Data access and regime competition: A case study of car data sharing in China

Bertin Martens and Bo Zhao

Abstract
We study the case of a Chinese industrial policy, implemented in Shanghai that makes it mandatory for car manufacturers to share electro-mechanical performance and real-time navigation data from their entire fleet of electric and hybrid vehicles with local and central government authorities. This policy seeks to prevent fraud in state subsidies, reduce emissions, assess the performance of New Energy Vehicles and strengthen the competitiveness of Chinese manufacturers of these vehicles. We argue that economies of scope in data aggregation may provide traditional market failure arguments in favor of government intervention and mandatory data pooling. Our paper illustrates how data access regimes could be used for economic competition. The EU and China pursue similar data sharing and pooling policy goals that hinge on economies of scope in data aggregation. However, they follow very different political processes to achieve these goals.

Keywords
Data access, data regime competition, B2G and B2B vehicle data sharing, China

Introduction
During the US Senate hearing on the Cambridge Analytica case in April 2018, Marc Zuckerberg, Facebook CEO, argued that, if the US would follow the EU’s strict privacy regulation, Chinese competitors may gain the upper hand in technological competition. While he agreed with the need for data regulation, he also suggested privacy carve-outs to enable innovation in the face of rivalry from China (Horwitz, 2018, Lomas, 2018). Similar arguments have been made by other American tech corporations regarding regulatory constraints on privacy imposed by technological competition (Wu, 2018). Empirical economic research corroborates this point of view. Several studies show how the entry into force of personal data protection in the EU General Data Protection Regulation (GDPR) slowed down investment in innovative start-ups in the EU. It may also have adverse effects on competition in digital services in the EU, compared to other countries and regions (Degeling et al., 2019; Janssen et al., 2021; Jia et al., 2018; Johnson et al., 2020; Layton, 2019; Peukert et al., 2020). These studies have highlighted possible tension between individual data protection and economic growth, competitiveness and innovation benefits for society. Proponents of privacy regulation will retort that data protection is a fundamental human right that should not be subject to economic reasoning.

This paper does not focus on the tension between individual and societal value of personal data. It explores similar tensions in non-personal commercial and machine data that fall outside the scope of the EU privacy regulation. Business-to-business (B2B) access and trade in non-personal data is mostly determined by market forces and technical protection measures. Until recently, there were few instances of regulatory intervention in this domain. Over the last years however, regulators have been gearing up for intervention in the B2B data market, mostly with a view to increase competition around large online platforms with monopolistic market power. The Digital Markets Act is an example of this approach (European Commission, 2020b). However, several recent EU policy proposals go beyond this competition perspective and seek to promote B2B data access and sharing as a tool for a more efficient use of data and better societal outcomes in a wide range of sectors (European Commission, 2020b). Bughin et al. (2019) suggested that Europe should enable secure access for innovators to business data pools that they do not own. The European Commission has taken some steps in

1Joint Research Centre, European Commission, Seville, Spain
2Tilburg Institute for Law, Technology, and Society (TILT), Tilburg University Law School, the Netherlands

Corresponding author:
Bertin Martens, Joint Research Centre of the European Commission, Calle Inca Garcilaso 2, Edificio Expo, Seville, Spain.
E-mail: Bertin.Martens@ec.europa.eu

Creative Commons NonCommercial-NoDerivs CC BY-NC-ND: This article is distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 License (https://creativecommons.org/licenses/by-nc-nd/4.0/) which permits non-commercial use, reproduction and distribution of the work as published without adaptation or alteration, without further permission provided the original work is attributed as specified on the SAGE and Open Access page (https://us.sagepub.com/en-us/nam/open-access-at-sage).
that direction, with proposals for Business-to-Government data sharing (B2G) when in the public interest (European Commission, 2020a), new regulation for data sharing platforms under the Digital Governance Act (European Commission, 2020c) and possibly wide-ranging horizontal B2B data sharing rules under a forthcoming Data Act. Some authors even propose that governments should be central players in B2B data sharing and the allocation of access rights (Prüfer and Graef, 2021). The perceived trade-off here is between exclusive private business control of commercial data versus the innovation and competition benefits of wider access to business data.

While the B2B data policy debate is mostly focused on domestic competition issues around large platforms, global data regime competition is looming in the background. We define data regime competition as the use of data, and data access regulations, to give an advantage to domestic firms over firms in foreign jurisdictions. While individuals are unlikely to switch countries because of differences in data protection regimes, firms may benefit from data access regulation in their domestic jurisdiction to strengthen their competitive position in export markets. Data regulation will depend on the nature and characteristics of political regimes, including how they account for domestic consumers’ and firms’ preferences, how they trade off private welfare of individuals and firms against overall welfare for society, and how they deal with this trade-off in a global competition setting where other countries may opt for different trade-offs.

The objective of this article is to explore these complex trade-offs with a concrete case study of mandatory B2G data sharing for electric cars in China. In 2017, a Chinese law entered into force that mandates all sellers of New Energy Vehicles (NEV, mostly electric and hybrid vehicles) to collect electro-mechanical and navigation data during the daily use of all their vehicles and transmit these to local government-operated servers. Government in turn can make the data available to manufacturers (B2B) and researchers to accelerate innovation. The objectives of the law are to promote the use of clean vehicle technologies in China and to accelerate domestic innovation in electric vehicles. Taking a case study from the automotive sector has several advantages from an EU data policy perspective. First, the sector has a long track record of mandatory B2B data sharing to increase competition in maintenance services (European Union, 2018). Second, the first timid steps towards very limited mandatory B2G data sharing have been taken in this sector (European Commission, 2013). Third, there is an ongoing policy debate on further B2B and B2G data access regulation to facilitate rapid technological innovation in electric and self-driving cars and in the organization of sustainable mass mobility (European Commission, 2018 and 2020a). Fourth, one could argue that here is a personal data dimension in these mechanical and navigation car data because it can be linked to the behavior of individual drivers. However, we argue that personal data are irrelevant for the industrial and technological innovation applications that we discuss in this paper. Fully anonymized data are just as valuable for these applications. Our Chinese case study covers all these aspects and pushes them to a rather extreme form of almost unconditional B2G and B2B data sharing. This enables us to explore the consequences of far-reaching data sharing policies and highlight the implications for regime competition. Moreover, this case is set in a Chinese political economy context that puts relatively more emphasis on societal benefits compared to individual gains. We illustrate how this enables Chinese data regulators to go far beyond what is conceivable or acceptable in the EU context.

