

## **A Price Index for Residential Real Estate from 1866-1953 in Baltimore**

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### **Abstract**

This paper introduces the first repeat sales index of US residential real estate prices in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries. The index reveals greater price declines during the 1890s and 1930s than scholars have previously described, and higher leverage as well. During the Great Depression in particular, while previous data suggest most borrowers should have been able to retain positive equity, I estimate that about 28 percent of residential mortgage borrowers had negative equity by 1932, and more than one in four such borrowers experienced foreclosure.

## 1. Introduction

The 2007-2009 financial crisis has demonstrated the need for more historical perspective on housing prices. Prior to the crisis, even such a luminous figure as Ben Bernanke asserted “We've never had a decline in house prices on a nationwide basis.”<sup>1</sup> Lenders, rating agencies, and regulators doubted the possibility of such a decline, and as a result badly under-predicted the extent of defaults that subsequently occurred (Gerardi, Lehnert, Sherlund, and Willen 2008).

In this paper I construct the first repeat sales index for US house prices in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, covering the city of Baltimore MD from 1866 to 1953. The index shows two significant declines in housing prices, in the 1890s and 1930s. Both of these episodes are major turning points in the history of the US mortgage market, associated with a large wave of defaults, wholesale changes to the composition of lending institutions, and in the 1930s a sweeping government response.

I estimate the price decline during the 1890s to be about 18 percent. In contrast, the price estimates typically used by economists, constructed by Grebler, Blank, and Winnick (1956, henceforth GBW), show basically no change in this period. During the Great Depression, I estimate a decline of 45-50 percent, compared to the 25-40 percent estimates of GBW and Fishback and Kollman (2013, henceforth FK). I thus confirm the longstanding conjecture of economic historians that the data underlying GBW and FK studies yield biased price estimates. Economists have extensively used the GBW series to examine the impact of house prices on other economic outcomes, such as Jorda, Schularick, and Taylor (2015) and Giesecke, Longstaff, Schaefer, and Strebulaev (2014).

The results help resolve a puzzle regarding the Great Depression housing market in particular. Foreclosures were widespread during the Depression even though previous estimates of prices and leverage suggest that most borrowers should have been able to retain positive equity. Indeed, in addition to finding larger price declines than previously estimated, the data show higher leverage than most accounts of this period have described. From the late 19<sup>th</sup> century through the 1920s, the median loan-to-value ratio among mortgage borrowers at origination was about 75 percent, and borrowing reached as much 90 or 100 percent of value, often on a single mortgage. In contrast, previous accounts of this period have described total borrowing as capped at around 80 percent at most, with first mortgages limited to 50 percent of value (Green and Wachter 2005, Postel-Vinay 2016). A back of the envelope calculation suggests that about 28 percent of mortgaged homeowners as of 1930 in Baltimore would have experienced negative equity at the trough of prices in 1932. These price declines therefore created one of the “double triggers” that economic theory suggests are necessary for default (Foote, Gerardi, and Willen 2008), with Depression-era widespread unemployment satisfying the other trigger. Indeed, the data show foreclosures among more than one in four of such borrowers estimated to negative equity.

Regarding external validity, Baltimore’s price developments are likely to represent a middle of the pack outcome compared to other cities. Its housing market was fairly typical, with average levels of construction and homeownership growth during the 1920s and foreclosures during the 1930s, statistics that are well correlated in the cross-section of cities with existing house price data (Brocker and Hanes 2014). Baltimore itself ranked between the 6<sup>th</sup> and 8<sup>th</sup> largest cities in the United States during the period under study. The conclusion discusses external validity in more detail.

## 2. Literature: previous price estimates

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<sup>1</sup> CNBC interview, 2005

The GBW index is the most widely used index of historical house prices. This index is derived from the 1934 Financial Survey of Urban Housing, which asked homeowners in a sample of cities (not including Baltimore) to estimate the values of their houses as of 1934, and to report the prices paid for their houses when purchased. By comparing the 1934 value with the purchase price, GBW created an index from 1890 to 1934. Fishback and Kollman (2013) subsequently found data from the same survey for additional cities, and report an augmented GBW-style index. These indexes estimate peak-to-trough price declines of 27-30 percent, and slightly less if an *ad hoc* depreciation adjustment is applied.

The Financial Survey of Urban Housing data have shortcomings. First, the survey necessarily excludes homeowners who no longer owned their homes as of 1934, because of foreclosure for example. As a result, the survey will understate price declines if homeowners with the most severe declines foreclosed before 1934, which is likely. Second, though the comparison of 1934 prices with purchase prices somewhat resembles a repeat sales index, the index was actually constructed using city-level averages of purchase prices per year, effectively weighting properties by their values and creating bias if lower-valued properties had bigger price declines.<sup>2</sup> Third, homeowner systematically overestimate the value of their properties (Agarwal 2007).

