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Cost of manufacturing operations around the globe

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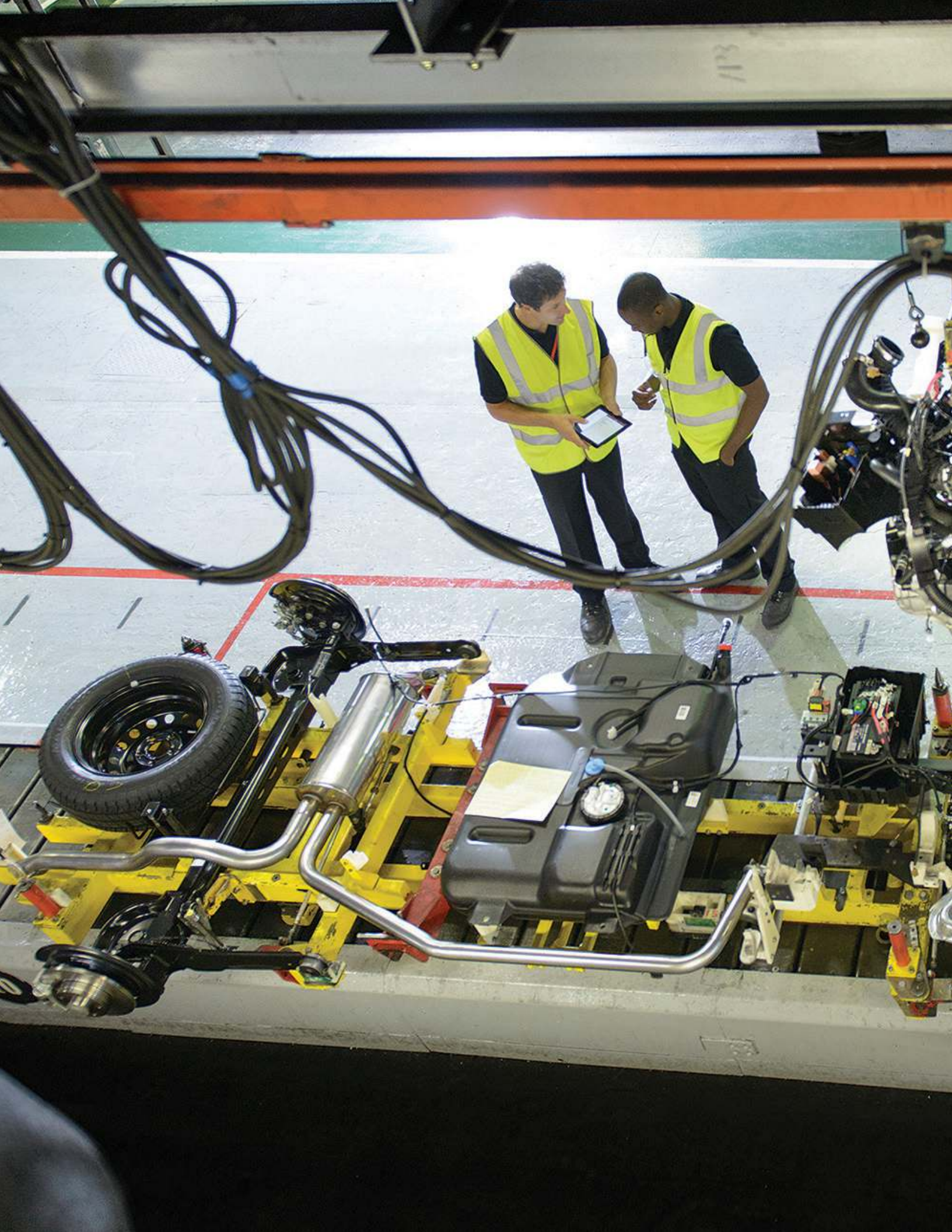

Contents

This report is a result of a collaboration between KPMG and The Manufacturing Institute.

Glossary

Term	Definition
Access to internet/ Wi-Fi	The percentage of each country's population that has used the internet within the last three months
Airport connectivity	The International Air Transportation Authority's (IATA) airport connectivity indicator, which measures the degree of integration of a country within the global air transport network
Burden of government regulation	The burden of government regulation as measured by business executives' response to the question: "In your country, how burdensome is it for companies to comply with public administration's requirements (e.g., permits, regulations, reporting)?"
CoDB	Cost of Doing Business (CoDB) refers to the direct and indirect costs incurred by businesses engaged in manufacturing operations.
Corporate tax rates	Statutory corporate tax rates, including federal and provincial tax rates but excluding tax incentives for certain types of businesses
Corruption perception index	A measure of experts' and business people's perceptions of corruption in the public sector, including both the frequency and magnitude of corrupt behaviors as well as the strength of anticorruption measures
Days to start business	The number of days it takes for a small- to medium-size limited liability company to start up and formally operate in each economy's largest business city, as calculated by the World Bank
Electric power losses (% of output)	Measures the percentage of a country's energy output that is lost in transmission and distribution
Enforcing contracts	A measure of the time and cost for resolving a commercial dispute through a local first-instance court and the quality of judicial processes index, evaluating whether each economy has adopted a series of good practices that promote quality and efficiency in the court system
Exposure to unsafe drinking water	The risk-weighted percentage of the population exposed to unsafe drinking water
Hourly compensation costs	The average price firms must pay for an hour of an employee's labor, including hourly pay for time worked, hourly direct benefits, and hourly social insurance expenditures and labor-related taxes
Interest rates	The monetary policy-related interest rates reported by the IMF for each country. Discount rates were used where monetary-policy interest rates were not available from the IMF.
Learning-adjusted years of schooling	The expected years of schooling for all residents multiplied by the country's relative scoring on international tests such as PISA or TIMSS
Liner shipping connectivity index	A measure of each country's connectivity to global shipping networks based on five components of the maritime transport sector: the number of ships, their container-carrying capacity, the maximum vessel size, the number of services, and the number of companies that deploy container ships in a country's ports

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Term	Definition
Political risk	Measures the likelihood of a risk caused by political and assimilated events connected to cross-border transactions with a risk horizon beyond one year
Primary costs	Costs that directly affect a firm's bottom line and can be easily expressed in dollars. These cost factors include expenses such as wages, utilities, real estate costs, and taxes.
Protecting minority investors	A measure of the strength of minority shareholder protections against misuse of corporate assets by directors for their personal gain as well as shareholder rights, governance safeguards, and corporate transparency requirements that reduce the risk of abuse
Railroad quality	The quality of railroads as measured by business executives' response to the question: "In your country, how efficient (i.e., frequency, punctuality, speed, price) are train transport services?"
Real estate costs	The average monthly rent per square foot for industrial properties in each country.
Real value added per employee	The net output of the manufacturing sector after adding up all outputs and subtracting intermediate inputs, divided by the number of workers employed by the manufacturing sector (including part-time and self-employed employees)
Registering property	A measure of the steps, time, and cost involved in registering a property, assuming a standardized case of an entrepreneur who wants to purchase land and a building that is already registered and free of title dispute
Reliability of water supply	The reliability of the water supply as measured by business executives' response to the question: "In your country, how reliable is the water supply (lack of interruptions and flow fluctuations)?"
Road quality index	The quality of roadways as measured by business executives' response to the question: "In your country, what is the quality (extensiveness and condition) of road infrastructure?"
Secondary costs	Factors that impact overhead costs and the firm's ability to operate efficiently. The secondary factors are typically related to the business environment or the ease of doing business.
Skill set of graduates	The skill set of graduates as measured by business executives' response to the question: "In your country, to what extent do graduating students from secondary education possess the skills needed by businesses?" and "In your country, to what extent do graduating students from university possess the skills needed by businesses?"
MI	The Manufacturing Institute is the research and education partner of the National Association of Manufacturers, a trade group for manufacturers in the United States.
Utility costs	The average price per kilowatt-hour (converted to USD) of electricity paid by all businesses and households in each country, excluding taxes and tariffs.

Executive summary

The competitiveness of the manufacturing sector in the United States has been discussed extensively in the press and economic literature in recent years. This joint study by KPMG and the Manufacturing Institute (MI) provides a current assessment of how the U.S. compares to its main trading partners as a location for manufacturing.

Specifically, this study compares the primary and secondary factors that impact the cost of operations (Cost of Doing Business or CoDB) of a business conducting manufacturing operations in the United States relative to 16 other countries that are leading manufacturing exporters to the U.S. These 17 economies together account for about four-fifths of global value added in manufacturing, and thus a comparative analysis across countries provides insight into how regional economic factors may affect the global competitive landscape in manufacturing.[1]

Our approach examines different cost factors including costs that directly impact a firm's bottom line (Primary Costs) and costs that typically impact a firm's operating costs and profits more indirectly (Secondary Costs).

Some of our key findings consist of the following:

- **Secondary Cost Index performance is a strong predictor of overall CoDB Index rank:** For a given country, performing well on the Secondary Cost Index generally correlates with performing well on the CoDB Index rankings.
  - Manufacturers in the U.S. face higher Primary Costs relative to other countries, particularly labor costs. This is reflected in a Primary Cost score of 3.40, a score that is 15.7 percent higher than the average score of the other manufacturing locations that are considered in this study and translates to a ranking of 14 out of a total of 17 on the Primary Cost Index.
  - However, strong performance on Secondary Costs for the U.S., such as the quality of labor and superior business conditions, results in the U.S. being ranked fifth on the overall CoDB Index.
- **Labor Quality is a differentiating factor for the US:** Examining the results from a labor market perspective, it is notable that the U.S.'s strength in labor quality allows it to be a strong competitive contender. Increasing the importance (i.e., 25% to 70% in the Secondary Cost Index) of the quality of labor component improves the U.S. ranking by one from fifth to fourth place. However, there is significant competition from European countries in this regard. The higher weight on the quality of labor component also causes Ireland, Germany, and Switzerland to jump to the top five on the overall CoDB Index ranking.
- **US tax reform has a material impact on US CoDB Index ranking:** As part of this analysis, we also examined if the recent U.S. tax reform had a material impact on the relative standing of the United States. In particular, we compared how the U.S. would have ranked had we used the pre-reform corporate tax rate of 40 percent (combined federal and state tax rate) instead of the post-tax-reform corporate rate of 27 percent. The impact of the reform on the CoDB Index ranking for the U.S. is quite significant: The ranking of the U.S. on the CoDB Index improved from 11th to 5th.