We argue that there are significant economic benefits in this NEV data sharing regime in terms of accelerating the pace of innovation in the electric vehicle industry, stemming from economies of scope in data aggregation or data pooling. This implies that more insights can be extracted from pooling of complementary datasets compared to keeping them in separate data silos (Martens, 2020). As a result, the social value of pooled data is higher than the sum of private values of segmented data. That is, by definition, an indicator of market failure. In an unregulated private data market, information about the performance of innovative electric car technologies remains locked in manufacturers’ private data silos. They have no incentive to share this information with competitors because it may erode their profits. As a result, the true performance of technologies remains hidden. This causes information frictions in markets and has negative effects on private consumer welfare and social welfare from emission reductions. The government’s mandatory data pooling overcomes these obstacles and can potentially reveal the best performing technologies to all stakeholders. That spurs innovation. To the extent that innovative technology is exported - embodied in cars, car parts or licenses to use the technology - consumers in other countries also benefit. As such, the regime can be justified from a traditional economic perspective as a regulatory intervention to overcome a market failure in data sharing markets. Producers in other countries will suffer from a competitive disadvantage however when they do not have access to the data. The government’s role as a data intermediary is not necessarily neutral and may create distortions in the competitive level playing field between manufacturers, in particular between domestic and foreign manufacturers, in order to strengthen the position of Chinese manufacturers in domestic as well as in foreign markets. This indicates a regime competition dimension in our case study.

The remainder of this paper is structured as follows. Section 2 gives a short overview of the wider literature on regime competition. Section 3 compares data regulation in general and in the automotive sector in the EU
and China. Section 4 describes the specific case of business-to-government (B2G) data sharing for electric cars in the city of Shanghai. Section 5 discusses the economics of data sharing and applies this to the case of electric cars in Shanghai. It shows how the Shanghai database could affect electric vehicle manufacturers and consumers in China, compared to their counterparts in the EU. Section 6 concludes.

A brief literature review on regime competition

Regime competition could be defined as competition between governments with a policy monopoly in their respective jurisdictions. This is not a new concept in social science, including in economics and political science. The objective of regime competition can be to ensure that a political regime prevails or to reinforce social welfare of citizens to enhance legitimacy of political regimes. Political regime competition emerged between western liberal democracies and Eastern socialist countries during the old Cold War period (Obinger and Schmitt, 2011). Budzinski (2008) linked the term to governance of global competition, including regulatory competition for example in labor law and labor market regulation. At the time of EU enlargement, competition between existing and new Member States in Central and Eastern Europe in labor and product markets was an issue (McDowell and Thom, 1999; Maslauskaite, 2013). Some authors regard the emerging rivalry between the US and China as a new form of political regime competition (Cooper and Brands, 2021). With the rise of China’s economic and geo-political power in recent years, the EU has taken China explicitly as “an economic competitor” and “a systemic rival promoting alternative models of governance” (European Commission, 2019), indicating emerging regime competition in terms of economic and governance models.

The EU has a market-driven economic regime where state intervention in the private sector is restricted by competition law. EU governments can intervene through taxes and subsidies, subject to restrictions in order not to distort the normal activities of open markets. Attempts by Member States to distort the level playing field to give local firms an advantage in international competition are subject to strict state aid rules. Guidelines on regulatory intervention emphasize that this can only happen in cases of demonstrated market failures, regulatory failures or equity concerns (European Commission, 2017). In contrast, China’s political economy regime allows for stronger state intervention whereby the Communist Party, state authorities and industry are closely interacting with each other. The government can intervene in public or private enterprises whenever it deems useful and necessary, without having to provide market failure arguments. Moreover, the Chinese government has direct control of State Owned Enterprises, a legacy of the old socialist economy. They are some of the biggest players in both domestic and global markets, and remain in charge of China’s key industries (Zhang, 2019). There is also strong competition between provincial governments to promote the competitiveness of local firms by means of subsidies and other advantages. Tiebout (1956) presented an economic model to explain this form of tax and subsidy regime competition between jurisdictions. The ability of people and firms to migrate between jurisdictions imposes restrictions on policy makers’ choice of tax regime. Taxpayers, whether firms or citizens, will compare the quantity and quality of public services that they receive in return for their taxes. Large global digital companies have exploited differences in tax regimes to set up headquarters in low tax jurisdictions. This has triggered action from the EU competition authority, most famously in the Apple-Ireland tax case (European Commission, 2016b).

With regard to data regimes, Roberts et al. (2020) argue that an important difference between EU and Chinese approaches is that the EU prioritizes individual privacy, commercial confidentiality and respect for private interests. This makes it easier for EU car manufacturers to push back against major data sharing initiatives when it does not suit their private interests. It contrast, the Chinese approach prioritizes collective national and societal welfare over individual welfare. It seeks to maximize the social value of data, even if this may come at the expense of private interests of firms and individuals.

Differences in approaches to privacy protection illustrate this. The EU enacted a new General Data Protection Regulation (GDPR) in 2018 to achieve coherent personal data protection as a fundamental right across the EU. Other countries have been inspired by the EU example (Manners, 2002), for example the California Consumer Privacy Act (2019). Economic research mostly finds that the GDPR has a negative impact on investment and innovation in the EU (Degeling et al., 2019; Janssen et al., 2021; Jia et al., 2018; Johnson et al., 2020; Layton, 2019; Peukert et al., 2020). Proponents of privacy rights will retort that privacy is a fundamental and non-tradable human right. They are not designed with economic costs and benefits in mind. In the EU policy context, these costs are acceptable to protect personal freedoms and rights.

