the review of income and wealth

Review of Income and Wealth
Series 0, Number 0, July 2023
DOI: 10.1111/roiw.12658

IS THE HOUSING MARKET AN INEQUALITY GENERATOR?

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We study inequality generated by capital gains in the housing market by exploiting two countrywide data sources in Norway: a registry of housing units and a database of transactions. We identify and follow all individuals in six birth cohorts in Norway, who were owners on January 1, 2007, and on January 1, 2019, and estimate the sum of their actual and potential capital gains from their owned and sold properties. We demonstrate that there is a substantial increase in capital gains inequality over the period, both across and within geographical strata and across and within birth cohorts. We find a statistically significant and economically meaningful difference between the distributions of capital gains of female and male owners in Oslo.

JEL Codes: D30, R21, R31

Keywords: capital gains, housing inequality, owner-occupiers

1. INTRODUCTION

Inequality is a topic that sits atop many contemporary discussions on economic challenges. From these discussions it has become apparent that there is a demand for understanding the sources of inequality. Such an understanding starts with a documentation of patterns and facets of inequality, and so economists have started to map different trends and regularities. At the same time, the interest among economists into inequality and its generators is increasing. However, studies

Note: The authors are grateful to André Kallåk Anundsen, Andreas Eriksen, Jeanette Fjære-Lindkjenn, and Dag Einar Sommervoll for comments and suggestions. The authors are grateful to Eiendomsverdi for data access. The authors also used open data from Statistics Norway (income) and the house price index of Real Estate Norway. The authors thank participants and discussants at the 2023 ASSA-AREUEA conference and the 94th Western Economic Association International conference, in addition to participants at seminars and workshops, including useful input from presentations at the Ministry of Finance and Norges Bank. Housing Lab receives partial funding from the Norwegian Ministry of Finance, the Norwegian Ministry of Local Government and Regional Development, SpareBank 1, and OBOS. This financial support is without constraints or conditions. Earlier in the project, we also received funding from Selvaag Bolig, with no constraints or conditions.

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of inequality typically examine aspects such as wages, income, and consumption (Heathcote et al. 2010; Furceri et al. 2018; Blundell and Etheridge 2010; and Attanasio and Pistaferri 2016). Although many studies use examinations of repeat cross-sections, it appears that fewer studies follow panels of individuals over a substantial period of time. Even fewer studies follow individuals in the housing markets across multiple years and multiple transactions to investigate the time development of the inequality created by individual accumulation of capital gains in the housing market. One reason for this paucity of analysis is the lack of data on individual owners across multiple years. Analysts of housing capital gains inequality need unique identifiers of individuals, houses, and transactions to be able to estimate capital gains by following individual owners over years. Moreover, to create a data set of capital gains accumulation over longer observation periods for owners who do not sell, but continue to own the unit, analysts need accurate valuation methods based on a sufficient number of observed attributes. This article uses a data set that is a combination of multiple data sources to overcome these challenges. It asks one simple question: Is the housing market an inequality generator?

Our study answers in the affirmative, and our contribution lies in presenting findings from novel data, mapping capital gains inequality, and econometric estimation of relationships. It consists of three key empirical findings on capital gains inequality. First, capital gains inequality increases over the time-period January 1, 2007–January 1, 2019. Second, capital gains inequality displays substantial variability along spatial, cohort, sex, and ownership share dimensions. Third, capital gains inequality is tied to income development. Let us complement the in-depth analysis by mentioning a few statistics. For example, the Gini index of house values January 1, 2007, was 0.26. On January 1, 2019, it was 0.29. In the segment of owners who have owned a unit in Oslo, the 90th percentile of capital gains 2007–2019 is NOK 3.35 million. For comparison, the average monthly wage in Norway in 2019 across all sectors was NOK 45,610; thus the 90th percentile of capital gains is almost 80 times larger than the average monthly wage before tax. At the same time, the 90th percentile of 2007–2019 capital gains among owners who always owned outside of Oslo is NOK 1.67 million. The difference between the 90th percentiles in the Oslo segment and the non-Oslo segment indicates substantial dispersion in housing capital gains.

When we partition owners into 20 groups of owned values on January 1, 2007, and sort by magnitudes, we find that the capital gain over the period 2007–2019 for each of these 20 groups was not only a curve with a positive slope but also a curve with an increasing slope. The group with the highest top five percentiles of owned values in 2007, that is, group 20, experienced a capital gain over the next 12 years of NOK 3,048,110, whereas the group with the second-highest owned values in 2007, that is, group 19, experienced capital gains of NOK 1,978,560. The implication is that group 20 had 54 percent larger capital gains than group 19. Group 19 in turn had 115 percent larger capital gains than group 10, which had capital gains of NOK 918,885.

To obtain these empirical findings, we combine data sources that allow us to follow individual owners over the 12-year period and to estimate the value of a non-transacted unit: a registry of all housing units and their owners and a registry of transaction data. We follow the same individuals instead of using repeat

cross-sections of different individuals because we want to control for composition effects. Because repeat cross-sections may consist of different individuals, unobserved heterogeneity may obfuscate the implications of the results. Thus, we first identify every individual, among six birth cohorts spanning the period 1965–1990 in 5-year intervals, that is, 1965, 1970, 1975, 1980, 1985, and 1990[1] who owned a home on January 1, 2007, and on January 1, 2019.

We then follow these individuals for 49 quarters (12 years and one quarter). We combine capital gains results with aggregate income data for each Norwegian municipality for the period 2007–2017 to find out how income is linked to capital gains inequality in the housing market across municipalities.

We limit our study to individual owners and do not study the inequality that arises between owners and tenants. We also exclude firms. We cannot follow households as the mapping of individuals into households is outside the scope of this article, but we present analysis of segments that simulate households of one and two members. Our focus of attention is on individual, private owners because in Norway ownership is bestowed on individuals through ownership shares.[2] We do include owners who hold more than one unit. We also include individuals who own shares of a unit by co-owning with a spouse, a partner, or a friend.

We focus attention on capital gains and compute the capital gains each owner accumulates for each ownership period and each share, and we estimate the capital gains for units they have owned throughout, units they have owned and sold, and units they have purchased and still own on January 1, 2019. Our data consist of 77,554 owners who owned a share in at least one housing unit at the start of the period (January 1, 2007) and at the end of the period (January 1, 2019).

To compute the potential gains for each owner in each quarter, also when they hold without selling, we employ Eiendomsverdi's automated valuation model (AVM). In the appendix, we demonstrate the validity of this approach by showing the high precision of the AVM.[3]

We study only the capital gains individuals have enjoyed in the housing market, and not gains from changes in labor income, payments on principal, inheritance, stock market returns, or any other source of wealth accumulation. The idea is to zoom in on the housing market only and the gains made therein.

Thus, we do not study debt nor leverage. Let us present an example that clarifies our ideas. Jensen and Hansen borrow NOK 2 million and NOK 4 million, respectively, to purchase houses at NOK 10 million and NOK 5 million. Both houses appreciate 20 percent to NOK 12 million and NOK 6 million, respectively. Jensen's equity has increased from NOK 8 million to NOK 10 million, that is, by NOK 2 million or 25 percent. Hansen's equity has increased from NOK 1 million to NOK

[1]There are only 72 individuals from 1990 in our panel. They are included to shed light on the development among very young owners.

[2]A couple may own the same house together, and then each will have an ownership share. The sum of the two shares is unity, for example, 0.5 and 0.5 or 0.7 and 0.3.

[3]For this exercise, we use the 23,374 transacted units among the 77,554 owners in the six birth cohorts. We compute the spread between estimated value and observed transaction price as percentage of observed transaction price. The median spread is −1.3 percent. The 10th and 90th percentiles are, respectively, −12 percent and 11 percent.

2 million, that is, by NOK 1 million or 100 percent. Arguments can be made to use both the level of capital gains and percentage returns to equity when the topic is inequality, but they do not yield the same answer to the question of who have had the most advantageous outcome. Hansen's equity increased by 100 percent compared to Jensen's increase of 25 percent, whereas Jensen's capital gains in nominal terms increased by NOK 2 million, which is larger than Hansen's of NOK 1 million. This article chooses to focus attention on the capital gains in nominal terms. These capital gains are directly translatable to purchasing power because households can downsize and use capital gains to purchase market goods or they can borrow against them in home equity withdrawal. We underline our thinking by pointing to the extreme case in which Olsen's equity increases from NOK 1 to NOK 11. In that situation, equity increases by 1,000 percent, but the capital gains are negligible.

In fact, we abstract away from debt in our attempt to answer whether the housing market is an inequality generator. Our thinking is that if Jensen and Hansen use leverage in different ways and obtain different returns to equity based on their choice of leverage, these differences are a matter of inequality of access to credit or inequality of financial acumen, not inequality generated in the housing market. Indeed, our aim is to isolate the housing market as an inequality generator from all other sources of inequality. This choice of focus separates our contribution from Fagereng et al. (2020a), who study returns to wealth in Norway. Whether the housing market is an inequality generator in and of itself is a separate question from the question of heterogeneity in returns because the latter involves differences in access to, and use of, debt and thus leverage.

