

UBS Global Real Estate Bubble Index

For housing markets of select cities
2016



Content

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Editor in Chief

Matthias Holzhey

Authors

Matthias Holzhey
Maciej Skoczek

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Contact

ubs-cio-wm@ubs.com

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Editorial

Dear reader,

In a world in which more than a third of all government bonds offer negative yields, investing in tangible assets remains popular. So it is hardly any wonder that housing markets are again overheating, just a few years after the last major wave of global correction. We see a significant overvaluation of housing markets in some key financial centers.

What these cities have in common are excessively low interest rates, which are not consistent with the robust performance of the real economy. This is illustrated by the Eurozone, where monetary policy cannot accommodate the macroeconomic differences between the countries. Yet other countries such as Australia, Canada and the UK are also keeping their interest rates artificially low. When combined with rigid supply as well as sustained demand from China, this has produced an ideal setting for excesses in house prices.

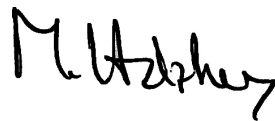
Even in the cities with the clearest signs of a real estate bubble, it is not possible to predict exactly the timing and duration of a correction. The situation is nevertheless fragile for housing markets. A sharp increase in supply, higher interest rates or shifts in the international flow of capital could trigger a major price correction at any time.

The publication *UBS Global Real Estate Bubble Index* reveals the financial centers where the imbalances are most apparent, and the cities where house prices still have fair valuations overall. In this issue, we have added Milan, Munich and Stockholm to our selection of cities.

We hope you find it an engaging read.



Claudio Saputelli
Head Global Real Estate
Chief Investment Office WM



Matthias Holzhey
Head Swiss Real Estate Investments
Chief Investment Office WM

Bubble risk on the rise

The *UBS Global Real Estate Bubble Index* is designed to track the risk of housing bubbles in global financial centers. Vancouver tops the index in 2016. Bubble risk also seems eminent in London, Stockholm, Sydney, Munich and Hong Kong. Deviations from the long-term norm point to overvalued housing markets in San Francisco and Amsterdam. Valuations are also stretched, but to a lesser degree, in Zurich, Paris, Geneva, Tokyo and Frankfurt. In contrast, Singapore, Boston, New York and Milan are fairly valued, while Chicago's housing market remains undervalued relative to its own history.

Out of touch with fundamentals

House prices of the cities within the bubble risk zone have increased by almost 50% on average

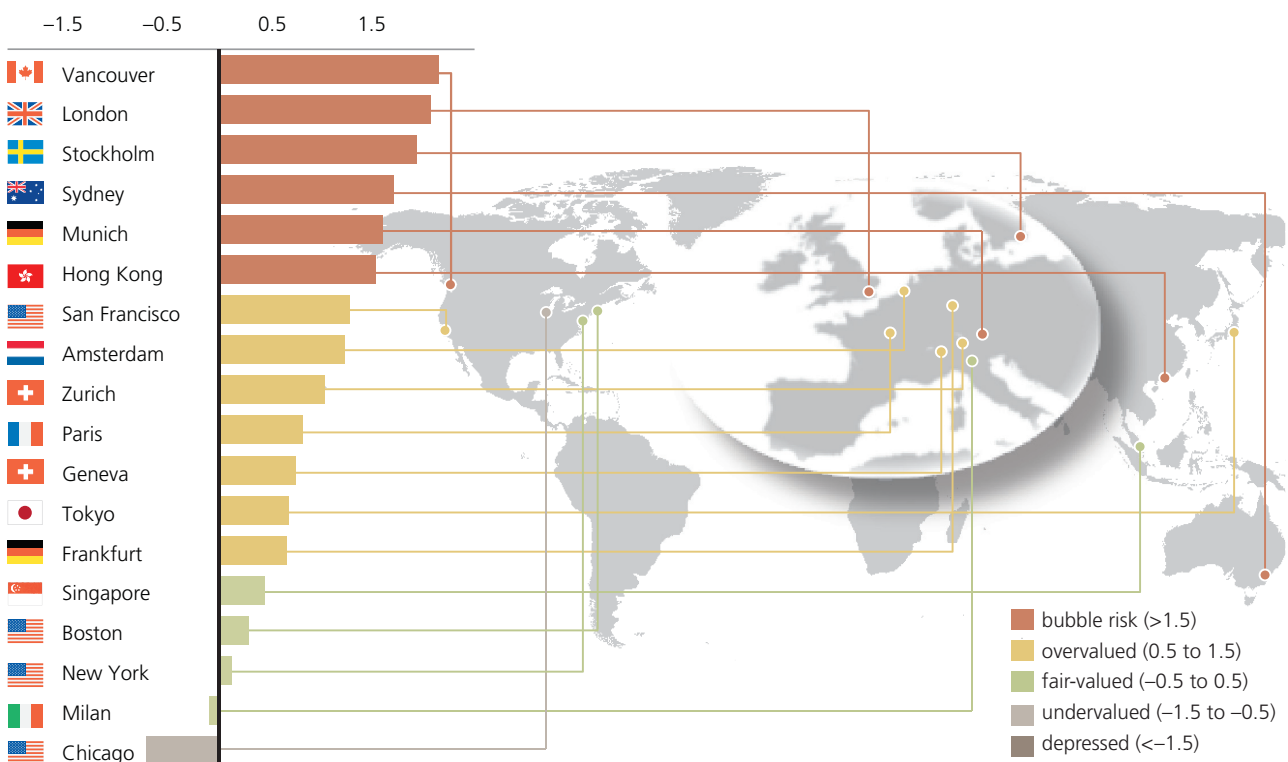
since 2011. In the other financial centers, prices have only risen by less than 15%. This gap is out of proportion to differences in local economic growth and inflation rates.

Elevated risk of a price correction

The discrepancies have emerged out of a mix of optimistic expectations, capital inflows from abroad and loose monetary policy. The weak economic foundations of the latest price boom make the housing markets in those cities vulnerable. A change in macroeconomic momentum, a shift in investor sentiment or a major supply increase could trigger a rapid decline in house prices. Investors in overvalued markets should not expect real price appreciation in the medium to long run.

UBS Global Real Estate Bubble Index

Latest index scores for the housing markets of select cities



Source: UBS. Remark: For explanation see the section on Methodology & data on page 17.

Different regional cycles

Europe – one-size-fits-all monetary policy increases imbalances

All European cities are overvalued, apart from Milan. The sharpest increase in the *UBS Global Real Estate Bubble Index* in Europe over the last four quarters was measured in Stockholm, followed by Munich, London and Amsterdam. The valuations in Zurich and Frankfurt rose somewhat more moderately. The index declined in Milan, Paris and Geneva.

