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# House Prices and Spatial Mobility: Lock-in Effects on the German Rental Market\*

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Since 2010, particularly in urban agglomerations, the German housing market has experienced stark house price and rent increases. Immigration from rural and smaller settlements as well as international migration into German urban areas, has fuelled an increase in housing demand and led to severe housing shortages in some parts of Germany. Incumbent tenants in these areas are often deemed lucky in the general public's discourse. Due to restrictions on rent increases within existing contracts, these sitting tenants pay rents significantly below the market level of new rental contracts whilst living in relatively popular areas. In the context of rising rents and house prices, this implies a growing residency discount, i.e. an increase in the gap of incumbent rents to new contract, market-level rents. However, long-term renting, in the context of changed circumstances from 2010 onwards, might also come at significant costs. Tenants who are dissatisfied with their home might not be capable of moving house or apartment as they may find themselves "locked-in". Using hedonic house price regressions and representative survey panel data, this paper will analyse whether residential mobility of sitting tenants in high rental and housing price areas is indeed restricted due to the aforementioned "lock-in effect".

**Keywords:** spatial mobility, housing market, lock-in effects.

**JEL classification:** R00; R21; R30; R31.

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# 1. Introduction

This paper assesses patterns of residential mobility on the German private rental market. Through spatial analysis of representative household and housing price data the paper will argue that recent developments in specific regional housing markets in Germany in combination with the German institutional setting for rent control imply lock-in effects, and hence lower levels of residential mobility for specific groups of private tenants in Germany.

Economic literature analysing the relationship between spatial mobility and housing prices has hitherto predominantly focussed on homeowners and social housing tenants. Homeowners are generally found to be less mobile than tenants, as they face higher transaction costs when moving dwellings (Oswald, 1996; Blanchflower and Oswald, 2013; Boeheim and Taylor, 2002; Dietz and Haurin, 2003). Further, social housing tenants have been shown to be less mobile than private housing tenants, as they pay below market rental prices, implying “lock-in effects” (Battu, Ada, and Phimister, 2008). Private renting in economic literature therefore is largely deemed to be the most mobile form of housing tenure. However, similar effects, as found for homeowners and social housing tenants, might also exist within the private rental market, as will be argued in this paper.

Generally, the analysis of spatial mobility patterns is a highly interesting field of research, as lower levels of spatial mobility have important implications for a range of economic and social aspects. For example, low levels of spatial mobility due to involuntary “lock-in” effects are associated with inefficiencies in the housing market, as tenants might not be able to live in or find adequate and affordable housing (Lui and Suen, 2011). Additionally, involuntary lower levels of spatial mobility might lead to inefficiencies on other markets, such as the labour market, as individuals might be bound to a specific regional labour market and therefore can not react to labour market shocks by moving locations (Oswald, 1996; Blanchflower and Oswald, 2013). Additionally, higher levels of spatial mobility are potentially correlated with higher levels of social mobility, as more mobile individuals are capable of moving towards places of economic and educational opportunity, thereby climbing up the social ladder (Wrede and Borck, 2018; Long and Ferrie, 2013). In contrast, lower residential mobility might also imply positive social aspects, as low levels of spatial mobility have been shown to positively impact the investment of social capital within respective neighbourhoods (Kan, 2007). The analysis of the underlying constituents of spatial mobility within the private rental market, such as housing prices, is therefore of the utmost importance for a range of economic and social aspects. This paper presents

novel evidence for Germany showing that under certain circumstances there are also severe mobility constraints for private market tenants. Most crucially, the paper identifies long-term tenants in the German private rental market to ultimately show that sitting tenants in areas of high housing and rental price increases suffer from lock-in effects, as they are not capable of moving houses even if they want to.