We believe our exercise is useful because the results may be relevant when policymakers think about the sources of inequality and whether or not they can or want to do something about it. Although multiple authors have mapped sources and effects of inequality arising from differences in income, ability, consumption, and financial wealth, fewer have been able to map the differences in purchasing power that arises with differences in housing capital gains. We want to examine whether the housing market is a systematic source of inequality, and if so, the magnitude of the wealth accumulation it offers.

This article is organized in the following way. Section 2 presents a brief literature review. Section 3 describes the data, the institutional framework, and the principles behind the AVM we employ. In Section 4, we go through our inequality framework and present a few motivating, basic patterns seen in the data. Section 5 comprises our main empirical results. Section 6 discusses the geographical dimension, the relationships between income developments and capital gains developments on a municipality level, differences between sexes, and differences between household composition simulated through ownership shares. Section 7 concludes and offers policy implications.

2. Literature

There exists a large research literature on the housing market, and there is also a substantial literature on inequality. However, the literature on the intersection of the housing market and inequality is smaller. This article's literature review is meant as a brief overview, in which we place relevant articles in a circle of interest surrounding

a topic center of capital gains inequality. The underlying idea of this arrangement is that capital gains inequality is related to many other studies by common themes such as determinants, units of study, and empirical techniques, but that these studies come from an array of branches of economics.

For example, Krueger and Perri (2006) ask whether income inequality leads to consumption inequality. They find that the increase in income inequality does not spill over into a corresponding rise in consumption inequality. They measure consumption as a flow of goods and services, and the consumption of housing services is captured by paid rent (tenants) and imputed rent (owner-occupiers). Aguiar and Bils (2015) attempt to correct for systematic measurement errors in the consumer expenditure survey (CES) and find that consumption inequality follows income inequality more closely than thought when based on expenditure evidence. Albouy and Zabek (2016) study inequality in house prices and rents, and point out the paucity of studies on housing outcomes.

Attanasio and Pistaferri (2014) explain that one of the limitations of consumption inequality studies has been that the only source for estimation has been the CES. They use a new measure sourced from the redesigned Panel Study of Income and Dynamics (PSID) data, and they emphasize that observations on rent is an important ingredient even if there is no information on rent equivalents for non-homeowners. For rent, they use an imputed rent measure equal to 6 percent of self-reported home value. In their broader review of the inequality literature, Attanasio and Pistaferri (2016) use survey information on imputed services such as imputed rent for homeowners. They study food, certain durables, and leisure, but do not discuss the role housing has in utility production.

In an attempt to broaden the scope from wage observations and consumption measures based on expenditures, Heathcote et al. (2010) examine wealth inequality using the Survey of Consumer Finances (SCF) and demonstrate that the net worth Gini coefficient increases from 1983 to 2007. Piketty and Zucman (2014) study wealth-to-income ratios in the long run and find that wealth-income ratios have risen strongly from 1970 to 2010. Blundell and Etheridge (2010) show that, for Britain, inequality growth has been on and off. It rises in the early 1980s, then stabilizes, then rises in the late 1990s. They write: "The transmission from wages and income through to consumption is of considerable interest in understanding the workings of the economy at both the macro and micro levels." They demonstrate a difference in the development of income and consumption inequality in Britain because the two series break apart in the late 1980s. They mention that "especially the value of real estate" as a possible explanation, but cannot offer empirical support. Benhabib and Bisin (2018) survey the literature on the mechanisms underlying wealth distributions. Benhabib et al. (2017) say: "The literature has largely emphasized the role of earnings inequality in explaining wealth inequality." They show, however, that the relationship is dubious, at best, by demonstrating that across the world, earnings Gini indices have little correlation with wealth Gini indices. They do not consider the housing market.

Effects from policy or the business cycle on inequality is a topic on which there exist several contributions. For example, Furceri et al. (2018) find that contractionary monetary policy appears to increase income inequality. Karahan and Ozkan (2013) ask whether an income shock persists through the life cycle. They

answer that for young workers, shocks to earnings are only moderately persistent. For middle-age workers, shocks are persistent. Barlevy and Tsiddon (2006) find supporting evidence for a model that implies that recessions exacerbate earnings inequality when inequality has an increasing trend.

The effect from the business cycle on inequality raises the deeper question of locating the sources of inequality. Van Nieuweerburgh and Weill (2010) ask why house price dispersion has gone up and construct a model in which households with heterogeneous abilities exit and enter areas and because the housing supply cannot respond rapidly, house prices respond instead. Hugget et al. (2011) study sources of lifetime inequality. They find that differences in starting conditions at age 23 explain more of variations in lifetime outcomes than shocks after 23. De Nardi and Fella (2017) ask why some people are wealthy and others are poor and say that to answer we must understand why people save. They study inter-generational mechanisms, human capital, preferences, earnings, medical risks, random shocks, and entrepreneurship, but say little about the role played by houses and choices of residential purchases.

The aforementioned questions of inequality trends, sources of inequality, life-cycle stages, and effects from the business cycle on inequality share key words with our study. These studies indicate that there is a paucity of knowledge about the inequality of housing capital gains. This article seeks to address that paucity.

3. Data and Institutional Background

3.1. *Data on House Transactions and Ownership*

We combine an AVM and a countrywide registry of units and transactions to construct our data set. We use the registry to classify an owner as a person who has bought a property, but not yet sold it. A person can buy a share of a property and can change this share over the period we study. The number of records is large because we count as a record an individual's ownership status for each quarter in our period, which is a necessary requirement for constructing our data set. The starting point for ordering data is the subset of registered, unique individuals belonging to birth year cohorts the period 1965–1985 who were owners on January 1, 2007. We retain the owners who also owned on January 1, 2019.[4] We limit our study to cohorts from 1965, 1970, 1975, 1980, 1985, and 1990 to make it tractable. For more information on Norwegian data sources, see Fagereng et al. (2020b) and Aaberge et al. (2021, pp. 10-23 and 36-40).

It is possible to suggest that the 1960 cohort is more useful than the 1990 cohort. The 1960 cohort, however, is very large and presumably quite similar to the 1965 cohort. In contrast, there are only 72 individual owners in our panel from

[4]This implies that we have a data set in which the same individuals are observed at the same time, but some individuals may be between ownership periods during these 12 years. We do not trim on ownership length, ownership time, ownership share, or number of units owned because we consider these dimensions as sources of what we study, inequality. We have 49 quarters in our period, and 90 percent of individuals in our data were owners in at least 48 quarters. One percent of individuals were owners in fewer than 35 quarters.

1990, and thus they do not pose a data tractability challenge. They could, however, potentially offer us a glimpse into a youth dimension; that is, that the 1990 cohort is relatively different from the 1985 cohort.[5]

In our procedure, we examine the owners in each quarter, and track individuals who were owners on January 1, 2007, and January 1, 2019. For these 77,554 owners, we compute the cumulative capital gains for each quarter, although some owners may be moving from one unit to another, and thus temporarily would have no owned unit. Their capital gains are then unchanged until they are owners again.

Transaction data and data on housing unit characteristics form the basis for Eiendomsverdi's AVM. We access this AVM to obtain estimates of the market value for all housing units owned by our 77,554 always-owners. The AVM estimates were computed on a given date, May 18, 2019. From this date, we back-estimate values using Eiendomsverdi's house price index, which is constructed with a high spatial resolution. This index is based on the same methodology as the more parsimonious, official index of Real Estate Norway. In the appendix, we include a validation exercise that demonstrates the accuracy of the AVM by comparing differences between AVM estimates and transaction prices.

Capital gains belong to one of several categories: realized, semi-realized, or potential. If an owner has bought and sold a unit, the capital gains are realized and directly observable. For this category, we subtract the observed purchase price from the observed sell price. Negative capitals gains are possible. If an owner sells the unit she owned on January 1, 2007, and had purchased before January 1, 2007, the capital gains are semi-realized. We then compute the difference between the observed sell price on the sell date and the AVM value on January 1, 2007. This difference is not equal to the actual capital gains this seller experiences, because the purchase pre-dates January 1, 2007. Conversely, if a seller bought a unit during the period between January 1, 2007, and January 1, 2019, and owned it for the remainder of the period, these capital gains are also semi-realized. For this type of capital gains, we compute the estimated semi-realized capital gains by taking the difference between the AVM value on January 1, 2019, and the observed purchase price. If a seller owns a unit throughout the period, from January 1, 2007, to January 1, 2019, all capital gains are potential. We compute these capital gains by taking the difference between the AVM value on January 1, 2019, and the AVM value on January 1, 2007. If an individual purchased and sold multiple times, we sum these realized capital gains. If an individual has an ownership share below one, we apply this ownership share.

