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# Market concentration and the Danish rental market

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**Abstract**

This memo provides two insights on the evolution of market concentration in the Danish rental market and its relation to rental prices.

First, we show that rental market concentration not only increased between 2010 and 2020, but also varied significantly across Danish municipalities. Second, we document a small positive empirical link between concentration and rents for apartments in the private Danish rental market.

Our results are especially relevant for the evolution of house prices, as the effect of market concentration on rents can spill over to the housing market by forcing sellers to stay longer than necessary in their homes before moving, which could lead to higher house prices.

Market concentration can have a significant negative effect on consumer welfare, as a rise in concentration typically brings about unwarranted price increases for goods and services traded on a given market (Kim and Singal, 1993). Moreover, rising market concentration has recently been shown to have negative effects on the macroeconomy as a whole, as the ensuing rise in firm markups is increasingly associated with the decline in the labor share and a decrease in labor market dynamism (De Loecker et al. 2020; Barkai 2020). The housing market has not been absolved of such issues. Increasing concentration in residential construction markets in the U.S. has resulted in lower housing supply and higher volatility of prices (Cosman and Quintero, 2021).

Given these circumstances, this memo analyzes the degree to which market concentration is an issue in the Danish rental market. Our memo provides answers to two relevant questions: i) Has the Danish rental market experienced any changes in market concentration over the past decade and ii) is there an empirical link between rental market concentration and rental prices in Denmark? While our empirical analysis of the second question is not sufficient to argue that this link is necessarily causal, it highlights the need to further investigate the relationship between rents and market concentration.

Providing answers to these questions is relevant not just for the rental market. Developments in the rental market are important for the economy at large, because they can affect the housing market indirectly. Homeowners can find it harder to switch between owning and renting in an environment in which rents rise above their fundamental value due to market concentration. The lack of affordable rentals could force homeowners to stay longer in their homes or to buy first before changing homes. Both of these developments would increase the buyer-to seller ratio and, as a consequence, house prices (Grindaker et al., 2021; Moen et al., 2021). Aside from potential spillovers to house prices, higher rents can also amplify the issue of affordability of housing. Unaffordable housing can have a

negative impact on the long-term economic prospects of a city, by preventing workers from finding reasonably priced accommodation next to their place of employment (Ingves, 2019).

We show that concentration in the Danish rental market has increased markedly between 2010 and 2020. The increase was entirely driven by the Capital Region, which experienced a tripling in market concentration while the other four Danish regions displayed a roughly constant trend in terms of ownership concentration. In 2020, 65 per cent of the dwellings listed for rent in the private rental market of the Capital Region were owned by the top 5 per cent of the owners, up from only 20 per cent in 2010. We also show that both the market segment of apartments and the market segment of villas/townhouses have experienced an increase in market concentration in the Capital Region. Furthermore, we document a large geographical dispersion across Danish municipalities with coastland areas being more concentrated than inland areas.

In the second part of the memo, we use a panel regression analysis to show a positive and significant association between rental market concentration and rental prices. We use the Herfindahl–Hirschman Index (HHI) as our measure of market concentration for a given municipality in the regression. This index is high when few market participants own most rentals in a given market.[1] Our results indicate that a 1 log point increase in our concentration measure is associated with a 0.03 log point increase in rents. Aggregate economic factors common to all municipalities explain most of the variation in rents, while market concentration within municipalities explains about 10 per cent relative to what common factors account for.[2]

To document changes in market concentration across the Danish rental market, we use micro-level data on rental prices from BoligPortal, an online platform that allows owners or their representatives to post announcements offering apartments and houses for rent. BoligPortal is the largest provider of such listing services in Denmark and reports having an almost complete coverage of rental units offered by businesses. The data from BoligPortal includes information on the rental price charged by landlords, the location of the property that is rented out, the day when the rental listings were posted, and the date when the property was rented out.

We augment this data with information from Tinglysning (the Danish Land Registration Court) and Bygnings- og Boligregistret – BBR (the Danish Central Register of Buildings and Dwellings). This allows us to identify precisely whether a given listing on BoligPortal is owned by a business or a private individual. In this memo, we focus solely on the supply of rentals by businesses.[3] Since we are primarily interested in computing market shares, we use the Danish Business Register (Virk) to identify the final owners of the businesses that own the properties listed on BoligPortal. We follow initial owners through the business ownership tree to retrieve a final owner of a property. We then use this information on final owners to construct our measures of market concentration.

We structure our memo as follows. First, we show that renting is an increasingly important form of residence for Danish households and that the share of businesses offering properties for rent has been growing steadily over time relative to that of individuals renting out their properties. Then, we document how market concentration has evolved across time and space in Denmark. Finally, we present the results of our regression analysis that

[1] The HHI index has an average value of 0.15, a median of 0.09, and an interquartile range of 0.12 in our sample. The index is computed based on market shares of firms expressed as fractions rather than per cent.

