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Working Paper

Corporate venture capital in the automotive sector

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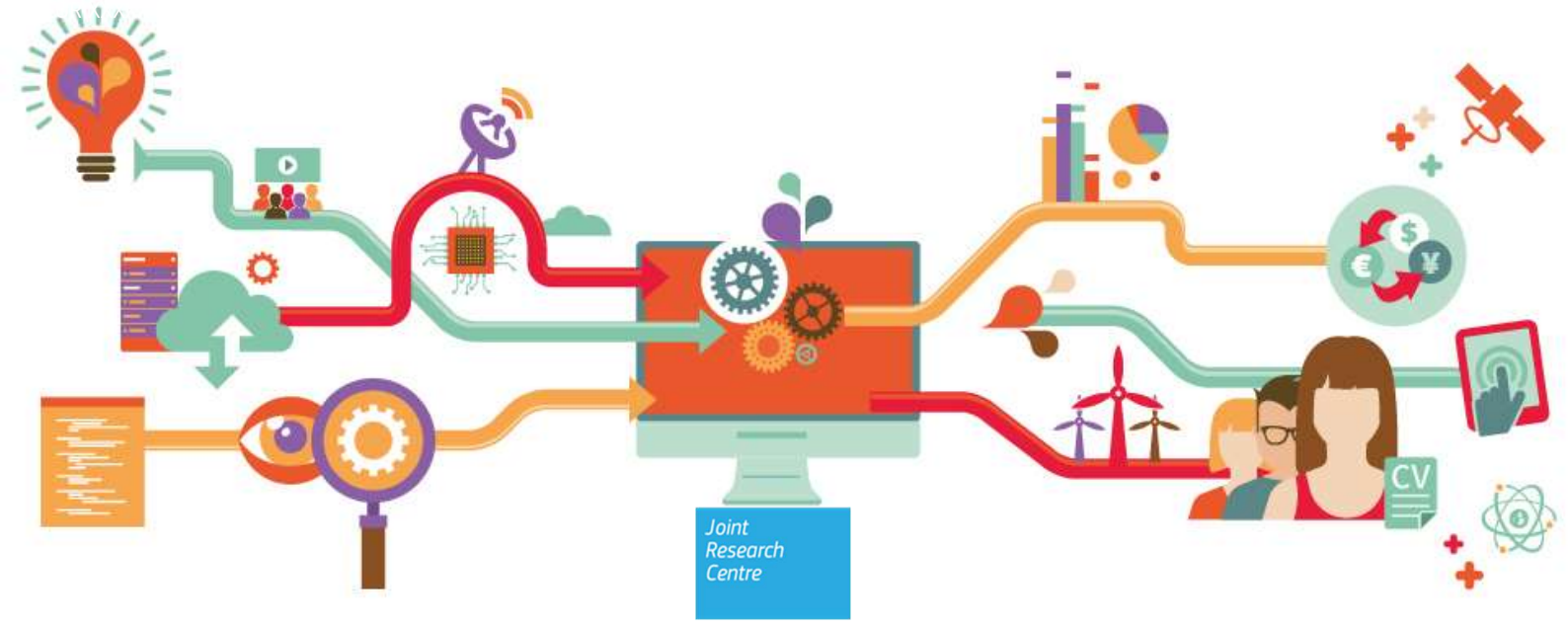
2024



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Contents

Abstract

The ongoing transformation of the automotive sector is in part driven by factors such as the unrelenting onslaught of electric/hybrid powertrain technologies, in-vehicle and networked software applications, rising demand for electric vehicles, and the emergence of new entrants like Tesla and others notably in China. The response of automotive firms to these challenges includes, inter alia, Open Innovation (OI) tools and strategies of which Corporate Venture Capital (CVC) is one element. CVC investments by large automotive companies are globally spread, but there is a clear concentration of these investments in the US, particularly in California. The vast majority of CVC investments in startups are made in conjunction with other co-investors, reflecting the high-risk nature of the innovative technologies being developed. Newcomers to the automotive industry, such as Tesla and BYD, are primarily beneficiaries of venture capital financing, including corporate VC, rather than themselves engaging in venture financing. Despite a drop in CVC in 2023, the rising trend in automotive CVC may return over the medium to long term, driven by increasing startup activity in automotive-relevant areas.

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Executive summary

The automotive sector is undergoing a significant transformation driven by a variety of factors. These include the competition of different electric/hybrid powertrain technologies to displace the internal combustion engine, new software applications, public-policy driven demand for electric vehicles, and the emergence of new entrants such as Tesla. This transformation poses a threat to incumbent firms dominated by internal combustion engines, and has high socio-economic and political significance, particularly in the EU.

In response to these challenges, automotive firms are turning to Open Innovation (OI) tools and strategies. OI refers to a structured approach to firm collaboration with external partners – startups, clients, suppliers, academic and public research organisations – aimed at accelerating the discovery, development and deployment of innovation. Corporate Venture Capital (CVC) is one such tool, and involves investing in startups to access their innovative technologies and solutions. This paper combines a qualitative discussion with qualitative analysis of automotive CVC, the latter based on data for 1173 financing deals for 827 startups in which one or more of the top 25 automotive corporates [by worldwide R&D spend] participated.

CVC investments by large automotive companies are globally spread, but there is a clear concentration in the US, particularly in California. This is likely due to the presence of a large pool of innovative startups and talent in the region. For example, 49 out of 66 startups in the portfolio of BMW i Ventures are based in North America.

The vast majority of CVC investments in startups are made in conjunction with other co-investors. This is understandable given the high-risk and exploratory nature of the innovative technologies and solutions that the startups are developing. Co-investment also allows for risk sharing and the pooling of resources and expertise.

Newcomers to the automotive industry, such as Tesla and BYD, are primarily beneficiaries of venture capital financing, including corporate VC. These companies, which are mainly in the electric vehicle business, have received significant financial support from various sources. Some of these newcomers have also begun to invest in other startups, primarily through acquisitions.

Despite a drop in CVC in 2023, the rising trend in automotive CVC may return over the medium to long term. This is likely to be driven by increasing startup activity in areas relevant to the automotive industry, such as electric vehicles, autonomous driving technology, mobility services, digitalisation, green technologies, and supply chain optimisation.

Introduction

The on-going transformation of the automotive sector is driven by many factors such as: different electric/hybrid powertrain technologies competing to displace the internal combustion engine (ICE); new software applications (Teece, 2018; The Economist, 2022); public-policy driven demand for electrical vehicles (IEA, 2023); emergence of new entrants such as Tesla and other car manufacturers particularly from China; and paradigm shifts such as smart factories, connected, autonomous and shared driving (Paunov & Planes-Satorra, 2019). The resulting threat to ICE-dominated incumbent firms (Altenburg et al., 2022, Thun, 2018, has high socio-economic and therefore political significance in the EU where, in 2022, the sector accounted for 7% of employment[1], 10% of exports[2], and 32% of its private R&D investments[3].

One way in which automotive firms are responding to the technological dimensions of these challenges is through the use of Open Innovation (OI) tools and strategies. OI refers to a structured approach to firm collaboration with external partners – startups, clients, suppliers, academic and public research organisations – aimed at accelerating the discovery, development and deployment of innovation (see for example the description of Volkswagen Group's approach to OI at https://www.openinnovation-volkswagengroup.com/#). OI complements traditional approaches to innovation involving in-house R&D, patenting and IP management activity, innovation procurement, research collaborations and joint ventures.

Section 2 of this Working Paper gives a snapshot[4] of startup orientated OI tools used by automotive firms focusing particularly on Corporate Venture Capital (CVC)[5]. It describes overall tendencies, citing examples of CVC investments by large automotive companies in the EU, US, China, Japan and the rest of the world (ROW). This mostly qualitative overview section is followed in Section 3 by a quantitative analysis of CVC financing of innovative startups from 2010 to 2023 by 25 automotive companies consisting of the top five R&D investors headquartered in, respectively, the EU, US, China, Japan and ROW.[6] The quantitative analysis is based on data on VC deals extracted from Dealroom in which at least one of these 25 companies or a subsidiary thereof is among the named investors. The data sample contains information on 1173 financing deals for 827 startups in which one or more of the 25 automotive corporates participated.

[1] 13 million jobs (https://www.acea.auto/figure/employment-in-eu-automotive-sector/)
[2] https://www.worldstopexports.com/european-unions-top-10-exports/
[3] Own calculation based on Scoreboard Panel for 2021.
[4] A comprehensive overview is not possible as corporates frequently adjust, terminate or start new activities aimed at such startups and much CVC activity is not publicly disclosed.
[5] i.e. equity financing and nurturing of startups by automotive OEMs or suppliers either by dedicated corporate VC branches or by fully or partly owned subsidiaries set up to manage such funds. N.B. included in this is CVC support to automotive startups by newcomers such as Tesla, Rivian or Lucid Motors in the US, Byd, Nio or Xpeng in China; however, not covered is CVC by corporates which are not primarily automotive firms – Dealroom data shows that there is a lot of such CVC coming from outside the industry - this is in keeping with the big transformations the industry is undergoing and the blurring of its boundaries.
6 according to the 2023 edition of the industrial R&D Scoreboard https://iri.jrc.ec.europa.eu/

Open Innovation tools and Corporate Venture Capital

A series of reports on Open Innovation (OI) in 100 global innovation leaders by 'Mind the Bridge'[7], lists six types of startup-orientated OI approaches. Two approaches involve acquiring equity in the startup (CVC, M&A), while the other four do not necessarily (Venture Client, Innovation Labs [including accelerators and incubators], Intrapreneurship, Outposts). CVC and Venture Client were reported in Mind the Bridge's Open Innovation Outlook 2023 report to be the dominant forms[8] of OI, though in its Outlook 2024, CVC is listed in fourth place behind Venture Client, Intrapreneurship and Outpost, possibly reflecting the overall shrinkage of VC in 2023.

