Via Electronic Mail

May 5, 2020

The Honorable Chair and Members
of the Hawai'i Public Utilities Commission
Kekuanao'a Building, First Floor
465 South King Street
Honolulu, Hawaii, 96813
Attention: Caroline Ishida, Esq.

Re: Docket No. 2019-0117, Young Brothers, LLC, for Approval of a General Rate Increase and Certain Tariff Changes – Response to COVID-19 Financial and Procedural Update Request

Dear Commissioners and Commission Staff:

On April 24, 2020, Young Brothers, LLC ("Young Brothers", "YB", or the "Company") filed Transmittal No. 20-0003, which sought to amend Local Freight Tariff No. 5-A to reduce the number of weekly sailings to certain ports in response to the current COVID-19 pandemic and the rapidly evolving circumstances surrounding YB's operations. Also on April 24, 2020, following the filing of Transmittal No. 20-0003, Young Brothers received a letter from the Hawaii Public Utilities Commission ("Commission") requesting that Young Brothers provide the Commission with an update informing the Commission of 1) any financial impacts Young Brothers has experienced, and predicts it will experience in the near-, medium-, and longer-term, as a result of the COVID-19 emergency, 2) any suggestions or proposals for financial assistance or relief during that time, if it deems that necessary, and 3) any procedural changes that YB anticipates it may request related to Docket No. 2019-0117, in light of the COVID-19 emergency. By this letter, Young Brothers respectfully responds to the above-referenced Commission requests for further updates as follows:

1) COVID-19 Related Financial Impact to Young Brothers

As discussed in Tariff Transmittal No. 20-0003, Young Brothers is experiencing drastic losses in cargo volume as a result of the COVID-19 emergency. At the rate volumes are decreasing since the COVID-19 emergency was declared, YB is forecasting a loss of at least $22.5 million dollars for 2020; these forecasted losses could further rise if cargo volumes continue to decrease. This means that YB's severe pre-COVID-19 financial situation may only worsen. Below is a more detailed discussion of the near-, medium-, and longer-term financial impacts that YB is expecting as a result of the COVID-19 emergency.

A. Near-term Financial Impacts

See Attachment 1 to this letter for a table displaying the Company's near-term financial update. For purposes of this response, the Company defines near-term to mean the 2020 calendar year. The near-term update in Attachment 1 starts from the Company's 2020 Budget (Column A), which was identified in its 2020 test year application in Docket No. 2019-0117, and separately identifies impacts associated with 1) actual results for the year-to-date through March 2020 (column B); 2) non-COVID-19 impacts anticipated to impact the remaining months (column C); and 3) COVID-19 related financial impacts (column D), in arriving at the Company's April Forecast (column E) for 2020. The information provided in Attachment 1 includes operating revenue and operating expenses in arriving at Earnings Before Interest and Taxes ("EBIT") for 2020.

As shown in Attachment 1, the Company's 2020 Budget initially identified an EBIT loss (expenses in excess of revenue at current rates) of approximately $12.3M[1] (Column A). As discussed further below, there is currently greater uncertainty around the extent and duration of the adverse impacts to the State of Hawaii's economy due to the COVID-19 emergency, and that uncertainty makes forecasting financial impacts to the Company extremely difficult. Nevertheless, based on information currently available as of the date of this letter, the Company now estimates in its April 2020 Forecast (column E) an EBIT loss for 2020 of $22.5M, or a loss of an additional $10.2M compared to the 2020 Budget.

Attachment 1 also shows that the estimated COVID-19 impact accounts for approximately $8.6M (Column D) of the additional EBIT loss reflected in the April 2020 Forecast. Adjustments to the annual forecast associated with year-to-date (through March 2020) actuals contribute an additional loss of $1.4M (Column B),[2] and adjustments for non-COVID-19 impacts contribute additional loss of $0.2M (Column C).

The primary driver of the overall $10.2M additional projected loss for 2020 is a forecasted sharp decrease in operating revenues at current rates, which are estimated to decline by $18.2M compared to the 2020 Budget due primarily to COVID-19 projected impacts of $16.4M (Column E). Combined intra and interstate freight revenues[3] are forecasted to decrease by $14.6M compared to the 2020 Budget. In addition, charter work and other revenue accounts[4] are forecasted to decrease by $1.4M and $0.4M, respectively. This updated forecast is based on the actual drastic decline in cargo volumes that the Company has already experienced, but as previously stated, there remains much uncertainty around the extent and duration of the adverse impact to the State of Hawaii's economy, which make forecasting revenue impacts even in the near term very difficult.

Operating expenses are currently forecasted to decrease by $7.2M compared to the 2020 Budget, due primarily to $7.8M of forecast changes related to the Company's response to COVID-19 impacts. The decrease is due primarily to reductions of $4.5M, $0.5M, and

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[1] See Docket No. 2019-0117, Exhibit No. YB-707 for the 2020 Budget for EBIT. As shown in YB-723, the Company's 2020 test year forecast for operating revenue at current rates, operating expenses and EBIT, based on its 2020 Budget, was estimated at a loss of -$13.4M.

[2] Leading up to the COVID-19 emergency, the Company's EBIT for the first quarter of 2020 was $1.4M below Budget due primarily to declining revenues. First quarter intrastate revenue tonnage and revenue dollars were both below Budget by 5%. 2020 first quarter cargo handling labor was higher than Budget largely due to significant weather impacts during January and March 2020. ILWU fringe benefits expense was higher than Budget due to higher net periodic pension costs, which increased by approximately $1M on an annual basis compared to Budget, as a result of revised actuarial reports as discount rates dropped roughly 120 basis points.

[3] Intra and interstate freight revenue accounts include associated General Excise Tax and Fuel Surcharge revenues.

[4] Other revenue accounts consist primarily of cargo handling insurance related to intrastate and interstate freight charges.

$0.9M to cargo handling, maintenance, and vessel wages related to volume reductions and revised sailing schedule changes (which are the subject of the Company's April 24, 2020 Tariff Transmittal No. 20-0003)[5] as well as reduced labor loan wages.

In its April 2020 Forecast, the Company has included approximately $70,000 for incremental increases in operating expenses due to COVID-19, primarily for personal protection equipment ("PPE") for the Company's employees. The Company anticipates additional COVID-19 impacts that may significantly increase 2020 operating expenses for items such as additional safety related expenses for additional PPE or changes in procedures needed to keep YB employees and customers safe, increased bad debt expenses if customers are not able to make payment on their accounts, and other items such as higher pension costs. However, in light of the uncertainty around the extent and duration of the adverse impacts of the COVID-19 emergency, the Company is not able to incorporate such effects into its April 2020 Forecast.

B. Medium-term and Long-term Financial Impacts

For purposes of responding to the Commission, the Company assumes that the "medium-term" and "long-term" outlook includes periods after 2020. As noted in Attachment 2 to this letter, a report prepared by Hawaii economist Paul Brewbaker, Hawaii's dependence on tourism will likely result in a slow and uncertain economic recovery from the pandemic recession. Because of that uncertainty, it is difficult for Young Brothers to provide meaningful financial forecasts for the Company for periods beyond 2020 at this time. Notwithstanding that uncertainty, Young Brothers, in providing essential services to the State of Hawaii, has a cost structure that is both largely fixed and capital intensive such that sustained declines in cargo volume are expected to continue to have substantial and prolonged adverse impacts on the Company's financial performance, financial condition, and ultimately on its financial integrity.[6]

2) COVID-19 Related Suggestions or Proposals for Financial Assistance or Relief

Young Brothers recognizes that it currently provides a unique and long-standing interisland water carrier service that is essential to customers across the State of Hawaii. In recent years, YB has been fortunate to receive, among other things, the financial support from its parent company to accommodate revenue shortfalls and the capital investments necessary to continue providing this essential interisland water carrier service. However, this is not sustainable going forward without adequate and immediate relief, particularly in the COVID-19 economic environment. In these difficult times, Young Brothers' current objectives include both preserving the critical functions/jobs of the Company's dedicated and hardworking employees while continuing to provide safe and reliable interisland water carrier service to customers at just and reasonable rates. To accomplish these objectives, the Company hopes to collaborate and work closely with the Commission, the Consumer Advocate, government officials, customers, and

[5] The Consumer Advocate did not object to the Company's tariff transmittal and the Commission, in Order No. 37128 filed May 4, 2020, approved the Company's requests set forth in Tariff Transmittal No. 20-0003.

[6] See Docket No. 2019-0117, YB T-7, pp 42-43.

other stakeholders to immediately implement fair, equitable, and balanced measures or mechanisms for relief including, without limitation, the potential provision of government funding to allow water carrier operations to, at the very minimum, break-even. In other words, with the assistance and support of all stakeholders, Young Brothers is working to survive this downturn, not profit from it.

Measures or mechanisms that would further assist Young Brothers to weather the COVID-19 related financial impacts and remain a going concern include, without limitation:

A. Immediate and near-term potential regulatory filings:

1. Deferral of COVID-19 related costs. Young Brothers is currently planning to file an application to defer COVID-19 related costs. Currently, the Company is incurring additional costs for labor and materials for disinfecting and cleaning, personal protective equipment, and other out of pocket expenses due to the pandemic. In addition, because the majority of the Company's costs are fixed, the expected substantial decreases in revenues directly impact its losses, while the fixed costs are not recovered. Young Brothers will be seeking the Commission's approval to defer these costs for later determination as to cost recovery. See In re Haw. Elec. Co., Inc., Docket No. 2009-0162, Decision and Order, filed Dec. 11, 2009, at 1, and In re Haw. Elec. Co., Inc. and Maui Elec. Co., Ltd., Docket No. 2011-0370, Order No. 30586, filed Aug. 22, 2012, at 1 (collectively allowing cost deferral for multiple "Big Wind" implementation studies); see also Haw. Elec. Co., Inc. et al., Docket No. 2020-0069, Application, filed April 22, 2020 (seeking approval to defer costs associated with COVID- 19 pandemic).
2. COVID-19 related lost revenue tracker. This would represent a novel regulatory solution to the COVID-19 related losses that YB is now facing. Young Brothers is considering filing an application to accumulate COVID-19 related lost revenues in a separate regulatory asset account. At some later date, Young Brothers may seek to recover these losses by amortizing them over a period of time in rates.
3. Disposition of pending dockets. By this letter, Young Brothers would appreciate if the Commission could issue its decision and order approving Young Brothers' application to dispose of Tug Hokulani in Docket No. 2019-0344, as soon as reasonably practicable. Approval of this application will allow Young Brothers to complete the sale of Tug Hokulani and secure the funds associated with the sale, and such funds will assist Young Brothers' financial condition.
4. Emergency rate relief. In the event that Young Brothers' financial condition deteriorates further, an application for emergency rate relief could be filed. See Molokai Public Utilities, Inc., et al., Docket No. 2008-0115, Order Approving Temporary Rate Relief for Molokai Public Utilities, Inc. and Wai`Ola O Moloka`I, Inc., filed Aug. 14, 2008, at 1.

B. Longer term potential regulatory solutions:

1. Reinstate AFRA or implement a similar cost recovery mechanism. In 2012, the Commission authorized Young Brothers to implement the Automatic Freight Rate Adjustment mechanism ("AFRA") as a three-year pilot that allowed YB to adjust rates annually to immediately account for increases in expenses, including bargaining unit labor expenses. The pilot program expired in 2016. Young Brothers may seek to reinstate AFRA at some later date. See In re Young

Brothers, Ltd., Docket No. 2013-0032, Decision and Order No. 31493, filed Oct. 11, 2013, at 1.

2. Revenue balancing account. Young Brothers may propose a mechanism to re-set its revenues for ratemaking purposes on an annual (or possibly semi-annual) basis to the last approved rate case. Even prior to the COVID-19 pandemic, Young Brothers faced a future of stagnant or declining cargo volumes. The pandemic has grossly exacerbated that situation. If volumes continue to decline, then Young Brothers may seek Commission approval of an annual mechanism that balances Young Brothers revenue to its last approved rate case, similar to the Revenue Balancing Account mechanism that Young Brothers understands was established for the Hawaiian Electric Companies. See Docket No. 2008-0274, *Instituting a Proceeding to Investigate Implementing a Decoupling Mechanism for Hawaiian Electric Co, etc.* Final D&O dated August 31, 2010.

C. Additional Proposals for Financial Relief

1. Subsidies and/or other financial support from the Legislature. In the aborted 2020 session of the State of Hawaii's Legislature, House Bill 2475/Senate Bill 2800, relating to *Special Harbor Funding to Subsidize Cargo Carriers*, was introduced and heard. Young Brothers is supportive of the intent of this type of legislation and would support other Legislative initiatives to provide financial support in addition to the support for Maui County in HB2475/SB2800.
2. Federal legislation. Young Brothers is in contact with Hawaii's Congressional delegation to request that the federal COVID-19 relief packages include protection for water carriers.

3) Anticipated Procedural Changes to Docket No. 2019-0117

Young Brothers recognizes that the COVID-19 pandemic changed the State of Hawaii's ("State" or "Hawaii") economic outlook for the next several years. Historically, Young Brothers' cargo volumes, in general, have followed Hawaii's economic condition. When the State's economy goes into recession, Young Brothers' cargo volumes tend to decline. As the Company notes in the above financial analysis and in Tariff Transmittal No. 20-0003, cargo volumes experienced an immediate reduction as soon as the State's Stay-at-Home order went into effect.

