instruments" clustering them by geographical origin: (*i*), the sum of characteristics of models of the same automobile group (by region), and (*ii*), the number of non-European models sold (also by region). The former accounts for the effect of own-group product positioning on the ability of each firm to raise markups without cannibalizing their own sales. The latter accounts for inexpensive non-European imports that critically increase competition in the segments they dominate.

Interaction parameters Π in equation (6b) capture variation in consumer preferences across regional markets with heterogeneous demographics resulting in correlated market shares, prices, and demographic variables. To account for the effect of demographics on prices, we take advantage of the uniform pricing policy to account for the effect of demographic taste heterogeneity across regions from other time varying demand shifters affecting price responsiveness.[19] Thus, we construct the following instruments for each period-region combination: (*i*) the average price for each product in other markets; (*ii*) the product of this average price in other markets and the own average income; (*iii*) the product of the average price in other markets times the own unemployment rate; (*iv*) the sum of other products in the same fuel-segment weighted by share of households in each region above the top 20% national income level; and finally (*v*) interactions of moments of the income distribution with some model segments or automobile attributes. The first set of instruments are the Hausman IVs (Hausman, 1996) while all others are different versions of Waldfogel IVs (Waldfogel, 2003) accounting for preferences being correlated across demographic groups, leading in our case to regional market shares that are a function of demographics because of national pricing.

Next, the elements of the matrix Σ of random coefficients result from the market share and relative position of a product attributes relative to substitutes in the product space. Assuming that product attributes are exogenous, we use variation in the product set to identify these parameters taking advantage of changes in product characteristic space. To control for this, we include a set are the "differentiation IVs" of Gandhi and Houde (2020) that we describe in detail in Appendix E. In particular, we use the empirical distribution of continuous characteristics HPW and C90 (fuel consumption in liters to cover a distance of 100km at a constant speed of 90km/hour) to compute instruments with nonlinear functions of distances (differences in probabilities and products of these differences times the spread of the distribution) for "close" products in (and out) of the company group, and distances for all products with the same fuel, and for all products. We follow a similar approach in constructing the supply-side instruments. See Appendix E.

[19] Appendix C shows that automakers broadly enforce national pricing strategies. But since we aggregate all trims of a model name, average prices of any given model are high correlated with income as they vary across regions.

4.5 Estimation results

Table 7 presents the parameter estimates of the structural equilibrium model of demand and supply of automobiles in Spain. We adopt a random coefficient logit specification for demand allowing for flexible substitution effects. We also account for automobile group ownership structure to determine the equilibrium oligopoly prices. Overall, estimates are reasonable, statistically significant, and congruent with the descriptive evidence of the Spanish automobile industry of Section 4.1.

Drivers value high performance (HPW > 0) as well as fuel efficiency (KPE > 0), although less so if she chooses a diesel vehicle (KPE $\times$ DIESEL < 0). The valuation of diesel vehicles also declines over our sample period (TREND $\times$ DIESEL < 0). This estimate does not capture the negative effect of the *Dieselgate* scandal of September, 2015, but rather the effect of the improved performance of gasoline models, particularly among SUV and other segments of large vehicels (see Table 4). Sports utility vehicles became more popular (SUV $\times$ TREND > 0), perhaps because of the increased availability of models in this segment, as automobile manufacturers exploited legal loopholes to minimize the costs of compliance with European environmental rules(Reynaert, 2021). However, on average, SUVs are still less valued than vehicles of the SMALL segment used as reference. Drivers favor COMPACT ("Focus" or "Golf") and SMALL ("Ibiza" or "Corsa") but not extremely small ones included in the CITY segment ("500" or "Twingo").

Vehicles of all automakers with domestic production facilities are preferred to imported European brands (reference category). The estimated effect is positive and significant for all automakers producing in Spain, with OPEL and SEAT topping the list. As for imports, Spaniards prefer European to Asian brands (NON-EU < 0), the result of the total share for this category decreasing over the sample period (see Table 4). Most importantly, there is a significant regional premium that is larger for models actually assembled in the vicinity (REGHBMODEL > 0) than for imported models of the local brand (REGHBBRAND > 0). Altogether these results show that the Spanish industrial policy had a permanent and long-lasting effect on consumer preferences that survives until today, many decades after the industrial policy was phased out.

Although vehicles from the SMALL (reference) and COMPACT are the most valued, there is substantial heterogeneity of preferences explaining cross-region variation in market shares, e.g., the strong effects captured by the σ estimates of LUXURY, SMALL-SUV, and EU, all of them more common in wealthy cities such as Madrid and Barcelona, than in other less developed regions. Demographic interactions also account for idiosyncratic preferences. Demand is downward sloping, although high income households are less price responsive (PRICE/INCOME < 0). In addition, estimates show that older households favor more expensive models (LUXURY $\times$ AGE > 0); budget constrained households with a minor dependent favor less expensive vehicles (CHEAP $\times$ CHILD > 0); and college graduates strongly favor diesel powered automobiles (DIESEL $\times$ COLLEGE > 0).

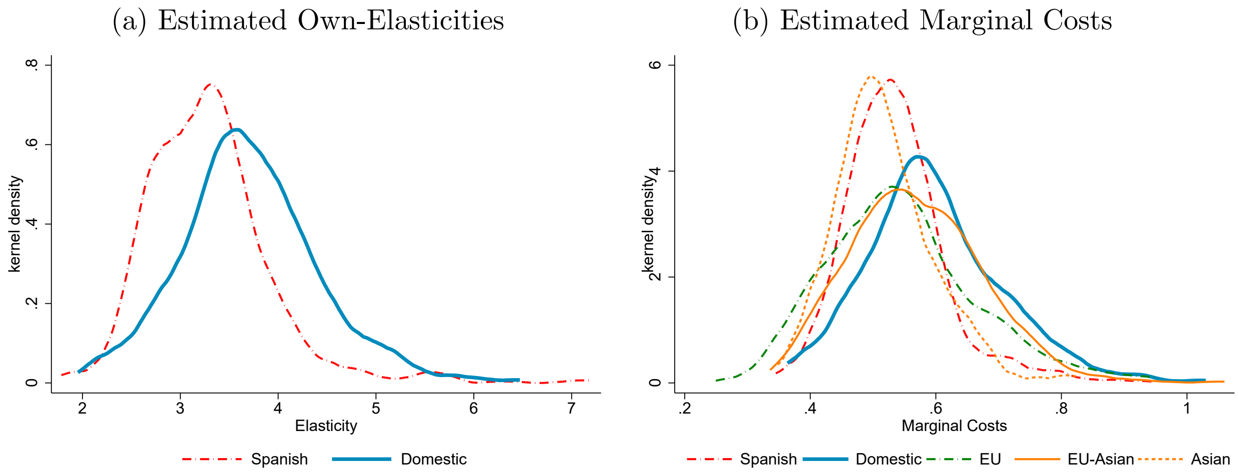
Estimates of marginal costs drivers are significant and intuitive. Cost shifts summarized by a row material price index has a stronger positive incidence on final prices for heavier (ln(WEIGHT $\times$ SPI) > 0) and more powerful vehicles (ln(HP $\times$ SPI) > 0), relative to the smaller CITY and SMALL

Table 7: Demand and Supply Estimates for Automobiles in Spain (2009–2015)