We remove non-market operations between January 1, 2007, and January 1, 2019 (inheritance, within-family transfer, divorce settlement, etc.) by requiring that a transaction started with an advertisement on the online sale platform Finn.no. We also trim data based on transaction information. We define an uncertain observation as an observation that satisfies one or several of the following list of conditions: (1) not observed sell date within 2007–2019, (2) absolute value of ask price less sell price on sell price larger than 0.7,[6] and (3) other tags (multiple properties connected

[5]In Norway, an individual becomes a legal adult at 18. Under-age individuals may own, but there are laws governing their rights and legal guardians who have oversight duties.

[6]The rationale is that a very small sell price might be a non-market sale.

TABLE 1
SELECTED SUMMARY STATISTICS

Type	Unit (N)	Gini	P10	Median	Mean	P90
House values Jan 1, 2007	House (75,592)	0.264	1,099,600	1,950,600	2,217,696	3,611,639
House values Jan 1, 2019	House (77,591)	0.290	1,893,685	3,510,830	4,092,026	6,828,160
Owner values Jan 1, 2007	Owner (77,554)	0.291	695,642	1,276,776	1,487,019	2,468,700
Owner values Jan 1, 2019	Owner (77,554)	0.310	1,208,114	2,249,533	2,710,598	4,641,895
Capital gains Jan 1, 2019	Owner (77,554)		421,334	873,137	1,094,006	1,986,294
			Birth year cohort			
	1965	1970	1975	1980	1985	1990
No. of owners	26,697	24,948	16,793	7,638	1,406	72

Notes: The four right-most columns in the upper panel are measured in NOK. "House" is short notation for houses and apartments, that is, housing units. We do not compute the Gini index for capital gains because capital gains may be negative. Active trimming filters: We remove uncertain transaction observations, which are transactions that satisfy at least one of several conditions: (1) Not observed sell date within 2007–2019; (2) absolute value of ask price less sell price on sell price larger than 0.7, (3) other tags (multiple properties connected to transaction and bankruptcy transaction).

to transaction and bankruptcy transaction). The implication is that individual owners may see one unit in their portfolio removed given the tag of "uncertain observation." In computing the owner's capital gains, we employ the ownership share. In Norway, it is possible to own shares ranging from zero to unity.

Table 1 summarizes the distribution of a few selected variables. We tabulate statistics on three variables: house values, owner values, and capital gains. We observe that the Gini index of house values increase from 0.26 in 2007 to 0.29 in 2019. The number of houses owned by owners in these six cohorts increases from 75,592 to 77,591 over the period. Because the number of individual owners is constant at 77,554 in our data set, the implication is that some owners own more units at the end of the period than they did at the start of the period, which is intuitive given the age cohorts. For all distributions, the mean is larger than the median, indicating a thick right tail. The last row presents statistics on capital gains. We do not attempt to compute the Gini index as some capital gains are negative. We observe that the 90th percentile of capital gains on January 1, 2019, is NOK 1,986,294. Such capital gains constitute more than half the value of the median house at the same time, which is NOK 3,510,830, evidence that supports the claim that capital gains are sizeable.

3.2. *Income Data*

The income data are acquired from official statistics[7] and are aggregate income levels for each municipality. In Norway, employers, financial institutions, and firms

[7]See Statistics Norway at ssb.no. We use information from tables 06944 to 09114.

register wages paid (and non-monetary benefits) with the tax authorities. The tax register covers all income, both taxable and non-taxable. Statistics Norway defines households and classifies individuals into households. A household is defined as all individuals who live in a house and share common housekeeping. Income is defined as all income from employment, returns to financial capital, transfers, support, and stipends. From Statistics Norway, we use data on all income within households and information on distribution statistics within municipalities (percentiles).

3.3. *The AVM and the House Price Index*

We employ estimated market values from Eiendomsverdi, a bank-owned firm that specializes in estimating market values for banks and realtors and is member of the European AVM Alliance, which is a nonprofit organization consisting of member firms that provide AVMs in their respective European countries.

This allows our value estimate to attain a higher accuracy than a simple hedonic model would have allowed because this firm employs multiple estimators. In particular, the company's AVM is based on an algorithm that assigns weights to separate value estimators. The weights of these estimators are also characteristics-dependent and functions of time. In the appendix, we have included the results from a validation exercise in which we inspect the accuracy of the predictions for each of the 23,374 units that were involved in transactions among the 77,554 owners in our birth cohorts. The median spread, that is, the difference between the estimated value and the observed transaction price as percentage of transaction price, is −1.3 percent. The 10th and 90th percentiles are, respectively, −12 percent and 11 percent.

The firm Eiendomsverdi constructs both the house price index used in their own AVM and the house price statistics published by Real Estate Norway[8] every month in a press conference. They follow the same index methodology in both index constructions, with only minor differences. The key element is the combination of observed sell prices and estimated values using the SPAR-methodology (Bourassa et al. 2006; De Haan et al. 2009). In this setup, one studies the ratio, for each transacted unit, of the observed sell price on the estimated market value for a base period. For each month one uses the median sell-price-on-estimated-value ratio, that is, the SPAR, as the index level. For intuition, it is possible to view the SPAR setup as an advanced square meter price index in which one adjusts the observed sell price not only by size, but all relevant attributes.

3.4. *The Capital Gains Data*

Figure 1 shows how we compute capital gains in two examples:

(I) An owner-occupier who sells the unit she was observed owning on January 1, 2007, on the date T1 and buys another unit on the date T2. T2 lies between January 1, 2007, and January 1, 2019. She owns the second unit on January 1,

[8]Available online: https://eiendomnorge.no. The statistics offered by Real Estate Norway is commonly viewed as the official house price statistics of Norway, and the data are used by banks, media, analysts, researchers, and the government.

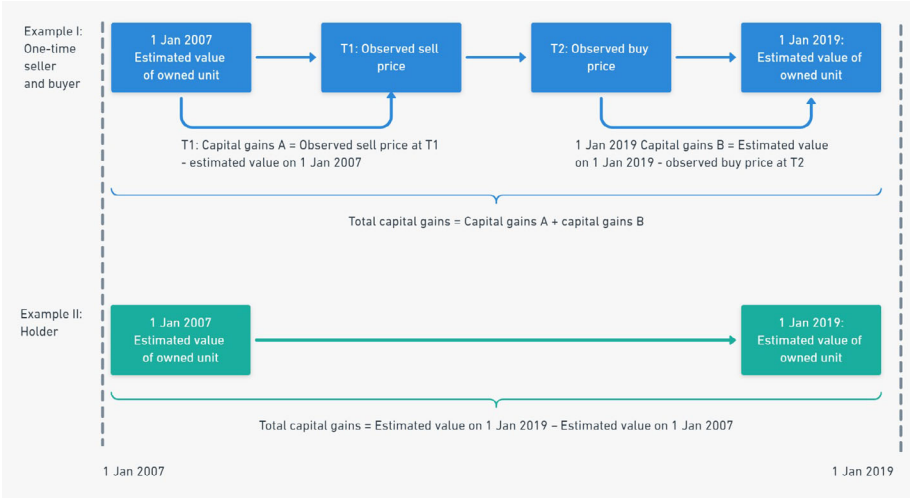

Figure 1. Examples of the Computation of Capital Gains for Sellers and Holders. [Colour figure can be viewed at wileyonlinelibrary.com].

2019. The capital gains of both the first and the second units are semi-realized capital gains because one of the two values is estimated using the AVM.

(II) An owner-occupier who holds the unit during the whole period January 1, 2007–January 1, 2019. The gains are potential capital gains because the values are estimated using the AVM, both at the start of the period and at the end of the period. These two cases are not exhaustive because there are other types. For example, a person may buy and sell within the period. Moreover, some individuals may transact multiple times.

Other owners may be involved in combinations of the aforementioned types. However, Figure 1 illustrates the thrust of our thinking. At any given point in time, we are able to trace an individual's holding of, and sale of, a given property. At any given point in time, we are also able to estimate the value of an individual's (share of a) property. Because we can both observe a sell price or estimate a house value, we can compare a sell price or a house value with both initial and final house values computed at given dates. Such differences are either realized, semi-realized, or potential capital gains. If there are repeat transactions, we compute the capital gains for each transaction and sum them.

3.5. *Institutional Background*

Transactions in the Norwegian housing market are organized as ascending bid (English) auctions. The typical transaction starts with an owner-occupier who decides to move house. First, he decides whether to buy or sell first. In Norway, we see a mix of buy-first and sell-first strategies. Often, owner-occupiers are involved in both processes simultaneously, and there is usually no problem for moving owner-occupiers to obtain interim funding if the household needs to hold two houses, and have two mortgages, for a short period of time.

To sell, a moving owner-occupier contacts a realtor with whom she discusses a sales strategy before setting an ask price. Then, the realtor announces, in an online advertisement, a date for the open-house (public showing). After the open-house, typically the day after, the auction commences. In this auction, bidders submit bids to the realtor, most often using digital platforms. Bids may be conditional and may have expiration time and date. Bids and acceptances of bids are legally binding. Because bids and acceptances are legally binding, we are able to pin down the exact date on which the transfer of ownership took place. This fine temporal granularity allows us to establish an accurate time line of individual capital gains.