From 1995 up to 2010, the German housing market was characterised by stagnating prices and relatively high vacancy rates (see Kholodilin, Mense, and Michelsen, 2016, pp. 4-6). However, since 2010 the German housing market, in some regions, has experienced stark price increases. Immigration from rural and smaller settlements as well as international migration into German urban areas has led to an increase in the demand for housing and a housing shortage, ultimately driving up prices for dwellings and new rental contracts, especially in urban areas (see Kholodilin, Mense, and Michelsen, 2016, pp. 4-6). Incumbent, long-term tenants in these areas are often deemed lucky by the general public as due to existing German rental law, and in particular due to restrictions on rent increases within existing contracts, they pay rents significantly below the market rent of new contracts whilst living in relatively popular areas. Sitting tenants in these areas therefore enjoy an increasing residency discount i.e. a growing gap between the incumbent rent and the rent for new contracts required to live in an equivalent dwelling within the same area (Fitzenberger and Fuchs, 2017, p. 213). However, long-term renting, in the context of changed circumstances from 2010 onwards, might also come at significant costs. Renters who experience a change in personal or professional circumstances or more generally are dissatisfied with their dwelling might not be capable of moving apartments as they pay comparatively low rents, cannot afford new high-rent contracts, to buy their own property or simply do not want to give up their residency discount. Residential mobility of these tenants therefore might be restricted leading to so called “lock-in effects”, ultimately leaving them less likely to move locations.

The paper seeks to identify private tenants on the German rental market who live in areas with high housing and rental price growth and who enjoy a substantial residency discount. In order to identify these tenants, hedonic house and rental price regressions are estimated. The information derived from the set of hedonic regressions in turn is used to derive region-specific house and rental price growth estimates and to calculate household-specific residency discounts across German postal code regions. The paper ultimately analyses whether the identified group of tenants is indeed less mobile than other private tenants, has a lower propensity to move even when dissatisfied with the current

dwelling and therefore suffers from lock-in effects. To do so it will employ representative survey data from the German Socio-Economic Panel (SOEP) between 2012 to 2016 as well as housing and rent price data provided by the *Empirica* market data base. Finally, it shows that sitting tenants living in areas with high housing and rental price growth indeed suffer from lock-in effects. The study is organised as follows. Section 2 includes a literature review and portrays the theoretical background on the relation between residential mobility, housing markets and tenure choices. Section 3 continues by providing a brief overview of the German housing market as well as the legal background. Section 4 describes the data and outlines the employed empirical methods. Section 5 presents the findings of the empirical analysis and Section 6 tests these findings in a sensitivity analysis. Finally, Section 7 concludes and provides an outlook for future research.

## 2. Literature Review and Theoretical Background

### 2.1. Theoretical Background

Microeconomic theory suggests that an individual's decision to move essentially depends on the present value of the net gains associated with moving house or apartment (Berger and Blomquist, 1992; Caldera Sanchez and Andrews, 2011). The net present value of moving is determined by a range of monetary and non-monetary components. Following Berger and Blomquist (1992) and Bartel (1979) individuals, in a stylised and simple discrete choice model, consider potentially higher wages, better job opportunities, the quality of life, housing costs and the cost associated with moving, when deciding on a change in dwellings. The net present value of the gains associated with moving can therefore be depicted as follows:

$$G_{it} = \sum_{t=0}^n (1 + r_t)^{-t} (\Delta WageJob_{it} + \Delta QoL_{it} + \Delta HousingCost_{it} - C_{it}) \quad (1)$$

where  $G_{it}$  is the present value of net gains in location/dwelling  $i$  at time  $t$ .  $R_t$  is the discount rate.  $\Delta WageJob_{it}$  is the difference of wages and job opportunities associated with a move at time  $t$  between old and new location, and  $\Delta QoL_{it}$  represents the difference in the quality of life between dwellings at time  $t$ .  $QoL_{it}$  can represent pecuniary as well as non-pecuniary aspects e.g. the price level, the quality of accommodation, neighbourhood, proximity of amenities, friends and families, and commuting times.  $\Delta HousingCost_{it}$  represents the difference in costs between dwellings at time  $t$ , such as the difference in

rental or mortgage payments between house and apartments.  $C_{it}$  represents the moving cost associated with a change in houses including search costs. If the net present value associated with moving is positive, individuals change dwellings. The probability to move hence is a positive function of the net present value associated with moving (see Equation 2).

