Kent Economics Society

Research Paper Series

Chinese Electric Vehicles and the UK Automotive Market

Competition, Risk, and Market Efficiency in a Transitioning Automotive Sector

Kent Economics Society Research Paper ▪ Paper No. KES-RP-2025-01

Date: 10 October 2025

Authors

Kgosi Ruri Molebatsi	University of Kent, School of Mathematics, Statistics and Actuarial Science (SMSAS), Canterbury, United Kingdom Correspondence: km105@kent.ac.uk
Eve Maynard	University of Kent, School of Economics, Canterbury, United Kingdom Correspondence: em746@kent.ac.uk
Kent Economics Society	Kent Economics Society Email: economics@ksu.co.uk

Intended Audience: Insurers, Policymakers, Academics, and Industry Analysts

Region of Focus: United Kingdom

Period Covered: 2010–2025

Abstract

This paper quantifies the structural transformation of the UK automotive market amid the rapid diffusion of Chinese-manufactured electric vehicles (EVs). Drawing on Department for Transport licensing data (2010 – 2025) the analysis traces shifts in market composition, competition, and global equity performance. Chinese automakers led by BYD and SAIC's MG expanded their share of UK battery-electric vehicle (BEV) registrations from under 2 % in 2020 to nearly 11% by 2025, coinciding with a marked decline in market concentration (Herfindahl Hirschman Index from 0.96 to 0.22). Cost efficiencies from scale, advances in lithium-iron-phosphate (LFP) battery technology, and maturing supply chains underpin this momentum. The findings reveal a decisive reconfiguration of the UK automotive landscape, with competition and investment increasingly shifting toward Asia-centred producers. The results underscore the need for policymakers and industry stakeholders to develop adaptive, data-driven frameworks that ensure competitive neutrality and long-term market stability during the EV transition.

JEL: G22; L11; Q48; C33

Keywords: Electric Vehicles; Insurance Economics; Market Structure; Actuarial Modelling; Competition Policy

Data Availability: The data supporting this study are publicly available from the UK Department for Transport (`df_VEH0120_GB`). Processed datasets and analysis scripts are available upon reasonable request to the authors.

Ethics: This study uses aggregated, publicly accessible secondary data and does not involve human subjects, personal data, or experimental intervention. Ethical review was therefore not required.

Acknowledgements: The authors thank members of the Kent Economics Society Research Division for comments on early drafts, and acknowledge the Department for Transport's open-data initiative for enabling empirical replication. All views expressed are those of the authors and do not necessarily reflect those of the University of Kent or affiliated institutions.

Contents

1 Introduction

The United Kingdom automotive industry is undergoing a fundamental transformation as the dominance of **internal combustion engine (ICE)** vehicles gives way to the rapid adoption of **battery electric vehicles (BEVs)**. This transition is driven by a convergence of technological innovation, environmental regulation, and strategic global realignment. Policy instruments such as the **Zero Emission Vehicle (ZEV)** Mandate, carbon-pricing mechanisms, and large-scale infrastructure investment have accelerated this diffusion process, reducing barriers to consumer adoption and shifting market expectations.

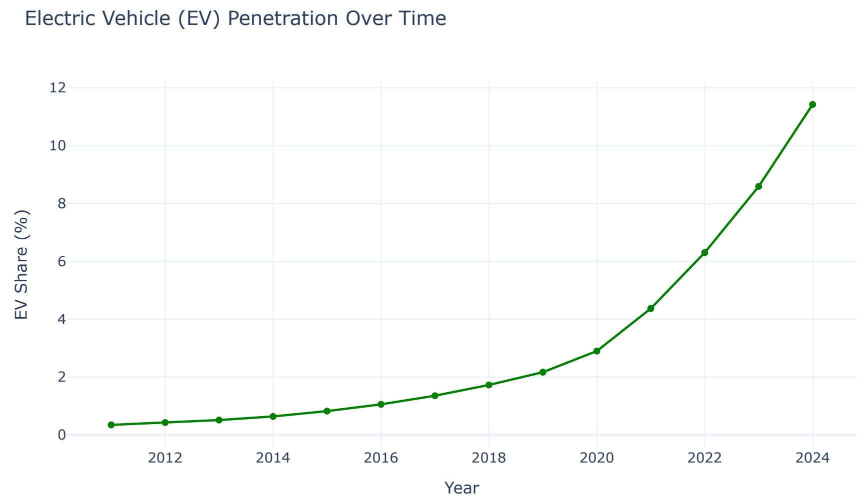

Figure 1: Electric vehicle (EV) penetration over time as a share of total registrations.

Figure 1 illustrates the exponential growth in EV adoption since 2019, with electric vehicles now accounting for roughly 11% of all new registrations. This upward trajectory marks a major shift in the composition of UK vehicle demand. It reflects the combined effects of declining battery costs, expanding charging networks, and evolving consumer perceptions of performance and reliability. At the same time, new entrants particularly from China, such as **BYD Co. Ltd.**, **SAIC Motor Corp. Ltd.**, and **Zhejiang Geely Holding Group Co. Ltd.** have intensified competitive pressures through aggressive pricing [7].

This paper quantifies these structural changes using **Department for Transport licensing statistics data** from 2010 to 2025. The analysis proceeds in three parts. First, it measures the evolution of market shares by propulsion type and manufacturer origin, identifying the inflection point at which BEVs overtook hybrid systems. Second, it evaluates the **Herfindahl–Hirschman Index** (HHI) to trace changes in market concentration as new entrants eroded incumbent dominance. Third, it links these structural shifts to global capital market behaviour through a mean–variance portfolio framework that maps automaker equities by country.

By combining industrial organisation metrics with financial performance indicators, the study provides an integrated view of how the UK's electrification drive reflects a wider rebalancing of global automotive power. The results reveal a decisive transition from a Europe-centred, combustion-based market to a more Asia-centric, software-enabled ecosystem, demanding equally adaptive policy and strategic responses.

2 Data

This papers analysis draws on the **DfT Vehicle Licensing Statistics** (`df_VEH0120_GB`), merged with a **brand - origin mapping** (`df_brand`) to assign each *Make* to its corresponding *Country*. From these sources, we derive yearly aggregates of registrations by propulsion type and origins. A final mapping links automotive brands to listed companies to construct equity portfolios in later sections.

Table 1: Variable descriptions for the main vehicle dataset

Column	Explanation
BodyType	Vehicle body type
Make	Manufacturer or brand
Fuel	Fuel type
LicenceStatus	Vehicle registration status
Registrations	Number of new registrations
Year	Year of registration
Fuel Group	Aggregated category of fuel types
Country	Country of origin

Table 2: Variable descriptions for the brand mapping dataset

Column	Explanation
raw	Original brand name as in source data
Make	Standardised manufacturer name
Country	Headquarters or primary country
ParentCompany	Parent company or group controlling the brand

Table 3: Variable descriptions for the economic/amount dataset

Column	Explanation
Year	Calendar or fiscal year label
Amount	Recorded quantity or financial value

Figures 2 and 7 illustrate the evolution of market composition by fuel group and manufacturer origin. Summary statistics (not shown) report sample coverage, unique makes, and total registrations across the 2010 – 2025 period.

3 Methodology Overview

This study combines market structure analysis, econometric modelling, and financial portfolio construction to examine the evolving composition and competitiveness of the UK automotive industry under **electric vehicle (EV) diffusion**.
The methodology proceeds in four sequential stages, summarised below.

3.1 Shares and Composition

The first step computes annual market shares by ***Fuel Group*** and ***Country*** to trace compositional shifts in the vehicle fleet. Formally, for each category i in year t,

$$MS_{i,t} = \frac{\text{Registrations}_{i,t}}{\sum_{j=1}^{N_t} \text{Registrations}_{j,t}}.$$

Stacked bar and area charts are generated to visualise the evolution of propulsion types (petrol, diesel, hybrid, electric) and manufacturer origin shares. This descriptive analysis follows the approach of [2], where market share trends are used to infer underlying competitive dynamics and diffusion patterns.