Fishback and Kollman also report results from an alternative source of price information, a survey of real estate professionals regarding the extent of price declines from 1929 to 1932-1936, depending on the time of the survey in each city. The data provide a valuable alternative perspective on house prices, but since they are the subjective opinions of real estate professionals and since the estimates tend to be round numbers, they are likely imprecise. In addition, the data give a range (consisting of a lower-end estimate and an upper-end estimate) for each date, rather than an estimate of the central tendency. These data suggest a greater decline from 1929 to roughly 1932-1936 of around 35-40 percent. For Baltimore, these data show a 36-38 percent decline from 1929 to 1933-1935, with a substantial recovery so that by 1937 the decline is only about 20 percent.

After 1934, the only available measure of prices comes from Shiller (2005), who compiled data on five cities from 1934 to 1951 using list prices in newspaper advertisements. The quality of the measurement resulting from these data is likely poor: the data may not reflect actual sales prices, there is no adjustment for changes in the composition of houses being sold, and the sampling methodology (described as the selection of 30 list prices per year per city) is unlikely to create a representative sample.

Finally, in contemporaneous work, Lyons (2018) uses a hedonic model to create a price index using newspaper-listed prices from several cities in the United States from 1890 to 1990. The upside of this method is the ready availability of data from newspaper advertisements, and the ability to observe quality attributes if included in the advertisements. The challenges of using newspaper listings are the uneven availability of quality attributes, whether list prices reflect actual sales prices, and whether newspaper-listed properties are representative.<sup>3</sup>

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<sup>2</sup> GBW state “a relative for each year was calculated for each city, based on the ratio of the total acquisition cost of the single-family owner-occupied houses acquired in each given year in a given city to their value in 1934. The median relative for each year was then determined” (page 346).

<sup>3</sup> Other measures of prices in this period include Garfield and Hoad (1937) who also use the *Financial Survey of Urban Housing* data to create price indexes for Cleveland and Seattle from 1907 to 1930; Wyngarden (1927) and Fisher (1951), who use list prices to create price indexes for Ann Arbor, Michigan from 1913 to 1925, and Washington, DC from 1918 to 1947, respectively; and Nicholas and Scherbina (2012) who create a hedonic price index for Manhattan from 1920 to 1940, but their data mostly cover commercial real estate, not 1-4 family housing.

Outside of the United States, scholars have produced high quality historical price indexes for several countries, all using repeat sales methods. Eitheim and Erlandsen (2004) produce a repeat sales index for four cities in Norway from 1819 to 1989; Conseil General de l'Environnement et du Developpement Durable (2013) produces a repeat sales index for Paris from 1870 to 1935 and nationwide in France from 1936 onwards; Söderberg, Blöndal and Edvinsson (2014) and Bohlin (2014) produce repeat sales/appraisal indexes for two cities in Sweden from 1875-1956; and Eichholtz (1994) produces a repeat sales index for 1628 to 1973 covering buildings on a single canal in Amsterdam. To the best of my knowledge, no other country has a repeat sales or hedonic index available for the period before 1950. Thus, while Knoll, Schularick, and Steger (2017) use house prices for 14 countries since 1870, the data for the remaining countries are measures of average or median prices.

### **3. Data**

#### *Sampling*

The dataset was hand collected from the municipal land records of Baltimore City, Maryland. Such land records exist throughout the US in local government facilities in order to allow for the tracing of a property's chain of title, and to verify the existence or absence of any liens on a property. The data capture all sales of the sampled properties from the time of their construction, as early as the 1860s or before, to 1953. All of the houses sampled are single-family properties, and may be occupied by owners or tenants.

The use of land records ensures the representativeness of the data. Given the large volume of records, I construct a one percent sample of 38 blocks out of the roughly 3,800 residential blocks in Baltimore as of 1930.<sup>4</sup> I use a stratified sample in order to ensure the sample captures geographic areas with different housing market characteristics. For the stratification, I cross-reference the municipal block map of Baltimore with a "residential security map" produced in 1935 by the Home Owners' Loan Corporation (HOLC) in conjunction with the advice of local realtors, lenders, and other real estate professionals. The map divides the city into four "security grades" based on the willingness of lenders to finance homes in those neighborhoods. In using this map, I must acknowledge the history of racism it embodies; my use here is to ensure proportionate representation of all neighborhoods, including those redlined.

Because the sampling takes place in the 1930s, the sample likely becomes less representative as time moves away from that decade. After the Great Depression, there was relatively little new construction in Baltimore until the second half of the 1940s when a major increase in construction activity occurred, and thus the sample may under-sample newly constructed houses from the post-war period. However, given the nature of repeat sales indexes, such houses would likely not transact twice in the sample period anyway. Before 1930, construction activity was significant during the 1920s in particular. As a result, the number of properties in the sample shrinks going back in time.