Automotive-relevant observations in Mind the Bridge's Dec 2022 "Evolve or be Extinct" report[9] include:

1. Outposts: Most innovation leaders have a structured presence in Silicon Valley and Israel (e.g. a CVC office, innovation lab, …) sometimes coupled with other activities – Bosch has both a CVC office and an R&D centre in Silicon Valley;
2. Innovation Lab examples: 1) Honda Xcelerator with presences in North America, Europe, Israel, Japan & southeast Asia, focuses on investment and strategic partnerships; 2) 1886Ventures, a so-called 'venture builder' or 'startup studio' is a now non-dependant spin-out of Mercedes-Benz.
3. Venture Client: In this approach, pioneered by BMW Startup Garage, no equity is taken but the company positions itself as lead client for the startups. Indeed, many if not all innovation leaders have Venture Client units: For example, Open Bosch was launched in 2018 to enhance Bosch's CVC activity. Volvo Group's[10] CampX incubator programme works with about 30 early stage deeptech startups not yet ripe for investment. Similar to Jaguar Land Rover's collaboration with Plug and Play (the world's largest startup accelerator), CampX permits Volvo to work with many more early stage deeptech startups than its CVC arm – Volvo Group Venture Capital which makes 3 to 5 VC deals per year of between $1-10 million.

2.1 Automotive CVC – a rising trend?

A 2017 paper entitled "The limited interest of carmakers in corporate venture capital: insights from a mature industry" (Flamand & Frigant, 2017)[11] found a relatively low level of CVC in the automotive sector. In the meantime, this has changed. Corporate venturing is commonly used by traditional automakers and large tier-1 automotive suppliers to stay abreast of rapid disruption by accessing external cutting-edge innovation and forging partnerships with startups. Even though CVC has seen a drop in 2023 (following an overall drop in VC investments over the past two years), the rising trend may well return over the medium to long term, driven by rapidly increasing startup activity in automotive-relevant areas:

- Electric vehicles, battery technology, charging infrastructure and all types of on-board software;
- Autonomous vehicles and self-driving technology;
- Mobility services, including ride-sharing, car-sharing, and on-demand transportation;
- Digitalization including in-car connectivity and other software-driven features;
- Green technologies and processes to reduce the automotive environmental footprint; and
- Technologies to optimize supply chains, manufacturing and logistics, and reduce production costs.

CVC activity also facilitates collaboration with startups of strategic potential for large automotive firms giving them access to non-core technologies and opportunities such as: expertise on urbanization and smart cities; global expansion via international partnerships; collaboration with tech giants like Amazon, Apple, and Google (leveraging their software and AI expertise); diversification into AI, cybersecurity; etc.

[7] see https://research.mindthebridge.com/reports
[8] 'Venture Client' is where the company takes no equity but becomes the first client for the startup
[9] https://mindthebridge.com/evolve-or-be-extinct-report-2022/
[10] Volvo Group produces trucks, buses, construction equipment & engines but does not include Volvo Cars (which has been part of Geely (China) since 2010 and runs its own CVC Volvo Cars Tech Fund since 2018)
[11] https://www.tandfonline.com/doi/full/10.1080/13691066.2017.1335959

2.2 Automotive CVC is implemented in a diversity of ways

Some automotive firms like BMW or Mercedes-Benz directly manage considerable CVC activities themselves. BMW i Ventures, based in California, operates a venture investment pool of $633 million or Mercedes-Benz Group, had a startup investment portfolio of 53 firms in Jan 2024, according to Dealroom.co.

Other Automotive companies set up CVC affiliates on which they exercise varying degrees of ownership and control. For example, Stellantis Ventures is a €300 million wholly-owned CVC fund of Stellantis[12]. Another example, GM Ventures owned by General Motors, was set up in 2010. A different example is 1886.ventures, which was created by Mercedes-Benz's innovation department in 2007 and spun out as a CVC fund in 2020. It is now owned by a holding group of companies with Mercedes-Benz retaining a minor share.

Sometimes corporate venturing activity follows the internal structure of the group by "brand" or by geographical location (e.g. VW with 12 brands has separate startup programmes in its SEAT and Skoda branches and its HQ, plus it has generic startup support entities located in Germany, Spain, the US, India, China and Japan, and a $300 million VC fund for decarbonisation startups).

At times, corporate venturing is conducted in collaboration with other organisations – e.g. with other automotive firms in the case of Alliance Ventures which is a joint CVC undertaking by Renault, Nissan, and Mitsubishi. In another, BMW Korea partners with KITA, Gyeonggi Creative Economy Innovation Center, and Future Play to find innovative startups in Korea and to promote the BMW Testbed Project and prospect for startups for BMW's Startup Garage Program. Another cooperative approach to corporate venturing is the MobilityXlab set up in Sweden in 2017. This originated in Zenuity – a joint venture between Volvo Cars and Autoliv. It has become an accelerator for startups cooperating with at least two of its partner companies - four automotive (CEVT, Magna, Polestar, Volvo Group) and two ICT (Ericsson, Zenseact). This case is described as a new kind of multi-partner strategic alliance in a June 2023 IESE Report on Corporate Venturing Squads[13].

Co-investment in start-ups is also normal practice in the sector outside of formal collaborative structures but tends to follow certain established cooperation preferences. For instance, Toyota Venture frequently co-invests with BMW and Hyundai; or Nauto, a technology company focused on AI-powered driver monitoring systems and fleet safety, received investments from both Toyota AI Ventures and BMW i Ventures. Automotive firms also participate as limited partners in independent capital funds specialized in the automotive sector. Examples include Fontinalis Partners or Maniv Mobility.

2.3 Automotive CVC investments are globally spread, but there is a clear concentration of investments in the US – notably in California

Typically, automotive CVC operations are run from offices close to the headquarters of the parent automotive company (e.g. Stuttgart, Germany -home to Mercedes-Benz and Porsche; Turin, Italy - Fiat Chrysler Automobiles; or Tokyo/Nagoya - Toyota. However, most also have offices in locations around the world close to the best talents and venture opportunities. A stark example of this is that 49 (3/4th) of a total of 66 startups in the portfolio of BMW i Ventures portfolio are in North America, with only 14 in Europe and three in Israel[14]. Volvo Group Venture Capital reports that 50% of its activity is in the US, 25% in Europe and 25% in Israel. Toyota set up its VC arm Toyota Ventures in San Francisco in 2017 investing to-date about EUR342 million[15] in 63 startups – 49 (79%) of which are in North America, four in Europe, four in Israel, two each in Australia, and one each in India and New Zealand[16]. Chinese firm SAIC has also a VC branch in Silicon Valley since 2014, called SAIC Venture Capital and it has a portfolio of 16 startups – 10 in the US, four in China and one each in Switzerland and the UK. Its portfolio is sectorally quite diversified supporting ventures in

12 Stellantis designs, manufactures, and sells 14 automobile brands: Abarth, Alfa Romeo, Chrysler, Citroën, Dodge, DS, Fiat, Jeep, Lancia, Maserati, Opel, Peugeot, Ram, and Vauxhall. Ferrari, once owned by Fiat but now public, is not included.

[13] IESE Report Open Innovation Corporate Venturing Squads: Teaming Up with Other Corporations to Better Innovate with Start-Ups June 2023

[14] Source: dealroom.co (last accessed: 02/02/2024)

[15] Including since 2021 two new funds Frontier Fund & Climate Fund of $150 million each. Source: dealroom.co (last accessed: 02/02/2024)

[16] Source: idem.

automotive, semiconductors, ICT, energy, travel industry, as well as engineering and equipment manufacturing[17].

2.5 The vast majority of CVC investments in startups are made in conjunction with other co-investors

As will be seen in the quantitative analysis below, 80% of the VC deals involving leading automotive corporations involve two or more investors with 2.4% of the deals involving 12 or more co-investors. This is arguably understandable in terms of the high-risk and exploratory nature of the innovative technologies and solutions, that the startups under scrutiny are developing, and which as a result, for corporate investors, sometimes clearly relate to core business but other times are more financial/ opportunistic. It is hard to identify patterns to the co-investment - occasionally, some of the co-investors are other automotive companies or corporates from sectors other than automotive, though more often than not they are non-corporate in origin (VC funds, private equity, angel investors, etc.).

2.6 Do newcomers to the automotive industry have CVC activities?

Newcomers to the sector such as Tesla, BYD and others – mostly in the electrical vehicle business - are or have themselves been primarily beneficiaries of venture capital financing from corporate and other private and public sources. Some of the newcomers in turn target other startups. According to Dealroom, BYD has 19 VC startup investments, though a September 2023 article[18] on BYD's CVC activities reports that many more – i.e. 74 companies - have received financial support from BYD in the past 12 years – investing € 63 million in 2021-22 alone. Tesla is a $ 630 billion (as of Feb 2024) business, but since 2003 as an EV startup it has long been at the receiving end of VC, or financial deals from public and private sources including corporate VC. For instance, Mercedes-Benz paid $50 million for nearly 10% of Tesla in 2010 and sold those shares for $780 million in 2014. However, in contrast to BYD, Tesla's own startup investments are primarily in the form of acquisitions with Dealroom listing nine such deals. Other than that BYD has been involved in two early and one late stage VC deals[19].

[17] Source: idem.
[18] https://xueqiu.com/5899108858/261059769
[19] Source: idem

Data on CVC activity for a selection of large automotive companies

3.1 The Auto25 CVC data set

To have a close look at automotive CVC activity, we extracted data from Dealroom on startup venture capital financing deals involving a number of large automotive companies. In particular, we focused on VC deals involving the top five R&D investing automotive companies[20] by corporate HQ location for each of the following: the EU, US, China, Japan and ROW (rest of the world). The names of the 25 companies (henceforth: Auto25) are listed in Table 1.