3.2 Market Concentration (HHI)

To quantify the degree of competition, the **Herfindahl Hirschman Index (HHI)** is computed annually as

$$HHI_t = \sum_i (MS_{i,t})^2,$$

where $MS_{i,t}$ is the market share (in decimals) for manufacturer or parent country i. Values closer to 1 indicate higher concentration, while lower values denote competitive dispersion ([4]). The HHI trend (Fig. `hhi_trend.pdf`) captures how the entry of new EV producers especially from China has altered the structure of the UK automotive market.

3.3 Equity Portfolio Construction

Finally, to connect market structure with financial exposure, brands are mapped to listed equity tickers to construct national portfolios. Two weighting schemes are used: equal-weighted and capitalisation weighted. Country level portfolios are then formed from monthly total returns, and their variance-covariance matrices are used to derive the **efficient frontier via mean-variance optimisation**:

$$\min_w w'\Sigma w \quad \text{s.t.} \quad w'\mu = \mu^*, \quad \sum_i w_i = 1,$$

where Σ is the covariance matrix of returns and μ the expected return vector. The resulting efficient frontier, Figure 17 summarises trade-offs between expected return and portfolio risk across national automotive markets. This framework builds on Markowitz's foundational portfolio theory ([9]).

3.4 EV Registrations-Equity Returns Correlation

The final stage tests whether changes in EV registrations co-move with automaker equity performance by country of origin. Annual EV registration data (2010–2025) from the *DfT Vehicle Licensing Statistics* were aggregated by manufacturer country and merged with monthly total returns for listed automakers, mapped to parent tickers. Monthly returns were compounded to annual totals:

$$\text{AnnRet}_{c,t} = \prod_{m=1}^{12} (1 + r_{c,m,t}) - 1,$$

and year-on-year registration growth was computed as

$$\text{Reg\_YoY}_{c,t} = \frac{R_{c,t} - R_{c,t-1}}{R_{c,t-1}}.$$

The resulting 2020–2024 panel was used to estimate the Pearson correlation coefficient for each country:

$$\rho_c = \text{corr}(\text{Reg\_YoY}_{c,t}, \text{AnnRet}_{c,t}),$$

and to fit an **Ordinary Least Squares (OLS)** trend:

$$\text{AnnRet}_{c,t} = \alpha + \beta\, \text{Reg\_YoY}_{c,t} + \varepsilon_{c,t}.$$

Figures 15 and 16 visualise the country-level correlations and fitted OLS relationships, linking diffusion dynamics with investor valuation.

4 Results

4.1 Fuel Mix and Propulsion Dynamics

The UK vehicle fleet has undergone a pronounced technological transformation over the past decade. Petrol vehicles, once dominant, have steadily declined in market share as electric and hybrid powertrains gained traction. Figure 2 illustrates this shift: while petrol and diesel combined represented nearly 95% of new registrations in 2010, their combined share fell below 70% by 2024, driven by the **Zero Emission Vehicle (ZEV) Mandate** and tightening emissions standards.

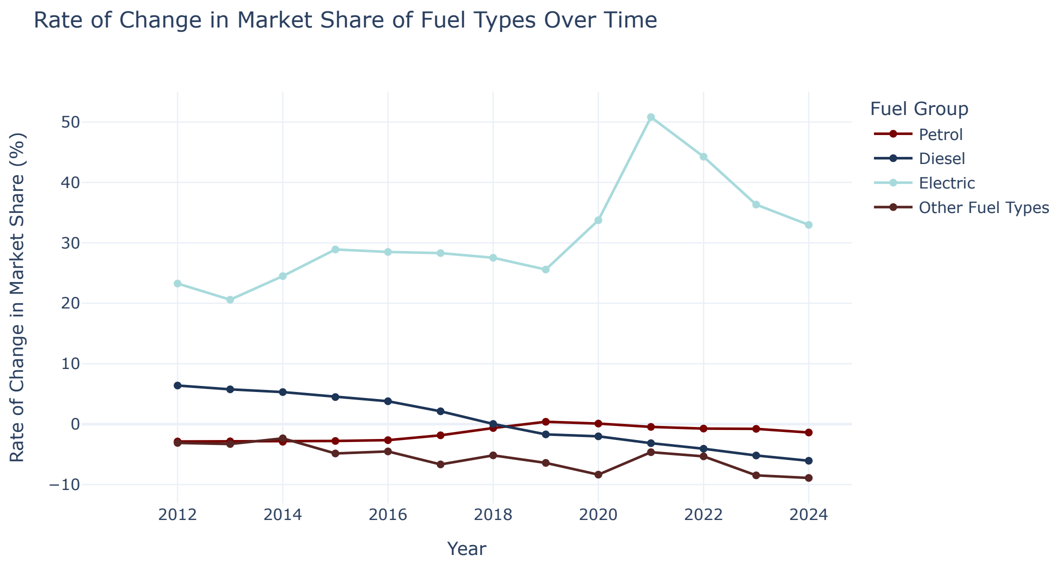

Figure 2: Market share by fuel type over time (2000 – 2025).

Within the electrified segment, the composition of electric vehicles (EVs) has evolved considerably. Initially, hybrid electric vehicles (HEVs and PHEVs) dominated the early stages of electrification due to consumer familiarity and cost advantages. However, as Figure 4 shows, battery electric vehicles (BEVs) began to surpass hybrids from 2022 onwards, reflecting both improved range efficiency and expanding charging infrastructure.

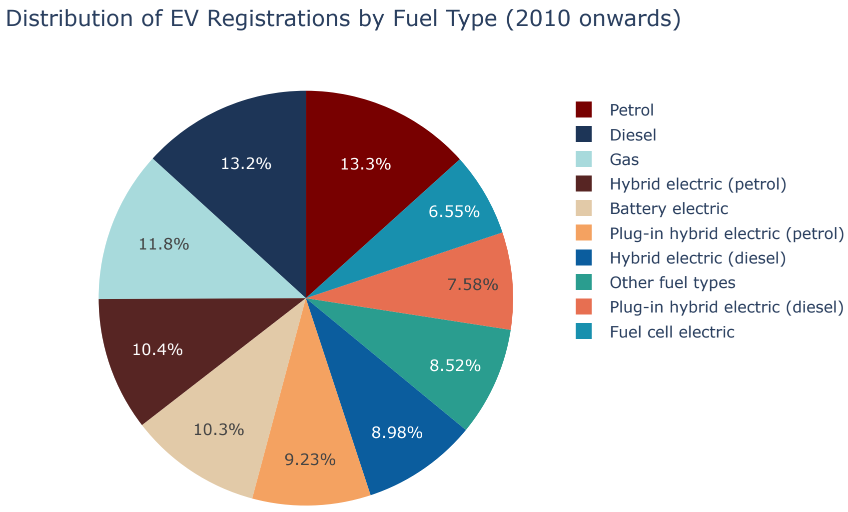

Figure 3: Fuel-group registrations by make (2024).

Figure 3 provides a snapshot of this transition in 2024, highlighting the growing diversity of propulsion systems across manufacturers. While internal combustion engines remain present, the dominance of electrified powertrains signals a structural realignment of market demand. Hybrids continue to act as a transitional bridge, yet the expanding footprint of BEVs across mainstream and premium segments underscores a maturing ecosystem driven by policy, technology, and consumer adoption. The figure therefore captures not just a change in fuel preference, but the broader industrial reorientation toward low-emission mobility.

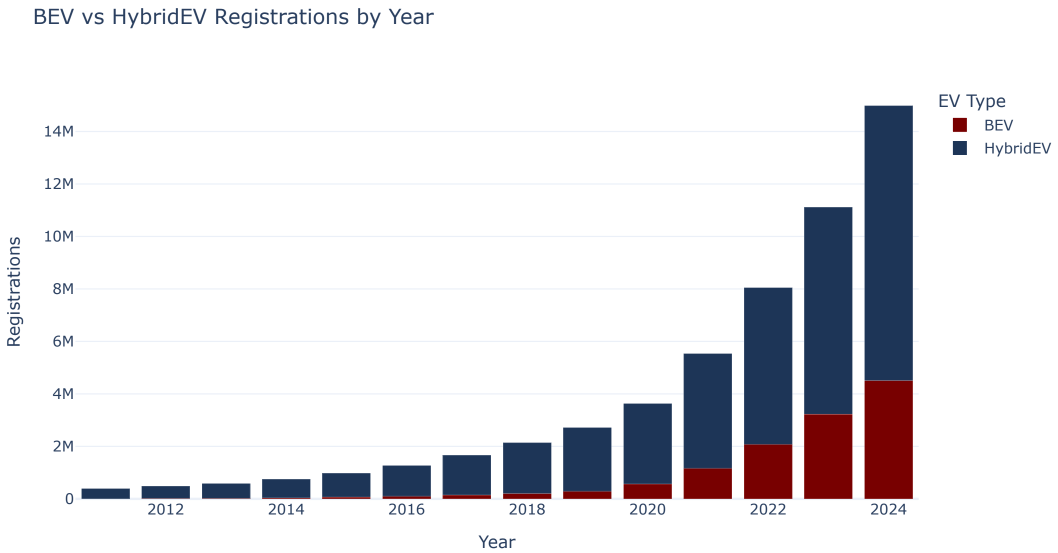

Figure 4: BEV vs HybridEV registrations (stacked bars).

