

“Measuring Inflation under Pandemic Conditions”: A Comment

*Naohito Abe*¹

Diewert and Fox (2022) examine various implications of the 2020 COVID-19 pandemic for constructing consumer price indexes. The authors state that the pandemic caused major changes in consumption expenditures and shares which makes fixed basket index number formulae inapplicable. They emphasize the need for more frequent surveys of consumer expenditure which will enable compilation of the Fisher index which is considered superior to the traditional Laspeyres or Young indexes. In addition, Diewert and Fox discuss the use of various “new” technologies such as web scraping, scanner data, and information from transactions through credit cards to estimate consumption expenditure.

Key words: Price index; COVID-19; demand shocks; supply shocks.

The Diewert and Fox article investigates a critical topic and offers useful discussion and valuable insights and advice, particularly for people who are constructing official price indices. In my view, the COVID-19 pandemic has highlighted the limitation of the traditional Laspeyres, Young, and Lowe price index number formulae. The changes in the consumption expenditure caused by the pandemic were so large that the price indexes that ignore those changes can be misleading and are inadequate as deflators for consumption expenditures.

My main comment on the Diewert and Fox paper concerns their treatment of missing or unobservable prices during the 2020 COVID-19 pandemic. During the pandemic, in many countries, statistical offices were not able to collect price data, which lead to missing or unobservable prices. Diewert and Fox (2022) introduce “the market clearing reservation prices” and name the price index that uses the reservation prices for missing prices as a “true” index. They point out that the inflation adjusted carry forward prices by national statistical offices are below the corresponding reservation prices, thus understate the “true” inflation during the pandemic. In this comment, I raise two issues. The first issue is how relevant the market clearing reservation prices are when inferring missing price data. The second is whether the inflation adjusted carry forward prices are likely to be below the “true” but unobserved prices or not.

Diewert and Fox (2022) state:

“What has happened is that the supply curve for product n has become straight line that is parallel to the price axis and this line has shifted to become identical to the vertical

¹ The Institute of Economic Research, Hitotsubashi University, Institute of Economic Research 2-1, Naka, Kunitachi, Tokyo, 186-8603, Japan. Emails: nabe@ier.hit-u.acu.ac.jp

Acknowledgments: I have benefitted greatly from discussion with the Statistical Bureau in Japan, D.S. Prasada Rao, and Chihiro Shimizu. I also thank the editor and the reviewers for carefully reading the manuscript and comments. Financial supports from JSPS KAKENHI, 19H01467 and 20H00082 are gratefully acknowledged.

price axis. Thus the (unobserved) market price for the product n under consideration is the price where the demand curve intersects the vertical price axis; (pp.XX) . . .”

Using [Figure 1](#) below, I demonstrate that the case discussed by Diewert and Fox is only one of several possible types of shocks that may have been observed during the Covid-19 pandemic. I discuss demand side and supply side shocks observed during the past year. In fact, the situation considered by [Diewert and Fox \(2022\)](#) can be illustrated as Case 1 as follows.

Case 1: Pure Supply Shock (Diewert and Fox)

Suppose the economy is at E , where the demand curve, D , intersects the supply curve, S . The pandemic shifts the supply curve from S to S' so that the curve overlaps the vertical axis, while the demand curve is unaffected. The economy moves to equilibrium point $E1$ where the quantity demanded is zero. The price level at $E1$, identified by Diewert and Fox as the market clearing reservation price, is greater than the price level at E as long as the demand curve slopes downward.

To make use of the market clearing reservation price as defined in [Diewert and Fox \(2022\)](#), some assumptions on the demand functions are necessary. First, to obtain a finite value for the reservation price, the marginal substitution of the commodity at zero consumption must also be finite, which excludes a popular class of utility functions that use logarithms of quantities. The second and more controversial assumption is that the demand curve remains invariant through the pandemic. Generally, given prices, shifts in demand occur when people's marginal willingness to pay for commodities change, which can arise without changes in technologies, prices of other commodities, and due to legal restrictions. Because the 2020 COVID-19 pandemic affected our daily life to a great extent, the assumption that the pandemic did not affect demands appears particularly strong.

