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Is There Such a Thing As a Skyscraper Curse?

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ABSTRACT: There is an emerging literature on the subject of skyscrapers and business cycles. Lawrence (1999) first noticed the correlation between important changes in the economy and the building of record-breaking skyscrapers. Thornton (2005) established a theoretical link between the two phenomena. Several papers have subsequently examined the impact of skyscraper building on the economy and in particular on the role of psychological factors on the building of record-breaking skyscrapers. Not surprisingly, most people scoff at this notion, and Barr et al. (2015) present extensive empirical evidence that skyscrapers do not cause changes in GDP, but precisely the opposite. Here we show what the skyscraper curse actually is, and show that the entire empirical literature on this subject supports the existence of a skyscraper curse, including most of Barr et al. (2015). In addition, we present new empirical evidence supporting the skyscraper curse.

KEYWORDS: Skyscraper Curse, business cycle, Austrian School

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INTRODUCTION

On March 28, 2015, the *Economist* magazine published an article that is the title of this paper. They came to the conclusion that there should be great doubt about the existence of the skyscraper curse. "In other words, you cannot accurately forecast a recession or financial panic by looking at either the announcement or the completion dates of the world's tallest building." The *Economist* article is just the latest installment of the increasing fascination of the financial and news media with the skyscraper curse.

There has also been an increasing attraction of economists to the relationship between skyscraper building and economic crises. Several economists have examined the data and tried to make sense of the suggested correlation to determine the underlying causes and relationships. This all began with Andrew Lawrence (1999), the founder of the skyscraper index who coined the phrase "skyscraper curse." He believed building booms were the result of easy credit conditions and expansionary monetary policy. Lawrence focuses on "over investment, monetary expansion and speculation" as the basis of building record-breaking skyscrapers and that when this pattern cannot be sustained the economy falls into economic crisis. Thornton (2005) provides both a theoretical model for the skyscraper curse and additional evidence in support of the curse.

In contrast, another thread in this literature is based on the idea that skyscraper building is rational and that skyscraper construction does not cause economic crises. In particular, Barr et al. (2015) present extensive empirical evidence that skyscraper construction is rational and that skyscraper construction does not cause changes in GDP. The argument presented here is that *all* the empirical evidence in this literature actually confirms the same thing: the existence of the skyscraper curse. This in turn provides for a more complete understanding of just what the skyscraper curse means, as well as its cause.

HISTORY AND DEBATE

Lawrence (1999) bases his correlation on an examination of the record-breaking skyscrapers that occurred over the previous 100 years. He begins with the Singer Building and the Metropolitan Life Building, which were completed in 1908 and 1909 respectively. These new records occurred concurrently with the Panic of 1907. He notes that there is a remarkably accurate relation between the two variables over the next century, with the exception of the Woolworth Building which was completed in 1913.

Lawrence's article and research was the jumping off point for many economists to follow. Thornton (2005) shows how artificial interest rates[1] link skyscraper height and economic crises. Artificially low interest rates and sustained easy credit conditions allow for both a booming economy and record-breaking skyscrapers. The causal link is based on three different Cantillon effects involving artificially induced structural changes that occur throughout the economy. The three effects work together to both cause an abnormally large expansion in the economy and the building of record-breaking skyscrapers.

The first Cantillon effect is the impact of the rate of interest on the value of land and the cost of capital. A lower interest rate causes land values to increase, especially in high-value areas such as metropolitan cities. Lower rates increase land prices due to, among other things, the decreased opportunity cost of owning land. Higher land prices lead builders to build taller, more capital intensive structures in order to better maximize profits. This is well-known through theory and experience (Capozza and Li, 1994) and this effect is also confirmed empirically in some of the papers reviewed below.