[2] The set of common factors in our panel regression is comprised by the overall state of the Danish economy, housing regulation, common labor market dynamics, or geography and location.

[3] We do not include properties rented out by private individuals as we cannot identify the final owners of such properties due to data protection regulation.

investigates the link between market concentration and rental prices.

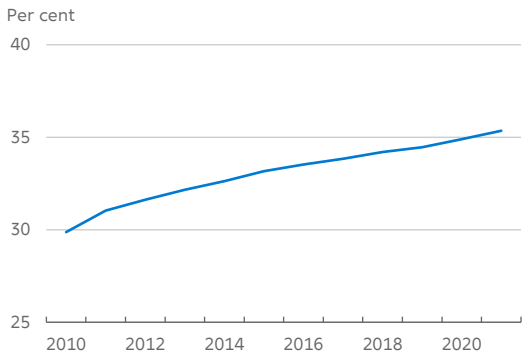
**The private rental market is increasingly important**

The rental market in Denmark consists of two segments. The first segment is comprised of rentals provided by local public authorities and non-profit building societies (almene boligselskaber). The dwellings rented out by these owners are typically in limited supply, entail long waiting lists, and can be subject to income requirements.

The second segment of the rental market consists of dwellings provided by private owners. We refer to this segment as the *private rental market*. Businesses and individuals can rent out their properties by listing them on the private market through various online and offline media outlets. In this memo, we study the evolution of rents and market concentration in this particular segment of the Danish rental market, as entry into this market is subject to market forces unlike entry in the publicly owned segment of the rental market. Properties rented out in the private rental market are also subject to some regulation that specifies the degree of rent control that local housing boards can exercise. However, owners of rental properties that were built after 1992 can set rent freely.

Figure 1 shows that the share of registered dwellings occupied by tenants relative to total number of privately owned dwellings (both rented out and owner-occupied) has been steadily increasing since 2010. When computing this share, we focus solely on dwellings that are rented out by owners and exclude the dwellings that are owned by public authorities and non-profit building societies.[4] In 2010, the share of rented dwellings was about 30 per cent of the total number of privately owned dwellings. In 2020, this share grew to close to 36 per cent of the total private housing stock. This evidence highlights the growing importance of the private rental market for Danish households.

**Share of privately owned dwellings occupied by tenants in Denmark** Figure 1




Note: The share is computed as the ratio between dwellings occupied by tenants and the total number of dwellings occupied by private tenants or owners. Dwellings owned by public authorities and non-profit building societies (almene boligselskaber) are excluded from calculations.
Source: Statistics Denmark and own computations.

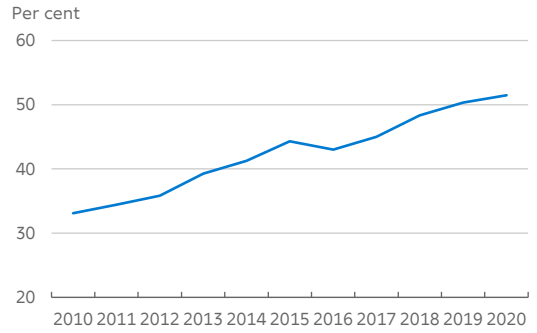
**A larger share of rentals is owned by businesses**

Next, we investigate the degree to which firms that operate rental businesses dominate the private rental market relative to private individuals supplying rentals on the same market. To this end, we use data from BoligPortal that we combine with data from BBR to determine whether the owners of properties rented out via BoligPortal are private individuals or private businesses.

Figure 2 shows that, as of 2020, businesses own roughly 50 per cent of all listings in the private rental market. This share has been growing at a fast pace over the past decade, starting from a value in 2010 of about 33 per cent and reaching 51 per cent in 2020. Given the slower growth of the overall private market described in figure 1, the evolution shown in figure 2 is indicative of a market in which businesses gain market share by purchasing units from individuals and renting them out on the private rental market.

[4] The number of dwellings owned by public authorities and non-profit building societies was stable during the previous decade at around 30 per cent of the total number of dwellings occupied by owners and tenants in the private rental market.

**Share of rented out listings where the owner is a business** Figure 2




Note: The share is computed as the ratio between the number of listings that have a business as their owner and the total number of listings.
Source: BoligPortal, BBR and own computations.

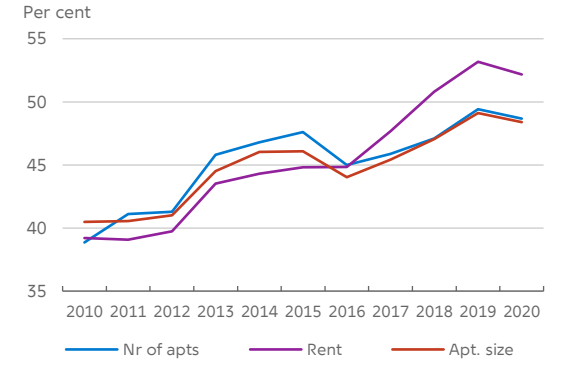
**Market concentration has increased between 2010 and 2020**

We study next the degree to which the private rental market has become more concentrated. Our measure of rental market concentration captures the extent to which a small number of businesses own a large share of the total private rental market. We measure market share in terms of the number of properties owned by each business (apartments and villas), the total value of rents charged by each business on its rentals, and the total area of rented space in square meters.