Many owner-occupiers choose to buy before selling, and one often observes that the moving owner-occupier attempts to make arrangements with both the buyer of the old house and the seller of the new home to coordinate move-out and move-in dates.

Between three-fourths and four-fifths of Norwegian households are owner-occupiers (Røed Larsen and Sommervoll, 2009). Most households finance purchases using variable interest rate mortgages. In the Norwegian capital, Oslo, the time-on-market is typically short, often only a few weeks. The wider metropolitan area surrounding and including Oslo accounts for about one-fifth of the Norwegian population of 5.5 million citizens.

4. Inequality Framework and Motivating Patterns

4.1. *The Gini Index and the P90-P10 Measure*

Due to the cyclicality of capital gains, we observe negative values early on in the period. We could have estimated Gini indices for negative capital gains by imputing zero for negative values. However, because this imputation skews the impression of inequality, and other alternative approaches appear impractical, we make use of, and prefer to use, the 90th and the 10th percentiles of estimated capital gains when we compute our inequality measure. In the choice between the difference and the ratio, we prefer the P90-P10 difference because it has several advantageous features. One advantage is that it does not require conversion of negative capital gains because the 90th percentile never is smaller than the 10th. A second advantage of this dispersion measure is that it directly measures the difference in purchasing power between individuals at two percentile levels. Thus, we prefer the difference between P90 and P10 to the ratio of P90 to P10 because the latter does not capture the purchasing power inherent in the difference between two monetary values.

To see this, we refer to the thought experiment mentioned in the Introduction. While the Gini index is unitless, the P90-P10 difference is measured in monetary units, that is, Norwegian krone (NOK).

4.2. *Example Capital Gains*

In Figure 2, we have drawn four groups of 10 random individual owners using two partitions: (1) born in 1970 or in 1980 and (2) have owned in Oslo during the period or not. We then compute the mean capital gains for each of the four groups

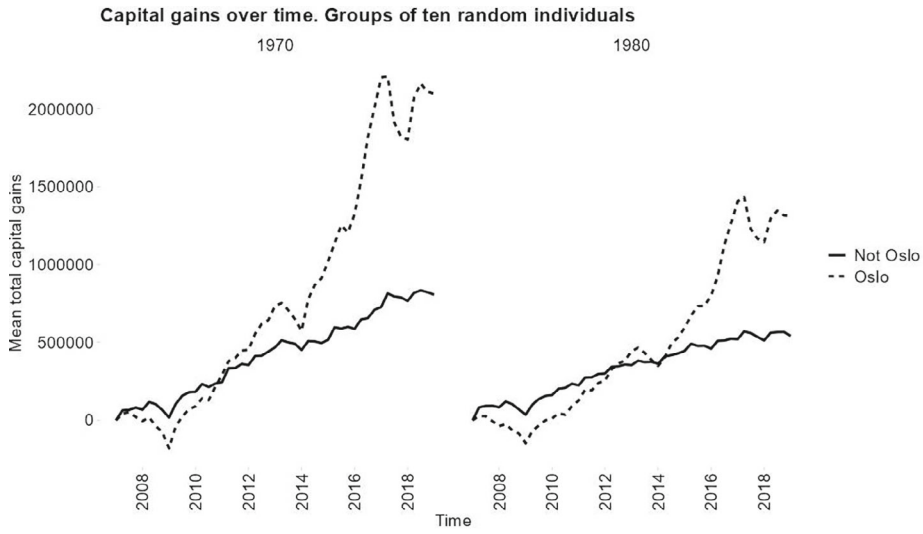

Figure 2. The Development of Mean Capital Gains from 2007 to 2019 for a Few Random Owners. Not Oslo Versus Oslo. Birth Years 1970 Versus 1980.
Notes: "Oslo" means that the owner has been registered as having owned a unit, or share of a unit, in Oslo at least once during the period January 1, 2007–January 1, 2019. "Not Oslo" means that the owner has not owned a unit in Oslo.

at each quarter in the period January 1, 2007, and January 1, 2019. For illustration, we plot the time development in two graphs, one for owners who were born in 1970 (left panel) and one for owners born in 1980 (right panel).

First, we observe a time development because capital gains in all four groups increase. However, we do see a reduction in capital gains during the financial crisis. During that crisis, Norwegian house prices decreased for about 18 months, from May 2007 through December 2008.

Second, we observe a birth cohort effect because the capital gains in the 1970 cohort are larger than those in the 1980 cohort. Most likely, owners in the older 1970 cohort had been able to purchase a more valuable home, which increased more in value.

Third, we find a spatial component because owners who had been owners of a unit in Oslo experience larger capital gains than non-Oslo owners. This illustrates three of the dimensions we explore in more detail below: time development, birth cohort effects, and geographical differences. While Figure 2 plots capital gains, below we turn our attention to differences between capital gains at different positions in the distribution.

4.3. *The House Price Index and the Gini Index of Estimated AVMs of Housing Units*

In Figure 3, we plot the time development of the house price index and the time development of the Gini index of owner values. The idea behind comparing these

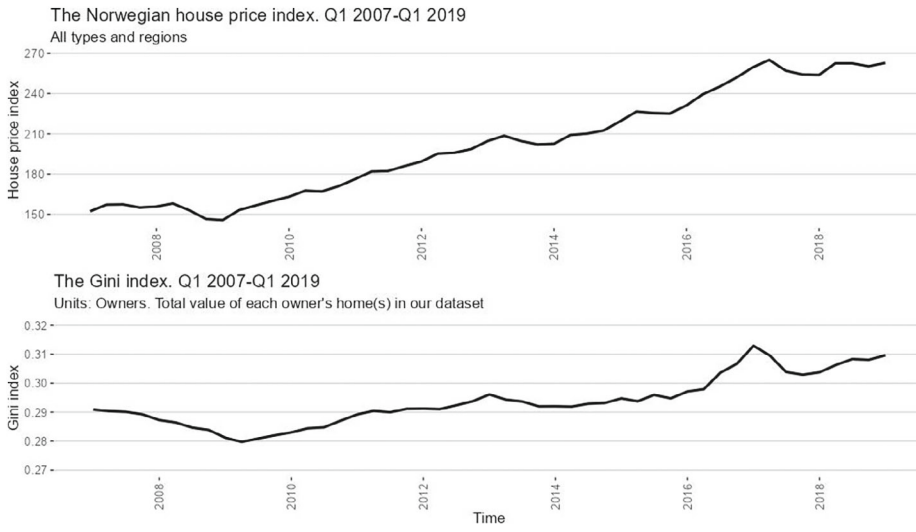

Figure 3. The House Price Index and the Gini Index. Norway, 2007–2019.
Notes: The index is sourced from Real Estate Norway (Eiendom Norge); see above and eiendomnorge.no for a description of methodology. The Gini index is constructed so that for each owner, we sum the estimated value of each home weighted by owner share. Then, we compute the Gini index across owners. Some owners may have sold before buying and experience a period with zero owned homes even though they owned on January 1, 2007, and January 1, 2019. These owners are not included in the computation of the Gini index of owner values in the quarter in which they did not own because the zeros would have disturbed the picture. However, for capital gains computations below, they are included.

two figures is to motivate the notion that there is an association between the time development of house prices and the time development of housing inequality.

We make two observations. First, both the house price index and the Gini index have a rising trend. Second, for both the price index and the Gini index there are deviations from trend, and they seem to occur roughly at the same time. For example, the minimum Gini index occurred in 2009, just a short time after the trough in the housing market during the financial crisis, in which Norwegian house prices reached their minimum in December 2008 (Røed Larsen, 2018). Moreover, the maximum of the Gini index series was reached on January 1, 2017. This is the same time as the end of a period with high growth in the house price index. Figure 3 is an exhibit that supports a notion of co-movements in the house price index and the Gini index.[9]

5. Empirical Results

5.1. *Time Development of Capital Gains Inequality*

Figure 4 contains four plots. The upper panel contains plots of the Gini index of owner values for owners in Oslo and not Oslo over the period January 1, 2007,

[9]We have tested the hypothesis that house prices Granger-cause housing inequality and found that they do, but do not report the details.

