EC1410-Spring 2026
Problem Set 2 solutions

(Updated 12 December 2025)

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1. COVID, Rent and Asset Price Gradients.

   This problem will examine the change in the rent and purchase price gradients from Gupta et al. (2021).

   (a) Before the pandemic, the rental price gradient was described by:

   $$\ln R_0(x) = 7.6 - 0.04 \ln(x+1)$$

   where x is distance from the city center. This is shown in panel A of Figure 3 from Gupta et al. (2021). During the pandemic, the rental gradient changed to:

   $$\ln R_1(x) = 7.5 - 0.004 \ln(x+1)$$

   What are the monthly rental prices at $x = 0$, before and during the pandemic? What is the percent change in rent at $x = 0$?

   Before the pandemic, at $x = 0$:

   $$\begin{aligned} \ln R_0(0) &= 7.6 - 0.04 \ln(1) \\ R_0(0) &= e^{7.6} \\ R_0(0) &\approx \$1998.20 \text{ per month} \end{aligned}$$

   During the pandemic, at $x = 0$:

   $$\begin{aligned} \ln R_1(0) &= 7.5 \\ R_1(0) &= e^{7.5} \\ R_1(0) &\approx \$1808.04 \text{ per month} \end{aligned}$$

   The percent change in rent is given by

   $$\frac{R_1(0) - R_0(0)}{R_0(0)} = \frac{1808.04 - 1998.20}{1998.20} = -0.095$$

   We see a 9.5% decrease in monthly rents.

   (b) As shown in Panel B, the asset price gradient before the pandemic was described by

   $$\ln P_0(x) = 13.2 - 0.127 \ln(x+1)$$

   During the pandemic, this gradient changed to

   $$\ln P_1(x) = 13.15 - 0.115 \ln(x+1)$$

   What are the asset prices at $x = 0$, before and during the pandemic? What is the percent change in asset price at $x = 0$?

Before the pandemic, at $x = 0$:

$$\begin{aligned} \ln P_0(0) &= 13.2 \\ P_0(0) &= e^{13.2} \\ P_0(0) &\approx \$540{,}364.94 \end{aligned}$$

During the pandemic, at $x = 0$:

$$\begin{aligned} \ln P_1(0) &= 13.15 \\ P_1(0) &= e^{13.15} \\ P_1(0) &\approx \$514{,}011.03 \end{aligned}$$

The percent change in asset price is given by

$$\frac{514{,}011.03 - 540{,}364.94}{540{,}364.94} \approx -0.049$$

We see a 4.9% decrease in asset prices at the center of the city.

(c) Suppose that the pandemic-related changes in rental prices are permanent. Use 1a to find the implied asset price of rental properties at $x = 0$ before and after the pandemic, using $\rho = 0.03$. What is the percent change in these implied asset prices?

First note that the rental prices given in 1a are the monthly rents, while the capitalization formula we learned in class, and used on the first problem set, is based on annual rents. So to find the implied asset price of rental properties at $x = 0$ before the pandemic, we compute:

$$\frac{12 * e^{7.6}}{0.03} \approx \$799{,}278.36$$

After the pandemic, the implied asset price of rental properties at $x = 0$ is given by:

$$\frac{12 * e^{7.5}}{0.03} \approx \$723{,}216.97$$

And then the percent change in these implied asset prices is

$$\frac{723{,}216.97 - 799{,}278.36}{799{,}278.36} \approx -0.095$$

or a 9.5 percent decrease. This is the same as the percent change in monthly rents, $\frac{R_1(0)-R_0(0)}{R_0(0)}$ as we can see from the following formula:

$$\begin{aligned} \text{Percent change in implied asset prices} &= \frac{\frac{12*R_1(0)}{\rho} - \frac{12*R_0(0)}{\rho}}{\frac{12*R_0(0)}{\rho}} \\ &= \frac{\frac{12(R_1(0)-R_0(0))}{\rho}}{\frac{12*R_0(0)}{\rho}} \\ &= \frac{R_1(0) - R_0(0)}{R_0(0)} \end{aligned}$$

which is equal to the percent change in monthly rents, as in part 1a.

(d) Compare this implied change in asset prices, which assumed that the change in rental prices due to COVID would be permanent, to the actual change in asset prices from 1b. Which is larger? What does this suggest about how long people expect the pandemic to last?

The implied change in asset prices calculated above, under the assumption that the change in rental prices due to COVID would be permanent, is larger than the actual change in asset prices from 1b. This suggests that people do not expect the change in rental prices due to COVID to be permanent - so the pandemic presumably is not expected to be permanent, either.

(e) Throughout the pandemic, people have speculated that COVID would be "the death of cities". What does your work above suggest about this sort of speculation?

The changes in rental and asset prices in the centers of cities suggests that people do expect there to be a decreased value of living in the center cities - but that this value will recover (at least somewhat) over time, presumably after the pandemic improves. In other words, there is certainly a negative effect of COVID on the value of living in cities, but it is not expected to last forever. Calling these decreases in rental and asset prices the "death of cities" is likely a bit of an exaggeration.