The second Cantillon effect from artificially low interest rates is an increase in the size and scope of firms. A lower cost of capital encourages firms to grow in size and to become more capital intensive and to take advantage of new technologies and economies of scale. In particular, it encourages firms to engage in more roundabout production processes. An example of adopting a more roundabout production process would be when local dairy firms are replaced by regional dairy firms. As local firms

[1] Artificially low interest rates occur when actual rates are below levels that would have existed if they were solely determined by market forces. As such, pure market rates are not observable and are difficult to estimate although you can get some sense of their effect by examining data on total lending in the economy.

are replaced by regional firms and regional firms are replaced by national and international firms, there will be an increased demand for office space for corporate headquarters, especially in central business districts of major metropolitan cities. Empirical support for this effect can be seen in Harford (2005) who shows that merger waves are dependent on "sufficient overall capital liquidity" and that such waves do not occur in the absence of this liquidity.

The third Cantillon effect from artificially low interest rates is the development of new technologies and production processes needed to produce record-breaking skyscrapers. Record breakers typically require new innovations and efficiencies in order to effectively reach record heights. In terms of construction, building higher structures often requires new types of cranes, cement pumping systems, etc. In terms of the actual structure, building higher often requires newer and faster elevators, lighter cables, new efficiencies in moving water and sewage, space saving temperature control systems, etc. Ali and Moon (2007) show that designers and engineers have a tremendous desire to innovate with technology in order to conserve on the size of building systems or to increase the capacity of those systems. For example, just one standard elevator shaft of 2x2 meters would take up the space of 10 efficiency apartments in a 100 story building. At standard speeds, it would take about 10 minutes to get from the ground floor to the top floor of the Burj Khalifa Tower, plus the time it took for the elevator to arrive at the ground floor. Therefore as building height rises, technology must also advance to conserve on the building systems footprint. Ames (2015) reports, for example, that KONE engineers have created a new elevator cable that weighs less than 7 percent of the weight of traditional steel cables, which weigh over 20 tons for a 400 meter building.

Cantillon effects explain why buildings are built taller, firms become larger, and technologies are developed that would otherwise be uneconomical all during periods of artificially low interest rates. There are two things to take note of here. First, these effects are not limited to the record-breaking buildings, but are present throughout the economy. Second, it might at first seem that some of these effects, such as technological change, are beneficial, but they are all inconsistent with the most efficient use of resources. All three effects are typically revealed when interest rates adjust to market-determined levels as a cluster of entrepreneurial errors consisting of unrealized profits, foreclosures, bankruptcies, unemployment, and often bailouts.[2]

In addition to describing the Cantillon effects that give rise to the Skyscraper Curse, Thornton (2005) shows that the Woolworth Building—which Lawrence saw as an exception to the curse—was not really an exception because World War I intervened lifting the US economy out of a steep slide into recession. Thornton also extends Lawrence's data to include the late 19*th* century—showing that record height buildings in that period also followed the Skyscraper Curse.

Kaza (2010) supports Thornton's arguments concerning the role of Cantillon effects, and entrepreneurs are not immune to the errors that are eventually revealed as an economic contraction. He also supports Thornton's position that the Woolworth Building was not an exception to the Skyscraper Curse. He points out that the Woolworth Building and other less severe cycles match up well, but not consistently with cycle data provided by the National Bureau of Economic Research. Kaza also shows that there is some evidence of the skyscraper curse at the state level as exemplified by the history of tall buildings in Arkansas and Michigan and that the tallest building in 40 of the 50 US states were completed during economic contractions, as defined by the National Bureau of Economic Research

Loeffler (2011) also examined record-breaking skyscrapers to determine whether they can be used to forecast US stock returns. He finds that during the five years after construction of a record-breaking skyscraper, the stock market returns are substantially lower than they were in the years prior. Loeffler shows this result is due to "over optimism" in the economy which gives rise to skyscraper building, but also leads to an overvalued stock market. Using data from the US from 1871–2009, Loeffler's statistical analysis shows a relationship between the building of skyscrapers and in changes in the stock market. Loeffler finds that stock returns are associated with the information regarding

[2] In the event that interest rates are not allowed to return to higher market-determined levels, keeping interest rates from rising requires a commitment to expanding the money supply at an increasing rate—which runs the risk of hyperinflation.

the start of a record-breaking skyscraper and then the two years following. Loeffler uses these findings to test the determinants of skyscraper building, and notes that they are able to capture market conditions such as risk and confidence. His prior analysis shows weak evidence of overvaluation, but through these tests he is able to conclude that there is a stable and significant relationship over time. He finds that the "predictive content of tower building is at least partly related to overvaluation" (Loeffler, 2011, p. 2).