China has recently adopted a number of significant regulations that include multiple provisions to protect personal data, such as in China’s Tort Liability Law (Art. 30), the new E-commerce Law (Art. 13, 18 and 24), the Cybersecurity Law (Art. 76), the recent cross-border data protection draft law (Luo et al., 2019), and a new draft Personal Data Protection Law recently released for public consultation (Zhang and Yin, 2020). This includes a definition of personal data similar to the GDPR in Art. 76 of the Cybersecurity Law, and specific clauses for data protection and legal duties for data controllers and processors.
under Art 25 of the Chinese E-Commerce law. However, unlike the EU, China does not have a comprehensive data protection law yet (although in preparation) for unified, cross-sector personal data protection. It has given higher priority to economic and technological development compared to privacy protection (Zhao and Yang, 2021). We also need to consider lenient law enforcement and less privacy awareness among citizens in China. At the same time, these regulations grant state authorities (almost) unlimited access to all data held by private firms whether personal or non-personal and for whatever reason deemed in the interest of the state. For instance, Art. 25 of China’s E-Commerce Law obliges e-commerce operators to provide e-commerce data according to any existing laws and regulations, without further specification of which laws and regulations.

In the EU, the GDPR allows government access to personal data for security reasons but not for economic reasons. Mandatory B2G access to commercial data is very restricted. There are some specific legal frameworks that mandate access for taxation and statistical purposes, for environmental reporting or prudential supervision of banks for example. With the rise of digital data, digital firms often hold data that could be very useful for government policy making. The European Commission (2020b) released a policy report on voluntary initiatives to facilitate B2G data sharing in the public interest. It is very hesitant to recommend mandatory B2G data sharing. This stands in contrast to China where government access to private data is an integral part of the legal framework.

**Access to automotive data in the EU**

Modern cars produce substantial volumes of data while driving. These data can be collected outside the car and used for a wide variety of private aftermarket services as well as for public policy purposes such as environmental policies and the promotion of innovation in new car technologies (Kerber and Frank, 2017; Martens and Müller-Langer, 2020). In the EU, automotive (and more generally transport and mobility) data policies are moving towards more B2B and B2G data sharing (European Commission, 2018). However, these initiatives often run into opposition from private firms that collect and use data for commercial services. Sharing may entail private costs for data holders. The shared data may be used by competitors to improve their market position (Carballa, 2018).

In order to overcome market failures from incentive misalignment, government intervention with mandatory data sharing rules may be required, as the case of the Chinese electric vehicle data sharing initiative illustrates.

B2B car data sharing is not new in the EU. Car manufacturers have to share basic repair and maintenance data with service providers under the Type Approval Regulation (European Union, 2018). This includes provisions for one-to-one B2B access to car maintenance data but not pooling of these data across businesses. There are mandatory B2G data sharing provisions for a very limited set of road safety data, between car manufacturers and road traffic authorities (European Commission, 2013). Policy initiatives to promote B2B digital car data sharing started in 2014. However, an automotive industry working group admitted that conflicting interests prevented an agreement on B2B car data sharing between car manufacturers and aftermarket service providers (European Commission, 2016a, 2016b, 2016c).

The European Commission’s Third Mobility Package (European Commission, 2018) launched more ambitious policy proposals for wider data access and sharing between transport devices, infrastructure and mobility management services. These programs seek to promote B2B and B2G data sharing among automotive and transport service providers with a view to develop more efficient transport and mobility systems. It also announced European Commission Recommendation on data governance in the mobility sector that did not materialize so far.

**Mandatory access to electric vehicle data in China**

The Chinese government is aware of the significance of New Energy Vehicles (NEV) for the future of China’s car industry, and launched a car data sharing initiative as part of its industrial policy in the automotive sector (Heller, 2017). While Western car manufacturers have a comparative advantage in combustion engines and car mechanics, the Chinese strategy seeks to leap-frog towards the development of electric cars that it sees as the most promising future of car technology. Heller documents how the Chinese government has taken five measures to boost China’s NEV sector, including tax cuts, government subsidies to consumers and car makers, industrial policy measures and mandatory government procurement of NEVs. These policies explicitly seek to boost domestic NEV manufacturers and enable them to compete with top foreign players, on domestic and foreign markets (Yulan, 2018). The most important (policy) law is the “Management Rules on the Market Entry of New Energy Vehicles Manufacturers and Products” by the Ministry of Industry and Information Technology (2017), which came into force as of July 1st 2017. Art. 3 defines NEVs as vehicles “that adopt new types of power systems and that are completely or mainly driven by new types of energy, including plug-in hybrid, pure electric and fuel cell vehicles, among others.” This national regulation makes it compulsory for all NEV manufacturers, both domestic and foreign, to establish their own NEV data platform to monitor the security and operating status of their cars. These platforms must share their data with both national and local platforms as a condition for
market size, technical capacities and local government and technical features may vary depending on local to the national data center in Beijing. Size, organization supported by university research institutes with data ports and Hunan province, and Tian Jing. They are technically centers, including in Jiangxi (Yang et al., 2018), Anhui form, which is over half of all NEVs in China (Yulan, 2018). NEV data collection and transfers.

The stated objectives of the 2014 law include the promotion of sustainable economic development and carbon emission reductions. However, other applications are legitimate in the law. This includes government oversight of NEV technology developments and enhancing product quality and safety for Chinese NEV manufacturers, stimulating the adoption of break-through technologies, improving public safety and governance such as land planning for charging stations, and combating fraud in applications for NEV subsidies. Art. 18 mandates NEV producers to collect data over the lifespan of each NEV, tracking driving, repairs and maintenance, battery use and recycling. It is also mandatory under Art. 18 to analyze and synthesize the technical status of their NEVs, problems and other major issues, and compile annual reports. Art. 22 allows relevant government authorities at provincial level to check manufacturers’ NEV monitoring platforms and request reporting of major changes in technology, security risks in production and management, and any breaches of the law to the Ministry of Industry and Information Technology. The law has caused concern among foreign car manufacturers because it may affect their competitive position and commercial secrets, as well as privacy protection for drivers (Kinetz, 2018). They are forced to comply with the law in order to gain access to the world’s largest NEV market (O’Kane, 2018).

