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## **APPENDIX**

### **Walking through the Analysis of the Impact of the HOLC**

For the interested reader, we walk through the analysis that led to the numbers on the HOLC's impact on housing markets discussed in chapter 9. This appendix also shows how the results change as the analysis starts with the simplest comparisons and then takes into account more and more issues that would influence the final results. The appendix is designed to show the thought processes that go into a careful statistical analysis and to show why the simplest comparisons can be misleading.

One note before continuing: The HOLC program focused on nonfarm homes because there was an alternative program for farm owners through the Farm Credit Administration. Throughout this appendix, therefore, every time home owners and housing values are mentioned, they refer to nonfarm owners and nonfarm housing values.

#### **The Simplest Analysis**

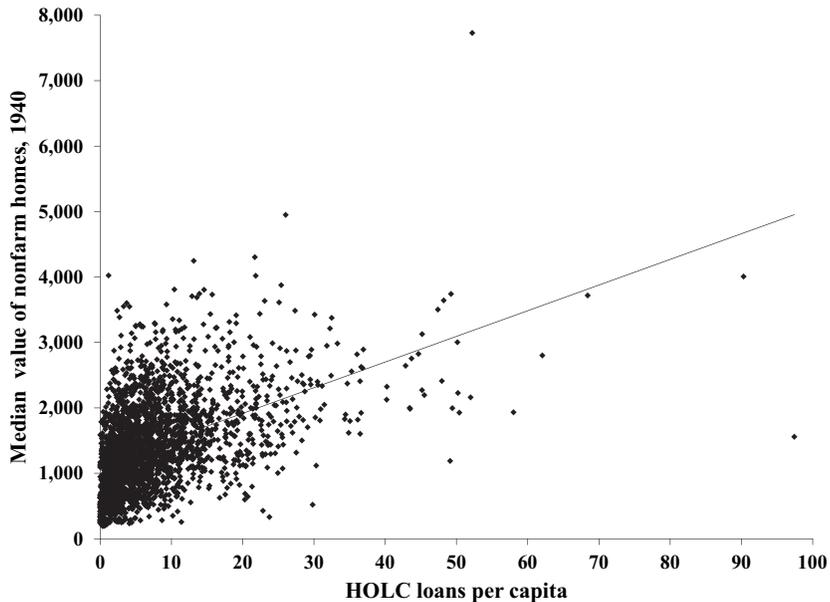
The simplest, but flawed, analysis can be shown by plotting relationships on some graphs. Figure A.1 plots the relationship between the value of owned nonfarm homes in 1940 and the value of per capita HOLC loans distributed between 1933 and 1936 for the nearly 2,500 counties with fewer than fifty thousand people. Counties with fewer than fifty thousand people accounted for 87 percent of all counties and 39 percent of the population at the time. The focus is on this group of counties because the research teams found that the HOLC was most successful in smaller counties. Discussion of the larger counties will follow.

Figure A.1 does not show much. If you squint, the huge mass of points with stray dots spraying out somewhat upward to the right might look like a group of bees leaving a hive. The line on the graph best captures the simple average relationship between the HOLC loans and the housing values, but from the wide scattering of points around the line, clearly this relationship is not too strong. The slope of the line tells us that \$1 in annual HOLC loans per capita increased the value of the home by \$160. Since the typical median value of homes in these counties was about \$1,431 in 1940, the \$160 increase is an increase of 11.2 percent. The median value of \$1,431 may not seem like much money to modern readers, but it was roughly double the average annual earnings of manufacturing workers in these small counties in 1939. Housing