Table 1: Top five automotive companies by size of their overall R&D investment in 2022 and by corporate HQ location, in brackets the total R&D investments spent by the companies in 2022 in EURbn (source: JRC Industrial R&D Scoreboard[21])

EU		US		CN		JP		ROW	
Company	**R&D 2022**	**Company**	**R&D 2022**	**Company**	**R&D 2022**	**Company**	**R&D 2022**	**Company**	**R&D 2022**
Volkswagen	18.9	Ford	7.3	Saic	2.8	Toyota	8.8	Magna	0.6
Mercedes-Benz	8.5	General Motors	9.2	Geely	1.1	Honda	6.2	Hyundai Motor	2.5
Robert Bosch	7.5	Caterpillar	1.7	Nio	1.4	Denso	3.7	Kia	0.5
BMW	7.2	Deere	1.8	Byd	2.5	Nissan	3.7	Tata	2.1
Stellantis	6.7	Tesla	2.9	Great Wall	1.6	Aisin	1.6	Hyundai Mobis	1.0

For this exploratory study of automotive CVC, even though the sample size is small, the findings are significant as the 25 corporates in question account for a very large share of the sector's activity, be it in terms of sales, R&D investment, innovation outputs, etc. and arguably of CVC also. The relatively small number of corporates permitted thorough searches to identify all or most of the separate divisions or subsidiaries in each corporate structure acting as CVC investors.

As can be seen in Table 2, this resulted in the identification of 116 different investing entities for Auto25. The identification of the CVC-investing entities for each of the selected companies involved the following:

1. Earmarking in Dealroom those investors identified as belonging to each automotive company. Searches were performed by company name and company website. Regarding investor type, investors related to Auto25 are mostly classified in Dealroom's "corporate" and "investment fund" categories;
2. Searching the websites of the automotive corporates for the names of potential CVC company divisions or subsidiaries. Information is contained typically in consolidated annual reports as well as other sources, e.g. documents filed to the Security and Exchange Commission in the US (SEC.gov);
3. Searching and cross-checking the websites of relevant professional and sectoral organisations;
4. Screening published literature on automotive CVC, including news items.

One of the measures of CVC activity reported here is the number of participations of Auto25 companies in the deals. In this, we count as one participation independently of whether it is as sole investor in a deal or as one among several co-investors. In other words, we do not fractionate deal participation as is sometimes done in the literature (i.e. we do not count the deal fractions whereby each of 'n' parties in a multi-investor deal accounts for 1/n of the deal). However, as described in the next paragraph, we do fractionate the deal investment amount when possible. For this, we distinguish between numbers of deal participations where the financial volume of the deal is disclosed by Dealroom as opposed to when it is not specified (i.e. undisclosed deals).

Dealroom (similar to other data providers such as Pitchbook, Crunchbase, etc.), provides the total value of each disclosed investment deal, but not the breakdown by investor. We estimate the contribution of each investor to be the arithmetic average of the total investment over the number of investors, i.e. [total deal amount divided by the number of investors 'n']). This is in line with similar estimations in the scientific literature.

[20] according to the 2023 Industrial R&D Investment Scoreboard

[21] https://iri.jrc.ec.europa.eu/scoreboard/2023-eu-industrial-rd-investment-scoreboard

Table 2: Auto25 CVC investors (divisions or subsidiaries). Source: JRC elaboration based on Dealroom data (last accessed 02.02.2024)

Company Name	Name of CVC investing entities (investor location, # deal participations)
Volkswagen	Audi* (DE, 6) Audi* (IE, 1) Audi Electronics Venture (DE, 2) MAN (DE, 3) Navistar (US, 3) Porsche (DE, 30) Porsche Digital (DE, 2) Porsche SE (DE, 14) Porsche Ventures (DE, 44) Scania (SE, 2) Scania Growth Capital (SE, 16) Skoda Auto (CZ, 1) Traton (DE, 1) VW Group (DE, 20) VW Financial Services (US, 2) VW Credit (US, 1)
Mercedes-Benz	Athlon (NL, 1) Daimler Technology and Venture (DE, 24) Daimler Truck (DE, 2) Daimler Trucks North America (US, 3) EvoBus (DE, 1) Mercedes-Benz* (DE, 6) Mercedes-Benz* (UA, 1) Mercedes-Benz Capital (NL, 1) Mercedes-Benz do Brasil (BR, 1) Mercedes-Benz Group AG (DE, 30) Mercedes-Benz Mobility (DE, 1)
Robert Bosch	Bosch (DE, 35) Bosch Ventures (DE, 129) Bosch Home Appliances (DE, 2) Robert Bosch GmbH (DE, 1) Robert Bosch Engineering (IN, 1) Bosch (China) Investment (CN, 3) Bosch (DE, 1)
BMW	BMW (DE, 8) BMW i Ventures (US, 102) BMW Innovation Lab (UK, 3) BMW Capital (CN, 3)
Stellantis	PSA Group (FR, 4) Share NOW (DE, 1) PSA Unboxed (Singapore, 10) Stellantis (NL, 6) Peugeot Invest (FR, 1) Stellantis Ventures (NL, 13)
Ford	Ford Motor Company (US, 17) Ford Smart Mobility (US, 2) Ford Otosan (TK, 1)
GM	Performance Equity Management (US, 2) GM Ventures (US, 58) General Motors (US, 20)
Caterpillar	Caterpillar (US, 24)
Deere	John Deere (US, 4)
Tesla	Tesla Motors (US, 3)
Saic	SAIC Motor* (CN, 20), SAIC Motor Corporation* (CN, 3) SAIC Venture Capital (US, 17), SAIC General Motors ((CN, 1) SAIC Investment (CN, 29) SAIC Capital (US, 10) SAIC Goldstone Innovation Industry Fund (CN, 1) SAIC Hengxu Capital (CN, 1)
Geely	Geely (CN, 16) Geely Automobile Holdings Ltd. (HK, 2) Geely Houtong Capital (CN, 2)
Nio	Nio Capital (CN, 57)
Byd	Byd Company* (CN, 20) Byd Auto. Co. Ltd.* (CN, 1)
Great Wall	Great Wall Motors (CN, 2)
Toyota	Toyota Motor Corporation (JP, 33) Toyota Tsusho (JP, 30) Toyota Financial Services (US, 11) Toyota Research Institute (US, 1) Toyota Ventures (US, 98) Toyota Mobility Foundation (JP, 1) Toyota Industries Corp (JP, 2) Toyota AI Ventures (US, 1) Hino Motors (JP, 1)
Honda	Honda Motor Co Ltd (JP, 13) Honda Soltec (JP, 2) Honda R&D Europe (DE, 2) Honda Trading (US, 1) Honda Cars Shinano (JP, 1)
Denso	Denso International America* (US, 6), Denso Corporate Ventures (US, 1) Denso Corporation (JP, 29) Denso (JP, 9)
Nissan	Nissan Motor (JP, 2) Alliance Ventures (NL, 19) Mitsubishi-Renault-Nissan Alliance (FR, 2) Nissan Chemical Industries (JP, 2)
Aisin	Aisin Corporation (JP, 3)
Magna	Magna International (CA, 16)
Hyundai Motor	Hyundai Motor Company* (US, 61) Hyundai Motor Group* (S.Korea, 12) Hyundai Technology Investment or Venture Investment (S.Korea, 20) Hyundai Cradle (US, 2) Hyundai Card Co (S.Korea, 1) Hyundai Motor Company (US, 6) Hyundai Motor Group Zero One (S.Korea, 4) Hyundai Motor Securities (S.Korea, 4)
Kia	Kia Motors* (S. Korea, 1) Kia* (S. Korea, 1)
Tata	Tata Motors (IN,2) InMotion Ventures (UK, 45) Jaguar Land Rover (UK, 4) Jaguar Land Rover Tech Incubator (UK, 4)
Hyundai Mobis	Hyundai Mobis (SK, 6)

* Repeated names correspond to different investing entities with different investor ID numbers assigned by Dealroom

The data set extracted has information on 1173 VC deals financing 827 startups in which one or more of Auto25 participate over the period 2010 to 2023. As seen in the data analysis, most of the deals involve multiple investors, though for a significant proportion (22%), one of the Auto25 companies is the sole

investors. Note also that the amount of finance is disclosed in 945 deals (81% of the total number of deals), in which 676 startups are involved[22]. Table 2 lists the names of the investors for each automotive company in the sample and the number of deal participations by each of these investors.

3.2 Time evolution and analysis by VC stage (seed, early, late) of Auto25 CVC activity

Figure 1 show that, in terms of number of deals, CVC activity rose rapidly from a low level after 2014 to the much higher levels of 2021-2023, peaking in 2021. In terms of amounts invested, it reached the highest annual amount in 2021 and dropped rapidly afterwards – coinciding with the general global VC trend. While early stage VC deals seem to be more numerous, the dominance of late stage deals in terms of amounts invested is obvious. (Note also that the average deal sizes have also dropped significantly from 2021 onwards.