As noted by Hawaii economist Paul Brewbaker, Hawaii's dependence on tourism will likely result in a slow and uncertain economic recovery from the pandemic recession. Young Brothers' 2020TY revenue forecasts are now significantly overstated given the recent dire economic recovery predicted for the State. The proposed sailing schedule changes should result in lower expenses; however, the forecast for lost revenues in 2020 will far outstrip the savings from the schedule change and other cost-cutting measures that Young Brothers already is implementing.

To the extent necessary and required, Young Brothers is willing to update the 2020TY revenue requirement in light of the pandemic recession and work with the Consumer Advocate in revising the rate case procedural schedule. However, Young Brothers' concern is that the pandemic recession is just beginning. No one is certain when there will be a vaccine, sufficient testing kits and facilities, and other necessary health care measures that will allow a return to normal. Medical technology breakthroughs could accelerate economic recovery. Similarly, medical setbacks could slow the recovery. Young Brothers does not want to be in a position of

having to constantly update its 2020TY forecasts and revenue requirement as new predictions for economic recovery become available.

Although Young Brothers recognizes that other jurisdictions/public utility commissions may be taking certain actions in light of the pandemic such as suspending on-going rate case dockets, this is not a viable option for Young Brothers for its pending rate case. A significant delay in this rate case will be financially disastrous for Young Brothers and would jeopardize the Company's ability to provide safe and reliable interisland cargo transportation throughout the State of Hawaii. Young Brothers understands the hardship the pandemic is wreaking on everyone's individual finances. No one wants to see a rate hike of any sort for any service during an economic recession, but the damage to Hawaii's economy will be far greater if Young Brothers is not provided adequate and immediate rate relief. Young Brothers is asking that the Commission consider the need to balance Young Brothers' current financial condition against the desire to keep rates stable.

In doing so, Young Brothers suggests a more collaborative approach to processing the pending rate case. The Company recommends the Commission, the Consumer Advocate, and Young Brothers work together to solve this issue of constantly needing to update the 2020TY and resulting revenue requirement as the State's economic forecasts change over the ensuing months and strike the appropriate balance between Young Brothers' financial distress and the hardship consumers are facing. Specific to the rate case, Young Brothers requests that it be allowed to keep the 2020TY regardless of when and how often the Company has to update the revenue requirement. For example, requiring Young Brothers to move to a 2021TY is unreasonable and not feasible as it would only add to Young Brothers' rate case costs and further delay the Company's ability to obtain the necessary rate relief.
Thank you for your consideration in this matter. Please contact the undersigned if you have any questions.

Sincerely,

Jay Ana
President,
Young Brothers, LLC

Young Brothers, LLC

Near-Term Financial Update: April 2020 Forecast

Revenue	A 2020 Budget	B Q1 Actuals Impact	Fav / (UnFav) vs. Budget	C Non-COVID-19 Forecast Impact	Fav / (UnFav) vs. Budget	D COVID-19 Forecast Impact	Fav / (UnFav) vs. Budget	E April 28 Forecast
Intrastate General Freight	$ 76,094,011	$ (887,152)	(1.2%)	$ (268,720)	(0.4%)	$ (11,297,925)	(14.8%)	$ 63,640,215
Interstate General Freight	$ 34,404,178	$ (222,488)	(0.6%)	$ (236,265)	(0.7%)	$ (3,280,212)	(9.5%)	$ 30,665,213
Charter Revenue	$ 3,399,970	$ (491,497)	(14.5%)	$ -	0.0%	$ (1,393,861)	(41.0%)	$ 1,514,612
Other Revenue	$ 6,533,452	$ 305,368	4.7%	$ (9,730)	(0.1%)	$ (409,068)	(6.3%)	$ 6,420,022
Total Revenue	**$ 120,431,611**	**$ (1,295,769)**	**(1.1%)**	**$ (514,714)**	**(0.4%)**	**$ (16,381,066)**	**(13.6%)**	**$ 102,240,062**
Operating Expense								
Cargo Handling	$ 57,755,594	$ 187,706	(0.3%)	$ 631,075	(1.1%)	$ (5,269,794)	9.1%	$ 53,304,582
Voyage	$ 31,857,618	$ 192,162	(0.6%)	$ -	0.0%	$ (1,342,435)	4.2%	$ 30,707,345
Maintenance	$ 16,126,624	$ (450,567)	2.8%	$ (118,854)	0.7%	$ (575,403)	3.6%	$ 14,981,800
Total Operating Expense	**$ 105,739,836**	**$ (70,699)**	**0.1%**	**$ 512,221**	**(0.5%)**	**$ (7,187,632)**	**6.8%**	**$ 98,993,727**
Contribution Margin	**$ 14,691,774**	**$ (1,225,070)**	**(8.3%)**	**$ (1,026,936)**	**(7.0%)**	**$ (9,193,434)**	**(62.6%)**	**$ 3,246,335**
Contribution Margin %	**12.2%**							**3.2%**
G&A Expense	**$ 19,973,013**	**$ (489,151)**	**2.4%**	**$ (10,835)**	**0.1%**	**$ (586,678)**	**2.9%**	**$ 18,886,350**
Non-Op Income (Expense)	**$ 46,560**	**$ 37,242**	**(80.0%)**	**$ (200,000)**	**429.6%**	**$ -**	**0.0%**	**$ (116,198)**
Earnings Before Interest Taxes Depreciation & Amortization	**$ (5,327,799)**	**$ (773,161)**	**(14.5%)**	**$ (816,100)**	**(15.3%)**	**$ (8,606,756)**	**(161.5%)**	**$ (15,523,817)**
Depreciation & Amortization	**$ 7,005,725**	**$ 618,688**	**(8.8%)**	**$ (618,688)**	**8.8%**	**$ -**	**0.0%**	**$ 7,005,725**
Earnings Before Interest Taxes	**$ (12,333,524)**	**$ (1,391,850)**	**(11.3%)**	**$ (197,412)**	**(1.6%)**	**$ (8,606,756)**	**(69.8%)**	**$ (22,529,542)**
NET PROFIT (LOSS)	**$ (12,333,524)**	**$ (1,391,850)**	**(11.3%)**	**$ (197,412)**	**(1.6%)**	**$ (8,606,756)**	**(69.8%)**	**$ (22,529,542)**
NET PROFIT (LOSS) %	**-10.2%**							**-22.0%**

A Internal management reporting package presentation of Board approved annual budget. See Exhibit No. YB-707.

B Difference between Q1 budget and Q1 actual results (includes the beginning of lower revenue volume related to the COVID-19 impact from the last week of March).

C Forecast adjustments based on the continuation of Q1 non-COVID-19 actual trends.

D Forecast adjustments based on decreasing volumes and resulting operational changes based on the proposed sailing schedule changes due to COVID-19 impacts (assumed effective date of May 5, 2020).

E Summation of Q1 actuals, non-COVID-19 forecast, and COVID-19 forecast impacts (E = A + B + C + D).

ATTACHMENT 1

Background discussion on short-term, medium-term, and long-term scenarios for Hawaii economic forecasts after the SARS-Cov-2 novel coronavirus

prepared for Young Brothers Ltd.
by Paul H. Brewbaker, Ph.D., CBE
TZ Economics, Kailua, Hawaii
May 3, 2020

This background discussion provides guidance for framing forecasts over the short-term of a few months or quarter or two, the medium-term of six months to one year or more, and the long-term peering further into the 2020s. Spread of the novel coronavirus SARS-CoV-2 has created a global pandemic during the last six months. It is believed to have emerged initially from zoonotic origins of unexplained pneumonia cases in Wuhan, China late in 2019. At the time of this writing the associated disease, COVID-19, has been identified worldwide with 3.3 nearly million cases and 230,000 deaths by the World Health Organization (WHO).[1] The United States is identified as the location of almost one-third of global COVID-19 cases and deaths. The pandemic and public health policy responses—social distancing and stay-at-home protocols—produced a Sudden Stop in economic activity and an impulse response in job loss and business interruption. Air travel to and within Hawaii has almost completely halted. Tourism as a channel of transmission of exogenous macroeconomic shocks disproportionately impaired economic activity in Hawaii among the 50 states since mid-March, six weeks ago.

So-called leptokurtotic or "fat-tailed" event risks—an expression referring to the shape of the underlying frequency distributions—are highly improbable (*in*frequent) and highly costly. Consequences of a leptokurtotic event such as the current SARS-Cov-2 pandemic on Hawaii economic performance can be profound. Tourism comprises approximately 17 percent of Hawaii value-added (GDP) directly and indirectly via inter-industry linkages, and 19 percent of Hawaii jobs.[2] Containment of the novel coronavirus in January and February 2020 was non-existent in Hawaii. An air travel shutdown necessitated during March 2020 to exclude introduction of the novel coronavirus from overseas removed one-sixth of Hawaii GDP comprising tourism by April 2020.[3] An additional one-sixth, approximately, of Hawaii economic activity shut down temporarily as an outcome of mitigation strategies (*e.g.* stay-at-home). One-third of Hawaii's labor force was rendered unemployed by April. Mitigation efforts were epidemiologically successful (Figure 1), momentarily, but the future of travel and tourism, Hawaii's principle export, and Hawaii's economy generally, remain uncertain.

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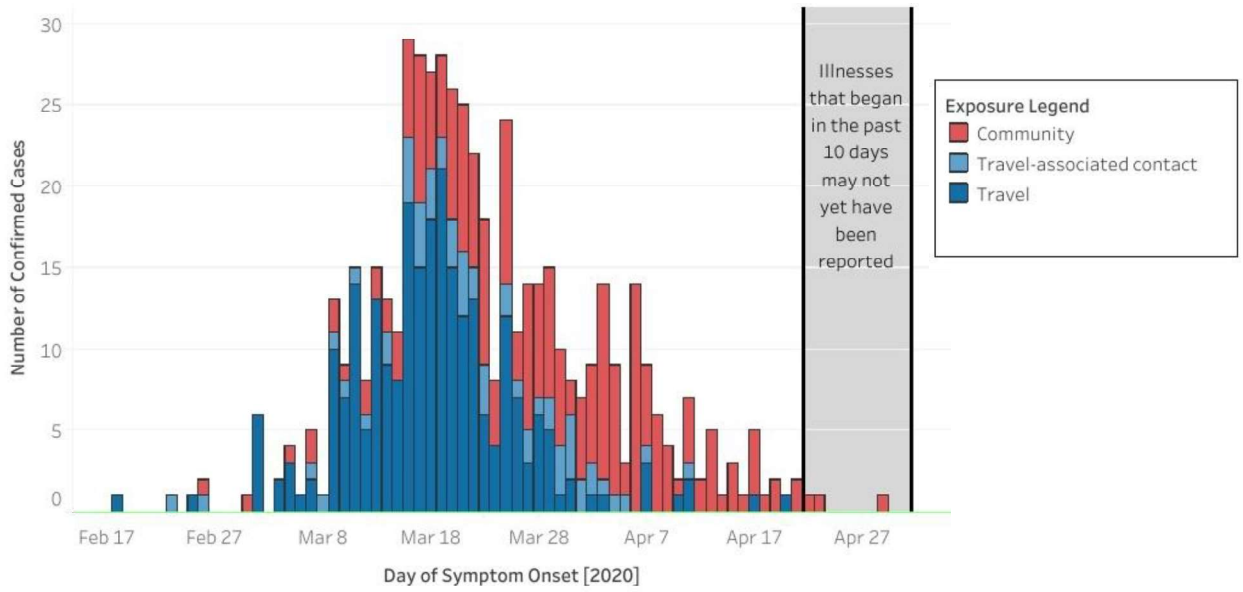
[1] World Health Organization (WHO) *Situation Report – 103* (10:00 CEST, 2 May 2020) (https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200502-covid-19-sitrep-103.pdf?sfvrsn=d95e76d8_4).

[2] Another 6 percentage points of value-added in Hawaii can be attributed to federal military activity; together tourism and the military, as exports, comprise nearly one-quarter of GDP in Hawaii, a fairly large concentration even for small, open economies. Hawaii DBEDT, Table 7.34, *State of Hawaii Data Book* (http://files.hawaii.gov/dbedt/economic/databook/2018-individual/07/073418.xls).

[3] Eighty percent or more of confirmed cases in Hawaii in March and April 2020 originated in returning residents from places with outbreaks like Seattle and Las Vegas.

Figure 1. Confirmed Hawaii COVID-19 cases by source ("epi curve") as of May 2, 2020



Source: Hawaii Department of Health (https://health.hawaii.gov/coronavirusdisease2019/what-you-should-know/current-situation-in-hawaii/), accessed 11:00 HST May 3, 2020.

The novel coronavirus presents a *novel challenge* in economic forecasting because of the extremeness of extreme consequences the pandemic has produced in a very short time. It even seems as if it makes talking about a forecast—a conditional expectation for future outcomes with explicit assumptions about influencing factors—a pointless exercise. As it happens, however, there are both economic forecasts already being published which help guide thinking about making such assumptions and help developing one's own forecast revision. In addition, believe it or not, there are actually *quantifiable* prior experiences *of similar magnitude* which inform such scenario-building exercises. Things only seem crazy because this event is so uncommon, which in itself raises the question, "why do we behave as if this won't happen when it does?"