Variable	Description	Estimate	Std.Err
Mean Utility – Product Characteristics (β)			
CONSTANT		−15.0580	(0.5717)***
HPW	Horsepower per ton	3.9303	(0.1666)***
KPE	Kilometers per euro	0.2579	(0.0190)***
KPE × DIESEL	Kilometers per euro × diesel indicator	−0.3485	(0.0205)***
TREND × DIESEL	Time trend × diesel indicator	−0.0591	(0.0133)***
CITY	Segment A: FIAT *500*, RENAULT *Twingo*	−4.1514	(0.7372)***
COMPACT	Segment C: FORD *Focus*, VW *Golf*	0.0783	(0.0465)*
LARGE	Segment D: AUDI *A5*, VW *Passat*	−0.7928	(0.1411)***
MINIVAN	Segment M: FORD *S-Max*, VW *Touran*	−1.2180	(0.1427)***
SUV	Segment J: NISSAN *Pathfinder*, TOYOTA *Rav4*	−0.8639	(0.3523)**
SUV × TREND	SUV × time trend	0.0696	(0.0166)***
Mean Utility – Home Bias (ζ)			
REGHBMODEL	Regional preference for model produced locally	0.6956	(0.0721)***
REGHBBRAND	Regional preference for brand producing locally	0.1755	(0.0628)***
OPEL		3.1131	(0.2925)***
SEAT		3.0592	(0.2893)***
AUDI		2.9282	(0.2796)***
VW		2.7659	(0.2823)***
PSA		2.7513	(0.2895)***
FORD		2.7495	(0.2892)***
RENAULT		2.6776	(0.2912)***
MERCEDES		2.6776	(0.2837)***
NISSAN		2.3486	(0.2891)***
NON-EU		−0.8301	(0.2967)***
Standard Deviations (σ)			
CITY	Segment A: FIAT *500*, RENAULT *Twingo*	2.5983	(0.6467)***
LUXURY	Expensive D, M, J: MERCEDES *Classe C*	1.6155	(1.3065)
SMALL-SUV	Small J: FORD *Kuga*, BMW *X1*	1.9252	(0.4871)***
SPAIN	OPEL, SEAT, and all other brands with domestic production	0.1797	(3.8534)
EU	Europeans not producing in Spain: BMW *Serie 3*, SKODA *Fabia*	3.3664	(0.3369)***
EURASIAN	Asians producing in Europe: HONDA *Civic*, HYUNDAI *Sonata*	5.1212	(0.1493)***
Interactions (Π)			
PRICE/INCOME	MSRP divided by income (both in thousand euros)	−4.1700	(0.1083)***
LUXURY × AGE	Luxury indicator × log of age of the household head	0.5916	(0.2099)***
DIESEL × COLLEGE	Diesel indicator × college education indicator	7.7094	(0.3245)***
CHEAP × CHILD	Inexpensive indicator × household with a minor indicator	1.6685	(0.1562)***
Cost (γ)			
ln(HP × SPI)	ln(HP) × automobile raw material index	0.8801	(0.0165)***
ln(WEIGHT × SPI)	ln(WEIGHT) × automobile raw material index	0.9153	(0.0357)***
ln(CO_2)	Log of CO_2 emissions in g/km	−0.3095	(0.0250)***
DIESEL	Diesel engine	0.0548	(0.0069)***
COMPACT	Segment C: FORD *Focus*, VW *Golf*	0.0704	(0.0049)***
LUXURY	Expensive D, M: RENAULT *Scenic*, MERCEDES *Classe C*	0.1401	(0.0110)***
AFFORDABLE-LARGE	Inexpensive D, M & SMALL-SUV: SEAT *Toledo*, TOYOTA *Avensis*	0.0955	(0.0059)***

Notes: Results using 20,536 observations for 231 automobile models and 1,000 simulated agents per region-year. Segment B: SMALL is the demand reference category. EU defines the default home bias valuation. We report brand dummy estimates in decreasing order of magnitude. OTHERS comprises the rest of imported brands without production facilities in Europe until very recently, i.e., both EURASIAN and NON-EU. Table B.2 details models in the SMALL-SUV, LUXURY, and AFFORDABLE-LARGE categories. The supply reference group combines segments A: CITY and B: SMALL. A model is "Expensive" ("Inexpensive") if it price exceeds (falls short) of the mean price of its segment-fuel-region-year set. We do not report the supply estimates of manufacturers and year cost fixed effects, nor the 104 region-year demand dummies. Robust standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively. *GMM* J-statistic for the estimated random coefficient logit model is 1,622.86.

Figure 4: Demand Elasticity and Marginal Costs by Origin



Notes: Sales weighted Kernel density based on the estimates of Table 7.

segments (reference category). On average, versions with a diesel engine have an associated 5% higher production costs than the corresponding model powered with a gasoline engine (DIESEL > 0). Cleaner vehicles (with lower emission levels) are always more expensive to produce, irrespective of the fuel engine technology used ($\ln(CO_2) < 0$). Thus, a 1% reduction in CO_2 emissions increases the marginal cost of production by 0.31%. Since cars sold between 2009 and 2015 reduced their CO_2 emission on average from 140.36 g/km to 114.32 g/km, this 18.55% emission reduction to achieve the goals of the environmental policy resulted in 5.75% increase of automobile production costs.

Before proceeding to conduct our counterfactual analysis in the next section, we perform a simple "sanity check" validation of the model fit using within sample predictions of the model. Figure 4 summarizes results that we find intuitive for the Spanish automobile industry. Although a large share of local production is exported, models produced locally are particularly profitable in the Spanish market, with consumers favoring them while at the same time manufacturers enjoy a relative cost advantage on these generally small and fuel efficient vehicles. Panel (a) shows that, among domestic brands, demand is generally less elastic for models assembled in Spain than for models built in other European countries by these same domestic manufacturers. Models assembled in other European countries are generally more expensive and powerful, e.g., Table 4. Panel (b) shows that the distribution of marginal costs of automobile models produced in Spain first order stochastically dominates any other imports, except inexpensive Asians. This confirms the long held view that automakers located in Spain for cost reasons, something that is still valid several decades after the autarkic intervention of the 1950s. However, missing in that argument is the fact that demand for locally produced models, because they are aligned with local preferences, allow domestic automakers to charge high markups and profit greatly from local consumer loyalty. What is the size of the distortion of this, by now, well-documented domestic brand loyalty? We turn to counterfactual analysis in the next section to approximate the tariff equivalence of home biased preferences using the present equilibrium model.

5 Trade Distortions of Home Biased Preferences

In this section we put our equilibrium model to work to uncover the size of the trade distortion inflicted by Spaniards' preference for domestic brands. It could be argued that there is no loss of efficiency since Spanish drivers purchase the vehicles they want. However, as we indicated in the Introduction, this preference for local brands may become an important trade barrier. Our goal is thus to measure how important this trade barrier is, accounting for both a general preference for domestic vehicles and the unique case of intranational home bias that we have documented. Our estimates correspond to the long-run steady-state configuration of the market using the 2009-2015 sample period, i.e., nearly a quarter of a century after import restrictions were lifted. We evaluate the counterfactuals for the sample value of economic variables of 2015, the last year of our data.