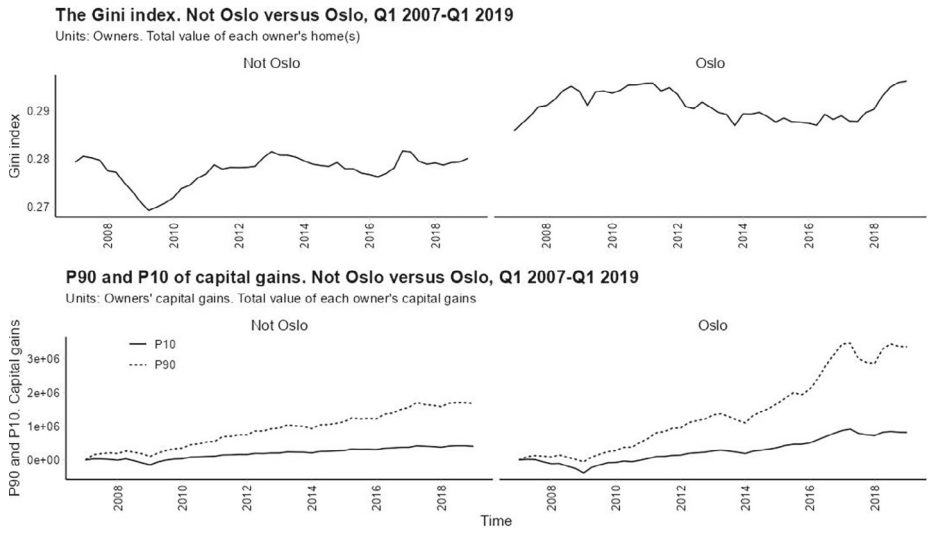

Figure 4. Gini Index of Owner Values and 90th and 10th Percentiles of Capital Gains. Per Individual Owner. Not Oslo and Oslo, January 1, 2007–January 1, 2019.

Notes: "Oslo" is the short notation for having owned a unit in Oslo. This graph was generated by constructing a list of owners in each quarter between January 1, 2007, and January 1, 2019, among birth cohorts 1965, 1970, 1975, 1980, 1985, and 1990. For each point in time t (quarter), we compute the Gini index across owner values at t and capital gains between January 1, 2007 and t. Oslo is defined as owners who have owned in Oslo at one point. Among these estimated capital gains, we identify the 10th and the 90th percentiles.

and January 1, 2019. The lower panel contains plots of P90 and P10 of total capital gains for Oslo and not Oslo during the same period. The two pairs of plots are juxtaposed by each other so that we can inspect the similarities and dissimilarities between the two measures. We observe that the upper panel gives a different impression than the lower panel. Although there does not seem to be a time trend in the Gini index of owner values, there is a clear time trend in the difference between P90 and P10 of capital gains.

The dissimilarity of the upper and lower panels may support the argument for using the P90-P10 as an inequality measure. The reason is that the P90-P10 reflects the absolute increase in values in the housing market, whereas a Gini index of owner values may reflect a combination of several mechanisms, one of which could be a uniform appreciation rate across heterogeneous units. Another mechanism could be heterogeneity in the use of debt.[10]

To explore possible explanations for the finding of no trend in the upper panel, we include Figure A2. It shows capital gains across the period 2007–2019

[10]Keep in mind that the Gini index would indicate no change in inequality if two houses A and B increased from NOK 5 million and NOK 10 million to NOK 7.5 million and NOK 15 million, respectively. The owner value Gini index would indicate no change in inequality between two owners C and D if they both initially had values of NOK 5 million and eventually owned NOK 7.5 million even if C only held onto to the initial house, which appreciated 50 percent, whereas D's initial unit did not appreciate, but the increase in owner value was due to debt-financing of the purchase of a NOK 2.5 million unit.

as fractions of owner values in 2007 for each of 20 ranked groups of 2007 owner values. Group 1 consists of owners with 2007 values among the bottom 5 percent. Group 20 consists of the individuals with the top 5 percent of owner values in 2007. Whereas the latter ratio of gains-to-value is below 0.75 over the period, the former ratio is above 0.85. Again, these results emphasize the difference between studying relative gains and absolute gains.[11] Figure A3 in the appendix plots the time development of the group means of capital gains on initial owner values ratio and current owner values on initial owner values for Oslo owners in group 3 and group 19. Again, potential debt-financing of new purchases would create a difference between the two. We observe that the group means of group 3, that is, owners between the 10th and 15th percentiles of owner values in 2007, had a higher increase in the ratios than group 19. These results indicate that individuals with low initial owner-values may observe high percentage growth even if the absolute gains could be small.

The measure P90-P10 of capital gains displays the absolute value gains made within the portfolio of houses. We observe in the lower panel of Figure 4 that there is a rising time trend of capital gains inequality during the period as the 90th percentile increases more strongly over time than does the 10th percentile. This pattern is accentuated in Oslo. In Oslo, the capital gain of the 90th percentile on January 1, 2019, is NOK 3.4 million. The 90th percentile outside of Oslo increases much less than within Oslo. Thus, Figure 4 documents an increase in housing inequality within and across geographical areas.

Table 2 tabulates results that support the notion of a trend in the P90-P10 as it contains the estimates of fitting a linear trend to the P90-P10 measure. The estimated slope coefficient is 54,914 for Oslo owners. The interpretation is that for each quarter the difference in capital gains between the 90th percentile and the 10th percentile increases by NOK 54,914, a monetary value that exceeds the average monthly pre-tax wage.[12]

Figure 5 allows us to explore the result of increases in the P90-P10 difference in more detail. The figure plots results from a grouping of individual owners into 20 value groups based on the estimated value of their ownership on January 1, 2007. Group 1 comprises owners with the 5 percent smallest owned values, that is, the least valuable units. Group 20 comprises owners with the largest owned values, that is, the top 5 percent of most valuable units. The left-hand side panel plots the distribution of capital gains 2007–2019 for each of the 20 groups. The right-hand side panel plots the within-group mean capital gains 2007–2019 for each of the 20 groups in increasing order of 2007 owned values. We observe from the right-hand side panel that groups with the highest-value ownership in 2007 also experience the largest capital gains, in absolute terms, consistent with the proposition that the housing market is an inequality generator and generates inequality of economic opportunities. We

[11] Notice that the gains-to-value is not returns to the values owned in 2007 because individual owners may buy and sell other units throughout the period.

[12] Compared to the increases in differences in capital gains, the consumer price index (CPI) increases over the period are small, so the nominal increases are also real. Using the Table 2 model for Oslo, the estimated P90-P10 difference was 18 times larger in 2019 compared to 2008, whereas the CPI rose 26 percent. (Source: Statistics Norway. Online: ssb.no, Table 03013.)

TABLE 2
REGRESSION OF P90-P10 ON LINEAR TIME. NOT OSLO AND OSLO, 2007-2019

	Not Oslo		Oslo	
Intercept	34,219	(14,580)	−261,396	(62,176)
Slope	26,195	(508)	54,914	(2,165)
Adj. R2	0.982		0.931	
No. of owners	67,254		10,300	

Notes: The data used in the regression were generated by constructing a list of owners in each quarter between January 1, 2007 and January 1, 2019, among birth cohorts 1965, 1970, 1975, 1980, 1985, and 1990. For each point in time t (quarter), we compute the difference between the 90th and the 10th percentiles of capital gains between January 1, 2007 and t. Oslo is defined as owners who have owned in Oslo at one point. Not Oslo and Oslo, 2007–2019.

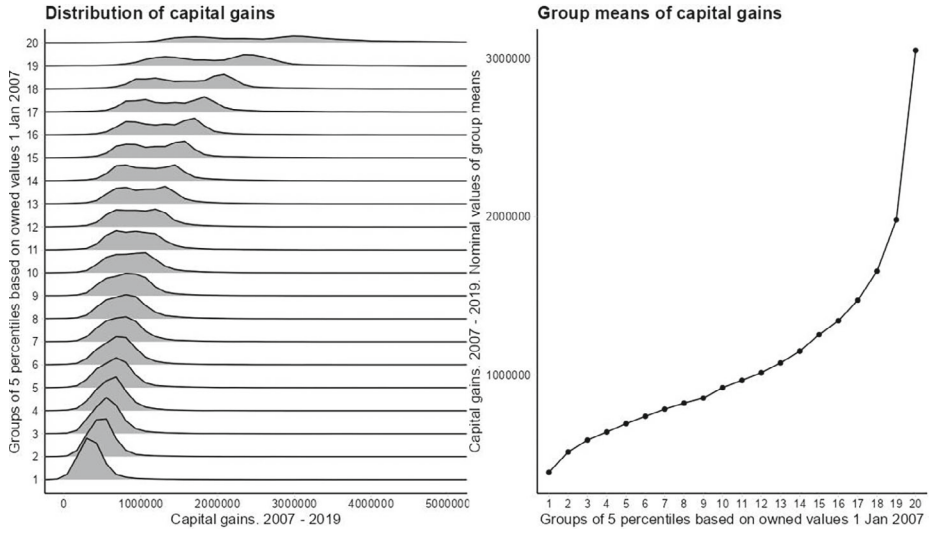

Figure 5. Capital Gains by Groups of 5 Percentiles of Owned Values in 2007, Norway.
Notes: We sort individual owners by their owned value on January 1, 2007, and group them in 20 groups. Group 1 comprises individuals with the lowest owned values on January 1, 2007. Group 20 comprises individuals with the highest owned values on January 1, 2007. The left-hand panel plots the distribution of capital gains across the period 2007–2019 within these 20 groups. The right-hand panel plots the within-group mean capital gains across the period 2007–2019. We trimmed the distributions in the left panel on 0 and NOK 5 million.

also see from the left-hand side panel that there is substantial heterogeneity within the 20 groups. In particular, the distributions display large right tails.

