

# A housing price index for Stockholm 1840-2017:

## Putting new light on the “hockey stick”<sup>1</sup>

Rodney Edvinsson, Klas Eriksson and Gustav Ingman<sup>2</sup>

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### **Abstract**

The aim of this paper is to investigate the long-term development of housing and real estate prices in Stockholm. In Sweden there is an ongoing discussion whether the substantial price increases since the early 1990s are generating a new housing bubble. Recently property prices have decreased fast, which may point towards the end of the long-term increase seen in the last decades. A longer time horizon can add significant weight to this discussion. The experience of the last years shows that the lessons learned from previous crises are still relevant. A historical housing price index for Stockholm is presented for the period 1840-2017, which extend a previous index by 35 years, which puts the recent upturn in house prices in a new perspective. In real terms there have been two long upswings of similar magnitude, one by 335 percent in 1855-1887, and one by 370 percent in 1993-2017. In the other periods, real prices were stagnant or even slightly declining. This new data puts new light on the picture of a “hockey stick” in house prices, i.e. of long stagnation followed by sharp rise upward. The development in Stockholm is similar to other cities for which data exist. We also show that volatility was higher in the beginning of the period of investigation.

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<sup>2</sup> Department of Economic History and International Relations, Stockholm University, SE-106 91 Stockholm. E-mail: rodney.edvinsson.@ekohist.su.se, klas.eriksson@ekohist.su.se, gustav.ingman@ekohist.su.se.

## **Introduction**

In the last two decades a considerable increase in real estate prices in Stockholm has taken place. There is a vibrant debate in Sweden whether this increase in prices are sustainable or if they might be a sign of a price bubble. With this paper we aim at developing more knowledge to this important question by putting the last decade's price increase in a historical perspective. Our price index regards real estate in Stockholm from 1840 to 2017. However, creating a long-term price index also imply methodological challenges. We use and discuss two methods in this paper namely repeated price index and sales price ratio method. By combining these two forefront time series methods we think our index holds for robust scrutiny. Our aims are to put the last decades increase in a historical perspective and to compare, elaborate and discuss methodological problems in regards to long term price indexes.

In the next section we present previous research on historical property prices, and then the sources and methods used in this study to reconstruct house prices in Stockholm. Next follows a discussion on long term trends, international comparisons and volatility.

## **Previous research**

Although real estate prices are very well researched especially in relation to financial instability and financial crisis there are strikingly few studies which examine real estate prices over long periods of time. For Stockholm there are numerous studies that put real estate prices in various contexts and institutional settings for example Anas et al (1991), Hårsman and Quigley (1991), Lind and Lundström (2011), Johnsson (2017), Mörner (1997), Sheibans (2002), Jacobson (1996), and Perlinge (2012). However, none of these studies have attempted to reconstruct an actual long term price index.

Another important study on historical real estate prices is Robert Shiller's index on US house prices index 1890 (Shiller 2000). Swedish and Norwegian researchers has made important contributions through projects on behalf on the central banks in each country. We develop further the study of Söderberg, Blöndal, Edvinsson (2014) for Stockholm. Bohlin (2014) uses the same methods as we do but for the city of Gothenburg which is the second largest city in Sweden. Eitrheim and Erlandsen (2003) presents long term housing prices through the weighted repeat sales method in four of Norway five largest cities namely Oslo, Bergen, Trondheim and Kristiansand; the price index is presented both in each city separately and on an aggregated level.

Knoll, Schularick, and Steger (2017) compares the house price development for 14 advanced economies since 1870. They find almost no long run real price growth in the first 90 years, but

a sharp rise after 1960, creating a “hockey stick pattern”. This pattern was, indeed, also apparent in the house price index compiled by Edvinsson, Blöndal, and Söderberg (2014) for Stockholm 1875-2012. The question is whether an even longer period can add new light on this pattern. Eichholtz (1997) deviates from earlier studies in its long term approach. The study examines housing prices in Amsterdam Herengracht district where the same real estates have been at a constant quality level during all these years; which makes them exceptionally feasible for these kind of price index since changes in the standard of the real estate is a problem when creating historical price series for real estate since changes in standard naturally creates a different product. The Herengracht index is constructed with a hedonic repeated-measures index method. It is estimated in both real and nominal terms. Interesting finding here is that although real prices have increased with 3.2 percent every year, on average, since world war two, the real price was only twice as high in 1973 compared to 1628.

### **Sources and methods**

The primary sources for our price index is the so called “Lagfartsprotokoll” - which a protocol of legal sales - which are to be found in Stockholms magistrate court (“rådhusrätten”). The main source consists of these protocols.<sup>3</sup> These documents give us information about what address the traded real estate is located, whether it is on free or unfree ground, who the seller and the buyer was, what price the real estate was sold at and the date when the trading was registered. The label “unfree ground” means that the ground belonged to the city whereas the label “free ground” meant that the ground was included in the price and therefore belonged to the buyer. Free properties were therefore significantly more expensive. For the period up to 1851, there are also more accessible registers of the sales.<sup>4</sup> The technical and sanitary standard and the size of the real estate is unfortunately not present in our sources.

The sales in lagsfartprotokollen are divided in three “bids” (“uppbud”). This is a formality originated from the 14<sup>th</sup> century. If the relatives and neighbors wanted to claim the property they had to do it before there was more than three bids. The price was however always the same as in the first bid. This had no practical implications in the 19<sup>th</sup> century since the pre-emption for relatives and neighbors was then abolished, but the formality lived on even though all aspects of the sale being the same in the three bids, including the price.

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<sup>3</sup> Stockholms stadsarkiv, Stockholms magistrat- och rådhusrätt, A 6 a Lagfarts-, uppbuds, protokoll, vol. 71-85; Stockholms rådhusrätt, Avdelning 1, A 1 A Lagfartsprotokoll, vol. 1-12.