This transition is further reinforced in Figure 5, which depicts BEV share as a percentage of total EV registrations. BEVs rose quickly in popularity during 2019 and have gained steady rise in popularity post 2020. BEVs now constitute more than 20% of all EV's registered in 2024, indicating a clear pivot away from transitional hybrid technologies toward full electrification.

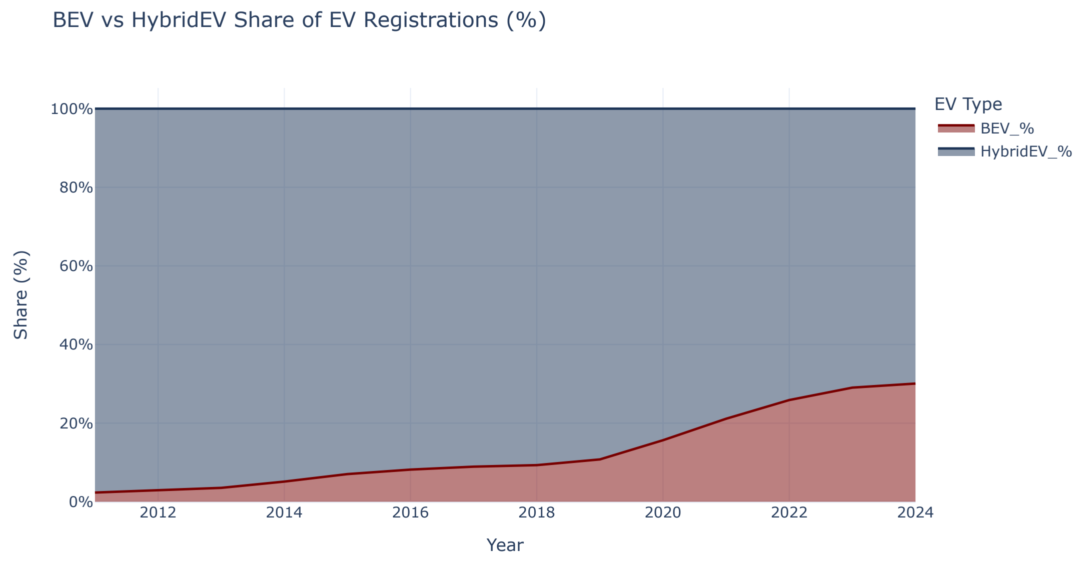

Figure 5: BEV vs HybridEV share of EV registrations (%).

The relative dominance of BEVs is further captured through the BEV to hybrid ratio in Figure 6. The ratio is etching closer to 0.45 as of 2024 and the market assumes it to continues to rise steeply, confirming a structural tipping point in consumer adoption behaviour consistent with technology diffusion theory ([6]).

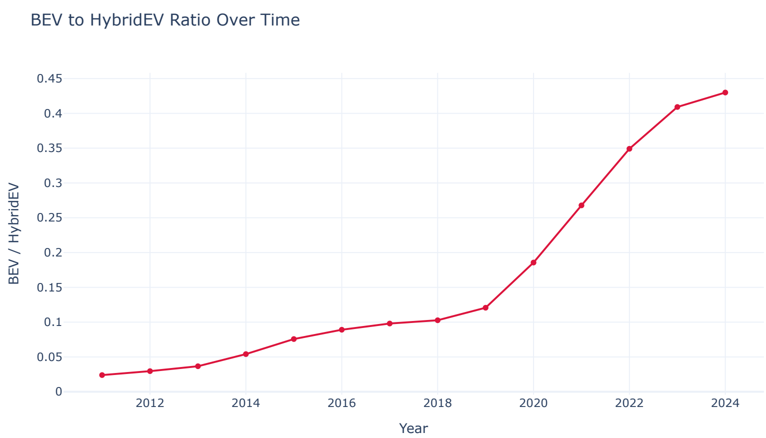

Figure 6: BEV-to-Hybrid ratio over time.

4.2 Country of Origin and Chinese Brand Composition

The composition of vehicle registrations by manufacturer origin highlights the growing diversification of the UK market. Figure 7 illustrates this evolution, revealing the gradual erosion of traditional dominance and the concurrent rise of lesser known brands from emerging markets since 2018. German, Japanese, and Korean manufacturers remain key players; however, their market shares are increasingly challenged by cost competitive Chinese and other new entrants.

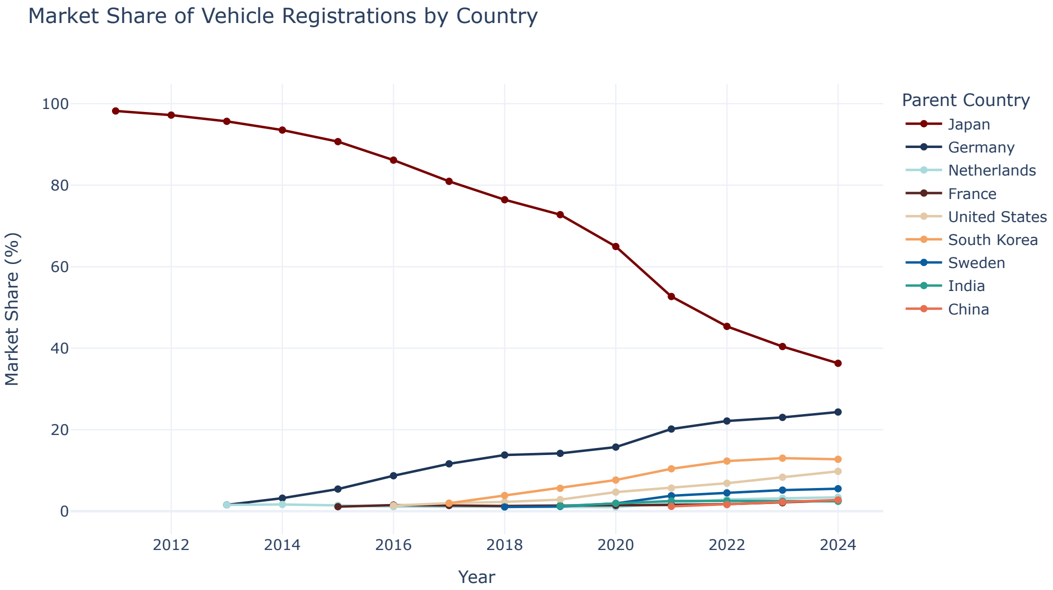

Figure 7: Market share of vehicle registrations by country (2000 – 2025).

By 2024, the top contributors to the UK automotive market remain Germany, Japan, and the United Kingdom, but Figure 8 reveals that China now ranks among the fastest growing sources of new registrations, particularly in the BEV category. This mirrors similar dynamics observed in continental Europe, where BYD and SAIC (MG) have achieved rapid penetration through aggressive pricing and dealership expansion.