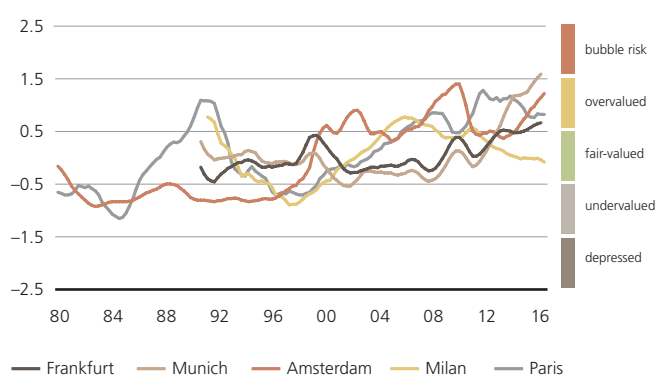
Within the Eurozone, interest rates cannot be adjusted to the particular economic development in each of the member states. The economic weakness of the Eurozone is simultaneously forcing the other EU countries and Switzerland to pursue a supportive monetary policy. Yet buying a house in countries with an uncertain economic outlook is a high-risk option and banks only grant loans restrictively, with the result that the low interest rates only have a limited effect.

Conversely, the low-interest phase in the growth engines of Europe has contributed to overheating of markets for urban residential properties in recent years. As a result, prices in London, Stockholm, Munich and Zurich have reached new record levels after adjustment for inflation. Amsterdam is also on its way to making up for the losses after the financial crisis. Following a breather in 2013, Frankfurt too is showing clear signs of picking up momentum. On the other hand, falling interest rates have been unable to trigger any boom in Paris or Milan.

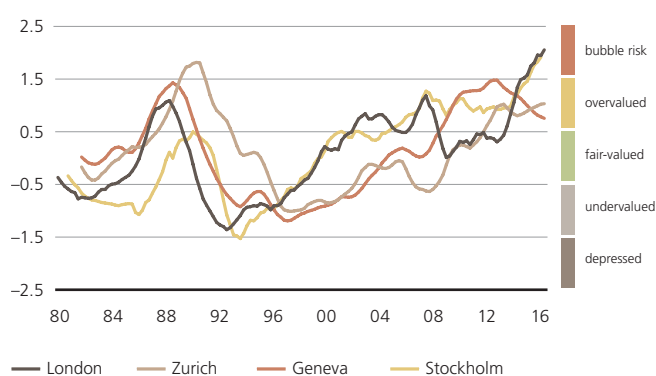
In the French-speaking cities of Geneva and Paris, the risk of a real estate bubble now seems to have been averted. Even though the housing markets in both cities have cooled down considerably, valuations are still well above the long-term average.

UBS Global Real Estate Bubble Index

Eurozone



Rest of Europe



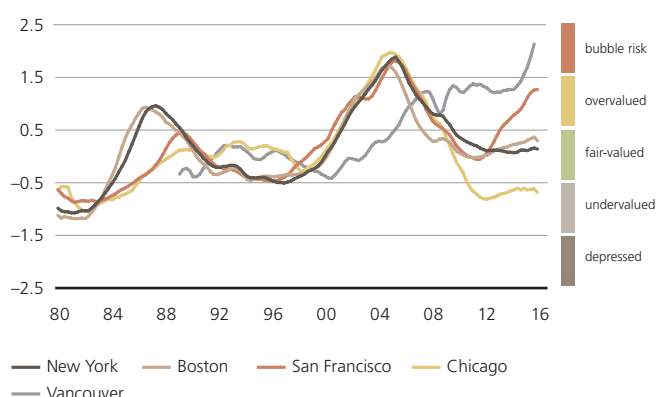
North America – widening gaps between the cities

The housing market recovery after 2010 has been very uneven across US cities. In San Francisco, real prices have increased by more than 50% since 2011 and the market seems – despite the fast growth of the local economy – on a path towards bubble risk. Meanwhile, real price growth in Boston has remained close to the national average of 15% in the last four years, while New York and Chicago have been outpaced by the overall US market. While the slow recovery in Chicago can be attributed to fiscal problems and a comparatively weak local economy, the recent price growth deceleration in New York is a sign of weakness of the financial sector. Overall, New York and Boston seem fairly valued while Chicago is undervalued.

Vancouver’s housing market has not been dragged down by either the financial crisis or weakening commodity prices. The index has signaled a significant overvaluation since 2007. Over the last two years, the housing market has gone into overdrive due to strong demand for local properties among foreign investors and a loose monetary policy. Currently, house prices in Vancouver seem clearly out of step with economic fundamentals, and are in bubble risk territory.

UBS Global Real Estate Bubble Index

North America



APAC – shift in demand away from Tiger cities

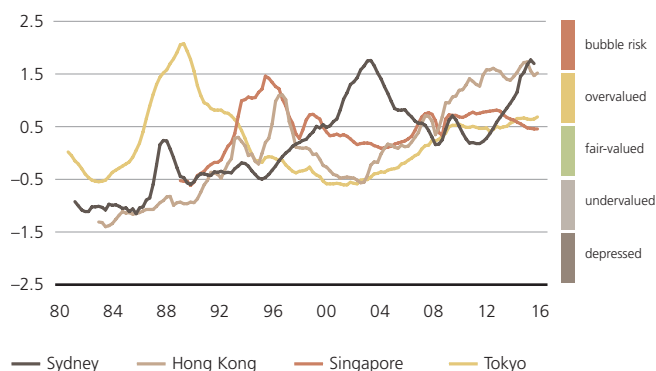
APAC cities have shown different patterns compared to their European and US counterparts. With the exception of Tokyo, there were no severe housing bubbles in the late 1980s and housing markets were mostly fairly valued in 2006. Tokyo’s property market has started to rebound slowly from its secular downtrend in 2000. In recent years, the Tokyo market has been showing signs of overheating.

Property prices in Hong Kong and Singapore soared by double digits after the financial crisis due to capital shifting towards emerging economies. Subsequently, Singapore managed to cool down the housing market through a variety of regulatory measures. For five years now, prices have been falling modestly and the market is currently fairly valued, according to the index. In Hong Kong, however, regulatory steps to reduce the dynamics of price growth were less effective. The city reentered bubble risk territory in 2015, the housing market apparently topped out, and prices have been falling rapidly in the past year.

Sydney’s housing market has been overheating since the city became a target for Chinese investors several years ago. While Sydney showed the lowest index score of all our covered APAC cities in 2012, the market now ranks in the bubble risk category and tops all other cities in the region.