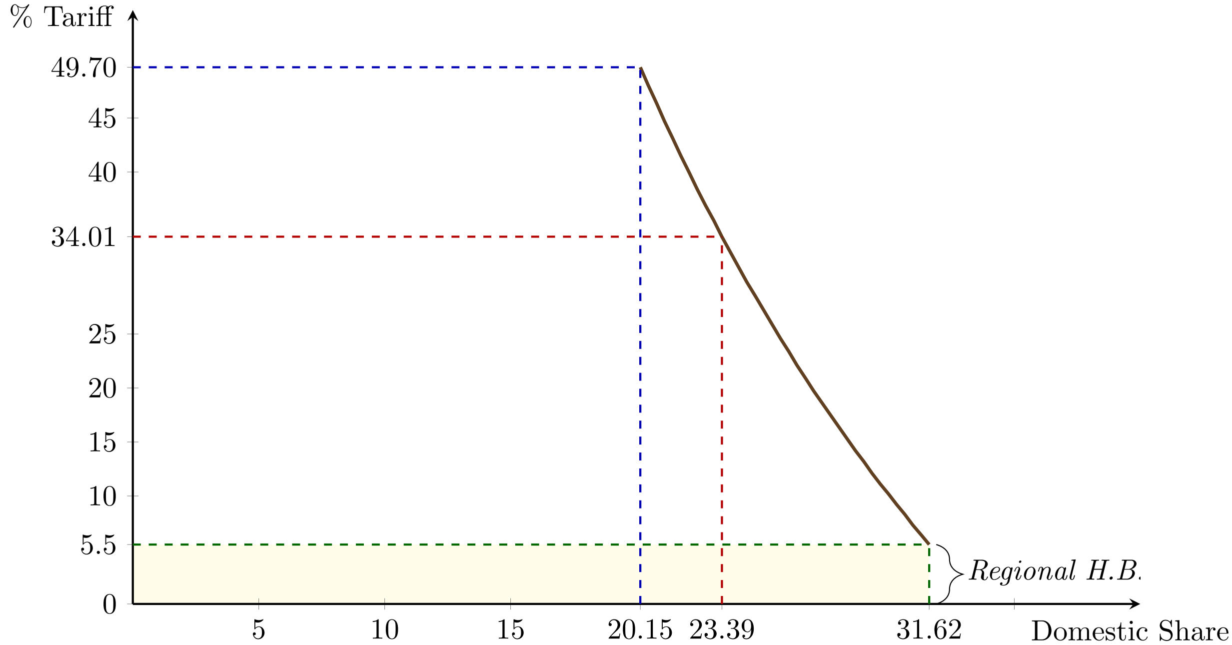
5.1 The Protection Value of Home Bias

To assess the protective value of home biased preferences, we first recompute the equilibrium of a model that ignores regional home bias effects, i.e., we restrict REGHBMODEL and REGHBBRAND to be zero. To uncover the tariff shadow value of these parameter estimates, we target the market share of domestic production to remain at its initial value of 31.62% in 2015. To achieve it, we set a counterfactual tariff τ on all vehicles imported into Spain by domestic and non-domestic manufacturers, and regardless of whether they are produced in Europe or not. Consistent with current policy proposals, the idea is to favor local production. We then recompute the equilibrium repeatedly for different values of τ until we restore the initial share of domestic production. This happens with an import tariff of $\tau = 5.5\%$, which we interpret as the shadow value of regional home bias. Note that the current EU import tariff on automobiles stands at 10.3%. The $\tau = 5.5\%$ equivalent import tariff captures only the effect of drivers preferring the automobiles of the brand producing in their vicinity, i.e., CITROËN in Galicia, FORD in Valencia, or SEAT in Cataluña. This is a sizable tariff rate for the rarely documented intranational home bias effect.

We now address the effect of national home bias of brand dummies ζ in Table 7. Canceling all those brand-specific premiums at once is too drastic. To avoid evaluating an equilibrium of the model that is too different from the initial market configuration used in the estimation, we first reduce the brand home bias estimates ζ by 1% and then recompute the market equilibrium with this reduced home bias effect. This counterfactual equilibrium is characterized by a smaller market penetration of vehicles manufactured in Spain. A second related counterfactual restores the initial market share of vehicles produced in Spain, 31.62%, with an additional increase in import tariffs beyond the initial $\tau = 5.5\%$ accounting for regional home bias. Figure 5 is the result of repeating this process for further reductions, 2%, 3%, ..., and up to 35% of the home bias estimates, ζ.

Figure 5 shows that eliminating regional home bias and weakening domestic home bias by 25% reduces the market share of domestically produced vehicles from 31.62% to 23.39%. The original 31.62% domestic market share is restored if a 34.01% tariff is adopted. How reasonable are

Figure 5: Shadow Tariff Protection of Domestic Sales



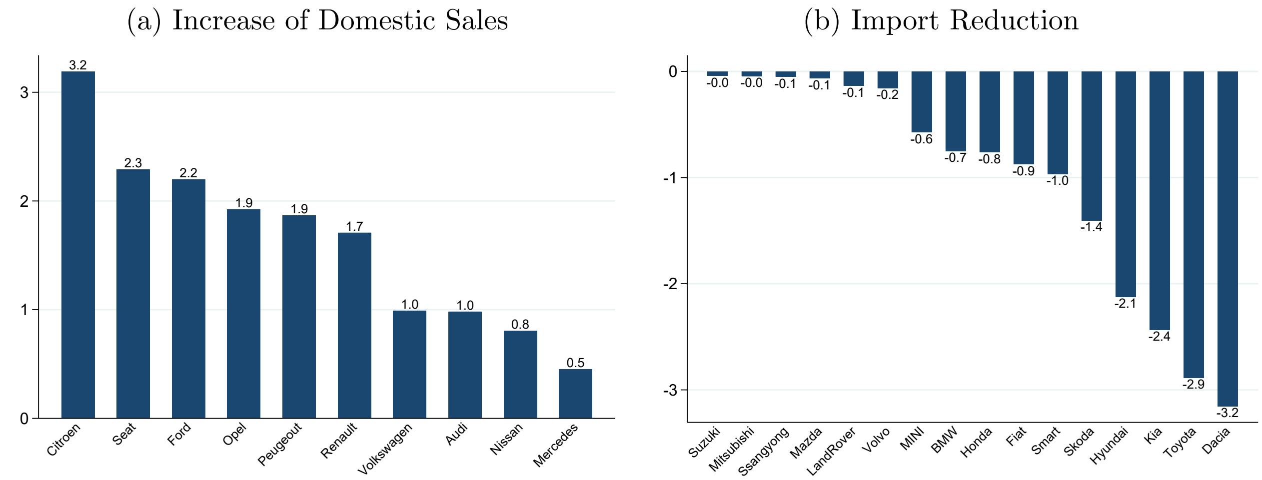
Notes: Canceling regional home bias effects requires a 5.5% tariff on all imported vehicles for domestic production to keep its original 31.62% market penetration.

these tariff predictions? On October 30, 2024, the EU set special import tariffs on Chinese electric vehicles ranging between 17% and 35.3% (20.7% being the most common rate) to explicitly defend the European automobile industry against the "unfair competition" of government subsidized Chinese brands. These tariffs are in addition to the common EU 10.3% import tariff. Our estimated shadow tariffs are thus not too excessive relative to the current European import tariff policy.

Note that the plotted relationship between tariff protection and domestic market penetration is slightly convex. With a 25% reduced home bias effect, the penetration of domestic production is only 23.39% of the market. The marginal tariff, i.e., the required tariff increase necessary to compensate for a 1% loss in domestic market share in the neighborhood of a 23.39% share is 4.36%. If home bias preference were cut by 35%, domestic market penetration would fall to 20.15%. This requires a 49.70% import tariff to restore the market penetration of automobiles produced in Spain, with a 5.41% marginal tariff in the neighborhood of a 20.15% market share. At the current market penetration of 31.62% the marginal tariff hike is 2.80%, which we interpret as the shadow value of Spaniards' preference for domestically produced vehicles.

To summarize, home biased preferences are an effective and sizable trade barrier against imports even in an integrated European economy with a single currency. The marginal tariff protection due to loyalty to home brands nears 3%. Most interestingly, loyalty for regional manufacturers amounts to an additional 5.5% tariff protection. In total, home bias adds the equivalent of 80% of the current EU tariff protection against vehicles not produced in Spain.

Figure 6: Home Bias and Domestic Market Distortion



Notes: Market share increase of sales of domestic brands and reduction of imports due to home bias (difference in predicted market shares with and without home bias effects).

5.2 Home Bias: Winners and Losers

Figure 6 highlights who wins and who loses due to home bias by comparing the current market conditions relative to the counterfactual of eliminating regional home bias effects and reducing the national brand loyalty by 25%. Overall, home bias scrambles the Spanish market configuration by shifting demand away from imports in favor of brands with local production plants. This effectively reduces imports and protects the Spanish automobile industry against foreign manufacturers.

Panel 6(a) identifies the winners, who coincide with the core Spanish brands. CITROËN and SEAT, present from the very beginning, resulting in an excess market penetration in 2015 of 3.2% and 2.3%, respectively. They are followed by early entrants FORD and OPEL who built manufacturing facilities in Spain well ahead of EU membership. Their market share advantage due to home bias amounts to 2.2% and 1.9%, respectively. The additional market penetration of VW and other late entrants is less than half of SEAT's gain due to customer loyalty, all of which is consistent with the narrative of Section 3.

Panel 6(b) identifies the losers, none of which own an assembly facility in Spain. We can distinguish three groups. The first is a group with a percent share reduction smaller than 0.6%. They include VOLVO, previously owned by FORD and a set of brands that at some point were produced locally such as LAND ROVER, MINI, and SUZUKI.[20]. European brands that are either affiliated to domestic groups (SKODA and VW) or that have never been manufactured in Spain (BMW and FIAT) lead an intermediate group, with market share reductions of up to 1.2%. Asian manufacturers that entered the European market more recently are the ones suffering the largest percent sales reductions, up to 3.3%, as they are the least favored brands among Spanish drivers.

[20] In the 1960s and early 1970s, the SANTANA brand produced LAND ROVER in Spain, while MG produced MINI.