5.2. *Controlling for Cohort Effects*

We segment individual owners into birth year cohorts from 1965 to 1990 and plot the inequality measure P90-P10 in Figure 6. All cohorts display an increasing time trend of the inequality measure, and the deviations from trend occur at the same time. However, both the slope of the time trend and the magnitudes of deviations from trend differ between birth year cohorts. Inequality is largest among the oldest, consistent with the notion that differences in owned values increase with age

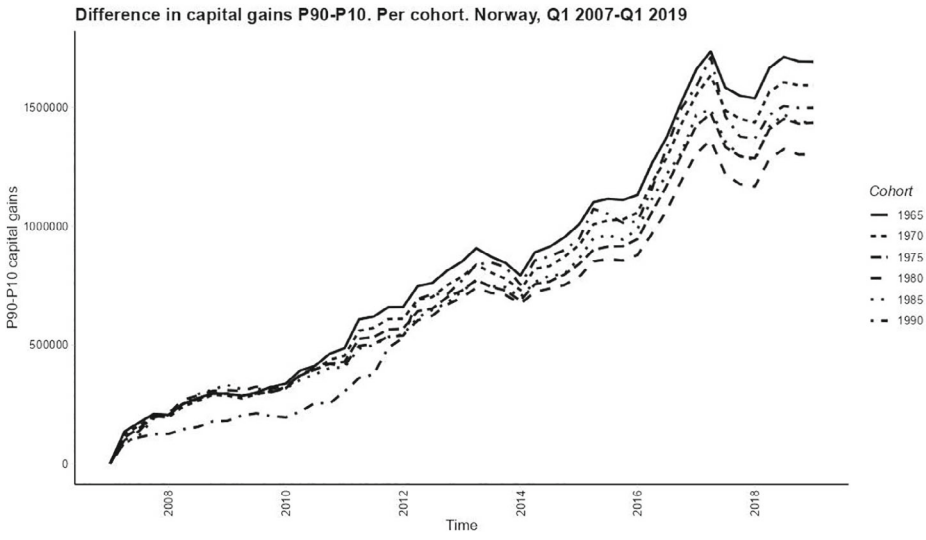

Figure 6. Difference Between the 90th Percentile and the 10th Percentile of Estimated Capital Gains. By Birth Year Cohort. Norway, 2007–2019.

Note: We identify the 90th and 10th percentiles of capital gains in each of the birth year cohorts and compute the difference, P90-P10.

as life outcomes tend to diverge with time. Inequality tends to be smaller among younger, but the 1990 cohort deviates from the pattern. The heterogeneity among the individuals in the youngest group indicates that this cohort might be selected differently than the others. As individuals born in 1990 turned 17 years of age in 2007, inheritance may have played a role for some of these owners.

The difference between the inequality measure developments for cohorts 1965 and 1985 is statistically significant.[13] To demonstrate this, we ran a Monte Carlo bootstrap simulation in which we constructed simulated same-size-samples through a sampling with replacement algorithm and computed the inequality measure on the simulated samples. Table 3 reports the simulation results. We see that whereas the 99.5th percentile of the 1985 cohort is 1,572,632, the 0.5th percentile of 1965 cohort is 1,653,505. Thus, we reject the null of no difference between the two distributions.

The empirical evidence is consistent with the notion that capital gains inequality in the period 2007–2019 for the 1965 birth year cohort is larger than the capital gains inequality for the 1985 birth year cohort. In summary, capital gains inequality increases both within and between birth year cohorts.

6. Discussion

6.1. *Spatial Dimensions of Inequality*

To explore the geographical dimension of capital gains inequality, we continue to use two segments, Oslo and not Oslo. We also segment into birth year cohorts.

[13] We use the birth year cohort 1985, not 1990, due to sample size and selection issues.

TABLE 3
BOOTSTRAP SIMULATION OF THE P90-P10 DISTRIBUTION ON JANUARY 1, 2019 FOR COHORTS BORN IN 1965 AND 1985

	Percentiles of P90-P10 in year 2019				
Birth year cohort	0.5	2.5	50	97.5	99.5
1965	1,653,505	1,659,679	1,691,446	1,719,913	1,724,673
1985	1,313,681	1,355,333	1,438,024	1,553,688	1,572,632

Notes: The data used in the regression were generated by constructing a list of owners in each quarter between January 1, 2007, and January 1, 2019, among birth cohorts 1965, 1970, 1975, 1980, 1985, and 1990. For each point in time t (quarter), we compute the capital gains between January 1, 2007 and t. We then identified the 90th and the 10th percentiles and computed the difference, P90-P10, in each quarter for each birth year cohorts. For the bootstrap simulation, we randomly drew with replacement same-size samples 1,000 times for both the 1965 cohort and the 1985 cohort on January 1, 2019, and computed the P90-P10 for each of the 1,000 samples.

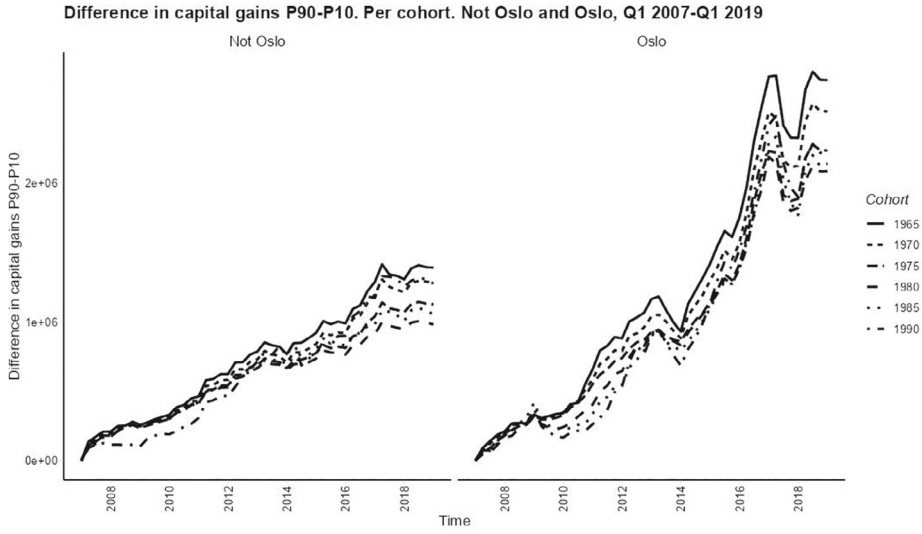

Figure 7. Difference in 90th Percentile and 10th Percentile of Capital Gains by Cohort. Not Oslo and Oslo, January 1, 2007–January 1, 2019.
Notes: The P90-P10 difference in capital gains for individuals belonging to the not Oslo segment is plotted to the left, and the P90-P10 difference for individuals belonging to the Oslo segment is plotted to the right. An individual belongs to the Oslo segment if this owner had been registered as owning a unit in Oslo in the time period January 1, 2007–January 1, 2019.

Figure 7 plots the development of the capital gains inequality measure, the P90-P10 difference, for each birth year cohort. We observe that the time trend in Oslo is steeper than the rest of Norway for all cohorts. Whereas P90-P10 for the not Oslo segment on January 1, 2019, is around NOK 1 million, the P90-P10 measures for the Oslo segment lie between NOK 2 million and 3 million for the different birth year cohorts. The interpretation is that the spatial component is a factor in understanding capital gains inequality.

To further emphasize the spatial dimension, we plot in Figure 8 the median capital gains for each municipality in Norway for the period 2007–2019. Peripheral

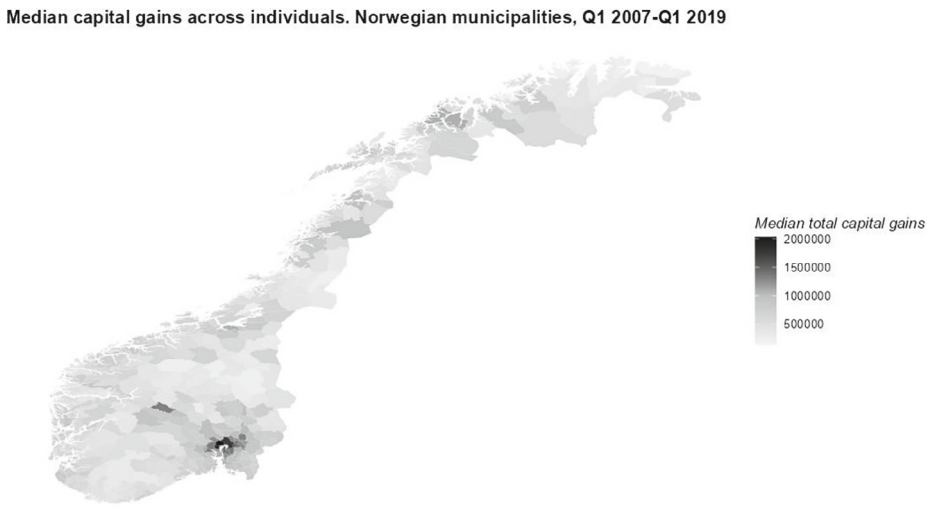

Figure 8. Median Capital Gains Across Individuals within a Municipality. Norway, 2007–2019.
Notes: For each individual owner we compute total capital gains for the period January 1, 2007–January 1, 2019. For each municipality we find the median total capital gains across individuals. For each individual owner we ascribe a municipality. If their ownership is sequential, we ascribe to each individual the municipality in which they owned a unit on January 1, 2007. If they owned several units at that point in time, we use the municipality in which they owned the most valuable unit. The map shows Norwegian municipalities, and the Oslo region is the one in the darkest areas in the lower right corner. The borders of Norwegian municipalities date from 2018, and these borders are changing as there is an ongoing restructuring project of Norwegian municipalities.

areas of Norway have seen smaller median capital gains over the 12-year period. In these municipalities, median capital gains are around NOK 500,000. In contrast, the median in the southeast area, which includes Oslo, is much higher, indicated by the darker areas in the heat map. The largest capital gains are found in Oslo. This graph illustrates the strong presence of spatial components in the development of capital gains inequality.

