The Overhang of Structures before and since the Great Recession

Margaret Jacobson and Filippo Occhino

Investment in structures is still 29 percent below its pre-recession peak. Using a new indicator of the level of structures that would be warranted by economic conditions, we find evidence that the level of investment was too high in the first half of the 2000s. This overinvestment created an overhang of structures which has held down the growth of investment in structures during the recovery.

The economic recovery in the US has been atypically weak, and one reason for this weakness is the failure of investment to rebound as strongly as it has in previous recoveries. We are four and a half years into the recovery, and yet the real level of investment spending by businesses, households, and nonprofits on structures, equipment, and software is still below its pre-recession peak.

In turn, the current low level of investment is mainly the result of an exceptionally large and persistent drop in one of its key components, investment in structures. Structures include both residential buildings, such as homes and apartment buildings, and nonresidential buildings, such as factories, office buildings, stores, and hospitals. After peaking in early 2006, investment in residential and nonresidential structures dropped by an unprecedented 45 percent, and it began to recover late, two years after the official beginning of the recovery. Currently, it is still 29 percent below its pre-recession peak. By comparison, investment in equipment dropped by 31 percent during the recession, but it began to pick up right when the recovery started and is now above its previous peak (figure 1).

Why is investment in structures so low? One reason that is often cited is overhang, the idea that the excess, or overhang, of structures that have been built in the past

is now holding investment down. Using a new indicator of the optimal level of structures—the level that would be warranted by economic conditions—we measure the level of overhang before, during, and since the recession. We find evidence that investment in structures was too high in the years leading up to the recession and that an overhang of structures has held down investment growth during the recovery.

Figure 1. Investment in Structures and Equipment

Billions of chained 2009 dollars
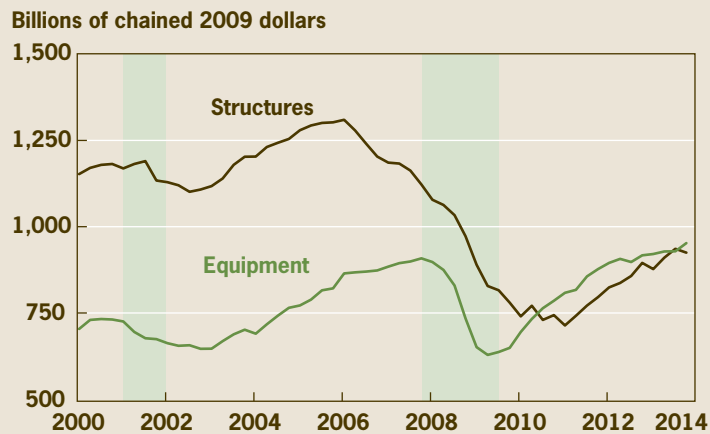
Note: Structures are the sum of residential and nonresidential investment categories.
Source: Bureau of Economic Analysis.

Measuring Overhang

To assess whether the investment level is adequate in any given year, we need to know both what the actual level of structures is as well as what the optimal level should be. As there is no measure of the optimal level of structures, we construct our own. Our measure provides the stock of structures that would have been warranted by economic conditions and growth prospects in each year.

We get this stock by assuming that a firm should build a new structure only if it anticipates that the cost of building it will be smaller than the discounted value-added that the structure will likely generate in the future. Hence, both a higher cost of structures and a lower expected future value-added of structures should lower the optimal level of structures. (See box 1 for a description of the measure). We calculate the optimal stock for each industry separately, and for the private sector as a whole.

Then, we compute the overhang of structures as the percentage difference between the actual stock of structures and the optimal level. So an overhang of 1 percent indicates that the actual stock of structures is 1 percent larger than what it should have been based on economic conditions and growth prospects.[1]

Overhang Builds Up

According to our measure, structure overhang in the private sector increased in the first half of the 2000s, peaking at 21 percent in 2006. It remained elevated throughout 2009, and then declined rapidly during the recovery, reaching 11 percent in 2012.[2] This suggests that overhang built up because of excessive investment before the crisis, rather than resulting from the unanticipated drop in economic activity during the Great Recession. For comparison, our measure of overhang for the equipment category was negative for

all the years after 2001, which indicates an actual level of equipment lower than the optimal one (figure 2).