We compute the market concentration ratio in three steps.[5] First, we sum up all the apartments that each business owns in a given year and region. Second, for each year we define the top 5 per cent businesses as those who are in the top 5 percentile of the distribution of apartments owned, i.e. businesses that own more apartments than 95 per cent of the rest of businesses. Third, we compute the share of apartments that the top 5 per cent businesses own relative to all businesses. Note that the composition of top 5 per cent businesses changes from year to year since it is a relative measure.[6] If we compute the market concentration ratio based on a time-invariant cutoff that assigns businesses to the top group if they own more than five apartments each year, our results regarding market concentration are even more pronounced.

While the average number of apartments owned by the top Danish businesses more than doubled between 2010 and 2020, it stayed constant for the rest. More specifically, businesses in the top 5 per cent owned on average 14 apartments in 2010, while in 2020 they owned 37.5 apartments. In contrast, businesses in the bottom 95 per cent owned on average only one apartment both in 2010 and 2020.

**Top 5 per cent rental market share** Figure 3



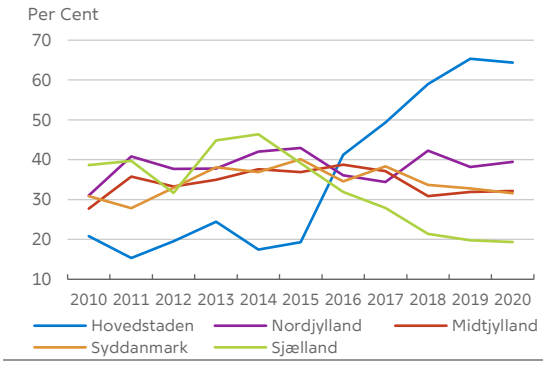

Note: The share is computed as the ratio of (a) the sum of the number of apartments, (b) the sum of rents, and (c) the total size of apartments that the top 5 per cent of businesses own to the total number, rents, and size of all apartments in a given year.
Source: BoligPortal, BBR, Virk and own computations.

Figure 3 plots our measure of market concentration over time based on number of apartments, rent value, and apartment sizes for Denmark. Overall, the top 5 per cent business ownership share increased from 40 per cent in 2010 to 50 per cent in 2020, which is reflected across all market size definitions. From now on, we focus on apartment sizes in square meters when discussing market concentration as it best reflects rental supply considerations. To identify the driving forces of the increase in rental market

[5] For illustration only, we focus here on apartments, but we repeat the same exercise when studying market concentration for the market segment of villas and townhouses.

[6] The number of businesses in the top 5 per cent group increased from 134 businesses in 2010 to 354 businesses in 2020.

**Top 5 per cent rental market share by region** Figure 4



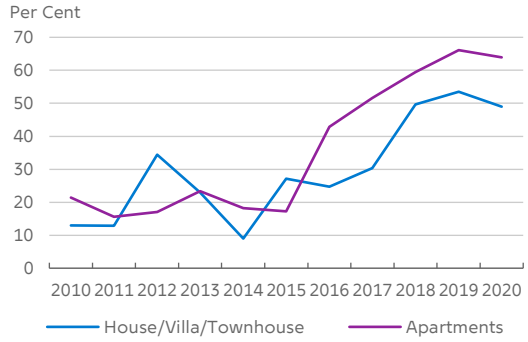

Note: The share is computed as the ratio of summing up the size of all apartments that the top 5 per cent of businesses own to the total size of all apartments in a given year by region.
Source: BoligPortal, BBR, Virk and own computations.

ownership concentration, we exploit the granularity of our data and analyze housing market segments by property type and geography separately.

Figure 4 plots the top 5 per cent business ownership share for the five Danish regions. While Nordjylland, Midtylland, and Syddanmark experienced a rather constant ownership concentration over the last decade of around 35 per cent, Hovedstaden and Sjælland show starkly different dynamics. The rental market share of top 5 per cent for Hovedstaden stayed fairly stable around 20 per cent until 2015 and then increased substantially to 65 per cent in 2018. In contrast, Sjælland had a rental market concentration share of 40 per cent until 2014, which then gradually declined below 20 per cent in 2018. Overall, figures 3 and 4 suggest that the general increase in business ownership concentration in the Danish private rental market is mainly driven by an increase in concentration in Hovedstaden.

While apartments constitute the majority of dwellings rented out in the private market, Danes can also rent houses (villas or townhouses).[7] From an economic perspective, it is worthwhile to distinguish these two segments because apartments are considered to have higher liquidity than houses. Furthemore, houses are typically rented out by larger households while apartments are favored by younger households. Given these differences in the type of demand characteristic for each segment, we show next how market concentration within each of these two segments has evolved over the past decade.