Geographically, Baltimore City contains both urban and suburban housing. By focusing on Baltimore, the sample does not miss much suburban housing in the surrounding area until the late 1930s and 1940s, when suburban development outside of Baltimore City became much more common. Still, by 1950 the population of the surrounding Baltimore County was only 22 percent of the population in the city.

#### *Price data details*

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<sup>4</sup> The sampling is done by block rather than by household as sampling by blocks yields enormous economies of scale, as the indexes needed to track properties over time are grouped at the block level.

Regarding the price data, Maryland required disclosure of sales prices until 1905, but not after. Indeed, nondisclosure of prices is a practice that continues in some states to this day. After 1905, in some cases prices were still reported, either voluntarily or because certain transactions still required price disclosure, such as sales overseen by a court for the administration of an estate or for a foreclosure. In addition, for several years after 1905 many ordinary deeds still include price information even though it is not required, but this practice fades. If no price is available, I use two sources of price information to fill in the gap.

First, federal excise tax payments were required from December 1914 to March 1926 and from July 1932 through the end of the period under study. The tax took the form of a step function, increasing for each \$500 price increment. As a result, a tax payment of, say, \$2.50 indicates that the price was between \$2,000 and \$2,499. I take the midpoint of these \$500 ranges as estimates of the prices. From 1937 to 1947, Maryland's excise tax yields more precise estimates, as it required an additional stamp for each \$100 price increment.

Second, for the remaining observations without observed prices or excise payments, particularly from 1905 to 1914 and 1926 to 1932, I use concurrent mortgage loans to estimate transaction prices. Unfortunately, this means that transactions without the use of credit in these years usually have no price information of any kind and cannot be included. Using credit data requires an assumption about the ratio of loans to sales prices. As a baseline, I calculate the median leverage for the period before 1905 and from 1914 to 1926 by type of lender, and use that data to estimate purchase prices for the 1905-1914 and 1926-1932 periods, respectively. The accuracy of the results varies, since borrowers' actual leverage may have differed from the average leverage. As an alternative, I restrict the sample to transactions with two or more mortgages, which likely indicates that homeowners borrowed the maximum amount possible. Indeed, the data show a much tighter distribution of leverage for transactions with multiple mortgages compared to a single mortgage.

Overall, prices up to 1905 are predominantly from direct price reports; prices from 1914 to 1926 and 1932 to 1953 are predominantly estimated from excise tax payments; and prices in the remaining periods from 1905 to 1914 and 1926 to 1932 are predominantly estimated from financing.

I also adjust prices for an unusual feature of the Baltimore housing market, leaseholds. To this day, it is common in Baltimore for properties to be owned subject to long-term leases (99 years with the option to renew, and therefore indefinite in practice). In 1930, about three-fifths of properties in the data were owned as leaseholds. Leasehold properties naturally transact at lower prices compared to fee simple properties (i.e. owned outright not subject to a lease). Because leaseholds are redeemable, the data contain properties that were transacted at different points in time as both leasehold and fee simple properties. To allow for homogenous comparisons of such transactions, I adjust all leasehold prices to be on a fee simple basis. This adjustment is relatively straightforward as state law mandated a six percent capitalization rate for redemptions.

#### *Data restrictions*

I exclude transactions that cover multiple properties or partial interests in a single property. I also exclude transactions from the culmination of sales contracts, since the final purchase price does not represent the entire amount paid for the property, as the previous payments are unobservable. The raw data contain

8,019 transactions, but implementing these restrictions leaves 6,879 observations, about 70 percent of which have price information.<sup>5</sup>

Finally, the index is biannual before 1890, given smaller numbers of observations in those years.

#### 4. Repeat sales index construction

This paper uses a repeat sales index. The advantage of using such an index is the ability to control for time-invariant quality attributes, which are often hard to measure. The disadvantages are that the index does not control for time-varying quality, and that properties transacting only once are excluded.

The estimation takes three stages, following Bailey, Muth, and Nourse (1963) and Case and Shiller (1987). In the first stage, the regression takes the following form:

$$r_{i,t,t'} = \sum_{s=1866}^{1953} \beta_s D_s + u_{i,t,t'}$$

In this equation,  $r$  is the log ratio of the pair  $i$  of sales prices for the same house at dates  $t$  and  $t'$ ;  $D_s$  equals 1 if  $s = t$ , -1 if  $s = t'$ , and 0 otherwise; and  $u$  is the error term.