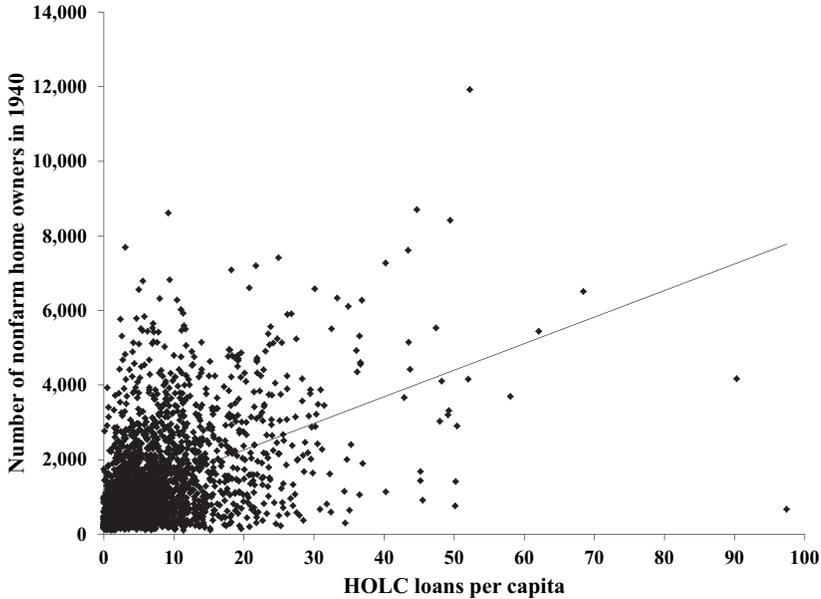
prices had fallen sharply since 1930, when they were roughly 3.3 times the average earnings of manufacturing workers in counties of this size. Around the year 2000, the median housing values nationwide were about seven or eight times average annual earnings for manufacturing workers.

The reason that a large number of points on the graph in figure A.1 do not fit the line is because the HOLC was not the only factor underlying house prices. A large number of other factors also determine housing values in each city. They include incomes, interest rates on loans, geographic features of the cities, the demographic features of the population, the effects of other federal and state programs, the housing prices earlier in the decade, and prior trends in housing prices in the 1920s. Many of these factors varied a great deal across cities. The results after controlling for differences across cities in these factors are shown below.

If we do the same exercise, except we look at the number of nonfarm home owners instead of house prices, we find another very loose relationship,



**Figure A.1.** HOLC activity and home values in 1940, by county. Counties with fewer than fifty thousand people. Self-reported values. (Data from Federal Home Loan Bank Board 1938a and US Census 1933, 1943.)



**Figure A.2.** *HOLC activity and number of home owners in 1940, by county. Counties with fewer than fifty thousand people. (Data from Federal Home Loan Bank Board 1938a and US Census 1933, 1943.)*

displayed in figure A.2, again for counties with less than fifty thousand people. The line that shows the simplest relationship between the HOLC loans per capita and the number of home owners suggests that an additional dollar of annual HOLC loans per capita would have increased the number of home owners by 295, which implies a rise of about 21 percent from the average of 1,406 in 1930. The number of nonfarm home owners in these counties seems small, but remember that most counties with fewer than fifty thousand people had a large number of farmers, who were not eligible for HOLC loans.

### **One Step Forward: Controlling for Initial Conditions in 1930**

Both graphs suggest that the HOLC must have been very successful, because both housing values and the number of home owners in 1940 were substantially larger in areas with more HOLC loans per capita. Yet a great deal of care should be taken before accepting these figures at face value. Many of the counties with higher housing values in 1940 also had higher values in 1930 before the HOLC ever existed. For example, borrowers in Reno, Nevada, re-