In the data, elevated levels of structure overhang tend to be associated with the slow growth of investment in structures. Structure overhang is negatively correlated with the current and future investment growth of structures.[3] A standard model indicates that an unanticipated shock that raises structure overhang by 1 percentage point causes investment growth in structures to decline by 0.82 percentage points in the same year.[4] In the same model, the coefficient of overhang in the investment growth equation implies that, when overhang is higher by 1 percentage point, next-year investment growth is reduced by 0.17 percentage points.

This evidence suggests that structure overhang may have been a factor behind the large and persistent drop in the growth of investment in structures during the recession and the subsequent early years of the recovery. To the extent that the stock of available structures exceeded the level warranted by economic conditions and growth prospects, there was less need for building new structures. Firms reduced their investment in new structures in order to bring the stock of available structures back in line with the optimal level. The process of absorbing the overhang of structures took especially long because structures last very long, having an average age of approximately 24 years.

Looking separately at the behaviors of the actual stock of structures and the optimal one is an informative exercise. It shows that the buildup of overhang in the first half of the 2000s was associated with a decline in the optimal level of structures, while the actual level of structures continued to increase at a pace similar to the one before 2000, only starting to slow down in 2008 (figure 3). In turn, the decline of the optimal level was associated with a large increase in

Figure 2. Aggregate Overhang for Structures and Equipment
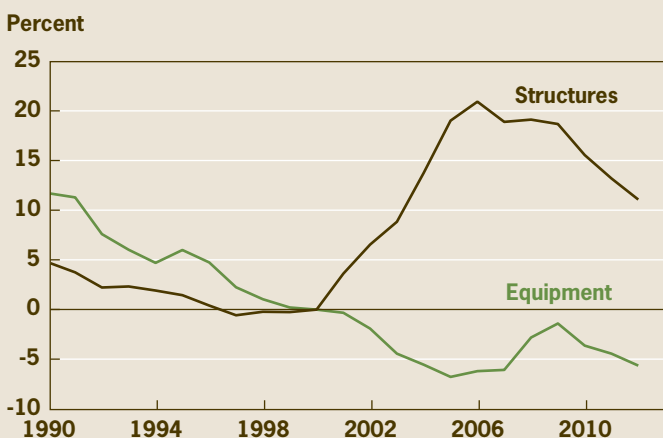
Source: Bureau of Economic Analysis; authors' calculations.

Figure 3. Optimal and Realized Stock of Structures
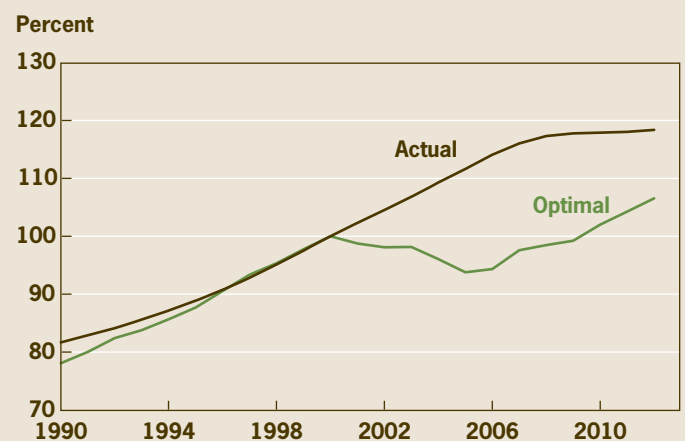
Source: Bureau of Economic Analysis; authors' calculations.

the cost of structures in the first half of the 2000s. The cost of structures increased cumulatively by 42 percent between 2000 and 2006, and this more than outweighed the 34 percent increase in the expected discounted value-added of structures, leading to a decline in the optimal stock of structures. The evolution of overhang in the subsequent years is, again, explained by the optimal level of structures, which rose in 2007, slowed down in the recession years, and then picked up during the subsequent years of recovery.

