



Updated Analysis, February 20, 2020

COVID-19 Outbreak: Consequences for the US Auto Industry

Key findings of this update

1. The auto industry experts at Anderson Economic Group estimate that the crisis will cause production in China to drop by at least 2 million units in 2020—roughly equivalent to the seven times the production loss during the 2019 UAW-GM strike in the US.
2. The list of strongly affected automakers has grown to include Jaguar-Land Rover, which faces imminent production difficulties in the UK.
3. Battery-electric vehicles, including those manufactured by Tesla, are at significant risk to supply disruption.
4. Chinese government censorship, surveillance, detentions, and quarantines have increased the human calamity in many parts of China, and render much information provided by large institutions in that country unreliable.

Preface

This updated economic analysis follows previous AEG releases dated February 4, 6, and 10. It is focused on impacts to the automotive industry and its affected workers and consumers due to the “coronavirus” outbreak that began in China.

The outbreak represents a human calamity first. The economic consequences, while substantial, are secondary. Our analysis notes the immediate human effects, and then assesses the likely consequences of those human effects upon the auto industry, including its workers and its customers.

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Analysis summary

1. US businesses—and the US business press—missed early signs of serious risks

This analysis from Anderson Economic Group follows three previous releases. As early as our first analysis, issued Tuesday, February 4, we identified three specific threats:

A. ***China is operating with political imperative, not public health focus.***

China is still operating with the primary imperative of maintaining political control, not protecting public health.

B. ***Battery-electric vehicles will be seriously affected.***

There are specific risks to battery production and battery-electric vehicles, for which China is a critical source of materials and assemblies.

C. ***This is a crisis, not a slowdown.***

Numerous business media articles reported predictions that the coronavirus would cause a slowdown in production in China, mentioning a figure of 15% for the first quarter. We pointed out then—and reiterate now—that this is a crisis, not a slowdown.

Unfortunately, even in mid-February it was common to see stock market analysts and news reporters predicting the coronavirus outbreak would cause a “slowdown;” anticipating that most manufacturing facilities would be back operating by February 15; and reporting that the official figures indicated the epidemic was “tapering off.” As is clear from this analysis and from growing evidence, this is indeed a crisis in China, not a slowdown.

2. Wuhan and the surrounding provinces are important centers for China and the auto industry

Wuhan and the surrounding province have historical and geographical reasons for their importance. However, Wuhan is not the only center of manufacturing or automobile production in China. See *The Chinese auto industry and Wuhan, a “motor city” in China*, page 5.

Probably more important, the fact that Wuhan sits astride important rail and water transit routes helped it become an industrial powerhouse and contributed to the rapid spread of the virus.

3. Every Chinese automaker is strongly affected

We identify every Chinese automaker, and nearly their entire workforce, as strongly affected by the crisis. Because China is the world’s largest consumer of vehicles, and is among the world’s largest producers, this alone involves millions of people and enormous losses in production and income. More importantly, the human toll of this crisis already involves mass relocations, quarantines, detainments, loss of income, illness, and death.

4. At least six US, European, and Asian automakers are strongly affected

Among automakers not headquartered in China, we identify the following as strongly affected, with serious dislocations of workforce, loss of production, and workforce health risks:

- A. Volkswagen
- B. Honda
- C. General Motors in China
- D. Hyundai
- E. Tesla
- F. Jaguar-Land Rover

See strongly affected automakers on page 6.

5. The Chinese auto industry will likely see a production drop of over 2 million units

Our assessment of the likely consequence of the virus, and the human calamity it has caused, is stark: we anticipate a drop in production of at least 2 million units from Chinese production in 2020. That is nearly 7 times the losses due to the UAW strike against GM in 2019.

Even this assessment underplays the actual cost of the outbreak to China. Possibly three-quarters of a billion people are currently detained, quarantined, restricted from travel, or otherwise prevented from living their normal lives in China. That enormous human toll will have direct consequences on earnings, employment, production, and nearly every other economic and social indicator.