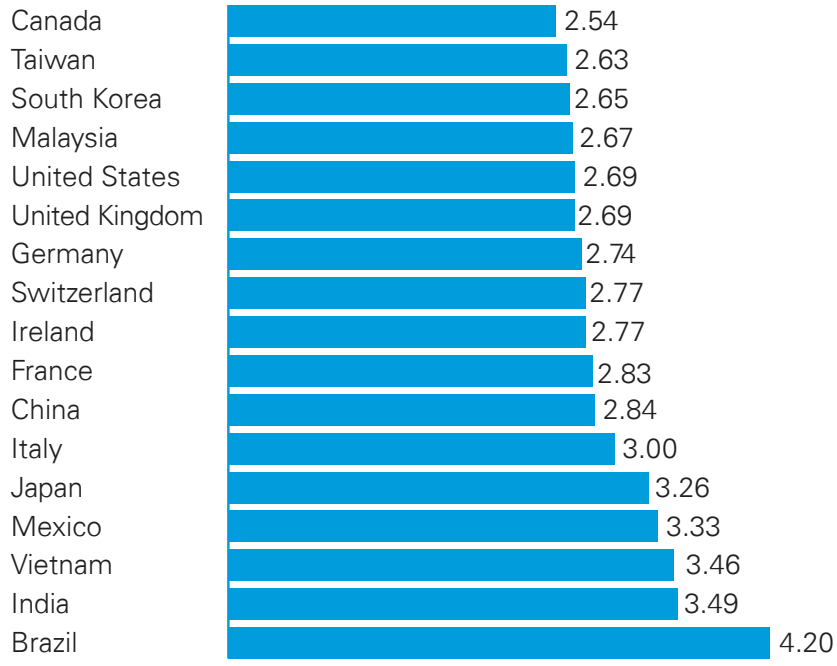
[1]World Bank, *Manufacturing, Value Added*. Accessible at https://data.worldbank.org/indicator/NV.IND.MANF.CD

We collected data on 23 measures and then quantitatively evaluated each country based on these measures to develop an overall CoDB index (CoDB Index) to assess the economy's competitiveness as a manufacturing hub. The components of the CoDB Index, in turn, consist of an index of Primary Costs (Primary Cost Index) that includes factors such as labor costs, real estate costs, costs of financing (as measured by interest rates), and utility costs as well as an index of Secondary Costs (Secondary Cost Index) made up of 18 measures grouped into four main areas: quality of labor, ease of doing business, infrastructure, and risk.

We note that this study and our conclusions are based on certain CoDB factors that are commonly considered in manufacturing facility location decisions and the results provide a high-level perspective on the attributes of various countries with respect to these factors. However, the location decision is specific to each company and its consideration of additional factors such as industry, type of product, supply chain, access to consumer markets, and the company's overall business strategy. It is therefore important to recognize that an individual location decision of a company may involve more factors and considerations than we have evaluated in this analysis.

Finally, we note that while we have used the most recently available data on the cost factors, such data is available only with a lag. As such, the rankings are based on the best historical information available, and as a consequence, the impact of recent trade disputes or the market disruptions from COVID-19 are not reflected in the results.

CoDB Index Score by Country (1=best,5=worst)



Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

Introduction

Where to locate a production facility is an important strategic decision for a manufacturing company. The location decision can have a long-term impact on performance. The selection of a particular site (or country) requires more than just an assessment of labor costs. It requires the consideration of multiple factors including the cost of setting up the facility, real estate costs, energy costs, the quality of the labor force and infrastructure, the regulatory environment, and intellectual property protections.

In 2011, MI published a cost of doing business study (the MI Report).[2] The MI Report compared the cost of production in the United States and nine major trading partners: Canada, China, France, Germany, Japan, South Korea, Mexico, Taiwan, and the United Kingdom. The study examined the "raw" cost of production based on wage costs relative to value added in manufacturing and a variety of other "structural" costs of doing business in each country including corporate tax rates, employee benefits, tort litigation, regulatory compliance, and energy. The study noted that unlike in previous years, manufacturers in the U.S. faced lower "raw costs" (i.e., wage compensation relative to total valued added in manufacturing) than its trading partners. Specifically, raw costs faced by U.S. manufacturers were about 9 percent lower than the trade-weighted average of its nine largest trading partners. However, the study noted that this advantage was entirely offset by the higher structural costs (i.e., corporate tax rates, employee benefit costs, tort litigation, regulatory compliance, and energy), with U.S. manufacturing costs (on a trade-weighted basis) being about 9 percent higher than that of its nine largest trading partners.

This study seeks to update the MI Report by:

- Including more recent data
- Considering additional indicators of the cost of doing business
- Expanding the comparison to seven additional countries; Brazil, Ireland, Italy, India, Malaysia, Switzerland, and Vietnam.

[2]The Manufacturing Institute and the Manufacturers Alliance for Productivity and Innovation, *2011 Report on the Structural Cost of U.S. Manufacturing*, 2011.

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What are the "Costs of Doing Business"?

Companies consider a variety of CoDB factors when evaluating their international manufacturing location decisions. Our study considers the factors evaluated by companies at the country level and seeks to incorporate these into country-level rankings. A country's competitiveness is often judged by the cost of labor and an often cited motivation for moving manufacturing offshore (relative to higher-cost countries like the U.S.) is the desire to gain access to low labor costs and to lower the cost of production. Studies, however, have indicated that a range of other factors go into the location selection decision.[3] The leading factors identified in the literature that contribute to the location decision are:

1. Availability of skilled labor
2. Cost and productivity of labor
3. Availability of and proximity to transportation infrastructure
4. Tax rates
5. Regulatory environment
6. Real estate costs
7. Availability and cost of power, communications, water, and other utilities
8. Access to and cost of capital
9. Transparency in government and business practices and ease of doing business
10. Politically and economically stable environment with ability to enforce legal and property rights

We compiled data on each of these factors, directly or through proxy measures, over the 2012 to 2019 time period for the 17 countries (see Appendix A for details). The selection of specific categories of costs to compare were guided by the surveys and studies we reviewed (see Appendix A for details). We note here that data for every cost element was not available for every country or not available for a recent time period. Thus, the cost types analyzed are those that could be obtained from public sources spanning 2012–2019, but we use only the most recent data in our analysis where available.

Given the large number of indicators being considered, we categorized these decision factors into two groups:

— **Primary Costs** – Those that can be measured in cost terms (dollars or percentage, in the case of cost of capital and tax rates). These cost factors are more readily assessed and include expenses such as wages, utilities, real estate costs, and taxes.

— **Secondary Costs** – Factors that impact overhead costs and the facility's ability to operate efficiently. The secondary factors are typically related to the business environment or the ease of doing business. For instance, it takes into consideration the level of transparency in business and government processes, legal protection of property rights, and regulatory burden.

For Primary Cost factors, the specific measures we included are:

— Labor costs – Hourly labor rates (including benefits)

— Utility costs – Energy costs

— Real estate costs – Lease costs for industrial/logistics locations

— Cost of capital – Borrowing interest rates

— Corporate tax rates.

For Secondary Cost factors tied to the business environment and infrastructure, we considered a range of indicators reflecting the quality of labor, ease of doing business, infrastructure, and risk and protections. Table 1 on the following page summarizes the measures and cost types considered.

[3] For a discussion of these factors see for example:

a. B.L. MacCarthy and W. Atthirawong. "Factors affecting location decisions in international operations – a Delphi study," *International Journal of Operations & Production Management*, 2003

b. C. Manning. M. Rodriguez, and Chinmoy Ghosh, "Devising a Corporate Facility Location Strategy to Maximize Shareholder Wealth," *Journal of Real Estate Research*, 1999

c. F. Karakaya and C. Canel, *Underlying dimensions of Business Location Decisions*, Industrial Management & Data Systems, 1998

d. S. Turhan, B.C. Ozbag, and B. Cetin. "Factors Affecting Location Decisions of Food Processing Plants.: *Journal of Applied Sciences*, 2007

e. M. Plaziak and A.I. Symanska, *Role of Modern Factors in the Process of Choosing a Location of the Enterprise*

Table 1: Primary and secondary measures by subcategory

#	Measure	Cost type	Subcategory
1	Hourly compensation costs	Primary	-
2	Real estate costs	Primary	-
3	Utility costs	Primary	-
4	Corporate tax rates	Primary	-
5	Interest rates	Primary	-
6	Learning-adjusted years of schooling	Secondary	Quality of labor
7	Skill set of graduates	Secondary	Quality of labor
8	Real value added per employee	Secondary	Quality of labor
9	Days to start business	Secondary	Ease of doing business
10	Burden of government regulation	Secondary	Ease of doing business
11	Registering property	Secondary	Ease of doing business
12	Road quality index	Secondary	Infrastructure
13	Railroad quality	Secondary	Infrastructure
14	Airport connectivity	Secondary	Infrastructure
15	Liner shipping connectivity index	Secondary	Infrastructure
16	Electric power losses (% of output)	Secondary	Infrastructure
17	Exposure to unsafe drinking water	Secondary	Infrastructure
18	Reliability of water supply	Secondary	Infrastructure
19	Access to internet/Wi-Fi	Secondary	Infrastructure
20	Political risk	Secondary	Risk and protections
21	Enforcing contracts	Secondary	Risk and protections
22	Protecting minority investors	Secondary	Risk and protections
23	Corruption perception index	Secondary	Risk and protections

Based on these indicators, we first developed separate indices, one for the Primary Costs and another for Secondary Costs, and then combined the two to produce the CoDB Index, an overall competitiveness index. We adopted this approach to produce one common index by which to rank the countries with respect to CoDB while retaining the ability to explore how the Primary and Secondary Costs influenced the overall rank.

Appendix A provides details on the sources from which the data on these measures were gathered.

Developing the index

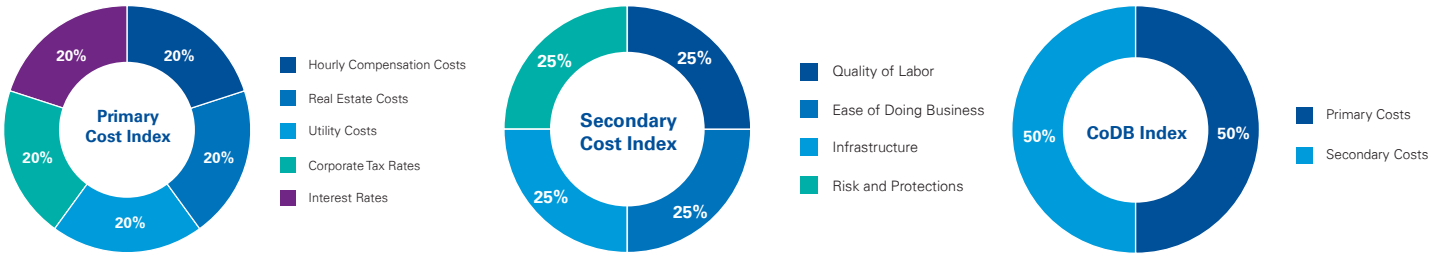
Since we are evaluating 23 factors—some that impact a manufacturing company operations in a country directly and others more indirectly—it is challenging to draw cross-country inferences by evaluating each separate CoDB factor. Instead, we created a composite index that would jointly reflect the information provided by the various individual measures. We recognize that such an index will subsume a significant range of information across all the identified measures. To provide transparency and to allow further exploration to identify the set of factors driving a country's index level (and rank), we developed two indices—one for the Primary Cost factors and another for the Secondary Cost factors. Subsequently, we combined them to generate an overall index (CoDB Index) to benchmark country performance. This allowed us to analyze the relative importance of each set of factors to each country's overall index score.