Distribution of Structure Overhangs across Industries
So far, we have looked at the general evolution of structure overhang in the private sector as a whole. We can also see what has happened in each industry. The industry-by-industry data reveals a fair amount of heterogeneity across industries.

Starting with the real estate industry, which accounts for more than 60 percent of the stock of structures, we notice that the overhang built up similarly to the rest of the private sector. It peaked in 2006 at 21 percent, but then dropped rapidly and was 6 percent in 2012. The overhang in the rest of the private sector, however, peaked later and remained more elevated (figure 4).[5]

These results are consistent with the evidence on unused and underutilized structures coming from vacancy rates. The housing vacancy rate peaked in 2008, while nonresidential vacancy rates tended to lag, reaching their highest levels in 2010. The housing vacancy rate declined earlier and by more, relative to commercial vacancy rates (figure 5).

For the real estate industry as well, the structure overhang is mostly explained by the evolution of the optimal stock of structures. The optimal stock declined in the first half of the 2000s, mainly due to a surge in the cost of structures, but then it bounced back in 2007 and 2008, and narrowed the gap with the actual stock of structures (figure 6).

Overhang evolved differently in other industries.[6] For some cyclical industries, like manufacturing, retail trade, and finance and insurance, overhang spiked during the recession, as those industries' output declined, but then it decreased during the recovery. For other industries, like mining and utilities, the evolution of overhang was less affected by the business cycle (figure 7). The overhang was unevenly distributed across industries, and it was even negative in some cases. In 2012, for instance, overhang was higher than 30 percent in retail trade, while it was negative 6 percent in healthcare, where the actual stock of structures fell short of the optimal one (figure 8).

Because the overhang was negative in a few industries, our measure of overhang actually understates the true size of the total overhang existing in the private sector. For example, in 2012, our measure of overhang in industries excluding real estate was 11.3 percent, but this was the result of a 13.6 percent contribution from industries with structures in excess of the optimal level, minus a 2.3 percent contribution from industries with structures below the optimal level.

Also, our measure overstates the true decline of overhang since 2009. Starting in 2009, the overhang in the private sector excluding real estate declined by 6.7 percent, but only 5.6 percent was really due to a decline of overhang in the industries with an excessive amount of structures. The remaining 1.1 percent decline in the measure was actually the result of an increase in the gap between the optimal and the actual stock of structures in industries with a lack of structures, especially agriculture, management, and healthcare (figure 9).

Implications
According to our measure of overhang, the level of investment in structures was too high in the first half of the 2000s. This created an overhang of structures that likely held down the growth of investment in structures during the recovery after the 2007 recession. These findings suggest that investment in structures may pick up further in the future, as the remaining overhang gets absorbed, but it will not likely return to the high pre-crisis levels.

Our findings also raise the question of why firms didn't reduce their investment activity in the first half of the 2000s, as the cost of structures surged and the optimal level of structures declined. One possibility is that firms had overly optimistic expectations about future revenue prospects. Another possibility is that the high investment activity was the result of decisions that had been made previously and could not be reversed. Investment in structures is a long process, and, once a firm has started a project, completing it may be worthwhile or it may be required by the financial contract.

However, while these explanations may account for a temporary divergence between the actual and the optimal stock of structures, it is hard to explain why the gap between the two continued to widen for so many years, between 2000 and 2006. Other explanations perhaps based on low financing costs or on alternative models of investment activity may provide more insights, and we hope our findings can stimulate further study on the determinants of investment in the pre-crisis years.