This discussion adopts a *visualization* approach to examine some of the currently available economic forecasts, as well as some of the quantifiable historical experiences, with emphasis on documentable tourism economic history. This approach frames a conceptual basis for short-term, medium-term, and long-term economic forecasting of Young Brothers ocean surface carriage volumes. This discussion will be limited to scenarios, but there will come a time, in the near-term (in the next few months and quarters) when a YB revenue tonnage forecast revision will become feasible. Currently it is probably premature: the bottom of the unfolding trough has not yet been determined, and the starting point for the eventual recovery has not been established; both appear at this juncture likely to occur in second quarter 2020. To the visualizations this discussion turns.

1. Short-term economic forecasting

First, why visualization? Because, in the case of the novel coronavirus, you can't believe it until you see it (literally). The profound impact of the coronavirus is manifested in myriad economic statistics. While this discussion also illustrates ways in which recent outcomes are *not* unprecedented, it remains the case that all are rare, extreme events. SARS-CoV-2 is the Mother of leptokurtotic events—or at least one of the small number of Aunties in data for the last century.

Two recent economic forecasts highlight several attributes of the novel coronavirus event. The April 2020 survey of the National Association for Business Economics (NABE), illustrated in Figure 1, exemplifies the challenges.

- The median NABE forecast (Figure 1(*a*)) anticipates a decrease in annualized, quarterly U.S. real GDP growth of 25 percent in second quarter 2020, near zero growth (no change from the bottom of that trough) in third quarter 2020, and only the most tentative recovery during the five subsequent quarters ending in 2021.[4]

- For context, quarterly U.S. real GDP grew at a 2.2 percent annual average rate during the 2010s expansion, ending in fourth quarter 2019, in the longest and *least volatile* economic expansion in history. Figure 1(*b*) illustrates the contrast.

- The NABE forecast is also notable for the sheer dispersion of forecasts. The top five estimates forecast −1.0 percent growth in 2020Q2. The bottom five estimates forecast −50.0 percent growth in 2020Q2. This is a sign of sheer *uncertainty*.

First quarter 2020 U.S. real GDP growth was −4.8 percent (Figure 2(a), twice the rate of decrease of the NABE median forecast for 2020Q1, −2.4 percent. Unlike typical recessions, most often investment-led, the current presumed recession is *consumption*-led, composition also indicative of its extreme nature. The V-shaped or "Nike Swoosh-shaped" trajectories in the NABE forecasts exhibit a long climb out of a deep trough.

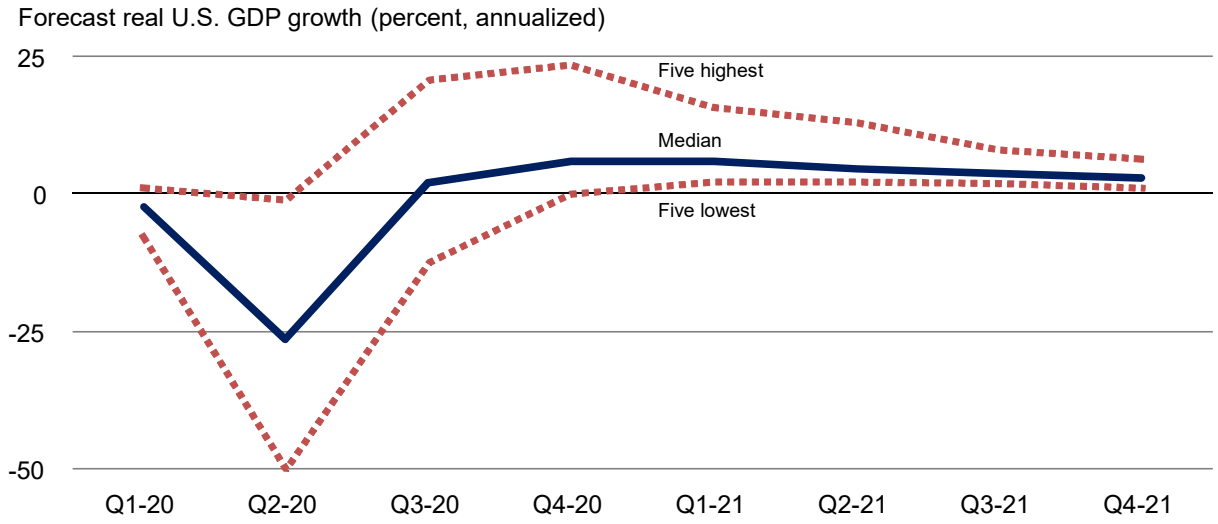
The Congressional Budget Office updated its January 2020 forecasts with an April 2020 revision (Table 1). This followed massive fiscal stimulus initiated by the U.S. Congress, and extraordinary monetary policy accommodation by the Federal Reserve. It embraces a Nike Swoosh-like comparison of newly-forecast to previously expected U.S. real GDP, with 2020Q2 output nearly 15 percent lower than anticipated only three months earlier (Figure 3).

For the short-term, a precipitously sharp, V-shaped economic downturn, followed by only gradual recovery, is a widespread shared assessment for the remainder of 2020.

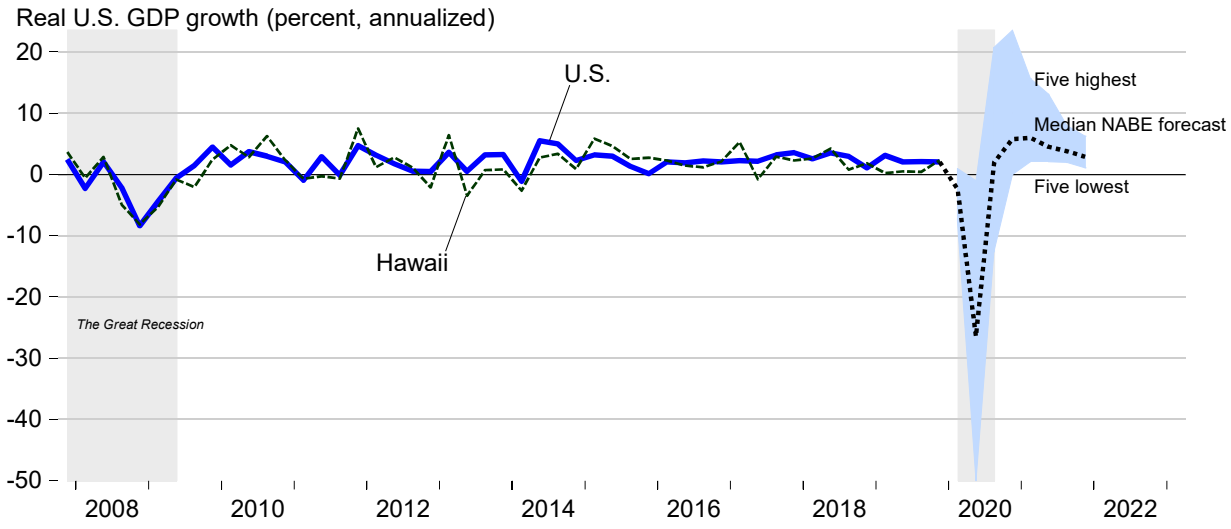
[4] Median NABE forecast growth rates are 2.0% (2020Q3), 5.8% (2020Q4), 6.0% (2021Q1), 4.5% (2021Q2), 3.8% (2021Q3), and 2.9% (2021Q4).

Figure 2. U.S. real GDP growth forecasts

(*a*) National Association for Business Economics (NABE) member survey, April 2020



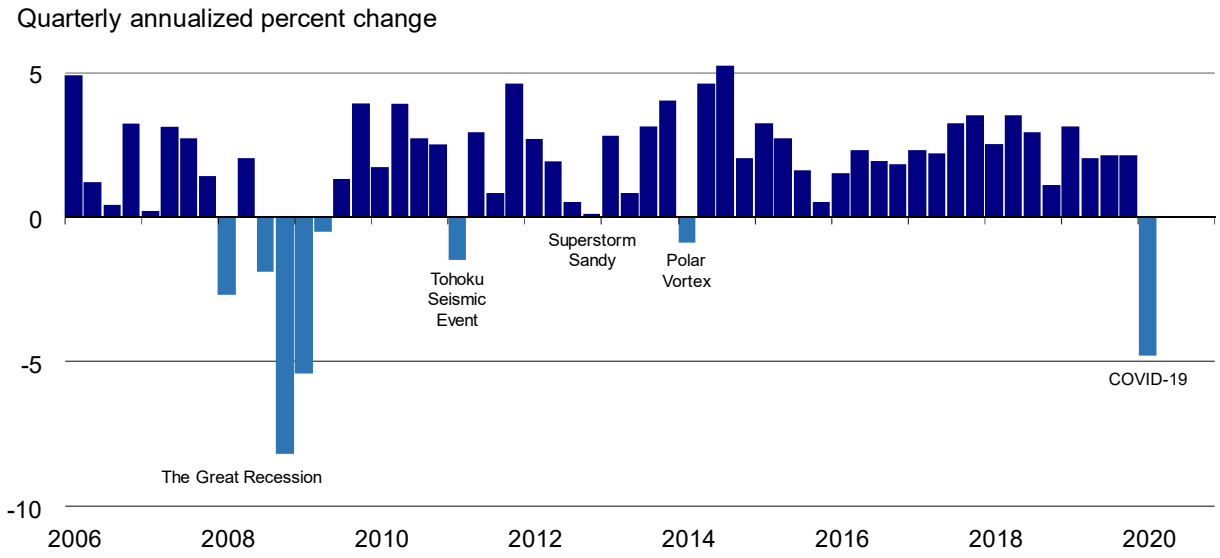
(*b*) NABE forecast and actual data



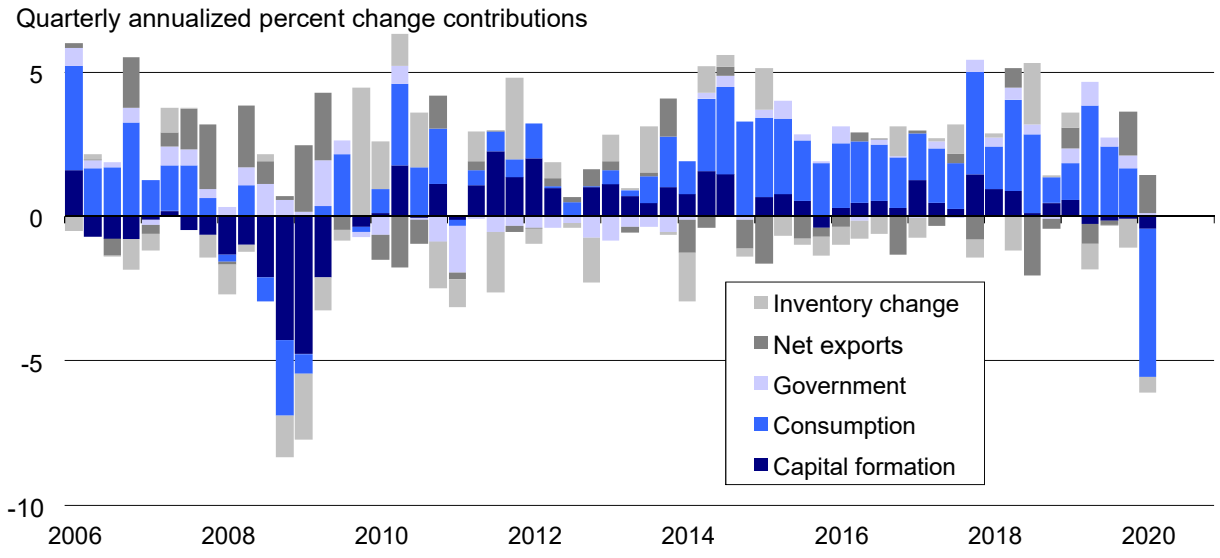
Source: Bureau of Economic Analysis, U.S. Department of Commerce (https://www.bea.gov/data/gdp/gross-domestic-product, https://www.bea.gov/data/gdp/gdp-state), National Association for Business Economics (https://files.constantcontact.com/668faa28001/765a4afd-4ed3-4ea0-b98b-ae631771042b.pdf); actual quarterly data through 2019Q4, including revisions, NABE April 2020 outlook flash survey (April 3-7, 2020).

Figure 3. U.S. real GDP growth rates

(*a*) U.S. real GDP growth, quarterly at annual rates, through first quarter 2020



(*b*) Contributions to quarterly, annualized U.S. real GDP growth by component



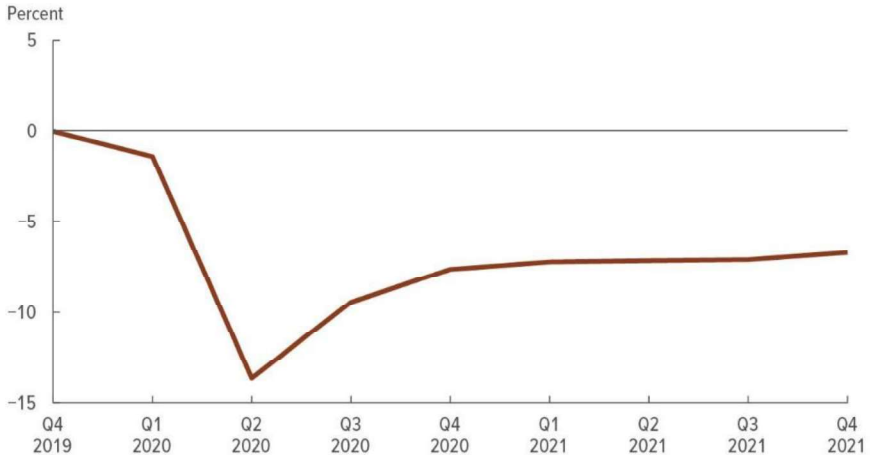
Source: U.S. Bureau of Economic Analysis (https://apps.bea.gov/iTable/index_nipa.cfm).