UBS Global Real Estate Bubble Index

APAC



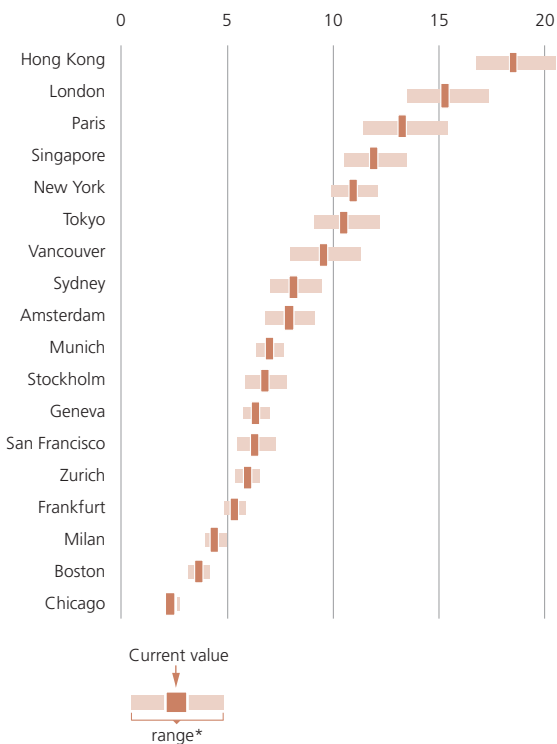
Benchmarking confirms alert signals

Global cities' benchmarks

Price-to-income

The number of years a skilled service worker needs to work to be able to buy a 60 m² flat near the city center.

Buying a 60m² apartment exceeds the budget of most people in most world cities who earn the average annual income in the highly skilled service sector. In Hong Kong, even those who earn twice the average income would struggle to afford an apartment of that size. House prices have also decoupled from local incomes in London, Paris, Singapore, New York and Tokyo, where **price-to-income** (PI) multiples exceed 10. Unaffordable housing is often a sign of strong investment demand from abroad and tight rental market regulations. If investment demand weakens, the risk of a price correction will increase and the long-term appreciation prospects will shrink. In contrast, housing is affordable in Chicago, Boston, Milan and Frankfurt, which limits the risk of a price correction in these cities. Due to relatively high incomes, purchasing an apartment is also still feasible for residents of San Francisco and most European cities, with the exception of Paris and London.



Price-to-rent

The number of years a flat of the same size needs to be rented to pay for the flat.

Vancouver and Zurich have the highest **price-to-rent** (PR) ratios, followed by Munich. Their extremely high PR multiples indicate an undue dependence of housing prices on low interest rates. Overall, more than half of the covered cities have PR multiples above 30. House prices in all these cities are vulnerable to a sharp correction should interest rates rise. PR values below 20 are found only in the US cities of San Francisco, Boston and Chicago. Their low PR multiples reflect, among others, a relatively mildly regulated rental market. Conversely, rental laws in France, Germany, Switzerland and Sweden are strongly pro-tenant, preventing rentals from reflecting true market levels.



Source: UBS. Remark: For explanation see the section on Methodology & data on page 17.
 * Uncertainty range due to differing data quality

London



Fragile equilibrium

Key facts

The *UBS Global Real Estate Bubble Index* score for London is 2.06, in bubble-risk territory.

Price growth at a double-digit rate since 2013 has decoupled house prices from local household earnings and rents. Only Hong Kong exhibits worse affordability levels.

Ample financing liquidity and tight supply should be able to sustain the inflated prices for the time being.

Since 2013, London's property prices have increased at a double-digit rate every year, leading to a 50% rise in values in inflation-adjusted terms. Over the last four quarters property prices in London have increased by almost 10%, outpacing those in the rest of the country by more than seven percentage points.

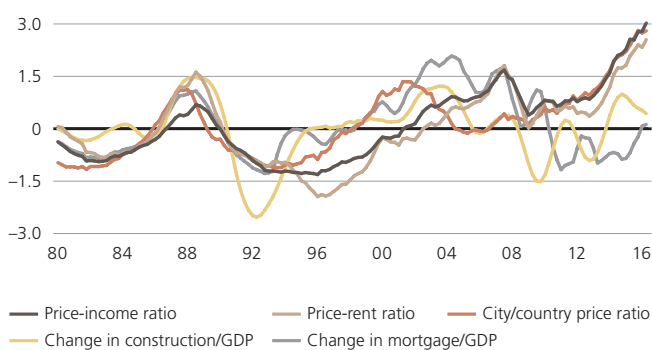
The *UBS Global Real Estate Bubble Index* score rose further to 2.06 by midyear, which is in bubble-risk territory. Real prices now are 15% higher than at the 2007 market peak, while real incomes are 10% lower. It now takes a skilled service-sector worker approximately 15 years of average earnings to be able to buy a 60m² dwelling.

High stamp-duty rates for luxury properties and new stamp-duty rates for buy-to-let have failed to cool down the broader housing market. However, prices for the high end are stagnating, reflecting an end to the global boom for luxury properties. While buyers from overseas matter for the prime market, their overall impact on the housing market should not be overstated. The renewed GBP depreciation following the UK's vote to leave the EU may be seen as an entry point into the London market for international buyers. But we expect economic uncertainty and the ample supply of high-end developments to deter a renewed luxury boom.

The Bank of England's easing policy may add support to the already overheated market in the short term. We advise caution, however, as the *UBS Global Real Estate Bubble Index* and the cross-sectional benchmarks point to the risk of a substantial price correction. A severe recession – which we do not expect – could halt the unsustainable price growth fueled by ample liquidity and tight supply.

London's housing prices continue to rise

Development of sub-indices, standardized values



Hong Kong



In the midst of a correction

Key facts

With a score of 1.52, the housing market is in bubble-risk territory, according to the *UBS Global Real Estate Bubble Index*, despite a significant decrease over the past year.

Following a perennial increase of real estate prices, the market reached a peak in mid-2015 and prices have corrected by almost 10% in real terms since then.

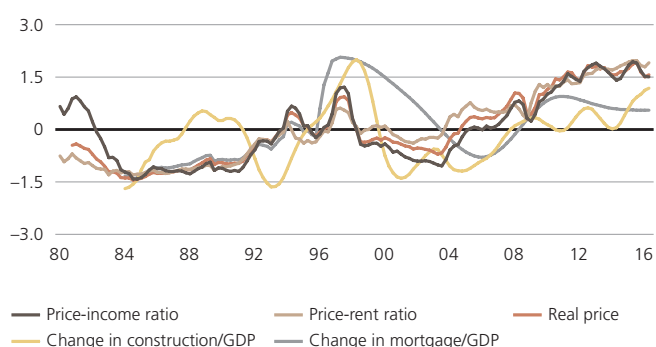
A record-high price-to-income ratio of 18.5 and a price-to-rent ratio of 34 point to still unsustainable price levels.