<sup>4</sup> Stockholms stadsarkiv, Stockholms magistrat- och rådhusrätt, D4, Förteckning över uppbundna fastigheter, vol. 1-2.

We have therefore only gathered the first bid since it naturally is closest in time for the trade deal between seller and buyer (Wikström 1970). To construct this index it has been necessary not just to gather the sales prices but also the taxation values. This in order to make the index comparable over a long period of time. The taxation values we have gathered from *Stockholm Adresskalender (Stockholmskällan 2018)*.

There are several methods to reconstruct a price index of residential properties. These methods usually assumes that the same property sold does not undergo any qualitative changes. This assumption may be questioned. On the one hand a house becomes older, on the other hand, renovations may increase its value. Usually it is simply assumed that the one effect counteracts the other. Ideally, there would exist some data on the objective properties of the residential house, which would make it possible to hold quality constant. However, in this study we have not been able to establish such properties of individual houses.

Some of the properties investigated in this study had undergone profound increases in their value during a very short time period. This was due to the building of new house at the area. For Stockholm, there exist information of application to construct new houses, which may be used to only consider those properties that have not undergone any large changes (however, such properties may have decreased in value because of depreciation).

Assuming constant quality over time for the same properties (and possibly deleting the properties that undergo large physical changes), there are two main methods to construct an index: repeated sale methods and the ratio of market price to tax evaluations.

The repeated sale method was first adopted by Bailey, Muth and Nourse (1963). The advantage with this method is that no data on the tax assessment value is necessary for its application. The only information that is necessary is the price, sales date and address of the property. Although this method is now conventionally used there are other methods used in influential studies, for instance the Eichholtz (1997) which uses a hedonistic model. However, Englund, Quigley, and Redfearn (1999) recommended caution on the downsides of repeated sales price method.

The regression for a repeated sales index can be expressed as following, where the period of investigation starts with year  $T$  and is of length  $L$  years:

$$LN(p_{t+k}/p_t) = a + \sum_{j=1}^L b_j D_j + u;$$

$$D_j = 1 \text{ if } t - T < j \leq t + k - T; D_j = 0 \text{ otherwise}; k > 0 \quad (1)$$

The constant should usually be set to zero. However, sometimes the sale by itself can change the value of a property. In Söderberg, Blöndal and Edvinsson (2014) it is shown that using the constant in the regression, yields similar result as the “sales price ratio method”, although the constant is quite high, showing that every sale adds quite much to the value of a property (related to the possible renovations and new building activity associated with such sales).

The so-called “sales price ratio method” (köpeskillingskoefficientmetoden) is used by Söderberg, Blöndal and Edvinsson (2014) for the period back to 1875, entailing that a ratio between the sales price and the tax assessment value is first constructed. Secondly an index of the tax assessment value is reconstructed for the whole period under investigation. The tax assessment value only changes after few years, which entails it is constant for periods of several years. Thirdly to arrive at a market price index, the ratio of the sale price and tax assessment value is multiplied by the tax assessment value index. In this study we only use the “sales price ratio method”, but we have only the 1874 taxation values.

Our series is then linked up to the series from 1875- 2012 as presented in Söderberg, Blöndal and Edvinsson (2014). The series in Söderberg, Blöndal and Edvinsson (2014) consists of several different series. The main series covers the period 1875-1957, and applies the “sales price ratio method”, and covers the Inner City. In the period after 1957 the area is expanded to reflect the growth of Stockholm. For the period 2012-2017, we extend the index using data on the value of small houses in Stockholm County from [www.maklarstatistik.se](http://www.maklarstatistik.se).

There are several different methods that can be used to apply the “sales price ratio method”. For example, should each sale be weighted the same, or should they be weighted by the sale price? Should extreme values be included?

To estimate the Housing Price Index in year  $t$ , linking up to the Housing Price Index ( $HPI$ ) from 1875 onwards, we use the following formula, where  $p_{i,t}$  is the price of object  $i$  in year  $t$  and  $T_{i,t}$  is the taxation value of object  $i$  in year 1874:

$$HPI_t = HPI_{1875} \frac{\sum_i p_{i,t}}{\sum_i T_{i,1874}} \bigg/ \frac{\sum_j p_{j,1875}}{\sum_j T_{j,1874}} \quad (2)$$

It should be noted that properties  $i$  are the ones sold in year  $t$ , and properties  $j$  are the ones sold in year 1875. This entails that the estimated index may be spuriously affected by what types of sale were made the actual year. For example, during some years larger properties may have been sold, which may not reflect the price level of the total stock. This may yield spurious fluctuations in the index.

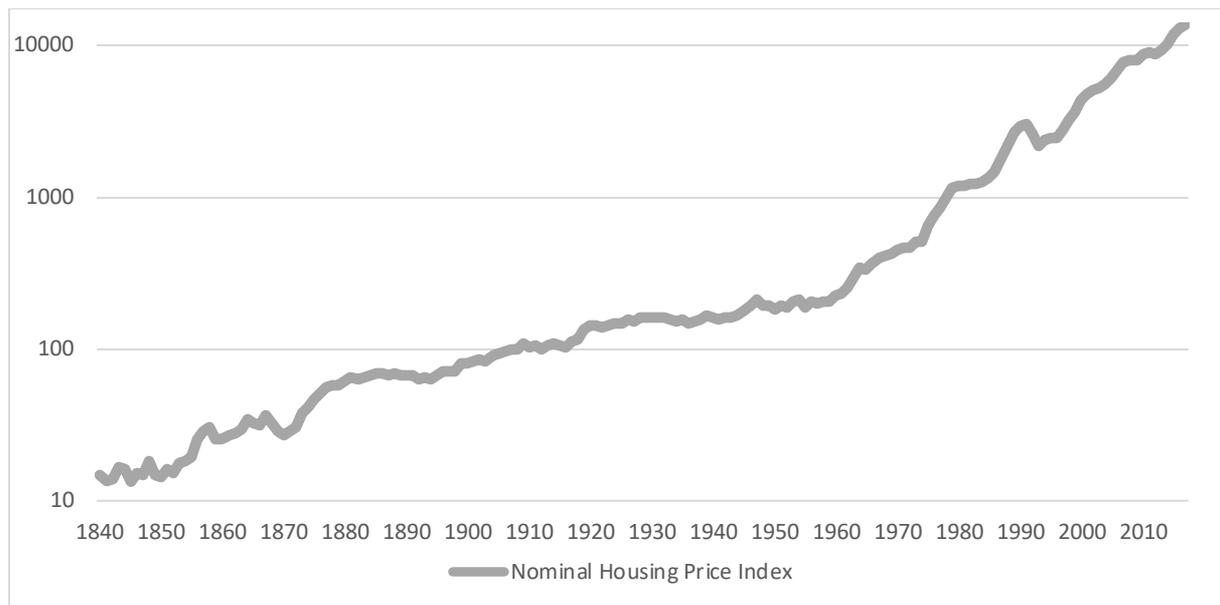
An alternative method to estimate the Housing Price Index is based on the unweighted central measure (median, arithmetic average, geometric average, etc), CM, of the ratios of market price to the taxation value:

$$HPI_t = HPI_{1875} \text{CM}_{i,t} \left( \frac{p_{i,t}}{T_{i,1874}} \right) / \text{CM}_{j,t} \left( \frac{p_{j,1875}}{T_{i,1874}} \right) \quad (3)$$

A problem with giving equal weight to each sale is that properties of lower value would then have too large impact on the index. Giving equal weight may also be ad hoc, since sometimes one sales consists of the sale of several properties. Using equal weights is also more sensitive to extreme values, when using just one taxation year, instead of applying several consecutive taxations. An alternative is to use the average, median or the geometric average ratios, which are both less sensitive to extreme values. The unweighted average ratio is, however, very sensitive to extreme values, when the taxations value is close to zero. Therefore, when using formula (3), either the outliers should be deleted when using the arithmetic average, as is done in Söderberg, Blöndal and Edvinsson (2014), or alternative central measures, such as the median or the geometric average should be used, which are less sensitive to outliers. Although formula (2) is the appropriate formula to use if all properties would be sold every year, since they are not, various variants of formula (3) may be less sensitive for high valued properties being sold representing a large share of the total value sold in a given year.

Figure 1 presents the nominal Housing Price Index, setting 1912 to 100. Between 1840 and 2017, the nominal index increased on average by 3.9 percent per year, while the inflation was on average 2.5 percent per year.

Figure 1: The nominal Housing Price Index 1840-2017, 1912=100.



The growth of the Stockholm City have some problematic repercussions. Both the “sales price ratio method” and the repeated sale method entails that the quality is assumed to be the same of the same property. However, in reality this may not be the case, and a future study could more closely look into holding the actual objective characteristics constant. The countryside also have much lower value than the city, but when the city expands the value of houses that previously were located in the countryside may increase faster than houses in the city – the index will therefore be sensitive to exactly which geographic area is covered. It may also be suspected that some of the properties in the countryside initially did not have any house of substantial value; the building of a new house may have substantially increased the value of that property.

Figure 2 compares the nominal Housing Price Index for the Inner City as a whole, and for the Old Town (the parish of Nikolai). The Old Town did not undergo the same transformation as the rest of the Inner City. Nevertheless, when comparing the two indices it shows that prices in the Old Town largely followed the Inner City, although the increase during the whole period 1840-1875 was lower.

Figure 2: The estimated nominal Housing Price Index of Stockholm 1840-1875 (1840=100) according to various methods and geographical coverage.

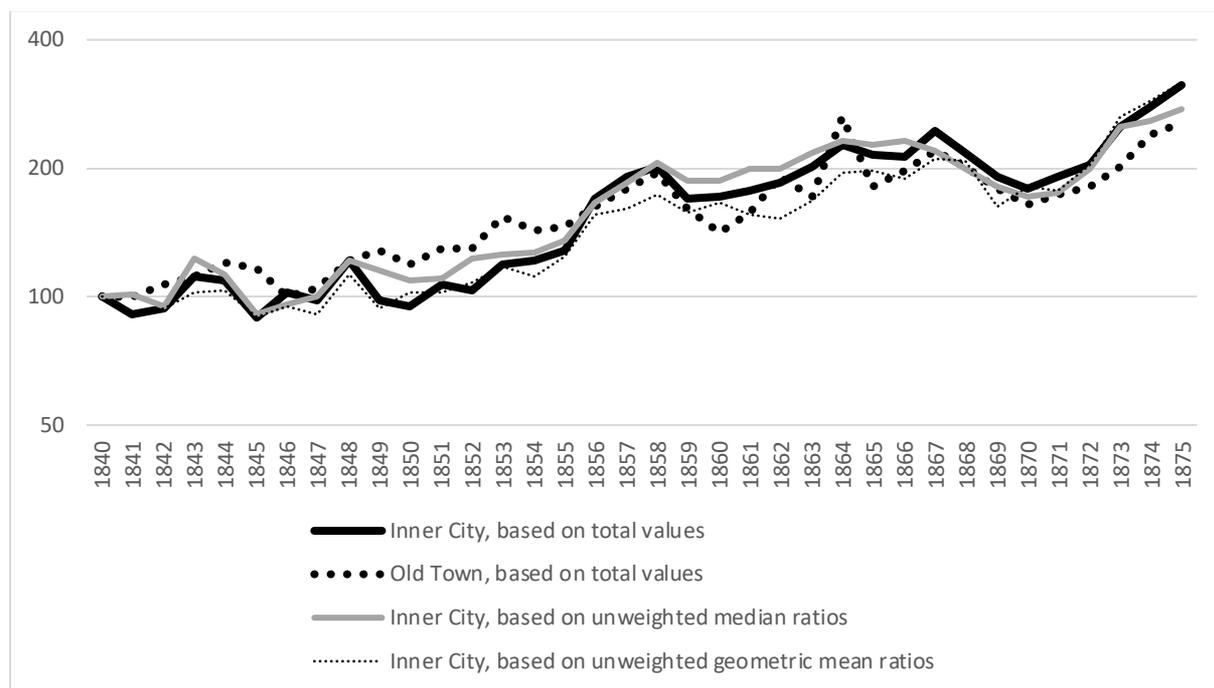


Figure 2 also compares the Housing Price Index when using formula (3), applying the median and the geometric mean as the central measure. The two alternative methods yields a similar index as the one applied in the present study.