As with any index, the weighting placed on each component is a key consideration. Most studies that examine CoDB factors tend to weight the key factors equally.[4] It did not appear that one or some of the five Secondary Cost categories we considered—quality of labor, ease of doing business, infrastructure, and risk—stood out in importance relative to the others. Accordingly, the assumption of equal weighting appeared to be reasonable for all factors (see Appendix D for a specific breakdown of the weights).

With respect to the Primary Cost factors, namely, labor, utility, real estate costs, interest rates, and tax rates, we evaluated the need to place higher weight on labor given its perceived importance as a factor in location decisions. Specifically, we reviewed data on the contribution of labor costs to manufacturing. Analysis performed by Morgan Stanley on the contribution to total costs of various components indicates that for the manufacturing sector, labor costs account for approximately 16 percent of total manufacturing costs in the U.S. (and as high as 30 percent of total costs for certain sectors such as electronics and apparel and as low as 6–7 percent for sectors such as motor vehicles, where capital costs are much more significant).[5] The 16 percent weight indicated by this analysis is similar in magnitude to the 20 percent weight that we use for labor under an equal weighting approach. In the absence of any clear indication that pointed to an alternate weighting choice, we assigned equal weighting to the five primary factors.[6]

In summary, we utilized the following weights presented when calculating index values for each country:

Index weights



[4]For example, the Brookings Institution's report *Global manufacturing scorecard: How the US compares to 18 other nations*, accessible at *https://www.brookings.edu/research/global-manufacturing-scorecard-how-the-us-compares-to-18-other-nations/*

[5]Morgan Stanley Analyst Report as cited in "The Cost Of Manufacturing Stuff," *Business Insider*. May 2013

[6]We recognize that there are alternate index weighting choices that could be adopted and that an alternate set of weights would likely yield a different ranking on the overall index. To allow the interested reader to alter the weights to reflect their facts and circumstances and to explore sensitivity of results to these changes, we have developed a Tableau visualization tool in conjunction with this study. This tool provides the ability to emphasize or deemphasize various cost factors and to visualize the impact of the changes on the CoDB Index rank.

Results

The application of the indexing methodology resulted in a ranking of countries as summarized in Table 3 (based on score from 1–5, with 1 being the best and 5 being the worst).

Table 3: Country ranking – CoDB Index

Countries	Ranking	CoDB Index Score by Country (1=best, 5=worst)
Canada	1	2.54
Taiwan	2	2.63
South Korea	3	2.65
Malaysia	4	2.67
United States	5	2.69
United Kingdom	6	2.69
Germany	7	2.74
Switzerland	8	2.77
Ireland	9	2.77
France	10	2.83
China	11	2.84
Italy	12	3.00
Japan	13	3.26
Mexico	14	3.33
Vietnam	15	3.46
India	16	3.49
Brazil	17	4.20

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

Canada, Taiwan, and South Korea ranked as the top three countries on the CoDB Index, which equally weights Primary Costs factors and Secondary Cost factors. The United States ranked fifth among the 17 countries. The country with the lowest rank was Brazil, with Japan, Mexico, Vietnam, and India ranking just above.

To understand the overall CoDB rankings based on the Primary Cost Index and the Secondary Cost Index, Table 4 (Primary Costs) and Table 5 (Secondary Costs) summarize the rankings across the two subcategories of factors. For Primary Costs, unsurprisingly for the most part, Malaysia, China, Mexico, and Vietnam are all tied for top position (i.e., most competitive).

Table 4: Country ranking – Primary Cost Index

Countries	Ranking	CoDB Primary Score Index by Country (1=best, 5=worst)
Malaysia	1	2.40
China	1	2.40
Mexico	1	2.40
Vietnam	1	2.40
India	5	2.60
Canada	6	2.80
Taiwan	6	2.80
Italy	6	2.80
South Korea	9	3.00
Ireland	9	3.00
France	9	3.00
Germany	12	3.20
United Kingdom	13	3.20
United States	14	3.40
Switzerland	14	3.40
Brazil	16	3.60
Japan	17	4.00

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

From a review of the Primary and the Secondary Cost Indices, it becomes apparent there are different reasons why countries rank where they do on the CoDB Index. Consider the case of Canada, which scored highest on the CoDB Index. The primary driver of this rank is the fact that Canada scored very highly on the Secondary Cost Index while maintaining a middle rank on the Primary Cost Index. The United States' overall 5th place ranking is primarily driven by its score on the Secondary Cost Index, since it ranks 14th on the Primary Cost Index.

Table 5: Country ranking – Secondary Cost Index

Countries	Ranking	CoDB Secondary Index Score by Country (1=best, 5=worst)
United States	1	1.97
Switzerland	2	2.13
United Kingdom	3	2.19
Canada	4	2.27
Germany	5	2.28
South Korea	6	2.29
Taiwan	7	2.47
Japan	8	2.52
Ireland	9	2.54
France	10	2.65
Malaysia	11	2.93
Italy	12	3.21
China	13	3.28
Mexico	14	4.26
India	15	4.38
Vietnam	16	4.51
Brazil	17	4.81

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

In contrast, the ranks of Malaysia and Taiwan on the CoDB Index result from high scores on the Primary Cost Index. For instance, Taiwan ranks second on the CoDB Index despite a ranking of seventh on the Secondary Cost Index.

Interestingly, China's middling score of 11 on the CoDB Index, despite being part of a four-way tie for first on the primary factors, is caused by its poor performance (rank of 13th) on the Secondary Cost Index. China's low score on Secondary Cost Index arises primarily from higher operating risks. Overall, it appears that countries that do well on primary factors do less well on the secondary factors and vice versa. The clear exception appears to be Brazil, which ranks poorly on both indices.

Primary Costs are clearly important to location decisions. To examine how the overall CoDB ranking may change under an alternate set of weights, we recomputed the results placing a a greater consideration on Primary Costs. That is, we re-ran our analysis, changing the weight of the Primary Costs and Secondary Costs from equal or 50 percent–50 percent weighting to 70 percent–30 percent in favor of Primary Costs. As presented in Table 6, not surprisingly, this caused China's ranking on the CoDB Index to move up significantly, from 11th to 3rd, and the U.S. ranking to decline from 5th to 12th. However, Canada, Malaysia, and South Korea retained their top-five CoDB rankings despite this change.

Table 6: Country ranking with higher weight on Primary Costs

Countries	CoDB Index ranking	Primary Cost Index ranking	Secondary Cost Index ranking
Malaysia	1	1	11
Canada	2	6	4
China	3	1	13
Taiwan	4	6	7
South Korea	5	9	6
Ireland	6	9	9

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

From a labor market perspective, the quality of labor available in the U.S. is a strong asset. However, increasing the weight of the quality of labor measure reveals that there is also significant competition from European countries and Canada in this regard. For example, as presented in Table 7, increasing the weight on the quality of labor to 70 percent from 25 percent within the Secondary Cost Index (but maintaining equal weight between Primary and Secondary Costs) causes Ireland, Germany, and Switzerland to rise to the top five most competitive countries, with the U.S. and Canada rising and falling by one rank, respectively.[7]

Table 7: U.S. ranking with higher weight on labor quality

Countries	Overall ranking	Primary Cost ranking	Secondary Cost ranking
Ireland	1	9	2
Canada	2	6	5
Germany	3	12	4
United States	4	14	1
Switzerland	5	14	3
South Korea	6	9	6

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

Understanding the results

To understand these results better, we further examined the constituents of the Primary and Secondary Cost Indices.

Primary Cost Index

To further understand the drivers of our findings, we examined which factors cause East Asian countries such as Vietnam, Taiwan, and Malaysia to rank highly on the Primary Cost Index and the U.S. to rank 14. Table 8 to follow presents constituent ranks for countries that rank highly on the Primary Cost Index—Vietnam, Taiwan, Malaysia, India, China, and Mexico—and for the United States. Note, that the table shows percentile ranks, that is to say a percentile rank of 5 represents top 15 percentile of costs. The percentile ranking of 1 indicates the best performing in the category and the percentile ranking of 5 indicates the worst performing in the category (see Appendix D for additional details). As Table 8 indicates, the differences are most stark with respect to hourly compensation costs between U.S. and other countries.

Table 8: Selected country Primary Cost percentile rankings (sorted by Primary Cost Index)

Country	Hourly compensation costs	Real estate costs	Utility costs	Corporate tax rates	Interest rates
Malaysia	2	1	3	2	4
China	2	2	1	3	4
Mexico	1	1	1	4	5
Vietnam	1	4	1	2	4
India	1	1	2	4	5
Taiwan	3	4	2	2	3
United States	**5**	**3**	**3**	**3**	**3**

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

In terms of real estate costs and cost of capital, the United States is relatively competitive compared to the Southeast Asian nations. Among these countries, only India, Malaysia, and China had lower average costs for industrial property than the U.S., while only Taiwan had a lower interest rate. The U.S. compares less favorably to the Southeast Asian nations on the measures of utility costs and corporate tax rates.[8] The U.S. is tied with Malaysia for the highest electricity costs among these countries, significantly higher than the average rate paid by Chinese electricity users. In terms of corporate tax rates among this group, only India and Mexico have higher statutory tax rates, at 30 percent compared to 27 percent for the U.S.

[7] We increase the weight on quality of labor to 70 percent in the Secondary Cost Index and equally weight the other three measures at 10 percent each.

[8] The U.S. tax rates used here are after tax reform.

Ranking of the industrialized countries

Table 9 provides a comparison to some of the industrialized countries relative to the U.S. The table shows percentile ranks, that is to say a percentile rank of 5 represents the top 15th percentile of costs (worst performing from competitiveness standpoint) while a percentile rank of 1 slots into the best performing in the category (see Appendix D for additional details). We note that even compared to the industrialized countries, U.S. labor costs are high. Hourly rates in Canada, United Kingdom, and Japan range between $23 per hour and $30 per hour compared to $39 per hour in the U.S. With respect to corporate tax rates, where tax reform lowered rates significantly, the U.S. rates are lower than Japan, comparable to Canada, but still higher than that imposed by the United Kingdom.

Table 9: Industrialized country Primary Cost percentile rankings (sorted by Primary Cost Index)

Country	Hourly compensation costs	Real estate costs	Utility costs	Corporate tax rates	Interest rates
Canada	3	3	2	3	3
South Korea	3	3	3	3	3
United Kingdom	3	5	4	1	3
United States	**5**	**3**	**3**	**3**	**3**
Japan	3	5	5	5	2

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

The impact of tax reform

As part of this analysis, we also examined if tax reform had a material impact on the relative standing of the U.S. In particular, we examined how the U.S. would have ranked had we used the pre-tax-reform corporate tax rate of 40 percent (combined federal and state average) instead of the post-tax-reform combined rate of 27 percent.