Table 1. Congressional Budget Office projections for U.S. real GDP growth and other macroeconomic variables, 2019Q2 to 2020Q2 (April 2020)

	2020				Annual	
	Q1	Q2	Q3	Q4	2020	2021
Real GDP (Percentage change from preceding quarter)[a]	-0.9	-11.8	5.4	2.5	n.a.	n.a.
Real GDP (Percentage change, annual rate)[a]	-3.5	-39.6	23.5	10.5	-5.6[b]	2.8[b]
GDP (Trillions of dollars)	21.6	19.1	20.1	20.7	20.4	21.3
Unemployment Rate (Percent)	3.8	14.0	16.0	11.7	11.4	10.1
Interest Rate on Three-Month Treasury Bills (Percent)	1.1	0.1	0.1	0.1	0.4	0.1
Interest Rate on Ten-Year Treasury Notes (Percent)	1.4	0.6	0.7	0.7	0.8	0.7

The nation's output is projected to decline sharply in the second quarter of this year and to begin rising thereafter.

Figure 4. April 2020 CBO projections of U.S. real GDP relative to CBO's January 2020 projections



Output at the end of 2021 would be more than 6 percent lower than CBO projected in January.

Sources: Philip Schwagel (April 2020) CBO's Current Economic Projectionsand a Preliminary Look at Federal Deficits and Debt for 2020 and 2021 (https://www.cbo.gov/system/files/2020-04/56344-CBO-presentation.pdf), Congressional Budget Office, "CBO's Current Projections of Output, Employment, and Interest Rates and a Preliminary Look at Federal Deficits for 2020 and 2021," *CBO Blog* (April 24, 2020) (www.cbo.gov/publication/56335).

2. Medium-term to long-term economic forecasting

Beginning in the first week March 2020, Hawaii began testing confirmed its first COVID-19 cases, tourism volumes began to drop precipitously, and the state moved to impose stay-at-home and social distancing protocols for a period of some weeks. Restrictions began to be removed, incrementally, in May, after case counts fell in April about as fast as they had risen in March. Hawaii had "flattened the (cumulative) curve," for the moment. Of course, the risk of secondary infection waves persists and, historically, pandemic second waves are well-remembered.[5]

Forecasting beyond the initial, short-term drop into and out of the "V," formed by the initial catastrophic biological event, into the medium-term from six months to one year or more, becomes more challenging because future outcomes are contingent on successes in the present. Several case studies provide some guidance. The first one seems like a natural: the 1918-1919 global influenza pandemic. While it killed many millions more than the current coronavirus event should because of modern public health and medical capabilities, the economic impacts of this pandemic one century ago are instructive.

Because the pandemic played out in at least two waves in major U.S. cities, the first wave in October-November 1918 is pertinent to the event this spring. A subsequent wave over the winter of 1918-1919 deepened that pandemic's initial depression of economic activity, several measures of which are illustrated in Figure 4, such as U.S. industrial production. Later waves were not insignificant: Hawaii's mortality rate jumped as late as 1920 as a result of an influenza wave. After a recession from August 1918 to March 1919 contemporaneous to the pandemic's main U.S. impacts, the U.S. also experienced an even deeper recession from January 1920 to July 1921.[6] More recently, U.S. industrial production only just decreased in March 2020, and is likely to have fallen further in April (Figure 5). It is early days.

The key takeaway over the medium term, from this summer to next spring, is that even amidst economic recovery risks will persist: the risk of retrenchment from a second infection wave and reinstitution of social distancing was a common phenomenon during the 1918-1919 pandemic. Hawaii still has no apparent plan to safely restore air travel and 10 million tourist arrivals annually even though the critical elements—passenger screening, diagnostic testing for presence of the virus and/or serological testing for antibodies, contact tracing, and smartphone app-based tracking all have been implemented in countries with much better mitigation track records than the U.S. or Hawaii. That is, while recovery remains the probable medium-term outcome, all the risk is to the downside.

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[5] Howard Markel, MD, PhD; Harvey B. Lipman, PhD; J. Alexander Navarro, PhD; Alexandra Sloan, AB; Joseph R. Michalsen, BS; Alexandra Minna Stern, PhD; Martin S. Cetron, MD (August 8, 2007), "Nonpharmaceutical Interventions Implemented by US Cities During the 1918-1919 Influenza Pandemic," *Journal of the American Medical Association*, Vol. **298**, No. 6, pp. 597-706 (https://jamanetwork.com/journals/jama/fullarticle/208354).

[6] National Bureau of Economic Research, *US Business Cycle Expansions and Contractions* (http://nber.org/cycles/cyclesmain.html).

Case Study 1. The global influenza pandemic of 1918-19

Figure 5. Industrial production and related indicators, 1915-1922

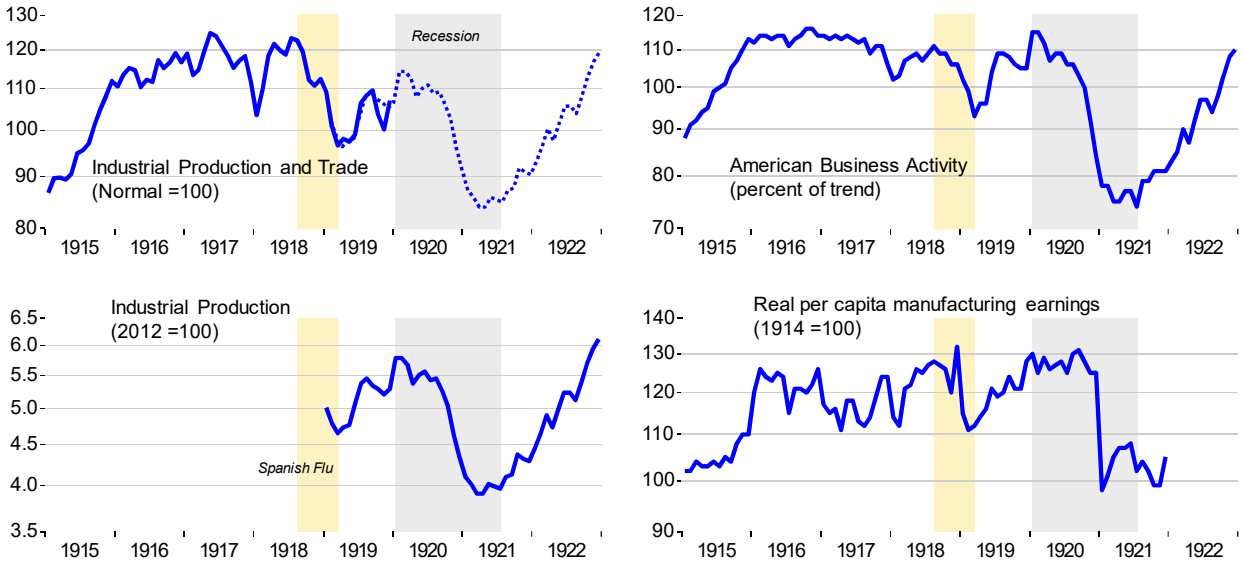
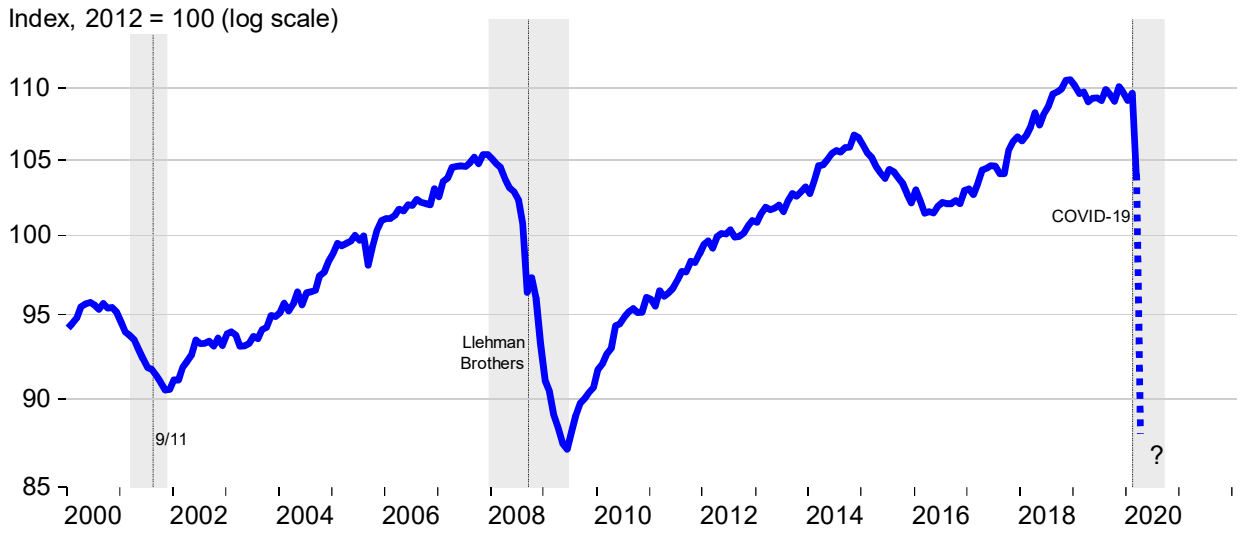


Figure 6. U.S. industrial production index through March 2020



Sources: Board of Governors of the Federal Reserve System (US), retrieved from FRED, Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org/series/INDPRO), and National Bureau of Economic Research (NBER), retrieved from FRED (https://fred.stlouisfed.org/series/M1204BUSM363SNBR, https://fred.stlouisfed.org/series/INDPRO, https://fred.stlouisfed.org/series/M12003USM516NNBR, https://fred.stlouisfed.org/series/M08067USM325NNBR); retrieved April 30, 2020.

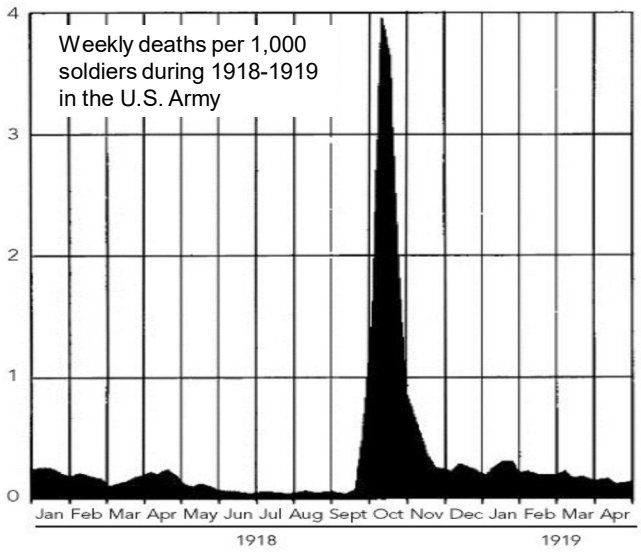
Key takeaways from Case Study 1, the 1918-1919 influenza pandemic: in spite of data challenges, clear, profound, *repeated* adverse economic impacts of multiple infectious waves are exhibited in data extant.

- 1918-19 influenza pandemic coincided with America's participation in the Great War (as known at the time), World War I, primarily in the Western European theatre (1917-1918).
- Pandemic dates are not firm, ranging from 1917-1920: Hawaii mortality surged in 1920, contributing to a long-held and enduring perception that "Hawaii lags."
- Half of American Expeditionary Force (AEF) deaths in WWI were attributed to disease, presumptively (occurring contemporaneously with) influenza.
- Nearly one-third of all AEF deaths occurred before service members left the U.S. for Europe—boot camps, troop ships, and trenches were the killing fields.
- Multiple waves of infection were linked to cities which prematurely abandoned stay-at-home and social distancing protocols, causing the influenza outbreak(s) to recur.[7]

Figure 7. American Expeditionary Force (WWI) morbidity, January 1918 – April 1919

as noted	Number (000)	Share (%)
Disease	57.460	49.7
Battle	50.280	43.5
Other	7.920	6.8
	115.660	100.0
Of which:		
in U.S.	36.000	31.1
AEF abroad	79.610	68.8

Note: *Half* of all battle deaths were associated with the Battle of the Meuse-Argonne, from September 26, 1918 through Armistice Day, November 11, 1918, coinciding with most acute phase of the contemporaneous influenza pandemic (October 1918)



Source: Ayres L.P. (1919), *The war with Germany: a statistical summary*, p. 127. Washington: Government Printing Office, cited in Carol R. Byerly, "The U.S. Military and the Influenza Pandemic of 1918–1919," *Public Health Reports (2010)* **125**(Suppl 3), pp. 82-91 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2862337/figure/F2/).

[7] See footnote 5.

While there is temptation to think that "this time is different," and while it seems to be a somewhat surprisingly widely-held belief that Hawaii has never experienced anything like this before, there are actually previous leptokurtotic events which parallel the current one qualitatively and in at least some quantifiable dimensions. For example, even though we may not have the sheer breadth of data on economic performance available today with which to analyze past experience, even data sets with limited scope can inform. Tourism may not have been as big in the past as today, but it has always been an important Hawaii export with material economic impacts and good historical tourism data do exist.