In the second stage, I estimate weights to address potential heteroskedasticity, as observations with long gaps between transactions likely have larger errors. To compute the weights, I regress the squared error terms from (1) on the time gap between transactions, using both a linear specification of the gap (as suggested by Case and Shiller 1987) and a quadratic specification (as suggested by Abraham and Schuman 1991). I find this choice has little effect, and use the linear specification as the baseline.

Finally, in the third stage I re-estimate the model from the first stage using the weights estimated in the second stage, and compute the price index  $I_t = 100 \times \exp(D_t)$ .

Since main purpose of this index is to help understand the equity position of individual home owners, I do not adjust the index as suggested by Goetzmann (1992) to estimate an approximate arithmetic mean. I view the geometric mean as the appropriate measure for understanding the compound growth rates relevant for individual homeowners.

#### 5. Results

Figure 2 shows the baseline estimate of the price index. The index shows two significant declines in prices, during the 1890s and during the 1930s.

The 18 percent decline in house prices took place during and after the Depression of 1893. This depression is less well known to modern economists compared to the Great Depression of the 1930s, but it was severe and led to large disruptions in the real estate sector (Bodfish 1931, Hoyt 1933). Davies (1958) describe a persistent “psychological hangover” that led development and prices to stay depressed until around 1908. Indeed, this index shows prices not recovering for about 15 years, and nonfarm housing starts were also depressed for a similar time period. Among lending institutions, the Depression

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<sup>5</sup> Price information may be missing for a variety of reasons. Intrafamily transfers are common and typically were at no price. Deed-in-lieu of foreclosure transactions from borrowers to their lenders also typically carried no price. Price information is also missing in particular from 1905 to 1914 and 1926 to 1932, when no excise taxes were required.

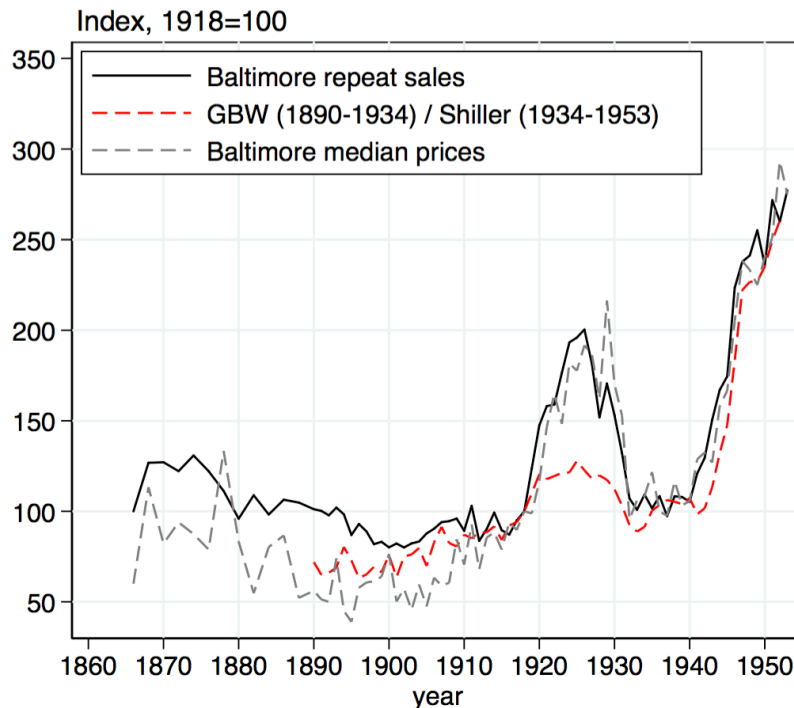
led to a collapse of a set of institutions known as “National” building and loans, and ended a wave of securitization (Snowden 2013).

Prices rose considerably following World War I. This is typically attributed to a combination of pent-up demand from war-time construction restrictions, along with strong economic growth in the 1920s. According to this index, prices peaked in the years 1924 to 1926, and began falling well before the onset of the Great Depression in 1929. Indeed, by 1929 the price index had already declined about 25 percent from peak, and by the mid-1930s had declined about 50 percent in total. The resulting disruptions in the residential real estate sector have been researched extensively in the past several years.<sup>6</sup>

Finally, prices show no meaningful recovery until the onset of World War II, which reduced housing supply by restricting building materials, and also marked a major economic mobilization.

In comparison with the GBW-Shiller index, and a median price series using the Baltimore data intended to mimic the Shiller post-1934 data. The GBW-Shiller index estimates a much smaller increase in prices during the early 1920s of a little less than 30 percent, and similarly estimates a smaller decline thereafter. These differences may reflect a bias in the GBW index from including only homeowners who owned their houses as of 1934 and therefore likely experienced milder price declines. The Shiller data on median prices (1934 and after) show a small bounce back of prices after the first half of the 1930s which the Baltimore data do not show. These data also show a similar increase in prices during World War II.