Footnotes
1. It should be emphasized that there is large uncertainty surrounding the optimal level of structures, especially because we don't observe firms' expectations of future revenues and costs, and we don't know precisely how the optimal level of structures depends on those expectations. In particular, our measure does not incorporate all available information about profit expectations—for instance it does not make use of information about energy trends in determining the optimal level of structures in the mining industry. Hence, our measure of the optimal level of structures and the associated overhang may contain large errors and should be interpreted as an approximation only.
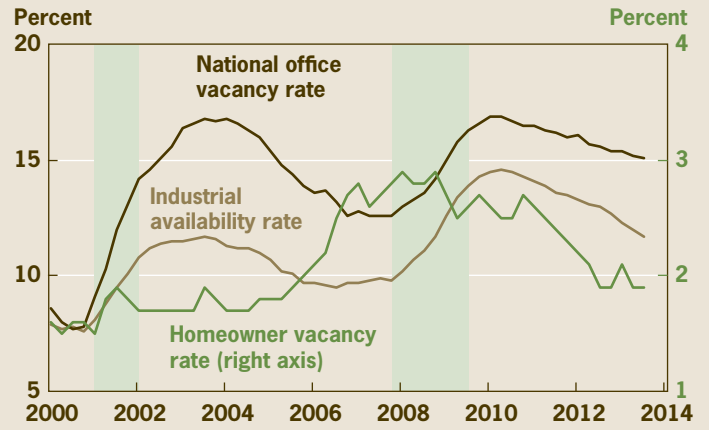
2. There is a discrepancy between this measure of private sector overhang, obtained directly from the aggregate data, and an alternative one obtained by aggregating the industry-

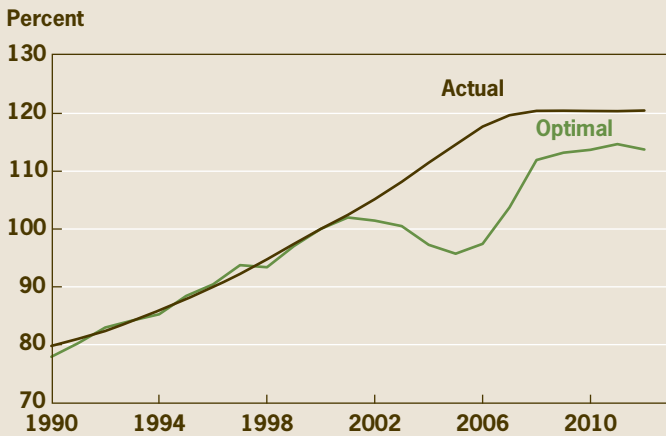## Figure 4. Overhang for Real Estate and Other Industries

Percent

Real estate

Other industries
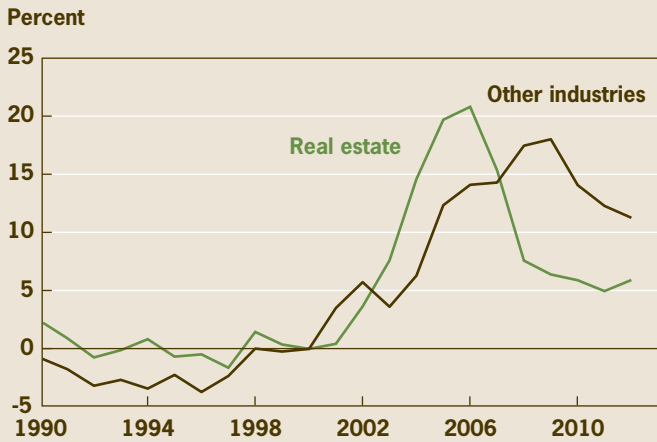
Source: Bureau of Economic Analysis; authors' calculations.
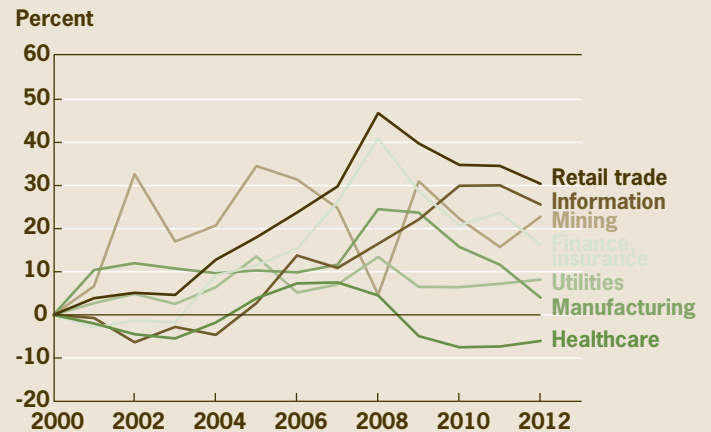
Figure 5. Residential and Nonresidential Vacancy Rates