- In Case Study 2, monthly Hawaii tourist arrivals 1922-1938 illustrate remarkably similar outcomes to those now unfolding in more recent tourism data (Appendix 1). Prior to transpacific commercial air passenger service by the Pan American Honolulu Clipper in 1937, tourists came by ship. Honolulu was a coaling stop; tourists were defined as passengers staying two nights or longer, excluding passengers in transit (Figure 8).

    1. Procyclical movement with respect to macroeconomic activity is clear in the data for the 1920s and 1930s: a long ascent during the Roaring Twenties, a withering decline during the Great Depression, a subsequent rebound after the New Deal.

    2. A crushing decline in passengers accompanied maritime strikes from October 1936 through May 1937 during which tourism went nearly to zero, declining 90 percent (Figure 9) before rebounding after about six months.

- Case Study 3 concerns what previously was the single worst leptokurtotic event in the history of Hawaii tourism of the last half century or more. In the wake of the 9/11 terror event, Hawaii domestic tourist volumes dropped 20 percent, and international tourist volumes 50 percent, recovering only gradually during the subsequent 6-12 months (Figure 10). The international tourism recovery never was fully completed at the time (Figure 11). International tourism was vulnerable later in 2003 when the SARS event reduced travel again for a second six-month period.

A familiar, initially V-shaped impulse response to exogenous shocks transmitted through tourism to Hawaii's economy generally is evident in all these prior experiences, whether work stoppages or geopolitical event risk are origins. Subsequent recoveries from decreases from 20 to 50 to 90 percent of pre-event travel volumes have taken at least six months and up to a year or more, sometimes still without having fully recovered over the medium term. These historical experiences establish a pattern which can be helpful in guiding boundary-setting on likely alternative recovery trajectories through 2021, following the initial appearance of the SARS-CoV-2 contagion in early 2020.

Case Study 2: Monthly Hawaii tourist arrivals 1922-38

Figure 8. Honolulu tourist arrivals excluding passengers in transit

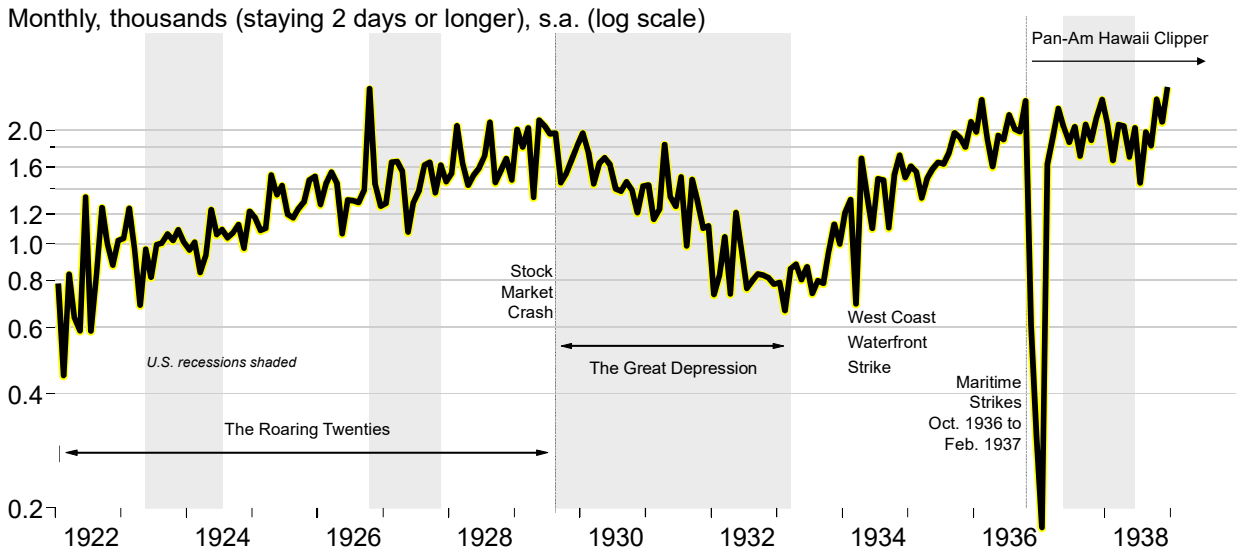
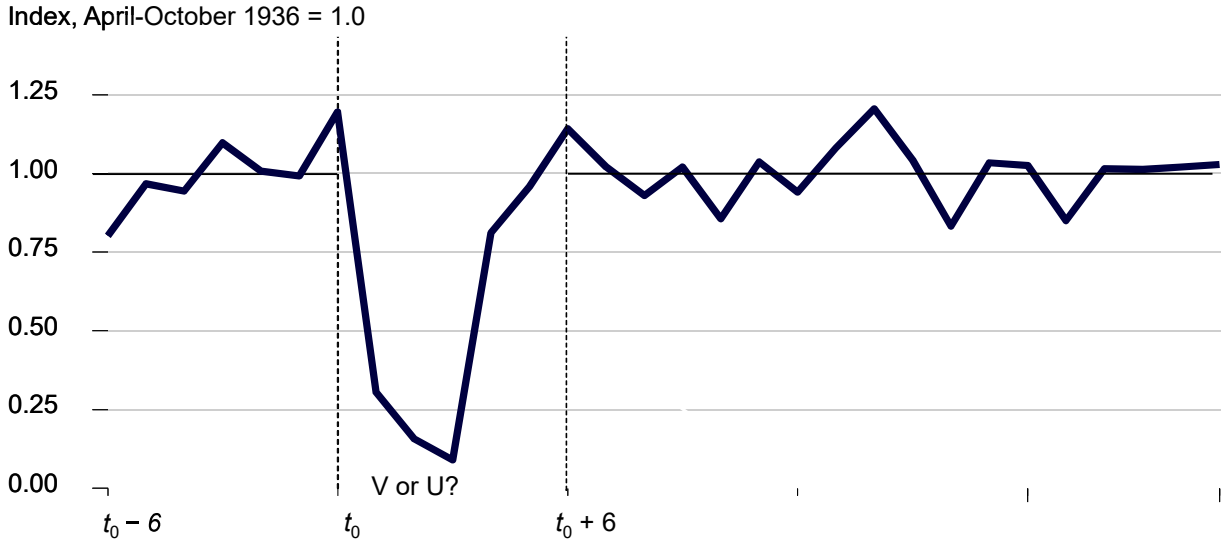


Figure 9. Honolulu tourist arrivals indexed to pre-maritime strike volumes



Sources: George T. Armitage, Hawaii Tourist Bureau, "Hawaii's Tourist Business," Hawaii Territorial Planning Board *An Historic Inventory of the Physical, Social and Economic and Industrial Resources of the Territory of Hawaii* (February 8, 1939), p. 317; U.S. Bureau of Labor Statistics "The Maritime Strikes of 1936-37." *Monthly Labor Review* **44,** no. 4 (1937): 813-27. (www.jstor.org/stable/41815101)seasonal adjustment using the Census Bureau X-12 ARIMA filter by TZ Economics.

Case Study 3: The 9/11 terror events

Figure 10. Domestic visitor arrivals six months before, during, and after The 9/11 terror event (month 6 is August 2001; month 7 is September 2001)

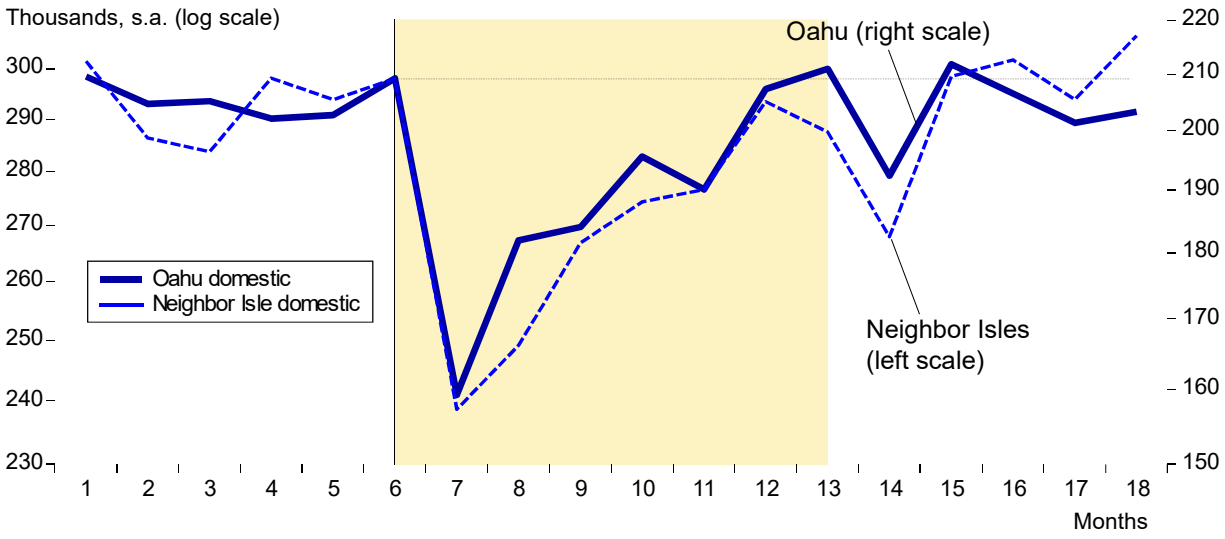
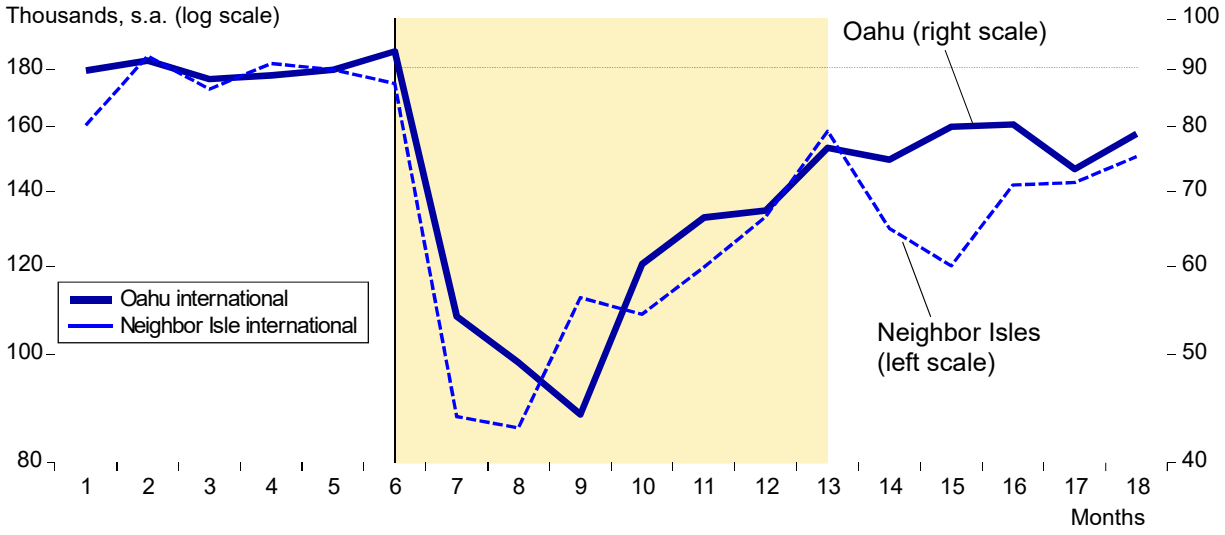


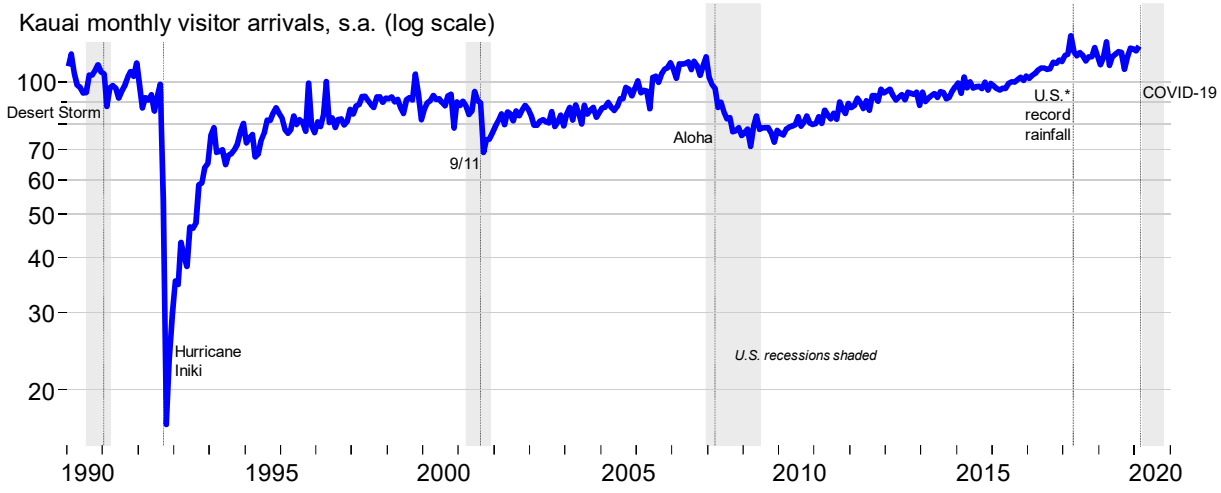
Figure 11. International visitor arrivals six months before, during, and after The 9/11 terror event (month 6 is August 2001; month 7 is September 2001)



Sources: Hawaii Tourism Authority, Hawaii DBEDT (http://dbedt.hawaii.gov/economic/mei/), seasonal adjustment using Census X-13 ARIMA filter; seasonally-adjusted data may be downloadable from UHERO and the DBEDT Data Warehouse. Simply translating month 6 values into a base period (divide all other months by its value) will index proportionate impacts to that starting point.