Figure 1: Price index for Baltimore residential real estate



<sup>6</sup> Fishback, Rose, and Snowden (2013), Field (2014), White (2014), Gjerstad and Smith (2014), Ghent (2011)

The figure also displays median sales prices for each year for the data underlying the Baltimore index. Compared to the repeat sales index, median prices increased significantly more from 1900 to 1930, suggesting that the average quality of housing increased in this period.

## 6. Robustness

In this section I report the results from estimating the index under a variety of different restrictions and assumptions to test for robustness of changes over certain key periods. Table 1 summarizes the results of the different resulting indexes during those periods.

Table 1: Results from alternate specifications

	Percent change		
	1892-1900	1918-1926	1926-1933
Baseline Specification	-18.1	100.4	-49.7
<i>Alternate Specifications</i>			
1. Omit foreclosures	-19.2	99.6	-48.7
2. Use only multi-loan financing estimates	-20.1	111.7	-50.3
3. Median regression	-13.3	97.4	-51.3
4. Use only transactions with financing	-15.1	99.1	-43.4
5. Use excise tax equivalent prices	-15.7	93.8	-46.9
6. Use quadratic specification of weight estimates	-18.4	100.7	-49.8
7. Index with age effects taken out	-4.7	128.8	-39.3

1) *Foreclosures*. Foreclosed properties differ from typical market transactions, and may not reflect the market price between two ordinary market participants. To understand the impact of these transactions on the index, I re-estimate the index omitting such transactions.

2) *Precision of estimates from single mortgage financing data*. Some of the prices underlying the index are estimates based on financing in periods when no direct price information is available. These estimates have measurement error since loan-to-value ratios varied widely. I have re-estimated the index using only financing estimates in which two or more mortgages were taken out by the borrower. Such transactions have a much tighter loan-to-value distribution in the data and therefore likely provide a more precise price estimate, with fewer down-side errors for transactions with low amounts of leverage.

3) *Sample selection due to the use of financing data*. Transactions with financing may be systematically different than transactions without financing, and therefore the index may be biased in the years when most of the prices are estimated from financing. To test for this, I have re-estimated the index using only observations in which financing was used by the buyer, whether direct price information is available or not.

4) *Non-OLS estimators*. Bourassa, Cantoni, and Hoesli (2013) note that estimating repeat sales indexes with OLS makes the coefficient estimates vulnerable to outliers, and suggest a few more robust estimators, including a quantile regression.

5) *Precision of excise tax information*. For the latter half of the data, most of the direct price information comes from excise taxes, which are somewhat imprecise. To gauge the impact on the data, I estimated the entire index with an alternate version of the data in which all direct price observations were converted to their excise stamp equivalent prices.



6) *Quadratic weights*. In the second stage of the estimation, I estimate the baseline weights using a linear specification of the time gaps between observations, as noted above. In an alternate specification, I use a quadratic specification.

7) *Depreciation*. Repeat sales indexes control for time-invariant quality within a property, but do not account for time-varying quality attributes. Thus, depreciation could impart a downward bias, offset to some extent by new investments. In the extreme, a property might be rebuilt completely, though this was not common in this period of Baltimore's history.<sup>7</sup> I do not have much if any information on time-varying quality for which I can directly control. However, the date of construction is available, and I can estimate the model suggested by Cannaday, Munneke, and Yang (2005), which separately controls for age and time.

Table 1 reports key statistics from the price indexes resulting from each of these alternative specifications. Overall, the price changes remain fairly steady across these specifications. The price change from peak-to-trough during the Great Depression, for example, remains at around 45-50 percent across the specifications. One exception is the depreciation-adjusted index, which ascribes all of the price decline in the late 19<sup>th</sup> century to an age effect, and in fact shows a small increase from the pure price effect in that period.

#### *Late 1920s Sensitivity*

The price index is sensitive in the late 1920s to two factors that together can affect the path of prices in this period. The first is the inclusion of foreclosure observations, which average about 13 percent of observations from 1926-1930 (and peak later at nearly 40 percent in 1933). The second factor is the use of price estimates based on single mortgages in the period from April 1926 to June 1932, the period when transfer taxes were repealed and therefore direct price observations are unavailable on most transactions in that period. As noted above, some price estimates based on single mortgage estimates are likely too low if leverage is substantially lower than the average used for price estimate. Excluding foreclosures alone or excluding single-financing observations alone has little effect, but excluding both types of observations materially changes the path of prices in the late 1920s. Specifically, excluding both types of observations leads to only a modest decline in prices from the peak of prices in the mid-1920s to 1929, as displayed in Figure 2. After 1929, the path of prices declines quickly to reach a trough in 1932 regardless of the inclusion of these types of observations.