Percent

Percent

National office vacancy rate

Industrial availability rate

Homeowner vacancy rate (right axis)

Sources: Census Bureau; CB Richard Ellis/Haver Analytics.
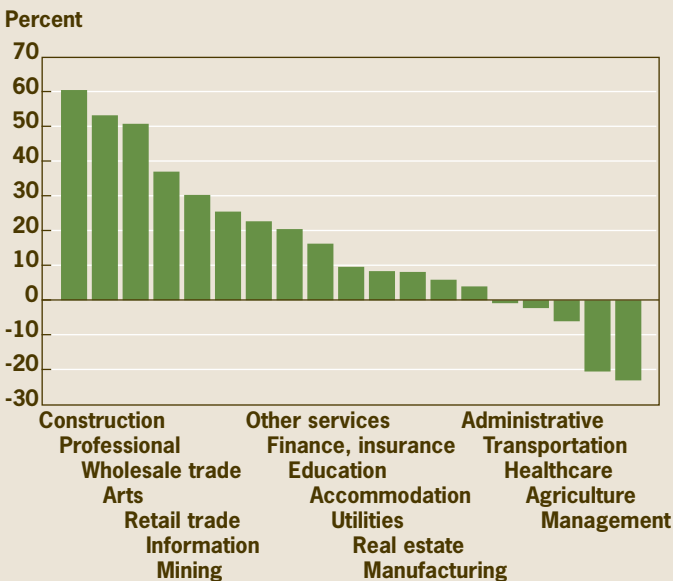
Figure 6. Optimal and Realized Stock for Real Estate

Percent

Actual

Optimal

Source: Bureau of Economic Analysis; authors' calculations.

Figure 7. Overhang for Selected Industries

Percent

Retail trade
Information
Mining
Finance, insurance
Utilities
Manufacturing
Healthcare

Source: Bureau of Economic Analysis; authors' calculations.

Figure 8. Overhang for All Industries, 2012

Percent

Construction
Professional
Wholesale trade
Arts
Retail trade
Information
Mining

Other services
Finance, insurance
Education
Accommodation
Utilities
Real estate
Manufacturing

Administrative
Transportation
Healthcare
Agriculture
Management

Source: Bureau of Economic Analysis; authors' calculations.

Figure 9. Positive and Negative Contributions to Overhang

Percent

Industries with excessive structures

All industries (excluding real estate)

Industries with a lack of structures

Note: Data are for private sector excluding real estate.
Source: Bureau of Economic Analysis; authors' calculations.

Box 1. Computing the Optimal Stock of Structures

We compute the optimal stock of structures in individual industries and in the private sector as a whole. The optimal stock is computed in the same way for industries and the private sector as a whole, by considering the private sector as one industry. Once the optimal stock has been computed, overhang is simply the percentage difference between the actual stock of structures, which is obtained from data, and the optimal one.