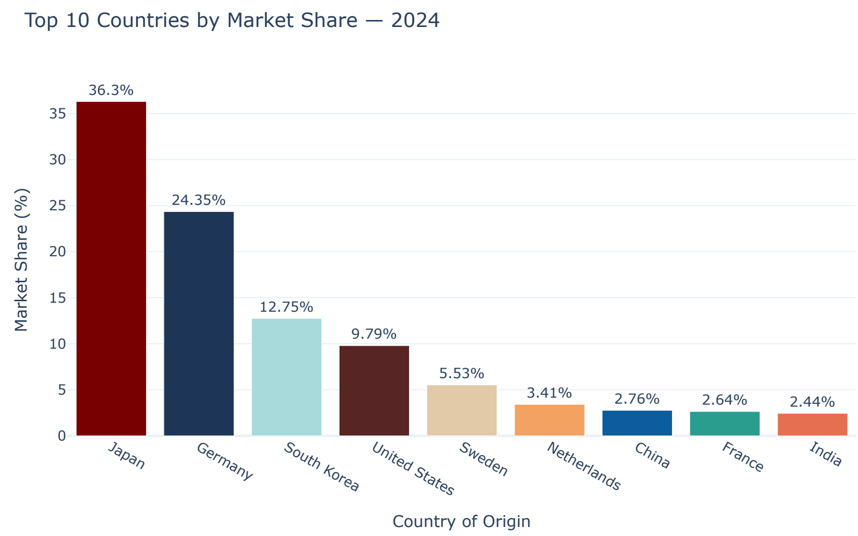

Figure 8: Top countries by market share in 2024.

Figure 9 disaggregates the Chinese market segment, illustrating the relative contributions of **BYD**, **SAIC (MG)**, **Great Wall (ORA)**, and emerging brands such as **Chery** and **XPeng**. BYDs growth trajectory has been particularly pronounced since 2023, positioning it as a leading foreign entrant in the UK's BEV segment.

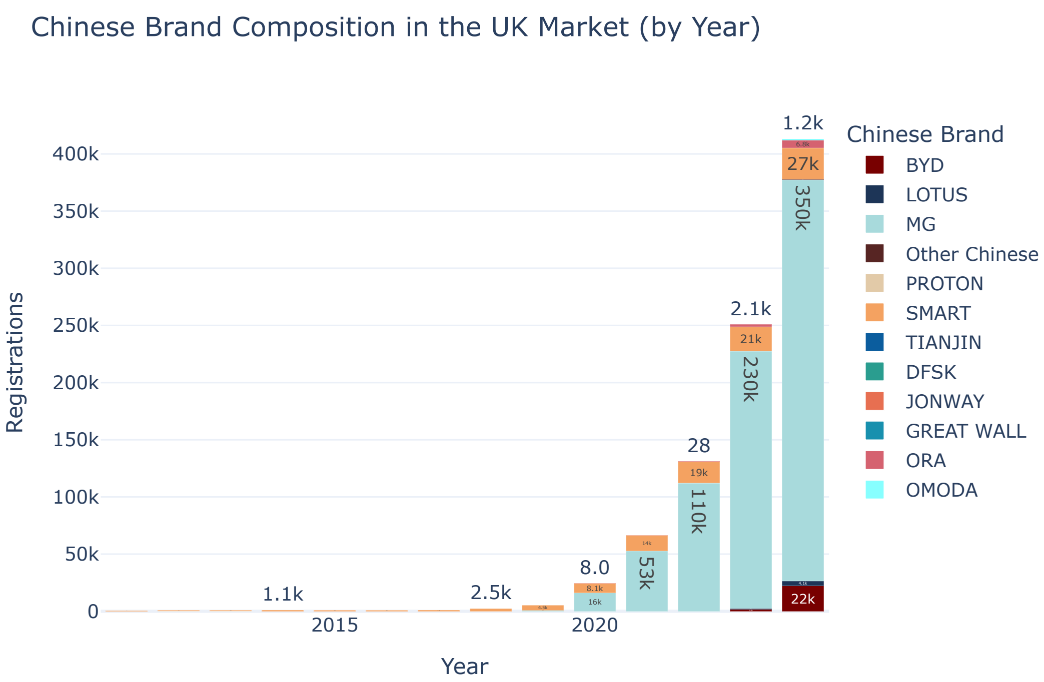

Figure 9: Chinese brand composition across years (stacked).

4.3 Make-Level Highlights

Figure 10 presents the ten largest manufacturers by cumulative vehicle registrations in the United Kingdom between 2010 and 2024. While the market is undergoing a structural shift toward electrification, legacy manufacturers continue to anchor demand and consumer confidence. The **Toyota Group** comprising Toyota and Lexus dominates the rankings with a combined market share of approximately 49.1%, underscoring the enduring influence of hybrid technology and the group's early strategic positioning around energy efficient powertrains. Their sustained leadership demonstrates how established manufacturers can retain market relevance amid the transition to electric mobility.

Other major participants such as **BMW**, **Kia**, **Hyundai**, and **Nissan** maintain strong representation, reflecting diversified model portfolios and resilient production networks. In contrast, the entry of **MG** *now under Chinese ownership* within the top tier marks a significant inflection point in the market's composition, highlighting the expanding integration of Chinese capital and manufacturing capability into the UK automotive ecosystem. Meanwhile, **Tesla**'s rapid ascent, securing approximately 6.1% of cumulative registrations despite being a relatively new entrant, exemplifies how strong branding, advanced battery technology, and software driven design can accelerate market penetration even against long-established incumbents.

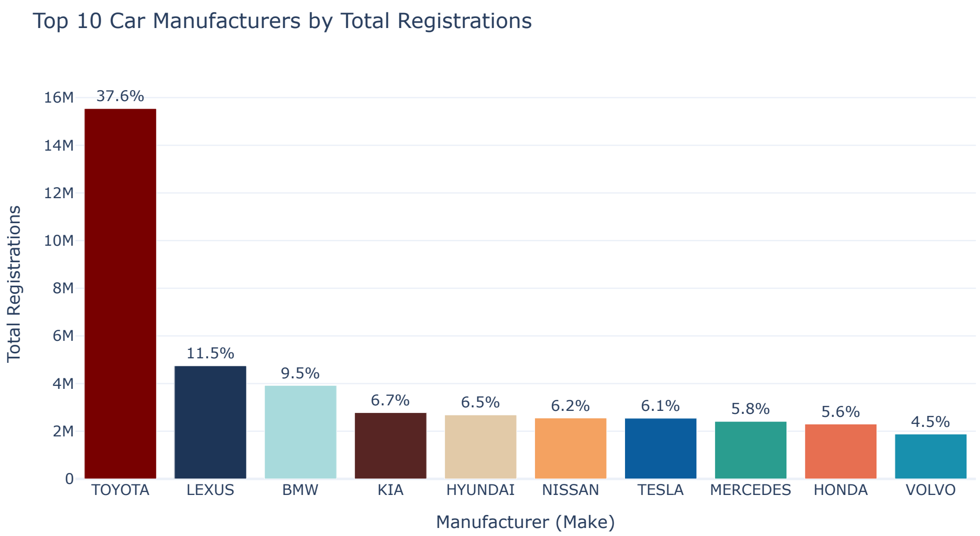

Figure 10: Top 10 car manufacturers by total registrations in the UK, 2010-2024.

Collectively, these findings highlight a decisive reconfiguration of the UK automotive landscape. Electrification has moved from the periphery to the core of market growth, and the competitive frontier now includes both legacy giants and technologically agile entrants. The growing prominence of Chinese linked and software oriented firms illustrates a deepening convergence between industrial capacity, technological innovation, and strategic brand positioning in determining long-term market leadership.

5 China vs Germany: Levels and Shares

5.1 A Structural Shift in Automotive Leadership

Figure 11 contrasts the evolution of vehicle registrations from Chinese and German automakers within the UK market. Since 2020, Chinese manufacturers have experienced exponential growth in registrations, while German brands have exhibited stagnation. This divergence signifies not merely a cyclical demand shift, but a structural transformation in global automotive competition.