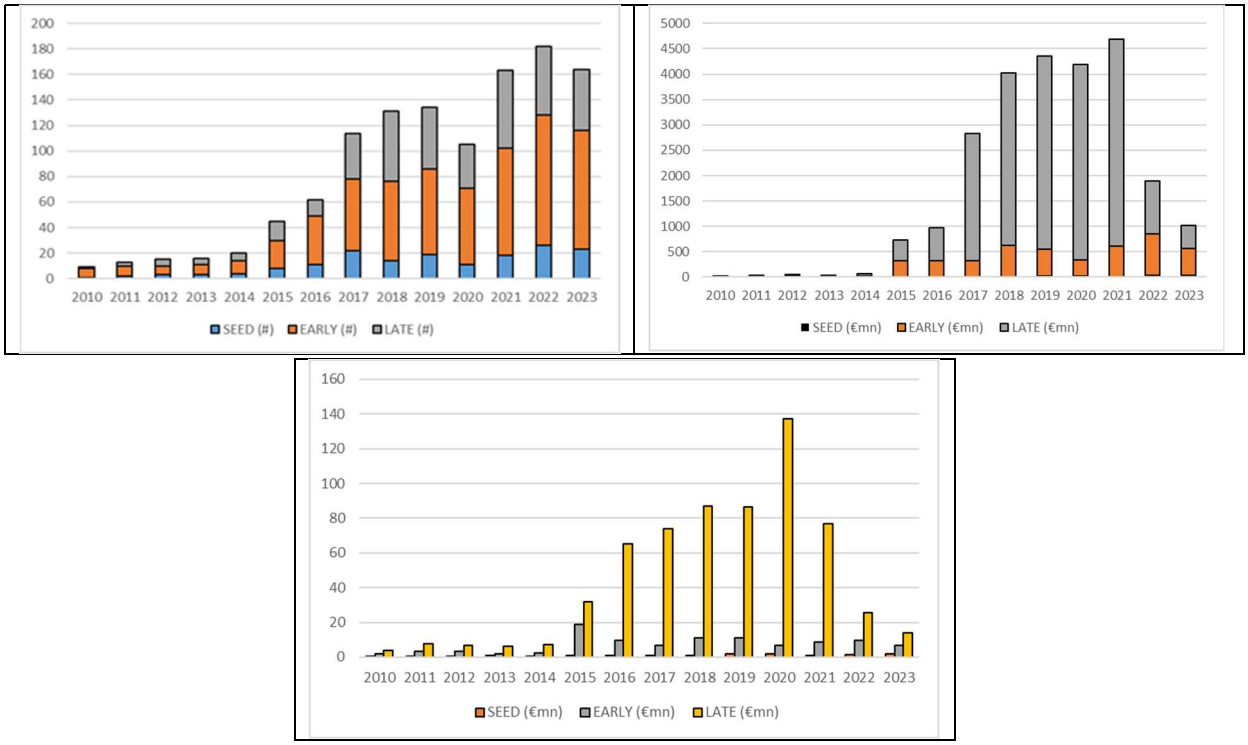


Figure 1 Annual number (left), amount of CVC investment (right) and* average deal sizes (total value of deals/total number of deals, bottom) by VC stages *by Auto25 investors in 2010-2023 by three main VC stages (seed, early, late). Source: JRC elaboration based on Dealroom data (last accessed 02.02.2024)

Figure 2 shows the 2010-23 aggregate CVC investment by type of VC for each of Auto25, revealing how a handful of automotive companies dominate. While these are investors related mainly to Volkswagen and Toyota, carmakers like Ford, Honda, and General Motors are also among larger players. Late stage investments are preferred. The only exception seems to be Geely for which early stage investments look to be more significant. This is due to three series A deals through which Geely invested in a mobility company (Caocao Chuxing, EUR330 million), and two electric vehicle production companies (Zhidou, EUR140 million, and JIDOU, EUR176 million), all of them headquartered in China. Interestingly, companies to which the most important CVC activity can be linked are the established OEMs still producing mainly ICE driven cars. New EV producers like Tesla, BYD or NIO invest significantly less via this channel. The reasons may be that, given that incumbent OEMs companies usually possess much larger amounts of disposable cash than NEV producers, they can more afford to diversify and/or improving their knowledge via the acquisition of ideas and technologies instead of their "in-house" development.

[22] In a number of cases the same startup company is the object of undisclosed as well as disclosed deals.

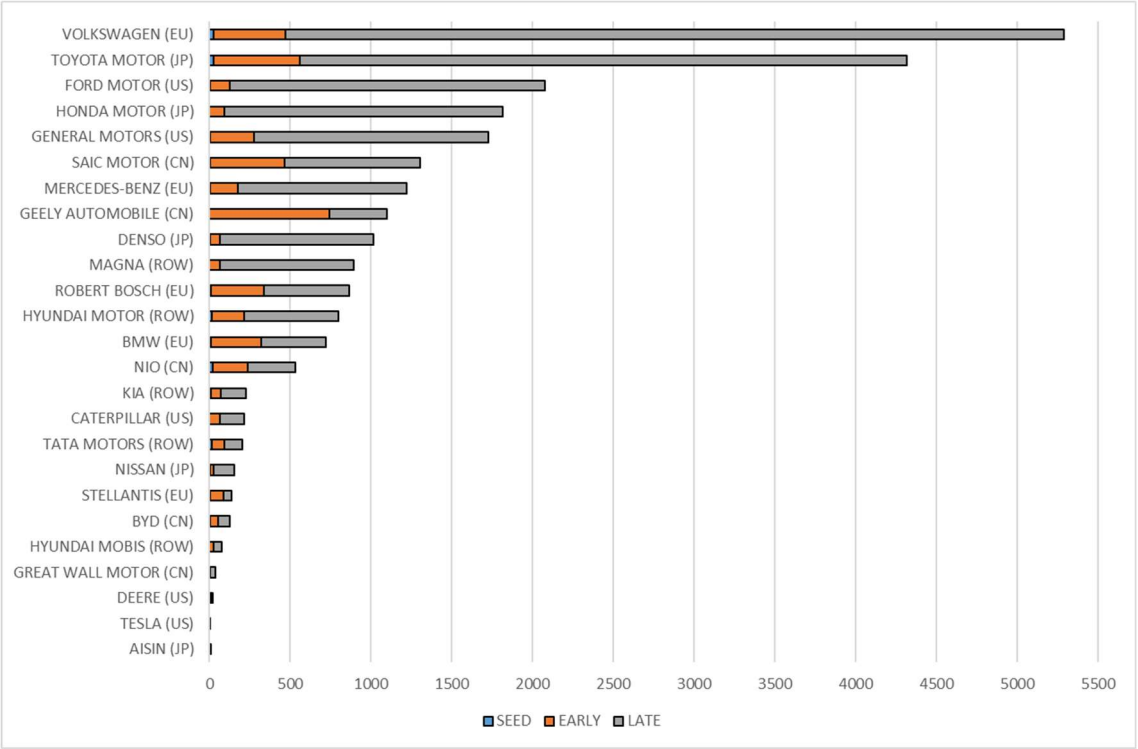


Figure 2 The total CVC investment (Million EUR) by deal type for showing the dominant position of the world's top two automotive corporations VW and Toyota, Source: JRC elaboration based on Dealroom data (last accessed 02.02.2024)

3.3 Analysis by number of investors per deal

The data sample contains information on a total of 1344 VC deal participations[23] by Auto25 investors. In 254 cases (ca. 19% of the total), automotive companies are the sole investor in the deal. The number of startups benefiting from these deals was 228 (with the deal value disclosed for 138 deal participations by Auto25 companies involving 125 startups). These figures indicate that most startups benefited from several different CVC deals – not always from the same company (Table 3). Of the 1344 Auto25 deal participations, 1101 participations have a disclosed investment value, the total sum of which is EUR 88 billion over the period 2010-2023. These participations (i.e. some individual deals have more than one Auto25 company in the group of co-investors – in fact 90 deals have two Auto25 investors, 19 have three, six have four, three have five and one has six and seven) account for EUR 21.2 billion (24% of the total).

Overall, there is a tendency for less single investor deal values to be disclosed compared to multi-investor deals. Out of the total sample, 116 of the 254 (46%) single investor deals are undisclosed, compared to just 112 or 12% of the 919 multi-investor deals. This may indicate a tendency for single investor deals to be closer to core and proprietary competence of the investing automotive company, and therefore their wish not to share openly information on the size of the investment. Looking further into how these data break down by location of investors, it turns out that the EU headquartered Auto25 companies disclose less single investor deals than those of other HQ locations – i.e. 68 out of 492 deals (14%) for the EU, compared to 13 deals (11%) for the US, 15 deals (7%) for Japan, 7 deals (4%) for China and 13 deals (7%) for the ROW.

[23] The total number of deals in which at least one Auto25 CVC company participates is 1,173. The number of disclosed deals corresponding to this total is 945.

Table 3 Distribution by number of investors per deal of the total number of Auto25 deal participations & the associated number of startups; the number of disclosed deal participations, startups, Auto25 investment and total investment. Source: JRC elaboration based on Dealroom data (last accessed 02.02.2024).

#inves-tors	# deals	#disclosed deals	# comps	#comps in disclosed deals	Auto25 CVC investments*	Total investments
1	254	138	228	125	9,110	9,110
2	178	125	150	108	2,872	5,744
3	153	127	127	104	4,056	12,169
4	160	145	134	125	2,403	9,612
5	136	121	110	98	1,088	5,441
6	113	108	97	92	852	5,113
7	107	103	74	70	1,707	11,949
8	85	81	62	58	1,417	11,334
9	44	43	35	34	290	2,606
10	33	32	30	29	148	1,481
11	24	23	19	18	239	2,624
12	24	23	11	10	282	3,112
>12	33	32	23	22	407	7,711
Total	**1,344**	**1,101**	**n.a.**	**n.a.**	**24,870**	**88,006**

*: sum of the parts of the Auto25 investors from a certain deal, fractioning uniformly across the total number of investors participating in a deal (e.g. total number of investors = n, number of Auto25 investors 2. The column will show the 2/nth part of the total amount).

3.4 Breakdown of Auto25 CVC investment by sector/ thematic area

The data sample of CVC investment deals participations records the area or sector of activity of the startup investees. As expected, most of the startups of interest to automotive firms are active in areas directly or indirectly relevant to automobiles. However, as is the case for corporates across all industrial sectors, many CVC investments target technological areas, which at best have a tentative link to core business or indeed no link at all and as such no different from mainstream VC fund investments.

In order to define the sectors of activity we used Dealroom industry categories and subcategories and grouped them further in order to ensure parsimony and relevance. The automotive sub-industries represent the backbone of the present analysis, therefore we provide their definition hereunder[24]. While for seven out of the eight automotive sub-industries we use the Dealroom definition, for the last sub-industry from the list below (evie) we provide our own (Table 4). We also defined sectors of activity by grouping the Dealroom industry categories (Table 5).