A number of factors suggest that house prices declined beginning in the mid-1920s, well before the onset of the Great Depression.

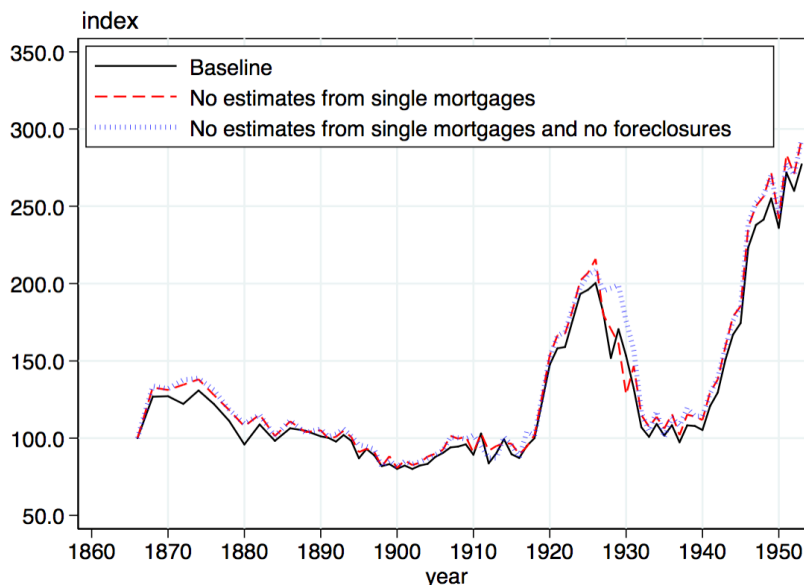
First, the rise in foreclosures, noted above, is a source of downward pressure itself and also a sign that borrowers were no longer enjoying the escape valve of rising equity positions from price increases. Second, building permits peaked in 1925 in Baltimore—and around that date in most other cities as well—and had dropped almost 50 percent in Baltimore already by 1929. Third, a short-lived securitization wave showed signs of significant pressure and winding down well before the Depression, a result of the inability of the securitization companies to raise additional funds from investors in response to rising losses from defaults. Rose (2017) describes how National Surety, an insurance company that guaranteed MBS issued by mortgage companies, ceased this line of business in 1928 in response to rising loss rates, and how several of those mortgage companies then quickly went out of business. Indeed, some of these companies operated in Baltimore, such as Chesapeake Mortgage Company and Sun Mortgage

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<sup>7</sup> One account dating to 1935 stated that “no house has ever been torn down to make way for another single residence” (HOLC Papers, Baltimore Survey, page 8).

Company, both of which largely ceased writing new mortgages by 1928 according to the city land records. Snowden (2010) describes the volume of new MBS issues as falling dramatically in 1929.

Figure 2: Sensitivity of price estimates in the late 1920s



Finally, as an additional experiment, I incorporate data from the 1930 census, which asked owner-occupants to report their assessments of the value of their houses. These data provide another perspective on house prices, and also an opportunity to test the bias that could result from using self-assessed values, as in the GBW index. Including these 1930 self-assessed values in the repeat sales index leads to a much higher estimate of 1930 prices, about 15 percent higher than the repeat sales index, and only a small 10 percent decline in prices from peak in 1924-1926.

Overall, the exact path of prices from 1926 to 1932 remains somewhat unclear, though the beginning and end points are much clearer. Indeed, the extent of the decline in prices from the mid-1920s to the mid-1930s is largely unchanged by these robustness checks, as is the path of prices in the 1930s.

## 7. Leverage

Previous scholars have generally described leverage in this period as relatively low. For example, Green and Wachter (2005) state that before the Great Depression “home mortgages typically had very low loan-to-value ratios of 50 percent or less.” Jaffee (1976) describes “prudent upper bounds on loans at somewhere between 50 percent and 60 percent of appraised value.” Postel-Vinay (2014) notes that with second mortgages, total leverage could reach 75-83 percent.