It is worth noting here that our analysis of the tax input is limited to the statutory corporate rate only. We recognize that many other factors contribute to the overall tax burden in any given jurisdiction – including but not limited to the methodology of cost recovery, deductibility of debt service, and the taxation of cross border flows of income. Those other factors, which vary from jurisdiction to jurisdiction, were outside the scope of this report. Still, we believe that use of the statutory rate alone provides valid directional information even if not necessarily the entire picture.

As presented in Table 10, the tax reform improved the U.S.'s ranking not only on the corporate tax measure but also on the Primary Cost Index and the CoDB Index. With tax reform, the U.S. was considered a median tax country. Had the U.S. corporate tax rate continued to be 40 percent, it would have one of the highest corporate tax rates in the comparison group of countries. The tax reform resulted in the U.S. ranking on the Primary Cost Index to improve two notches, from being 16th to 14th out of the 17 countries. The impact on the CoDB Index score is even more significant with the U.S. ranking increasing from 11th place (considering pre-reform tax rates) to 5th (after tax reform).

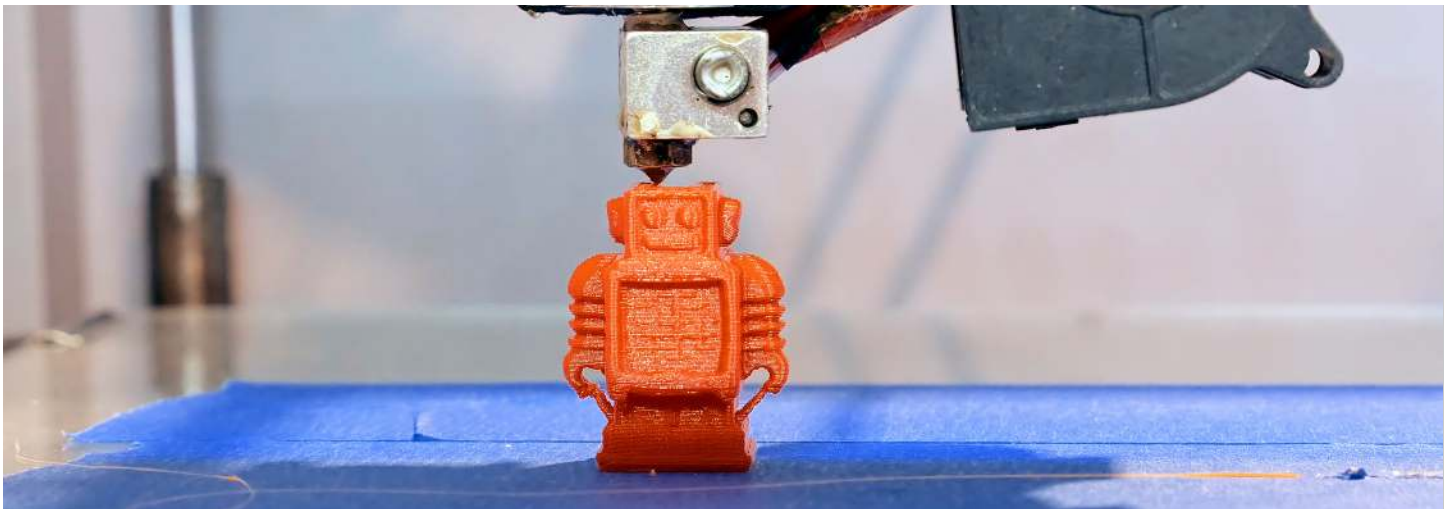


Table 10: Impact of the U.S. tax reform

Countries	Current CoDB index rank	Pre-tax-reform CoDB index rank	Change in rankings due to U.S. tax reform
Canada	1	1	0
Taiwan	2	2	0
South Korea	3	4	+1
Malaysia	4	5	+1
United States	5	11	+6
United Kingdom	6	6	0

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

Secondary Cost Index

With respect to Secondary Cost factors, the U.S. clearly is in a strong position. As Table 11 below indicates (the countries sorted by their respective rank on the Secondary Cost Index), the U.S. scores are among the top three on almost all of the metrics, including quality of labor, transport infrastructure, and ease of doing business. The scores below represent weighted averages of percentile ranks for each measure considered under the category. A score of one (1) is best while five (5) is worst (see Appendix D for additional details).

Table 11: Secondary Index Cost factor scores (sorted by Secondary Cost Index)

Countries	Quality of labor score	Ease of doing business score	Infrastructure score[10]	Infrastructure – Transport score	Infrastructure – Utility score	Risk and protections score
United States	1.67	2.00	2.22	2.00	2.67	2.00
Switzerland	1.67	1.67	2.44	3.00	2.33	2.75
United Kingdom	2.67	2.33	2.25	2.75	3.00	1.50
Canada	2.33	2.33	2.42	3.25	3.00	2.00
Germany	1.67	2.67	2.28	2.50	2.33	2.50
South Korea	2.33	3.33	1.50	1.50	2.00	2.00
Taiwan	3.00	2.33	2.78	3.00	2.33	1.75
Japan	2.33	3.00	2.25	1.75	2.00	2.50
Ireland	1.33	3.00	3.58	4.75	3.00	2.25
France	2.67	3.00	2.69	2.75	2.33	2.25
Malaysia	3.33	2.33	3.06	2.50	3.67	3.00
Italy	3.33	3.00	3.50	3.50	3.00	3.00
China	3.67	2.33	3.64	2.25	3.67	3.50
Mexico	4.33	4.00	4.44	4.00	4.33	4.25
India	5.00	4.33	4.42	3.25	5.00	3.75
Vietnam	4.67	4.33	4.31	4.25	4.67	4.75
Brazil	5.00	5.00	4.47	4.75	4.67	4.75

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

[9] Infrastructure score is a combined score across transportation, utility, and internet. Details are shown for transportation and utility subcomponents while internet access is not shown in the table, but is included the combined score. Each of these three factors (transport, utility and internet) get an equal weight.

On all of the secondary factors considered, including quality of labor, the United States ranks significantly better than countries that offer lower labor costs, such as Vietnam, China, Mexico, and India. To put it differently, the low ranking of these countries on the Secondary Cost Index reflects the weaker investment climate—for example, the poorer connectivity from limited road, rail, and airline networks; more challenging business operating environments; and lower levels of transparency in government operation and reduced legal protections available to businesses.

The industrialized countries generally rank favorably and similarly across secondary metrics, falling for the most part in the top half of the countries. Among them, however, the U.S. clearly ranks better with respect to at least two factors, the quality of labor and ease of doing business. Thus, relative to the other 16 countries considered, the U.S. ranks best on the Secondary Cost components.

Labor – Cost and quality

As noted earlier, compensation cost is often the most cited factor for locating manufacturing facilities in Asian countries such as China, Taiwan, or Vietnam. As the data confirm, these countries do offer among the lowest hourly compensation costs for labor. Further, the hourly compensation costs in the U.S. are among the highest in the world.

As Table 12 shows, a different picture emerges when productivity attributes are considered in addition to the quality of labor. For example, countries with the most favorable cost attributes are not always the ones with the highest real value added per employee. In fact, Table 12 suggests a high degree of positive correlation between costs and productivity.

Thus, it would appear that for manufacturing activities that are more routine in nature and require less advanced skills, where the loss of productivity may be outweighed by lower costs, companies may consider locating their manufacturing facilities in lower costs countries such as China, Vietnam, or Taiwan; however, in higher-value-added manufacturing where the process is more complex or automated and requires highly skilled labor to manage, the United States may be considered more favorably as a location.

Table 12: Percentile ranks for cost and quality of labor

Countries	Hourly compensation costs	RVA per employee
Vietnam	1	5
India	1	5
Mexico	1	4
China	2	4
Malaysia	2	4
Brazil	2	5
Taiwan	3	3
South Korea	3	3
Japan	3	3
United Kingdom	3	2
Canada	3	3
Italy	4	3
Ireland	4	1
France	4	2
United States	5	1
Germany	5	2
Switzerland	5	1

Source: Cost of Manufacturing Operations Around the Globe, KPMG LLP, 2020

Conclusions

Our results indicate that countries that placed better on the Secondary Cost Index generally performed better on the overall rankings. Of the top five most competitive economies on the overall rankings, only two—Malaysia and Taiwan—have a better primary than secondary cost score.

In keeping with this trend of lower Secondary Cost countries scoring better on the CoDB Index, the United States placed fifth on the CoDB Index despite being tied with Switzerland for 14th on the Primary Cost Index. This high Primary Cost Index ranking was primarily due to high labor costs. The United States was able to compensate somewhat for these unfavorable scores on the Primary Cost Index by placing first in the Secondary Cost Index.

As part of this analysis, we also examined if tax reform had a material impact on the relative standing of the U.S. In particular, we compared how the U.S. ranks now (post-tax-reform combined federal and local tax rate of 27 percent) relative to the pre-reform with a corporate tax rate of 40 percent (combined federal and state average). The impact on the U.S.'s CoDB Index ranking is quite significant. After tax reform, the U.S.'s competitiveness increased—as evidenced by its current rank of 5—compared with its previous rank of 11 under pre-reform tax rates.

A closer look at the countries that outperformed the U.S. on the CoDB Index ranking indicates some interesting factors. For example, the U.S. outperformed all of the countries on the Secondary Cost Index due to better labor productivity and business conditions. This implies that the outperformance on the CoDB Index by Canada, Taiwan, South Korea, and Malaysia are all driven by Primary Cost factors. Specifically, Canada's rank is driven primarily by its ability to offer lower compensation costs and slightly lower electricity rates while still maintaining Secondary Cost Index rankings that were not far behind the U.S. South Korea ranked third by offsetting weaker ranking on the Secondary Cost Index with even lower compensation costs. A sharper version of the tradeoff between Primary and Secondary Cost explains the rankings of Taiwan and Malaysia, with Taiwan offering higher primary costs but lower secondary costs.

This study has focused on certain CoDB factors that are commonly considered in manufacturing facility location decisions—at the country level—and the results provide a high-level perspective on the attributes of various countries with respect to these factors. However, the location decision is specific to each company and its consideration of the supply chain and access to markets. The decision may be impacted by the type of industry the company is active in, the type of product, where customers are, and the company's overall business strategy. Thus, individual location decisions are significantly more complex than we can address in an analysis such as this.

For instance, for heavy equipment manufacturing, from a transportation point of view, it may be better to locate the facility closer to suppliers and the market, whereas from a production standpoint, it may be more desirable to locate the facility closer to where the desired type of workforce or raw materials might be available. Alternatively, for a specialized precision products manufacturing operation, the firm's decision may be heavily impacted by the availability of labor with advanced manufacturing skills. In other instances, tax and operating incentives offered by a country may be significant enough to outweigh weakness on other dimensions. As such, the location decision is often guided by unique factors that may go well beyond those we have considered.