$$Pr_t = f(G_{it}) \quad (2)$$

In the real world, the decision to move is a significant undertaking for individuals over the course of the life-cycle. It depends on a range of macroeconomic and microeconomic factors that impact the decision process depicted above. In settings of Linear Probability or Probit models empirical mobility studies, mostly condition the decision to move on individual and household characteristics. Household and individual characteristics change over the course of a lifetime and are crucial factors that impact and determine the quality life as well as job and wage opportunities which individuals gain from moving houses (Caldera Sanchez and Andrews, 2011, p.188). The level of education, the current job situation, job changes, age, health, divorce, amount of school children within a household or family size and formation in general are all factors that have been shown to impact spatial mobility (Caldera Sanchez and Andrews, 2011, p.188). For example, individuals with higher levels of education may have better information about non-local real estate and job offers, which in turn influences the potential earnings and costs in a new location. Additionally, individuals with high levels of education might have lower language barriers and are therefore more likely to consider moving to foreign destinations, as their quality of life in international locations would not be negatively impacted by a lack of language fluency. Therefore, the probability of moving is generally shown to be positively correlated with an individual's level of education (Caldera Sanchez and Andrews, 2011, p.188). Further, families with school children might be less likely to move house as they do not wish to uproot their children from a known and stable environment, thereby decreasing the quality of life in the new potential location (Caldera Sanchez and Andrews, 2011, p.188). Generally, previous research has shown that short-distance moves are most commonly conducted in order to adjust housing and/or neighbourhood characteristics. In contrast, households are more likely to move long-distance for job or educational purposes (Coulter and Scott, 2015). In addition to the household and individual characteristics described above, factors such as the time period, the institutional setting, interest rate developments, access to financing and regional housing demand and supply patterns impact the cost of moving, house prices, the availability of jobs and flats

and hence the propensity to move (Caldera Sanchez and Andrews, 2011, p.187). Beyond these patterns, an extensive amount of economic research has focussed on the impact of tenure choices on residential mobility, as briefly portrayed in the introduction. The following literature review will summarize the main strands of economic research in the field of housing choice, prices and their impact on residential mobility.

## 2.2. Literature Review

Economic literature on the impact of tenure choice has mainly focused on the impact of homeownership on mobility. Homeowners face higher transaction costs and taxes when moving and are therefore deemed to be less mobile than private tenants. In 1996, Oswald developed his oft-debated hypothesis that low residential mobility of homeowners implies longer spells of unemployment, a greater risk of unemployment and lower wages for homeowners (Oswald, 1996). The breadth of literature seeking to test the so called Oswald hypothesis tends to find that homeowners are indeed less mobile than private tenants (Best and Henrik, 2017; Van Ommeren and Van Leuvensteijn, 2005). However, the link between homeownership and unemployment is strongly contested. After correcting for the likely endogeneity of housing tenure status, microlevel studies generally find that there is no evidence of a negative correlation between homeownership and employment (Munch, Rosholm, and Svarer, 2003; Laamanen, 2013; Broulikova, Montag, and Sunega, 2018). Aggregate level studies, however, find that there is a positive correlation between the share of owner-occupied dwellings and aggregate unemployment in a region. (Blanchflower and Oswald, 2013; Coulson and Fischer, 2009; Laamanen, 2013). To reconcile these findings, Laamanen (2013) suggests that high homeownership in regions implies externalities such as consumption and displacement effects. High rates of local homeownership increases local job competition, as homeowners are bound to the job market within their region, causing displacement effects for other residents in the region (Laamanen, 2013). Low spatial mobility rates for homeowners can also lead to higher social capital investment of individuals and households within their neighbourhood. For example, DiPasquale and Glaser (1999) show that homeowners are more engaged in their communities and more aware of and involved in local government decisions.

As mentioned in the introduction, a second strand of housing tenure and mobility research has focused on the effects of social housing tenure on residential mobility. Generally, studies in this area of research show that public housing tenants are less mobile than tenants in the private rental sector (Lui and Suen, 2011; Battu, Ada, and Phimister,

2008) and that the average duration of tenure in social housing has been increasing over time (Bahchieva and Hosier, 2001). Social housing is therefore frequently associated with so called lock-in effects implying that social housing tenants are less likely to move to more appropriate housing, even after their circumstances have changed, as they pay below market prices for their subsidised dwellings. This in turn leads to a misallocation of social housing apartments (Lui and Suen, 2011; Boyle and Shen, 1998). Further, Battu, Ada, and Phimister (2008) as well as Gregoir and Maury (2018) find that public housing tenants without a job, *ceteris paribus*, are less likely to obtain a job than unemployed private renters.