China established a national data center, the NEV Monitoring and Management Platform, at the National Engineering Laboratory for Electric Vehicles at the Beijing Institute of Technology. This national center collects NEV data from all local data centers. By July 2018, 1.025 million NEVs were connected to the state data platform, which is over half of all NEVs in China (Yulan, 2018). Several Chinese provinces started local NEV data centers, including in Jiangxi (Yang et al., 2018), Anhui and Hunan province, and Tian Jing. They are technically supported by university research institutes with data ports to the national data center in Beijing. Size, organization and technical features may vary depending on local market size, technical capacities and local government’s policy orientations. The NEV center in Shanghai is the most important. The local government of Shanghai adopted a temporary policy to encourage purchase and use of NEVs in 2016, and more permanent rules as from 2018 (Nengyuan Toutiao, 2020). As more or less a copy of the national regulation, the 2016 policy provided subsidies for NEV owners up to 50% of the purchase price. According to Art. 8(2) and 9, subsidies are conditional on a remote real-time connection to transfer vehicle data to Shanghai’s NEV data center. Local subsidies run the risk of fraudulent use by consumers living outside the local area. Car navigation data enable the authorities to monitor the effective use of subsidized NEVs in Shanghai.

Art. 9 explains the legal status of the Shanghai Electric Vehicle Development Centre (SHEVDC) as an independent institute in charge of establishing Shanghai’s NEV data platform (Yulan, 2018). SHEVDC’s responsibilities include: (1) collect data related to NEVs in Shanghai and provide security monitoring for NEV promotion; (2) conduct customer behavior analysis and battery health research; (3) provide consulting support for NEV promotion, policy making and evaluation, and complementary infrastructure planning; (4) establish the Shanghai NEV Data Open Innovation Laboratory and explore open data innovations; (5) actively conduct domestic and international cooperation and exchange, and build a professional, open and integrated platform for cooperation and exchange. The Centre cannot carry out any for-profit activities connected to the data processing without permission of car manufacturers. The Centre has been incorporated into a larger local industrial project by Shanghai Municipality Xiaozheng Strategy that aims to develop a world-class open data and innovation center. Five university data labs and one state-owned local data center joined the project to set up a data innovation lab within the Centre.

The Centre currently collects 44 static data points for each car, including information on car models, registration number, chassis and vehicle identification number, engine and battery types and fuel use, mechanical malfunction codes, E-engines and batteries, etc. Moreover, it collects 80 dynamic data points while the vehicle is driving. These include vehicle status and speed, engine temperature, revolutions and torque, battery charging status and temperature, any alarms and error codes produced by the vehicle, and vehicle position. These data are sufficiently detailed to track the performance of different models of electric engines and batteries from various suppliers.

The Centre compiles basic analytics of NEV use, including charging and energy consumption patterns (Hai, 2017). It can provide tailored research reports upon request. It organized research competitions, for instance to study the performance of batteries, that was open to all university researchers (SHEVDC, 2019). The National NEV Data Center at Beijing Institute of Technology organized a similar open competition on NEV data in 2019 focusing on data analysis and algorithms design (National NEV Data Centre, 2019). The Centre has a data lab where researchers can access the collected data on the server of the Centre subject to certain conditions. In principle, any researcher including car manufacturers, can access the data provided that permission is granted by the Centre. Upon payment of a fee, access is allowed to anonymized
mechanical data. Anonymization requires stripping car and driver identities from the data and diluting fine-grained navigation data that could reveal home and work addresses. From a legal point of view, it could be argued that, to the extent that personal identifiers are effectively stripped from the NEV data when used for research purposes, they constitute non-personal machine data. For the purpose of most technological performance research, personal and fine-grained navigation data are anyway irrelevant.

Concerns have been raised about driver privacy protection. Car manufacturers share a complete datasets with the SHEVDC server (B2G), including car identification details that permit the identification of the driver or at least the owner. In principle, the Centre shares only anonymized data with researchers and other manufacturers (B2B). While the identity of car drivers is irrelevant for the purpose of NEV technology research that focuses on the technical performance of cars and car parts, the Centre, and government authorities retain access to personal driver data. If Chinese data protection law would have been strictly applied, such a large scale personal data collection would be problematic. Current and draft legislation aims for a higher level of protection. The Chinese government may have purposely applied a lenient interpretation of data protection - in contrast to more restrictive data protection law developments in recent years (Zhao and Yang, 2021) - in order to verify illegal use of NEV subsidies. In the EU, digitally connected cars also share personal data with car manufacturers, including car and driver identities and navigation data. The GDPR does not permit re-use and sharing of these personal data with governments or other firms, unless the driver has given his consent or after anonymization.

According to the Centre’s website, it has published a series of annual reports on NEV use in Shanghai (2017 and 2018), on Shanghai’s NEVs market characteristics and customer behavior (2014 and 2016). There is also a report on the state of charge of batteries in NEVs, including the length, time, and charging locations, and drivers’ charging habits, on designing and planning of charging stations, and a report on consumer awareness and experiences (2015). One report found that for 48% of purely electric cars the cruising radius is less than 200 kms. Besides, the open data competitions will have produced research obtained from analyzing the data pool in order to help them improve their technologies and the quality of their cars. We have not found any published reports that document technological innovations extracted from the data pools or government-to-industry data sharing policies. Given the stated objective of the NEV law that explicitly seeks to promote industrial innovation in NEVs, and given the strong interaction between universities and domestic industries in China, selective and secretive information sharing and spill-overs to NEV manufacturers is a more likely scenario. One could also imagine a scenario whereby data sharing is extended to all automotive parts and components suppliers and aftermarket service providers, or full data sharing across all firms involved in the NEV industry ecosystem. The governmental NEV data institutes would then serve as a conduit to achieve full B2B NEV data sharing. This scenario would further increase competitive pressures in the NEV industry and accelerate the pace of innovation at the level of components suppliers. The benefits from successful innovations in engines, batteries and other key NEV technologies would rapidly spill over to competitors.

It is not clear how these research institutes collaborate with NEV manufacturing firms and give them direct access to the data or indirectly share technology insights...
Chinese firms. Since EU (and US) manufacturers have factories all over the world, they can transfer the knowledge gained in China to all their factories. This would create a global level playing field in NEV manufacturing and disseminate the welfare effects from the China NEV data pool worldwide. The effectiveness of data regime competition thus depends on the degree of technology transfers between domestic and foreign manufacturers and the extent to which access to data centers is biased in favor of domestic researchers and manufacturers.