**Top 5 per cent rental market share by segment for the Capital Region** Figure 5

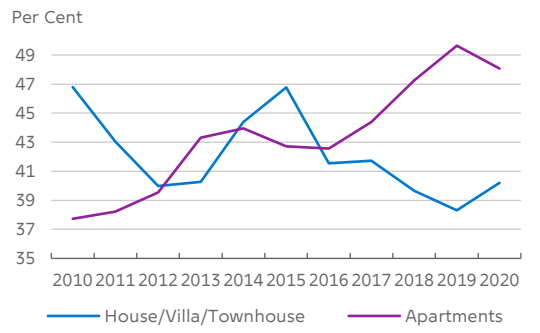



Note: The share is computed as the ratio of summing up the size of all apartments that the top 5 per cent of businesses own to the total size of all apartments in a given year by segment for the Capital Region.
Source: BoligPortal, BBR, Virk and own computations.

Figures 5 and 6 trace rental market concentration for these two segments separately. Figure 5 highlights that for both apartments and houses, ownership concentration in the Capital Region increased from 20 per cent in 2010 to almost 65 per cent towards the end of the last decade. The market concentration measure for the segment of villas and townhouses is more volatile than that for apartments. However, in Denmark as a whole, we find a slightly diverging pattern between the two segments. Figure 6 points towards a stable ownership concentration for the villas segment and an increasing top 5 per cent ownership share in the market segment of apartments. One reason for the diverging trends between Denmark as a whole and the Capital Region might be that the house segment in the Capital

[7] Houses, villas and townhouses made up 12 per cent of listings in the private rental market in 2010. Their share increased to 18 per cent in 2020.

**Top 5 per cent rental market share by segment for all regions** Figure 6




Note: The share is computed as the ratio of summing up the size of all apartments that the top 5 per cent of businesses own to the total size of all apartments in a given year by segment for all regions.
Source: BoligPortal, BBR, Virk and own computations.

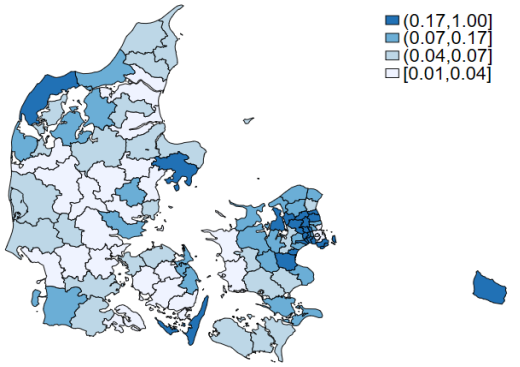
Region is more liquid than in the rest of Denmark and, hence, businesses can also consolidate their market share to exploit developments in the price of properties not just in their rental value.

**Large heterogeneity in market concentration across private rental markets in Danish municipalities**

Given the diverging trends in market concentration that we documented above for Danish regions, we also explore how concentration is distributed across municipalities in Denmark. To this end, we compute the Herfindahl-Hirschman Index based on the total rented area of apartments and houses for each municipality (as described in box 1) and plot the values of the index in 2020 for each municipality in figures 7 and 8.[8]

Figure 7 presents our evidence on market concentration for apartments that are rented out by businesses across Danish municipalities. The figure shows that there is a high degree of heterogeneity in terms of market concentration across Denmark.

**Market concentration – apartments – 2020** Figure 7



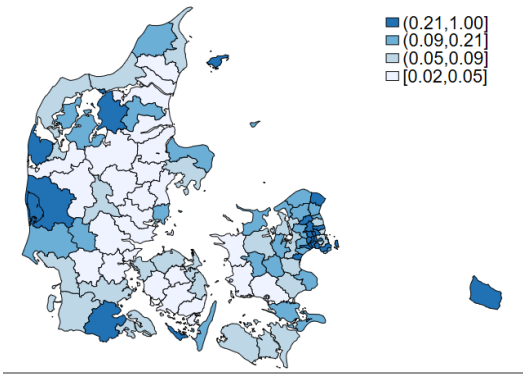

Note: The Herfindahl–Hirschman Index based on total rented area by businesses operating within a municipality is used as a measure of market concentration. Darker shades correspond to higher market concentration. We separate the distribution of HHI into four different equally sized groups when creating the shades. Only apartments are considered when computing the measure of market concentration.
Source: BoligPortal, BBR, Virk and own computations.

Figure 8 shows how market concentration is distributed across Danish municipalities in the case of the rental market segment of villas and townhouses. This segment of the rental market is also characterized by a large degree of geographical heterogeneity in terms of concentration. As in figure 7, the HHI is higher for municipalities situated on Sjælland, especially around Copenhagen, and lower for municipalities on the island of Fyn. Unlike in figure 7, there are more municipalities with a higher degree of market concentration in Jutland when it comes to villas and townhouses that are offered for rent compared to our evidence on apartments.