One indicator—and by far from the most important—is that even Apple has announced significant reductions in sales in China. Electronics, travel, manufacturing, health, clothing, and nearly every sector of the Chinese economy will be directly and seriously affected, because the people that build, sell, and buy these products are all suffering.

The Chinese auto industry and Wuhan

Wuhan, a “motor city” in China

To properly understand the human consequences of this outbreak, it is important to understand the city and province in China where the outbreak began, and which has been most seriously affected.

Wuhan, the center of the outbreak, is in China’s Hubei province. Hubei accounts for a large share of China’s auto production, and Wuhan is sometimes called “the motor city” of China. There are streets in Wuhan with legendary auto industry names, such as Chevrolet and Cadillac. However, Wuhan is not the equivalent of Detroit in the United States, and it is more accurate to call it “a motor city” in China. Similarly, Hubei province is not the equivalent of the industrial heartland that stretches from Ontario through Michigan and into Ohio and Indiana. Hubei has 57 million people—well more than the most populous US state.

Wuhan is both an industrial and transportation center. It lies at the confluence of the Yangtze and Han rivers, both among the most important in the world in terms of population within their watersheds. River port cities in Hubei province were opened to international trade in the 1860s (after the “opium” or “arrow” wars, and under what are commonly called “unequal treaties”), thus exposing it to Western trade and technology much earlier than the majority of China. Rail networks and longstanding manufacturing facilities led to the development of the modern Chinese auto industry here in recent decades.

Directly affected models and drivetrains

Very few passenger vehicles assembled in China are directly sold in the United States. The short list includes a Buick and a Volvo model. As a result, we anticipate little effect from complete shutdown of Chinese-assembled vehicles.

However, we can identify a set of models that are at risk of serious production interruptions. We have identified one strongly affected drivetrain: battery-electric vehicles (BEVs) that rely upon battery assemblies originating in China. This drivetrain is now part of vehicles sold in the United States by GM, Ford, Tesla, Toyota, Honda, and many other manufacturers. While dealers in the US are well-stocked and will remain so in the short term, there is significant long-term risk, particularly for the BEV drivetrain.

The lithium ion batteries required for the BEV drivetrain travel thousands of miles between manufacturing and assembly. While assembly usually takes place in the country where the batteries will be installed in an electric vehicle, the preceding journey is extensive, and is heavily reliant upon Chinese companies. Furthermore, most companies have moved previously local operations to China in the past 2 years due to government subsidies. These brands include

Tesla and LG Chem, two of the five largest lithium ion battery producers. The other two companies in the list are CATL and BYD, both of which are Chinese owned, operating within China.

It is more than manufacturing that is likely to be affected. According to a 2018 report, “more than one-half of the cost of a finished lithium-ion battery pack is the cost of...materials. Among the common materials, lithium, graphite, and cobalt face supply constraints, while the other metals do not face similar issues.” China is a world leader when it comes to refining cobalt, and if processing facilities are affected by the coronavirus—a strong likelihood—it will directly impact both lithium battery prices and those of the resulting electric vehicles.

Strongly affected automakers

Strongly affected automakers: every automaker in China

Automakers with operations in Hubei province include GM-SAIC, Nissan, Renault, Honda, and PSA. Most of these manufacturing facilities have effectively shut down, at least temporarily. A large population exodus, as well as escalating public health containment efforts and the human weight of the number of ill people, have combined to cause a near shutdown of the industry in this region.

Strongly affected automakers in the US market

We have identified the following automakers active in the North American market as the most directly affected by the 2019-nCoV virus in China:

1. **Volkswagen.** VW sells approximately 40 percent of its vehicles in China. Volkswagen owns and operates 23 facilities in China¹, 11 of which are assembly plants and 3 are engine/powertrain plants. Although none of their engine facilities have been identified as high risk, 7 of their assembly plants fall within those regions. Furthermore, 13% of all Volkswagen employees work in China.
2. **Honda.** Honda has extensive production in Hubei province, and reported record sales in China in mid-2019. Our research indicates that Honda has all 3 of their assembly plants located in high risk provinces as well as 1 of their motorcycle plants and 2 of their engine plants.