[24] The definitions of the remaining industry categories can be found on Dealroom's website at https://intercom-help.eu/dealroom/en/collections/4768-definitions-dictionary-taxonomy.

Table 4 Automotive and other transportation sub-industries definitions and abbreviation used. Source: Dealroom and JRC elaboration

Automotive sub-industry	Description
Search, Buy & Rent (sbr)	Marketplaces and other solutions to enable and facilitate new and used vehicle purchasing, vehicle rental and leasing, as well financing
Maintenance (mt)	Solutions to improve maintenance and aftermarket for vehicles including platforms to connect users to networks of repair dealers, claim estimation for insurance, B2B solutions and marketplaces for parts
Navigation & Mapping (nm)	Startups developing solutions to track vehicles, provide navigation and mapping. This includes navigation apps, telematics providers, platforms for mobility data sharing, logistics tracking
Autonomous & Sensor Tech (ast)	Startups developing solutions for autonomous driving or to enhance other vehicle sensing capabilities. This included autonomous driving vehicles, software and sensors and V2X
Vehicle Production (vp)	Startups producing or developing solutions for vehicle production, as well as vehicle parts such as motors, chassis
Mobility (mb)	Startups developing transportation solutions getting people from point A to point B. This includes ride hailing, ride sharing, public transport and micromobility
Logistics & Delivery (ld)	Startups developing solutions for the transportation of goods, the packaging of products for storage and shipment involving both internal and external distribution networks
EV charging (evie)	Startups explicitly developing deploying e-v charging and other energy infrastructures

Table 5 Clustering of Dealroom industry definitions into larger Sector groups. Source: JRC elaboration, Dealroom

Sector (JRC)	Dealroom industry
Advanced manufacturing, industrials	robotics, engineering and manufacturing equipment, 3D printing, chemicals, mining, real estate construction
Automotive	Autonomous & sensor tech, vehicle production, search & buy & rent, navigation& mapping, EV charging, maintenance
Transportation - other	mobility, logistics & delivery
Energy	energy
Fintech	Fintech
ICT hardware	semiconductors
ICT software	enterprise software, security, telecom, hosting
Leisure, fashion, entertainment	consumer electronics, sports, travel, music, gaming, wellness beauty, fashion, home living
Life sciences tech	health, food, agritech
Marine, aeronautics, space	marine & air transport, space
Other	real estate (other than construction), media, marketing, education, jobs recruitment, event tech

Investments of Auto25 investors in 2010-2023 were concentrated in relatively few sectors that are strongly related in their nature to their mother company's main activity (Figure 3). Thus, 77% of all investments went to the transportation sector, mainly to automotive sub-sector (54%), but the mobility and logistics & delivery industries also got significant capital injections (23%). Relatively lower shares were spent in the energy sector (9%), and in ICT software and hardware (7%). The remaining six sectors, encompassing 26 Dealroom-defined industries got marginal amounts reaching altogether 7% of total investments. Within the automotive sector, the autonomous and sensor tech (ast) industry dominates the landscape of investments with its 64% share of total automotive investments. It is followed by the more general vehicle production (vp) industry (23%). The lower importance of EV charging (evie) investments (5%) may be due to the still relatively smaller share of the EV segment of the automotive market. However, the segment is expected to face significant growth in the

near future supported by a predicted six-fold increase of public charging, even though private charging would still dominate (IEA, 2024). It is somewhat puzzling the low share of the navigation & mapping sub-sector, and it may be related to the relatively smaller needs of physical capital. Investments in less capital intensive segments such as automotive retail captured by search & buy & rent (sbr) industry or vehicle maintenance (mt) are of lower importance (3% altogether).

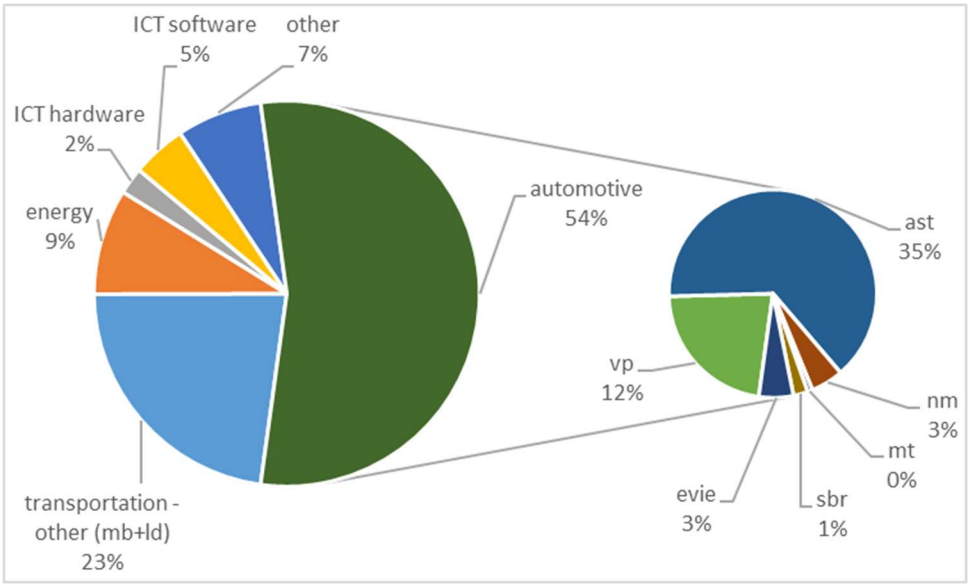


Figure 3 Distribution of the aggregate amount of Auto25 CVC investments and Auto25 CVC investments in automotive sub-industries in 2010-23, broken down by the sector of activity of the investee startups. (ast: autonomous & sensor tech, vp: vehicle production, nm: navigation & mapping, mt: maintenance, sbr: search & buy & rent, evie: EV charging). Source: JRC elaboration, data source: Dealroom

There are altogether 411 deal participations in the automotive sector, 339 (83%) of them the amount invested is disclosed, for the other 52 the deal amount is not disclosed. These participations represent 328 separate deals, 261 of them disclosed and 67 nondisclosed. Based on the percentile distribution of the cumulated amounts of investment by Auto25, there is a significant concentration of the invested amounts in a fairly low number of deals: while the 3 largest deals account for one third of the total globally invested CVC amount by Auto25 during 2010-23, the top 8 deals account for half of the total, and only 32 deals for 80% of the full amount going to the automotive industry[25]. The lowest 10% in terms of amounts invested comprise a total of 200 deals. The amounts of these deals are individually less than EUR27 million. Further to this, data shows that 157 deals, i.e. 60% of the sample are less than EUR10mn[26]. This means that the other 40% of the sample is characterized by relatively larger investments (Table 6).

Sector-wise, the autonomous &sensor tech and vehicle production are the two sectors where the largest deals were made, the former being in the lead. Likewise, the US is the region where the most significant investments took place, e.g. the largest three deals, accounting for one third of the total Auto25 invested amounts were all done in the US. However, in the lower quartile with amounts between EUR27mn and EUR125mn per deal, Chinese startups seem to become more interesting for the Auto25 investors: in this value range one third of the deals concern investees headquartered in China (Table 6).

[25] Not to confuse the amounts with the full amounts of the deals. The distribution of the latter shows similar trends, the table depicting these amounts is in the annex.
[26] Available upon request

Table 6 Number of disclosed deals by percentiles of the cumulated amount of investments made by Auto25 CVC investors in the six sub-sectors of the automotive industry by sub-sectoral and geographical breakdown (ast: autonomous & sensor tech, vp: vehicle production, nm: navigation & mapping, mt: maintenance, sbr: search & buy & rent, evie: EV charging). Source: JRC elaboration, data source: Dealroom

Perc.	amounts, EUR	# of D deals	ast	vp	nm	mt	sbr	evie	EU	US	CN	JP	ROW
25	1.1-2.3billion	2	2							2			
32	> 939 million	3	3							3			
50	> 346 million	8	7	1						7	1		
66	> 197 million	17	9	6				2	1	13	3		
75	> 125 million	24	12	10				2	3	14	7		
80	> 80 million	32	14	12	3			3	4	16	10		2
90	> 27 million	61	26	17	9		4	5	5	29	20	0	7
100		**261**	**102**	**58**	**30**	**14**	**36**	**21**	**31**	**122**	**48**	**2**	**58**

Key players in the top deals are CVC investors related to Volkswagen A.G. (accounting for the largest deal, EUR2.3 billion, acting also as single investor), Ford Motors, Toyota Motors, and Honda. They participated in the top 4-6 deals of our sample[27], investing altogether EUR5 billion in only two, US headquartered self-driving technology companies, Argo AI (EUR3.25 billion) and Cruise (EUR1.75 billion). Volkswagen's investment in Argo AI is the largest investment of the sample in terms of total amount invested. This is followed by a similarly large (EUR2.28 billion) investment in Northvolt (SE, energy) where Scania and Volkswagen Group participated along 20 other investors, and the EUR2.1 billion investment in Rivian Automobiles, where Ford Motors participated along seven other investors (Table 7).