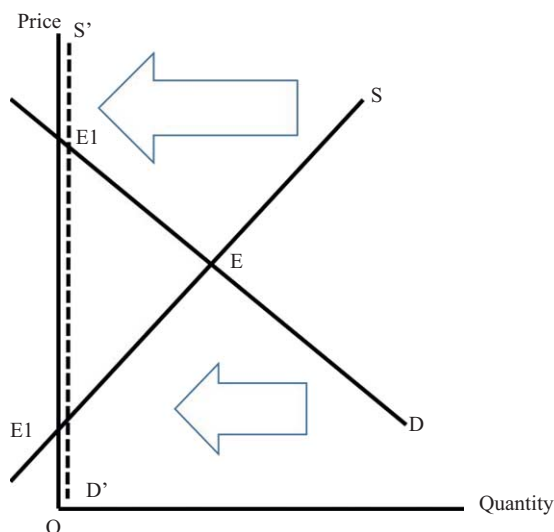


Fig. 1. Demand and supply during pandemic.

In [Figure 1](#), we can easily consider demand shocks as the underlying cause for the missing price problem.

Case 2: Pure Demand Shock

Suppose the economy is at E before the pandemic. Then, consider the case where the 2020 COVID-19 pandemic shifts the demand curve left so that it overlaps the vertical axis, while the supply curve is unchanged. In this case, the economy moves to new equilibrium $E2$ and the “true” or equilibrium prices are lower than those before the pandemic.

Similar to Case 1, to obtain non-zero “true” price, the following assumptions are required: (1) supply curve is upward sloping and (2) the supply curve intersects the vertical axis at positive price level, which implies that the marginal cost at zero quantity should be positive. Similar to Case 1, the second assumption excludes a popular class of cost functions that use logarithms of quantities. However, in the short run, the assumption of positive marginal costs at zero seems plausible

[Diewert and Fox \(2022\)](#) derive a sufficient condition for the true price index to be higher than the index based on the inflation adjusted carry forward price. Because the treatment of supply and demand is symmetric between Cases 1 and 2, it is possible to derive a corresponding sufficient condition under Case 2.

Following notations by [Diewert and Fox \(2022\)](#), define P^{11}, P_{LQ}, P_B^{CI} as the inflation adjusted carry forward price, the Laspeyres and Young indexes using PII, respectively. Also define $P_n^{1*}, P_{LQ}^*, P_B^*$ as the “true” prices computed based on economic theory, the Laspeyres and Young indexes using P_n^{1*} , respectively. Then, a sufficient condition for $P_{LQ}^* < P_{LQ}$ and $P_B^* < P_B^{CI}$ is given by

$$P_n^{1*} < P^{11}. \quad (1)$$

The above condition is very similar to Equations (10) and (13) in [Diewert and Fox \(2022\)](#). The only difference is the direction of the inequality sign. That is, if the “true” prices are lower than the inflation adjusted carry forward prices, the fixed basket indexes such as the Laspeyres and Young indexes with the carry forward price overstate the true price changes.

Thus, to infer the missing prices due to zero quantities caused by the pandemic, we have two options. In Case 1, the case considered by [Diewert and Fox](#), we estimate the prices by fixing the demand function. In Case 2, the “true” prices are obtained by fixing the supply function. Which of the two cases is relatively more appropriate to infer the missing prices during the pandemic is an empirical question which is addressed in the remaining part of this paper. Using Japanese examples of the missing price problem due to the 2020 COVID-19 pandemic, I discuss which shocks, demand or supply, are more plausible to interpret the data.

The [Statistical Bureau in Japan](#) faced the missing price problem in October and November 2020 for some items in international tour packages. The bureau collects six specific packages, such as a round trip between Tokyo and Seoul for three days, two persons including various fees and surcharges. During the pandemic, even though the demand was limited, travel agencies in Japan were selling tours with their list prices, which enabled the bureau to collect the list prices. In October 2020, travel agencies stopped selling some tour packages, which forced the bureau to infer prices for these

packages. The Statistical Bureau in Japan adopted the inflation adjusted carry forward prices for the missing items.