Jason Barr has examined different determinants of skyscraper height in several papers. Barr (2010) began by examining Manhattan, once the skyscraper capital of the world. Here he looked at skyscraper height in Manhattan from 1895–2004 as both a function of economic variables and "builder competition." Here a skyscraper is defined as a building over 100m in height. He identified skyscraper building cycles that appear to last about twenty five years, giving rise to the thought that "their construction is determined by major economic, demographic, and political forces" (Barr, 2010, p. 568). In areas such as Manhattan, height is the easiest way to make the most of the relatively scarce land, in turn maximizing profit. However, Barr also expresses the notion that building height is also affected by "builder competition"—the builder's desire to "obtain a degree of societal status" (Barr, 2010, p. 569).

Barr shows that there is a high degree of correlation between the number of completions and the height of each completed building. This demonstrates that fertile economic conditions encourage taller buildings to be built. He also shows that the level of building activity is dependent on employment in the finance, insurance and real estate industries as well as the stock market and other economic factors such as building material prices and interest rates.

He then expands his model to include ego variables to look for a trend between completions and heights. Barr finds that since the beginning of the 20th century, height trends have been determined by economic factors that affect building costs. He considers that if ego was playing a significant role in the height of skyscrapers, there would have a trend between height and completion of buildings in the surrounding area. However, Barr did not find such evidence, so that his time series tests provide "support for the profit maximization hypothesis, rather than the ego hypothesis" (Barr, 2010, p. 570). However, Barr still believes that "record breaking height appears to be due to the right combination of ego and economics" (Barr, 2010, p. 592) because ego competition can only take place once the economy is in a solid position to build.

Barr (2012) next examines skyscraper height as a function of cost, benefits of construction and "height competition." He finds that skyscrapers "not only provide profits but also social status" for both the city and for the architect because a new skyscraper announces to the world that a city has arrived as an economic power. To a builder, a record-breaking skyscraper is also strategic. By standing out in the city skyline and the record books, the architecture and construction companies "build" status in society and their business communities. Social status can be viewed as ego in the height competition between builders or between cities.[3] He employs a variety of models to test responsiveness to nearby buildings and he determines "that builders positively respond to the height decisions of nearby buildings." To start, Barr creates a model of the height of skyscrapers in New York from 1895–2004. Through various economic variables Barr is able to measure construction costs and profits. He is able to determine which of the skyscrapers were economically too tall at the time they were built and which buildings responded to the building of nearby skyscrapers. His results show support for the "height competition" hypothesis, i.e., ego matters, and that height competition is at its peak during times of economic expansion, when the "opportunity cost of seeking social status is lower." Barr also finds evidence that economic factors such as a fall in interest rate and building costs or an increase in population and job growth all increase height.

To look further into the strategic interaction underlying the competition hypothesis, Barr (2013) looked for evidence of building competition between New York and Chicago to determine if there is a "height race" and "strategic interaction" between the two cities (Barr, 2013, p. 369). In order to test to see if there is competition Barr creates an annual time series of the number of skyscraper completions in each city. For each city Barr uses a different cut off in defining what buildings qualify as a skyscraper. In Chicago he uses 80 meters, and in New York he uses 90 meters. From the data of

[3] Helsley and Strange (2008) had previously presented a game-theoretic model for skyscraper height, which suggests the hypothesis that Barr (2010b) is testing.

the qualifying buildings, Barr creates a time series of the number of skyscrapers in each city to determine if building in one city had an impact on the other. Based on the assumption that such competition would take place at the highest level of buildings, he looks at the tallest building completed in each city during each year since 1885.