6 Concluding Remarks

This paper evaluates the Spanish automobile industrial policy enforced between 1950 and 1985. This long time span allows us to document, not only the immediate impact of the autarkic policy on domestic production, but also the overall impact of a strict import prohibition that lasted nearly half a century. We also estimate an equilibrium model for the 2009-2015 period, nearly three decades after the industrial policy was phased out to evaluate its long lasting effect on consumer preferences favoring brands with production facilities in Spain.

Was the Spanish automobile industrial policy a "success"? Starting from nothing, it certainly managed to develop an industry that became the second largest automobile producer in Europe and fifth in the world in about four decades. The automobile industry still accounts for 8% of Spanish GDP. Focusing on a sales metric alone we cannot but to conclude that the Spanish automobile industrial policy was a resounding success. However, if we honestly consider all the evidence we provide in the present case study, with its unusual length and institutional features, the evaluation of the Spanish automobile industrial policy has to be somewhat more nuanced.

Our empirical setup is unique in the sense that one region of the country, Canarias, was spared from the prohibitive import restriction of the industrial policy. This offer the possibility to evaluate the impact of the industrial policy as it changed over the decades. While most Spaniards could only purchase domestically produce automobiles, residents in the Canary Islands, blessed with a free trade regime, purchased a much larger share of non-Spanish cars, most notably Japanese imports. Purchasing behavior of Canarians converged to that of other Spaniards a decade after Spain joined the EU. Thus, using Canarias as a suitable control group, we document how the industrial policy led to a permanent change in consumer preferences in favor of domestic brands that outlived the industrial policy itself.

We show that entry of automobile manufacturers triggers an immediate and long-lasting loyalty effect among Spaniards. This effect is particularly strong for those who benefited from import prohibition and entered well ahead of Spain joining the EU. This home bias effect is even stronger for the region where the entrant locates its production facility. We show that this effect is robust across time and regions as well as to consumer inertia, and the phasing out of tariff protection. The evidence presented amounts to the most complete description of the genesis and economic consequences of intranational home bias in a homogeneous institutional environment, where firms operate with the same currency and laws. This loyalty to local brands has survived the industrial policy by more than thirty years. We show that home bias amounts to an effective trade barrier against imports from the rest of the European Union or Asia, equivalent to at least an 8.30% import tariff, 5.50% due to regional or intranational home bias and a minimum 2.80% to domestic or national home bias. Overall, the protective effect of home bias amounts to 80% of the current EU's import tariff.

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Appendix

A Spanish Automobile Registrations for 1961–2015

The database used in Section 2 and 3 comprises automobile registration information for the fifty Spanish provinces aggregated by automaker (not distinguishing by models of a given brand). We collected the data manually from pdf copies of the Statistical Yearbooks of *Dirección General de Tráfico*, *DGT*, the Spanish Department of Motor Vehicles for each year between 1961 (as far as we know the first year it was issued) until 2015.

To conduct the reduced form econometric analysis we remove for any given year those automakers selling less than seven units across all provinces in Spain. This eliminates mainly luxury brands such as Rolls-Roice, Lamborghini, Bugatti, or Buick.

Table A.1: Market Shares by Automaker – 1961-2015

Automaker	Average	Maximum	Years	Automaker	Average	Maximum	Years
Core Spanish Brands				**European Brands**			
SEAT	25.24	60.43	55	ALFA ROMEO	0.52	2.62	55
RENAULT	19.28	35.58	55	BMW	1.59	4.45	55
CITROËN	8.33	11.65	55	DACIA	2.05	4.76	11
				DAEWOO	1.35	2.12	11
				FIAT	2.17	5.76	55
				LANCIA	0.32	1.45	55
Early Entrants				LAND ROVER	0.16	0.44	30
FORD	8.01	15.47	55	MINI	0.78	1.04	13
PEUGEOT	5.98	10.90	55	SAAB	0.13	0.35	43
MERCEDES	1.72	4.55	55	SMART	0.48	1.76	13
OPEL	6.33	14.64	55	SKODA	0.62	2.11	54
				ROVER	0.59	2.32	42
				Eurasian Brands			
Late Entrants				HONDA	0.65	1.82	43
NISSAN	1.92	5.14	43	HYUNDAI	1.98	4.18	30
VW	4.56	9.15	55	KIA	1.59	4.17	21
SUZUKI	0.33	0.76	34	LEXUS	0.22	0.44	15
AUDI	2.10	4.89	44	TOYOTA	1.80	5.56	43
				VOLVO	0.54	1.15	55
				Non-European Brands			
Exiting Brands				CHEVROLET	0.43	2.33	44
SANTANA	0.42	1.43	10	MAZDA	0.43	1.43	43
MG	0.24	2.43	29	MITSUBISHI	0.34	0.92	42
AUTHI	1.49	6.93	35	LADA	0.18	0.71	27
DODGE	0.23	2.65	38	SSANGYONG	0.14	0.40	23
SIMCA	5.23	14.63	24	JEEP	0.10	0.38	26
CHRYSLER	0.67	6.74	39	FSO	0.08	0.16	5
TALBOT	5.26	10.63	9	SUBARU	0.07	0.18	37

Average and maximum domestic share during the years of production of each automobile brand in Spain between 1961 and 2015. Years indicates the number of years that a particular brand is sold during the sample, whether because it was produced in Spain or imported.

Despite being more popular, we also drop luxury brands Jaguar and Porsche. We also eliminate other marginal brands such as DKW or Daihatsu, as well as any other sold only no more than two years. Even after applying all these selection criteria, some brands are only sold in a handful of provinces, particularly in the 1960s and 1970s. Our econometric analysis is thus conducted at the regional level after aggregating yearly sales information of the corresponding provinces, for a unique unbalanced panel of 25,124 observations (55 years, 17 regions, and up to 44 automakers, respectively).

B Data (2009–2015)

Automobile Registration Data. We obtained detailed vehicle registration data including information on make, model, trim, market segment, list price, automobile characteristics (type of engine, horsepower, weight, CO_2 emissions, fuel consumption), as well as sales by Spanish provinces between 2009 and 2015 from *MSI Consulting*. We only consider the 47 mainland provinces in mainland Spain grouped into 15 regions (Autonomous Communities) to define local markets. Table B.1 reports mean values for those characteristics by regional market at the beginning and the end of the sample period. Moreover, we also collected fuel prices from the *Instituto Nacional de Estadística* (*INE*), the Spanish National Statistics Agency. Other cost related information (e.g., steel, electricity and rubber prices or wages) was obtained from *Eurostat*.

Table B.1: Automobile Characteristics by Regional Market

	SHARE		PRICE		DIESEL		HPW		KPE		CO_2	
REGION	2009	2015	2009	2015	2009	2015	2009	2015	2009	2015	2009	2015
AN	15.10	11.95	21.48	22.11	74.90	69.02	0.80	0.84	19.61	20.24	138.51	114.08
AR	2.62	2.35	23.28	23.58	75.63	66.18	0.83	0.88	18.96	20.55	144.31	116.64
AS	2.59	1.70	22.25	22.87	71.99	70.12	0.84	0.87	18.81	20.25	139.73	113.36
CB	1.34	1.03	21.87	22.56	70.90	64.48	0.81	0.86	19.16	20.55	139.49	115.31
CL	5.29	3.49	22.63	23.39	74.04	68.66	0.84	0.88	19.17	20.61	140.62	115.14
CM	3.76	3.30	23.20	23.51	80.90	76.66	0.84	0.87	19.00	20.78	140.21	113.23
CT	15.35	16.76	22.77	23.18	68.67	63.16	0.85	0.88	18.19	20.14	143.10	116.27
EX	1.94	1.34	21.93	22.52	78.76	76.39	0.81	0.85	19.56	20.78	139.56	113.29
GA	6.55	4.12	21.65	22.86	76.37	73.05	0.82	0.87	19.44	20.47	136.55	112.43
MC	2.43	2.34	22.36	22.61	77.13	73.75	0.82	0.85	19.83	20.86	138.48	113.81
MD	24.98	33.84	23.11	23.19	75.36	71.83	0.84	0.86	18.88	21.06	140.81	112.83
NC	1.61	1.12	22.21	23.53	76.91	65.94	0.80	0.88	19.88	20.82	139.12	116.27
PV	4.92	3.89	22.87	23.95	72.18	63.49	0.83	0.89	19.01	19.96	142.51	118.05
RI	0.57	0.50	23.27	23.33	75.04	62.33	0.83	0.88	18.87	20.39	144.55	116.35
VC	10.95	12.28	21.13	21.13	66.63	54.76	0.80	0.85	18.88	19.64	139.14	115.07
SPAIN	100.00	100.00	22.38	22.82	73.35	67.48	0.83	0.86	19.00	20.49	140.36	114.32

Notes: SHARE and DIESEL are the average percent market penetration per category over total sales in each region. PRICE is denominated in thousands of 2011 euros and includes value-added taxes and import tariffs. All other variables are also sales weighed averages. They are defined in Figure 1 and in Table**??**.