Private tenants have hitherto frequently served as a reference group to which mobility patterns of homeowners and social housing tenants have been compared. However, the effects of rent controls in parts of the private rental sector have also occasionally been the focus of research. Fitzenberger and Fuchs (2017) point out that rents of German sitting tenants are regulated more extensively than new rental contracts. In a quantile regression approach, they show that German incumbent tenants enjoy a significant residency discount that grows in times of price increases for new rental contracts and generally increases with the duration of tenure. Diamond, McQuade, and Qian (2017) show that rental regulations and consequent tenancy discounts in San Francisco for specific segments of the rental market imply a lower probability to move houses for those tenants living in rent-controlled dwellings. Clark and Heskin (1982) find that partial rent control is associated with residency discounts and a drop of the spatial mobility rate in the region of Los Angeles during the mid 1980s. Other studies focus on tenancy durations rather than the propensity to move. By employing a proportional hazard rate model, Munch and Svarer (2002) find that living in strongly rent-regulated apartments in the Danish housing market significantly increases the tenancy duration of households. Using a similar approach, Nagy (1995) finds that tenants living in rent-controlled apartments in New York City on average tend to stay longer in their dwellings. However, after controlling for individual- and household-specific characteristics, these durational differences are no longer attributable to living in a controlled rental apartment. Krol and Svorny (2005) find negative impacts of rent control on residential mobility. By analysing census data from New Jersey, the study finds that tenants in rent controlled apartments are more likely to have longer commute times, as they are unlikely to give up controlled housing due to a change in circumstances such as a change in the location of employment. Finally, Skak and Bloze (2013) show that partial rent control leads to misallocations of dwellings amongst tenants. Studies examining the German housing market so far have not directly



focussed on the potential relation between rent control and spatial mobility. Kholodilin, Mense, and Michelsen (2016), for example, analyse the effects of the *Mietpreisbremse*, a recently introduced rental price control for parts of the German housing market (see Section 3.2). Further, Vandrei (2018) examines the impact of the rental brake on housing investment and sales prices of regulated apartments. In contrast to these studies, the paper focuses on the relation between housing prices, rent control and spatial mobility. More precisely, the study will contribute to the existing literature by analysing the relation of spatial mobility and differing degrees of rent control between incumbent and new, initial rental contracts for the German market.

The topic of the paper is also related to the largely qualitative, geographical and sociological literature on displacement effects and gentrification (Newman and Wyly, 2006; Slater, 2009). In one of the few quantitative studies, Freeman and Braconi (2007), for example, find that poor households in gentrified/gentrifying areas of New York have lower mobility rates than poor households in other neighbourhoods. They suggest that as neighbourhoods gentrify and local housing and rental prices increase, the neighbourhoods also become more secure and get better retail and job opportunities (Freeman and Braconi, 2007, p. 48). Thereby, as the authors suggest, these neighbourhoods might also become more attractive for poorer households causing them to ultimately benefit from gentrification. This argument, however, has been highly criticised by studies such as Newman and Wyly (2006) who point out that moving for poorer households might simply not be possible as they may live in rent-controlled apartments. In addition, other (surrounding) areas within the city also experience gentrification, thereby leading to housing and rental price increases in these areas and potentially “locking-in” poorer tenants. In order to move, these households would then need to relocate to cheaper, further away areas. Long-distance moves, however, imply a change of social networks and cultural links with significant personal cost, a decision more difficult to make than moving within proximity of one’s previous home (see Equation 1). Rather than positive spillover effects derived from gentrification, these involuntary patterns would therefore explain the lower mobility rates observed among poorer households in gentrifying neighbourhoods during the 1990s in New York (Newman and Wyly, 2006). In the long term, poorer households might, however, be forced to move to cheaper, further away areas, as the general costs of living in the analysed gentrified areas might increase so drastically that the pressure to move might become larger, ultimately leading to ‘exclusionary displacement’ and social segregation (Slater, 2009, p. 304 -305).