Barr does indeed "find evidence for skyscraper interaction across cities. That is, New York skyscraper decisions have impacted Chicago decisions and vice versa." (Barr, 2013, p. 370). Barr also examines zoning regulation changes over this time period and is able to see that as zoning regulation intensifies in one city, building in the other city increases. This suggests that the cities not only act as complements to one another, but also as substitutes. That is, when building is increasing in one city, it will also be increasing in the complement city. However, when zoning restrictions are intensifying in one city, building will increase in the other city. Although Barr does find evidence of height competition, he suggests that this height competition is only evident when the opportunity cost of competition is low.

In the most recent article by Barr, with coauthors Bruce Mizrach and Kusam Mundra (2015), the existence of the Skyscraper Curse is brought into question. In order to test for the Skyscraper Curse, Barr et al. (2015) examine record-breaking skyscraper building patterns and compares that with announcement dates and opening dates to determine if there is a correlation with GDP growth. They determined that there was "no relationship between record-breakers and recessions" (p. 149). Additionally, they used vector auto regression analysis for the annual time series of the tallest buildings completed in US, Canada, China and Hong Kong and their respective real GDP per capita. From these regressions they performed Granger causality and cointegration tests to determine the relationship between real GDP per capita and the time series data of tallest buildings completed in each country. They concluded that real per capita GDP and height are cointegrated, meaning that height and GDP per capita share a common pattern. Additionally, they find that "there is unidirectional causality from GDP to height." They therefore conclude that "height is not a useful predictor of the business cycle, and that while height may temporarily deviate from output, over the long run height and output move together." They believe these "temporary deviations" are the result of builder competition that results in taller buildings that are economically too tall, and that during a correction period construction height falls back towards a level consistent with GDP. Their evidence appears to create a strong dispute of the existence of the Skyscraper Curse.

The most current academic paper on this topic is Engelhardt (2015). He uses a Bid Rent function in residential cities to show what a buyer would be willing to pay for a given piece of land at a given time. Bid Rents decrease as one moves further from the city center due to the increase in transportation costs, leaving less money to spend on rent. Using this model he found that, "land prices will vary in proportion with rents, and will vary in inverse proportion with interest rates" (Engelhardt, 2015, p. 4). Therefore one can arrive at the conclusion that "land prices in the city center are typically higher than in the periphery" (Engelhardt, 2015, p. 4). He finds that height will increase if building up, or adding height, is less expensive than building out, or a more spread out building. "Land prices increasing will occur if land rents increase, or if interest rates decrease" (Engelhardt, 2015, p. 5). He also asserts that interest rates have an impact on wage rates. "A decrease in the interest rate leads to greater demand for labor… and therefore higher wages" (Engelhardt, 2015, p. 6).

Engelhardt uses these findings to demonstrate that higher wages from lower interest rates, increases the cost of transportation from the opportunity cost of not working. This shows that the increased incomes will change the demand and budgeting for rent, raising the bid rent function. This function is additionally steepened by the higher cost to transportation from the higher opportunity cost of a commute. This demonstrates that the boom increases demand for living in the city center. These effects will give rise to an increase in land prices in the city, due to the new higher income and due to the decrease in interest rates. These new higher land prices make it more cost efficient for buildings to build up rather than out, thus economizing their land usage.[4]

In looking at the various papers and research, there appears to be considerable uncertainty and doubt regarding the Skyscraper

[4] Chau, Wong, Yau, and Cheung (2006) find similar results—that optimal building heights rise when land is scarce.

Curse. Some papers seem to conclude that record-setting skyscrapers are indeed a curse. Several papers offer evidence of a variety of causes of the curse including monetary policy, various supply and demand factors, as well as psychological factors such as overvaluation, builder competition and ego. There is also a suggestion that the Skyscraper Curse, like other stock market indicators, is a figment of our imagination and the result of happenstance. In the next section we show there is much less disagreement than it appears.