[8] We focus here on HHI as our measure market concentration instead of the top 5 per cent share because we will be using this measure in our regression analysis below to document the relationship between rents and market concentration.

**Market concentration – villas/ townhouses – rented area – 2020**

Figure 8




Note: The Herfindahl-Hirschman Index based on total rented area by businesses operating within a municipality is used as a measure of market concentration. Darker shades correspond to higher market concentration. We separate the distribution of HHI into four different equally sized groups when creating the shades. Only villas and townhouses are considered when computing the measure of market concentration.
Source: BoligPortal, BBR, Virk and own computations.

Overall, our evidence suggests that the geographical dispersion in terms of market concentration in the private rental market is rather large in Denmark. We have also shown earlier in the memo that market concentration has been rising with time in some regions. These patterns motivate us to analyze next the degree to which market concentration is correlated with changes in rents.

**Higher market concentration is associated with higher rental prices**

Market concentration is typically viewed as a malign force when it comes to the evolution of prices in a certain market, as more concentrated markets are typically characterized by higher prices of goods and services sold. We test this hypothesis in the private rental market by estimating the degree to which rents are associated with market concentration in Denmark. To this end, we use the HHI measures that we constructed based on the ownership data in a regression model of log average rents on market concentration. We provide more details on the econometric model and the estimation routine in box 1.

Table 1 presents the results of our estimation. We provide evidence for three separate samples that include: (i) all rented properties, (ii) apartments, and (iii) villas and townhouses. As described earlier in the memo, we focus solely on rentals that are owned by businesses for which we can identify the final owner.

We start by testing the main hypothesis that rents are positively correlated with market concentration. Column (1) of table 1 shows that market concentration, when measured in terms of the total area of rentals provided by businesses, is positively correlated with average rent. A 1 log point increase in the HHI is associated with a 0.05 log point increase in rents. This estimate is highly significant at the 1 per cent level. In this column, we did not include any controls for other potential factors that may be driving both rents and concentration across Danish municipalities.

We describe next several competing hypotheses and how we address each of these in our estimation. To account for potential confounding factors, we add a number of controls to our regression in column (1). One competing explanation is that rentals and market concentration might be rising in municipalities that have severe limits on the supply of new housing. We include the number of building permits in a given municipality as a proxy for changes to supply to account for such an alternative hypothesis. Another explanation for rising rents could be an increase in the number of residents (e.g. students and immigrants) in a given municipality. An increase in the number of residents would result in an increase in the demand for rentals, pushing up rental prices as a consequence. We account for this competing factor by including in our regression the log of number of immigrants and the average number of persons per dwelling in a given municipality, which should proxy for the number of dwellings used by students in a given municipality.

We also include in the regression the average area per dwelling for each municipality, which should control for increases in rent stemming from a shift in

**Increased market concentration is associated with higher rents** Table 1

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| HHI (area) | 0.05*** | 0.03*** | 0.03** | 0.01 | | | | |
| | (0.00) | (0.00) | (0.01) | (0.35) | | | | |
| HHI (no. of units) | | | | | 0.06*** | 0.04*** | 0.03*** | 0.03* |
| | | | | | (0.00) | (0.00) | (0.00) | (0.08) |
| Segment | All | All | Apt. | House | All | All | Apt. | House |
| Controls | No | Yes | Yes | Yes | No | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1060 | 1060 | 1043 | 1006 | 1060 | 1060 | 1043 | 1006 |
| Adj. R-squared | 0.535 | 0.590 | 0.510 | 0.192 | 0.542 | 0.595 | 0.514 | 0.197 |

Note: Estimated coefficients measure how much the average rent changes in a given municipality when market concentration, as measured by the Herfindahl-Hirschman Index, increases in that municipality. HHI (area) is computed based on the market shares in total area of units rented out by businesses in a given municipality. HHI (no. of units) is computed based on the market shares in total count of units rented out by businesses in a municipality. Columns (1) and (5) use the sample that includes all rental listings and the estimation exludes any additional controls in these columns. Columns (2) and (6) are also based on the sample of all listings, but the estimation includes a set of additional controls (i.e. log of number of immigrants, log of disposable income per person, the employment rate, the number of building permits issued for multi-dwelling homes, the average number of persons per dwelling, and the average area per dwelling in square meters). Results in columns (3) and (7) are based on the sample of rental listings of apartments. The rest of the columns in the table use the sample of villas and townhouses. Data is from 2010 to 2020. Regressions are estimated using weights based on the population residing in each municipality in 2009. Standard errors are clustered at the municipality level. P-values are reported in parentheses, * p<0.1, ** p<0.05, *** p<0.01.
Source: Authors' estimation based on data from Boligportal, BBR, Virk and Statistics Denmark.

the preference for living in larger cities vs. smaller cities. Larger cities could have become more attractive for tenants over the past decade because of improvements in the productivity of jobs available in such cities. Gaining access to such productive workplaces comes with a trade-off in terms of less living space per dwelling, which we are using here as way to capture the hypothesis of shifting preferences.