We begin with a standard optimal investment equation stating that firms should build new structures up to the point where the cost of a new structure is equal to the expected discounted sum of the value-added generated by the structure next year and the depreciated value of the structure next year:

$$P = E \, [V + (1-d) \, P'] \, / \, (1+r)$$

In this equation, P and P' are, respectively, the prices of a new structure in the current year and in the next year, V is the value-added generated by the structure next year, d is the depreciation rate, r is the discount rate, and E stands for the expected value. This optimal investment equation follows from the standard assumption that firms should build a new structure only if the cost of building it does not exceed the expected discounted future stream of value-added generated by it.

We then add several simplifying assumptions. We assume that the additional value-added generated by a new structure is proportional to the average value-added per structure in the same industry, that is, the ratio of the industry value-added, call it Y, to the stock of structures. In addition, we assume that, for each industry, the depreciation rate, d, the discount rate, r, and the expected growth rates of the price of structures, P, and of the industry value-added, Y, are all constant over time, although they may differ across industries. Under these additional assumptions, the optimal stock of structures, call it K*, is proportional to the ratio of the industry value-added to the price of structures, i.e.:

$$K^* = cY/P,$$

where c is a number that may vary across industries, but, for each industry, is constant over time.

Then, the overhang of structures, O, is simply the percentage difference between the actual stock of structures, K, and the optimal stock, K*:

$$1+O = K/K^* = PK/(cY)$$

Hence, for each industry, 1+O is proportional to the ratio of the value of structures to the industry value-added.*

Finally, we notice that our measure of overhang for the whole private sector was very stable during the 1992–2000 expansion years, as is evident from figures 3 and 4. This suggests the absence of a significant amount of structure overhang in that period. We choose the year 2000, the most recent one before the 2001 recession, as a base year, and set the constant of proportionality, c, so that, in each industry, the overhang was equal to zero in that year. Choosing any other year between 1992 and 2000 does not much affect the results for the overhang in the real estate industry or in the private sector as a whole, but it may alter some results for other industries. The growth rate of 1+O over time, however, does not depend on the choice of the base year or of the constant of proportionality, c, so we can be more confident about growth rates than levels.

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*Notice that the inverse of 1+O can be interpreted as a measure of Tobin's q, the ratio of the market value of structures (measured by the expected present discounted value-added of structures) to the replacement value of structures (measured by the price of structures). Hence, the inverse of 1+O provides a measure of Tobin's q for structures, an index of the profitability of investment in structures, for each industry and for the private sector as a whole.

by-industry overhang. The latter is a few percentage points smaller than the former, and declines rapidly during the recession. Other than that, the two measures both peak in 2006 and tell a similar story.

3. The contemporaneous correlation is -0.28. In a regression of investment growth on overhang, a 1 percent rise of structure overhang is associated with a contemporaneous decline of investment growth by 0.34 percent.

4. The model is a vector auto-regression of structure overhang and structure investment growth with 1 lag, as suggested by the Bayesian information criterion. Shocks are identified using a Choleski decomposition in such a way that the overhang shock can affect investment growth contemporaneously. The effect of the shock on investment growth is significant only in the impact period.

5. The overhang in the rest of the private sector is computed as a weighted average of the overhangs in each industry, with weights proportional to the optimal value of structures in each industry.

6. As explained in box 1, our measure of overhang depends on the assumption that it was equal to zero in the year 2000. While we view this assumption as plausible for the real estate industry and for the private sector as a whole, we believe it is more arbitrary for the industries other than real estate. Hence, for these other industries, we are less confident about our estimates of the level of overhang and we view our results as suggestive only.
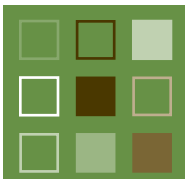
Magaret Jacobson is a research analyst at the Federal Reserve Bank of Cleveland, and Filippo Occhino is a senior research economist at the Bank. The views they express here are theirs and not necessarily those of the Federal Reserve Bank of Cleveland or the Board of Governors of the Federal Reserve System or its staff.