Case Study 4: Kauai and Hurricane Iniki (1992)

Figure 12. Kauai monthly arrivals and Hurricane Iniki



* NOAA (https://www.weather.gov/hfo/RecordKauaiandOahuRainfallAndFlooding-April2018

Sources: Hawaii Tourism Authority, Hawaii DBEDT (http://files.hawaii.gov/dbedt/economic/data_reports/mei/2020-02-kauai.xls); seasonal adjustment by TZ Economics.

Key takeaways from Case Study 4, Kauai hurricane experiences: *structural* change.

- In 2015-16, Kauai monthly total visitor arrivals, seasonally-adjusted, (98k) were essentially the same as in 1990-91 (100k); arrivals dropped almost 100 percent after Hurricane Iniki, and took years for the *initial* recovery.

- Pre-Iwa (1982), pre-Iniki (1992), virtually all of Kauai's visitor plant inventory comprised hotel and condominium-hotel units; post-Iniki, vacation rentals and timeshare comprised the same market share that hotel units *used* to constitute.

- Kauai lodging operators maximized *risk-adjusted* returns by dispersing leptokurtotic balance sheet risk exposure through securitization, partially converting hotel rooms into condos after Hurricane Iwa (1982), and partially to intervals after Hurricane Iniki (1992). Global lodging brands concentrated on lodging *services* rather than asset management.

    1. <1998, condominiumization ⇒ shift from asset management to lodging *services*; lodging brand owns a management company instead of hundreds of rooms.

    2. >1998, timeshare ⇒ securitization further transfers risk exposure to interval owners; risk associated with single condominium now distributed to 50 owners.

3. Securitization of hotel building to condominium units, and individual lodging units into intervals, breaks down the integer constraint confronting the investor (no need to buy "whole building;" no need to buy "whole condo"), yielding seller a liquidity premium (sum of interval prices > sum of condo prices > price of wholly-owned building).

Table 2. Kauai lodging shares over 20-years

*percent of total**	1998	2015-2019
Condo Hotel	41%	18
Hotel	50	32
Timeshare	0	30
Vacation Rental	5	20
Other	4	1

*Total Kauai lodging units: 6,969 (1998), 8,781 (average 2015-2019), 9,036 (2019)

Sources: Hawaii DBEDT annual Visitor Plant Inventory reports (http://dbedt.hawaii.gov/visitor/visitor-plant/), share calculations by TZ Economics.

- Hosting apps reduce search and matching cost, dismantle barriers to enter contestable, oligopolistic lodging industry (economies of scale and scope, first-mover advantages)

    1. Hosting apps fundamentally mitigate an information asymmetry: travelers don't know where alternatives to traditional lodging chains' units might be located the way locals do, but apps reduce *transaction* cost (information).

    2. Demand side: lower search, matching costs satisfy heterogeneous preferences, increasing lodging demand ("shift to the right").

    3. Supply side: lower barrier to entry in lodging industry ("democratization," contestability) increases lodging supply ("shift to the right").

    4. Both demand, supply increase: price impacts ambiguous; $\Delta Q \approx 1{,}500$ VRs.

- All of the net growth in lodging inventory on Kauai for 25 years comprises vacation rental units; jurisdictions finds political accommodation for "undocumented" units.

Kauai experienced not one but two "once in a century" hurricanes within a ten-year period. Whatever were perceptions of risk exposure for lodging investors before those events, they were radically reshaped afterward. These events permanently changed the structure of the lodging industry as a risk-management response to pre-empt future risk exposure. Today Kauai has the highest share of timeshare and vacation rental lodging units of any Hawaiian Island.

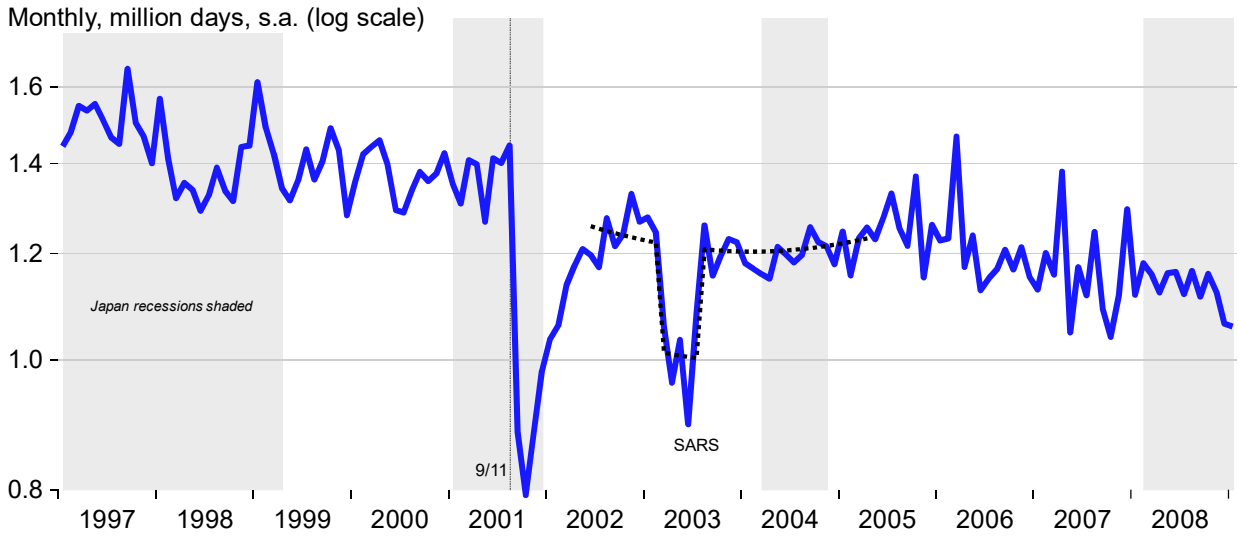
2. Long-term enduring consequences of major catastrophic events

Turning to the longer-run view looking out into the mid-2020s and beyond, the current coronavirus event faces additional uncertainties. History shows that leptokurtotic shocks, sometimes called Black Swans because of their rarity, can have enduring adverse effects on the economy far beyond the scope of the shock's initial economic impacts.

- On Kauai in the 1990s, tourist arrivals did not return to pre-Iniki volumes (1992) for six years (1998). While Kauai experienced an infrastructure investment boom in the meantime (first Hawaiian island with all fiber-optic telecommunications), Iniki and its predecessor, Iwa, permanently reshaped the composition of the lodging industry. Structural changes are often long-term consequences of leptokurtotic events.

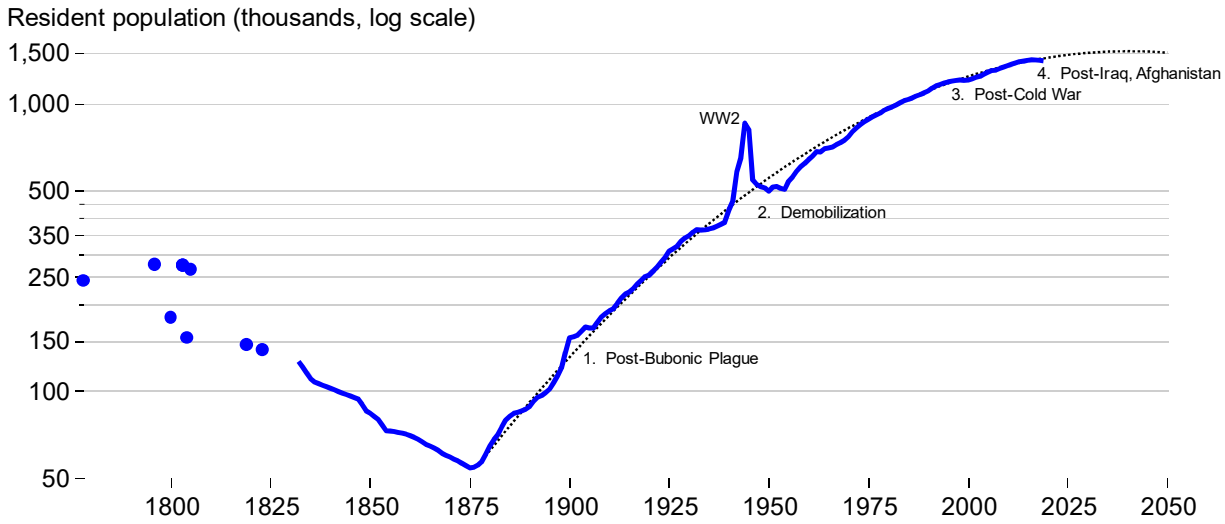
- International travel to Hawaii after 9/11 (2001) was lower in 2007, prior to the Great Recession, than it was one decade earlier in 1997. Long *after* the so-called Japan Bubble burst (the Nikkei 225 stock market index peaked at the end of 1988) and in spite of growth in travel from East Asian Emerging Market economies at the time, international travel to Hawaii steadily eroded for almost two decades (all the more remarkable considering how much rhetorical cheerleading there is in official state government tourism propaganda for international travel). Figure 13 illustrates the long slide in Hawaii international visitor days—arrivals times average stay length—from 1997-2007.

Figure 13. Hawaii international visitor days, seasonally-adjusted, and two notable leptokurtotic events, highlighting the SARS episode



Sources: Hawaii Tourism Authority, Hawaii DBEDT (http://dbedt.hawaii.gov/economic/mei), Federal Reserve Bank of St. Louis, OECD-based Recession Indicators for Japan from the Peak through the Period preceding the Trough [JPNRECP] (https://fred.stlouisfed.org/series/JPNRECP); seasonal adjustment by and polynomial regression estimates by TZE

Figure 14. Long-term Hawaii resident population trends point to stasis in 2030s



Sources: Robert C. Schmitt (1977), Historical Statistics of Hawaii UH Press; U.S. Bureau of the Census, Hawaii DBEDT (http://dbedt.hawaii.gov/economic/datawarehouse/, http://census.hawaii.gov/home/population-estimate/); trend regression of stationary component of resident population on time, 1878-2016 by TZE.

Four short intervals of Hawaii population decline associated with specific transitions (three post-war) punctuate the longer-term trend towards flattening in the 2030s (Figure 14). Population growth forecasts as recently published as in 2018 were significantly *over*estimated.[8]

Notoriously, homebuilding on Oahu is believed to have undersupplied housing needs for the last quarter century. Fewer than 2,000 new housing units were authorized for construction by building permit in 2019, while more than 2,000 new housing units were authorized in 1928 before the Great Depression. Average annual new housing unit authorizations on Oahu numbered 7,000 in the quarter century between 1950-1975. New homebuilding on the Neighbor Islands during the 2010s was lower than at any time since the 1960s, one-half century ago. It was "so good" on Oahu during the 2010s for homebuilding, "only world war was worse." The 1940s were the last time less homebuilding occurred on Oahu than in the 2010s.[9]

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[8] Official State of Hawaii projections published in 2018 were more than two standard errors outside the upper bound on a 95 percent confidence interval around a projection developed in 2019 by TZ Economics using methods similar to those illustrated in Figure 14. See Hawaii DBEDT (June 2018), *Population and Economic Projections for the State of Hawaii to 2045* (http://files.hawaii.gov/dbedt/economic/data_reports/2045-long-range-forecast/2045-long-range-forecast.pdf) ("2045"); Hawaii DBEDT (March 2012) *Population and Economic Projections for the State of Hawaii to 2040 - DBEDT 2040 Series*, Tables A-2 to A-6 (http://hawaii.gov/dbedt/info/economic/data_reports/2040-long-range-forecast), and recent actual enumerations (https://census.hawaii.gov/wp-content/uploads/2020/03/co-est2019-annres-15.xlsx).

[9] Hawaii DBEDT (http://dbedt.hawaii.gov/economic/qser/selected-county-tables/), Robert C. Schmitt (1977) *Historical Statistics of Hawaii*, University of Hawaii Press, SMS Research (December 2016), *Hawaii Housing Planning Study*, 2016 (Prepared for HHFDC) (https://dbedt.hawaii.gov/hhfdc/files/2017/03/State_HHPS2016_Report_031317_final.pdf).

Downward trends in population growth and housing capital formation reflect *structural* constraints on the ability of the local economy to grow which would have persisted through the 2020s without the coronavirus shock. "Steep slopes and water bodies" impose geographic constraints on homebuilding and urbanization,[10] and Honolulu is well-known for imposing regulatory barriers which compound those problems.[11] They impede household formation and economic growth generally. The prevailing political environment seems unlikely to relax such constraints over the next decade.

Yet, the possibility remains that short-run economic disruption created by SARS-CoV-2 could spawn political changes capable of reversing longer-term trends in Hawaii's economy. It is fair at least to contemplate this possible outcome. Its existence as an alternative scenario amplifies uncertainty that confront longer-term economic forecasting.