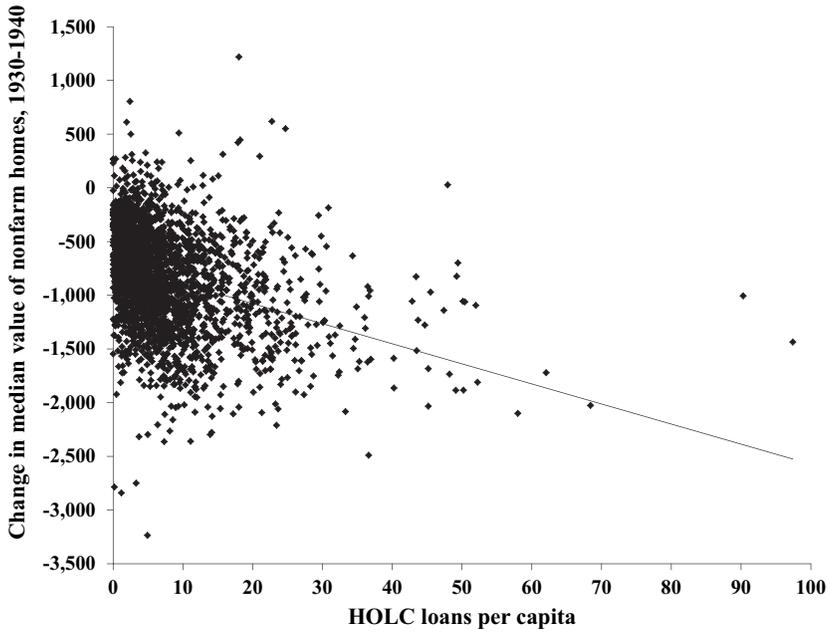
ceived HOLC loans of \$90.30 per capita, and median home values there in 1940 were \$4,007. Both were among the highest values in the country. At the other end of the scale, borrowers in Monticello, Mississippi, received only \$1.29 in HOLC funds per capita, and median home values in 1940 were only \$911. If we focused only on this information, it seems as though we would attribute a large effect to the HOLC.

However, the large gap in home values was already there before the HOLC ever existed. The average Reno home in 1930 was valued at \$5,013 compared to only \$1,081 in Monticello. In fact, a graph comparing 1930 housing values to the value of HOLC loans per capita for all counties under fifty thousand people looks a great deal like figure A.1. Similarly, a graph comparing the number of home owners in 1930 with the value of HOLC loans per capita looks quite similar to figure A.2.

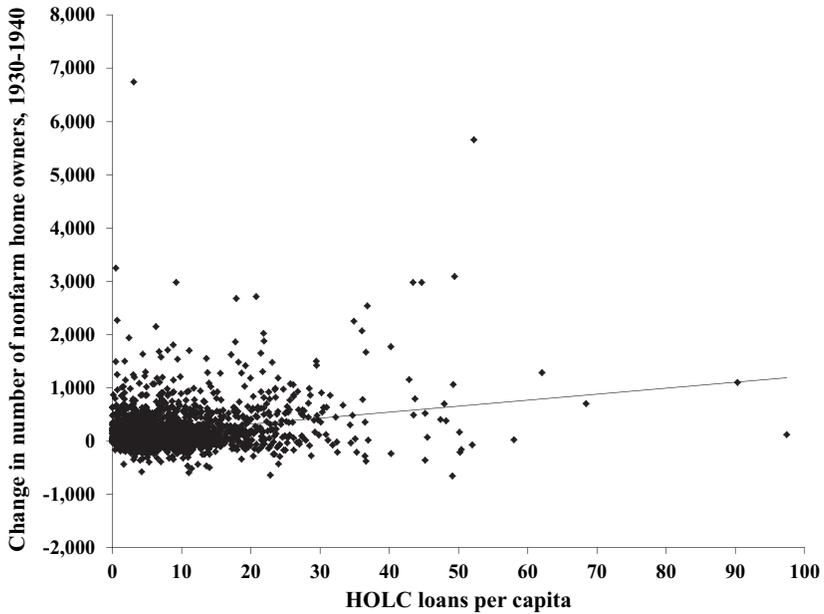
Therefore, it is important to take into account what the housing values looked like in 1930 when examining the relationship between the HOLC and housing values. One way to do this is to look at the relationship between the *change* in housing values between 1930 and 1940 and the *change* in HOLC loans per capita between the 1930s and 1920s. Since there were no HOLC loans in the 1920s, the change in HOLC loans per capita between the 1920s and 1930s is the same as the 1930s value of the HOLC loans per capita.