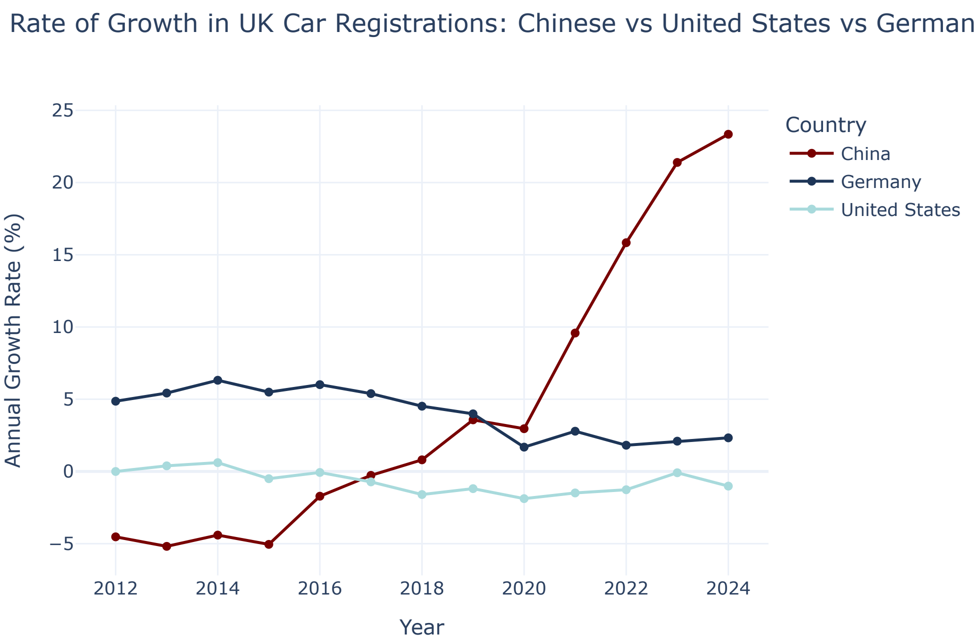

Figure 11: Registrations: China vs Germany (levels over time).

5.2 European Market: Parallel Trends and Policy Impacts

Across Europe, Chinese automakers have been expanding their footprint at an accelerating rate. By May 2025, Chinese brands captured approximately 5.9% of all new passenger car registrations across 28 European markets more than double their 2.9% share a year earlier ([3]). Though following the European Commission's 2024-2025 anti subsidy investigation into Chinese EVs, manufacturers such as BYD and Geely shifted focus toward hybrid models and explored local assembly to mitigate tariff exposure ([12]).

While the EU considers tariffs and subsidy countermeasures to protect its domestic industry, the UK has refrained from imposing equivalent import restrictions, making it an attractive entry point for Chinese OEMs seeking western market access. This policy divergence partly explains why the UK leads Europe in Chinese EV market share penetration. At the same time, German automakers' home markets remain relatively sheltered by brand loyalty, existing dealership infrastructure, and national industrial policy support. Consequently, the UK has become the most contested ground for this new competitive axis.

5.3 Tesla as Catalyst and the New Economic Paradigm

Underlying this upheaval is a redefinition of what constitutes competitive advantage in the automotive industry a paradigm Tesla has taken advantage of. Historically, automotive success derived from scale manufacturing, mechanical reliability, and brand prestige. In the EV era, leadership hinges instead on digital integration, data accumulation, and ecosystem design. Tesla's evolution from startup to global leader has reshaped the strategic logic of the sector in at least four dimensions.

1. Barriers to Entry Reimagined. By the late 2010s, Tesla had achieved economies of scale in EV production years ahead of its rivals, leveraging gigafactory level output to reduce per unit costs and accelerate learning in powertrain integration. Legacy automakers, meanwhile, were constrained by sunk investments in internal combustion engine (ICE) assets plants, tooling, and R&D. These "stranded assets" raised their breakeven thresholds for electrification, forcing difficult capital allocation choices ([5]). Tesla's first mover advantage inverted traditional barriers to entry: what were once protected incumbents *(scale and physical capital)* became liabilities in a technological transition.

2. Market Asymmetry through Data Accumulation. Tesla's fleet generated data estimated at 50 billion miles of driving in 2024 has become a compounding informational asset ([1]). Each car acts as a sensor, feeding algorithmic refinements to software such as Autopilot and battery optimisation systems. This self reinforcing data loop creates network effects unfamiliar to traditional automakers, whose customer relationships historically ended at the dealership. German OEMs are now investing heavily in software defined architectures and digital feedback loops to narrow this gap, yet Tesla's head start remains substantial.

3. Policy Arbitrage and Regulatory Credit Monetisation. Tesla also demonstrated how regulatory frameworks can be transformed into profit centres. Whereas legacy manufacturers view emission mandates as compliance costs, Tesla turned surplus emission credits into a lucrative revenue stream earning nearly $1.8 billion in 2023 alone ([11]).

4. Transition from Hardware to Software. Finally, Tesla's integration of over the air updates and user interface design signalled a deeper transformation. According to BCG projections, software and electronics will constitute up to 20% of vehicle value by 2030, creating over $650 billion in new industry value ([8]). German manufacturers have acknowledged this reality, accelerating efforts such as **Volkswagen's Cariad software division** and **Mercedes' MB.OS initiative**.

5.4 Ownership and National Identity in a Globalised Industry

This analysis classifies brands by ultimate ownership rather than legacy nationality. Thus, MG and Polestar (both Chinese owned) are counted as Chinese, while Mini (UK origin but BMW owned) counts as German. Such classifications reveal how economic value flows follow corporate rather than cultural geography. For policymakers, this distinction is crucial: the perceived nationality of a vehicle may differ from where profits and technology returns accrue. For instance, Volvo's success strengthens its Chinese parent Geely, while Tesla's Giga Berlin output still benefits a US headquartered firm.

6 Concentration and Competition

6.1 Market Concentration: Herfindahl - Hirschman Index (HHI)

To evaluate competition within the UK automotive sector, the **Herfindahl Hirschman Index** (HHI) was used. The HHI measures how evenly market shares are distributed among manufacturers, providing a concise indicator of market structure and dominance ([4]).
The index ranges from 0 **(perfect competition) to** 1 **(monopoly).** .

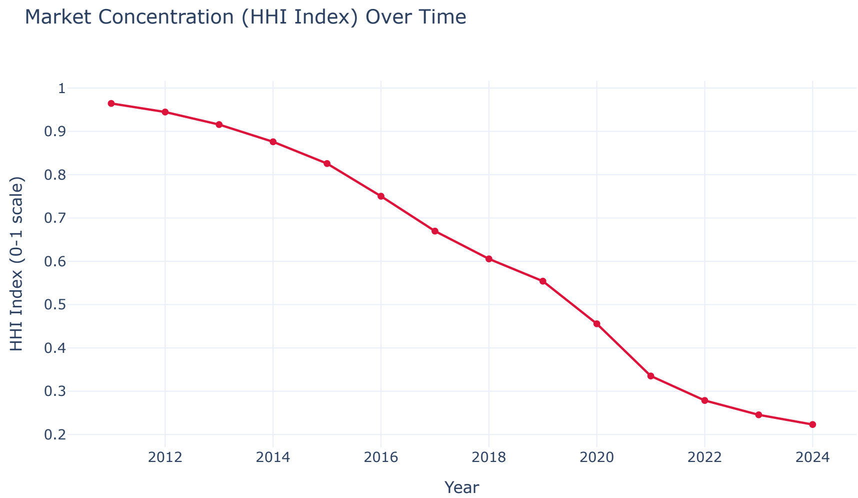

Figure 12: Market concentration (HHI index) over time.

Figure 12 shows that early in the electric vehicle (EV) era, a few incumbents dominated due to high entry barriers resulting in elevated HHI values. As Chinese automakers expanded globally, the index declined. Their vertically integrated production, cost advantages, and government backed scaling increased competition. Simultaneously, established **Original Equipment Manufacturers (OEMs)** in Europe and Korea accelerated EV production, diversified model lines, and launched affordable sub brands to defend market share ([10]). The resulting downward trend in HHI reflects the transition from an oligopolistic to a more competitive and fragmented market structure, driven jointly by Chinese entry and Western adaptation.

7 Portfolio and Frontier Analysis: Global Automaker Stocks

7.1 Cross Country Stock Performance

Figure 13 illustrates the five year cumulative stock performance of automakers across the ten best performing countries, constructed as equal weight indices rebased to 100. The chart reveals substantial divergence in performance across geographies. **India** and the **United States** display the strongest upward trajectories, with index levels exceeding 400 and 300, respectively. India's surge is underpinned by rapid electric vehicle (EV) adoption, domestic policy incentives, and export oriented production growth. The US performance reflects investor confidence in high growth innovators such as Tesla, Rivian, and EV related supply chain firms.