6.2. *House Prices, Income, and Capital Gains Inequality Across Norwegian Municipalities*

We cannot here investigate all determinants of capital gains inequality, but in this discussion section we seek to present some evidence of the role played by income development. In Norway, there were 428 municipalities until a recent reform process started at the end of our period,[14] and there is considerable variation across these municipalities in terms of size, population, infrastructure, and economic activity. We seek to exploit this variation to investigate whether there is evidence that supports a claim of an association between income development and capital gains inequality development.

Table 4 reports the result of municipality fixed effect regressions. The evidence suggests that there is an association between capital gains inequality and the income

[14]The number of municipalities thus decreases.

TABLE 4
MUNICIPALITY FIXED EFFECT REGRESSIONS OF CAPITAL GAINS DIFFERENCE P90-P10

	Dependent variable P90-P10 capital gains		
Independent variable	I	II	III
Median income	1.95 (0.17)		1.70 (0.16)
Median house price		0.390 (0.0074)	0.364 (0.0076)
Year FE	YES	YES	YES
Municipality FE	YES	YES	YES
Period	2007–2018	2007–2018	2007–2018
Adj. R2	0.678	0.884	0.888
No. of municipalities	368	251	251
N	4,416	3,012	3,012

Notes: Regressions are run using yearly observations for each municipality. Municipalities without all observations are removed to keep a panel structure. For privacy reasons, we only retain municipalities with multiple observations each year. The robust standard errors in parentheses are computed using the function vcovHC.plm in the lmtest-package in R, using the "arellano" method. Year FE is a short notation for using a collection of year dummies. Income is acquired from Statistics Norway (ssb.no) and is obtained using gross household income data on a municipality level from the Norwegian IRS (tax records) from Statistics Norway table no. 06944. These data are classified as open data; see regulations for use: https://www.ssb.no/diverse/lisens. Individuals are classified based on the municipality of the ownership of largest value. Capital gains are measured in the fourth quarter of each year.

level and the house price level. Model III shows that an increase in median income of NOK 100,000 is associated with an increase in the inequality measure P90-P10, across municipalities, of NOK 170,000. Moreover, model III shows that an increase in median house price of NOK 100,000 is associated with, across municipalities, an increase in P90-P10 of 36,000.

6.3. *Capital Gains by Gender*

We also explore whether there are differences between female and male owners. We first segment into Oslo and not Oslo, then into females and males. We compute the 90th and 10th percentile capital gains for females and males in the not Oslo area and in Oslo and plot the development in Figure 9. We observe that the main pattern is intact. Differences are larger in Oslo. However, we also observe that there are noticeable differences between females and males in the P90 of capital gains in Oslo.

We bootstrapped the P90 in Oslo for January 1, 2019, and found that the male P90 capital gains were larger than the female P90 capital gains for each of 1,000 Monte Carlo simulations. Thus, the difference is statistically significant. The difference in capital gains is NOK 19,000. This is not a considerable difference of capital gains, compared to the P90 capital gains of males, NOK 3.46 million, but it still is economically meaningful.

6.4. *Capital Gains by Ownership Shares*

In Norway, ownership is defined by individual ownership shares of units in the public registry; thus in this study our focus of attention is on individual capital

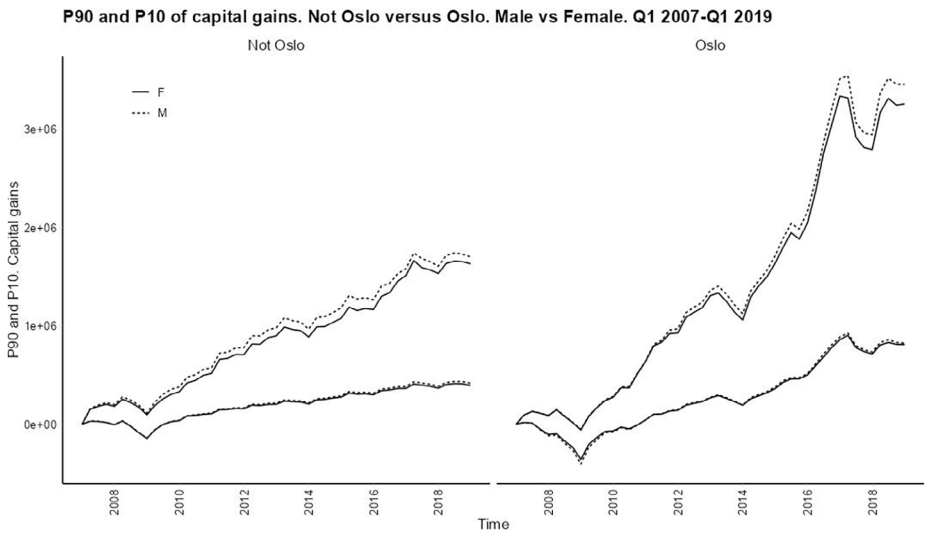

Figure 9. Gender Differences. P90 and P10 of Capital Gains. Not Oslo and Oslo, 2007–2019.
Notes: The P90 and P10 of capital gains for individuals belonging to the not Oslo segment are plotted to the left, and the P90 and P10 for individuals belonging to the Oslo segment are plotted to the right. An individual belongs to the Oslo segment if this owner had been registered as owning a unit in Oslo in the time period January 1, 2007–January 1, 2019. "F" represents females and "M" males as they are registered in the registry.

gains. However, individuals live in households, and inequality within and across households warrants inspection. In fact, it would be useful to map the relationship between capital gains across individuals and capital gains across households.

Measures of inequality across households could yield different results compared to measures of inequality across individuals because households consist of individuals and any aggregation of individuals would change the properties of the object of study. However, because households are fewer than individuals, but more varied in size, it is an empirical question how the measures would differ.

It is also a question of conceptual construction as analysts would have to take a position on a possible assumption that all members of a household extract the same utility level from the aggregate capital gains of the household.

There are several factors that could imply differences between individual-level and household-level analysis:

1. ownership share(s)
2. appreciation rates of the unit(s)
3. original values of the unit(s).

To see why ownership shares could be a factor, keep in mind that as individuals may own multiple units, there are no upper limits on the sum of shares for a given individual owner. This allows for a possible source of heterogeneity as high-share individuals could form households with other high-share individuals, a phenomenon that would entail aggregate shares above unity, whereas other

households have aggregate shares equal to unity. To see why appreciation rates and original values are factors, keep in mind that single-person households could, and most likely do, own different units than multiple-person households. This could be a source for divergence between individual-based and household-based analyses. Ideally, studies of housing inequality would present both types of analysis and compare the two.

However, mapping which individuals belong to which households is a major challenge as households form and dissolve. Such a mapping lies outside the scope of this article. Let us instead offer an alternative. If we make the simplifying assumption that one-person households own one unit and have an ownership share of 1.00 and two-person households own one unit together and have individual ownership shares between 0.25 and 0.75, we are in a position to inspect inequality development across different segments of our sample of owners. Put differently, we use observed ownership shares to construct subsamples that simulate individuals within certain types of households.

Our design is this: We first remove from our sample individuals who are observed to have ownership shares in multiple units. Then, we segment these one-unit individuals into three groups: (1) individuals who have an ownership share of 1.00 during the whole period, (2) individuals who have an ownership share between 0.25 and 0.75 during the whole period, and (3) other individuals. We believe a large share of the first group would be single-person household and that a substantial share of the second group would belong to two-adult households.[15]

It is not ex ante given which owner type would have the largest capital gains because capital gains are caused by ownership shares, appreciation rates, and original unit values. It is fathomable that single-owners, that is, individuals who own 100 percent of a unit, own units that are less valuable and thus have smaller capital gains. On the contrary, single-owners obtain all of the capital gains from the unit in question, whereas multiple-owners share the capital gains. Figure 10 displays the 90th and 10th capital gains percentiles for Oslo and not-Oslo owners for the three categories. The key finding is that the 90th percentile of the capital gains among individuals who always own 100 percent of the unit is larger than the 90th percentile of owners who always own between 25 and 75 percent. This pattern is repeated when we study the development of the 10th percentile. We observe that the capital gains between always 1.00-share individuals and 0.25–0.75-share individuals are sufficiently close; however, that households consisting of two 0.5-share owners often would, taken together, experience larger capital gains than single-person households with one owner would.