By looking at the changes, the analysis controls for a broad range of factors that did not change in the 1930s but would have influenced housing values and home ownership. The factors included things like climate, local building codes, locations of cities near rivers and coast lines, housing regulations, and infrastructure. Figure A.3 shows the relationship between the *change* in median home values between 1930 and 1940 and the value of HOLC loans per capita in the 1930s. Note the quite different shapes in figures A.3 and A.1. The line in figure A.3 suggests that housing values fell by \$75 more in counties with an extra dollar of HOLC loans per capita. In contrast, the positive slope of the line in figure A.1 implied a rise of \$160 for an extra dollar of HOLC loans per capita. These results are at odds, but we are not done with the analysis quite yet.

The plot of the change in the number of home owners from 1930 to 1940 against HOLC loans per capita in figure A.4 suggests a weak relationship between HOLC loans per capita and the change in the number of home owners. The line in figure A.4 shows that another dollar in HOLC spending per capita



**Figure A.3.** HOLC activity and the change in home values, 1930-1940, by county. Counties with fewer than fifty thousand people. Self-reported values. (Data from Federal Home Loan Bank Board 1938a and US Census 1933, 1943.)



**Figure A.4.** HOLC activity and change in number of home owners, 1930-1940, by county. Counties with fewer than fifty thousand people. (Data from Federal Home Loan Bank Board 1938a and US Census 1933, 1943.)

raised the change in nonfarm home owners by 45 households. This is a much weaker relationship than the 295-household increase suggested by the data in figure A.2.

### **Two Steps Forward: Accounting for Other Community Characteristics**

The introduction of the HOLC was not the only factor changing over the course of the 1930s. The New Deal introduced relief programs, public works programs, and farm programs. The economy in some counties fared better than in other counties. The changes in age structure, income distribution, education, and racial and ethnic features of the population also differed substantially across counties. The trends in housing values and home-ownership rates in the 1920s varied widely across counties and may have carried over into the 1930s. A number of states also changed their tax structures, spending on education, and rules about property. To account for this, the two research teams performed a regression analysis that estimates the effect of the HOLC on changes in housing markets while holding the other variables constant in a statistical sense. The regressions show that the relationship between the changes in home values and the HOLC loans per capita is still negative when the other factors are held constant. Counties with an additional dollar of HOLC loans per capita had an additional drop of \$50.50 in median home values. After controlling for these factors in an analysis of the number of home owners, an additional dollar of HOLC loans per capita was associated with virtually no change in the number of nonfarm home owners.

### **One More Step: Accounting for the HOLC's Attempts to Offset Housing Decline**

Thus far, it does not appear that the HOLC contributed to higher home values or to keeping people in their homes. But there is one more major issue that needs to be addressed. The HOLC program likely made more loans in hard-hit areas, where home values and the number of nonfarm owners were falling. Thus, the HOLC's focus on trying to stop declines in housing values and the number of home owners offsets the positive effects of the HOLC. In economics and statistics, this problem is known as negative endogeneity bias: the HOLC policies to help struggling housing markets counter any potential finding that the HOLC loans could have caused an increase in housing values and home ownership.

One method used to combat this problem is an instrumental variable analysis developed by econometricians, economists who specialize in applying statistical methods to economic data. The goal is to find features that influenced the HOLC's distribution of loans across the counties but did not directly influence housing values or home ownership after all of the other factors are included in the analysis. In essence, the goal is to find some feature of HOLC policy that strongly influenced housing markets *only through the HOLC loans* and not through an alternative avenue that has not been taken into account already in the analysis.