Table 7. Top ten deals – total amounts (left) and Auto25 CVC investor amounts (right). (ast: autonomous & sensor tech, vp: vehicle production, nm: navigation & mapping, mt: maintenance, sbr: search & buy & rent, evie: EV charging). Source: JRC elaboration, data source: Dealroom

deal rank	auto25	# of inv.	year	Total, EURmn	investee	industry code
1	VOLKSWAGEN (EU)	1	2020	2,310	Argo AI (US)	ast
2	VOLKSWAGEN (EU)	22	2021	2,283	Northvolt (EU)	energy
3	FORD MOTOR (US)	8	2021	2,115	Rivian Automotive (US)	vp
4	MAGNA (ROW)	6	2021	2,075	Waymo (US)	ast
5	MAGNA (ROW)	7	2020	2,034	Waymo (US)	ast
6	TOYOTA MOTOR (JP)	4	2017	1,737	Grab (ROW)	ld
7	GENERAL MOTORS (US)	3	2021	1,643	Cruise (US)	ast
7	HONDA MOTOR (JP)	3	2021	1,643	Cruise (US)	ast
8	SAIC MOTOR (CN)	8	2020	1,247	WM Motor (CN)	vp
9	FORD MOTOR (US)	4	2019	1,170	Rivian Automotive (US)	vp
10	GENERAL MOTORS (US)	4	2019	1,028	Cruise (US)	ast
10	HONDA MOTOR (JP)	4	2019	1,028	Cruise (US)	ast

deal rank	SB_mother	# of inv.	year	CVC investor amount, EURmn	Investee	ind. code
1	VOLKSWAGEN (EU)	1	2020	2,310	Argo AI (US)	ast
2	FORD MOTOR (US)	1	2017	940	Argo AI (US)	ast
3	TOYOTA MOTOR (JP)	1	2018	856	Grab (ROW)	ld
4	HONDA MOTOR (JP)	1	2018	653	Cruise (US)	ast
5	GENERAL MOTORS (US)	3	2021	548	Cruise (US)	ast
5	HONDA MOTOR (JP)	3	2021	548	Cruise (US)	ast
6	TOYOTA MOTOR (JP)	1	2019	535	Didi Chuxing (CN)	mb
7	VOLKSWAGEN (EU)	2	2019	443	Northvolt (EU)	energy
8	TOYOTA MOTOR (JP)	1	2018	433	Uber (US)	mb
9	MERCEDES-BENZ (EU)	2	2017	348	Beijing Benz (CN)	vp
10	MAGNA	6	2021	346	Waymo (US)	ast

Automotive and 'other transport' relevant startups by far account for most Auto25 CVC investment (Figure 3). However, while the number of automotive deal participations is almost the same as for the 'other' sector, the amount of investment per deal participation in automotive startups is significantly higher (Figure 4). The EU, US, CN and ROW headquartered Auto25 companies invest more in automotive startups than in any other areas. JP headquartered Auto25 companies invested more in logistics and delivery and mobility-related areas. They have done so through a relatively limited number of large deals (EUR3.3bn via 9 deals). The EU headquartered Auto25 companies invest disproportionately higher in energy-related startups, albeit of a total that is a small fraction of the amount for all transport-related startups. (Figure 4, left). The fact that these proportions are not at all apparent for the numbers of deals (Figure 4, right) indicates that a number of inordinately high deal values may be behind the amounts invested.

[27] Argo AI, Cruise, and Grab were the targets for the top four deals amounting to a total Auto25 participation of EUR4.8bn. Cruise's further capital injection of EUR1.1bn of which General Motors and Honda related CVC investors account for EUR500mn is the fifth largest deal in the sample. It is preceded by an investment share of EUR653mn made by Honda also in Cruise (US, ast)

Eight of the top 10 energy deals belong to Volkswagen, who invested EUR752mn in Northvolt through VW Group and Scania (deal included in Table 7), EUR100 million in 1Komma5° through Porsche Ventures[28], EUR270 million in QuantumScape, and EUR63 million in Group14Technologies, also via Porsche. The two non-EU Auto25 companies in the top 10 ranking of energy deals are Caterpillar (EUR131 million, Redwood) and Honda (EUR74 million, Lunar Energy). EU headquartered Auto25 such as Stellantis and BMW can be found among others further down, but close to the ranking of the top energy deals.

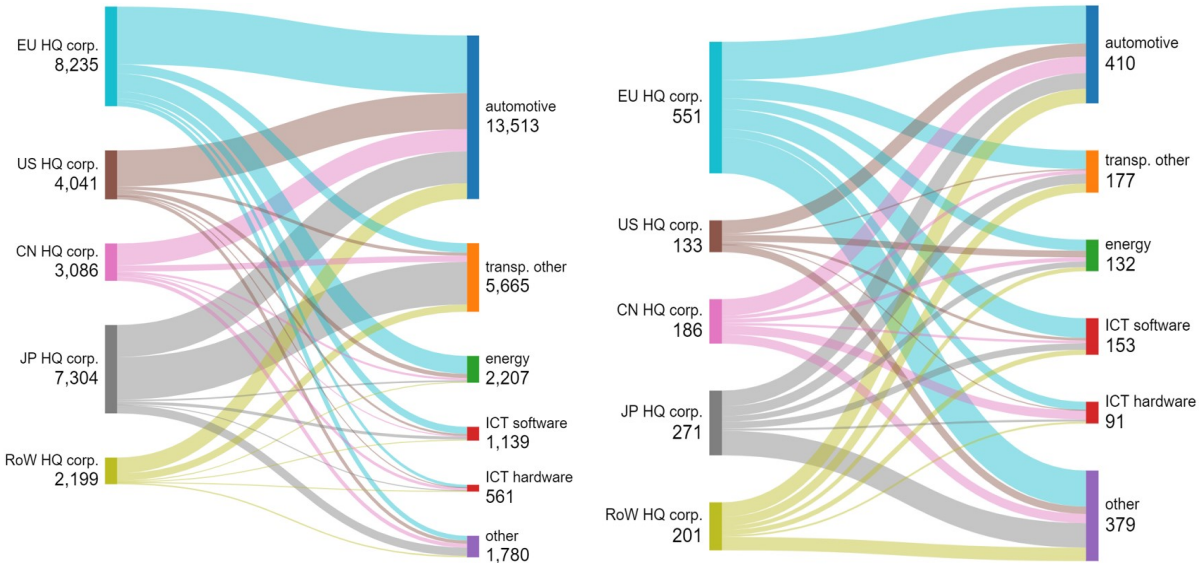
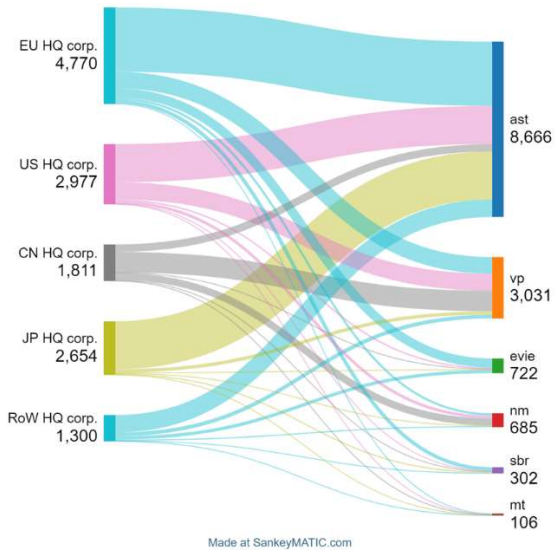


Figure 4 Destination by sector of activity of investees showing volume of CVC investment (left), and number of deal participations (right) summed over Auto25 by HQ location. Source: JRC elaboration, data source: Dealroom

As mentioned earlier, the bulk of corporate venture capital investments flew into the automotive & sensor technologies (ast) with 2/3rd of total automotive CVC of Auto 25 companies, followed by vehicle production (vp) with slightly less than a quarter of the total funds (Figure 5, left). Certainly, these two sub-industries are the most capital-intensive ones. The key players in the autonomous & sensor tech field are EU headquartered Auto25 companies who invested EUR3.2 billion (Table A2, annex), which may seem to be a good news for the companies of this region because this is the key sub-industry of the modern automotive industry with likely the highest added value in the automotive sector and that is likely to ensure the largest comparative advantages in the technological race within the sector as a whole. EU firms are followed by Japanese companies (EUR2.4 billion), and US companies (EUR1.9 billion). Investments from companies from the three largest global economic regions (the EU, the US and CN) are more evenly represented in the vehicle production sub-industry, with Chinese companies being somewhat in the lead, investing EUR1bn vs. EUR845 million of the US and EUR821 million of the EU companies (Figure 5, left). The four remaining sub-industries (EV charging, search & buy & rent, maintenance, and navigation & mapping) received more limited amounts of capital. It is noteworthy the relatively higher share of EU Auto25 companies in EV charging (62% of total CVC received by this sub-industry) and in the search & buy & rent (59%) subsector as well as that of Chinese Auto25 companies in navigation & mapping (52%).

The autonomous & sensor tech sub-industry received not only the largest invested amounts, but also the highest number of deals, that of disclosed deals as well as the largest average deal sizes (Figure 5, right). The strongest concentration was in the US, where a relatively lower number of deals coupled with significant investments resulted in an average deals size of EUR188mn, spiking out from the series. The largest deals on average in vehicle production took place in China with an average invested amount of EUR60mn per deal, and the same region stands out with its average deal size of EUR51mn in navigation & mapping. However, in navigation & mapping, search & buy & rent, maintenance, and EV charging the generally low number of deals are not robust enough for farther reaching conclusions.

[28] VW invested another EUR47mn in 1Komma5, too, but this deal does not reach the top 10.