THEORY AND HARMONY

When considered together, current research seems to conform to the theoretical description provided by Thornton (2005). Clearly there is a coincidence of economic expansion, higher stock prices, psychological changes and skyscraper construction prior to an economic crisis. If all of these phenomena share a common cause, then it should be no surprise to find that they are empirically connected. As Thornton (2005) establishes, lower interest rates serve as that common cause. So, while there is a Skyscraper Curse—in that skyscrapers are an omen of sorts—the skyscrapers do not cause the financial collapse that often follows. They are simply a very visible manifestation of the business cycle phenomenon brought about by artificially low interest rates.

Despite the general agreement regarding some of the key elements of the Skyscraper Curse story, there are certain deviations among the empirical papers. Thornton (2005) describes the Skyscraper Curse in terms of a rate of interest in the market that deviates from the pure market-determined rate of interest—a deviation that is unsustainable. Loeffler (2011) believes that unjustified economic optimism leads to both skyscraper building and stock market overvaluation. The two agree, then, that the Skyscraper Curse is brought on by a temporary, passing phenomenon that must be followed by some correction, while they disagree about the precise cause. Thornton supports the case for an economic cause in the form of a distortion in interest rates while Loeffler and others support the case for a psychological cause in the form of undue optimism.

So there are really two threads in the literature regarding the skyscraper curse. Lawrence (1999), Thornton (2005), Kaza (2010)

Thornton (2014), Engelhardt (2015) and Engelhardt and Thornton (2015) all rely on the notion of a distortion of interest rates and the resulting monetary and credit expansion to explain the connection between record-breaking skyscrapers and economic crises. The other thread involves various psychological explanations, including Barr (2010) "builder competition" which involves ego and social status, Loeffler (2011) "over optimism," Barr (2012) "height competition," Barr (2013) "height race and strategic interaction." Lawrence, Thornton, Kaza, and Engelhardt provide no hard evidence, only connections to the obviously low rates of interest and credit expansion. In contrast, Barr and Loeffler do provide hard evidence to back their stories of pop psychology. No matter who is right, the primary point is that both sides basically agree that there is some kind of distortion that helps correlate skyscraper construction with significant economic turns of the business cycle.

The one paper that does appear to openly quarrel with the existence of the Skyscraper Curse is Barr et al. (2015), which concludes that there is no curse. There are two primary points that would suggest their opposition to the curse. First, they show that the date of announcements and openings for record-setting skyscrapers do not empirically fit the pattern of changes in GDP growth. Second, they show that skyscrapers do not (Granger) cause economic crises and that both are part of a common trend i.e. cointegrated. However, a reinterpretation of Barr's work can allow it to support the existence of the Skyscraper Curse.

First, Barr (2013) suggests that skyscraper building is a combination of ego and economics—but that ego appears to only be unleashed when economic conditions are right. This lines up well with Thornton (2005)'s pro-Skyscraper Curse argument. When interest rates are artificially lowered because of credit expansion, skyscraper building is unleashed. In the end, skyscraper builders overestimate the value of height, an idea supported by Engelhardt (2015). Low interest rates also decrease the cost of pursuing social status. So, Barr's observations in this regard are supportive of the Skyscraper Curse.

Second, there is no particular reason that announcement, record setting, or opening dates should have a specific, precise relationship with business cycle peaks. There is no theoretical reason offered by Lawrence (1999) or Thornton (2005) that any of these dates can serve as a variable in a regression, for example. Skyscraper building is, at best, imprecise in its timing. All major construction projects are subject to idiosyncratic variations arising from work stoppages, regulatory delays, accidents, fires, and so on. The Skyscraper Curse is imprecise by nature. While this imprecision may invalidate (or at least complicate) statistical testing of the Curse, it does not invalidate the underlying logic of the Curse. So, Barr's observation that there is no strict correlation between these dates and business cycle peaks does not invalidate the existence of the Skyscraper Curse. The problem of using announcement and opening dates in this type of analysis is discussed more fully in Engelhardt and Thornton (2015). Thornton (2014) shows that groundbreaking and topping off dates are more relevant dates than announcement and opening dates.[5] The reader can compare the relationship between announcement, record breaking, and opening dates of record skyscrapers with historic economic crises in Table 1 below.