¹ According to <https://www.volkswagenag.com/en/group/portrait-and-production-plants.html>. (This lists 23 facilities in total, made up of assembly, engine, research and parts facilities. Non-assembly or engine plants are not listed in the table.)

3. **General Motors.** GM now sells more cars in China than it does in the United States. GM's fourth quarter 2019 earnings were already hit by the lengthy UAW strike and expensive "settlement payments" made to UAW workers after the strike ended. However, it also reported slowing sales in China.

Because GM has extensive operations in China that are devoted largely to the Chinese market, we have not categorized its operations in the same manner as the other non-China manufacturers active in the United States. However, GM's Chinese operations should be considered nearly all at high risk, given their size and GM's longstanding strength in integrated production planning.

4. **Hyundai and their affiliate Kia.** Hyundai has already closed at least one plant outside of China. Hyundai and Kia rely upon Chinese-built parts more than many other manufacturers, and it is more at risk for supply disruptions than the "Detroit 3" automakers in terms of production for sale in the US market. (Unconfirmed reports indicate that they have closed as many as seven plants outside of China.)
5. **Tesla.** Tesla is affected both by production in China of its key components, and by its exclusively BEV model line. Tesla recently opened a factory in Shanghai, and stock analysts had been talking up the "China opportunity" for the company. The "giga3" battery production facility there is critical for production of the company's Model 3.

Tesla has been an innovator in batteries and has reportedly started using a newer kind of battery in China called "NMC" in addition to the "NCA" batteries it used previously. Both are variations on Lithium-Ion or "Li-Ion" batteries. These batteries are so important to the world that their inventors shared the 2019 Nobel Prize for Chemistry. They use rare-earth materials (such as cobalt) that are heavily sourced in China. They are critical to BEVs, and Tesla's battery innovation is critical to its plans to expand electric vehicle production. Part of Tesla's plans involve innovative "LFP" batteries, a newer variant of Li-Ion batteries that could reduce the dependency on expensive cobalt.

A recently published patent application for NMC batteries underlines this importance. Tesla previously claimed that if it were to produce 500,000 vehicles per year, it would consume the entire world's supply of Li-Ion batteries. While this is not true today, there is no question that the company critically relies upon battery cells.

See Battery Types and BEVs, on page 12.

6. **Jaguar-Land Rover.** JLR announced on February 17th that it expected production shortages due to unavailability of parts from China. In news reports, the company's CEO, Ralf Speth, indicated it had been bringing parts in from China "in suitcases," and that it had only two weeks before shortages would affect production. We note that the unusually frank

assessment from the JLR underlines our assessment that major automakers located in China are under pressure to not state clearly the severity of the health crisis.

Other companies at risk

Companies that may experience future supply chain disruptions are Honda, Ford, FCA, Nissan and Toyota. All have at least 1 of their engine plants based in high risk regions. Note the following for two of these automakers:

- 6 out of the 7 Nissan plants within China are in areas we have identified as high risk. They currently don't operate any engine or powertrain manufacturing plants within China. As this release is going to press, unconfirmed reports suggest Nissan is closing six or more plants outside China due to parts shortages.
- We have identified 4 Ford assembly plants and 1 Ford engine/powertrain plant inside China, all 5 of which are in high risk regions.

If the coronavirus were to spread further or the disruptions, quarantines and detentions continued, they would likely experience shortages in their engine and powertrain production.

Notes on this analysis

In this analysis, we have updated the following table to reflect more detailed information regarding the automakers. The reason for the distinction between assembly and powertrain/engine plants is to distinguish the difference between automakers who at risk of experiencing short term shortages in final products and long-term shortages in supplies.

See the notes to the table, and the limitations stated in the Appendix regarding the difficulties in classifying some plants that are operated in joint ventures or other structures in China.