**The potential economic implications of the NEV database**

In this section, we present a more conceptual approach to examine the potential economic impact and welfare gains that could be achieved by mandatory B2G car data sharing. This revolves around the concept of economies of scope in the aggregation of complementary datasets. We argue that these economic benefits from data sharing are unlikely to occur in private car data markets where data remain confined in separate manufacturers’ data silos. Forgoing these benefits constitutes a market failure that would justify regulatory intervention in the form of mandatory data sharing. Data pooling creates new problems however: who has access to the pooled data and how to distribute the welfare gains from economies of scope?

Cars are rival goods. They can only be driven by one driver on one route at the time. Data are non-rival. They can be used for many purposes at the same time. If cars would be non-rival, many drivers could use the same car to drive different routes at the same time. Cost savings due to the re-use of the same product for a different purpose are known as economies of scope (Panzar and Willig, 1981; Teece, 1980). In the case of data, a peculiar form of re-use occurs when several datasets are merged or pooled. To the extent that the merged datasets are complementary and non-overlapping, the insights that can be obtained from the merged set, or the value of these insights, is greater than the sum of insights obtained from the separate datasets. In other words, keeping complementary datasets in separate silos entails a loss of knowledge or insights that can be extracted from the data (Martens, 2020). This additional value is called economies of scope in data aggregation.

In the economic literature, the concept of economies of scope in the aggregation of complementary datasets can be traced back to the economics of learning and division of labor (Rosen, 1983). When two datasets are complementary and not entirely separable, applying data analytics – the equivalent of learning – to the merged set will yield more insights and be more productive than applying it to each set separately, especially when the marginal cost of applying analytics to a larger dataset is relatively small. In the case of car data, the aggregation of mechanical and electrical performance data across car models and brands would produce better insights into the performance of different types of batteries and electrical engines, compared to the analysis of separate datasets for each manufacturer.

Manufacturers of cars and car parts invest in innovation to become more competitive and attractive to consumers. Industrial designs and technological innovations are non-rival but they can be made excludable, either because they are protected by Intellectual Property Rights (IPR, i.e. patents, trademarks, copyright) and/or by trade secrets. IPR enable manufacturers to reap innovation rents. IPR keep a balance between private technology rents and spill-over effects to promote innovation. Although competitors can at least partially observe the technical construction of cars and parts, they cannot use this information to replicate the innovation and sell it. That would be a violation of IPR. While parts in cars are observable for all, the performance of these parts in response to driver behavior is not readily observable or testable in laboratory settings. Digital sensors make it possible to collect that information in vivo. This brings faster and more fine-grained feedback to manufacturers to improve their car designs. Centralizing the data on manufacturers’ servers provides them with an exclusive performance overview of all car models and parts from their brand. They may share some of these insights with parts producers to improve the performance of parts. They will not share it with competing car manufacturers because it erodes their technology rents. It may be used against them and increase competitive pressure in their markets. Manufacturers know the true performance of their cars and parts but not of other cars and parts from other brands. This reduces technology spill-over effects and competition in the car market. It results in underinvestment in innovation by manufacturers and slows down the pace of innovation. The NEV data pool lifts the veil of commercial confidentiality over the performance of cars and car parts. While driver identities can be protected through anonymization of car data, there is no legislation that protects the identity of car and car parts manufacturers. Privacy regulation does not apply to legal or commercial entities. Exposure of performance characteristics accelerates the pace of innovation. Economic research finds that more neck-and-neck competition between firms accelerates the pace of innovation (Aghion et al., 2005). It also accelerates the rate of depreciation of capital stock and intellectual property invested in older and less-performing technologies. This increases investment costs for car manufacturers as well as for drivers who want to keep up with technological innovation.

There is consumer demand for better-performing NEVs. However, incomplete information on the performance of cars may steer consumers towards sub-optimal choices. They can only use general and more subjective car tests in consumer periodicals for example to fill up their
information gaps. This lowers competitive pressures, resulting in welfare losses for society. Genuine technological improvements cannot be monetized by the manufacturer through higher prices and sales because the consumer is not aware. For the same reason, technology laggards may monetize inferior technology. Manufacturers have no way to credibly signal the true performance of their cars to consumers. This creates information fictions and inefficiencies in the car market, both for consumers and manufacturers. Pooled NEV data could be used to set up more sophisticated consumer subsidy systems whereby better performing cars get higher subsidies. Variable subsidies would constitute a credible signal to buyers about the environmental quality of the vehicle. It could increase transparency and reduce asymmetric information in the car market, and help consumers make more informed choices. Manufacturers can monetize the environmental externalities from better performing NEVs through higher pricing of these cars.

Imperfect and asymmetric information are well-known sources of market failure (European Commission, 2017). Economies of scope in data sharing and pooling can reduce these frictions. It can boost welfare effects from innovation spill-over’s between competitors, speed up innovation and make better-performing technologies more widely and rapidly available. These frictions are more important in a fast-moving technology domain like NEVs and may lead to more sub-optimal choices by manufacturers and consumers. To be sure, the same asymmetric information problem existed in pre-digital car markets and in non-electric vehicles. The arrival of digital data makes it potentially easier to address the problem by re-using car performance data from manufacturers’ silos and pool them to generate economies of scope from complementary data aggregation across brands and models. This requires government intervention and mandatory data sharing because private car manufacturers have no incentive to share their car performance data.