[5] Thornton (2014) claims that ground breaking dates should be used as for a "skyscraper alert" for future economic trouble and that record-breaking dates should be used for "skyscraper signals" that suggest economic danger is imminent.

Table 1

Building	Announcement	Record Completion	Opening	Economic Crisis
Auditorium Building-Chicago		1889		Baring Crisis—Panic of 1890
Pulitzer (New York World)	Jun 1889	1890	Dec 1890	Baring Crisis—Panic of 1890
Masonic Temple-Chicago		1892		Panic of 1893
Manhattan Life	Feb 1892	1894	May 1894	Panic of 1893
Park Row	Mar 1896	1899	Apr 1899	No Crisis
Singer Building	Feb 1906	1908	May 1908	Panic of 1907
Metropolitan Life	Jan 1907	1909	Jan 1910	Panic of 1907
Woolworth	Jul 1910	1913	Apr 1913	World War I 1914
40 Wall Street	Mar 1929	1930	May 1930	The Great Depression
Chrysler	Oct 1928	1930	Apr 1930	The Great Depression
Empire State	Aug 1929	1931	Apr 1931	The Great Depression
World Trade Towers	Jan 1964	1970-1971	Dec 1970/ Jan 1972	Bretton Woods-Stagflation, Au standard
Sears Tower	Jul 1970	1973	Sep 1973	Bretton Woods-Stagflation, Au standard
Petronas Towers	Aug 1991	Mar 1996	Sep 1999	Asian Financial Crisis
Taipei 101	Oct1997	2004	Dec 2004	Asian Financial Crisis—Tech Bubble
Burj Khalifa	Feb 2003	Jul 2007	Jan 2010	The Great Recession

Third, Barr et al.'s (2015) work suggests that in terms of Granger causality (which is designed to establish timing rather than true causality in a scientific sense), increases in GDP Granger-cause building height. That is: economic booms begin before buildings begin increasing to record heights. Because of this, it is unreasonable, according to them, to suggest that the building of record-setting skyscrapers causes economic crises. However, this observation is perfectly consistent with the Skyscraper Curse. The Curse suggests that both skyscraper building and unsustainable economic booms are caused by the same underlying phenomenon: artificially low interest rates that fuel unsustainably easy credit conditions. It is, in fact, no surprise that, on average, economic booms precede increased building height in time. Buildings—skyscrapers especially—take a great deal of planning before they can be undertaken. This planning creates a lag between the initial cause (the low interest rates) and the effect (record-breaking skyscrapers). This lag may certainly be longer than the average lag for many or most interest-rate sensitive businesses. Those industries that can respond to interest rates more quickly do so—leading to the beginning of the boom. Those that can only respond more slowly—like skyscraper construction—only respond with a substantial lag.

How then can we explain the apparent disagreement? One possibility is that the seeming disagreement comes from an underlying methodological difference between the proponents of the Skyscraper Curse and those who deny it. The proponents—Lawrence (1999) and Thornton (2005) especially—rely on an underlying explanatory logic, and accept that any attempt to use data to make precise predictions about the onset of a crisis are likely doomed to failure. The connection in the timing is, by nature, imprecise. Record-breaking skyscrapers are unique events, and the timing of any particular date (announcement, record-setting, or opening) in relation to the larger business cycle is going to be imprecise, especially as the building of the skyscraper has no direct causal connection with the crisis. Much like the canary in the coal mine serving as indicator of toxic air conditions in a mine, skyscrapers can indicate that the economy has experienced an unsustainable credit expansion that must reverse itself in an economic downturn. Unlike the canary, skyscraper construction takes a long time to respond to economic conditions, and takes a long time to complete—and both of these lags allow for idiosyncratic variations. These variations, however, do not invalidate the underlying logic.