Additionally, even within the factors we have considered, the relative importance of these factors to a specific firm may be different than the weights we have considered. Furthermore, it may well be the case that the factors we classify for the purpose of convenience as secondary are in fact primary factors for consideration in a location decision for an individual firm or manufacturing sector. Finally, a number of local factors that go into firm location decisions may or may not be captured in the country-level analysis. For example, labor and rent costs are higher in urban areas relative to more distant suburban or rural areas. Recognizing this, we have developed a Tableau analytic and visualization tool in conjunction with this study that allows the interested reader to alter the weights and to reassess the score based on the relative importance of these factors to them. Click here for the Cost of Manufacturing Operations Tool.

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the reader that the Primary Cost factors are measured in U.S. dollars. Since we have compared costs on a U.S. dollar denominated basis, our results are impacted by the relative strength of the various currencies relative to the dollar. As the foreign exchange rates fluctuate, as they inevitably will, the cost measurements we have relied on would vary and possibly impact the ranking of individual cost components, even if local currency costs do not change.

Finally, we note that the rankings are based on the best historical information available. Such data is mostly available only with a lag, and therefore the impact of recent trade disputes or the market disruptions from COVID-19 are not reflected in the results.

Appendix A: Data sources

As discussed previously, we relied on a variety of sources to gather data on 23 metrics that spanned Primary and Secondary Cost factors.

Primary Cost Index

The Conference Board is a well-known source of data for economists. While researching international labor costs, we noted two indicators related to the manufacturing industry that we deemed useful for our study. The first is *hourly compensation costs*, which is a sum of hourly pay for time worked, hourly direct benefits, and hourly social insurance expenditures and labor-related taxes. The Conference Board did not have this information for Malaysia and Vietnam, so we substituted the Economist Intelligence Unit's *labor cost per hour* (*pay and nonpay costs*) figures for these two countries.

Real estate cost data, that is leasing cost per square foot, was compiled from a mix of sources. We collected data from real estate advisory firms and asset managers such as Cushman & Wakefield, Colliers International CBRE Group, Deutsche Bank DWS, and UBS.

Utility costs measure the average price per kilowatt hour of electricity paid by all businesses and households in each country, excluding taxes and tariffs. These prices were retrieved from each country's respective energy regulatory agency website.

Corporate tax rates were available through internal KPMG sources. The tax rates cited in this study reflect combined statutory federal and provincial tax rates only and do not account for specific tax incentives. International Financial Statistics provided *interest rates* for Brazil, Canada, China, India, Malaysia, Mexico, South Korea, Switzerland, the United States, and Vietnam.

Interest rate data for all economies except the Euro area countries, the United Kingdom, Japan, and Taiwan were obtained from the International Monetary Fund's International Financial Statistics database. Interest rates for Taiwan were retrieved from the Taiwanese central bank, while rates for the remaining economies were retrieved from the U.S. Federal Reserve Economic Data (FRED) database. Interest rates obtained from the IMF reflect the monetary policy-related interest rate, while interest rates obtained from all other sources measure the discount rate.

Secondary Cost measures

Quality of labor

Outside of the *Doing Business* report, the World Bank Group provided two additional measures for our study: *learning-adjusted years of schooling* and *access to internet/Wi-Fi*.

Learning-adjusted years of schooling, used in the *quality of labor* aggregation, gives us insight into how advanced a worker's skill set might be in different countries. It is calculated by multiplying the expected years of school by the ratio of the most recent harmonized test score and to advancement attainment on the Trends in International Mathematics and Science Study (TIMSS) test (The World Bank Group).[11]

The Global Competitiveness Index, published by the World Economic Forum, included an assessment of the *skill set of graduates (secondary and university graduates)* from each country, as captured by the WEF's Executive Opinion Survey. It is included in the "access to advanced education" category. Including this measure, while similar to the learning-adjusted years of schooling, takes into account how executives perceive the quality of the labor force and allows us to consider the perspective of a company operating in one of these countries.

Real value added per employee is a crucial metric for companies, as it has a direct impact on profits. It measures how much value each additional employee is adding to the industry. For example, real value added can increase if new employees are bringing advanced skill sets into the workforce. We used total real value added from the Conference Board as well as the total number of people employed to calculate *real value added per employee*. The Conference Board did not have this information on Malaysia and Vietnam, so we found comparable variables for *real value added per employee* from Malaysia and Vietnam from separate sources.

Ease of doing business

The World Bank Group annually publishes a report titled *Doing Business*, which ranks 190 countries based on their ease of doing business. This research involves very detailed quantitative indicators, and a few were particularly valuable to our study. We focused on the 2019 report, observing the *number of days to start a business, registering property, enforcing contracts,* and *protecting minority investors* indicators. As noted by The World Bank Group, the *number of days to start a business* measures how many days it takes for a "small- to medium-size limited liability company to start up and formally operate in each economy's largest business city." This is the only variable from the *Doing Business* report where we did not look at the overall score for the category (starting a business); we only observed the number of days. For the remaining three indicators, we used the scores. The *registering property* score is based on "the steps, time, and cost involved in registering a property, assuming a standardized case of an entrepreneur who wants to

purchase land and a building that is already registered and free of title dispute. In addition, the score includes the quality of the land administration system in each economy. The quality of land administration index has five dimensions: reliability of infrastructure, transparency of information, geographic coverage, land dispute resolution, and equal access to property rights" (The World Bank Group). *Number of days to start a business and registering property,* along with *burden of government regulation*, were used in our *ease of doing business* aggregation.

Burden of government regulation is another Executive Opinion Survey question from the *Global Competitiveness Index*. It is a response to the survey question "In your country, how burdensome is it for companies to comply with public administration's requirements (e.g., permits, regulations, reporting)?" Respondents can choose a number on a scale of 1 to 7, 1 being "extremely burdensome" and 7 being "not burdensome at all."

Infrastructure

The World Economic Forum's (WEF) *Global Competitiveness Index* (2018 Report) contains very useful indicators relating to starting a business. Based on the values or survey responses for each variable, each country is assigned a score from 1 to 100 (100 being the best). It is important to note that we used these scores for our study, not the direct values or survey responses.

The *Global Competitiveness Index* provides useful information regarding a country's infrastructure. We specifically look at transportation infrastructure and utility infrastructure. In this report, transportation infrastructure is addressed with eight variables —four are sourced from WEF's Executive Opinion Survey, and four are based on statistics that they compiled from external sources.

Of these variables, we used the survey-based figures to measure *road quality* and *railroad quality*, while we used the external index figures from the International Air Transport Association (IATA) and United Nations Conference on Trade and Development to measure *airport connectivity* and *liner shipping connectivity*, respectively. Index values were not used for the road and railroad figures due to inconsistencies with the WEF data when we attempted to reproduce the WEF's calculations for these measures.

The *road quality* survey results capture the response to the survey question: "In your country, what is the quality (extensiveness and condition) of road infrastructure? [1 = extremely poor, among the worst in the world; 7 = extremely good, among the best in the world]." Similarly, *railroad quality* captures the average response to the question: "In your country, how efficient (i.e., frequency, punctuality, speed, price) are train transport services? [1 = extremely inefficient, among the worst in the world; 7 = extremely efficient, among the best in the world]." *Airport connectivity* represents "the IATA airport connectivity indicator, which measures the degree of integration of a country within the global air transport network." The *Liner shipping connectivity index* "assesses a country's connectivity to global shipping networks" and is based on "five components of the maritime transport sector: the number of ships, their container-carrying capacity, the maximum vessel size, the number of services and the number of companies that deploy container ships in a country's ports" (World Economic Forum).

For utility infrastructure, we gathered *electric power losses*, *exposure to unsafe drinking water*, and *reliability of water supply* from the *Global Competitiveness Index*. *Electric power losses*, which measures a country's electricity quality, and *exposure to unsafe drinking water*, which takes into account "the extent of exposure by risk level and the severity of that risk's contribution to disease burden," are both based on statistics that were compiled from external sources. *Reliability of water supply* is taken from the WEF's Executive Opinion Survey and answers the question: "In your country, how reliable is the water supply (lack of interruptions and flow fluctuations)?" Respondents can choose a number on a scale of 1 to 7, 1 being "extremely unreliable" and 7 being "extremely reliable." As mentioned earlier, the World Bank Group provides us with our indicator *access to internet/Wi-Fi*, which is part of the overall *infrastructure* aggregation. It measures the percentage of the population that is using the internet.

Risk and protections

Our *political risk* data was sourced from the insurance company Credendo's "Country Risks Synthetizing Chart." Countries are classified into seven categories (from 1 to 7) reflecting the intensity of risks arising as a result of political and assimilated events. Category 1 includes those countries for which the risk is considered the lowest and category 7 contains those countries with the highest likelihood of risks being caused by political and assimilated events. In our study, we chose to focus on political risk over medium- and long-term periods.

Enforcing contracts and *protecting minority investors*, along with *political risk* and the *corruption perception index*, were included in our *risk and protections* aggregation. According to the World Bank Group, the *enforcing contracts* score "measures the time and cost for resolving a commercial dispute through a local first-instance court, and the quality of

judicial processes index, evaluating whether each economy has adopted a series of good practices that promote quality and efficiency in the court system." *Protecting minority investors* focuses on "the strength of minority shareholder protections against misuse of corporate assets by directors for their personal gain as well as shareholder rights, governance safeguards, and corporate transparency requirements that reduce the risk of abuse" (The World Bank Group).

The WEF's *Global Competitiveness Index* provided scores for each country based on the *Corruption Perception Index 2016* results. This index measures "perceptions of corruption in the public sector" and is scaled from 0 (highly corrupt) to 100 (very clean). According to Transparency International, who created the index, "The global average score is a paltry 43, indicating endemic corruption in a country's public sector. Top-scoring countries are far outnumbered by [low-scoring] countries where citizens face the tangible impact of corruption on a daily basis."

Specific data sources used and linked references are provided below.