Most of the literature reviewed above employs Linear Probability (see Broulikova, Montag, and Sunega, 2018, p. 21) or Probit models (see Lui and Suen, 2011, p. 6) in order to empirically assess the impact of housing tenure and housing prices on the propensity to move. A dichotomous variable indicating whether an individual has moved during a given time period is regressed on the respective housing tenure variable of interest. Additional variables such as demographic controls, socio-economic factors and local housing market characteristics, as illustrated above, are included (see Caldera Sanchez and Andrews, 2011, p.188 ). Alternatively, studies such as Bahchieva and Hosier (2001) employ duration models to assess the hazard rates of public housing tenants into other tenancy forms, conditional on the time they have spend in public housing whilst including a set of household characteristics. A key problem most empirical studies identify is the endogeneity of tenure choice. Despite the generally large amount of control variables included in most models, selection bias might be a concern if the choice of tenure is related to unobservable factors that also influence the decision to move (see Caldera Sanchez and Andrews, 2011, p.190 ). It is not evident whether individuals become less mobile due to their housing choice, or whether less mobile individuals self-select into tenure options such as homeownership (Broulikova, Montag, and Sunega, 2018). In order to account for the potential threat of endogeneity, a range of different approaches has been chosen. Broulikova, Montag, and Sunega (2018), for instance, exploit the exogenous variation stemming from privatisation of publicly-owned housing in Central and Eastern Europe. Wolf and Caruana-Galizia (2015) use World War II bombing in Germany as an instrument for homeownership to reassess the Oswald hypothesis. However, many studies such as Lui and Suen (2011) concede that finding valid instrumental variables is difficult and that including an extensive set of control variables might be the only option to attempt to account for the endogeneity of occupancy choice.

In summary, owning a home is associated with lower levels of residential mobility as homeowners face higher transaction costs when moving. Additionally, living in social housing or in rent-controlled accommodation has been shown to be negatively correlated with residential mobility. Tenants residing in these forms of housing would need to forego the present value of the price differential between their current relatively low rent and their future rental payments when leaving social housing or moving to an uncontrolled apartment, which in accordance with microeconomic theory (see Equation 1) decreases the propensity to move. With the exemption of Kholodilin, Mense, and Michelsen (2016); Vandrei (2018) and Fitzenberger and Fuchs (2017), topical empirical literature on the German private rental market and its legal settings is relatively scarce and with the

exemption of Wolf and Caruana-Galizia (2015), empirical studies, analysing mobility patterns for different tenure choices do not exist. The legislative and institutional design of the German housing market, however, implies a dual system of rental regulations for rental contracts of sitting tenants and new rental contracts. This in turn might impact the residential mobility of sitting tenants, as will be assessed by this study.

### 3. The German Institutional Background

#### 3.1. Protection for Sitting Tenants

As in most Western countries, the German rental market displays a residency discount for sitting tenants (Fitzenberger and Fuchs, 2017) as this group of tenants enjoys stronger rent controls than tenants in new rental contracts. The corner stone and most commonly used basis of rent setting and capping in the German system is the so called "*Mietpreisspiegel*" (De Boer and Bitetti, 2014, p.28) or "rental price barometer". The "*Mietpreisspiegel*" is essentially a survey of characteristic regional rents conducted or recognised by the municipality or by tenants' and landlords' associations. It serves to derive a comparable local reference rent and is legally required to be updated every two years (Kholodilin, Mense, and Michelsen, 2016, p.8). The local reference rent is derived as the average of local rent increases in existing contracts over the past four years and the prices of new contracts for comparable dwellings (De Boer and Bitetti, 2014, p.28). The reference rate derived in such a manner sets the maximum limit for rent increases within existing contracts <sup>1</sup>. There is an additional rent cap limiting the maximum rent increase to 20 percent over three years within existing contracts. Since 2013, federal states can introduce even tighter rental caps of 15 percent over three years in areas that face shortages of affordable rental space. Currently, these special regulations are in place in municipalities with tight housing markets in eleven out of sixteen federal states in Germany (Schoen, 2018; Kholodilin, Mense, and Michelsen, 2016). Further, landlords can only increase rents after a minimum tenancy duration of 15 months, and 15 months after the last rent increase. German rent control laws therefore constitute a typical second-generation type rent control system (Snelling, Turnerand, Marquardt, and Davies, 2017) which are wide-spread in industrial countries. Whilst first-generation rent controls im-

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<sup>1</sup>If the calculation of the "*Mietpreisspiegel*" is not possible, the local reference rate is derived by an expert's reported estimate or by rents in at least three comparable dwellings owned by other landlords (Kholodilin, Mense, and Michelsen, 2016, p.8).