# deals	vp	ast	nm	mt	sbr	evie
EU HQ corp.	27	50	20	11	31	20
US HQ corp.	19	15	9	4	3	5
CN HQ corp.	17	30	8	3	6	5
JP HQ corp.	10	40	3	1	6	6
ROW HQ corp.	7	26	8	7	6	7
Total	**80**	**161**	**48**	**26**	**52**	**43**

# disclosed deals	vp	ast	nm	mt	sbr	evie
EU HQ corp.	23	40	14	7	22	16
US HQ corp.	17	10	8	2	3	4
CN HQ corp.	17	27	7	3	5	3
JP HQ corp.	8	34	3	1	5	4
ROW HQ corp.	7	25	8	5	6	5
Total	**72**	**136**	**40**	**18**	**41**	**32**

average deal size	vp	ast	nm	mt	sbr	evie
EU HQ corp.	36	79	8	5	8	28
US HQ corp.	50	188	18	11	6	17
CN HQ corp.	60	14	51	7	7	5
JP HQ corp.	20	70	8	7	11	7
ROW HQ corp.	27	34	7	4	2	32
Total	**42**	**64**	**17**	**6**	**7**	**23**

Figure 5 Destination by automotive sub-industries of Auto25 investees showing volume of CVC investment (left), and the number of deals and disclosed deals as well as average deal sizes (the ratio of the invested amounts and the number of disclosed deal participations) (right) by HQ location. (ast: autonomous & sensor tech, vp: vehicle production, nm: navigation & mapping, mt: maintenance, sbr: search & buy & rent, evie: EV charging). Source: JRC elaboration, data source: Dealroom

In comparison to their own totals, Japan headquartered Auto25 companies invested the largest share of their capital in ast amounting to almost 90%. They are followed by the EU investors with around two third of the total capital invested as well as US Auto25 investors with slightly more than 60% of their own total. As mentioned previously, this is a noteworthy development given the rather high importance of ast in the modern automotive value chain. Another interesting fact is that although the EU lags behind the US and CN on the EV market, it is the main global economic region investing in evie. This may be due to an even more pronounced lagging behind in EV charging infrastructure. Last but not least, share of Chinese headquartered Auto25 CVC funds seem to be overrepresented in nm. The reasons may be multiple, e.g. continuous infrastructure development of a country of the size of China, share of transportation companies using these technologies, etc. (Figure 6). Further research is be needed to explore the fuller set of reasons behind these relative differences.

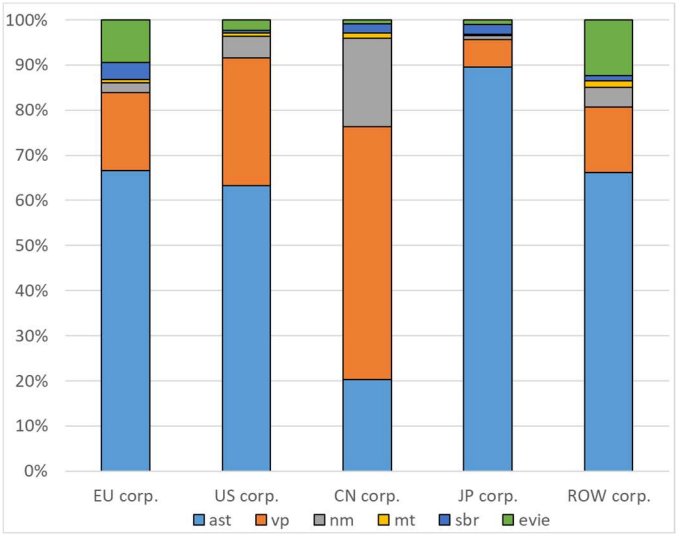
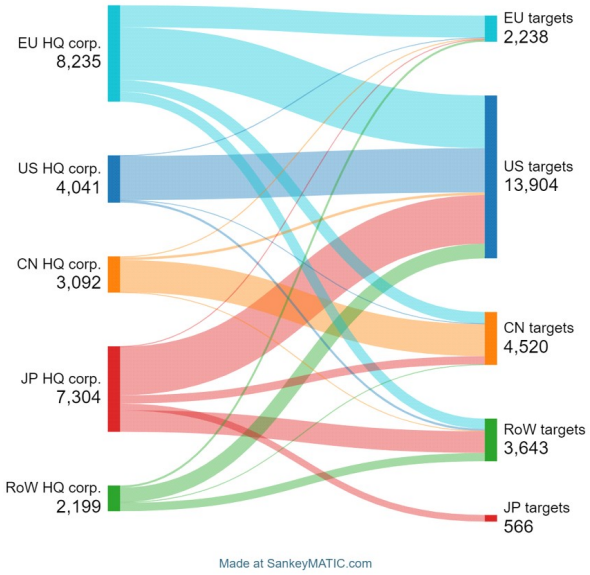


Figure 6 Share of investments in automotive sub-industries of Auto 25 CVC companies in their total automotive sector investment, by global regional headquarters. (ast: autonomous & sensor tech, vp: vehicle production, nm: navigation & mapping, mt: maintenance, sbr: search & buy & rent, evie: EV charging). Source: JRC elaboration, data source: Dealroom

3.5 Location of the startup investees

According to our sample, Auto25 investors from each global economic region under scrutiny target mainly US headquartered startups, except for Chinese investors, who invest mainly domestically. Likewise, US headquartered Auto25 investors prefer to invest mainly at home. European and Japanese Auto25 investors were the largest capital exporters, the latter being the most significant one compared to its own totals: while Japanese startups included in the sample were financed exclusively (100%) by Japanese Auto 25 investors, only 8% of the latter targeted domestic startups (i.e. a relatively modest amount of EUR566mln in total). EU and especially Japanese startups got funding mainly from domestic resources[29], which in the present case means first, a fairly large exposure to merely five large automotive companies and second, it may become a limiting factor if home resources of capital dried up for any reason, especially those unrelated to their own business, such as macroeconomic, or industrial policies. US investees are the most internationalised in terms of funding (Figure 7)[30].

From 2010 to 2023 the amount of Auto25CVC investments in the US was 6.21 times bigger than in the EU (i.e. 13904/2238, Figure 7, left) which is very similar to the US to EU ratio for the total amount of VC investment in the respective economies for the same period – i.e. 6.27[31]. By this reckoning, the relative amount of EU Auto25 CVC investment made in the EU compared to that made by the same firms in the US (i.e. 23% of the total, Figure 7, right) is considerably higher than the value corresponding to an amount of investment proportional to the relative size of the total VC investments in the two regions (i.e. 14%, based on own calculations using Pitchbook data). While this means that the EU Auto25 CVC investments show a certain degree of home bias in proportional terms, this in no way diminishes the serious necessity of overcoming the persisting deficit of the overall EU VC market compared to that of the US.



domestic CVC investments		domestic origin of startup funding	
EU HQ corp.	23%	EU startups	84%
US HQ corp.	93%	US startups	27%
CN HQ corp.	89%	CN startups	61%
JP HQ corp.	8%	JP startups	100%
ROW HQ corp.	33%	ROW startups	20%

Figure 7 CVC investment flows between HQ regions of the Auto25 investors and locations of the funded startups, EUR million (left) and % of domestic presence: Column 1: % of CVC by Auto25 firms from a given region or country invested domestically (x) ; and Column 2: x as % of all CVC investment in a given region regardless of its origin (right). Source: JRC elaboration, data source: Dealroom

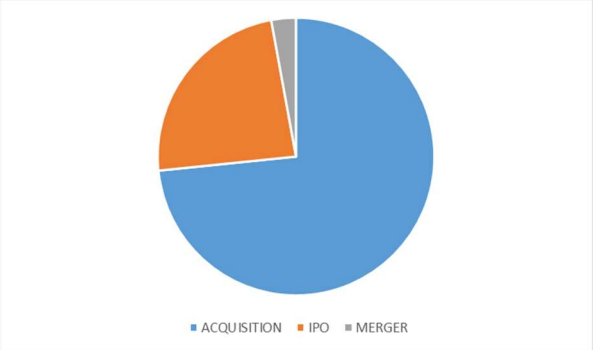
[29] In our dataset there is only one single deal involving a non-Japanese Auto25 and a Japanese investee and the amount of this deal is unknown. It is a 2019 early VC investment of Volkswagen in Takamtsu, a Japanese pharmaceutical company.

[30] The significant Japanese presence in the ROW funding is due to the massive investments of Toyota (mainly) and Honda (to a lower extent) in the Singapore based mobility and logistics & delivery company Grab (South-East Asia's UBER), totalling EUR1.6 bn (44% of the total investments in the ROW region).

[31] Based on Pitchbook data – i.e. total VC investment in the US over the years 2010-2023 was 6.27 times bigger than that for EU27 - €1870 billion [US]; €298.2 billion [EU27] (consulted on-line Sept 2024)

3.6 Focus on the startups

There are 827 startups in our sample. Most of these companies are operational, only 21 companies from the sample are either closed (12 firms) or classified by Dealroom as of low-activity (9 firms). The companies are overwhelmingly not-exited (private) companies: 688 companies (83% of the total sample) have not yet been subject of an exited round such as a merger, an acquisition, an IPO, etc. [32] The preferred exit strategy is a merger or acquisition (M&A) deal. A bit more than three quarter (76%) of the 139 exited companies were subject to such a deal (102 acquisitions, 4 mergers). Only about one quarter (33 companies, 24% of the total) of the startups included in the sample have gone public via an initial public offering (IPO), Figure 8, left.



	# startups	share
ACQUISITION	102	12%
IPO	33	4%
MERGER	4	0%
Private (not yet exited)	688	83%
Total	**827**	**100%**

Figure 8 Structure of the number of startups funded by Auto25 related CVC investors in 2010-2023, by exit strategy adopted (left) and structure of the full sample of the 827 startups funded by Auto25 related CVC investors in 2010-2023 (). Source: JRC elaboration, data source: Dealroom

In terms of number of companies financed, Auto25 investors preferred to provide CVC funding mainly for companies created after 2008-2009 (Figure 9, left), corresponding to the aftermath of the 2008-2009 financial crisis[33]. However, more significant amounts were disbursed to companies launched between 2009 and 2016, peaking in 2016, although this year may be somewhat biased by the Argo AI deal for a total amount of about EUR3.25bn. However, even without this deal, 2016 as launch year is strong in terms of financing received, significantly stronger than later launch years. In the meantime, Auto25 companies were not keen on providing significant financing to the very youngest firms, especially those launched after 2021. They were less keen on startups created before the 2008-2009 economic crises, despite the huge liquidities existing on the global financial markets in the running-up to the crisis. In other words, companies launched before the period under scrutiny (i.e 2010-2023) never became really interesting for Auto25 investors (Figure 9, right). This is because auto firms mostly go for later stage VC investments (i.e. early +late VC), as we have seen this at Figure 1. The relative paucity of seed CVC deals compared to early and late stage VC deals can be observed also irrespective of the sector of activity as it can be seen on a data extract from Pitchbook (Figure A2, Annex). We can conclude that the age of the startups do matter for CVC investment decisions.