China follows closely, supported by the global success of brands such as BYD, Geely, and SAIC, whose strong export pipelines and vertical integration into batteries have attracted heavy capital inflows. These trends jointly signal a structural shift in investor sentiment toward Asia centric automakers positioned at the frontier of EV and battery technologies.

In contrast, mature markets including **Japan**, **Germany**, and **South Korea** exhibit slower, steadier growth. Their trajectories suggest earnings stability but lower beta exposure to EV driven growth themes. European producers particularly in **France**, **Italy**, and **Sweden** remain constrained by higher regulatory costs, limited charging infrastructure rollout, and softer regional demand. This performance dispersion marks a global realignment of capital flows from legacy producers toward agile, innovation led manufacturers.

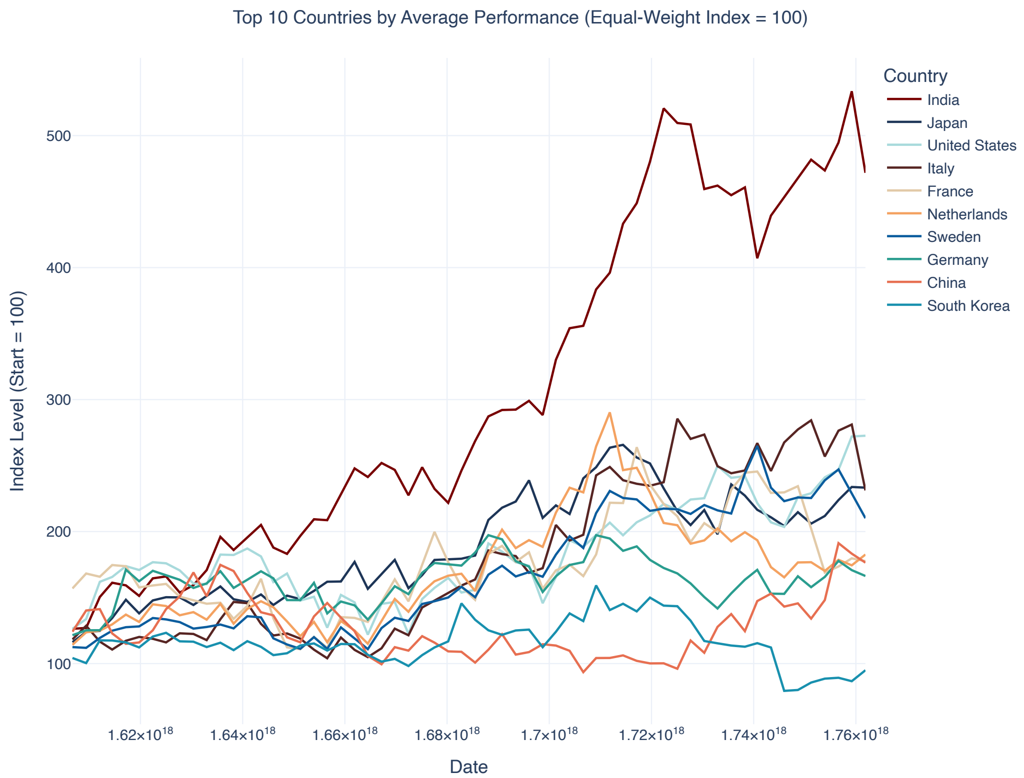

Figure 13: Top 10 countries by average stock performance over the past five years (equal weight index, rebased to 100).

Complementing the return trends, Figure 14 depicts the correlation structure among equal weight country portfolios. A clear clustering emerges: high correlations between **Germany**, the **Netherlands**, and **Sweden** ($\rho > 0.6$) point to an integrated European equity bloc. Conversely, strong alignment between **China** and **India** ($\rho \approx 0.66$) suggests shared exposure to EV manufacturing cycles and raw material markets such as lithium and nickel. Weaker correlations e.g. between **South Korea** and **France** ($\rho < 0.3$) reflect distinct policy frameworks and industrial compositions. Overall, two semi independent clusters dominate: an Asia - US high growth group and a stable but slower European cluster. The pattern indicates that cross regional diversification within automotive equities can meaningfully reduce portfolio risk.

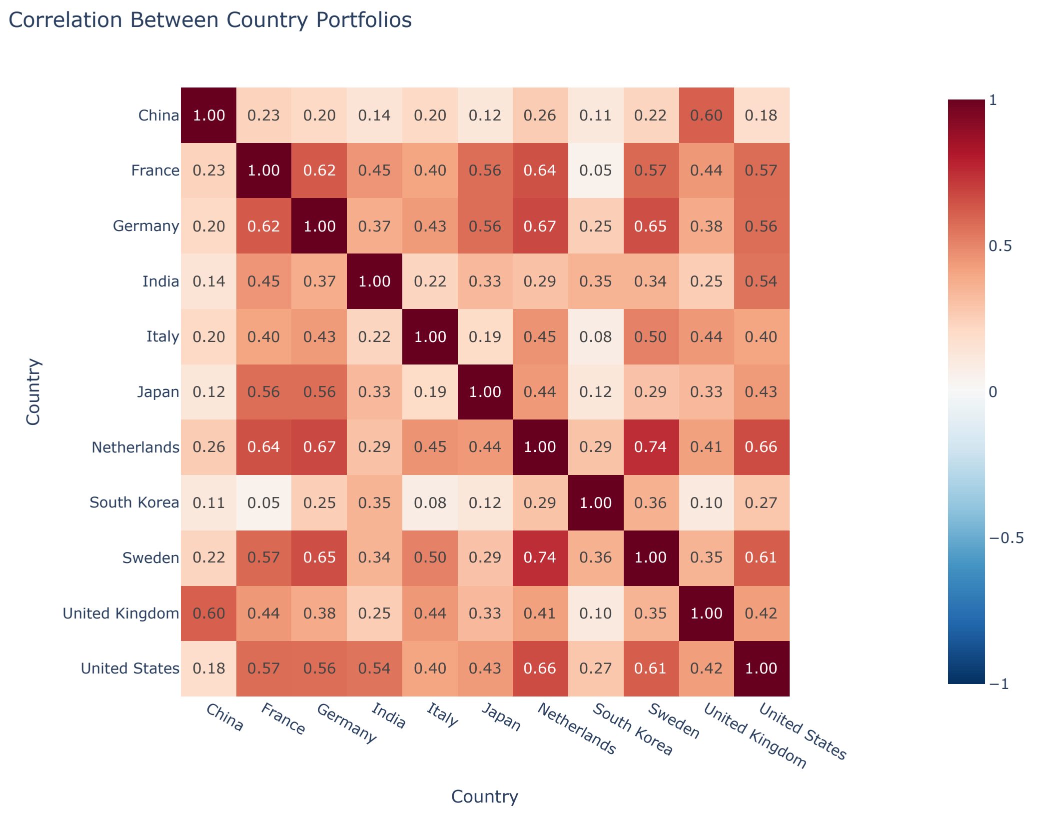

Figure 14: Correlation between country portfolios (equal-weight).

7.2 EV Registrations vs Equity Returns: Country-Level Correlation

We compare the growth of UK EV registrations by country of origin with annual equity returns of equal-weighted automaker country portfolios. Using 2020-2024 overlapping observations (five years per country), correlations are generally modest in magnitude and statistically weak due to the short sample. Point estimates are positive for China ($r \approx 0.61$) and Germany ($r \approx 0.52$), near-zero for India and South Korea, and negative for France ($r \approx -0.73$). These results should be interpreted as exploratory rather than causal.