Both teams of researchers focused on the distance from HOLC offices as the key feature. The instrumental variable analysis then estimates a relationship between the HOLC loans per capita and the distance from HOLC offices as well as all of the other factors that influenced the HOLC. A predicted value for HOLC loans per capita for each county is calculated from this analysis. The predicted value captures the aspect of the HOLC that was related to distance from the offices but was not related to the HOLC's attempts to offset declines in housing values and in home ownership. The final step is to estimate the relationship between housing values and the predicted value of HOLC loans per capita. This step is also performed for the number of home owners. If the instrument operates only through the HOLC loans, the estimated relationships have been cleansed of the negative bias arising from the HOLC's attempts to correct the housing problems.

The research teams focused on the distance from HOLC offices because the HOLC loan process was more costly when the home was located in a city with no HOLC office. The application and loan process for the HOLC loans involved extensive paperwork, negotiations with the lender, evaluations of the value of the home, visits to the neighborhood to evaluate its impact on the value of the home, and a variety of other steps. The costs of all of these activities were substantially lower if the HOLC had an office in the same town as the home. As the distance between the home's county and the HOLC office's county rose, the processing costs also rose. Thus, we would expect fewer HOLC loans per capita in places that were farther from the HOLC offices.

There still remains a worry that the HOLC located offices in places where there were more mortgage problems, and thus the negative bias problem would not be fully resolved. Both research teams tried alternative methods and found similar results. One method involved creating an alternative dis-

tribution of offices for the HOLC based on a national administrator who was setting up offices to minimize the cost of reaching the most people without regard to the extent of housing problems. This alternative distribution called for the administrator to locate an office in each state capital to reduce the costs of interacting with state officials. In addition, the cost-focused administrator would locate an office in the four largest cities in each state to insure that it reached the largest number of home owners in the state. The HOLC actually established 244 offices in 228 counties. This alternative cost-based method called for offices in 204 counties. The research teams then calculated the distance from each county seat to the county seats in the 204 counties with the alternative HOLC offices and used those distances as the instrumental variable. There are 137 counties that had an HOLC office and would have had an artificial office; 91 counties had an actual HOLC office but would not have had an artificial office; and 67 counties had no HOLC office but would have had an artificial office.

The idea is the following: suppose there were two counties with very similar housing markets in 1930, but one was closer to an HOLC office than the other. This could happen quite easily; compare, for example, New York and New Jersey, which both had six offices in mid-1935. Since New York is a much larger state, many counties in New York did not have an HOLC office, even though they were of similar size to counties in New Jersey that did have offices. Essentially, this methodology systematically compares counties like those in New York with similar counties like those in New Jersey. The only difference arises because the New York counties are farther away from HOLC offices due to the idiosyncrasies of office location. Since the HOLC was presumably more active in areas near their offices, this allows the identification of the impact of the HOLC rather than confusing it with some other differences between counties.

The first step in the analysis showed that there was a strong negative relationship between HOLC loans per capita and the distance to the alternative offices, as expected. Thus, the alternative office scheme helped explain the distribution of HOLC loans per capita, but it was structured in such a way that the distance from the alternative offices would not be something that anybody would believe was related to problems in housing markets.

The results we discuss here are from a paper in the *Review of Financial Studies* in 2011 by the research team of Price Fishback, Alfonso Flores-Lagunes,

William Horrow, Shawn Kantor, and Jaret Treber. A paper in the *Journal of Economic History* by the research team of Charles Courtemanche and Kenneth Snowden in 2011 found similar results using different measures, HOLC activity and home-ownership rates, rather than the number of home owners.<sup>1</sup> After going through the instrumental variable process, the estimates suggest that a dollar increase in HOLC loans per capita in counties with less than fifty thousand people would have raised housing values by \$115.70 in 1940. Similarly, an additional dollar would have raised the number of nonfarm home owners by 81.5 people (table A.1).