Last but not least, rents could be increasing due to rising incomes and increasing job prospects of the residents in some municipalities. To tackle this competing channel, we include in our regression the log of average disposable income per person and the employment rate in a given municipality.

Column (2) shows that after accounting for all these competing factors, the estimate for the effect of market concentration on rents drops slightly to about 0.03 log points. This estimate implies that a municipality moving from the 25th percentile of market concentration (municipality that would be classified as having a rental market that is not concentrated) to the 75th percentile of market concentration (i.e. moderately concentrated rental market) would be associated with an increase in rents of about 5 per cent. To put this effect into perspective, we compute the *marginal* adjusted $R^2$ statistic from a specification that only includes year and municipality fixed effects relative to a specification that adds the HHI variable. The difference in $R^2$ ratio of these two specifications reflects the relative contribution of market concentration to rental price dynamics. We find that relative to aggregate economic factors proxied by the fixed effects, rental market concentration explains 10 per cent of the variation in rental prices in Denmark between 2010 and 2020.

Column (3) provides similar evidence for the case when only rental apartments are included in the sample used for estimation. Our estimate for this sample is equal to the one in the aggregate sample, albeit the significance drops slightly. When focusing on villas and townhouses, we no longer find any positive correlation between rental prices and market concentration, as shown in column (4). Not only is the coefficient of interest in this column lower than in the previous two columns, it is also imprecisely estimated. Importantly, the explanatory power of our model as measured by the adjusted R-squared drops significantly when focusing on the sample based on rentals of villas and townhouses. This suggests that there are other more relevant factors than market concentration driving the evolution of rents in this submarket. Furthermore, as shown in figure 6, market concentration has been rather constant for this segment over the past decade, which could explain the lack of explanatory power for this variable when it comes to the evolution of rents.

Columns (5) to (8) of table 1 present our results when the HHI measure is constructed based on the number of listings offered by each owner in our data set. We find results that are largely consistent with our evidence in columns (1) to (4). Market concentration is positively correlated with rental prices. Furthermore, our results are moderately significant even for the sample of villas and townhouses.[9]

Overall, the evidence in table 1 suggests that increases in market concentration are positively correlated with increases in rents when market concentration is measured in terms of supply of units or rented area.[10] The correlation we uncover could be indicative of causality. However, reverse causality could also be responsible for our findings, as municipalities with higher rents could attract larger market players to a greater extent than municipalities with lower rents.

We address the issue of endogeneity next by presenting two additional tests of our main hypothesis. First, we rely on a lagged-variable approach to deal with reverse causality. While rents might drive the current levels of market concentration, it is less likely that past values of market concentration are subject to the same issue.

Second, we use an instrumental-variable approach to tackle the issue of endogeneity. We employ an instrument that has been used extensively in the industrial organization literature which studies the impact of market concentration on prices of various goods (e.g. Nevo, 2001), as well as more recently in the labor market literature which analyzes the effects of increased market power among employers on the wages of workers (see Azar et al., 2020). The instrument that we use is an average measure of market concentration in municipalities other than the one for which we instrument the degree of market concentration. The identifying assumption is that while local market concentration might be driven by changes in rents in a given municipality, the average value of market concentration across all other municipalities should not be influenced by rents in that municipality but rather by aggregate trends in market concentration across all Danish municipalities.

In box 2, we present the results of our benchmark regression when the measure of market concentration is replaced by the two alternatives described above: (i) lagged HHI and (ii) an instrument variable that is independent of local rents. In both of these cases that address endogeneity concerns, we find a significant positive estimate for the effect of market concentration on rental prices

[9] We obtain similar results when focusing only on the sample of municipalities that are part of the Capital Region; however, the precision of the estimates is somewhat smaller due to the significant drop in the number of observations when focusing on the Capital Region alone.

[10] We also estimated an econometric model in which we added the quadratic version of the municipality-level controls to the main regression in box 1. We found that the estimated coefficient for market concentration drops in terms of economic and statistical significance relative to results in table 1, but remains statistically significant at the 5 per cent level when HHI is constructed based on number of units and at the 10 per cent level when HHI is constructed based on area.

when all rentals are included in the regression sample. However, in the case where we use an instrumental variable (panel B), we no longer find a significant coefficient for market concentration in the samples that focus on apartments and townhouses/villas separately. Overall, our results in box 2 confirm the positive correlation between rents and market concentration that we uncovered in table 1. To properly establish causality, we would require a completely exogenous shift in market concentration which we could not corroborate in our sample. But we go a step closer to establishing causality with our instrumental variable setup as it removes at least partially some endogenous variation in market concentration.