Economies of scope in data aggregation increase the social value of data for society as a whole, compared to the sum of values of data for individual data holders. However, the distribution of that value-added may be unequal. Some car manufacturers may lose and others may gain. A fundamental question is how far regulators can go in imposing costs on private stakeholders with a view to improve overall innovation benefits. It puts individuals rights first. Individuals have the right to defend themselves against government intrusion in their private welfare. Under Pareto welfare rules, no individual should be made worse off as a result of a policy decision. It puts individuals rights first. Individuals have the right to defend themselves against government intrusion in their private welfare. Under Kaldor-Hicks welfare policy rules, some individuals can be made worse off as long as society as a whole benefits. In that case, winners can – at least theoretically - compensate losers while still keeping a net benefit. Kaldor-Hicks welfare policies put collective rights first

The fine line that separates the two approaches in precisely in the policy process that determines how to deal with winners and losers. China seems to have chosen a top-down approach with a government-imposed regime, while the EU prefers a bottom-up approach that seeks a consensus among stakeholders. The EU’s cautious approach to car data access and sharing (European Commission, 2016a) illustrates this. Regulators were favourably disposed towards an open car data pooling and access system but private maintenance service providers did not agree with the restrictive conditions that car manufacturers proposed on data access (Ducuing, 2020; Martens and Müller-Langer, 2020). The European Commission was reluctant to impose a mandatory data sharing system in the absence of consensus among industry stakeholders. That would have delivered gains for maintenance providers but a set-back for manufacturers. It would have violated the Pareto principle. In the presence of economies of scope in data aggregation however, mandatory data sharing could be beneficial for society. Replacing the Pareto principle with the Kaldor-Hicks principle could be desirable from a social welfare point of view.

Conclusions

This paper examines a case of data regime competition. It studies a policy initiative in China that makes B2G sharing of NEV usage data mandatory. The policy seeks to achieve three objectives: prevention of fraud in NEV subsidy applications, the acceleration of innovation in NEV technologies in China’s car industry, and the promotion of clean car technologies for environmental purposes. The EU pursues similar policy objectives but has so far shied away from mandatory B2G car data sharing, except in a few minor cases related to road safety. EU car manufacturers are resisting any measures that might erode their exclusive control over car data, as demonstrated by earlier attempts (European Commission, 2016a, 2016b, 2016c). Mandatory B2G data pooling policy would be perceived as excessively interventionist in the EU political economy context that puts more emphasis on industry self-regulation and market-driven initiatives to promote technical standards for data sharing. Regulatory intervention is possible only in the case of clearly demonstrated market failures (European Commission, 2017) or overriding public interest (European Commission, 2020b). In contrast, the state is a dominant player in the Chinese economy and actively intervenes in markets and firms in many ways, far beyond what would be politically feasible in the EU.

Data pooling exploits a peculiar economic characteristic of data: it can generate beneficial welfare effects by means of economies of scope in the aggregation of
complementary data. Data segmentation between car brands generates imperfect and incomplete information and creates information friction in car markets and markets for innovative technologies. That slows down innovation. Mandatory B2G data pooling can potentially overcome inherent B2B data market failures that inhibit the realization of economies of scope in data aggregation. From this perspective, the Chinese government’s mandatory B2G data sharing policy initiative is in line with traditional market failure criteria for regulatory intervention, including those advocated by the European Commission’s “Better Regulation Guidelines” (European Commission, 2017). However, it does not match with the EU’s policy preference for the protection of private rights over collective interests - contrary to China that tends to reverse these priorities.

We conclude that this form of data regime competition between China and the EU can give China an advantage in terms of promoting innovation in the electric car industry. There could potentially be discrimination between domestic and foreign NEV manufacturers in terms of access to the data and knowledge derived from the data. To what extent this is true is difficult to detect and would require further research on access to innovation in joint ventures in China’s car industry.

The EU has been working for several years on data access and sharing policy initiatives. All these initiatives are explicitly or implicitly based on welfare gains from economies of scope in data aggregation and re-use. Regulatory intervention is required because private data holders have no incentive to share their data and prefer to keep their data in inaccessible silos. Most recently, the European Commission’s (2020a) Data Strategy seeks to enable the emergence of common European data spaces for B2B pooling of industrial data in a variety of sectors. EU-promoted but privately run third-party industrial data pools have also come up in the context of AI innovation policy initiatives. While the objectives are broadly similar, the political process to achieve them is different. China goes for a top-down government initiative, while the EU prefers a more bottom-up industry-driven approach. The EU approach is slower because of conflicting interests between private stakeholders. The primacy of the Pareto principle over the Kaldor-Hicks welfare concept is an obstacle to collective action and the realization of societal welfare goals. The Chinese approach is faster in creating access and sharing policy initiatives and do not necessarily reflect those of their institutions. The authors would like to thank Giorgio Monti at TILEC (Tilburg Law and Economics Center) for his valuable comments and suggestions, as well as other colleagues at Tilburg Law School for their feedback on various occasions. A remaining errors are ours.

1. Bertin Martens is a senior economist at the Joint Research Centre of the European Commission in Seville, Spain. Bo Zhao is a senior research fellow at the Tilburg Institute for Law, Technology, and Society (TILT), Tilburg University Law School, the Netherlands. The views and opinions expressed in this paper are the authors’ and do not necessarily reflect those of their institutions. The authors would like to thank Giorgio Monti at TILEC (Tilburg Law and Economics Center) for his valuable comments and suggestions, as well as other colleagues at Tilburg Law School for their feedback on various occasions. A remaining errors are ours.

2. See the Center’s website, available at: https://www.shevdc.org/zyzn.html (Accessed 28 March 2021).
3. All information is available at SHEVDC’s website, see: http://www.shevdc.org/sysbtp06.html
4. See the brief introduction by the Centre, at: https://www.shevdc.org/sysbtp06.html (accessed 2 March 2021)
5. See: http://www.shevdc.org/report/original_report/ (accessed 15 Mar. 2021)
6. See NEV Report Shows, http://m.cqn.com.cn/zgzlb/content/2019-08/21/content_7444646.htm (Accessed 12 September 2021).
7. See: http://www.shevdc.org/laws1/1910.html (accessed Mar. 15 2021)
8. An overview of EC data policy initiatives over the last couple of years is available at: https://ec.europa.eu/digital-single-market/en/data-policies-and-legislation

**Declarations of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) received no financial support for the research, authorship and/or publication of this article.

**ORCID iD**

Bertin Martens https://orcid.org/0000-0002-6697-7872

**Notes**

1. Bertin Martens is a senior economist at the Joint Research Centre of the European Commission in Seville, Spain. Bo Zhao is a senior research fellow at the Tilburg Institute for Law, Technology, and Society (TILT), Tilburg University Law School, the Netherlands. The views and opinions expressed in this paper are the authors’ and do not necessarily reflect those of their institutions.