posed strict rent ceilings, second generation regulations are generally more flexible and allow rents to increase in line with reference rates (Kholodilin, Mense, and Michelsen, 2016; Vandrei, 2018). In addition to rent control laws within existing contracts, German tenants enjoy further legal protections. Standard German rental contracts, for example, run for an indefinite period and landlords need to give notice between three and nine months in advance before ending the contract. Permissible reasons to end the contract are limited and consist of serious violations of the contract such as rent arrears or illegal subletting. Alternatively, landlords have the right to end the contract if they intend to personally use and reside in the dwelling (De Boer and Bitetti, 2014).

### 3.2. New Rental Contracts

As previously mentioned, there is a divergence between the rental protection for existing contracts and new rental leases. From 2000-2015, new rents in Germany have in effect been unregulated. There have been legal provisions to ensure that new rents do not enter the market at an exorbitant level. For example, according to the German rental law, new rents that are 20 percent above the local reference rent are considered usury, and 50 percent above the local reference rate is considered a criminal act which can be penalised with time up to three years in prison <sup>2</sup>. However, these regulations have hardly been enforced and new rents remained largely unregulated (De Boer and Bitetti, 2014, p.28). Still, in 2015 the so called "*Mietpreisbremse*" was introduced. This "rental brake" seeks to limit and control the level of initial rents in areas of tight housing markets by imposing upper bounds of ten percent above the typical local rent (Kholodilin, Mense, and Michelsen, 2016, p.3). Under the rental brake law federal states can declare municipalities or specific parts within municipalities tight housing markets. In order to do so at least one of the following conditions must be satisfied: (1) rents within the region under examination grow faster than the national average, (2) the average share of rental payments out of income in the relevant location is significantly higher than the national average rent-to-income ratio, (3) there is a shortage of newly constructed housing whilst the local population increases and lastly (4) there is a large housing demand but a low vacancy rate (Kholodilin, Mense, and Michelsen, 2016, p.8). Newly built dwellings, dwellings that have undergone a substantial refurbishment, limited rental contracts and dwellings with a previous contract that already exceeded the upper bound, however, are exempt from the regulation. Since its introduction, the rental brake has been implemented in municipalities of twelve out of the sixteen German federal states (Kholodilin, Mense, and Michelsen,

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<sup>2</sup>see § 5 WiStG and §291 StGB

2018, p.109). Studies such as von Bodelschwingh, Dettmann, and Schlichting (2016) or Kholodilin, Mense, and Michelsen (2016) find that the impact of the rental brake has been limited. Kholodilin, Mense, and Michelsen (2018), however, show that the rental brake does work in areas that experienced very high rental price increases previous to the introduction of the rental brake. Further, the study shows that in these areas, significant rent price increases in the unregulated sector, for example in newly constructed flats, are observable. Despite the implementation of the rental brake, rents paid within new and old contracts, however, continue to differ significantly as differences in their respective regulations persist.

### 3.3. The German Housing Market

There is a strong regional variation within the German housing market. In rural and sub-urban areas, especially in eastern Germany, the housing market is relatively balanced. In some areas there even is an oversupply of dwellings with approximately 1.8 million empty apartments overall in Germany (BMF, 2017, p.5). In contrast, in urban agglomerations and student cities, severe housing shortages dominate the local housing markets, ultimately putting upward pressure on housing prices in these areas (Kholodilin, Mense, and Michelsen, 2016). However, even within big cities, substantial variations in local housing markets exist. Whilst some districts are characterised by high levels of housing demand and supply shortages, other more peripheral areas show relatively balanced housing markets (BMF, 2017, p.5). The regional differences in the German housing market in turn are reflected in rents and house prices. Since 2010, both have strongly increased in popular urban areas such as the Big Seven <sup>3</sup> and stagnated or only increased marginally in many rural areas such as the Harz or in parts of eastern Germany such as Mecklenburg-Vorpommern (BMF, 2017, p.5). In Germany, rents are estimated to have increased on average by 10.2 percent from 2010 to 2015. Disposable income over the same period rose by approximately 11.5 percent (BMF, 2017, p.5). Rents for new contracts, however, rose significantly faster showing an increase of approximately 18 percent. For metropolitan areas, this increase was even more pronounced with on average 26 percent (BMF, 2017, p.5). House prices also rose significantly. Between 2010 and 2015, Kholodilin, Mense, and Michelsen (2016) show that real house prices increased by approximately 25 percent. These regionally-varied increases in housing prices as well as the German system and its implied residency discount in turn might lead to lock-in effects as sitting tenants who need to move are no longer capable of doing so.