We distinguish four geographical production areas: The Domestic category (SPAIN) includes brands assembling at least one car model in Spain.[21] The European (EU) category includes traditionally European brands located somewhere else in Europe. The EURASIAN brands are firms with

[21] For instance, AUDI only started producing model Q3 in Spain in 2011. We report it as domestic for the whole sample for the purpose of data description but only from 2011 on for the estimation.

Asian parent companies that assemble some models in Europe and therefore its locally assembled models avoid the 10.3% import duty into the European Union. Finally, NON-EU includes brands that do not assemble any car passenger in Europe over the sample period.

Automobile Choice Set. Our sample definition ignores models that are not sold in all regions every single year. We remove observations with missing characteristics and brands with market shares less than 0.3% as well as exclusive high-end brands (Rolls-Royce, Masserati, Bently, Cadillac, Porsche or Ferrari) and "cheap" brands (Lada or Tata).

We classify vehicles according to standard market segments as defined by the European Commission: A: ultra-small CITY; B: SMALL; C: COMPACT; D: LARGE; M: MINIVAN; and J: SUV.[22] Our *starting data* includes 96.19% of the Spanish M1 sales reported by *DGT*.[23] We then select our sample by applying the following criteria:

1. Exclude vehicles with fuel engines other than gasoline and diesel. They only amount to a small share of the starting data set (1.57%).
2. Consolidate trims under a common model name and exclude models-years with national sales below 60 units to account for model entry and exit (0.2%).
3. Drop models for all years with average annual sales below 550 units (2.22%).
4. Eliminate very expensive models from non-exclusive brands, e.g., AUDI A6 or Q7; BMW-5 Series; JEEP Cherokee; MERCEDES Classes E, GL, and M; VOLVO XC70; and VW Touareg (1.76%).
5. Finally, we also drop ALFA ROMEO because it only has one model for a few years of the sample. We also exclude five models (Accent, Cordoba, Kadjar, Tiida, and Vitara) that are sold only in 2009 or in 2015 (0.13%).

Together these criteria define a sample with 20,536 observations comprising 89.66% of all sales of M1 vehicles in mainland Spain from 2009 to 2015. It comprises 26 automakers from 18 automobile manufacturing groups and 161 *model names*, for a total 231 models after distinguishing by fuel engine type. Table B.2 details the different automobile models by automaker and market segment (according to the passenger car classification of the European Commission).

Demographics. Data about the socio-economic characteristics of the Spanish households is available at the web page of the National Statistic Institute through the European Statistics on Income and Living Conditions (EU-SILC),

[22] Segment classification of the European Commission (*UNECE*). We have excluded the high-end segment F (MERCEDES S-Class, BMW-7 Series) because of its small presence in the Spanish market but instead we kept MINIVAN and SUV because of the important growth that they experienced during our sample period.

[23] M1 category comprises vehicles designed and constructed for the carriage of passengers with at least four wheels and no more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 3.5 tons.

Table B.2: Automobile Models by Make and Segment

Origin	Make	CITY	SMALL	COMPACT	LARGE	MINIVAN	SUV
SPAIN							
	AUDI		A1	A3	A4, A5		Q3, Q5
	FORD	KA	Fiesta	Focus	Mondeo	C-Max, S-Max, *Fusion*	*Ecosport*, *Kuga*
	MERCEDES			Classe A	Classe C	ClaseB, Viano	Classe GLA
	NISSAN	Pixo	Micra	Pulsar		Juke, *Note*, Qashqai	*X-Trail*, Pathfinder
	OPEL	Adam	Corsa	Astra	Insignia	Meriva, Zafira	*Antara*, *Mokka*
	PSA	107, C1, C2	206, 207, 208, C3	308, C4	407, 508, *C-Elysee*, C5	2008, 3008, 5008, C8, Picasso	
	RENAULT	Twingo	Clio	Fluence, Megane	Laguna	*Modus*, Scenic	*Captur*, *Koleos*
	SEAT	Mii	Ibiza	Leon	*Exeo*, *Toledo*	Alhambra, Altea	
	VW	Up	Polo	Golf, Jetta, Scirocco	CC, Passat	Sharan, Touran	*Tiguan*
EU							
	BMW		Serie 1	Serie 2	Serie 3, Serie 4		*X1*
	DACIA		Sandero	Logan		*Lodgy*	*Duster*
	FIAT	500, Panda	Punto	Bravo		Freemont	
	LAND ROVER						*Freelander*, Discovery, RRover
	MINI		Hatchback				*Countryman*
	SMART	Fortwo	Forfour				
	SKODA		Fabia		*Octavia*, *Rapid* *Spaceback*, Superb		*Yeti*
EURASIAN							
	HONDA			Civic	Accord		*CR-V*
	HYUNDAI	I10	I20	I30	*Sonata*, I40		*Santafe*, *Tucson*
	KIA	Picanto	Rio	Ceed		*Carens*, Carnival	*Sportage*, Sorento
	TOYOTA	AYGO	Yaris	Auris	*Avensis*	Verso	*Rav4*, LandCrusier
	VOLVO			C30	Serie 40, Serie 60		XC60
NON-EU							
	CHEVROLET	Matiz, Spark	Aveo		*Cruze*, *Epica*	*Orlando*	*Captiva*, *Trax*
	MAZDA		Mazda 2	Mazda 3	Mazda 6		*CX5*
	MITSUBISHI			Lancer			*ASX*, *Outlander*, Montero
	SSANGYONG					Rodius	*Actyon*, KorandoK4, Kyron
	SUZUKI	Alto	Swift				*Sx4*, *GrandVitara*

Notes: Models in *cursive* identify the small SUV subcategory in the SUV column, and the AFFORDABLE-LARGE subcategory in the LARGE and MINIVAN columns, as used in the structural estimation. In our sample, VOLVO was owned by FORD in 2009 and 2010, but it was its own independent group afterwards.

This data base includes information about socio-demographic characteristics of Spanish households with representativeness across the total population of all regions (Autonomous Communities, CCAA). Each observation corresponds with a household which represents to a different number of households (that is, the elevation factor). In other words, Using this elevation factor we obtain the total population for each region. Over this survey we apply some filters. First, we consider households in which the head of household is between 18 to 70 years of age. Moreover, we do not include extremely poor or extremely rich households. Regarding the first point we do not considered households below the "at-risk-of-poverty threshold" according OECD, that is, when their income (including social transfers) is below at 60% of the national median disposable income. On the other hand, the richest households not included are those belonging to the 99 percentile of disposable income. The population resulting to apply these filters is the used one to extract the 1,000 draws of households by region per year. The socio-demographic variables used are the following:

- INCOME. The disposable income per capita for members of the household taking into account the definition of members as a "OCDE unit" that gives a weight of 1 to an adult, a weight of 0.5 to the rest of the members over 13 years of age and a weight of 0.3 to those under 14 years of age.
- CHILDREN: A dummy variable that equal to 1 if household has one o more financially dependent children (that is, a child under the age of 18 or with 18 and over but under 25 and economically inactive).
- AGE: The age of the head of household (from 18 to 70 years old). This variable is introduce in log(age).
- COLLEGE: A dummy variable that equal to 1 if the head of the household has higher education.

C National Uniform Pricing

Automobiles are sold at the same list price across Spain. However the average price per *name model* varies substantially across provinces as the popularity of different trims correlates with income. In addition, automakers adopt different approaches to define what the base model is. In this appendix we document these pricing practices, evaluate wether differences between listed and transaction prices differ in any systematic way across local markets, and argue in favor of using a national average model price in the econometric analysis.