2. See the Center’s website, available at: https://www.shevdc.org/zyzn.html (Accessed 28 March 2021).
3. All information is available at SHEVDC’s website, see: http://www.shevdc.org/sysbtp06.html
4. See the brief introduction by the Centre, at: https://www.shevdc.org/sysbtp06.html (accessed 2 March 2021)
5. See: http://www.shevdc.org/report/original_report/ (accessed 15 Mar. 2021)
6. See NEV Report Shows, http://m.cqn.com.cn/zgzlb/content/2019-08/21/content_7444646.htm (Accessed 12 September 2021).
7. See: http://www.shevdc.org/laws1/1910.html (accessed Mar. 15 2021)
8. An overview of EC data policy initiatives over the last couple of years is available at: https://ec.europa.eu/digital-single-market/en/data-policies-and-legislation

**References**

Aghion P, Bloom N, Blundell R, et al. (2005) Competition and innovation: An inverted-U relationship. Quarterly Journal of Economics 120(2): 701–728.

Baujard A (2013) Chapter 42: Welfare analysis. In: Faccarello G and Kurz H (eds) Handbook of the History of Economic Analysis. Developments in Major Fields of Economics (Vol 3, pp. 612–642). Cheltenham UK: Edward Elgar Publishing Limited.
Buckland K (2018) Chinese Carmakers Under Pressure as Joint-Venture Caps Erased. Bloomberg.com, 18 April. Available at: https://www.bloomberg.com/news/articles/2018-04-18/tesla-bmw-unshackled-from-jv-era-puts-china-carmakers-on-notice (accessed 1 December 2020).

Budzinski O (2008) The Governance of Global Competition: Competence Allocation in International Competition Policy. Cheltenham, UK: Edward Elgar Publishing.

Bughin J, Windhagen E, Smit S, et al. (2019) Innovation in Europe. McKinsey Global Institute, discussion paper October 2019.

Carballa B (2018) Determinants of coopetition through data sharing in MaaS. Management and Data Science 2(3): 24–34.

Chipman J (2017) The Kaldor-Hicks Compensation Principle in the New Palgrave Dictionary of Economics. Published online by London: Palgrave McMillan.

Cooper Z and Brands G (2021) America will only win when China’s regime fails. Foreign Policy, March 11, 2021.

Degeling M, Utz C, Lentsch C, et al. (2019) We value your privacy, now take some cookies: Measuring the GDPR’s impact on web privacy. In: Network and distributed systems security symposium 2019, San Diego, CA, USA, 24–27 February 2019.

Ducuing Ch (2020) Beyond the data flow paradigm: Governing data requires looking beyond data, Technology and Regulation, 2020: 57–64.

Ellerman D (2009) Chapter 6: Numeraire illusion: The final demise of the Kaldor–Hicks principle. In: White M (ed.) published in Theoretical Foundations of Law and Economics (pp. 96–118). Cambridge, UK: Cambridge University Press.

European Commission (2013) Delegated Regulation (EU) No 886/2013 with regard to the provision of road safety-related minimum universal traffic information free of charge to users. European Commission (2016a) Cooperative, Connected and Automated Mobility (CCAM). Available at: https://ec.europa.eu/transport/themes/its/c-its_en (accessed 30 November 2020).

European Commission (2016b) State aid: Ireland gave illegal tax benefits to Apple worth up to €13 billion. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_16_2923 (accessed 2 April 2021).

European Commission (2016c) Final report of CITS Working Group 6. Available at: https://ec.europa.eu/transport/sites/transport/files/themes/its/doc/c-its-platform-final-report-january-2016.pdf (accessed 22 March 2021).

European Commission (2017) Better Regulation Toolbox.

European Commission (2018) Europe on the move, Communication from the Commission to the European Parliament and the Council, 17 May 2018, COM(2018) 293 final.

European Commission (2019) Joint Communication to the European Parliament, the European Council and the Council: EU-China: A strategic outlook.

European Commission (2020a) A European strategy for data, Communication from the European Commission to the Council and the Parliament, 19 February 2020, COM(2020) 66 final.

European Commission (2020b) Towards a European strategy on business-to-government data sharing for the public interest Final Report Prepared by the High-Level Expert Group on Business-to-Government Data Sharing.

European Commission (2021) Proposal for a Regulation of the European Parliament and of the Council on contestable and fair markets in the digital sector (Digital Markets Act), 15 December 2020, COM(2020) 842 final.

European Parliament (2018) Type Approval Regulation for Motor Vehicles. EU 858/2018.

Gallagher KS (2016) Foreign Technology in China’s Automobile Industry. China environment series nr 6 (pp 1–17). Washington DC, US:Wilson Center.

Hai X (2017) Three Chinese Ministries Issued Notices to Promulgate ‘The (Trial) Regulation on Smart Connected Car Road Test’ (in Chinese). Available at: http://www.miit. gov.cn/n1146295/n11652858/n11652930/n3757018/c6128243/content.html (accessed 2 May 2018).

Heller M (2017) Chinese Government Support for New Energy Vehicles as A Trade Battleground. The National Bureau of Asian Research (NBR). Available at: https://www.nbr.org/publication/chinese-government-support-for-new-energy-vehicles-as-a-trade-battleground/ (accessed 31 July 2019).

Horwitz J (2018) Zuckerberg’s talking points: Breaking up Facebook ‘strengthens Chinese companies’. Available at: https://qz.com/1249660/zuckebergs-senate-talking-points-break-up-facebook-strengthens-chinese-companies/ (accessed 23 July 2019).

Janssen R, Kessler R, Kummer M, et al. (2021) GDPR and the lost generation of innovative apps, mimeo, February 2021, available at https://conference.nber.org/conf_papers/116409.pdf

Jia J, Zhe G and Wagman L (2018) The short-run effects of GDPR on technology venture investment. NBER working paper nr 25248, November 2018. Cambridge, MA: National Bureau of Economic Research.

Johnson G, Shriver S and Goldberg S (2020) Privacy & market concentration: Intended & unintended consequences of the GDPR. Mimeo, July 2020.