Figure 2 depicts movements of the expenditure and price index for international tour packages in Japan since 2015. We can observe that the expenditures are close to zero since March, 2020, which was seven months before the missing price problem occurred. That is, the occurrence of zero expenditure did not automatically cause a missing prices problem. Until October 2020, travel agencies kept selling international tour packages even if demand for the tours was small. In other words, the supply curve before October 2020 was not the vertical axis. Some travel agencies offered tours at similar prices before the pandemic, which suggests that Case 2 seems more appropriate than Case 1 to interpret the movement of prices and quantities in Figure 2. Because the demand curve became the vertical axis before the missing price problem occurred, the price level reached $E2$ in Figure 2 before October 2020. The “true” price for the missing items do not seem to differ much from the list prices in previous months. In this case, the adoption of the inflation adjusted carry forward prices by the bureau seems a reasonable decision.

Another missing price problem the Statistical Bureau in Japan encountered was for admission tickets to professional baseball and soccer games. Figure 3 depicts the movements of expenditures and prices for the category. In April and May 2020, all the professional games were canceled so that price data became unavailable for the statistical bureau.

Because the prices of the admission tickets were stable until July, the Statistical Bureau adopted the prices in previous months for the missing prices. Professional games resumed in June 2020. Since July, the prices of admission tickets went up by few percentage points

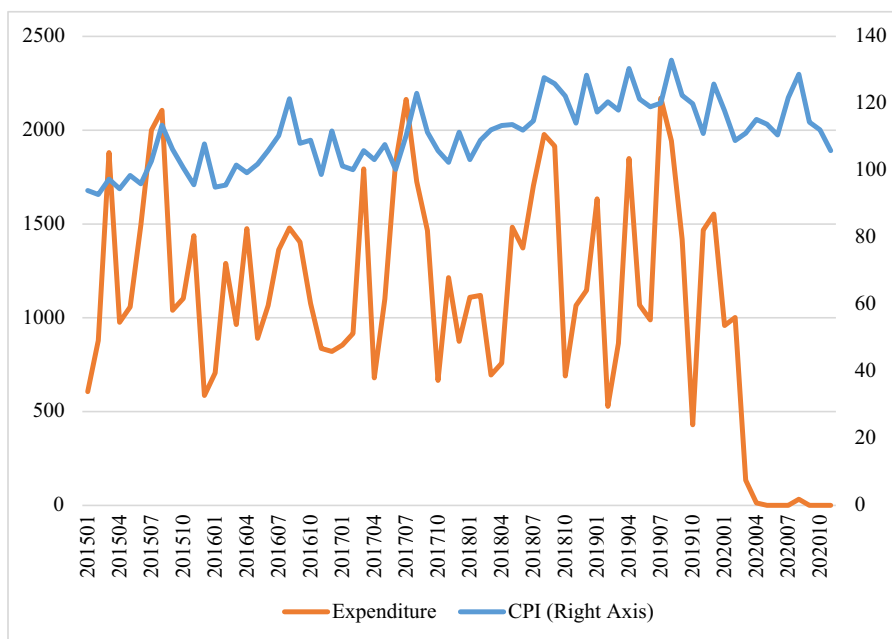


Fig. 2. Expenditures and prices of international tour packages in Japan.

Note: The data are from the Family Income and Expenditure Survey (two-or-more person households) and the Consumer Price Index by the Statistics Bureau of Japan. The unit is the Yen for the expenditure. The base year of the price index is 2015.