There is a counterexample to the secular stagnation scenario widely studied today by economists.[12] It is the post-WWII eruption of Hawaii economic growth for the thirty years from 1945-1975. This extraordinary period of economic growth and political change (Figure 15), documented by Tom Coffman in his book *Catch A Wave*, comprised three decades with only a single year of real Hawaii GDP decline at its conclusion, then only as a result of the OPEC petroleum price shock in 1975. Most of Hawaii's tourism capacity, two of its three freeways, all of its mountain highway tunnels, infrastructure for commercial passenger air travel and the modern Honolulu cityscape—Aloha Tower was the tallest structure in Hawaii in the early-1960s—arose in this dramatic growth wave. Its origins in a crushing post-WWII demobilization and crippling dockworker strikes during the late-1940s are an exact *quantitative* parallel to likely macroeconomic outcomes in 2020 (Figure 16).

Following the 1980s Japan Bubble, Hawaii real GDP declined at a 0.9 percent annualized rate, 1992-1997, prompting Governor Cayetano to mobilize an Economic Revitalization Task Force. Around that anomalous interval—a cautionary tale about economic booms associated with exogenous forcing factors—annualized Hawaii real GDP growth rates decelerated from 3.6 percent (1977-1992), to 2.8 percent (1998-2008), to 1.9 percent (2009-2019). A reversal of this trend is not impossible in the 2020s, but seems even more improbable after SARS-CoV-2.

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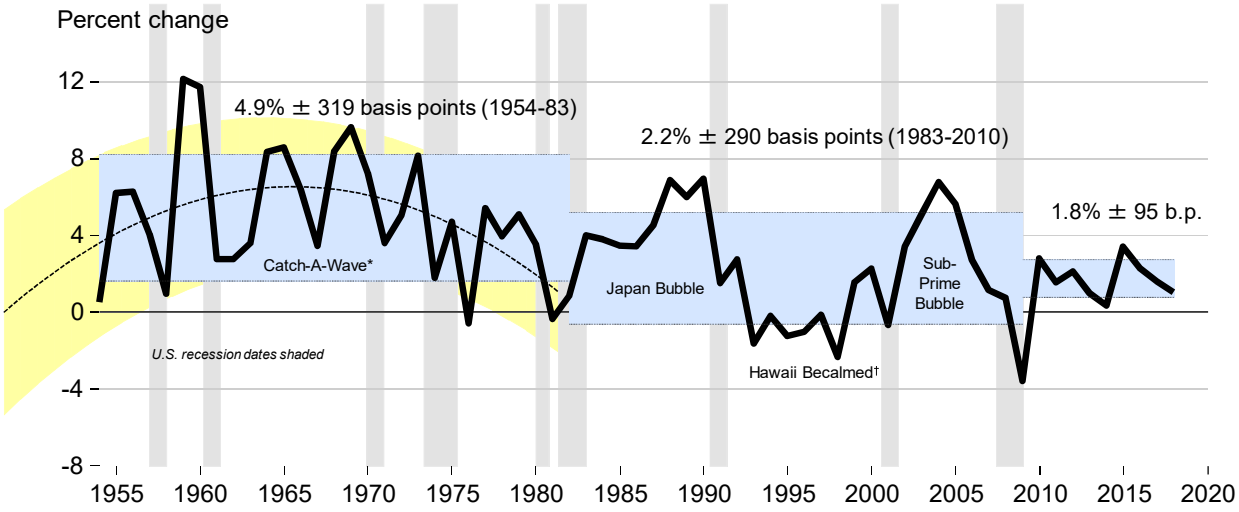
[10] Andrew D. Paciorek (December 2011), "Supply Constraints and Housing Market Dynamics" *Federal Reserve Board Finance and Economics Discussion Series WP 2012-01* (https://www.federalreserve.gov/pubs/feds/2012/201201/201201pap.pdf).

[11] Honolulu housing regulatory costs are highest in the country and leave housing supply elasticity among the lowest in the country. Edward L. Glaeser and Joseph Gyourko (2008), *Rethinking Federal Housing Policy: How to Make Housing Plentiful and Affordable*, Washington, D.C., AEI Press (https://www.aei.org/wp-content/uploads/2014/03/-rethinking-federal-housing-policy_101542221914.pdf), and Richard K. Green, Stephen Malpezzi, and Stephen K. Mayote, "Metropolitan-Specific Estimates of the Price Elasticity of Supply of Housing, and Their Sources," *American Economic Review Papers and Proceedings of the 117th Annual Meeting of the American Economic Association*, Philadelphia, PA, January 7-9, 2005, "Regulation and the High Cost of Housing", vol. **95**, no. 2 (May 2005) pp. 334-339 (https://www.aeaweb.org/articles?id=10.1257/000282805774670077).

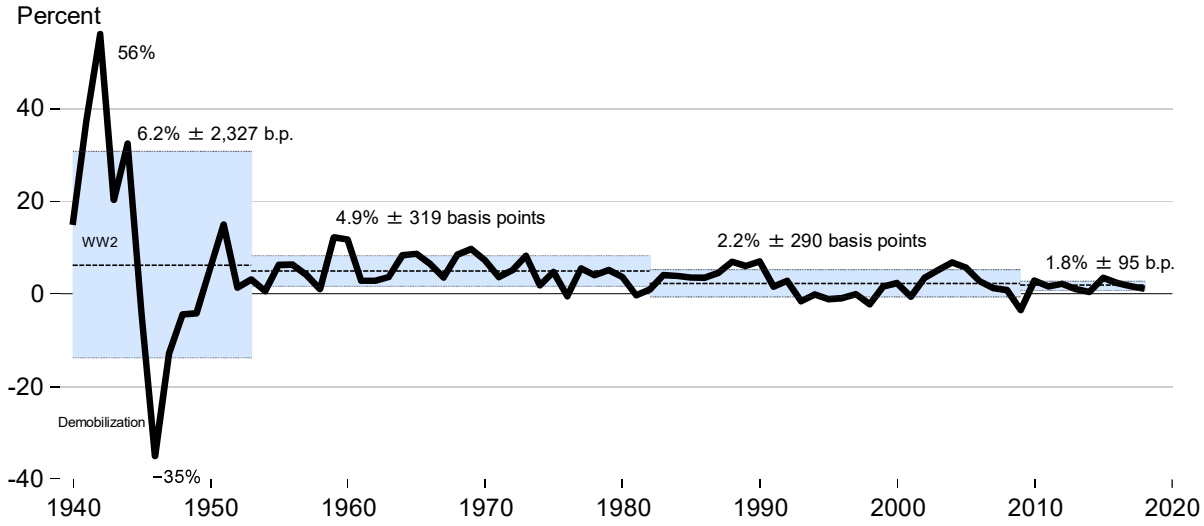
[12] Gauti B. Eggertsson, Manuel Lancastre, Lawrence H. Summers (December 2019), "Aging, Output Per Capita, and Secular Stagnation," *American Economic Review: Insights*, vol. **1**, no. 3 (pp. 325-42) (https://www.aeaweb.org/articles?id=10.1257/aeri.20180383).

Figure 15. Estimated Hawaii annual real GDP growth rates: after thirty years of war, pandemic, depression 1915-1945, thirty years of economic growth 1950-1980



*Tom Coffman (1973), *Catch a wave: A case study of Hawaii's new politics*, UH Press
† Chris Grandy (2002), *Hawai'i Becalmed: Economic Lessons of the 1990s*, UH Press

Figure 16. Estimated Hawaii annual real GDP growth rates: early-2020s = late-1940s?



Note: "Smooth pasting" issues complicate interpretation around 1997; underlying data are not strictly comparable.

Sources: Robert C. Schmitt, Table 6.1 (1976) *Historical Statistics of Hawaii*, based on UH Economic Research Center work by Harry Oshima, Mitsuo Ono, Bank of Hawaii (unpublished), Yung Shang, William Albrecht, Glenn Ifuku, Hawaii DPED (1988) *Hawaii's Income and Expenditure Accounts*, U.S. BEA (https://www.bea.gov/data/economic-accounts/regional), interval growth rates and 2 standard deviation bandwidths based on log changes of real GDP (or GSP, pre-1977) re-mapped to constant, 2018 dollars from NAICS data 1997-2018, SIC data 1977-1997, and prior estimates.

Appendix 1: Hawaii tourism impacts of the novel coronavirus SARS-CoV-2 and COVID-19

Figure A1-1: Hawaii daily air passenger arrivals through April 29, 2020

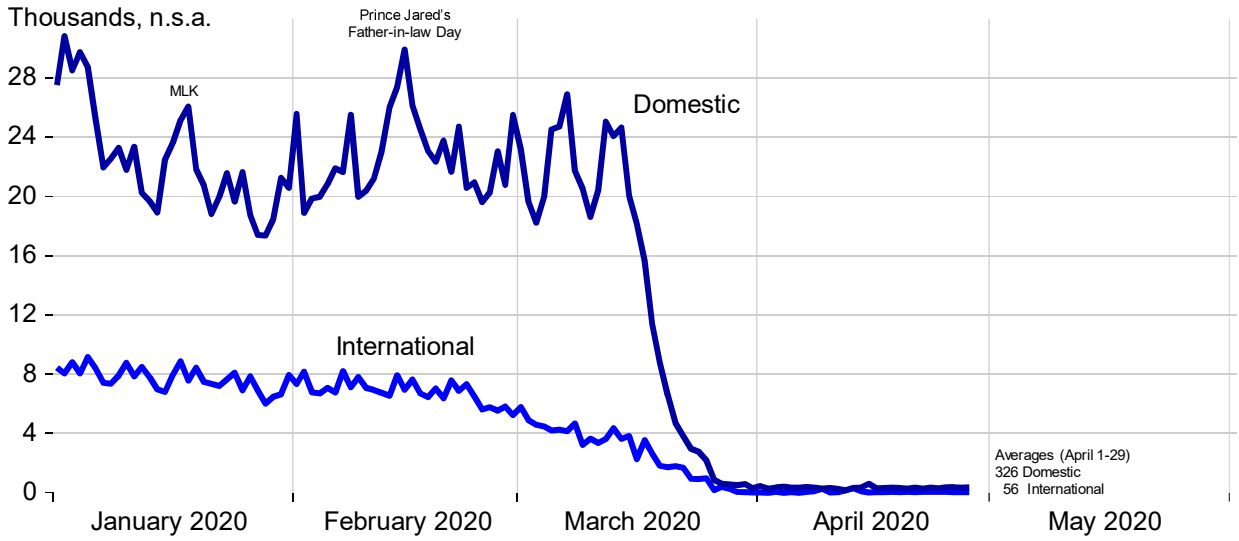
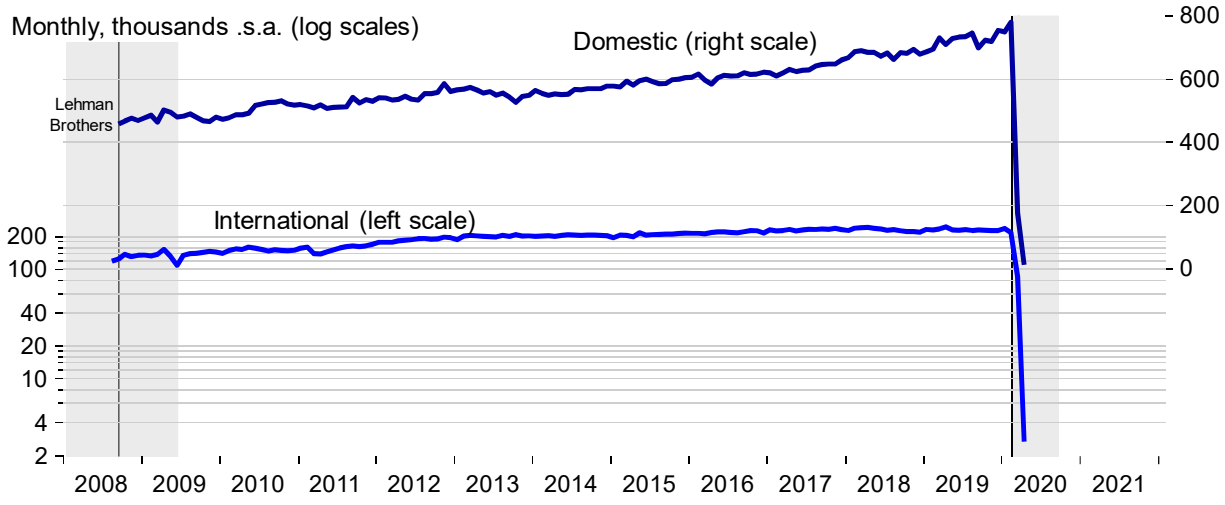


Figure A1-2: Hawaii monthly air passenger arrivals, seasonally-adjusted, through April 2020



Source: Hawaii DBEDT (http://files.hawaii.gov/dbedt/economic/data_reports/special/daily-pax-update.xls), accessed April 30, 2020; aggregations and seasonal adjustment by TZ Economics.