### Long run trends and historical context

It is crucial to understand the context and development in a society when constructing a long term price index. 1840 to 2017 is a long and eventful time period, not least for a city like Stockholm which has gone from poor and backwards to one of the most prosperous and modern cities in the world.

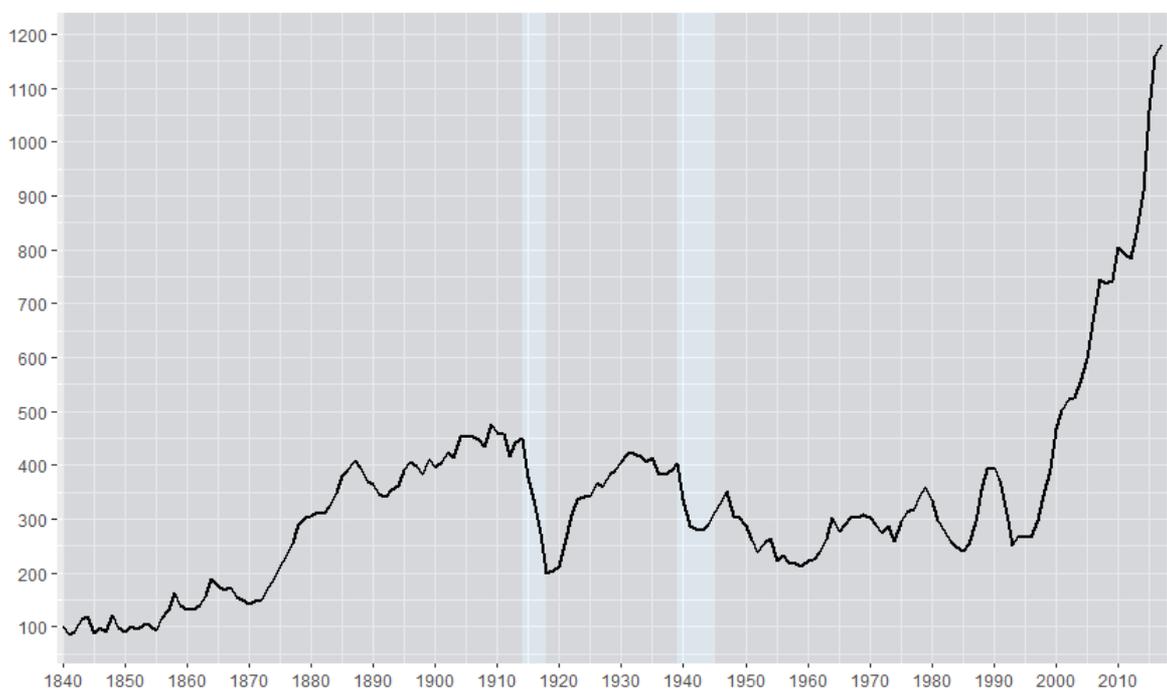
In Figure 3 our index is deflated by the Consumer Price Index.<sup>5</sup> Our newly collected data for 1840-1874 indicates that Sweden experienced another sharp growth in real prices during the second half of the 19<sup>th</sup> century, which puts the “hockey stick pattern” in Knoll, Schularick, and Steger (2017) under question. While they find almost no long run real price growth in the first 90 years, but a sharp rise after 1960, we show that an increase starts around 1855, accelerates from 1870 to 1886 and ends in 1887. In total, house prices more than trebled in real terms

<sup>5</sup> Edvinsson and Söderberg (2010).

during this period, an increase only exceeded by our present day increase 1993-2017, which almost quadrupled.

While declines in real prices by more than 20 percent occurred at several periods, declines of that magnitude was unusual for the nominal series; after 1875 it only occurred once, in 1991-1993 (compare Figure 3 with Figure 1). Our new extended series shows that there were another nominal decline of that magnitude, occurring in 1867-1870, following the severe harvest failure of 1867.