Selected automakers by number of facilities in high risk regions *February, 2020*

| Manufacturer | Total Engine, Powertrain and Assembly Facilities (a) | Facilities in High Risk Regions (b) | Total Employees (c) | China Employees (c) |
|---------------------|--|-------------------------------------|---------------------|---------------------|
| Volkswagen | 14 | 7 | 664,496 | 84,123 |
| Assembly | 11 | 7 | | |
| Powertrain / Engine | 3 | 0 | | |
| Nissan | 7 | 6 | 138,893 | N/A |
| Assembly | 7 | 6 | | |
| Powertrain / Engine | 0 | 0 | | |
| Honda | 7 | 6 | 219,722 | 17,174 |
| Assembly | 3 | 3 | | |
| Powertrain / Engine | 2 | 2 | | |
| Motorcycles | 2 | 1 | | |
| Ford | 5 | 5 | 198,964 | 17,890 |
| Assembly | 4 | 4 | | |
| Powertrain / Engine | 1 | 1 | | |
| Toyota | 6 | 3 | 370,870 | 31,390 |
| Assembly | 3 | 2 | | |
| Powertrain / Engine | 3 | 1 | | |
| FCA | 3 | 3 | 198,545 | 3,574 |
| Assembly | 2 | 2 | | |
| Powertrain / Engine | 1 | 1 | | |
| BMW Group | 3 | 0 | 134,682 | 2,000 |
| Assembly | 2 | 0 | | |
| Powertrain / Engine | 1 | 0 | | |
| Subaru | 0 | 0 | N/A | N/A |
| Assembly | 0 | 0 | | |
| Powertrain / Engine | 0 | 0 | | |
| GM | 17 | N/A | 173,000 | N/A |
| Assembly | 12 | N/A | | |
| Powertrain / Engine | 5 | N/A | | |
| Hyundai | 5 | N/A | 123,921 | 18,132 |
| Assembly | N/A | N/A | | |
| Powertrain / Engine | N/A | N/A | | |

Important notes:

- Information regarding facilities and their types have been taken directly from information obtained from the manufacturers, except for Hyundai, where the source is Reuters. The list does not include any parts, transmissions, forging, stamping or any other facilities that are not explicitly categorized. There may be missing plants due to joint ventures which are only reported under the Chinese partner(s) website(s). For this reason, this listing will not match other lists of auto manufacturing facilities in China. See also the limitations stated in the Appendix.
- We define “High Risk” regions as those where the number of confirmed cases exceeded 500 at the time of analysis, or at any time in February. The source regarding these numbers is DXY; see Sources in the text. Note that due to the rapid expansion of the number of cases, and the concerns we express regarding the accuracy and independence of this information.
- Data regarding employment in China, as well as specific facilities, has been gathered either through the company website or through their sustainability reports. Certain values, such as that of Toyota, may be figures from earlier years.
- “N/A” in this table means “data not available.” See the limitations stated in the Appendix regarding classification of plants that are operated in joint ventures and other legal structures in China. Data

Sources

As noted in the preface, the effects of this outbreak have been very fast moving, and information is often not available or comes from sources that cannot be assumed to be correct. In completing this and the prior releases on this issue, we considered the quality and independence of information sources as much as their content.

Main source: professional judgement

As of the beginning of February 2020, none of the auto manufacturers listed as most directly affected had publicly released a production effect schedule based upon the 2019-nCoV virus outbreak. Given this lack of information from the manufacturers themselves—who at this point are certainly focused on their employees—the main source for the analysis in this document is professional judgement by Anderson Economic Group consultants.

Specific sources

Among the sources we consulted are:

Automobile industry

- Auto production data, including from Auto News Datacenter. Their website is: <https://www.autonews.com/section/data-center>.
- Auto production and sales data from the China Association of Automobile Manufacturers. A summary on its website is found at: http://www.caam.org.cn/chn/4/cate_29/con_5228367.html.
- Public statements from manufacturers about their production in 2019, their factories in China and in the US, and their earnings in the fourth quarter of 2019.
- Investor disclosures (including sustainability reports) from Tesla, GM, Honda, Toyota, Ford, Volkswagen, and other automakers. This is the primary source for our listing of plants in China; see notes to the table in the report.
- Information from secondary news sources, including Reuters and the BBC, for information on some automakers including Hyundai and Jaguar-Land Rover.