**Conclusion**

In this memo, we present evidence on the evolution of market concentration in the Danish private rental market across time and space and analyze the link between rental market concentration and rental prices. We show that rental market concentration not only increased between 2010 and 2020 but also varied significantly across Danish municipalities. The increase in business ownership concentration is entirely driven by the rental market in the Capital Region, while the other Danish regions experienced a stable evolution in concentration, or even a decline as is the case of Sjælland.

We also document a positive empirical link between market concentration and prices for apartments and villas/townhouses in the private Danish rental market. A 1 log point increase in the Herfindahl-Hirschman Index in a given municipality is associated with an increase of about 0.03 log points in average rent. Note that this is not causal but rather an indication that rental market consolidation might drive rent dynamics. We make some progress in this memo in terms of documenting a causal link between the two by using two alternative estimation approaches that are less prone to endogeneity concerns. In both cases, we find that a rise in market concentration is accompanied by an increase in rents.

From a policy perspective, our result on the empirical link between market concentration and rents can have implications for the housing market as higher rents could hamper the process of homeowners selling their houses. Owners that are looking to sell have to monitor the rental market if they decide to vacate their home before moving to another property. If rents are too costly relative to fundamentals, sellers will be forced to stay longer in their properties while finding an affordable rental, or will be forced to buy before moving out of their current home. This delay in ownership status on the side of sellers would then cause an increase in the proportion of buyers to sellers. As a result, house prices are expected to rise in a market where sellers have limited rental options.

Our results are also relevant in the context of growing concerns regarding housing affordability and the role that the lack of affordable housing can play in the economic growth of major municipalities. As pointed out by Ingves (2019), a dysfunctional rental market can have negative effects on the labor market, since attracting labor to major cities can become extremely difficult when finding reasonably priced accomodation is next to impossible. The ensuing lack of a sufficient labor force can significantly hamper the economic growth of cities in the long run.

## Box 1: Regression model

We aggregate the rental market and ownership data at the municipality-year level and use it to estimate the following regression model:

$$\log(rent_{m,t}) = \beta \log(\mathrm{HHI}_{m,t}) + \gamma \mathrm{X}_{m,t} + \tau_t + \tau_m + \varepsilon_{m,t}$$

where the dependent variable is the log of real average rent in municipality $m$ in year $t$. We winsorize rents in the top and bottom 1 per cent of the distribution before aggregation to ensure that our measures of log average rents are not affected by outliers. Our main independent variable is the log of the Herfindahl-Hirschman Index of the total area in square meters and the total number of units rented out in municipality $m$ in year $t$. We describe below how this index is computed. To try to address the omitted variable bias, we also add a set of other controls, $\mathrm{X}_{m,t}$, to our regression model. The set of controls is also at the municipality and year level and includes: log of number of immigrants, log of disposable income per person, the employment rate, the number of building permits issued for multi-dwelling homes, the average number of persons per dwelling, and the average area per dwelling in square meters. We chose this set of controls to account for local demand and supply factors as well as rental market characteristics that might influence the evolution of rents in a given municipality. Our regression model also includes two fixed effects. $\tau_t$ stands for the time fixed effect. This fixed effect is designed to capture any aggregate changes that occur across all rental markets in Danish municipalities. We also include municipality fixed effects, $\tau_m$, to ensure that time-invariant municipality characteristics, such as geographical proximity to natural amenities, do not influence our estimation results. We estimate the model for the full sample based on all rentals and separately for the subsamples of apartments and villas/townhouses. A similar econometric model has been used by Azar et al. (2020) in the context of the U.S. labor market.

We compute the Herfindahl-Hirschman Index as follows:

$$\mathrm{HHI}_{m,t} = \sum_{i=1}^{N} s_{i,m,t}^2$$

where $s_{i,m,t}$ is the market share of business $i$ in municipality $m$ in year $t$. The market share for each business is computed based on two measures for the numerators: (i) total area in square meters provided by each business and (ii) total number of units rented out by each business. The market share of a business is then the total for each measure provided by business $i$ divided by the total across all businesses operating in municipality $m$ in year $t$.

## Box 2: Robustness

Our measure of market concentration might be endogenous to rental prices. Municipalities with higher rents can attract larger owners because of the higher returns they can generate in those markets, which can in turn drive up market concentration. We address this issue by showing how our empirical results change when we consider two alternative models to our benchmark specification described in box 1 that are less likely to have endogeneity as a concern. First, in panel A we replace HHI with its lagged value in our benchmark specification. Second, for each municipality *m* we use average of log(1/N) in all other municipalities each year as an instrument for the Herfindahl-Hirschman Index in panel B. The number N is the number of businesses renting out properties in a given municipality. This instrument for HHI does not depend on the market share in a given municipality but rather on the nationwide changes in the private rental market of Denmark. Therefore, it is less likely to be endogenous to rental prices in a given municipality. Table 2 shows that our results from table 1 are robust to the two changes in the econometric model described above. In fact, our benchmark results in table 1 are more conservative both in terms of magnitude and significance, at least when all the rentals are considered in the regression sample, but less so in panel B for the two subsegments of the rental market.