Transaction v.s. List Prices. Data include hundreds of models, each with multiple trims and optional equipment. Researchers commonly resort to using list prices (or manufacturer's suggested retail prices, *MSRP*) as a proxy for actual transaction prices. Many times transaction prices include discounts over the list price depending on unobservable market conditions, inventory, introduction of new models, or individual negotiation between buyer and seller (D'Haultfoeuille, Durrmeyer and Février, 2019). Most manufacturers set the base price based on a trim that already includes some common options but some others, particularly German automakers, tend to set list prices for very basic models and price add-on options, with list prices likely understating the actual transaction price because, most commonly, automakers set the price of the most popular model trim including a set of standard options.

There are two potential sources of unobservable discounts that we cannot account for but that are unlikely to have any influence on our results. One are dealer discounts linked to financing that the manufacturer normally facilitates only after the purchase of an extended the car's warranty. The other discount refers to unobservable trade-in allowances. Furthermore, during 2014 and 2015 there were two *cash for clunkers* programs in Spain for vehicles 10 years or older (Laborda and Moral, 2019). These programs offered a tax rebate not included in the taxable price, thus minimizing effects of trade-in allowance.

Data Sources of Transaction and List Prices. The Spanish Tax Agency (*Agencia Estatal de Administración Tributaria*, *AEAT*) facilitated the *taxable basis* for all new passenger car transactions in 2014 and 2015 grouped by "average car types" defined by make, fuel, cubic capacity, CO_2 emissions and province. We denote by *AEAT_Cluster* this product-trim-market vehicle grouping, which does not exactly coincide with the commercial name of a make-model combination. However, this definition is sufficient to control for average *real transaction prices* per province, *REALP*, based not on surveys but on the universe of actual transactions.

MSI Consulting facilitated the list prices for the whole sample. To combine these two databases we match the same make, fuel, cubic capacity, and CO_2 emissions information defining *AEAT*'s average car clusters. To match *REALP* with pre-tax list prices, *LISTP*, we first remove the 21% value added tax from the *MSI* price information. We also account for the CO_2 emissions excise duty, which is nonlinear in emissions and varies across regions as indicated in Table C.1.

Table C.1: Special CO2 Emissions Tax Rates

	Official CO_2 Emissions	Regional Rates	Tax Rate
Tranche 1	$CO_2 \leq 120g/km$		0
Tranche 2	$120 < CO_2 < 160g/km$		4.75
		EX	5.2
Tranche 3	$160 \leq CO_2 < 200g/km$		9.75
		EX	11.0
Tranche 4	$200 \leq CO_2$		14.75
		CB	15.0
		MC	15.9
		AS, EX, CT,VC	16.0
		AN	16.9

Non-rated vehicles pay the highest rate. Source: *AEAT*.

To combine both databases, we account for transaction and list prices for any *AEAT_Cluster* defined by 26 brands; two engine types (gasoline and diesel); six cubic capacity categories (less than 1199, $[1200, 1400)$, $[1400, 1600)$, $[1600, 2000)$, $[2000, 2500)$, and more than 2500); the four emissions categories of Table C.1; and 43 provinces. This results in an unbalanced panel with 15,726 *AEAT_Cluster*-year-province observations corresponding to a total of 271 *AEAT_Cluster*s, a number similar to the actual 231 models reported by *MSI Consulting* and described in Appendix B.[24] Table C.2 shows the distribution of these clusters by fuel type, cubic capacity and CO_2 emissions. Data from the Spanish tax agency also confirms similar product features highlighted when analyzing our sample: gasoline vehicles tend to be less powerful than diesels, but diesel automobiles emit less CO_2 and more powerful cars pollute more CO_2 regardless of fuel type.

Table C.2: Distribution of AEAT Clusters

	CUBIC CENTIMETERS						
EMISSIONS (g/km)	< 1199	$[1200, 1400)$	$[1400, 1600)$	$[1600, 2000)$	$[2000, 2500)$	> 2500	ALL
GASOLINE							
$CO_2 \leq 120g/km$	37	26	10	2	0	0	75
$120 < CO_2 \leq 160g/km$	16	25	36	25	2	0	104
$160 < CO_2 \leq 200g/km$	0	6	13	23	3	2	47
$200 \leq CO_2$	0	0	0	0	2	4	6
Total	53	57	59	50	7	6	232
DIESEL							
$CO_2 \leq 120g/km$	8	14	45	34	4	0	105
$120 < CO_2 \leq 160g/km$	0	2	32	39	22	1	96
$160 < CO_2 \leq 200g/km$	0	0	0	19	17	4	40
$200 \leq CO_2$	0	0	0	2	6	4	12
Total	8	16	77	94	49	9	253

Empirical model. The dependent variable, $DISCOUNT$, measures the percent difference of the listed and transaction price as follows:

$$DISCOUNT = \frac{LISTP - REALP}{LISTP}\,. \tag{C.1}$$

If the list price includes all possible options we expect $DISCOUNT$ to be positive. Only 7.3% of our observations present negative discounts and, with the exception of LAND ROVER, they are all German brands AUDI, BMW, MERCEDES, and MINI, that set the list price for the bare bone model, charging extra for options for the most popular trims. Since $DISCOUNT$ is defined in the $[-1, 1]$ interval, we study the inverse hyperbolic tangent, $y_{jmt} = \tanh^{-1}(DISCOUNT_{jmt}) \in \mathbb{R}$:

$$y_{jmt} = \ln\left(\frac{1 + DISCOUNT_{jmt}}{1 - DISCOUNT_{jmt}}\right) = \mu + \beta'\mathbf{x}_{mt} + \delta'\mathbf{z}_j + \upsilon_{jmt}\,, \tag{C.2}$$

for two years, $t = \{2014, 2015\}$; most mainland provinces, $m = 1, \ldots, 43$; and models (clusters) for each year $j = 1, \ldots, J_t$, where the number of models are $J_{2014} = 237$ and $J_{2015} = 248$, respectively. Regressors include variables controlling for demographic heterogeneity across local markets, $\mathbf{x}_{mt}$ and cluster-specific characteristics, $\mathbf{z}_j$, that we now describe.

[24] $AEAT$ does not include data for País Vasco and Navarra as they independently manage their own tax agencies. In addition, we do not include CHEVROLET in this analysis because this company exited the Spanish market in 2015. Moreover, we drop $AEAT\_Cluster$ observations with $REALP$ exceeding $55,000$ euros as *per capita* GDP during the 2014-2015 period was just $20,721$ euros. We also ignore a particular model if sold in three or fewer provinces.

$\mathbf{x}_{mt}$: Geographic market heterogeneity:

1. The GDP per capita (GDP_{pc}) captures the effect of mean income in a market as a proxy of the average permanent income. GDP per capita varies across provinces and time, with a national average of 20,510 euros. Income distribution is widely spread, with a minimum of 14,930 and the maximum of 31,630. The effect of this variable is very small but significantly negative. Discounts are smaller for wealthier markets where demand is likely stronger.

2. *Population density* is the province population/area ratio, with some provinces reaching only 9 inhabitants per squared kilometer while others include up to 804 inhabitants per squared kilometer. Results show that population density might correlate with the intensity of local competition resulting in larger discounts.

3. *Province fixed effects.* These 43 dummy variables control for anything else differentiating local markets. This variable is key for our analysis, as we test that there are no systematic discount differences across local markets by evaluating their significance. Our results indicate that they are not significant once we take into account income differences across markets.

$\mathbf{z}_j$: Heterogeneity of $AEAT\_Cluster$:

1. *Fuel*: Environmental incentives may induce demand for different fuel model types. Estimates show that discounts are significantly larger for diesel vehicles.

2. *Quality:* Nonlinear effect of engine size (cubic capacity) is controlled by six dummy variables. Similarly, four dummy variables control for CO_2 emission taxation categories. Discounts are larger for small, fuel efficient vehicles with lower emissions.

3. *Make:* We include 25 dummy variables to control for potentially diverse pricing strategies of different automakers. Results confirm the view of Kuntner (2017) that discounts are negatively correlated with the overall quality and reputation of the brand.

Estimation results. We regress several specifications of model (C.2) starting with only market fixed effects (Model 1) and successively introducing demographics (Model 2), product characteristics (Model 3), and finally brands fixed effects (Model 4). We omit province fixed effect estimates in Table C.3 but we report the number of significant coefficients and the market share that they represent in the sample. Once we account for observable demographics and product characteristics, province fixed effects are no longer significant. Thus, higher income households self-select purchasing more expensive trims, all offered at the same uniform national price across regional markets in Spain, which results in higher average price paid per *name model* in wealthier markets such as Madrid or Barcelona.