Since the all-time high valuation in mid-2015, residential market prices have been exhibiting a negative trend and have corrected by almost 10% in inflation-adjusted terms. This drop appears modest, considering that between 2003 and 2015, the price level tripled. The *UBS Global Real Estate Bubble Index* score for Hong Kong has decreased significantly, but is still in bubble-risk territory. The negative trend in prices is affecting the rental market, where rents are now down 8% from last year's peak.

Real incomes have virtually stagnated in Hong Kong for many years. As a consequence, the affordability of housing is the lowest among the cities considered, and the average living space per person amounts to only 14m². The recent price decrease has brought only a minor relief as buying a 60m² flat costs more than 18 years' income. However, affordability should improve somewhat as we expect further downward pressure on residential property prices.

Hong Kong market has passed the peak

Development of sub-indices, standardized values



The negative outlook is a consequence of supply growth and weak demand. Construction activity points to the strongest increase of the housing stock since 2004, while lackluster economic growth will keep local demand subdued. Moreover, growth uncertainty in the region, low rental yields and high stamp duties on property transactions for foreigners discourage international capital flows into the housing market. Finally, possible US interest rate hikes would translate into higher local rates, which would be detrimental for property values.

Zurich



Affordability rules a drag for price growth

Key facts

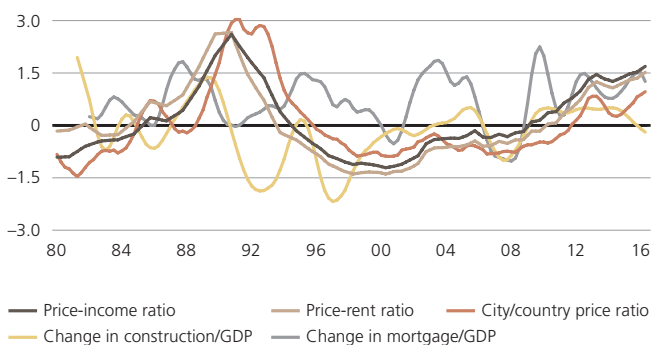
The *UBS Global Real Estate Bubble Index* score for Zurich is 1.03, which is in the overvalued territory.

While house prices have surpassed their previous peak in 1990, a price-to-income multiple of 6 is low in comparison to cities globally.

Tight regulations reduce the number of households that can afford a property, limiting future price growth.

Price growth outpaces growth in rents and incomes

Development of sub-indices, standardized values



According to *UBS Global Real Estate Bubble Index*, Zurich's residential market is overvalued. The annual real growth rate of property prices in Zurich in the second quarter of 2016 equaled 4%. Real prices are now 6% higher than at the previous peak in 1990 and over 55% higher than 10 years ago. Despite the price increases, affordability is still relatively sound. Buying a 60m² property in Zurich costs a skilled-service worker less than six years' income – a low number compared to cities globally, especially as wages in Zurich top all other cities. Moreover, the city has the best private rental market affordability of all financial centers included in the index.

The world's lowest interest rates have not triggered an acceleration of price growth in recent years as strict affordability rules, down-payments and newly introduced amortization requirements restrict bank lending. Consequently, a falling number of households can fulfill all the requirements for external financing, limiting the prospects for further price growth. There has also been a significant increase in construction activity within the city on top of already rising vacancy rates in the periphery.

Buying a medium-segment property in Zurich pays off after 37 years as measured by the price-to-rent ratio. This number is one of the highest worldwide and has even increased slightly over the last year as the housing market keeps attracting investors in light of the countrywide scarcity of investments. Thus, home prices in Zurich are highly sensitive to interest rates as a rate rise has a greater effect on purchase prices when yields are low.

Singapore



Fairly valued but correction continues

Key facts

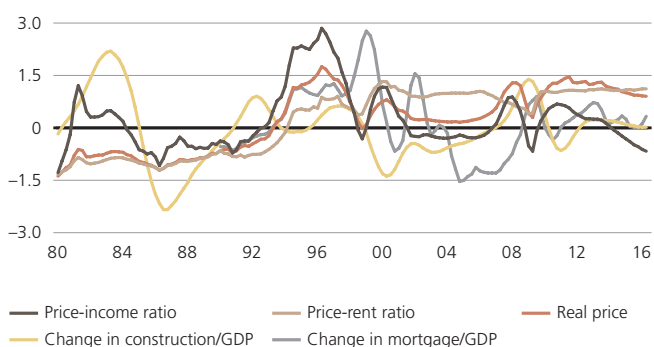
The *UBS Global Real Estate Bubble Index* score for Singapore is 0.45, which is in the fairly-valued territory.

Growth uncertainty and possible hikes in bond yields overshadow the outlook. However, construction numbers are expected to decline significantly in the coming years.

We expect the downward trend of house prices to continue for the next year.

Correction is not over yet

Development of sub-indices, standardized values



In the aftermath of the financial crisis between 2009 and 2011, the residential property market in Singapore appreciated by 50% in real terms. However, since the market peaked in 2011, real prices have corrected steadily by more than 15% in total. This is the longest uninterrupted real price correction in more than 40 years. In light of rising vacancy rates, real rents have dropped as well, by about 15% since 2011. According to *UBS Global Real Estate Bubble Index*, the market is now fairly-valued after being over-valued last year.

Because of solid economic growth, Singapore's household incomes have increased by almost 20% since 2011. Despite this success story, the housing market will likely deteriorate further in values, rents and occupancy rates as supply outpaces demand growth. Private market housing is still hardly affordable as the price-to-income ratio for a 60m² flat is still at an elevated level of 12 (public housing, however, represents 80% of the total market). Moreover, multiple rounds of restrictive government policies to cool down the property market have weakened demand. As a result of buoyant supply, vacancy rates have increased from 6% to 9% in the last three years. Hence, we anticipate an ongoing price correction for the next year.

On the other hand, due to the difficult market environment, supply growth is contracting. Housing permits have reached the lowest point since the early 1990s, which may prepare the ground for a turnaround in the medium-term.