*Figure 3: Stockholm Real House Prices 1840-2017, 1840=100.*

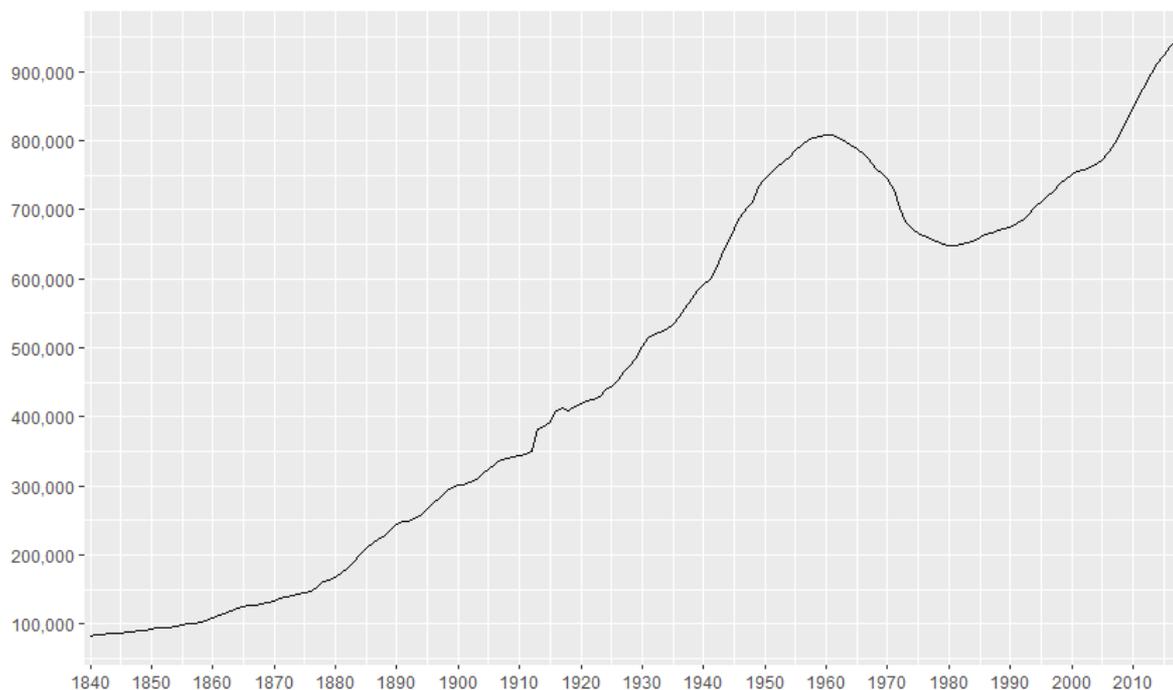


Shaded areas indicate years of world war. Source: Our data and Edvinsson, Blöndal, and Söderberg (2014).

At the beginning of our index, in the 1840s, Stockholm had been a stagnating town for about half a century - in 1843 there was about 86000 inhabitants (Johnsson 2017; see also Figure 4). Death rates was bigger than birth rates and the city was dependent on immigration from the countryside (Ahlberg 1958; von Vegesack 2005). Few new building had been built since the 18<sup>th</sup> century (Råberg 1976). Stockholm then consisted of the present inner city (with the exception of Reimners holme, Djurgården and the Essinge islands), hence Gamla Stan, Södermalm, Östermalm, Norrmalm and Kungsholmen. Both individual witnesses and public report tell us about a town with narrow streets, insufficient lightning, cobblestones in the mud,

no sewers, horrific stank, homelessness, extensive alcoholism, and exceptional poverty. Average life expectancy was 20 years for men and 26 for women (as opposed to 40 for men and 45 for women in Sweden as a whole) and the bad sanitary conditions, especially the dirty water from the cities wells, caused several epidemics of cholera whereas one of them caused the death of 3665 people (Johnsson 2017 p37-40). However, some important reforms were introduced during this decade that to a certain extent paved the way towards better times for Stockholm. Those included the public schooling bylaw ("Folkskolestadgan") for both boys and girls from 1842, the abolishment of the guild system in 1846 and the first limited company legislation in 1848. In 1850 there were only 3500 industrial workers in Stockholm (Råberg 1976). And in 1851 a building contractor by the name of Christer Tottie complained to the city council that Stockholm, contrary to civilized cities in the world, had neither gas lightning nor sewers and water pipes (von Vegeseck 2005, p. 29). The following decades saw an economic uprising and a significant increase in industrial workers and with the introduction of steam engine and the freedom of trade reform in 1864 the foundation was laid for the industrial revolution and what Anders Johnson called the entrepreneurial period in Swedish history. This corresponds to the upturn in house prices. The entrepreneurial spirit was shown not the least in the real estate business where a large number of building entrepreneurs rebuilt the new modern Stockholm and the housing conditions was considerably increased (Johnsson 2017 p7-10). The infrastructural standards that Christer Tottie was complaining about would soon be improved. A gas company was established during the 1850s and during the 1860s the first water pipes and sewer systems was built (Råberg 1976).

Figure 4: Population of Stockholm municipality 1840-2017.



Source: Statistiska Centralbyrån.

The 1870s and 1880s are exceptional decades in Stockholm, accompanied by an acceleration in the price rise of real property. Population increased by 20 percent (from 136000 to 169000 people) in the 1870s and by 46 percent (from 169000 to 246000 people) in the 1880s (the fastest relative increase in population ever in Stockholm). Several important enterprises were founded, for instance LM Ericsson and Atlas Copco. Telephone usage expanded and at one time Stockholm had most telephone subscribers in the world. New regulations for housing construction and sanitary condition were introduced as well as city plans for “Malmarna” (Östermalm, Norrmalm, Södermalm and Kungsholmen) which at this time has a rural character (Johnsson 2017 pp. 82-84). Housing and real estate had become a lucrative business for capital investment. The new “hypoteksinstitutet”, a sort of loan institute for real estate investment (which had been established in 1860), made investment possible for larger parts of the population, not just the well suited. Housing shortage was severe and was not regarded as a task for the society but for private investors who in 1870s constructed 900 building and over 2000 buildings in the 1880s. This was more houses than had been built during the whole previous part of the 19<sup>th</sup> century. However, certain regulations were also launched during these times for instance the city bylaw (“stadsstadgan”) and the building procedure (“byggnadsordningen”) in 1876, which for instance regulated the height of the building in relation to the width of the street

it lay ahead to. Also with the new regulations, no new buildings were allowed to have more than five floors.

After the mid-1880s there was instead a housing surplus which can be noted in a slight decrease of the price level of house prices. Also there were demands for certain professional qualifications for building contractors which since freedom of trade reform in 1864 had been a profession without any requirements on formal education or qualifications; anybody could call themselves a building contractor between 1864 and 1888 (Råberg 1976). During the 1890s the pace of the price increase leveled out slightly. At the same time, important foundations for future housing and living standards were taken place during this decade, for instance Stockholm's first power station for electricity were founded in 1892 (Johnsson 2017 pp. 113 and 146). The relatively modern and fast growing Stockholm at the turn of the century was a significantly different city than in 1840.