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<sup>3</sup>Berlin, Hamburg, Munich, Cologne, Duesseldorf, Frankfurt am Main and Stuttgart

## 4. Data, Descriptives and Empirical Strategy

The main aim of this paper is to analyse whether sitting tenants in areas of high rent increases who enjoy a significant residency discount show lower levels of residential mobility. To do so, the paper employs two sets of data. Firstly, it uses housing listings obtained from the *Empirica* data bank on real estate and rental prices. The available sample contains listings and deals from 2012 to 2016 conducted through Germany’s largest online real estate platforms such as *Immoscout* and *immowelt/immonet*, newspapers and local online platforms. The study has access to listings data from 75 out of 95 postal code regions in Germany.<sup>4</sup> In total, the data bank uses a set of over 100 sources. Secondly, the paper uses data from the *German Socio – Economic Panel*, which consists of a representative survey sample of longitudinal panel data on German households and has been conducted annually since 1984. The focus here lies on the period between 2012 and 2016, as the *Empirica* house and rental price data is only accessible for this period.

The data obtained from the *Empirica* data bank mainly consists of online house and apartment listings. The prices and rents included in the *Empirica* data bank are therefore advertised prices and rents of the respective listings and not the actual transaction prices. Advertised rental prices are frequently used to estimate price developments for new rental contracts (Kholodilin and Michelsen, 2014). However, it is important to note that using data derived from online advertisements might lead to a source of bias when estimating price and rent developments across German regions. Using the asked/advertised online rents and prices might imply an upward or downward bias of the observed prices as the final transaction prices/rents potentially deviate from the asked prices/rents (Kholodilin and Michelsen, 2014, p. 14). Data on actual transactions, however, is difficult to observe, obtain and collect. In the case of this study, working with advertised rents and prices might even imply a certain benefit. Individuals searching for flats and houses are firstly confronted with advertised prices and rents. Therefore the observed advertised prices might have a substantial impact on the initial decision to pursue moving plans or not, and hence ultimately might be crucial for determining residential mobility patterns.

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<sup>4</sup>See Appendix Table 15 and Section 4.1 for a more detailed description and illustration of German postal code regions.

The empirical part of the study proceeds as follows. Firstly, using the *Empirica* data, the study estimates a hedonic regression model. The model controls for a range of housing quality indicators, such as size and equipment of the respective listings, as well as regional differences across postal code areas in Germany. Secondly, using equivalent housing quality indicators given in the SOEP sample, the coefficients of the hedonic regressions obtained from the *Empirica* data are used to impute hypothetical new contract rents for each SOEP tenant household in the private rental market. The imputed rents indicate the per square-metre price each household would need to pay if it were to move to a similar dwelling within the same postal code region at the given time of observation. Additionally, by means of the hedonic regression approach and using the *Empirica* data, quality-controlled, regional nominal house and rental price developments are estimated. Ultimately, using a Linear Probability regression approach, the propensity to move dwellings of individuals in the *SOEP* sample is assessed. Particular focus is given to tenants who live in households that enjoy a relatively large residency discount, defined as the difference between households' current observed rents and their imputed new rents, and tenants who live in regions where rental prices rose strongly between 2012 and 2016. Tenants who live in these areas and enjoy a large tenancy discount are expected to be less likely to move, even when dissatisfied with their dwelling, a question asked within the *SOEP* survey questionnaire. A lower propensity to move for these tenants would suggest that they are indeed locked-in and cannot afford equivalent housing within their area. When wanting to move, the tenants under examination would therefore need to undergo a far-distance move. A far-distance move, however, is associated with higher cost of moving and a potential reduction in the quality of life, as friends, family and a relatively attractive (urban) area would need to be given up. Considering Equations 1 and 2 in Section 2.1 this would suggest a lower propensity to move dwellings. The remainder of this section will step by step present the empirical approach briefly depicted above. Further, it will discuss potential shortcomings of the chosen approach and present how the study attempts to address these shortcomings. It will also present descriptive and summary statistics of the data.