Those who deny the existence of the Skyscraper Curse tend to rely heavily on the necessity of data to show its existence. This method faces serious challenges for some reasons already described. First, the timing of skyscraper construction is influenced by many factors other than the phase of the business cycle. Second, record-breaking skyscrapers in particular provide only a very small sample size. Thus, we see that Barr, et al. (2015) only has 14 examples of record-breaking skyscrapers with which to test the prediction hypothesis—as a result, any statistical test is likely to be underpowered, and they simply note that there is a wide range of lags between skyscraper announcement and opening dates and business cycle peaks and troughs. But, simply looking at the range of a data set only tells us that the relationship is affected by factors outside those being considered or that the quantitative relationship is not perfectly constant. But, proponents of the Skyscraper Curse do not claim that skyscraper records are the cause of the business cycle, nor do they claim that the relationship is going to be quantitatively constant.

That said, to provide some kind of statistical evidence to call into question the work of Barr et al. (2015), we provide some very simple statistical evidence on the odds of being in a NBER-declared recession 12 months after a record breaking skyscraper on Table 1 was completed. The concerns that this evidence hopes to answer are threefold: (1) By considering months rather than skyscrapers, the sample size increases substantially—from 16 skyscrapers to 1510 months, allowing statistical approaches that Barr et al. (2015) could not use. (2) By considering only record breaking skyscrapers, this work is more true to the Skyscraper Curse's claims than Barr et al.'s (2015) Granger-causality tests using average construction height. (3) By allowing a reasonably long window of 12 months, the test does not assume a specific number of months passing between skyscraper completion and recession. (So, we are testing the idea that, after skyscraper completion, the economy will be in a recession some time during the next year—not that the recession will start exactly 12 months after the skyscraper is completed.)

For our data, we constructed two dummy variables. The first took the value of one if the NBER considered that month to be part of a recession, and zero otherwise. The second took the value of one if there was a record-breaking skyscraper completed in that calendar year, and zero otherwise. In performing the analysis, each month's values were based on the current recession dummy and the skyscraper dummy from 12 months prior. (So, a value of one in March 2008 indicates that a record-breaking skyscraper was completed at some point in 2007.) These dummy variables were used to divide every month from January 1890 through October 2015 into one of 4 categories: (1) No skyscraper, no recession, (2) No skyscraper, recession, (3) Skyscraper, no recession, (4) Skyscraper, recession. If the Skyscraper Curse were strictly true, then sets 2 and 3 would be entirely empty. However, recall that the Skyscraper Curse claims to predict major financial crises—not necessarily every recession. Rather than attempt to define what constitutes a "major financial crisis," we simply point out that the Skyscraper Curse would just predict that recessions are more likely following skyscraper construction than not following skyscraper construction.

Table 2

	Skyscraper Completed (Lag)	No Skyscraper Completed (Lag)	Totals
In Recession	108	304	412
Not in Recession	84	1014	1098
Total	192	1318	1510

Table 2 summarizes the results. To check for a significant difference in the odds of a recession following skyscraper construction, we can do a simple comparison of the proportions involved. In months shortly after a record breaking skyscraper was constructed, there is a 56.25 percent chance of being in a recession. In months that are not shortly after a record breaking skyscraper was constructed, there is a 23.07 percent chance of being in a recession. This difference of 33.18 percentage points has a z-value of 8.82 in the comparison of these proportions—so this difference is statistically significant. Subjectively, though, this difference seems to be not just statistically significant, but economically so. After all, the months following skyscraper construction have a more than 50 percent chance of being in a recession. Those not following skyscraper construction have a less than 25 percent chance. On a pure forecasting basis, it seems that knowing that a record-breaking skyscraper was built in the previous calendar year can significantly increase the odds of a correct recession forecast.