Primary Cost measures – References

Measure	Country	Source	Source detail	Year	Link
Hourly Compensation Costs	All (except Malaysia and Vietnam)	The Conference Board	International Comparisons of Hourly Compensation Costs in Manufacturing	2016	http://www.conference-board.org/ilcprogram/index.cfm?id=38269
Hourly Compensation Costs	Malaysia and Vietnam	The Economist Intelligence Unit, General Statistics Office of Vietnam, and Department of Statistics Malaysia	Estimated Labor Cost per Hour, Manufacturing	2016	**Both:** http://data.eiu.com/EIUTableView.aspx?initial=true&pubtype_id=1253181310 **Vietnam:** https://www.gso.gov.vn/default_en.aspx?tabid=783 **Malaysia:** https://newss.statistics.gov.my/newss-portalx/ep/epDownloadContentSearch.seam?contentId=54516&actionMethod=ep%2FepDownloadContentSearch.xhtml%3AcontentAction.doDisplayContent&cid=12789
Real Estate Costs	*See Appendix E*				
Utility Costs	China	China Electricity Council	Analysis of National Electricity Market Transaction Information in the Fourth Quarter of 2018	2018, Adjusted to 2015 USD	http://www.cec.org.cn/guihuayutongji/dianligaige/2019-03-04/189190.html

Measure	Country	Source	Source detail	Year	Link
Utility Costs	France, Germany, Ireland, Italy, and United Kingdom	Eurostat	Electricity prices for nonhousehold consumers – biannual data	2015	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_pc_205&lang=en
Utility Costs	Canada	Government of Canada – Canada Energy Regulator	Market Snapshot: Explaining the high cost of power in northern Canada, February 16, 2017	2016, Adjusted to 2015 USD	The Canada Energy Regulator, 2017. Reproduced with the permission of Public Works and Government Services, 2020.
Utility Costs	Brazil	Governo do Brasil	Anuário Estatístico de Energia Elétrica 2016	2015	http://pat.educacao.ba.gov.br/conteudos/conteudos-digitais/download/8667.pdf
Utility Costs	South Korea	Korea Energy Statistical Information System	Average revenues per kWh sold by segments	2015	http://www.kesis.net/sub/subChartEng.jsp?report_id=34110&reportType=0
Utility Costs	Malaysia	Malaysia Energy Data and Research	Malaysia Energy Statistics Handbook 2018	2015	https://meih.st.gov.my/documents/10620/c7e69704-6f80-40ae-a764-ad0acf4a844d
Utility Costs	India	Power Finance Corporation Ltd. (A Govt. of India Undertaking)	The Performance of State Power Utilities for the years 2013–14 to 2015–16	2015	https://www.pfcindia.com/DocumentRepository/ckfinder/files/Operations/Performance_Reports_of_State_Power_Utilities/1_Report on the Performance of State Power Utilities 2013-14 to 2015-16.pdf
Utility Costs	Switzerland	Swiss Office of Energy	Switzerland Utility Costs	2015	https://www.bfe.admin.ch/bfe/de/home.html
Utility Costs	Taiwan	Taiwan Bureau of Energy	Energy Statistical Annual Reports	2015	https://www.moeaboe.gov.tw/ECW/english/content/ContentLink.aspx?menu_id=1540
Utility Costs	Japan	U.S. Energy Information Administration – Independent Statistics and Analysis	Japan's electricity prices rising or stable despite recent fuel cost changes	2015	https://www.eia.gov/todayinenergy/detail.php?id=27872

Measure	Country	Source	Source detail	Year	Link
Utility Costs	United States	U.S. Energy Information Administration – Independent Statistics and Analysis	Average retail price of electricity, United States, annual	2015	https://www.eia.gov/electricity/data/browser/#/topic/7?agg=0,1&geo=g&endsec=vg&linechart=ELEC.PRICE.US-ALL.A~ELEC.PRICE.US-RES.A~ELEC.PRICE.US-COM.A~ELEC.PRICE.US-IND.A&columnchart=ELEC.PRICE.US-ALL.A~ELEC.PRICE.US-RES.A~ELEC.PRICE.US-COM.A~ELEC.PRICE.US-IND.A&map=ELEC.PRICE.US-ALL.A&freq=A&ctype=linechart<="" div="" style="box-sizing: border-box;">
Utility Costs	Mexico	U.S. Energy Information Administration – Independent Statistics and Analysis	Mexico electricity market reforms attempt to reduce costs and develop new capacity	2015	https://www.eia.gov/todayinenergy/detail.php?id=26932
Utility Costs	Vietnam	Vietnam Electricity – EVN	Vietnam Electricity Annual Report 2016	2015	https://en.evn.com.vn/userfile/User/huongbtt/files/2017/7/AnnualReport2016.pdf
Corporate Tax Rates	All	KPMG	Corporate tax rates table	2019	https://home.kpmg/xx/en/home/services/tax/tax-tools-and-resources/tax-rates-online/corporate-tax-rates-table.html
Interest Rates	Euro Area, India, and Japan	Federal Reserve Economic Data (FRED)	Discount Rates (Euro Area, India, and Japan)	2018	https://fred.stlouisfed.org/
Interest Rates	Taiwan	Central Bank of the Republic of China	Discount Rate (Taiwan)	2018	https://www.cbc.gov.tw/en/lp-695-2.html
Interest Rates	United Kingdom	Bank of England	Discount Rate (U.K.)	2018	https://www.bankofengland.co.uk/monetary-policy/the-interest-rate-bank-rate
Interest Rates	All (except Euro Area, the U.K., India, Japan, and Taiwan)	International Financial Statistics	Interest Rates and Monetary Policy-Related Interest Rate, percent per annum	2018	https://data.imf.org/?sk=388DFA60-1D26-4ADE-B505-A05A558D9A42&sId=1479331931186

Secondary Cost measures

Measure	Country	Source	Source detail	Years	Link
Learning-Adjusted Years of Schooling	All	The World Bank	Learning-Adjusted Years of Schooling	2017	https://tcdata360.worldbank.org/indicators/h00280750?country=BRA&indicator=40964&viz=bar_chart&years=2017
Skill set of Graduates	All (except China)	World Economic Forum	Global Competitiveness Index 2019	Weighted Average 2018–2019	https://tcdata360.worldbank.org/indicators/h00280750?country=BRA&indicator=40964&viz=bar_chart&years=2017 http://reports.weforum.org/global-competitiveness-report-2018/
	China		Weighted Average 2016–2017		
RVA per Employee	All	The Conference Board	International Comparisons of Manufacturing Productivity and Unit Labor Costs	2017	https://www.conference-board.org/ilcprogram/index.cfm?id=42672
Number of Days to Start a Business	All	The World Bank	Doing Business 2019	2019	https://www.doingbusiness.org/en/data
Burden of Government Regulation	All (except China)	World Economic Forum	Global Competitiveness Index 2019	Weighted Average of 2018–2019	http://reports.weforum.org/global-competitiveness-report-2019/
	China			Weighted Average of 2016–2017	
Registering Property	All	The World Bank	Doing Business 2019	2019	https://www.doingbusiness.org/en/data
Road Quality	All (except China)	World Economic Forum	Global Competitiveness Index 2019	Weighted Average of 2018–2019	http://reports.weforum.org/global-competitiveness-report-2019/
	China			Weighted Average of 2016–2017	

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Measure	Country	Source	Source detail	Years	Link
Railroad Quality	All (except China)	World Economic Forum	Global Competitiveness Index 2019	Weighted Average of 2018–2019	http://reports.weforum.org/global-competitiveness-report-2019/
	China			Weighted Average of 2016–2017	
Airport Connectivity	All	World Economic Forum	Global Competitiveness Index 2019	2018	http://reports.weforum.org/global-competitiveness-report-2019/
Liner Shipping Connectivity Index	All	World Economic Forum	Global Competitiveness Index 2018	2018	http://reports.weforum.org/global-competitiveness-report-2018/
Electric Power Losses	All	World Economic Forum	Global Competitiveness Index 2018	2016	http://reports.weforum.org/global-competitiveness-report-2018/
Exposure to Unsafe Drinking Water	All	World Economic Forum	Global Competitiveness Index 2018	2017	http://reports.weforum.org/global-competitiveness-report-2018/
Reliability of Water Supply	All (except China)	World Economic Forum	Global Competitiveness Index 2018	Weighted Average 2018–2019	http://reports.weforum.org/global-competitiveness-report-2018/
	China			Weighted Average 2016–2017	
Access to Internet/Wi-Fi	France, Germany, Ireland, Italy, Malaysia, Mexico, South Korea, U.K., Vietnam, Taiwan	The World Bank	Individuals using the Internet (% of population)	2018	https://data.worldbank.org/indicator/IT.NET.USER.ZS?view=map
	Brazil, Canada, China, India, Japan, Switzerland, U.S.			2017	
Political Risk	All	Credendo	Country Risk and Insights	2019	

Measure	Country	Source	Source detail	Years	Link
Corruption Perception Index	All	World Economic Forum	Global Competitiveness Index 2018	2018	http://reports.weforum.org/global-competitiveness-report-2018/
Protecting Minority Investors	All	The World Bank	Doing Business 2019	2019	https://www.doingbusiness.org/en/data
Enforcing Contracts	All	The World Bank	Doing Business 2019	2019	https://www.doingbusiness.org/en/data

Other supporting data sources

Measure	Country	Source	Source detail	Years	Link
Manufacturing Value Added	All except Taiwan	World Bank	World Bank National Accounts Data	2016	https://data.worldbank.org/indicator/NV.IND.MANF.CD
Manufacturing Value Added	Taiwan	The Conference Board	International Comparisons of Manufacturing Productivity and Unit Labor Costs	2016	https://www.conference-board.org/ilcprogram/index.cfm?id=42672
Manufacturing Exports to the U.S.	All	U.S. Census Bureau	Manufacturing Exports (Customs Value)	2016	https://usatrade.census.gov/
Labor Share of Manufacturing Costs	United States	Morgan Stanley – As reported in Business Insider	Chart of the Day: The Manufacturing Cost Components For A Bunch Of Different Things	2013	https://www.businessinsider.com/chart-the-cost-of-manufacturing-stuff-2013-4
Trade-Weighted U.S. Dollar Index	N/A	Federal Reserve Bank of St. Louis	Trade-Weighted U.S. Dollar Index: Major Currencies, Goods (Index Mar 1973=100, Monthly, Not Seasonally Adjusted)	2015–2019	https://fred.stlouisfed.org/series/TWEXMMTH

Appendix B: Review of other studies

While each company's location selection decision is unique and reflects a range of factors, various studies have attempted to compare how companies would fare if they considered alternate locations for their production facilities. For instance, the Boston Consulting Group performed a study in 2014 that examined the perception that Latin America or Eastern Europe offered lower costs of production than Western Europe, the U.S., or Japan. Based on a set of metrics such as manufacturing wages, labor productivity, energy costs, and exchange rates across 25 countries over time, the study concluded that some of the cost advantages of the lower-cost-base countries, such as Brazil and China, have eroded over time.[10]

The Congressional Research Service also performed a study to assess the health of U.S. manufacturing relative to other countries in 2018.[11] While focused primarily on overall manufacturing trends in areas such as value added by the manufacturing sector, countries' share of global manufacturing, manufacturing employment, and research and development spending, the study also compared hourly costs in manufacturing across 14 countries. The study concluded that U.S. labor costs are well above those in emerging economies but similar in magnitude to those in the major economies of continental Europe.

Yet another study performed by the Brookings Institution considered a broader range of indicators spanning topics such as overall policies and regulations, tax policy, energy, transportation, health costs, workforce quality, and infrastructure and innovation, across 19 countries.[12] This study however did not compare labor costs in manufacturing. Based on the scorecard developed by the authors to assess the manufacturing environment, the study noted that countries that had made investments in workforce and infrastructure such as the United Kingdom, Switzerland, the United States, Japan, and Canada fared much better than nations such as Brazil, Indonesia, Mexico, Russia, India, and China. Our study takes a more firm-centric approach. We consider only the leading manufacturing exporters to the U.S. as our comparison countries and consider a focus on primary costs including labor and real estate.