Overall, the pattern of time-increasing inequality for these segments is similar to what this article has documented earlier. We leave it to future research to examine in more detail the patterns of capital gains development on individual-basis versus household-basis.

[15]It is possible that, for example, one housing unit is owned by three individuals who each own shares of one-third or four individuals who each own shares of one-fourth, but we do not explore the permutations of ownership shares. These possibilities hint at the challenges of identifying households.

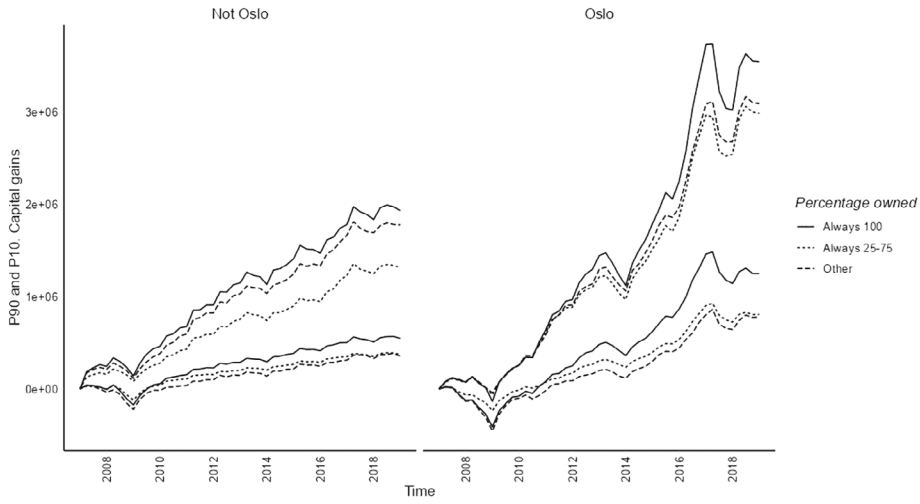

Figure 10. Ownership Shares. P90 and P10 of Capital Gains in Segments of Shares. Not Oslo and Oslo, 2007–2019.

Notes: There are six curves in each graph and three labels. Each label represents both the 90th percentile and the 10th percentile. The 90th percentile lies above the 10th. We retain a subsample of individuals who have had ownership shares in exactly one unit at the time. We segment this subsample into three categories: (1) individuals who always own a share of 1.00, (2) individuals who always own a share between 0.25 and 0.75, and (3) other individuals.

6.5. *Capital Gains Taxes and Debt*

Our study does not compute after-tax capital gains, but instead concentrates on pre-tax capital gains, which is defined as the difference between a market value at one point in time and a market value at another point in time. There are three reasons for this. First, in Norway housing capital gains are tax exempt if the seller has resided in the unit at least 12 months during the last 24 months before the sale. Most sellers are owner-occupiers and thus enjoy this tax exemption. The implication is that most of the realized capital gains we have computed are not subject to taxation and the potential capital gains we have computed also would not be subject to taxation once it is realized.

Second, if we had attempted to apply the tax rate onto realized capital gains and semi-realized capital gains from within-period selling, but not on potential capital gains or semi-realized capital gains from within-period buying, we would need to be able to differentiate between sellers for which the tax exemption was applicable. This would require mapping of sellers' historical home addresses, which in practice is infeasible.

Third, our study aims at documenting patterns in the inequality of capital gains of housing, and our choice of concentrating efforts on pre-tax capital gains is not likely to affect the patterns much. After-tax capital gains would be somewhat smaller, and thus after-tax capital gains inequality could be somewhat smaller. Further research might be able to establish a difference between pre-tax capital gains and after-tax capital gains.

Again, we do not study debt or the effect of leverage, so we do not study returns to initial home equity. It is, however, interesting to know whether leverage plays a role in inequality and whether leverage displays heterogeneity across spatial and age dimensions. This question is left for future research.

7. Concluding Remarks and Policy Implications

Although much research on inequality has studied the development of inequality in wages, income, wealth, and consumption, few studies have mapped the time development in the inequality of capital gains in the housing market. This paucity of capital gains studies may be due to a challenge of data access. To study the time development of capital gains inequality analysts need access to data that include transactions, owners, and units. Capital gains studies require the computation of realized, semi-realized, and potential capital gains and the ability to follow owners and units over time.

This study constructs a data set of 77,554 owners with housing unit identification. We follow these owners throughout the period, and we are able to compute the capital gains these owners made in the housing market in Norway during the period January 1, 2007, and January 1, 2019. At the start of the period, these 77,554 owners owned 75,592 units. We compute the total capital gains for each individual owner by summing realized, semi-realized, and potential capital gains. The classification depends upon how the value of the housing unit is observed. Observed purchases and sales allow the computation of realized capital gains. When either a purchase or a sale is not observed, because they happened before the start of the time period or had not happened before the end of the period, we estimate semi-realized capital gains by employing an AVM for the value of the unit instead of the market transaction. When neither the purchase nor the sale is observed, and the owner holds the unit throughout the period, we estimate both the entry and exit values using the AVM. We denote the estimated difference potential capital gains.

Our preferred measure of capital gains inequality is the difference between the 90th and 10th percentiles of the capital gains across individual owners. It is measured in nominal monetary units and thus reflects an absolute difference in actual purchasing capacity between individual owners. Alternative measures comprise the Gini index, the coefficient of variation, and the P90/P10. These measures have the disadvantages that they are relative, must be re-scaled and transformed to deal with negative values, and/or are unitless and thus less intuitive to interpret.

For data tractability reasons, we study individual owners belonging to birth year cohorts from 1965, 1970, 1975, 1980, 1985, and 1990. Our results show that the housing market is an inequality generator. During the time period of 12 years, the capital gains accumulated in the housing market varied substantially.

When we partition owners into 20 groups of owned values on January 1, 2007, and sort by magnitudes, we observe substantial differences. The group with the highest top five percentiles of owned values in 2007 experienced a capital gain of NOK 3,048,110, whereas the group with the second highest owned values in 2007 between the 90th and 95th percentiles had capital gains of NOK 1,978,560. Group 10 had capital gains of NOK 918,885.

We find considerable inequality trend differences between and within birth year cohorts and across geographical strata in Norway. Median capital gains in some municipalities were multiple times larger than those in other municipalities. We also find differences in the distribution of capital gains between females and males, especially in Oslo.

The increase in capital gains inequality represents an increase in the difference of economic opportunity, and it may affect households in ways that cannot easily be escaped. For example, when a household needs to move house because of labor market events, it matters not only where it happens or what year it happens, but also even what month it happens. This follows from the spatiality, cyclicality, and seasonality of the housing market. For example, Nenov et al. (2016) show that transaction seasonality in the housing market is associated with thick market effects. An implication of their findings may be that if individuals seek to solve the dual search-and-matching problem of finding both a job and a house, or if they simply seek a better match between their preferences and house attributes, they may discover that their future economic opportunities are affected by the month in which they are searching, selling, or buying. Anundsen and Røed Larsen (2018) show that when a sell price is higher than an appraisal value, the sell price tends to revert toward appraisal value in the next sale. The implication is that if an individual buys at a high price in a thick market, the capital gains will tend to be lower compared to an individual who bought at a low price in a thin market.

The income level plays a role. Using the variation in capital gains and income levels across municipalities, this study finds that the income level is associated with the size of capital gains. However, there are multiple factors. An individual's timing of choices in both labor and housing markets may be deliberate and due to skill, but timing may also be due to unforeseen events and thus due to bad luck. This means that not only is the inequality that arises with capital gains caused by year cohort effects and geographical effects, but also by the season in which individuals chose to or had to move.

The development of capital gains inequality shows that there are large differences between individuals. Thus, these findings open up the question of policy intervention. Norwegian tax rules, as do rules around the world, allow house owners several tax advantages. Such rules and polices make housing an attractive asset in Norway—again, as in many other countries. Given a political aim of limiting the increases of inequality, and leveling the playing field, the findings in this study invite a renewed look at whether and how to tax capital gains in the housing market.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix:

Figure A1: The distribution of the difference between the estimated AVM value and the observed transaction price as fraction of transaction price. Norway, 2007-2019.

Figure A2: Capital gains 2007-2019 in percent of owned values in 2007, Norway.

Figure A3: Owner values and capital gains as fractions of owner values in 2007. Oslo, 2007-2019.

Figure A4: Bootstrap simulations of P90 capital gains sex differences. Oslo, 2019.