New York



Price uptrend stalled

Key facts

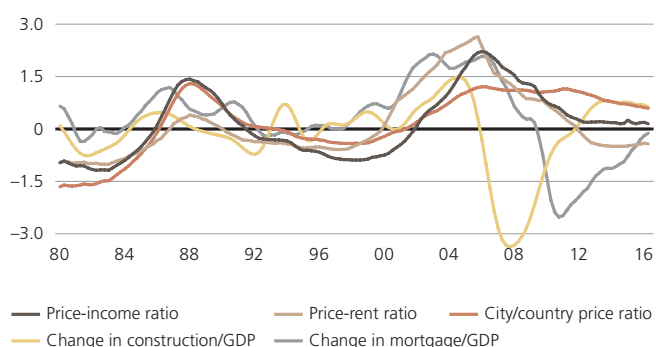
The *UBS Global Real Estate Bubble Index* score for New York is 0.13, which is in the fairly-valued territory.

The rebound in price growth rates has largely run out of steam, particularly at the high end. Growth rates in the second quarter halved compared to the previous year and remain below the countrywide average.

Supply expansion and the prospect of higher mortgage rates should dampen any overly optimistic price expectations in the short run.

Downside risks limited

Development of sub-indices, standardized values



Real house prices in the New York metropolitan area are almost 25% lower than they were 10 years ago. In the second quarter of 2016, residential prices increased by less than 2% in inflation-adjusted terms, about half the previous year's rise. It was the fourth consecutive year that real price growth in New York lagged the US average. The *UBS Global Real Estate Bubble Index* remains virtually unchanged in the fairly-valued territory, with a score of 0.13. Nevertheless, the city remains one of the most expensive and unaffordable cities in the world. A skilled-service worker from the New York area would need to work for about 11 years to buy a 60m² flat near the city center.

Most notably, rents are more than 50% higher in real terms than they were in 2006, making New York rents one of the highest worldwide. Consequently, the price-to-rent of 27 in Manhattan is below average compared to the other financial centers.

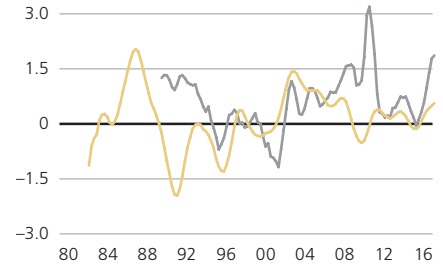
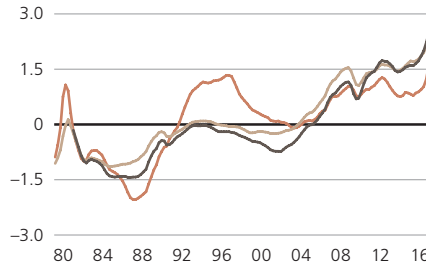
In Manhattan, house prices dynamics were stronger in the last couple of years than in the overall New York region, propelled by demand from global investors and a series of new luxury developments. The tide has turned, however, as the luxury market looks increasingly oversupplied.

A historically fair valuation, wage growth and low interest rates are supportive and should limit downside risk for the broader housing market. However, the ongoing supply expansion, strained affordability and the prospect of higher mortgage rates in upcoming years should also prevent faster price growth for the time being.

Select cities

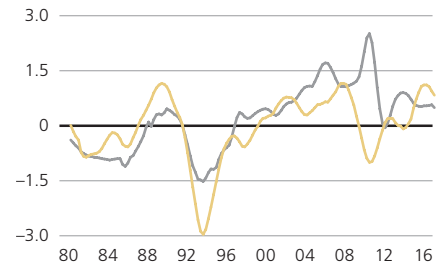
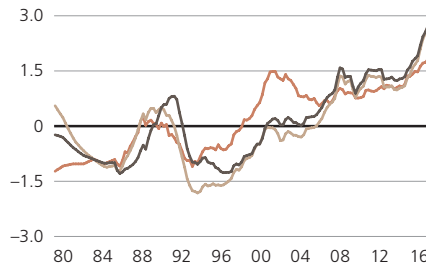
Vancouver 2.14 – bubble risk

Real house prices have increased by more than 25% since the end of 2014 in the wake of a weak Canadian dollar which apparently stimulated Asian demand even further. Moreover, loose credit conditions have offset the economic slowdown due to weak commodity prices. Mortgage growth rates have been accelerating lately. In response to still-high foreign demand, the local government has introduced an additional property tax for non-resident investors. The risk of a substantial price correction appears very elevated.



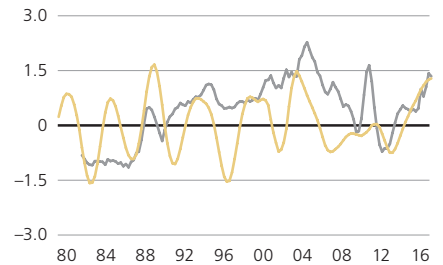
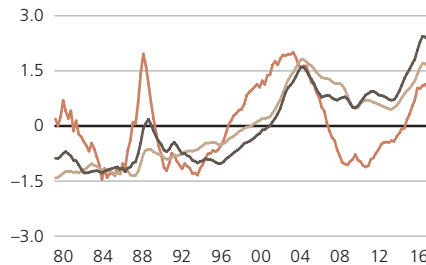
Stockholm 1.92 – bubble risk

Over the last 12 years, the real house price level in Stockholm has doubled. The pace of growth accelerated in the last two years as growth rates stood near 15%. However, lending rates declined swiftly, so that the cost of owning a house remained relatively stable. A dysfunctional rental market provides no incentives to counteract the long-lasting supply shortage. And recently enacted regulations to cool down the housing market have not shown any significant results yet.



Sydney 1.70 – bubble risk

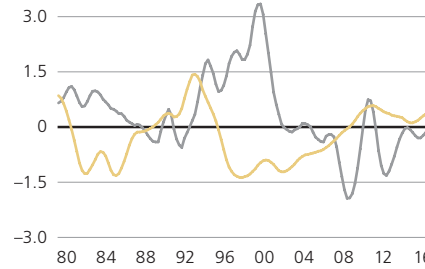
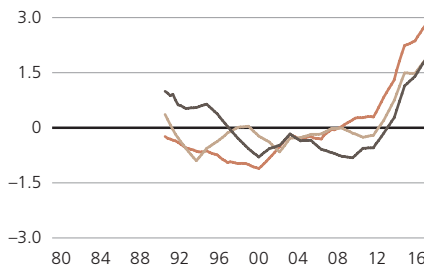
Real housing prices peaked in the second half of 2015 after an increase of 45% since mid-2012. Since then, prices have corrected by a low single-digit. The Australian residential market is influenced by a rapidly growing foreign demand (in particular, Chinese), which has tripled in value over the last three years. Increasing supply and further tax measures to reduce foreign housing investments may end the price boom rather abruptly.