Increases in sanitary standard continued in the beginning of the 20<sup>th</sup> century; for instance, fresh water supply was significantly enhanced with Norsborg Sewage treatment plan which was founded in 1904 (Johnsson 2017). Population in Stockholm also reached 300000 around the same time (Råberg 1976). Population in Stockholm had thus more than tripled since 1840. Even though the fast growth pace had leveled out slightly during the turn of the century companies were still founded, including major ones as Asea in the 1890s and Kreuger and Toll in 1908. However, after more than a hundred years of gradual privatization of Stockholm's land and real estate market, radical change in the opposite direction did take place in 1908 when a new real estate law called "Tomträätten" was launched. This new law meant that the city had the ownership to all land on which every building in the city was built. For over a century the so called free ground, which meant that the land below the building was in private ownership, had been more and more common in relation to unfree ground which meant that the land was owned by the city. With the new law from 1908 this system was abolished and the city had the ownership of all the land on which there were buildings. However not to the same extent as with the unfree ground in the old system, instead the city did formally own the land but with legal obligations to secure the basic ownership rights of the building owner. This reform was a part of a more state active housing policy to hamper the housing shortage as well as hinder land speculation; according to historian George Mörner the aim of hindering land speculation were accomplished but hardly the aim of hampering the housing shortage (Mörner 1997, pp. 127-139). During 1908 Sweden was also hit by a financial crisis that had been triggered by the San Francisco earth quake. Several banks were liquidated, and the state introduced new banking regulations and Riksbanken had for the first time in Swedish history a monopoly of money

supply and thus was able to use some effective monetary policy (Bäckström 2014, Johnsson 2017 pp. 200 onwards). However, as one can see in our index the effect on the real estate prices in Stockholm was moderate during the years around 1907, it is not until the First World War that prices drop radically (Figure 3). A highpoint is reached year 1908 from where the price trend turn negative; the 1908 price level is not reached before year 2000.

The modest effect on the housing prices during 1907 might partly have been due to the financial institute, AB Administrator, which was founded in 1908 to secure the creditors demands and complete the initiated building constructions (Johnsson, 2017, p. 201). Real prices dropped dramatically during World War One – which is not rare during in war years – mainly caused by the inflation. Sweden's first rent control was introduced during this period as well to avoid higher rent during severely lower construction but was abolished shortly after the war.

Following a turbulent trajectory, especially around years of world war and the crisis 1921 (all events associated with high inflation or deflation making the real prices look more turbulent than they really are), this negative trend continued into the 1960s.

Administratively, during the first two decades of the 20<sup>th</sup> century Stockholm expanded. Spånga, Bromma, Solna, Hägersten and Sundbyberg were among the commonalities that were incorporated in Stockholm city. Also Djurgården, which had the royal court as its former owner, was exploited for building constructions on behalf of Stockholm city - although relatively sparsely. The idea was to lessen the housing shortage by encourage housing constructions with state support, an embryo to the more active public housing policy than the city would engage in later during the 20<sup>th</sup> century (Johnsson, 2017).

The high inflation period after World War One is clearly shown in our price index. The deflation crisis in the beginning of the 1920s is however not, except a moderation of the pace of the price increase. Also, the 1929 depression and the Kruger crash did not lead to a severe drop but rather a stagnation and a slight downturn of real estate prices (Figure 3). Also, the Second World War as accompanied by increased volatility in real estate prices.

During the Second World War rent control was introduced again and still intact to this day, except for some slight revisions (Lindbeck, 2016). Price control on housing cooperation (bostadsrätter) and villas was introduced but abolished at the end on the 1960s. Zoning laws and construction laws were tightened and the municipalities planning monopoly ("kommunala planmonopolet") from 1907 was significantly strengthened in 1947 (Tobé, 1960). This paved the way for an active state policy for housing construction with large, partly state owned, housing cooperation's that got financial support from the state, the private real estate businesses got bankrupt to a much larger extent. This lead to oligopoly in the real estate market and a new

era corporatism was introduced in Sweden with is almost diametrically the opposite from the late 19<sup>th</sup> early 20<sup>th</sup> century many free building entrepreneurs. HSB, Riksbyggen and housing companies owned by the municipalities dominated the real estate market during the 1950s, 60s and 70s. Housing shortage was severe and in the 1960s the “Miljonprogrammet” was launched, in where the building cooperation’s with the help of large state subsidies and advantageous loans built around 100,000 houses and apartment buildings per year for ten years and also demolished a large extent of the old building stock. During the late 1960 and 1970s the inner city of Stockholm was partly depopulated in favor of villas or “egna hem-boenden” in the suburbs. According to economic historian Jan Jörnmark (2005 and 2007) the trend of depopulated city centers were broken when the new housing cooperation (bostadsrätter) were produced in the wake of the deregulated housing cooperation market. The post-war period in Sweden was thus associated with active state policy for the creation of cheap apartment houses. This so called “social housing policy” probably contributed to the stagnating house prices, and was abandoned during the 1990s crisis (Strömberg 1992).