Kerber W and Frank J (2017) Data Governance Regimes in the Digital Economy: The Example of Connected Cars.

Knetz E (2018) In China, your car could be talking to the government. Available at: https://apnews.com/4a749a421190478486b45e812c9f4ca (accessed 19 December 2018).

Layton R (2019) The 10 Problems of the GDPR: The US can learn from the EU’s mistakes and leapfrog its policy. Available at: https://www.judiciary.senate.gov/imo/media/doc/Layton%20Testimony1.pdf

Lomas N (2018) Zuckerberg urges privacy carve outs to compete with China. TechCrunch. Available at: http://social.techcrunch.com/2018/04/10/zuckerberg-urges-privacy-carve-outs-to-compete-with-china/ (accessed 23 July 2019).

Luo Y, Yu Z and Shepherd N (2019) China Seeks Public Comments on Draft Measures related to the Cross-border Transfer of Personal Information. Available at: https://www.insideprivacy.com/international/china/china-seeks-public-comments-on-draft-measures-on-security-assessment-for-the-cross-border-transfer-of-personal-information/ (accessed 28 July 2019).

McDowell M and Thom R (1999) Eastern Europe: The EU’s frontier – incorporation or regime competition? Journal of Economic Studies 26(4/5): 383–403.

Manners I (2002) Normative power Europe: A contradiction in terms. Journal of Common Market Studies 40(2): 235–258.

Martens B (2020) An economic perspective on data and platform market power. JRC Digital Economy working paper 2020-09, Joint Research Centre of the European Commission, Seville, Spain.
Martens B and Müeller-Langer F (2020) Access to digital car data and competition in aftermarket maintenance services. *Journal of Competition Law & Economics* 16(1): 116–141.

Maslauskaite K (2013) *Social Competition in the EU: Myths and Realities*. Institut Jacques Delors. Available at: https://institutdelors.eu/en/publications/social-competition-in-the-eu-myths-and-realities-3/ (accessed 30 November 2020).

Ministry of Industry and Information Technology (2016) National Technical Specifications of Remote Services and Managing System of Electric Automobiles (GBT 32960-2016, in Chinese). Available at: https://www.chinesestandard.net/PDF/English.aspx/GBT32960.1-2016 (accessed 2 April 2021).

Ministry of Industry and Information Technology (2017) Management Rules on the Market Entry of New Energy Vehicles Manufacturers and Products. Available at http://english.www.gov.cn/policies/latest_releases/2017/12/12/content_281475973694618.htm

National EV Data Center (2019) China’s NEV Big Data Research Report Released (In Chinese). Available at: https://www.shevdc.org/laws1/1935.jhtml (accessed 7 January 2020).

Nengyuan Toutiao (2020) Interpretation of Shanghai’s New NEV subsidizing Policies (in Chinese). Available at: http://www.nengyuantoutiao.com/xinnenyuanqiche/20200315/24695.html (Accessed 28 March 2021).

Obinger H and Schmitt C (2011) Guns and butter? Regime competition and the Welfare State during the Cold War. *World Politics* 63(02): 246–270.

O’Kane S (2018) Automakers give the Chinese government access to location data of electric cars. Available at: https://www.theverge.com/2018/11/30/18120148/car-companies-china-location-data-electric-cars-mercedes-tesla (accessed 30 November 2020).

Panzar J and Willig RD (1981) Economies of scope. *American Economic Review* 71(2): 268–272.

Peukert C, Bechtold S, Baltikas M, et al. (2020) European Privacy Law and Global Markets for Data. ETH Zurich working paper 2020-03. Center for Economic Research, Zurich, Switzerland.

Prüfer J and Graef I (2021) Governance of Data Sharing: a Law & Economics Proposal (January 22, 2021). In: TILEC discussion Paper No. 2021-001, Law School, Tilburg University, Netherlands.

Roberts H, Cowl J and Morley J (2020) The Chinese Approach to Artificial Intelligence: An Analysis of Policy, Ethics, and Regulation. *AI & SOCIETY* 36: 59–77.

Rosen S (1983) Specialization and human capital. *Journal of Labour Economics* 1(43): 43–49.

Shanghai Electric Vehicle Development Corporation (SHEVDC) (2019) University Battery Research Open Competition Result Released (in Chinese). Available at: https://www.shevdc.org/laws1/1935.jhtml (accessed 7 January 2020).

Teece D (1980) Economies of scope and the scope of the enterprise. *Journal of Economic Behaviour and Organisation* 1(1): 223–247.

Tiebout C (1956) A pure theory of local expenditures. *Journal of Political Economy* 64(5): 416–424.

Wu T (2018) Don’t Fall for Facebook’s China Argument. *The New York Times*, 10 December 2018. Available at: https://www.nytimes.com/2018/12/10/opinion/facebook-china-tech-competition.html (accessed 23 July 2019).

Yang J, Dong J and Zhang Q (2018) An investigation of battery electric vehicle driving and charging behaviors using vehicle usage data collected in Shanghai, China. *Transportation Research Record* 2672(24): 20–30.

Yang L (2018) Jiang Xi Launched new NEV Data Center. *Jiang Xi Daily*. Available at: http://www.gov.cn/xinwen/2018-05/27/content_5294002.htm

Yulan L (2018) New Energy Vehicles Opening Big Data Age (in Chinese). Available at: http://epaper.gmw.cn/gmrb/html/2018-07/29/nw.D110000gmrb_20180729_1-04.htm (accessed 30 November 2020).

Zhang G and Yin K (2020) A Look at China’s draft of Personal Data Protection Law. Available at: https://app.org/news/a/a-look-at-chinas-draft-of-personal-data-protection-law/ (accessed 25 November 2020).

Zhang Z (2019) China’s SOE Reforms: Assessing Their Impact on the Market. Available at: https://www.china-briefing.com/news/chinas-soe-reform-process/ (accessed 25 November 2020).

Zhao B and Yang F (2021) Mapping the development of Chinese data protection law: Major actors, core values and shifting power relations. *Computer Law & Security Review* 40: 1. Available at: http://www.sciencedirect.com/science/article/pii/S0267364920301035.