**Robustness: increased market concentration is linked to higher rents**

Table 2

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (6) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Panel A | | | | | |
| Lagged HHI (area) | 0.03*** | 0.02** | 0.03*** | | | | | | |
| | (0.01) | (0.03) | (0.01) | | | | | | |
| Lagged HHI (rent) | | | | 0.02** | 0.02** | 0.02** | | | |
| | | | | (0.01) | (0.04) | (0.04) | | | |
| Lagged HHI (no. of units) | | | | | | | 0.03*** | 0.03** | 0.02** |
| | | | | | | | (0.00) | (0.01) | (0.01) |
| Observations | 957 | 938 | 894 | 957 | 938 | 894 | 957 | 938 | 894 |
| Adj. R-squared | 0.590 | 0.538 | 0.242 | 0.588 | 0.538 | 0.237 | 0.591 | 0.540 | 0.239 |
| | | | | Panel B | | | | | |
| HHI (area) IV | 0.07*** | 0.04 | -0.02 | | | | | | |
| | (0.00) | (0.25) | (0.53) | | | | | | |
| HHI (rent) IV | | | | 0.09*** | 0.04 | -0.02 | | | |
| | | | | (0.00) | (0.25) | (0.53) | | | |
| HHI (no. of units) IV | | | | | | | 0.07*** | 0.04 | -0.02 |
| | | | | | | | (0.00) | (0.25) | (0.54) |
| Segment | All | Apt. | House | All | Apt. | House | All | Apt. | House |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Municipality FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1060 | 1043 | 1006 | 1060 | 1043 | 1006 | 1060 | 1043 | 1006 |
| Adj. R-squared | 0.523 | 0.457 | 0.096 | 0.383 | 0.431 | 0.096 | 0.534 | 0.462 | 0.090 |

Note: Estimated coefficients measure how much the average rent changes in a given municipality when market concentration, as measured by the Herfindahl-Hirschman Index, increases in that municipality. HHI (area) is computed based on the market shares in total area of units rented out by businesses in a given municipality. HHI (rent) is computed based on the market shares in total value of rent for units rented out by businesses in a municipality. HHI (no. of units) is computed based on the market shares in total count of units rented out by businesses in a municipality. Data is from 2010 to 2020. Regressions are estimated using weights based on the population residing in each municipality in 2009. The first stage F-statistic in panel B in column (1) is equal to 43.12. Standard errors are clustered at the municipality level. P values are reported in parentheses, * p<0.1, ** p<0.05, *** p<0.01.

Source: Authors' estimation based on data from Boligportal, BBR, Virk and Statistics Denmark.

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MICRO DATA SCIENCE

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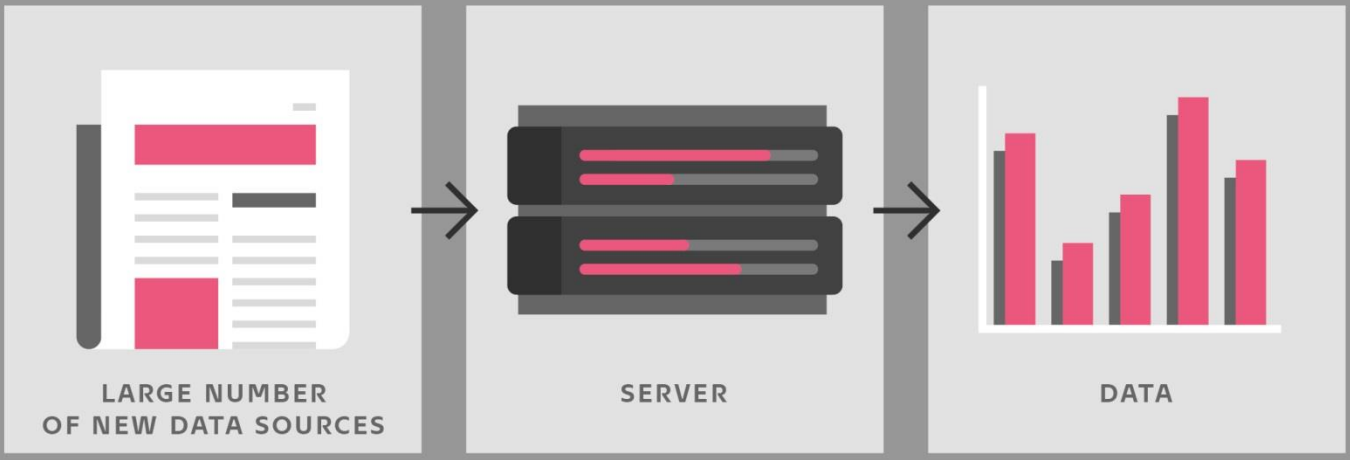

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