Figure A1-3: Hawaii monthly total visitor arrivals, seasonally-adjusted, 1966-2020(March)

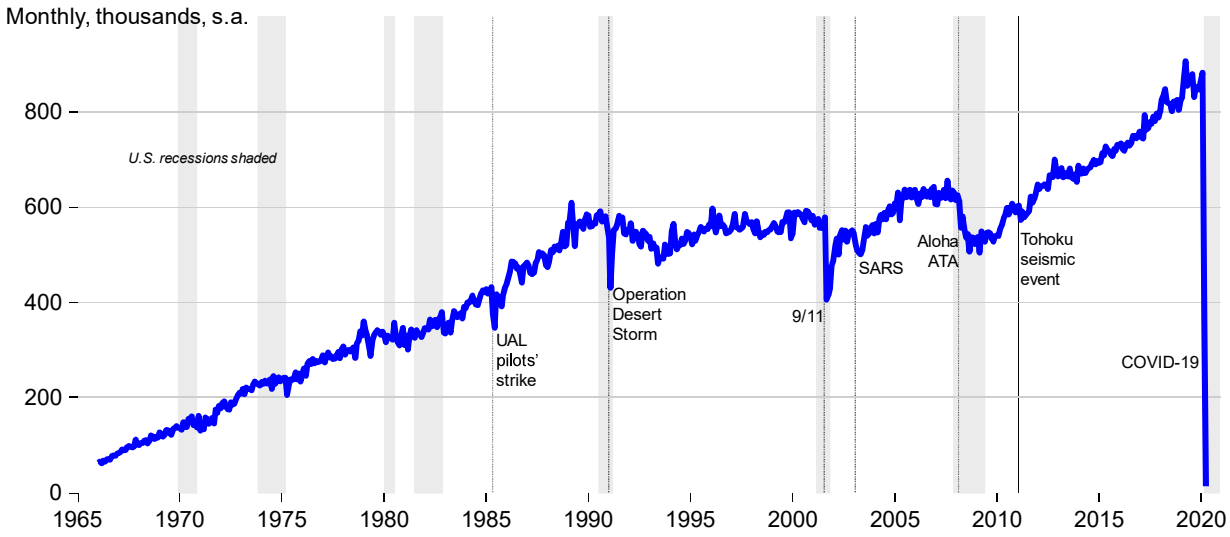
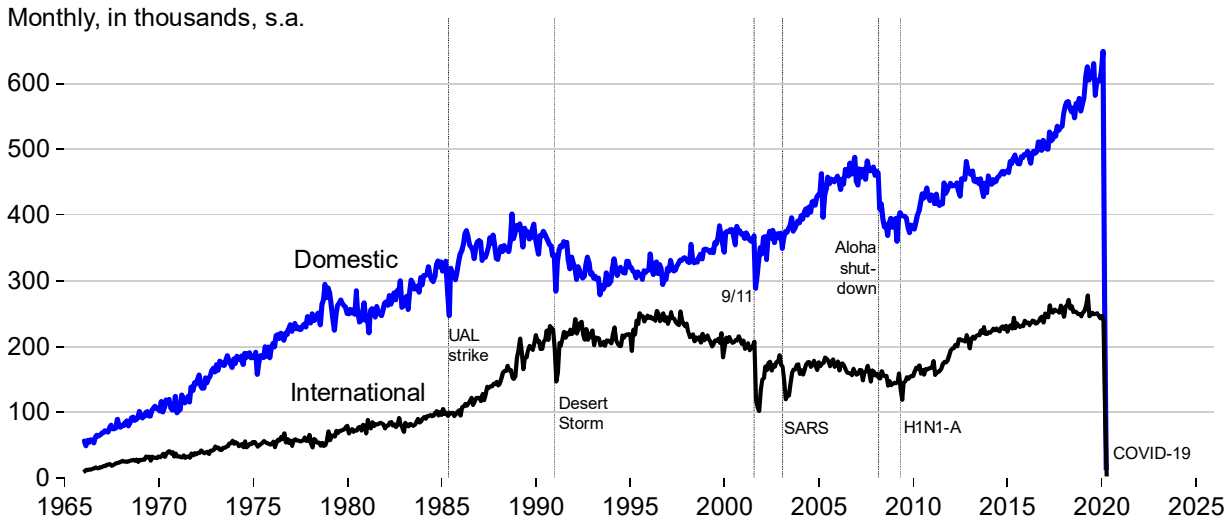


Figure A1-4: Hawaii monthly visitor arrivals, domestic and international, 1966-2020(March)



Sources: HTA (https://www.hawaiitourismauthority.org/research/monthly-visitor-statistics/), Hawaii DBEDT (http://dbedt.hawaii.gov/economic/mei/), monthly data January 1966 – February 2020 with March-April 2020 estimates based on year-over-year percent changes in daily disembarking passenger counts through April 16, 2020; seasonal adjustment by TZE.

Appendix 2. "Fat-tailed" distribution of log changes of monthly Hawaii tourist arrivals

Leptokurtosis is an attribute of stochastic variables such as the number of tourists arriving in Hawaii on a monthly basis which distinguishes them from those with a normal distribution often found in nature, like the average height of people at given ages. In a normally distributed stochastic variable, the first and second moments of the distribution (mean, variance, respectively) suffice to characterize its behavior. For example, if the annualized growth of tourist arrivals is some average number, 5 percent, and its volatility is a measurable constant, say 13 percent, projections or forecasts can be constructed within estimable confidence intervals based on the assumption that those changes are normally distributed. A plausible conjecture of 5 percent tourism growth, plus or minus 13 percent, under normal circumstances, therefore can guide a risk manager implementing a business plan. Hedging activities or insurance can be engaged to mitigate risk exposures aligned with these estimates. The growth of tourist arrivals, however, has a distribution is *not* normal even though average growth of 4 percent and volatility of 13 percent *are* actual parameterizations from more than one-half century of monthly data on Hawaii tourism. In a normal distribution kurtosis is a small constant (3). Leptokurtotic events raise that parameter substantially, as can be seen in Hawaii tourism.

- From 1966 through 2019, 53 years plus January and February 2020, mean monthly growth of visitor arrivals was 5 percent *p.a*. Events such as Operation Desert Storm (1991), 9/11 (2001), SARS (2003), H1N1-A (2009), the Tohoku Northeast Japan Seismic event (2011), and work stoppages (*e.g*. United Airlines pilots' strike (1985)) yielded kurtosis of 12, higher than the 3 associated with a normal distribution, in monthly growth in tourist arrivals.

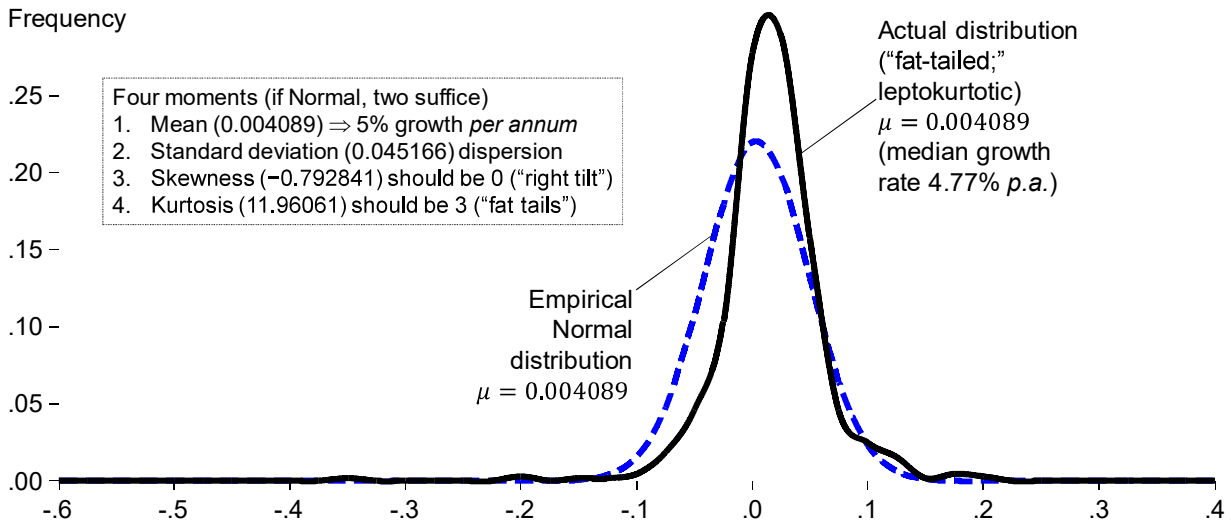
- If you include March 2020 Hawaii tourist arrivals, the first month of partial impacts of the travel contraction caused by the novel coronavirus, kurtosis increases from 12 to 99, with only that additional month.

- If you include an estimate for April 2020 Hawaii tourist arrivals based on daily passenger disembarkation enumerations, kurtosis increases to 460.

If the annualized monthly growth rate of seasonally-adjusted Hawaii tourist arrivals was normally distributed, then an interval based on a criterion like "plus or minus two standard errors" of an estimated forecast path would be associated with a customary amount of confidence (e.g. 95%). The Normal distribution associated with *actual* Hawaii tourist arrivals, for the actual mean and standard deviation, does not "fit." Jarque-Bera statistics show that the probability is nil that the distribution is Normal (Table A2-1). The actual distribution is negatively skewed (where skewness should not exist), and has a much longer tails, particularly the one associated with *downside* risk. Conventional forecasts failing to incorporate this *leptokurtosis* will systematically, if infrequently, be blinded by much more negative outcomes than statistically predictable under the common assumption of normality. When rare but large, negative outcomes

occur, they are dramatically disruptive precisely because they are, literally, "outside the norm." The novel coronavirus SARS-CoV-2 has produced the *most* extreme negative outcome, ever.

Figure A2-1. Actual and Empirical Normal approximation to the monthly log change of seasonally-adjusted Hawaii tourist arrivals, 1966 – 2020 (January)

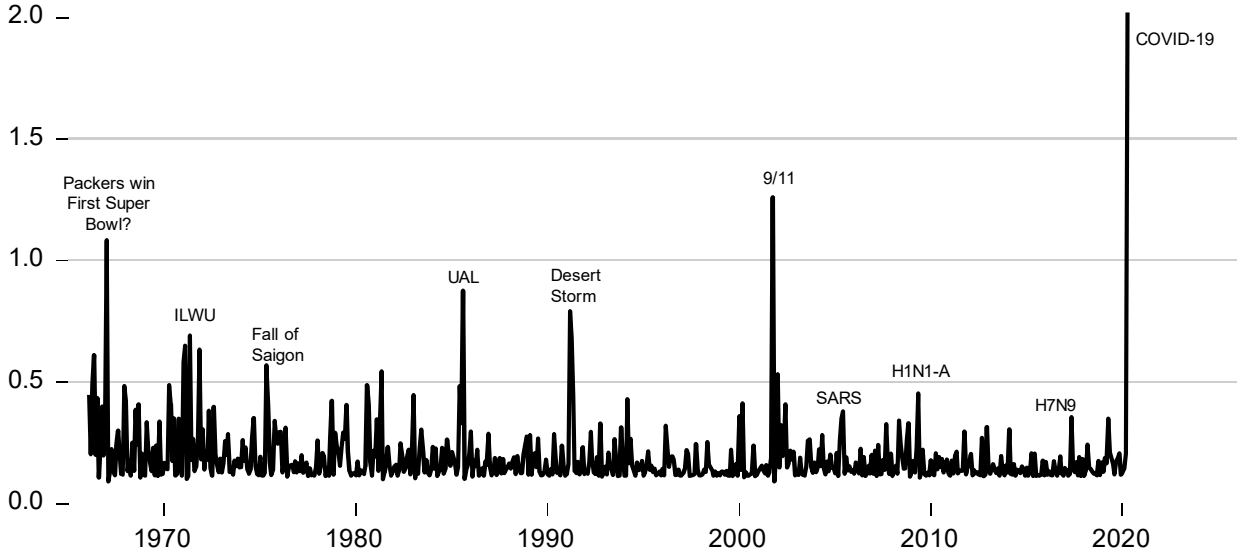


Sources: HTA (https://www.hawaiitourismauthority.org/research/monthly-visitor-statistics/), Hawaii DBEDT (http://dbedt.hawaii.gov/economic/mei/), monthly data January 1966 – January 2020; seasonal adjustment and estimated empirical Normal distribution by TZ Economics.

Table A2-1: Statistics of monthly log changes of seasonally-adjusted Hawaii tourist arrivals beginning in 1966 and ending sequentially in February 2020, March 2020, and April 2020[13]

	1966-2020 February	1966-2020 March	1966-2020 April
Mean	0.004109	0.002907	-0.002417
Median	0.004255	0.003886	0.003517
Maximum	0.186803	0.186803	0.186803
Minimum	-0.355890	-0.777087	-3.463033
Standard Deviation	0.045150	0.054537	0.146364
Skewness	-0.794053	-4.915766	-20.58931
Kurtosis	11.96217	70.14216	482.8509
Jarque-Bera	2240.201	124711.4	6291713
Probability (that the distribution is Normal)	0.000000	0.000000	0.000000
Sum	2.666521	1.889434	-1.573598
Sum of Squared Deviations	1.32098	1.930308	13.92459
Observations (*n*)	649	650	651

Figure A2-2. Leptokurtic event risk implies conditional tourism volatility jumps: Threshold Autoregressive Conditional Heteroskedasticity (TARCH) estimates



Sources: Hawaii Tourism Authority (https://www.hawaiitourismauthority.org/research/monthly-visitor-statistics/), Hawaii DBEDT (http://dbedt.hawaii.gov/economic/mei/); Threshold Autoregressive Conditional Heteroskedasticity (TARCH) estimates of annualized standard deviations of log changes in monthly Hawaii visitor arrivals, seasonally-adjusted, by TZ Economics.

[13] Based on an April visitor arrivals estimate calibrated to partial-month changes in daily passenger arrivals.

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