[32] We consider the first exit round. Note that some companies may then suffer a change afterwards, such as merger, acquisition, going private again, etc. For example, the startup Velodyne Lidar was first floated on the stock market via SPAC IPO in September 2020 (for a value of $bn1.8) and afterwards was acquired by Ouster in November 2022, https://s27.q4cdn.com/377532724/files/doc_presentation/2023/closing-update-on-merger-of-equals-between-ouster-and-velodyne.pdf

[33] Further research is needed to decide whether or not this is only a coincidence.

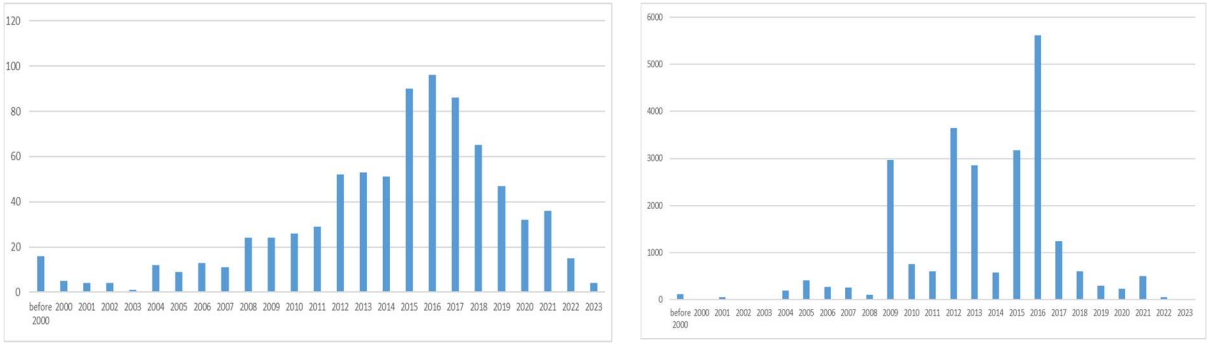


Figure 9 Histogram of the number of startup companies by their launch year (left) and of the amounts of CVC investments received by them in 2010-2023 from Auto 25 companies (right) Source: JRC elaboration, data source: Dealroom

Main messages

Corporate venture capital by leading EU automotive firms is on a par with competitors and is being put into the technological innovation that is transforming the sector: autonomous driving, sensor technologies, etc. What is worrying, however, is that most CVC investment by EU automotive leaders goes to US-based startups. In contrast, CVC from leading Chinese automotive firms, for example, is invested domestically.

#1 Corporate venture capital is an important tool for automotive firms to tap into high-potential, startup-driven innovation

In addition to traditional approaches to expanding knowledge-based assets (in-house and collaborative R&D, IP management, innovation procurement, joint ventures, mergers and acquisitions), automotive firms also target new technologies through structured 'Open Innovation' (OI) external collaboration with startups, clients, suppliers, and academic and public research organisations. One prominent form of OI is corporate venture capital (CVC) in which automotive firms acquire equity in innovative startups. We have analysed all CVC funds associated with the sector's 25 main corporates, taking the top five per region (Europe, US, China, Japan, Rest-of-the-World) – which, for the sake of simplicity, we refer to as 'Auto25'.

While aggregate automotive CVC data show a considerable increase over the past decade with rapid investment growth recorded from 2014 to 2021, CVC investment levels vary considerably from firm to firm with a handful of incumbent automotive companies dominating. While automotive CVC investment is substantial, has increased over the years and has become one of the backbones of corporate's open innovation strategy, the overall level remains – on average – at least an order of magnitude lower than internal R&D[34].

Most Auto25 CVC investment from 2010 to 2023 – about 56% - went to startups active in areas directly or indirectly related to automobiles. As in other industrial sectors, a diversification pattern can also be observed with significant amounts also invested in startups active in other fields such as energy (9%) or ICTs (7%).

CVC investment directly related to automobiles amounted to €13.5 billion, from 412 deal participations in startups active in six different sub areas distributed As follows: 64% in autonomous driving & sensor technology startups; 23% in vehicle production startups; only 5% in EV charging & related infrastructure startups, with the remainder going to startups active in the navigation & mapping, maintenance or sell-buy-rent segments. However, while the International Energy Agency expects the public EV charging segment to undergo a six-fold increase, private charging will continue to dominate. By HQ location, Japanese EU and US firms invested 90%, 66% and 60% respectively in autonomous driving & sensor technology. Chinese firms however have been investing in the period considered a relatively high proportion of CVC in navigation and mapping and a relatively low proportion in EV charging & related infrastructure.

#2 Most CVC investment by EU automotive firms goes to the US – indicative of the less-developed EU VC market for scale-up financing

Automotive CVC activity is typically handled by offices close to the headquarters of the parent firm (e.g. Stuttgart, Germany – home to Mercedes-Benz and Porsche; Turin, Italy – Fiat Chrysler Automobiles; or Tokyo/Nagoya – Toyota). Most also have CVC offices in locations around the world close to talent and venture opportunities.

The analysis shows that US-based startups are the main beneficiaries of global automotive CVC investment with EU, Japanese and ROW Auto25 firms investing more in US based startups than in domestic ones. Chinese and US Auto25 investors invest mainly at home. On the other hand, startups located in the EU and especially in Japan get CVC funds mainly from domestic (by HQ) Auto25 firms.

Most (78.5%) of the CVC deals in this sample involve two or more investors. Sometimes these other investors are other automotive firms but often they are private VCs and other investors not active in the auto sector. Single investor deals probably involve cases where the corporate investor expects exclusive or priority access to what the startup investees are developing. However, the preponderance of multi-investor deals is indicative of a cooperative approach by corporates to CVC investments, possibly because either the technologies are high-risk or it makes good business sense to jointly support the development by investees of shared technology standards.

[34] See also section 1.4.1 Corporate Venture Capital in The 2021 EU Industrial R&D Investment Scoreboard

Final words

The above discussion of CVC activities of a select number of automotive corporates presented in this working paper illustrates the types of analyses which can be carried out using a combination of publicly available information and commercially available data (in this case via Dealroom.co). The number of corporates covered was by both choice and necessity limited and so the insights obtained cannot be considered to be entirely representative of the sector. However, it is likely that the findings give a reasonably accurate illustration of CVC activity in the sector as a whole given that the larger automotive corporates account for a disproportionately high share of such investments.

Nonetheless, depending on the need or interest in having more robust data and evidence to underpin relevant policy discussions, more complete analyses may have to be conducted, for example, using a much larger number of automotive firms and possibly having sufficient numbers to discriminate between different typologies of firms in the sector (e.g. OEMs as opposed to tier-1 or tier-2 suppliers), or to do comparative analyses between different territories (regions or countries), or to contrast CVC practices in older automotive firms to those in newly emerging players in the sector, linking such analyses to the major technological transformations underway such as digitalisation, electrification, autonomous driving, etc. In such cases, this working paper provides a tested analytical frame which can be readily applied to larger, more specific or customised datasets as needed.

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Annex

Table A1 Time series of undisclosed deals by VC stages

YEAR	SEED (#)	EARLY (#)	LATE (#)	Total
2010	0	0	0	0
2011	1	1	1	3
2012	1	1	1	3
2013	1	1	2	4
2014	1	4	0	5
2015	3	5	2	10
2016	2	6	3	11
2017	6	9	2	17
2018	3	6	16	25
2019	3	21	4	28
2020	3	11	6	20
2021	7	16	8	31
2022	5	17	13	35
2023	4	16	16	36
Total	**40**	**114**	**74**	**228**

Table A2. Destination of Auto25 CVC investment flows by automotive sub-industries

automotive	Vp	ast	nm	mt	sbr	evie	
EU hq Auto25	821	3178	107	36	179	449	**4770**
US hq Auto25	845	1883	142	21	17	68	**2977**
CN hq Auto25	1014	369	355	22	37	15	**1811**
JP hq Auto25	164	2375	24	7	55	29	**2654**
ROW hq Auto25	188	861	56	20	14	161	**1301**
	3031	**8666**	**685**	**106**	**302**	**722**	**13513**

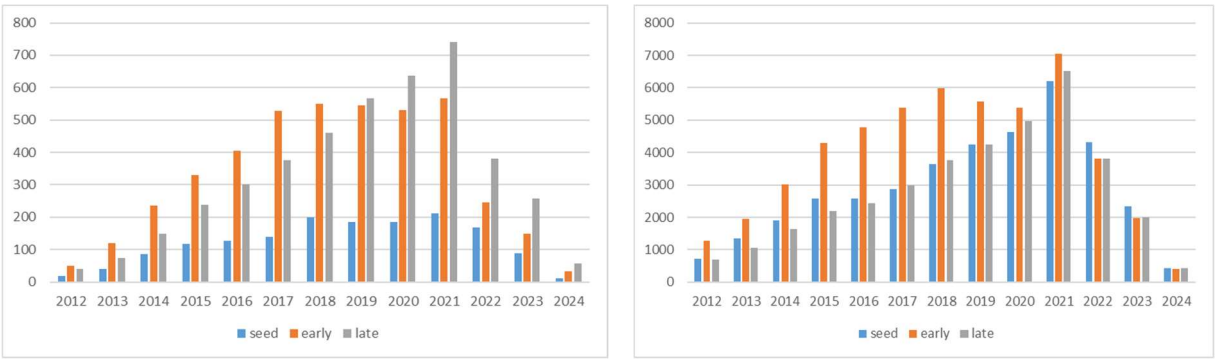

Figure A1 Number of CVC deals in 2012-2024 by stage (left) and number of VC deals in 2012-2024 by stage (right). Source: JRC elaboration, data source: Pitchbook

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