[10] Boston Consulting Group, "The Shifting Economics of Global Manufacturing: How Cost Competitiveness is Changing Worldwide," 2014

[11] Congressional Research Service, *U.S. Manufacturing in International Perspective*, February 21, 2018

[12] Brookings Institution, *Global Manufacturing Scorecard: How the US Compares to 18 Other Nations*, 2018

Appendix C: Shortlist of comparison countries

This analysis considers a total of 16 economies in addition to the United States. Table 13 lists each of these economies as well as their respective rankings by manufacturing exports to the U.S. and total value added in manufacturing in 2016. Figure 2 presents the accompanying dollar value of manufacturing exports for each economy to the U.S. in 2016.

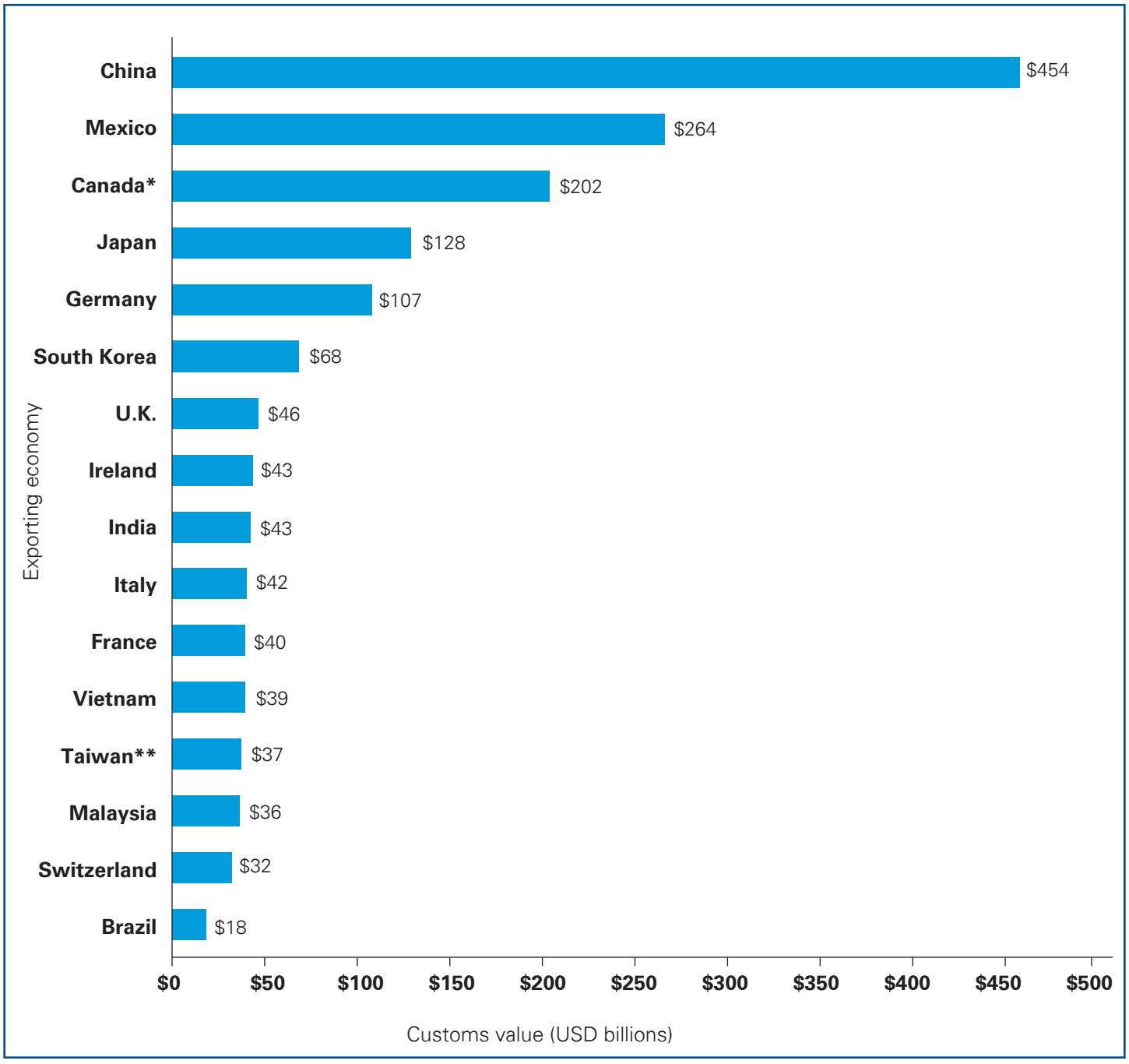
Table 13: 2016 global country rankings

Country	Manufacturing exports to U.S.	Total manufacturing value add
China	1	1
Mexico	2	12
Canada*	3	16
Japan	4	3
Germany	5	4
Korea, Rep.	6	5
United Kingdom	7	9
Ireland	8	19
India	9	6
Italy	10	7
France	11	8
Vietnam	12	46
Taiwan	13	13
Malaysia	14	26
Switzerland	15	17
Brazil	18	10

Source: U.S. Census Bureau, World Bank

These countries were first selected based on the customs value of manufacturing exports to the U.S. However, the list generated on this basis did not include any countries from South America. To make the study more comprehensive, Brazil, the leading economy in South America with an industrial manufacturing base in automotive, aircraft and other sectors, was added to the list.

Figure 1: 2016 Total Manufacturing Exports to the U.S.



Source: U.S. Census Bureau

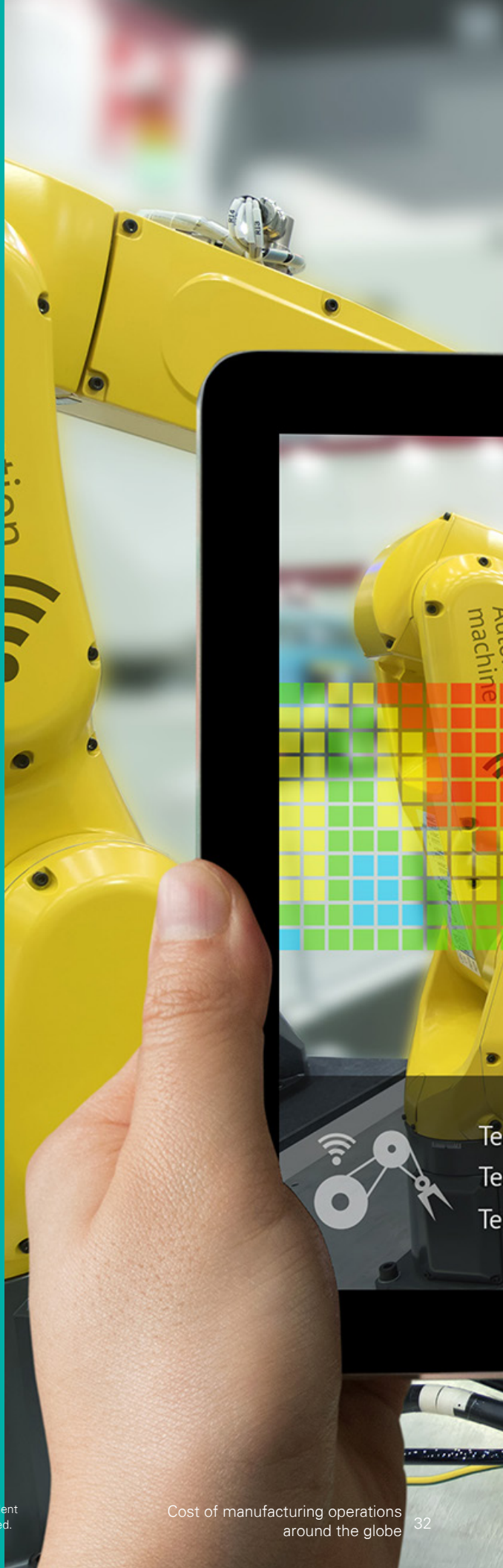
* Note that Canada data is as of 2015 and Taiwan does not contain World Bank data for any year.

** The global manufacturing output ranking from the World Bank source is also included for reference.

We note here that while we use exports to the U.S. as a basis for selecting these countries, the selected benchmark countries generally rank highly when based on manufacturing output as well.[13] There is also a significant overlap between these countries and those considered in other studies that we reviewed.

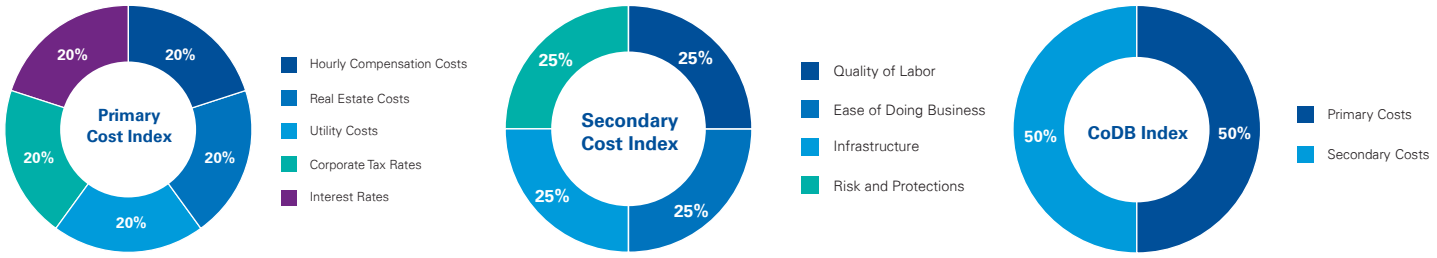
[13] U.S. Census Bureau, *Manufacturing Exports (Customs Value)*. Accessible at https://usatrade.census.gov/

Appendix D: Index methodology



We use 23 metrics to develop an overall weight of the country. The metrics are further segregated into Primary and Secondary Costs. The Primary Costs consist of five subcategories of costs and the Secondary Costs consisted of an additional four subcategories (with a varying number of metrics for each category for a total of 18 categories).

Figure 2: Weights by measure category



The Primary and Secondary Cost Indices are equally weighted at 50 percent each, and each subcategory within these two broad categories was also equally weighted. The weighting for each individual factor, however, varies as the number of factors consider for each metric varies—thus the five Primary Costs have 20 percent weight each, for an overall ranking weight of 10 percent (50 percent*20 percent), while the secondary factors have 25 percent weight each. Quality of labor for example, has three metrics associated with it, with each metric weighted at 4.2 percent (approximately 50 percent*25 percent*1/3). The table below shows the final weights for each metric.