Battery technology and supply

- Coffin, David, and Jeff Horowitz. “The Supply Chain for Electric Vehicle Batteries.” *Journal of International Commerce and Economics*, December 2018.
- Patent applications and technical information on battery technology, including from WIPO, Battery University, and from reporting on the 2019 Nobel Prize for Chemistry from the *New York Times*, *Forbes*, and *Popular Mechanics*.

Public health

- Information on the virus, its type, its name, and its prevalence, from the US CDC and the World Health Organization. Similar information from the National Health Commission of the People’s Republic of China was also consulted.

Related websites include: <https://www.cdc.gov/coronavirus/2019-ncov/faq.html> , <http://who.maps.arcgis.com/apps/opsdashboard/index.htm> , and http://www.nhc.gov.cn/xcs/yqtb/list_gzbd.shtml.

- Information on the number of confirmed cases in provinces of China and other places, from the private physician organization DXY, which is headquartered in China. This is the primary information source we used in assessing the relative severity of the outbreaks within China. The DXY website is: <http://www.dxy.cn/>, and

- Information on the number of cases in various places, originating from multiple sources (including DXY) from *Johns Hopkins University Center for Systems Science and Engineering*. Their data visualization is at:

<https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html>

Additional data were obtained from the GitHub repository for some of these data, which includes a bibliography of sources. This site is: <https://github.com/CSSEGISandData/COVID-19>.

Historical and geographical context

- Historical and geographical information on China, Hubei province, and Wuhan, including from *Britannica*.
- Laws (and opinions) on public health in China were obtained from the “Public Law Knowledge” section of the website of the National Health Commission of the People’s Republic of China, including at: <http://www.nhc.gov.cn/xcs/pfzs/202002/6090ed34d8e64d038fbed94b9f957059.shtml>.

Note: Sources upon which we did not rely

We observed reports and information from the following sources, and in some cases noted these statements. However, we did not rely upon them, given the observations stated in Recap of Warnings: US businesses missing serious risks, on page 4.

- Official statements from China, including statements from news organizations headquartered in China. This includes statements from prominent health authorities in China on containing the outbreak; see notes in the text.

- Statements attributed to unnamed financial analysts, stock market advisors, and rating agencies, including investment advisories that were released in January or the first week of February 2020. See the discussion in the text.

Appendix

Definitions

Coronavirus

A coronavirus is a type of virus that affects humans, often leading to an upper respiratory infection (URI). There are multiple known coronaviruses, including the MERS-CoV, SARS-CoV, and the virus recently called “2019 Novel Coronavirus” or 2019-nCoV. On February 11, 2020, the WHO named this virus “COVID-19.” The US CDC and other institutions, as of the date of this publication, indicated it would adopt the new term.

Battery Types and BEVs

Battery types used in BEVs include multiple variations on the category known as Lithium-Ion batteries. This includes: “NMC,” which stands for nickel-manganese-cobalt and more precisely Lithium Nickel Manganese Cobalt Oxide (LiNiMnCoO₂); “NCA” Lithium Nickel Cobalt Aluminum Oxide (LiNiCoAlO₂), and “LFP” (Lithium Iron Phosphate). NCA and NMC are in common use in BEVs.

Identification of plants and facilities in China

As noted in the notes to the table, many manufacturing plants in China are joint ventures between a non-Chinese entity and a Chinese partner. For this and other reasons, the classification of facilities in China by manufacturer requires judgement as well as objective information. In this assessment, we primarily relied upon the statements of the manufacturers themselves to determine which assembly plants were operated primarily by them, rather than by suppliers.

Limitations and disclaimers

Course of Epidemic Currently Not Knowable: This is an economic analysis of a public health crisis. It is not intended to predict the future course of the public health effects, nor to predict production changes that cannot possibly be known at this time.

Forward-Looking Statements: This entire document should be considered a “forward-looking statement” that involves judgement and projections based on partial information. Interested readers should obtain additional information before making investment or business decisions based on the information contained in this document.