Price-income ratio
 City/country price ratio
 Change in construction/GDP
 Change in mortgage/GDP

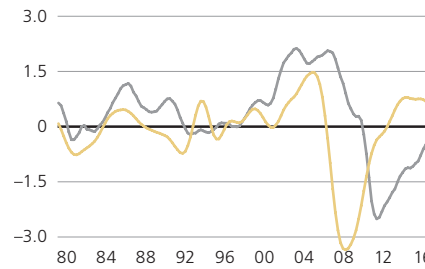
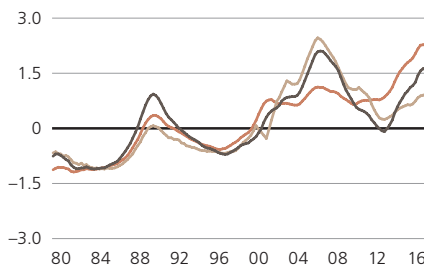
Munich 1.59 – bubble risk

Germany's economic boom and very expansionary monetary policy ended 20 years of real house price stagnation in 2010. Subsequently, Munich property prices rose by double digits and have increasingly lost touch with economic fundamentals. Affordability has also worsened in recent years. It now takes a skilled-service worker seven work years, an all-time high, to buy a 60m² flat.



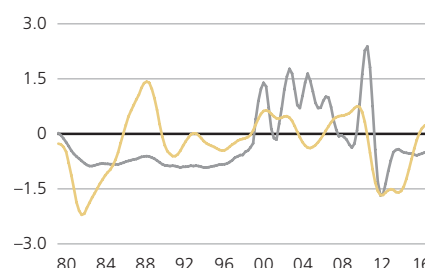
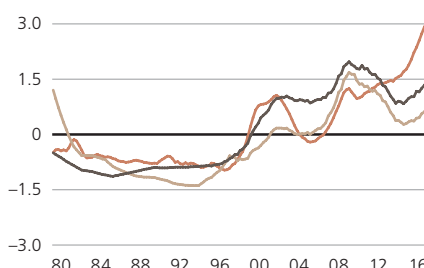
San Francisco 1.27 – overvalued

In the wake of the technology boom and buoyant foreign demand, real house prices have increased in San Francisco by more than 50% since 2011, while the national price level has risen by just 15%. Moreover, the price level in the City by the Bay has surpassed the previous peak in 2006 by 5%. Even though income growth rates have been above the national rate, the imbalances in the city's real estate market have increased.



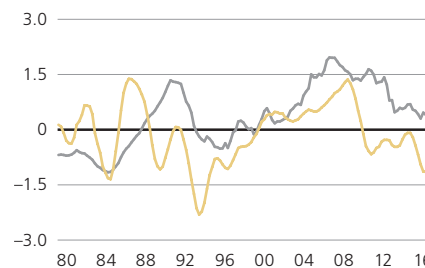
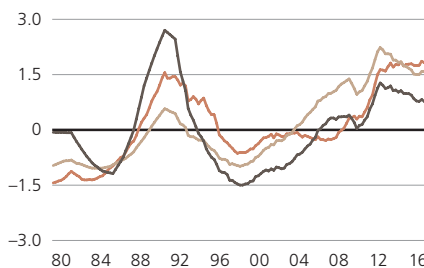
Amsterdam 1.22 – overvalued

House price growth in Amsterdam accelerated to an unsustainable rate of almost 15% over the last four quarters. Since the market bottomed in 2013, real prices have grown 25%, way above the national average of roughly 5%. The imbalances in the market have increased as income and rental growth have remained relatively low and have not been able to keep pace with prices since 2014.



Paris 0.82 – overvalued

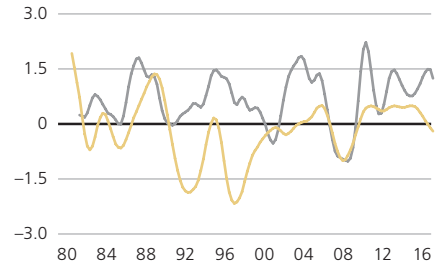
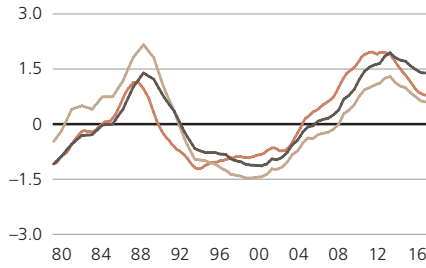
Between 1998 and 2011, real prices for housing almost tripled. Since then, they have corrected by almost 10% and virtually stagnated last year. Still, the recent correction is nowhere near offsetting the significant overvaluation. Although incomes have increased faster than prices since 2012, housing affordability remains low, limiting a renewed price recovery.



— Price-income ratio — City/country price ratio — Change in construction/GDP — Change in mortgage/GDP
 — Price-rent ratio

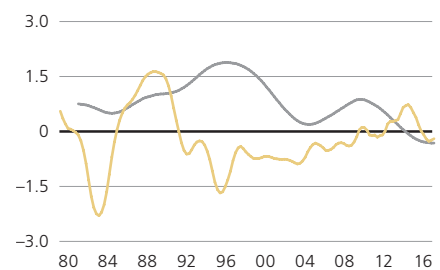
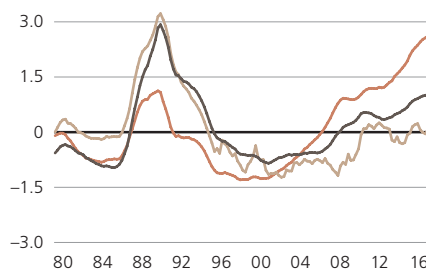
Geneva 0.75 – overvalued

Market valuations have cooled down significantly over the last four years. Between 2000 and 2012, real house prices more than doubled. However, since 2012, prices have corrected by 6%, while national price growth rates have remained positive. Regulatory measures impair the already strained affordability, limiting further price growth. The meager supply growth in the region, however, restricts further corrections in the short run.