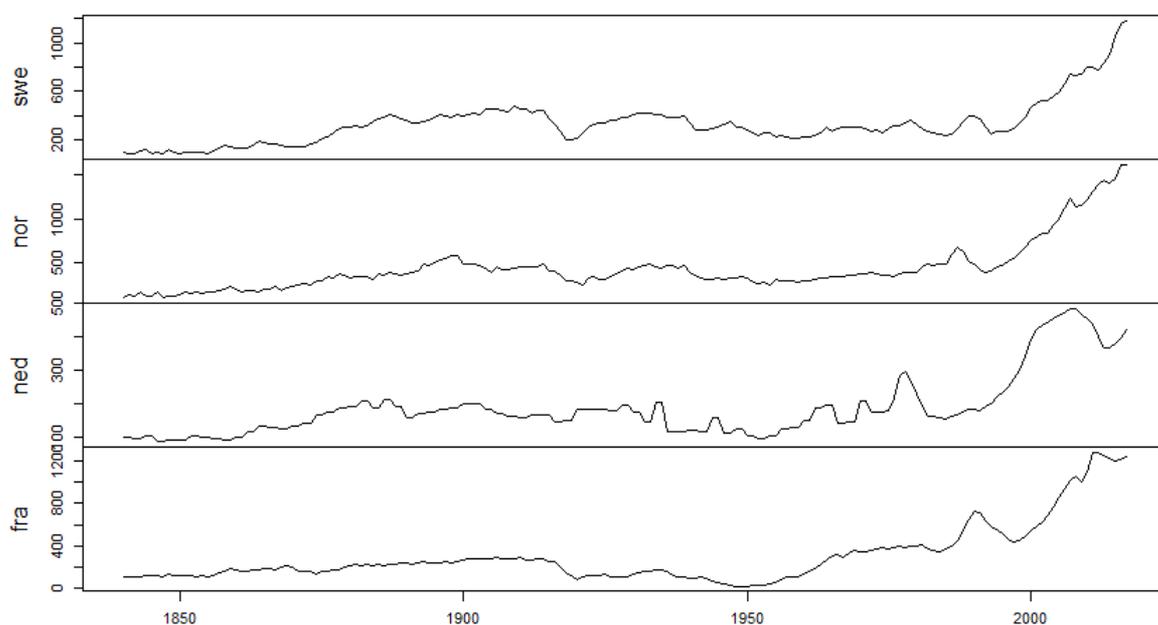
The sharp upturn in 1986-1990 coincided with the deregulation of Swedish financial markets and a rising private indebtedness. Another deregulation, namely the credit deregulation in 1985, created a boom in the late 1980s which pave the way to the 1990s financial crisis with severe price decreases in the Stockholm housing market (Larsson, Lönnborg 2014). The severe crisis that hit Sweden 1990 was triggered by a price collapse on the real estate market (Edvinsson 2010; Larsson and Lönnborg 2014; Ahnland 2015). What may later have counteracted a sharp decline in the nominal Swedish house prices (Figure 3) is the fact that the Swedish currency was set free to a floating exchange rate in 1992. Both the declines in the 1860s and 1990s occurred in periods of fixed exchange rates. For example, while nominal prices in Stockholm declined by around 10 percent in 2017-2018, the decline measured in euro was twice as much; it may be suspected that the loss of value of the krona against the euro and the dollar counteracted the present decline.

After a few stagnating years in the early 1990s the trend has been a fast pace in real price increases for real estate in Stockholm ever since. As we can see, the last two and a half decades has been characterized by dramatically increased prices at a pace and for a stamina that is unprecedented during this period from 1840 to 2017.

### International comparison

Most long run house price indices starts around 1900 or later and only a few stretches as far back as ours. We do, however, have data covering other towns from 1840: the Norwegian towns Oslo, Bergen and Kristiansand (Eitrheim and Erlandsen 2005) and Paris (Jacques Friggit 2009). Also Eichholtz's (1997) Herengracht index collects biannual house price data from 1628 to 1973. The indices are depicted in Figure 5. Strikingly, all of them shows a price increase for the period 1850-1880.

Figure 5: Real House Prices 1840-2017; Stockholm, Norway, Herengracht and Paris.



Source: Our calculations, with data from Edvinsson, Blöndal, and Söderberg 2014; Edvinsson and Söderberg 2011; Eitrheim and Erlandsen 2005; Grytten 2004; Eichholtz 1997; Jacques Friggit 2009; Jaques Friggit 2008). The last two years for Paris is estimated with house prices for France from OECD. The Herengracht index is biannual and ends in 1973. The years 1974-2017 are estimated with data OECD data for house prices in the Netherlands and gives therefore a simplified and probably underestimated picture of the house price growth.

In Table 1 below, the growth rates for the different cities in different periods can be compared. Herengracht sticks out in the period 1840-1859 as the only town with a negative trend, this is, however, caused by the price fall in the 1840s. In all our indices, growth is in general stronger

in the early decades and fades out towards the end of the 19<sup>th</sup> century. They thereafter enters some decades of stagnation, with turbulence around the two world wars and starts to pick up pace around the 1960s. All countries have experienced booming house prices the last 20 years. Most of today's longer house price series only stretches back to around 1900. This, however, may mislead us to think that the strong price growth that most advanced countries have experienced since the 1960s is historically unique. Without noticing it, these indexes might on the contrary start in the end of another period of steep growth. Data collection for more towns would bring light over this interesting issue.

Table 1: Mean percentage real house price growth 1840-2017.

	Stockholm	Norway	Paris	Herengracht
1840-1859	3.02	6.60	3.78	-0.45
1860-1879	4.25	2.59	0.73	7.66
1880-1899	1.52	2.71	1.35	0.37
1900-1913	0.65	-1.39	0.55	-1.48
1914-1918	-10.84	-5.26	-7.49	-7.27
1919-1938	3.65	2.25	-0.79	0.37
1939-1945	-2.84	-3.41	-8.86	8.36
1946-1959	-2.38	-0.58	8.45	-1.42
1960-1979	2.85	1.74	6.75	10.40
1980-1999	1.04	3.19	1.54	2.56
2000-2017	6.48	5.05	5.52	3.36

Sources: See Figure 4.

### **Volatility**

Figure 6 depicts house price volatility in Stockholm 1840-2017. Volatility can be used to capture turbulence on markets and can be measured in many different ways. We here measure volatility as the yearly deviation from the mean difference. All values are transformed with the natural logarithm. What really stands out is the turbulent period in the beginning of the time series, 1840-1880. Adopting a test for detecting multiple structural breaks (Bai and Perron 2003), we found one significant break with an optimal break date (the one generating the lowest BIC-values) at year 1866. The break date is marked with a dashed vertical line in Figure 5.

The turbulence in the beginning of our period of investigation cannot be explained by volatility in the consumer price index. Measuring the standard deviation for each decade, the 1940s stand out as with a relatively small number: 2.53 compared to 5.94 for the 1880s and 3.52 for the 1890s.