How much did the HOLC stave off the declines in housing? In the typical county with fewer than fifty thousand people, the median house value fell from \$2,278 in 1930 to \$1,431 in 1940. The mean of annual HOLC spending per capita was \$1.90 in this sample. Based on the estimates above, when a county went from zero HOLC spending per capita to \$1.90, the 1940 home value would have been \$231.40 higher. Without the HOLC, the median house value would have fallen from \$2,278 in 1930 to \$1,200 in 1940. The \$1,200

**Table A.1. Change in housing market variables associated with an additional dollar of HOLC loans per capita in counties with fewer than fifty thousand people as more controls are added to the analysis**

House value in 1940	\$160.00
Change in house value between 1930 and 1940	-\$75.00
Change in house value 1930–1940 after controlling for changes in wide range of factors	-\$50.50
<i>Change in house value 1930–1940 after controlling for changes in wide range of factors and reducing negative bias</i>	\$115.70
Number of home owners in 1940	295
Change in home owners between 1930 and 1940	45
Change in home owners 1930–1940 after controlling for changes in wide range of factors	6
<i>Change in home owners 1930–1940 after controlling for changes in wide range of factors and reducing negative bias</i>	81.5

figure comes from subtracting \$231.40 from the mean of \$1,431 for homes with a \$1.90 of HOLC loans per capita. Therefore, the HOLC helped reduce a potential decline in housing values of 47 percent from \$2,278 to \$1,200 over the decade of the 1930s to a decline of only 37.2 percent from \$2,278 to \$1,431 (table A.2).

Remember that much of the decline in housing values occurred between 1930 and January 1934, which was about the time the HOLC began making loans. The Civil Works Administration survey implied an average drop of about 32 percent in home values during that time. If this was the average for all counties below fifty thousand people, the typical median value of housing would have fallen from \$2,278 in 1930 to \$1,549 by the beginning of 1934. Without the HOLC, the typical median house value would have fallen from \$1,549 in 1934 to \$1,200 in 1940, roughly a loss of \$349 in value. Average HOLC loans per capita would have raised the price by \$231.40 from \$1,200 back to \$1,431 in 1940. Thus, the HOLC loans per capita were able to stave off \$231 or 69 percent of a potential decline of \$349 in housing values between 1934 and 1940.

Comparisons of the 1930 and 1940 census for counties with fewer than fifty thousand people suggest that the average number of nonfarm home owners rose from 1,200 to 1,378 over the period. Without the HOLC average spending of \$1.90 per capita, the typical county would have had only 1,223 home owners. The 1,223 figure is calculated as the average of 1,378 for counties in 1940, which would have experienced the average HOLC spending per capita of \$1.90, minus \$1.90 times the 81.5 increase in home owners associated with a dollar of HOLC spending per capita. Thus, with the HOLC the average number of nonfarm owners rose by 178 between 1930 and 1940, while without the HOLC it would have risen by only 23 over the decade. The HOLC therefore helped account for nearly all of the increase in the number of nonfarm home owners in a typical small county over the course of a decade.

We don't have good figures on the number of home owners in the mid-1930s. Comparisons of 1930 census home-ownership rates to home-ownership rates in a 1934 survey of 61 cities by the Civil Works Administration suggest an average drop in the home-ownership rate of about 3 percent. This seems roughly consistent with the rise in foreclosure rates to around 1 percent each year in the early 1930s. Thus, the number of home owners probably fell by about 3 percent between 1930 and the beginning of 1934. If the

**Table A.2. Evaluating the impact of HOLC spending per capita on nonfarm home values and the number of home owners in counties with fewer than fifty thousand people**

How much of the decline in median house value between 1930 and 1940 was prevented by HOLC?

A	Typical median house value in 1930	\$2,278
B	Typical median house value in 1940, which incorporates the effect of an average HOLC loan per capita of \$1.90	\$1,431
C	Effect on typical median house value in 1940 of an added \$1.90 of HOLC loans per capita (\$1.90 times 115.70 effect of \$1 of HOLC spending per capita)	\$231
D	Typical median house value in 1940 if county had received no HOLC loans (line B – line C)	\$1,200
E	Change in typical median house value between 1940 and 1930 with no HOLC loans (line A – line D)	\$1,078
F	HOLC loans prevented \$231 loss out of \$1,078 potential loss between 1930 and 1940 for a percentage of (line C ÷ line E)	21.4%

How much of the decline in median house value between 1934 and 1940 was prevented by HOLC?