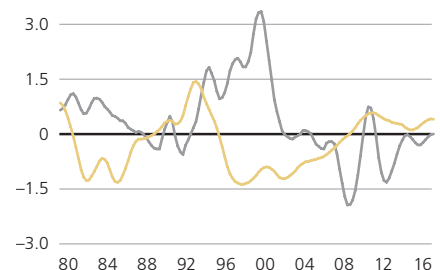
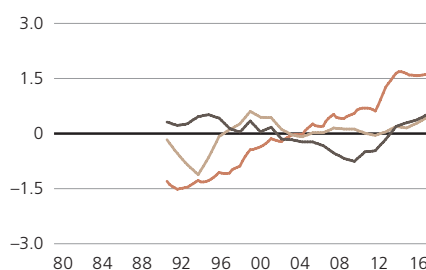
Tokyo 0.68 – overvalued

While the nationwide house price level has corrected strongly, Tokyo's real prices have increased by 60% since the market bottomed in 2000, decoupling from the rest of Japan. The long-running expansive monetary policy has not boosted the economy. Moreover, real incomes have decreased by about 10% since 2000 in Tokyo. Housing affordability is strained as a skilled service-sector worker needs to work 10–11 years to buy a 60m² flat.



Frankfurt 0.66 – overvalued

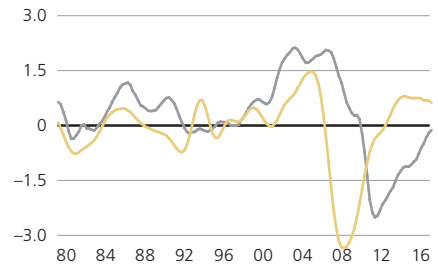
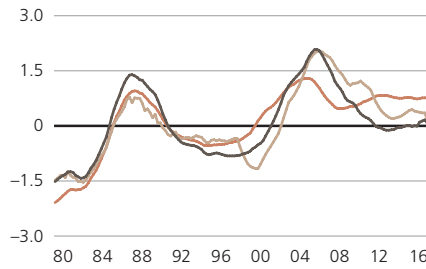
Real house prices have climbed by 30% since the boom began in 2011. In light of the modest single-digit growth in real incomes, housing affordability has declined somewhat in the past few years. Recently, local price growth has regained momentum but growth rates remain in line with the countrywide average. Overvaluation and the risks of a correction seem modest. If Frankfurt is able to improve its standing as a European financial center, further price appreciation is likely.



Price-income ratio
 City/country price ratio
 Change in construction/GDP
 Change in mortgage/GDP
 Price-rent ratio

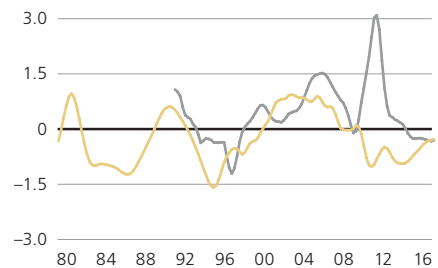
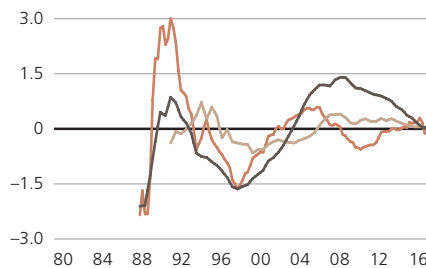
Boston **0.29 – fair-valued**

House prices have increased by almost 15% in real terms over the last four years. Over this period incomes rose by 10%, keeping housing comparatively highly affordable. A 60m² flat costs only about four years' salary of a skilled service-sector worker. The robust tech-driven local economy has not triggered a strong price boom as supply has kept pace with demand.



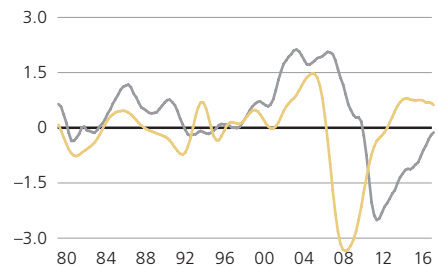
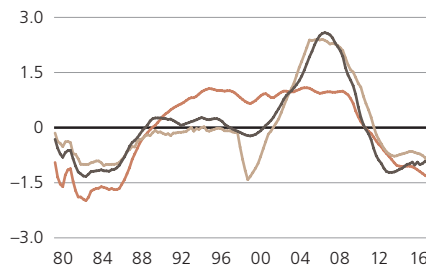
Milan **-0.09 – fair-valued**

Prices have been contracting for several years due to the combination of a credit crunch and sluggish economic growth. Depending on the location, prices now are as much as 30% lower than in 2007. The sharp decline in mortgage rates and international investor demand following the Expo and the completion of new developments should support the market, whilst the challenging economic outlook hampers a full market recovery for now.



Chicago **-0.70 – undervalued**

After a severe correction of 35% in real terms between 2006 and 2012, house prices have only recovered by 10% over the last four years. The pace of price recovery has been weak due to relatively high unemployment and fiscal problems. Very low price-to-income and price-to-rent multiples mirror the low valuation of the housing market. However, good affordability and the recent economic recovery have led to falling vacancy rates.



— Price-income ratio — City/country price ratio — Change in construction/GDP — Change in mortgage/GDP
 — Price-rent ratio

Methodology & data

UBS Global Real Estate Bubble Index

Price bubbles are a regularly recurring phenomenon in property markets. The term bubble refers to a substantial and sustained mispricing of an asset. Their existence cannot be proven conclusively unless they burst, but recurring patterns of property market excesses are observable in the historical data. Typical signs are a decoupling of prices from local incomes and rents, and distortions of the real economy, such as excessive lending and construction activity. The *UBS Global Real Estate Bubble Index* gauges the risk of a property bubble on the basis of such patterns.

The index traces the fundamental valuation of housing markets, the valuation of cities in relation to their country and economic distortions (lending and building booms). Tracking current values, the index uses the following risk-based classifications: depressed (score below -1.5), undervalued (-1.5 to -0.5), fair-valued (-0.5 to 0.5), overvalued (0.5 to 1.5) and bubble risk (above 1.5). This classification is aligned with historical bubble episodes.

The index score is a weighted average of the following five standardized city sub-indices: price-to-income and price-to-rent (fundamental valuation), change in mortgage-to-GDP ratio and change in construction-to-GDP ratio (economic distortion) and relative price-city-to-country indicator. The price-city-to-country indicator in Singapore and Hong Kong is replaced by an inflation-adjusted price index. The approach cannot fully satisfy the complexity of the bubble phenomenon. We cannot predict if or when a correction will happen. Hence, "bubble risk" refers to the prevalence of a high risk of a large price correction.