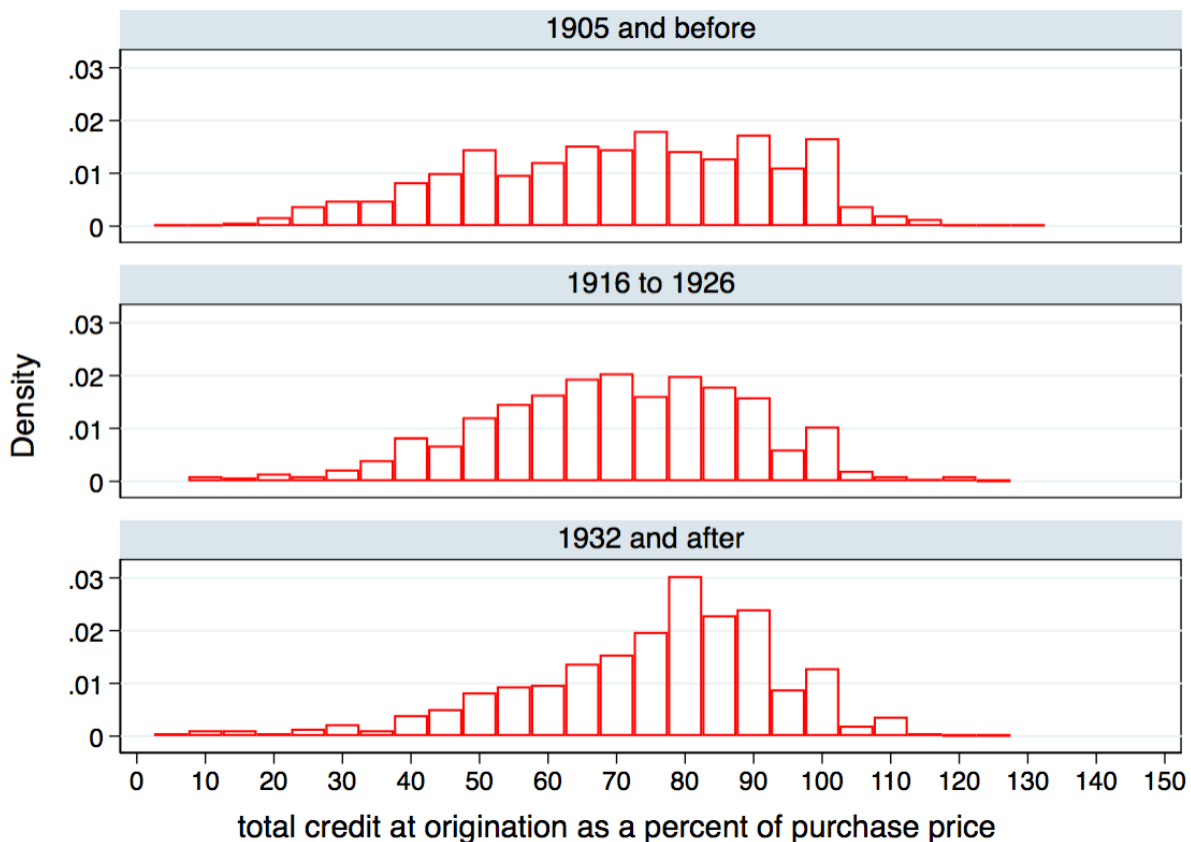
These leverage estimates, combined the price movements estimated by GBW, have led scholars to puzzle over why foreclosures occurred to any great extent during the Great Depression. Field (2014), for example, concludes that foreclosures must have been few in number: “Since loan-to value ratios rarely exceeded 50 percent in the 1920s, and the average nominal price decline between 1929 and 1933 appears to have been about 30 percent, simple arithmetic tells us that the phenomenon of underwater houses... must have been infrequent” (p. 67). Yet, national statistics suggest that foreclosures occurred on about 10-20 percent of loans on residential properties, cumulatively from 1926 to 1936 (Fishback, Rose, and

Snowden). Indeed, in this Baltimore data set, 14 percent of mortgage outstanding as of 1930 ended in foreclosure.

Existing data are likely to underestimate actual leverage. Jaffee cites a sample of loans taken by the NBER from institutions in 1947, but these data suffer from a sampling bias, since institutions that survived to 1947 may have been more conservative than lenders that failed. Postel-Vinay cites the 1934 Financial Survey of Urban Housing, which excludes homeowners who had lost their homes prior to 1934, and therefore likely understates leverage. Postel-Vinay also cites a survey that excluded building and loan associations (B&Ls). This is a problematic exclusion as B&Ls were the largest institutional source of residential mortgages in the 1920s, and also a key provider of high leverage long-term fully amortized loans.

The data from Baltimore allow for calculation of leverage at origination. Since direct price observations are somewhat limited from 1905 to 1914 and 1926 to 1931, leverage observations are also limited in those years, and likely unrepresentative given that prices were not reported for typical transactions. Therefore, Table 2 displays leverage information from the Baltimore data, but excluding those periods.

Figure 3: Distribution of loan-to-value ratios at origination



Notes: Loan-to-value ratios are measured at origination, among mortgaged properties. The data are truncated at 150 percent, excluding a handful of observations.