G	Estimate of median house value in 1934 if it had fallen by 32 percent between 1930 and 1934 (line A reduced by 32%)	\$1,549
H	Typical median house value in 1940, which incorporates the effect of an average HOLC loan per capita of \$1.90	\$1,431
I	Effect on typical median house value in 1940 of an added \$1.90 of HOLC loans per capita (\$1.90 times 115.70 effect of \$1 of HOLC spending per capita)	\$231
J	Typical median house value in 1940 if county had received no HOLC loans (line H – line I)	\$1,200
K	Change in typical median house value between 1940 and 1934 with no HOLC loans (line G – line J)	\$349
L	HOLC loans prevented \$231 loss out of \$349 potential loss between 1934 and 1940 for a percentage of (line I ÷ line J)	66.2%

(continued)

**Table A.2** (continued)

How much of the increase in the number of home owners between 1930 and 1940 was contributed by the HOLC?

M	Typical number of home owners in 1930	1,200
N	Typical number of home owners in 1940, which incorporates the effect of an average HOLC loan per capita of \$1.90	1,378
O	Change in typical number of home owners between 1940 and 1930 (line N – line M)	178
P	Effect on typical number of home owners in 1940 of an added \$1.90 of HOLC loans per capita (\$1.90 times 81.5 increase in home owners associated with another dollar of HOLC spending per capita)	155
Q	HOLC loans helped account for 155 out of the 178 increase in home owners between 1930 and 1940 for a percentage of (line P ÷ line O)	87.0%

How much of the increase in the number of home owners between 1934 and 1940 was contributed by the HOLC?

R	Estimate of number of home owners in 1934 if it had fallen by 3 percent between 1930 and 1934 (line M reduced by 3%)	1,164
S	Typical number of home owners in 1940, which incorporates the effect of an average HOLC loan per capita of \$1.90	1,378
T	Change in typical number of home owners between 1940 and 1934 (line S – line R)	214
U	Effect on typical number of home owners in 1940 of an added \$1.90 of HOLC loans per capita (\$1.90 times 81.5 increase in home owners associated with another dollar of HOLC spending per capita)	155
V	HOLC loans helped contribute 155 out of the 214 increase in home owners between 1934 and 1940 for a percentage of (line U ÷ line T)	72.4%

number of home owners fell 3 percent from the 1930 census average of 1,200, the typical number of home owners would have fallen from 1,200 to 1,164. Then, the typical number of home owners would have risen by 214 from 1,164 to 1,378 between 1934 and 1940. With \$1.90 in HOLC spending per capita, the HOLC would have raised the number of home owners by 155, which is

about 72 percent of the rise of 214 between 1934 and 1940 in a typical small county.

In chapter 9 we point out that neither research team could find a strong positive effect of the HOLC in counties with more than fifty thousand people. There are two potential reasons for this: either the HOLC had little impact there or the research teams could not effectively resolve the negative endogeneity bias. We discussed the reason that the HOLC might have had little impact in chapter 9. Here we discuss why the instrumental variable strategy designed to eliminate the negative bias may have been less effective for larger cities. The instrumental variable strategy worked for small towns because many of them were significant distances away from counties with HOLC offices. Many of the counties with more than fifty thousand people had HOLC offices. In fact, some like New York City, which was treated as one large area in both analyses, had several offices. Thus, the measured distance to an HOLC office or the artificial office was often zero for the larger cities. The instrument was therefore not as effective for large cities at picking out an aspect of HOLC lending that was not related to problems in housing markets. We are still working on this issue but have made little headway on it.