Table 14: Final weights in overall ranking by metric

#	Measure	Cost type	Subcategory	Overall ranking weight
1	Hourly compensation costs	Primary		10.0%
2	Real estate costs	Primary		10.0%
3	Utility costs	Primary		10.0%
4	Corporate tax rates	Primary		10.0%
5	Interest rates	Primary		10.0%
6	Learning-adjusted years of schooling	Secondary	Quality of Labor	4.2%
7	Skill set of graduates	Secondary	Quality of Labor	4.2%
8	Real value added per employee	Secondary	Quality of Labor	4.2%
9	Days to start business	Secondary	Ease of Doing Business	4.2%
10	Burden of government regulation	Secondary	Ease of Doing Business	4.2%
11	Registering property	Secondary	Ease of Doing Business	4.2%
12	Road quality index	Secondary	Infrastructure	1.0%
13	Railroad quality	Secondary	Infrastructure	1.0%
14	Airport connectivity	Secondary	Infrastructure	1.0%

#	Measure	Cost type	Subcategory	Overall ranking weight
15	Liner shipping connectivity index	Secondary	Infrastructure	1.0%
16	Electric power losses (% of output)	Secondary	Infrastructure	1.4%
17	Exposure to unsafe drinking water	Secondary	Infrastructure	1.4%
18	Reliability of water supply	Secondary	Infrastructure	1.4%
19	Access to internet/Wi-fi	Secondary	Infrastructure	4.2%
20	Political risk	Secondary	Risk and Protections	3.1%
21	Enforcing contracts	Secondary	Risk and Protections	3.1%
22	Protecting minority investors	Secondary	Risk and Protections	3.1%
23	Corruption perception index	Secondary	Risk and Protections	3.1%

In addition to the weights assigned for each metric, the methodology for developing the index consisted of the following steps:

— Performance on each metric is ranked using a percentile-based methodology. The top (or bottom from an operating cost perspective based on the metric) 15 percent receives the highest rank, and the lowest (or highest) 15 percent receives a rank of 5. Ranks for real estate costs are shown below as an example. Thus, the cheapest or lowest 15 percentile of real estate costs is rank 1, percentiles between the 15 and 35 percentiles receive a rank of 2 and so on. This is further illustrated in the table below.

Table 15: Percentile rankings by metric

Real estate costs		
Ranking	**From**	**To**
1	0.00%	14.99%
2	15.00%	34.99%
3	35.00%	64.99%
4	65.00%	84.99%
5	85.00%	100.00%

— The final scores are calculated by applying the appropriate weights for each metric first at the subcategory level and combined (using weight multiplied by the rank) with the Primary and Secondary Cost scores and ultimately to the overall score. The scores are then ranked for ease of display and comparison.

Appendix E: Real estate data sources in various cities

Country	City	Property type	Source	Link
Brazil	Santa Cruz/ Campo Grande	Industrial	Cushman & Wakefield Industrial Marketbeat: Q2 2019 Brazil Industrial Report	https://www.cushmanwakefield.com/en/brazil/insights/brazil-marketbeats
Brazil	São Paulo	Industrial	Cushman & Wakefield Industrial Marketbeat: Q2 2019 Brazil Industrial Report	
Brazil	Rio de Janeiro	Industrial	Cushman & Wakefield Industrial Marketbeat: Q2 2019 Brazil Industrial Report	
Canada	Calgary	Industrial	Cushman & Wakefield Industrial Marketbeat: Q2 2019 Canada Industrial Report	https://www.cushmanwakefield.com/en/canada/insights/canada-marketbeats
Canada	Ottawa	Industrial	Cushman & Wakefield Industrial Marketbeat: Q2 2019 Canada Industrial Report	
Canada	Toronto	Industrial	Cushman & Wakefield Industrial Marketbeat: Q2 2019 Canada Industrial Report	
China	Chengdu	Logistics	Colliers Quarterly Logistics Research: Chengdu-Chonqing Q1 2019	https://www.colliers.com/-/media/files/marketresearch/apac/china/southwestchina-research/westchina-logistics-q1-2019-en.pdf?la=en-GB
China	Beijing	Logistics	Colliers Quarterly Industrial: Beijing-Tianjin-Langeang Q1 2018	https://www.colliers.com/-/media/files/marketresearch/apac/china/northchina-research/bj-tj-lf-industrial-q1-2018.pdf?la=en-GB
China	Tianjin	Logistics	Colliers Quarterly Industrial: Beijing-Tianjin-Langeang Q1 2018	
France	Paris	Industrial and Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 France	https://www.cushmanwakefield.com/en/france/insights/france-marketbeat
France	Lyon	Industrial and Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 France	

Country	City	Property type	Source	Link
France	Marseille	Industrial and Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 France	https://www.cushmanwakefield.com/en/france/insights/france-marketbeat
France	Bordeaux	Industrial and Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 France	
France	Strasbourg	Industrial and Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 France	
France	Lille	Industrial and Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 France	
France	Toulouse	Industrial and Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 France	
Germany	Berlin	Industrial and Logistics	Colliers Industrial and Logistics Markets Overview: Germany 2018/2019	https://www.colliers.de/wp-content/uploads/2019/06/ColliersResearchMarket-Report-IL20182019engl.pdf
Germany	Dusseldorf	Industrial and Logistics	Colliers Industrial and Logistics Markets Overview: Germany 2018/2019	
Germany	Frankfurt	Industrial and Logistics	Colliers Industrial and Logistics Markets Overview: Germany 2018/2019	
Germany	Hamburg	Industrial and Logistics	Colliers Industrial and Logistics Markets Overview: Germany 2018/2019	
Germany	Cologne	Industrial and Logistics	Colliers Industrial and Logistics Markets Overview: Germany 2018/2019	
Germany	Leipzig	Industrial and Logistics	Colliers Industrial and Logistics Markets Overview: Germany 2018/2019	

Country	City	Property type	Source	Link
Germany	Munich	Industrial and Logistics	Colliers Industrial and Logistics Markets Overview: Germany 2018/2019	https://www.colliers.de/wp-content/uploads/2019/06/ColliersResearchMarket-Report-IL20182019engl.pdf
Germany	Stuttgart	Industrial and Logistics	Colliers Industrial and Logistics Markets Overview: Germany 2018/2019	
India	Delhi	Industrial	Cushman & Wakefield Industrial Marketbeat: Q4 2018 Delhi Industrial Report	https://www.cushmanwakefield.com/en/india/insights/delhi-ncr-marketbeat
India	Mumbai	Industrial	Cushman & Wakefield Industrial Marketbeat: Q4 2018 Mumbai Industrial Report	https://www.cushmanwakefield.com/en/india/insights/mumbai-marketbeat
Ireland	Dublin	Logistics	Cushman & Wakefield Industrial Marketbeat: Q1 2019 Ireland Industrial Report	https://www.cushmanwakefield.com/en/ireland/insights/ireland-marketbeat
Ireland	Cork	Logistics	Cushman & Wakefield Industrial Marketbeat: Q1 2019 Ireland Industrial Report	
Ireland	Galway	Logistics	Cushman & Wakefield Industrial Marketbeat: Q1 2019 Ireland Industrial Report	
Italy	Rome	Logistics	CBRE Italy Logistics MarketView Q4 2019	https://www.cbre.de/en/research/Italy-Logistics-MarketView-Q4-2019
Italy	Milan	Logistics	CBRE Italy Logistics MarketView Q4 2019	
Italy	Bologna	Logistics	CBRE Italy Logistics MarketView Q4 2019	
Japan	Osaka	Logistics	CBRE Japan Real Estate Market Outlook 2019	https://www.cbre.com/research-and-reports/Japan-Real-Estate-Market-Outlook-2019
Japan	Nagoya	Logistics	CBRE Japan Real Estate Market Outlook 2019	

Country	City	Property type	Source	Link
Malaysia	Klang Valley	Industrial	CBRE Malaysia Real Estate Market Outlook 2019	https://www.cbre.com/report-download?PUBID=44c7f5c6-5dbe-4a76-a335-ff80e9c57a79
Malaysia	Penang	Industrial	CBRE Malaysia Real Estate Market Outlook 2019	
Malaysia	Iskandar Malaysia	Industrial	CBRE Malaysia Real Estate Market Outlook 2019	
Malaysia	Kuching	Industrial	CBRE Malaysia Real Estate Market Outlook 2019	
Mexico	Mexico	Industrial	CBRE Mexico Industrial Market Outlook Q2 2019	https://www.cbre.com.mx/en/research-and-reports
South Korea	Greater Seoul	Logistics	DWS Market Outlook 2018	https://www.dws.com/globalassets/institutional/research/pdfs/DWS_South_Korea_Real_Estate_Market_Outlook_April_2018.pdf
Switzerland		Industrial	UBS Real Estate Focus 2019	https://fiabci.org/uploads/swiss-real-estate-focus-2019-en.pdf
Taiwan	Neihu District, Taipei	Industrial	Colliers Radar Industrial: Taiwan August 2019	https://www.colliers.com/-/media/files/apac/taiwan/other%20reports/2019radarreport-en.pdf?la=en-GB
Taiwan	Nangang, Taipei	Industrial	Colliers Radar Industrial: Taiwan August 2019	
Taiwan	Xizhi, New Taipei City	Industrial	Colliers Radar Industrial: Taiwan August 2019	
Taiwan	Jhonghe, New Taipei City	Industrial	Colliers Radar Industrial: Taiwan August 2019	
Taiwan	Xindien, New Taipei City	Industrial	Colliers Radar Industrial: Taiwan August 2019	
Taiwan	Sanchong, New Taipei City	Industrial	Colliers Radar Industrial: Taiwan August 2019	
Taiwan	Xinchuang, New Taipei City	Industrial	Colliers Radar Industrial: Taiwan August 2019	
Taiwan	Tucheng, New Taipei City	Industrial	Colliers Radar Industrial: Taiwan August 2019	

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Country	City	Property type	Source	Link
United Kingdom	London (Heathrow)	Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 UK	https://www.cushmanwakefield.com/en/united-kingdom/insights/uk-marketbeat
United Kingdom	Manchester	Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 UK	
United Kingdom	Birmingham	Logistics	Cushman & Wakefield Industrial Market Snapshot: Q2 2019 UK	
United States	Boston	Industrial	Cushman & Wakefield U.S. Industrial Marketbeat: Q2 2019	https://www.cushmanwakefield.com/en/united-states/insights/us-marketbeats/us-industrial-marketbeat
United States	Omaha	Industrial	Cushman & Wakefield U.S. Industrial Marketbeat: Q2 2019	
United States	Detroit	Industrial	Cushman & Wakefield U.S. Industrial Marketbeat: Q2 2019	
Vietnam	Ho Chi Minh City	Industrial	CBRE Vietnam Marketview Q2 2018	http://www.cbrevietnam.com/?useful=cbre-vietnam-marketview-q2-2018
Vietnam	Long An	Industrial	CBRE Vietnam Marketview Q2 2018	
Vietnam	Dong Nai	Industrial	CBRE Vietnam Marketview Q2 2018	
Vietnam	Binh Duong	Industrial	CBRE Vietnam Marketview Q2 2018	
Vietnam	Hanoi	Industrial	Colliers Vietnam Real Estate Quarterly Knowledge Report Q1 2019	https://www.colliers.com/-/media/files/apac/vietnam/pdf/vietnam-quarterly-knowledge-report-q1-2019-en-1.pdf?la=en-GB

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