The data on leverage in Figure 3 shows higher leverage by the 1920s than the estimates provided by previous scholars. Indeed, for the period from 1914 to 1926, median loan-to-value ratios were around 70

percent, and a sizable portion of borrowers financed more than 83 percent maximum suggested by Postel-Vinay. Indeed, the data show little sign of a cap on loan-to-value ratios at any figure below 100 percent. The data actually show a small fraction of observations with credit totaling more than the purchase price. Overall, the distribution moves slightly upward in the period after 1932, but the previous periods show the availability of very high leverage to at least some borrowers.

## 8. Negative equity

The data in the previous section pertain to leverage at origination, but the question remains what the distribution of leverage was at any given point in time. Of particular interest is the prevalence of negative equity at the trough of prices beginning in 1932.

To estimate leverage at a given point in time requires an estimate of the value of a property and the debt outstanding. First, regarding the value of the properties in 1932, the index from this paper is well-suited for the task. For each transaction of each property, I compute a 1932-equivalent price using the baseline price index, and take the average across transactions within a property. Second, regarding the debt outstanding in 1932, this is unobservable, as debt is only observable at origination in the land records. Therefore, to estimate outstanding debt in 1932 requires making fairly strong assumptions about amortization payments. As a baseline, I assume that payments were made as required by the contracts, and I ignore the possibility of delinquent payments in the early 1930s. The latter is likely to underestimate the amount of outstanding debt; Bridewell (1938) for example finds that 40 percent of urban mortgages were delinquent at the beginning of 1934, with an average duration of delinquency of 15 months. On the other hand, it may overstate debt to assume borrowers made no optional principal payments on unamortized loans, e.g. 1-5 year balloon loans that were fairly common in the 1920s mortgage market.

Table 2: Estimated debt-to-value ratios in 1932

	101-125	126-150	151 and over	Total 101 or over
Percent of observations	15.1	6.6	6.3	28.0
Foreclosure rate in each bin	24.2	29.6	34.6	27.8

This back of the envelope calculation suggests that about 28 percent of mortgage borrowers had negative equity by 1932, as displayed in Table 2. About 15 percentage points of these borrowers were only modestly underwater, with debt-to-value ratios of between 101 and 125 percent, with the remaining 13 percentage points were more deeply underwater. For comparison, borrowers with estimated debt-to-value ratios of 100 percent or less had a total foreclosure rate of 12 percent.

## 9. Conclusions and external validity

This paper has presented the first repeat sales index for US residential housing before 1950. The index shows larger declines in house prices than previously documented during Depressions of the 1890s and 1930s. During the 1930s, these data provide ample support for one leg of the double trigger that economic theory suggests is necessary for widespread foreclosures.

The main limitation of the price index is its coverage of only one city, Baltimore. The external validity of the results, therefore, depends on the extent to which Baltimore's housing market was typical or unusual. Among US cities, Baltimore was either the 6<sup>th</sup>, 7<sup>th</sup>, or 8<sup>th</sup> largest throughout the period under study.

One way to assess whether Baltimore's price developments were unusual is to compare other characteristics of its housing market with other markets. Focusing on the 1920-1940 period in particular, Brocker and Hanes (2014) show that various housing market statistics are correlated in the cross section with house price developments as measured by the Financial Survey of Urban Housing data, either from 1920 to 1934 or 1930 to 1934. Such statistics suggest that Baltimore was a middle of the pack city. Baltimore's homeownership rate rose 4.6 percentage points from 1920 to 1930 in Baltimore, compared to a 6.4 percentage point average among major cities (with populations of 100,000 or more). Building permits from 1924 to 1926 equaled 8.9 percent of families as of 1920, compared to a 9.1 percent average among major cities. Foreclosures from 1932-1934 totaled 4.8 percent of dwellings in 1930, compared to a 4.7 percent average among major cities.<sup>8</sup>

As a result, the Brocker and Hanes results suggest that Baltimore's price developments should fall around the average as measured by the 1934 Financial Survey of Urban Housing. Yet, Baltimore's price decline from 1930 to 1934 of around 50 percent, in this index, is far above the cross-sectional average decline of 33 percent in the FSUH data, or the 27-30 percent average decline obtained by the method of GBW. Moreover, the cities in the FSUH data which show declines of at least 45 percent—Birmingham, AL, San Diego, CA, Syracuse, NY, and Wichita Falls, TX—tend to display unusual values for at least one housing market statistic. For example, San Diego recorded permits from 1924 to 1926 equaling 40.6 percent of 1920 families, far above the 8.9 percent average. Baltimore does not display extreme statistics in any of these attributes. Overall, Baltimore's relatively large price decline during the Depression compared to the FSUH data should be taken as an indication that the FSUH price data are biased, and not that Baltimore's price developments were an outlier compared to other cities.

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<sup>8</sup> Data on homeownership and the number of families come from the census; Building permits data come from the Bureau of Labor Statistics *Bulletin*; and foreclosure data come from the *Federal Home Loan Bank Review*, April 1936.

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