Table C.3: Estimations for Discounts

	Model 1		Model 2		Model 3		Model 4	
CONSTANT	0.332	(0.002)***	−0.520	(0.785)	−0.489	(0.730)	−0.485	(0.591)
LOCAL COMPETITION								
GDP_{pc}			−0.009	(0.005)*	−0.008	(0.004)*	−0.010	(0.004)***
DENSITY			0.010	(0.007)	0.009	(0.006)	0.009	(0.005)*
FUEL								
DIESEL					0.062	(0.003)***	0.031	(0.002)***
ENGINE SIZE (CC)								
$[1200, 1400)$					0.151	(0.005)***	0.049	(0.004)***
$[1400, 1600)$					0.013	(0.004)***	0.006	(0.003)*
$[1600, 2000)$					−0.069	(0.004)***	−0.063	(0.003)***
$[2000, 2500)$					−0.143	(0.005)***	−0.074	(0.005)***
$[2500, max)$					−0.113	(0.014)***	0.006	(0.012)
CO2 EMISSIONS (gr/km)								
$120 < CO2 < 160$					0.014	(0.005)***	0.034	(0.004)***
$160 \leq CO2 < 200$					−0.015	(0.006)**	0.011	(0.005)**
$200 \leq CO2$					0.037	(0.013)***	−0.064	(0.011)***
Province FE	Yes		Yes		Yes		Yes	
Make FE	No		No		No		Yes	
Test of Uniform National Pricing:								
At 95% significance	39.70	(19)	0.0	(0)	0.0	(0)	6.4	(4)
At 99% significance	35.77	(15)	0.0	(0)	0.0	(0)	0.0	(0)
Adj. R^2	0.0121		0.0131		0.1389		0.4483	

OLS estimates using a sample of 15,726 market-time-cluster observations. Heteroskedastic-consistent standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively. To test for the null hypothesis of uniform national pricing, we report the total market share and number of province fixed effects (in parenthesis) that are significantly different from zero at 95% and 99% significance, respectively.

D Additional Results

Table D.1: Preference for Local Brands – Canarias vs. Baleares

	Model 1.B1	Model 1.B2	Model 1.B3	Model 1.B4	Model 1.B5	Model 1
CONSTANT	-6.1573***	-5.8787***	-5.7709***	-5.8559***	-5.8511***	-5.8516***
	(0.0149)	(0.0510)	(0.0863)	(0.0884)	(0.0883)	(0.0883)
NHB-CORE	4.1495***	4.1162***	4.2341***	4.2897***	4.2699***	4.2719***
	(0.0206)	(0.0584)	(0.0667)	(0.0668)	(0.0671)	(0.0670)
NHB-EARLY	3.3730***	3.5381***	2.2379***	2.2788***	2.2625***	2.2646***
	(0.0242)	(0.0431)	(0.0527)	(0.0489)	(0.0491)	(0.0489)
NHB-LATE	2.2252***	2.3455***	1.4680***	1.5219***	1.5089***	1.5109***
	(0.0475)	(0.0788)	(0.0653)	(0.0612)	(0.0611)	(0.0609)
NHB-EXIT	1.8389***	2.9083***	4.0791***	4.1408***	4.1238***	4.1259***
	(0.0597)	(0.0730)	(0.0856)	(0.0847)	(0.0852)	(0.0850)
H.B. CANARIAS	-0.2964***	-0.2922***	-0.2982***	-1.2810***	-1.2620***	-1.2641***
	(0.0642)	(0.0579)	(0.0598)	(0.0830)	(0.0831)	(0.0830)
H.B. BALEARES	-0.02211	-0.03094	-0.03573	0.01200	0.03078	
	(0.0584)	(0.0455)	(0.0567)	(0.0715)	(0.0716)	
RHB-CORE					0.2539***	0.2524***
					(0.0869)	(0.0869)
RHB-EARLY					0.2282***	0.2267***
					(0.0685)	(0.0684)
RHB-LATE					0.1698	0.1683
					(0.1082)	(0.1082)
RHB-EXIT					0.2233	0.2219
					(0.2146)	(0.2146)
Firm FE (42)		✓	✓	✓	✓	✓
Year FE (54)			✓	✓	✓	✓
Region FE (16)				✓	✓	✓
Adj. R^2	0.4403	0.5830	0.6610	0.6701	0.6702	0.6702

OLS estimates using a sample of 25,124 region-year-automaker observations. The endogenous variable is the log of the regional market share of sales of all models of each automaker Absolute value, heteroskedastic-consistent, standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively.

Table D.2: Preference for Local Brands – Canarias vs. Murcia

	Model 1.M1	Model 1.M2	Model 1.M3	Model 1.M4	Model 1.M5	Model 1
CONSTANT	-6.1573***	-5.8787***	-5.7711***	-5.8562***	-5.8513***	-5.8516***
	(0.0149)	(0.0510)	(0.0864)	(0.0883)	(0.0883)	(0.0883)
NHB-CORE	4.1438***	4.1107***	4.2287***	4.2906***	4.2709***	4.2719***
	(0.0207)	(0.0584)	(0.0668)	(0.0668)	(0.0672)	(0.0670)
NHB-EARLY	3.3674***	3.5325***	2.2325***	2.2798***	2.2635***	2.2646***
	(0.0244)	(0.0431)	(0.0528)	(0.0491)	(0.0492)	(0.0489)
NHB-LATE	2.2197***	2.3400***	1.4626***	1.5228***	1.5098***	1.5109***
	(0.0474)	(0.0788)	(0.0653)	(0.0612)	(0.0611)	(0.0609)
NHB-EXIT	1.8334***	2.9027***	4.0735***	4.1417***	4.1249***	4.1259***
	(0.0596)	(0.0729)	(0.0855)	(0.0846)	(0.0851)	(0.0850)
H.B. CANARIAS	-0.2908***	-0.2867***	-0.2927***	-1.2819***	-1.2630***	-1.2641***
	(0.0642)	(0.0579)	(0.0598)	(0.0830)	(0.0831)	(0.0830)
H.B. MURCIA	0.06772	0.05776	0.05132	-0.002742	0.01596	
	(0.0547)	(0.0434)	(0.0544)	(0.0692)	(0.0693)	
RHB-CORE					0.2531***	0.2524***
					(0.0869)	(0.0869)
RHB-EARLY					0.2275***	0.2267***
					(0.0685)	(0.0684)
RHB-LATE					0.1691	0.1683
					(0.1083)	(0.1082)
RHB-EXIT					0.2226	0.2219
					(0.2146)	(0.2146)
Firm FE (42)		✓	✓	✓	✓	✓
Year FE (54)			✓	✓	✓	✓
Region FE (16)				✓	✓	✓
Adj. R^2	0.4403	0.5830	0.6610	0.6701	0.6702	0.6702

OLS estimates using a sample of 25,124 region-year-automaker observations. The endogenous variable is the log of the regional market share of sales of all models of each automaker Absolute value, heteroskedastic-consistent, standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively.

Table D.3: Dynamic Treatment Estimates

	NHB-CORE	NHB-EARLY	NHB-LATE	NHB-EXIT
$t-5$		0.4983***	0.2934	1.3287***
		(0.1549)	(0.2037)	(0.1738)
$t-4$		-0.2122	-0.03866	1.4681***
		(0.1673)	(0.2106)	(0.1842)
$t-3$		-0.3376**	0.1993	0.4999*
		(0.1685)	(0.2237)	(0.2566)
$t-2$		-0.2578	0.4364**	0.9023***
		(0.1713)	(0.1953)	(0.2523)
$t-1$		-0.3229*	-0.3255	0.3738
		(0.1710)	(0.2331)	(0.2402)
t	4.4162***	1.5471***	0.7471***	4.0735***
	(0.1667)	(0.1698)	(0.1918)	(0.1614)
$t+1$	4.5464***	2.8941***	1.1334***	4.4674***
	(0.1905)	(0.1373)	(0.2377)	(0.1728)
$t+2$	5.1050***	2.9020***	0.5005**	4.4197***
	(0.1460)	(0.1363)	(0.1955)	(0.1778)
$t+3$	5.4155***	2.8226***	0.8161***	4.0968***
	(0.1505)	(0.1400)	(0.1437)	(0.1969)
$t+4$	5.9135***	2.7007***	0.7922***	4.8498***
	(0.1408)	(0.1372)	(0.1495)	(0.1291)
$t+5$	4.1962***	2.0434***	1.7826***	4.2723***
	(0.0678)	(0.0563)	(0.0681)	(0.1069)

Notes: These are the estimated national dynamic treatment effects of Model 4 in Table 2. Absolute value, heteroskedastic-consistent, standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively.