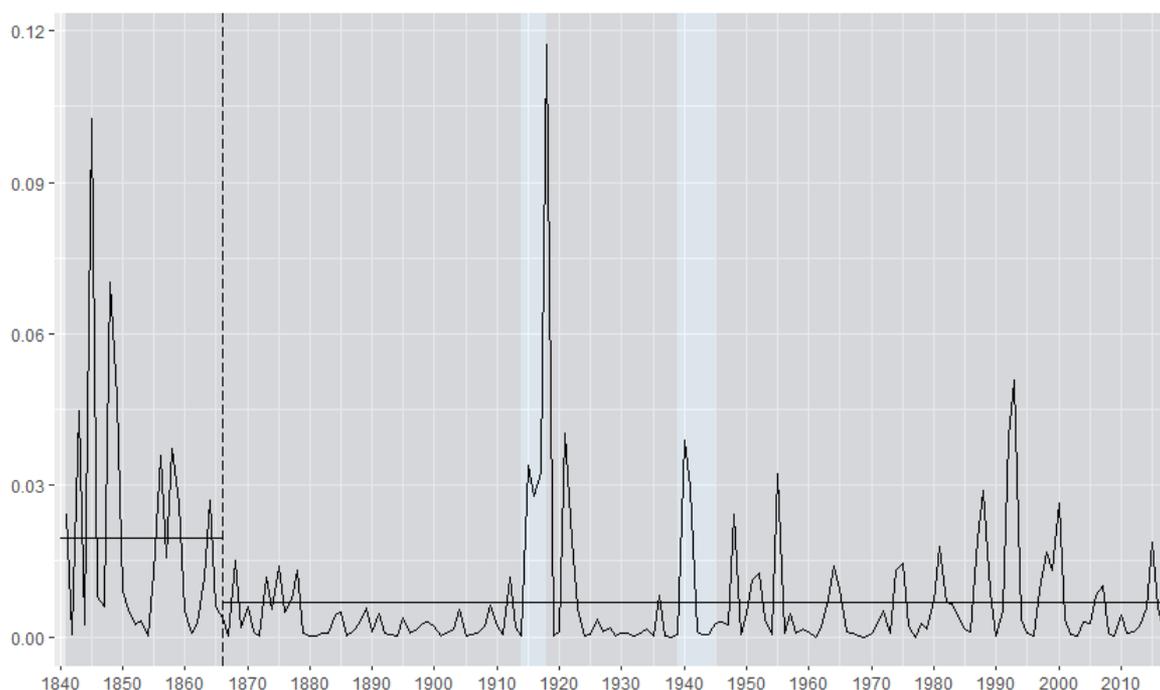
What is troubling is that the period of turbulence coincide quite well with where our new index end and the old one by Edvinsson, Blöndal, and Söderberg (2014) begin. Because of differences in methods used when constructing the indices, the higher turbulence may be due to differences in measurement techniques.

On the other hand, we know that the years 1850-1870 economically were very turbulent for Stockholm. Furthermore, after a period of stagnation the construction industry expanded rapidly by the end of the 1870s continuing to 1882 (Gustafson 1976). Interestingly, neither the crisis 1885 discussed by Gustafson (1976) nor the one 1907 described by Perlinge (2012) are visible in the volatility series although both were connected to a bursting construction sector bubble. Both of the crises, however, coincide with lower house prices (see Figure 3).

This is just a preliminary analysis, but we do think that the period 1840-1910 might give valuable insight to today's fear of what might happen if house prices in Stockholm starts to decrease. Not only because of the long run increase in house prices, but also because the market driven construction sector seems to have moved in tandem with house prices which might have had a significant impact on the real economy.

While many of the peaks in the 20<sup>th</sup> century depicted in Figure 5 can be explained by changes in the consumer price index, some cannot: that goes for the house price fall around 1990 and the following spikes after it that represent extraordinary high growth.

Figure 6: Stockholm Real House Price Volatility 1840-2017.



Note: Shaded areas indicate years of world war. Vertical line indicate year of structural break. Horizontal lines indicates mean volatility.

Table 2 presents volatility for real house prices in different cities on 20 years basis. We here use standard deviations as measure for volatility. No town seems, in this simple comparison, to in general have more turbulent house prices than another. Not surprisingly, the world wars were very turbulent in all of our cases. The same goes for 1980-2000, with its financial deregulations and real estate booms.

*Table 2: Real house price volatility 1840-2017.*

	Stockholm	Norway	Paris	Herengracht
1840-1859	15.68	19.22	9.26	8.43
1860-1879	8.25	10.89	9.56	6.83
1880-1899	4.47	7.21	3.18	8.95
1900-1913	5.00	6.71	3.15	5.23
1914-1918	9.51	8.70	10.67	5.76
1919-1938	6.70	8.39	13.14	21.03
1939-1945	8.54	8.08	9.65	14.22
1946-1959	7.22	10.36	24.10	15.21
1960-1979	6.32	3.76	8.57	23.66
1980-1999	10.95	9.85	9.47	15.17
2000-2017	6.04	5.39	6.16	11.61

Sources: See Figure 4.

## **Conclusions**

This study demonstrates the importance of having longer time series of house prices, which can put light on the recent upturn. Are we now experiencing a bubble, which will soon burst, or are the present levels of property prices sustainable in the long run? We do not know the answer until the future, but history can provide us with time periods that are comparable. History can make us more open to several possible outcomes. While the study of Knoll, Schularick, and Steger (2017) indicates a “hockey stick” development, with stagnation in real prices up to the 1960s, followed by a rapid increase, we show that the rise in the last decades had a precedence in the second half of the 19<sup>th</sup> century. This rise was not immediately followed by a burst of a bubble back to the level before the rise, but there was a sharp decline in the 1860s, followed by a new rise. However, after the 1880s, there was a century of stagnant, or even slightly declining, real prices. The real price in 1993 was 39 percent below the level in 1887. Interestingly the earlier upturn was more volatile than the present one.

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