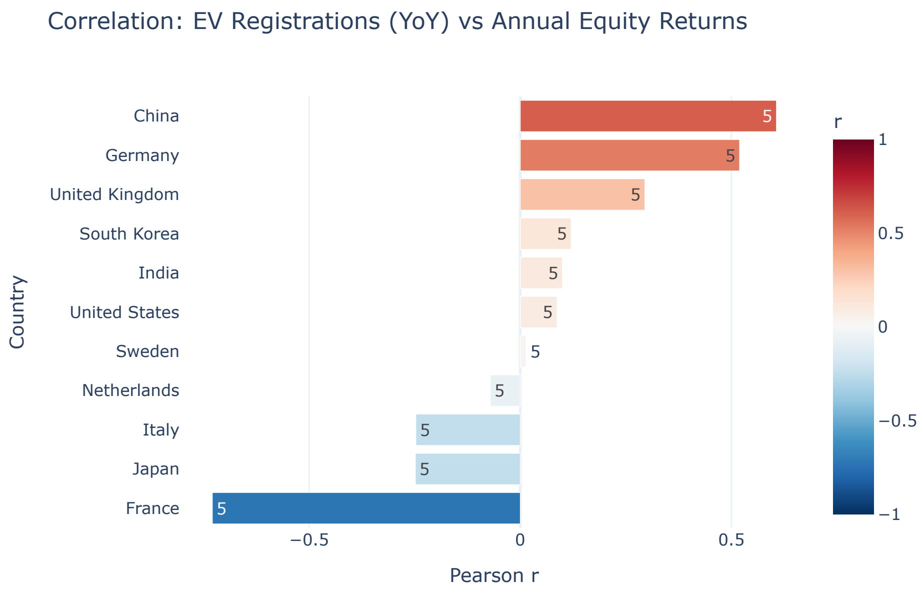

Figure 15: Correlation between EV registration growth (YoY) and annual equity returns, by country (2020 – 2024).

7.3 Diagnostics and Trend Structure

To assess linear fit, Figure 16 plots country-year points with an **Ordinary Least Squares** (OLS) trend.

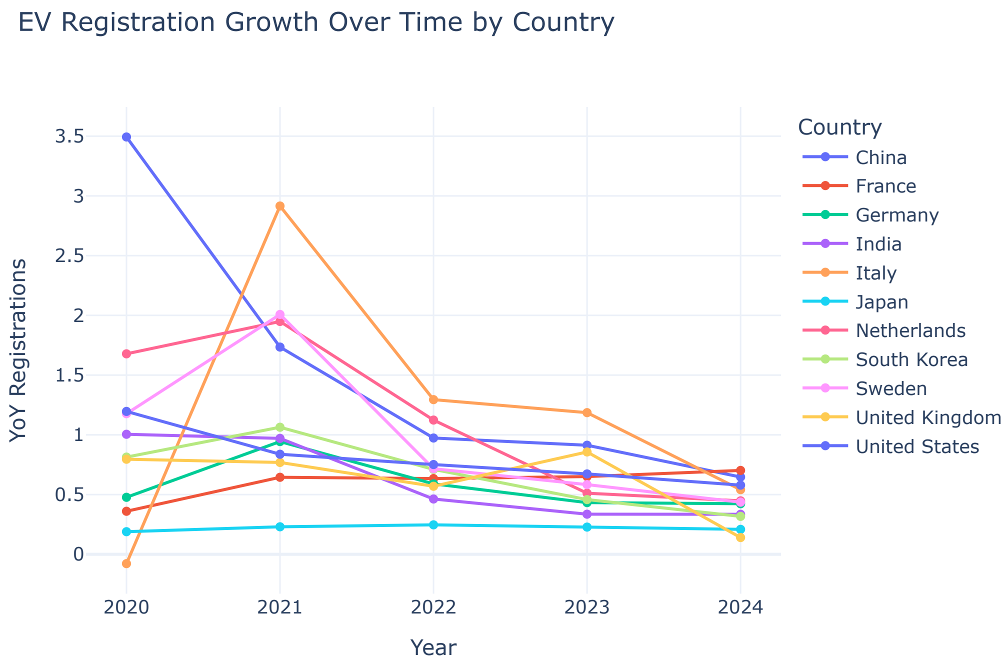

Figure 16: Registrations growth (YoY) vs annual equity returns, coloured by country, with OLS fit (2020 – 2024).

Interpretation and limitations. Correlations capture co-movement, not causality; they are sensitive to sample length, regime shifts (policy, tariffs, supply chains), and composition (brand coverage per country). With $n = 5$ per series, p-values are large and signs can flip with an extra year of data. Quarterly alignment would increase power and allow lead lag testing (e.g., registrations leading returns by one to two quarters).

7.4 Global Efficient Frontier Construction

To extend the analysis from market performance to portfolio efficiency, we built an international equity universe of publicly listed automakers. Monthly total return data were mapped to each firm's parent country and annualised. Figure 17 plots the resulting global efficient frontier, estimated using mean-variance optimisation under both minimum-variance and maximum-Sharpe configurations. The curve demonstrates the classic trade off between expected return and volatility, with the tangency (optimal) portfolio lying well above the global average illustrating the strong reward to risk potential within select automaker equities.

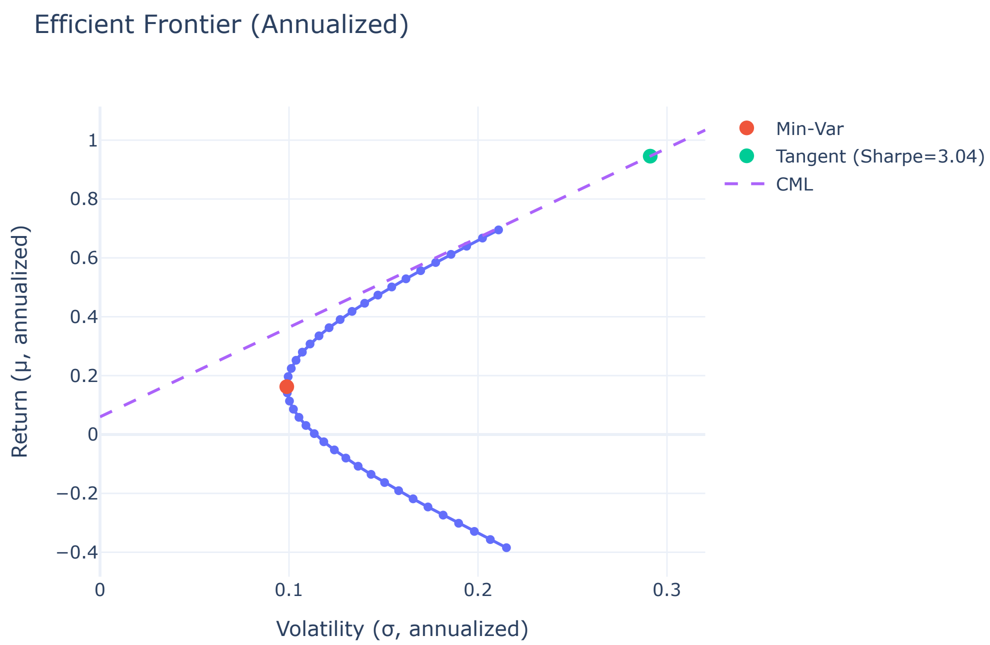

Figure 17: Efficient frontier across country portfolios (annualised).

The slope of the capital market line (CML) implies a Sharpe ratio above 3, confirming that an actively optimised automaker basket can substantially outperform passive benchmarks on a risk adjusted basis. This is largely attributed to the high growth of Indian and Chinese equities relative to their moderate correlations with Western incumbents.

7.5 Minimum-Variance Portfolio

The **minimum-variance** (MinVar) solution yields the risk-minimising combination of automaker equities given observed covariance structures. Table 4 presents the resulting weights, which tilt toward firms with stable cash flows and diversified product lines. **Royal Enfield (Eicher Motors)**, **Ferrari**, **Maxus (SAIC)**, and **DAF (PACCAR)** dominate due to their low return volatility and consistent profitability. The portfolio's composition illustrates investor preference for established producers over high growth entrants when minimising variance.

Ticker	Brand	Country	Weight
EICHERMOT.NS	Royal Enfield	India	0.248
RACE	Ferrari	Italy	0.244
600104.SS	Maxus	China	0.223
PCAR	DAF	United States	0.201
VOW3.DE	Audi	Germany	0.183
7267.T	Honda	Japan	0.174
1211.HK	BYD	China	0.157
7211.T	Mitsubishi	Japan	0.141
VOLV-B.ST	Renault Trucks	Sweden	0.128
7270.T	Subaru	Japan	0.114
MBG.DE	Daimler	Germany	0.078
CAT	Caterpillar	United States	0.062
005380.KS	Genesis	South Korea	0.062
HY	Hyster	United States	0.034
0489.HK	DFSK	China	0.016
7272.T	Yamaha	Japan	0.014
AML.L	Aston Martin	United Kingdom	0.007
7203.T	Lexus	Japan	0.005
M&M.NS	Mahindra	India	0.001
003620.KS	KGM	South Korea	0.001

Table 4: Minimum-Variance Portfolio composition by automaker and country of domicile.