Table D.4: Inertia and Preference for Local Brands – Full Model

	Model 1.I	Model 1.II	Model 1.III	Model 1.IV	Model 1.V	Model 1.VI
CONSTANT	-7.2778***	-6.8836***	-6.8562***	-6.7171***	-6.7580***	-6.6602***
	(0.1279)	(0.1325)	(0.1317)	(0.1294)	(0.1325)	(0.1331)
NHB-CORE	3.5023***	3.3305***	3.3520***	3.3558***	3.3626***	3.3673***
	(0.0646)	(0.0557)	(0.0556)	(0.0550)	(0.0546)	(0.0540)
NHB-EARLY	1.7421***	2.2230***	2.2328***	2.2817***	2.2691***	2.2830***
	(0.1134)	(0.1154)	(0.1161)	(0.1175)	(0.1197)	(0.1213)
NHB-LATE	1.1329***	1.2963***	1.3365***	1.3830***	1.4190***	1.4762***
	(0.0756)	(0.0711)	(0.0713)	(0.0738)	(0.0769)	(0.0803)
NHB-EXIT	4.6244***	5.0597***	6.3148***	6.2719***	6.2329***	6.1517***
	(0.2086)	(0.4468)	(0.2310)	(0.2283)	(0.2269)	(0.2269)
H.B. CANARIAS	-0.6014***	-0.2109***	-0.1732**	-0.1464**	-0.1417*	-0.1335*
	(0.0817)	(0.0722)	(0.0732)	(0.0739)	(0.0742)	(0.0744)
RHB-CORE	0.3377***	0.2259***	0.2559***	0.2819***	0.3047***	0.3316***
	(0.0891)	(0.0685)	(0.0672)	(0.0655)	(0.0646)	(0.0634)
RHB-EARLY	0.2304***	0.2030***	0.2193***	0.2323***	0.2416***	0.2484***
	(0.0615)	(0.0591)	(0.0586)	(0.0582)	(0.0577)	(0.0574)
RHB-LATE	0.1487	0.1760**	0.1375	0.1407*	0.1378*	0.1475**
	(0.1064)	(0.0831)	(0.0856)	(0.0825)	(0.0811)	(0.0729)
RHB-EXIT	0.1240	-0.6935	-0.07362	-0.08421	-0.09233	-0.08623
	(0.5053)	(1.3305)	(1.0567)	(1.0446)	(1.0468)	(1.0483)
PAST DOMESTIC SALES		0.0036***	0.0029***	0.0022***	0.0016***	0.0010***
		(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
PAST IMPORTS		0.0316***	0.0301***	0.0281***	0.0269***	0.0262***
		(0.0018)	(0.0017)	(0.0017)	(0.0017)	(0.0017)
Lagged Years Windows	[0]	[4–9]	[5–10]	[6–11]	[7–12]	[8–13]
Observations	20,835	17,228	16,791	16,343	15,899	15,443
Adj. R^2	0.6825	0.7241	0.7305	0.7335	0.7382	0.7426

The endogenous variable is the log of the regional yearly market share of sales of all models for the sample starting in 1975. "Past Domestic Sales" and "Past Imports" are the cumulative regional sales of vehicles of brands with domestic production and imports, respectively, for the past year windows indicated at the bottom of the table. All regressions include firm, year, and region fixed effects. Absolute value, heteroskedastic-consistent, standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively.

Table D.5: Trade Liberalization and Preference for Local Brands

	Model 1.A	Model 1.B	Model 1.C	Model 1.D	Model 1.E	Model 1.F
CONSTANT	-5.8516***	-7.3508***	-6.2571***	-5.7302***	-5.6353***	-5.3935***
	(0.0883)	(0.1166)	(0.1028)	(0.0983)	(0.0724)	(0.0627)
NHB-CORE	4.2719***	4.0172***	3.0573***	2.7251***	2.9365***	2.8505***
	(0.0670)	(0.0715)	(0.0528)	(0.0473)	(0.0349)	(0.0405)
NHB-EARLY	2.2646***	2.2503***	1.8025***	2.7782***	3.0041***	2.9327***
	(0.0489)	(0.0727)	(0.2345)	(0.0473)	(0.0352)	(0.0411)
NHB-LATE	1.5109***	1.4383***	0.6818***	-0.02896	0.07859	0.1238**
	(0.0609)	(0.0691)	(0.0781)	(0.0638)	(0.0583)	(0.0564)
NHB-EXIT	4.1259***	4.8437***	1.3350***	0.4215*		
	(0.0850)	(0.1100)	(0.2922)	(0.2194)		
H.B. CANARIAS	-1.2641***	-0.9919***	-0.2478***	0.1107*	0.1994***	0.2582***
	(0.0830)	(0.0840)	(0.0753)	(0.0672)	(0.0643)	(0.0659)
RHB-CORE	0.2524***	0.2794***	0.3327***	0.3068***	0.3051***	0.2745***
	(0.0869)	(0.0949)	(0.0682)	(0.0476)	(0.0436)	(0.0450)
RHB-EARLY	0.2267***	0.2348***	0.2153***	0.2763***	0.3094***	0.3238***
	(0.0684)	(0.0654)	(0.0574)	(0.0511)	(0.0476)	(0.0514)
RHB-LATE	0.1683	0.1596	0.1215	0.08625	0.1741***	0.1506***
	(0.1082)	(0.1081)	(0.1043)	(0.0984)	(0.0441)	(0.0548)
RHB-EXIT	0.2219	0.2846	-0.03614	0.6032		
	(0.2146)	(0.2763)	(0.4580)	(0.7868)		
Starting Year	1961	1970	1980	1986	1992	2000
Observations	25,124	22,568	19,519	17,049	14,143	9,702
Adj. R^2	0.6702	0.6739	0.6983	0.7126	0.7571	0.7846

The endogenous variable is the log of the regional yearly market share of sales of all models for different starting years up until 2015. All regressions include firm, year, and region fixed effects. Absolute value, heteroskedastic-consistent, standard errors are reported in parentheses. Significant estimates with p-values less than 0.1, 0.05, and 0.01 are identified with *, **, and ***, respectively.

E Instruments

To better address how the price responsiveness relates to demographics we add some additional instruments to those made explicit in the main text. For instance, we interact the percentage of high-income households with an expensive vehicle indicator; the percentage of middle class households times a cheap vehicle indicator; a dummy variable defined as SMALL times regions other than Madrid and Catalonia; the product of the root mean square distance for HPW interacted, first with the ratio of high income households, and next with the product of the percentage of households with children and inexpensive vehicles.

To instrument for random coefficients, we use, among others, the differentiation IVs instruments of Gandhi and Houde (2020) to control for endogenous pricing accounting for product positioning. The idea is to use the distributions of product characteristics to identify random coefficients in Σ by constructing distributions for continuous characteristics based on the pairwise distances among any two products. For example, we can construct a distribution for a 2009 AUDI A4 in the HPW space by computing all differences between the A4's power and the power of other models in 2009. This approach could also be extended to compute these distance distributions within both product segments and origin of the firm depending on how we compute the demand or the supply instruments, respectively.

We implement this approach by replacing the large-dimensional cumulative distribution functions with sample statistics. Specifically, at period t and market r, instrument for product j and characteristic k in a "specific category", Υ, e.g. firm, market segment, fuel or the whole market, we compute $d^k_{rj,t} = x^k_{r,t} - x^k_{j,t}$, the distance in product characteristic space k between products j and r. We also compute $sd(x^k)$, the standard deviation of characteristic k with respect to a particular group of products. We then define four sets of instruments: (i), the sum of the square of the distances products in the same category than product j; (ii), the sum of products of other categories; (iii), the sum of the square of the distances of close products (with distances smaller than the standard deviation) in the same category than product j; and (iv), the sum of the square of the distances of close products of other categories.