The sub-indices are constructed from specific city-level data, except for mortgage-to-GDP and construction-to-GDP ratios, which are calculated on the country level. Publicly available data is used in most cases. In a few cases, the

data consists of or is supplemented by additional sources, including the results of *UBS Prices & Earnings survey*. The index length varies by city depending on data availability. The longest data series starts in 1975, the shortest in 1990. For time series shorter than 30 years, the coefficient of variation of an equivalent indicator on the country level is used as a floor value to calculate the volatility of the city-level indicator. The availability of data was also a criterion when including the cities in the index. We considered the importance of the city for global financial markets and residential real estate investments. Please see the description of data sources on page 18.

The weights of the sub-indices are determined using factor analysis, as recommended by the *OECD Handbook on Constructing Composite Indicators (2008)*. Factor analysis weights the sub-indices to capture as much of the common underlying bubble risk information as possible. As the drivers of bubbles vary across the cities, the method results in city-specific weights on sub-indices. These weights are also subject to minor changes when new data enters into the calculation or past data is revised.

Benchmarking

The analysis is complemented by a city benchmarking using current price-to-income (PI) and price-to-rent (PR) ratios. The PI ratio indicates how many years a skilled service worker needs to work to be able to buy a 60m² flat near the city center. The PR ratio reveals how expensive owner-occupied homes are relative to rental apartments. The higher the ratios, the more expensive buying becomes. Earnings data is taken primarily from *UBS Prices and Earnings 2015 survey* and from official statistical sources. Real estate prices and rents range widely near the city center. Our estimates are cross-checked and validated using different sources. However, we also specify an uncertainty range due to the differing quality of our data sources.

UBS Global Real Estate Bubble Index data sources

		Price Index (City)	Rent Index (City)	Income Index (City)	Price Index (Country)	Mortgage, Construction, GDP, Inflation (Country)
New York	2016Q2	FHFA	CBRE, FED St. Louis	BEA	FHFA	FED, BEA, Bloomberg
Boston	2016Q2	FHFA	CBRE, FED St. Louis	BEA	FHFA	FED, BEA, Bloomberg
Chicago	2016Q2	FHFA	CBRE, FED St. Louis	BEA	FHFA	FED, BEA, Bloomberg
San Francisco	2016Q2	FHFA	CBRE, FED St. Louis	BEA	FHFA	FED, BEA, Bloomberg
Amsterdam	2016Q1	CBS, Maastricht University	NVM, UBS P&E	UBS P&E, Bloomberg	CBS, FED Dallas	DNB, CBS, EUKLEMS, Bloomberg
Hong Kong	2016Q2	RVD	RVD	Census and Statistics Department Hong Kong, Bloomberg	RVD	Census and Statistics Department Hong Kong, HKMA, Bloomberg
Singapore	2016Q2	Government of Singapore	Government of Singapore, UBS P&E	Government of Singapore	Government of Singapore	Government of Singapore, Bloomberg
Sydney	2016Q1	REIA, ABS	REIA, NSW Government, UBS P&E	ABS, UBS P&E	FED Dallas	ABS, RBA, Bloomberg
Tokyo	2016Q2	The Real Estate Transaction Promotion Center, Haver Analytics	Miki Syoji, Official Statistics of Japan	INDB, Tokyo Metropolitan Government, UBS P&E	FED Dallas	ESRI, EUKLEMS, Bloomberg
Vancouver	2016Q1	Sauder School of Business UBC, Bloomberg	Canadian Housing Observer, Sauder School of Business UBC	Statistics Canada, Government of British Columbia	FED Dallas	Statistics Canada, BoC, Bloomberg
Zurich	2016Q2	Wüest & Partner	Statistik Stadt Zürich	FTA, FSO	Wüest & Partner	SNB, SECO, BFS
Geneva	2016Q2	Wüest & Partner	Statistique Genève	FTA, FSO	Wüest & Partner	SNB, SECO, BFS
Paris	2016Q1	BIS, CGEDD	CGEDD, Clameur, UBS P&E	Insee, Bloomberg, UBS P&E	FED Dallas	BdF, Insee, EUKLEMS, Bloomberg
London	2016Q2	Nationwide, Lloyds Banking Group	ONS, UBS P&E	ONS	Nationwide, Lloyds Banking Group	BoE, ONS, EUKLEMS, Bloomberg
Frankfurt	2015Q4	Bulwiengesa	Bulwiengesa, OECD	Destatis, UBS P&E, OECD	FED Dallas	Deutsche Bundesbank, Destatis, EUKLEMS, Bloomberg
Munich	2015Q4	Bulwiengesa	Bulwiengesa, OECD	Destatis, UBS P&E, OECD	FED Dallas	Deutsche Bundesbank, Destatis, EUKLEMS, Bloomberg
Milan	2016Q2	Nomisma	Nomisma, OECD	Dipartimento delle Finanze, UBS P&E	FED Dallas	Banca d'Italia, Hypostat, Istat, EUKLEMS, Bloomberg
Stockholm	2016Q1	Statistics Sweden	Statistics Sweden, UBS P&E	Statistics Sweden, UBS P&E	Statistics Sweden	Statistics Sweden, Bloomberg

Benchmarking sources

	Earnings	Real Estate (prices and rents)
New York	BEA	Elliman, Zillow, Globalpropertyguide.com
Boston	BEA	Zillow, CBRE
Chicago	BEA	Zillow, CBRE
San Francisco	BEA	Zillow, CBRE
Amsterdam	UBS P&E 2015	NVM, Globalpropertyguide.com
Hong Kong	UBS P&E 2015, Census and Statistics Department Hong Kong	Hong Kong Statistical Office
Singapore	Department of Statistics Singapore, Demographia.com	Government of Singapore
Sydney	UBS P&E 2015, ABS	REIA, Globalpropertyguide.com
Tokyo	UBS P&E 2015	Globalpropertyguide.com, numbeo.com
Vancouver	Statistics Canada (2014), BC Statistics	Canada mortgage and housing corporation (CMHC), Globalpropertyguide.com
Zurich	UBS P&E 2015, Federal Income Tax Statistics 2013, FSO	Wüest & Partner
Geneva	UBS P&E 2015, Federal Income Tax Statistics 2013, FSO	Wüest & Partner
Paris	UBS P&E 2015	Globalpropertyguide.com, numbeo.com
London	UBS P&E 2015	GLA datastore, findproperly.co.uk
Frankfurt	UBS P&E 2015, Destatis	Bulwiengesa, Globalpropertyguide.com
Munich	UBS P&E 2015, Destatis	Bulwiengesa, Globalpropertyguide.com
Milan	UBS P&E 2015, Dipartimento delle Finanze	Nomisma
Stockholm	UBS P&E 2015, Statistics Sweden	Statistics Sweden, Globalpropertyguide.com

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