One substantial caveat to this result: Here, skyscrapers were used to predict the existence of a recession—not the onset of a recession. If we attempted to forecast the onset of a recession, we would again run into a possible small sample problem, as there have only been 26 recessions (and therefore 26 first months of recessions) in that time. Preliminary work using a "first month of a recession" dummy suggests a positive, but not statistically significant, relationship between skyscraper construction in the previous calendar year and the first month of a recession. However, the small sample size suggests that the insignificance could be driven by this test simply being underpowered. That is, even if the relationship exists statistically, the sample size is too small to provide the degree of confidence needed to establish that relationship.

A second caution: there is obviously substantial autocorrelation in the dummy variables. Obviously, February in a calendar year in which a skyscraper is completed follows January of that same year. Also, months in which there are recessions tend to be followed by months in which there are recessions. As a result, some of the strength of this relationship may be the result of autocorrelation. To get around this problem, we performed a very rough Granger-causality-style test using the dummy variables. These are the results:

$$\text{Recession}_t = \underset{(3.5658)}{0.0199} + \underset{(3.3215)}{0.0478}\ \text{Skyscraper Dummy}_{t\text{-}12} + \underset{(84.0972)}{0.9048}\ \text{Recession}_{t\text{-}1}$$

Numbers in parentheses are t-statistics from the regression. So, while the economic significance of the skyscraper dummy is diminished once recession inertia is accounted for, the skyscraper dummy does show a positive and statistically significant impact on the odds of a recession. This result is held up against that of Barr et al. (2015), where they showed that height does not Granger-cause output. Here, we show that the building of a record-breaking skyscraper does Granger-cause recessions. How do we reconcile these two results? Simply put: Barr et al.'s results are affected by all construction—not only record-breaking skyscraper construction—and are also impacted by the severity of the business cycle. Ours only considers record-breaking skyscraper construction and the existence of a recession—regardless of its severity. If we believe that height generally increases over the business cycle, but that record-breaking skyscrapers precede crises, then a Barr et al (2015) style analysis will find almost no Granger-causality—as the years in which record-breaking height does predict a downturn will be counterbalanced by the (more common) years in which height is gradually increasing over the course of a boom (or decreasing through a recession).

Once we set aside demands for a precise statistical relationship, however, we can see a great deal of agreement between the papers dealing with the Skyscraper Curse. This relationship can even be found by loosening the relationship that is being considered. For the most part, skyscraper building can be understood as profit-maximizing—and the profit-maximizing height increases during economic booms. This does not deny the possibility that economic booms may induce psychological motives other than profit—like ego and height competition—to increase the height of buildings.

CONCLUSION

The debate surrounding the Skyscraper Curse has raged around two issues. First, there is substantial theoretical disagreement regarding the underlying causes of the Curse which reflect the underlying theory of construction. Some (Lawrence (1999), Thornton (2005), Engelhardt (2015), Barr et al. (2015)) present skyscraper construction as being primarily a profit-maximizing enterprise. Thus, the Skyscraper Curse would arise if economic conditions arose which simultaneously made skyscraper construction profitable and sowed the seeds of an unsustainable boom. Others (Loeffler [2011], Barr [2012, 2013]) allow more room for psychological factors in skyscraper construction. In this case, the Skyscraper Curse would arise if the same psychological factors that lead to overvaluation in asset markets also lead to skyscraper construction.

Second, there is the question whether something like the Skyscraper Curse exists empirically. That is: can skyscraper construction be used for economic forecasting? Lawrence (1999), Thornton (2005, 2014), and Loeffler (2011) all suggest that the answer is yes. Barr et al. (2015) suggest that the answer is no. Rather than building height predicting output, output predicts height. We provide new evidence that, by sacrificing a certain degree of precision (regarding the depth of recessions), the completion of record-breaking skyscrapers do predict recessions one year later—though the test used here does not distinguish between the onset or the continuance of a recession.

The debates surrounding the Skyscraper Curse draws out an important fundamental point: forecasting turns in the business cycle is—and will continue to be—art as much as science. There will always be a role for entrepreneurial judgment. However, having an understanding of the underlying theory allows one to interpret the signs that surround us. Included among these signs: skyscrapers, which serve all at once as a monument to the successes of the past and as a harbinger of the suffering that is to come.

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