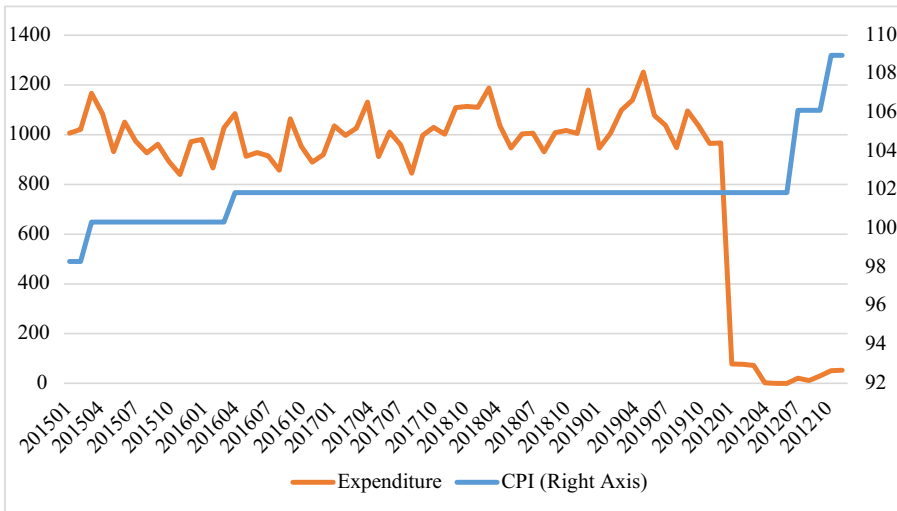


Fig. 3. Expenditures and prices of admissions to professional Baseball and soccer games.
 Note: The data source is the same in Figure 2.

probably due to increases in costs for sanitization of seats. In September, the number of maximum admissions for each game was set to between 33% to 50% of the maximum number before the pandemic. However, the expenditure remained 1% to 5% of the usual level.

If we assume Case 1 occurred for professional games in Japan, the market clearing reservation prices during April and May 2020 would have been much higher than the official price index. However, the statistical office would have faced a problem when considering the situation after the pandemic. In September 2020, many seats were sold at relatively higher prices than before the pandemic, while the expenditures remained at low level. If the demand curve is unchanged, Figure 3 suggests that the supply curve is close to the vertical axis in September–November 2020. The prices during the period that are higher than the pre-pandemic level by 5–8 percent points must be close to the market clearing reservation prices. The magnitude of the increase in prices seems too small because it implies an unlikely large price elasticity of demand. Therefore, it seems natural to think that the pandemic affected the demand curve even after the lockdown to a great extent. In other words, the scenario in Case 2 seems more appropriate to interpret Figure 3 than that in Case 1.

The two examples discussed above suggest occurrences of significant demand shocks during the pandemic, which renders Case 1 unsuitable as a description for the mechanism behind the missing price problem.

Before concluding this short comment, let me mention a possibility that the 2020 COVID-19 pandemic makes it difficult to evaluate changes in consumer welfare from the cost of living index. The combination of the positive prices and low expenditure depicted in Figures 2 and 3 suggests the occurrence of excess supplies. If prices are not determined at the intersection of demand and supply, there are some people who cannot purchase commodities at the list prices, or there exist some sellers who cannot find customers who purchase the products at the prices. In fact, during the pandemic, broadcasts reported many empty seats in flights and long-distance trains. Long queues for purchasing face masks and hand sanitizers were frequently observed. If excess supply or excess demand exists, the

observed price becomes higher or lower than the marginal willingness to pay. The cost of living index based on the observed prices ignores the plight of people who cannot purchase at observed prices even if they wish to buy, thus, the cost of living index becomes inappropriate to evaluate their welfare.

Missing price problem caused by the 2020 COVID-19 pandemic is a serious challenge. The inference of the missing prices is difficult even if we have plenty of data. The market clearing reservation price proposed by [Diewert and Fox \(2022\)](#) is one of several possible methods to infer the prices, which can potentially result in huge price changes from the previous periods. However, if we allow for changes in demand functions, as opposed to [Diewert and Fox \(2022\)](#), it seems that the missing prices do not differ much from the carry forward prices from the previous periods. Based on the analysis of the two cases, supply versus demand shocks, illustrated using [Figure 1](#) and the data illustrated in [Figures 2 and 3](#), the decision by statistical agencies to use inflation adjusted carry forward prices seems to be a reasonable practice.

References

- Diewert, E.W. and K.J. Fox. 2022. "Measuring Inflation under Pandemic Conditions." *Journal of Official Statistics*, this issue.
- Statistical Bureau of Japan 2022. *Frequently Asked Questions: the Consumer Price Index*. Available at: <http://www.stat.go.jp/data/cpi/4-1.html#Z8> (accessed February 2022).

Received February 2021

Revised October 2021

Accepted October 2021