At a regional level, Japan (30 %), Sweden (19 %), and South Korea (17 %) contribute most to total weight, followed by India (14 %) and Italy (11 %). These economies combine robust export capacity with conservative leverage profiles. China's modest 8.5 % share reflects the sector's growth promise tempered by higher equity volatility. Overall, the MinVar portfolio acts as a defensive allocation stable, globally diversified, and less exposed to EV-valuation swings.

7.6 Tangency (Maximum-Sharpe) Portfolio

In contrast, the tangency portfolio identifies the most efficient risk-return mix at the current risk-free rate of 4.6 %. Its composition, shown in Table 5, is markedly growth oriented. Weights concentrate in **Honda**, **Volvo Trucks**, **Kia**, and **Ferrari**, complemented by high beta innovators such as **BYD** and **Tesla**. Traditional industrials like Caterpillar also appear prominently due to their cyclical leverage to global infrastructure spending.

Ticker	Brand	Country	Weight
7267.T	Honda	Japan	0.548
VOLV-B.ST	Renault Trucks	Sweden	0.540
000270.KS	Kia	South Korea	0.513
CAT	Caterpillar	United States	0.483
RACE	Ferrari	Italy	0.466
1211.HK	BYD	China	0.251
7211.T	Mitsubishi	Japan	0.242
0489.HK	DFSK	China	0.184
7272.T	Yamaha	Japan	0.149
TSLA	Tesla	United States	0.145
EICHERMOT.NS	Royal Enfield	India	0.113
M&M.NS	Mahindra	India	0.091
RNO.PA	Renault	France	0.079
601633.SS	Great Wall	China	0.072
7269.T	Suzuki	Japan	0.068
7270.T	Subaru	Japan	0.040
7203.T	Lexus	Japan	-0.007
6301.T	Komatsu	Japan	-0.024
TATAMOTORS.NS	Jaguar	India	-0.033
HY	Hyster	United States	-0.053

Table 5: Tangency (Maximum-Sharpe) Portfolio composition by automaker and country of domicile.

The optimisation yields an **annualised return of 74.5 %**, volatility of **22.4 %**, and a Sharpe ratio of **3.20**. Negative weights for firms like Komatsu and Hyster indicate short exposures to cyclical manufacturing, enhancing overall risk efficiency by offsetting volatility in growth-driven names.

7.7 Country-Level Interpretation

Table 6 summarises the geographic composition of both portfolios. The Minimum-Variance allocation is dominated by **Japan** (30%), **South Korea** (18%), and **Sweden** (16%), reflecting their globally diversified, export-driven automaker bases and historically stable balance sheets. **India** (14%) and **Italy** (11%) also feature prominently, benefiting from strong domestic demand and luxury-brand resilience (Ferrari, Mahindra). **China's** 10% contribution indicates rising but still volatile EV-sector exposure.

Country	MinVar (%)	Tangency (%)
Japan	30.24	18.06
South Korea	17.80	≈0.00
Sweden	16.42	0.83
India	13.91	61.34
Italy	11.49	13.36
China	10.16	6.41
France	≈0.00	≈0.00
Netherlands	≈0.00	≈0.00
United Kingdom	≈0.00	≈0.00
Germany	0.00	0.00
United States	0.00	0.00

Table 6: Country level portfolio allocations (% of total weight) for Minimum-Variance and Tangency configurations.

By contrast, the Tangency (Maximum-Sharpe) portfolio shows a decisive reorientation toward **India** (61%), **Japan** (18%), and **Italy** (13%), with only marginal allocations to **China** (6%) and **Sweden** (1%). This composition mirrors investor preference for growth and innovation hubs particularly India's accelerating EV equity performance while minimising exposure to slower-growth developed markets. The near zero weights for the United States, Germany, and France further underscore the diminishing global dominance of traditional Western automakers in optimal risk-return configurations.

8 Conclusion

This study demonstrates that the diffusion of battery electric vehicles has triggered a genuine structural reconfiguration of the UK automotive market. Using registration data from 2010 to 2025, the analysis shows that BEVs, once peripheral, have become a central growth engine, while market concentration, measured by the HHI, has declined sharply. The rise of Chinese-owned brands such as BYD and MG is both a symptom and a catalyst of this transformation, signalling a redistribution of technological and economic leadership toward East Asia.

The equity portfolio evidence reinforces this shift. Mean-variance optimisation of global automaker returns positions India, China, and Japan on the efficient frontier's high-growth edge, whereas Germany and the United Kingdom now occupy its low-volatility periphery. In investment terms, this indicates that the global automotive sector's risk-reward balance has rotated eastward toward producers that combine manufacturing agility, supply-chain control, and software capability.

Several caveats remain. The brand ownership classification may overstate Chinese exposure for firms with European design and assembly footprints. The dataset aggregates vehicle models, masking intra-brand heterogeneity, and policy uncertainty around tariffs and ZEV targets could alter diffusion trajectories. Nevertheless, the direction of change appears robust: electrification has lowered barriers to entry and intensified competition in ways unseen since the early 1980s liberalisation of the European car market.

Policy implications. Declining concentration and falling prices enhance consumer welfare but heighten transitional risks for domestic producers. To sustain competitiveness, UK policymakers should establish a stable multi-year ZEV and tariff framework, expand investment in local battery manufacturing, and incentivise software-engineering capability within automotive supply chains. For incumbents, strategic focus must shift from incremental electrification toward full digital integration autonomy, connectivity, and over-the-air innovation where the new sources of value creation lie.

Next steps. Three extensions would strengthen the evidence:
(i) dual classification by ownership and assembly
(ii) re-estimating frontiers under tariff and rate scenarios
(iii) integrating vehicle-level cost data to capture heterogeneity in BEV diffusion patterns.

Bottom line. Across market structure and equity performance, the evidence points to a genuine regime shift favouring Asian EV leaders and software-centric manufacturers. Yet the very dynamics that drive this change policy fluidity, learning curves, and software externalities also make it unstable. The frontier estimated here is not an endpoint but a moving constraint that will rotate with policy, cost, and code. The analytical task is less to predict equilibrium than to build adaptability: clear rules, interoperable data, and resilient capital allocation. If the falsification tests fail, we revise; if not, the burden shifts incumbents must prove they can catch up.

References

[1] Road to Autonomy. *Tesla's fleet data advantage and AI feedback loops*. 2024.

[2] Dennis W. Carlton and Jeffrey M. Perloff. *Modern Industrial Organization*. 5th. Pearson Education, 2015.

[3] JATO Dynamics. *Chinese car brands continue their ascent across Europe*. 2025. URL: https://www.jato.com.

[4] Eurostat. *Glossary: Herfindahl–Hirschman Index (HHI)*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Herfindahl_Hirschman_Index_(HHI). Accessed October 2025.

[5] Evannex. *German automakers face stranded ICE assets in transition*. 2024.

[6] José A. García-Avilés. 'Diffusion of Innovation'. In: *The International Encyclopedia of Media Psychology*. John Wiley & Sons, Ltd", 2020, pp. 1–8. ISBN: 9781119011071. DOI: https://doi.org/10.1002/9781119011071.iemp0137. eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781119011071.iemp0137. URL: https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119011071.iemp0137.

[7] GlobalData. *China OEMs by Revenue — Top Companies by Sector*. https://www.globaldata.com/companies/top-companies-by-sector/automotive/china-oems-by-revenue/. Accessed: 2025-10-17.

[8] Boston Consulting Group. *Software to represent 20% of vehicle value by 2030*. 2025.

[9] Harry Markowitz. *Portfolio Selection*. https://www.math.hkust.edu.hk/~maykwok/courses/ma362/07F/markowitz_JF.pdf. 1952.

[10] McKinsey & Company. *China's Electric-Vehicle Market: Powering Ahead*. Tech. rep. Accessed October 2025. McKinsey Automotive & Assembly Insight Report, 2024. URL: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/chinas-electric-vehicle-market-powering-ahead.

[11] CBT News. *Tesla earns $1.8 billion from regulatory credit sales*. 2023.

[12] Reuters. *BYD expands European footprint with Hungarian factory*. 2025.