#### 4.1. Identification of the 'Treatment Group' : A Hedonic Approach

The first part of the empirical approach focuses on identifying the tenants of interest described above, which in the following will be referred to as the 'treatment group' <sup>5</sup>. In

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<sup>5</sup>Note that the term 'treatment group' in this study does not refer to the usual use of 'treatment group' in studies using quasi-experimental variation seeking to estimate the average treatment effect of the

order to do so, the study utilises hedonic regression methods. First introduced by Rosen (1974), hedonic price modelling is one of the most commonly applied methods in the field of housing price evaluations. Its theoretical underpinnings derive from the idea that a good can be valued by its attributes. Each characteristic of a good has an intrinsic value and the sum of each attribute’s value constitutes the overall value of a good. This assumption in turn implies that a good’s final price can be regressed on the good’s attributes to determine in which way each trait adds to the overall composite price (Xiao, 2017, p. 12). For example, typical attributes used in hedonic housing regressions are the size and type of the dwelling, the equipment of the property such as the existence of a garden or a balcony as well as the dwelling’s age (Kholodilin and Michelsen, 2014). In order to obtain estimates for the impact of each characteristic, the following hedonic price regression is estimated for each year between 2012 and 2016. The dependent variable,  $R_i$ , is the rental price per square metre.  $X_i$  is a vector controlling for a range of structural and equipment attributes of dwelling  $i$  (see Table 1), and  $ZIP_i$  is a vector containing postal code region fixed effects. Lastly,  $u_i$  is the error term.

$$R_i = \beta_0 + X_i'\beta_1 + ZIP_i'\beta_2 + u_i \quad (3)$$

In order to obtain imputed new rents for each household in the *SOEP* data by using the estimated coefficients, the structural and quality variables contained in  $X_i$  are limited to the variables that are contained in both, the *Empirica* as well as the *SOEP* data set (see Table 1). Using the obtained estimated coefficients of the included structural and equipment variables estimated for each year by equation 3, it is then possible to calculate, for each private tenant household contained in the *SOEP* data set, the hypothetical new rent, it would have to pay if it was to move to an equivalent dwelling<sup>6</sup> within the same postal code region at the given time of observation.

Additionally, the study estimates a set of regressions controlling for the regional yearly change in house prices and rental prices. This in turn allows to calculate the average yearly percentage increase in house and rental prices for different postal code regions across Germany, whilst still controlling for the quality, size and equipment of the apart-

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treated. The design employed in this study is not quasi-experimental due to a lack of adequate data. However, the term ‘treatment group’ is used nonetheless as the identified group is the major group of interest whose mobility patterns the study seeks to analyse.

<sup>6</sup>i.e. a dwelling with similar equipment and structural features as the current residence.



Table 1: Hedonic Regression: Overview of Quality and Control Variables

Structural Features	
Living Space	Measured in square-metres
Number of Rooms	Counts rooms larger than five square-metres
Detached/Semi-Detached	Equal to 1 if dwelling is detached/semi-detached
Built before 1972	Dwelling was built before 1972
Equipment	
Built-in kitchen*	Dwelling comes with a built-in kitchen
Cellar	Access to storage in a cellar compartment
Garden	Access to a garden
Bathroom with windows*	At least one bathroom with a window
Balcony or Terrace	Access to balcony or terrace
In need of refurbishment	Dwelling is in need of refurbishment

\*Only included in hedonic regression modelled in equation 4, Source: Empirica Databank 2012 -2016

ment. Equation 4 depicted below is the cornerstone of this approach.

$$\ln(Y_i) = \beta_0 + X_i' \beta_1 + ZIP_i' \beta_2 + ZIP_i' * Year_i \beta_3 + u_i \quad (4)$$

$Y_i$  is either the rental price per square metre of the apartment or the purchase price per square metre of a dwelling, depending on which specification is estimated.  $Year_i$  is a year dummy. For example, focusing on the years 2012 and 2013,  $Year_i$  would equal one if the listing is from the year 2013. The coefficient of the interaction term between the respective postal code region contained in  $ZIP_i$  and the year dummy,  $\beta_3$ , multiplied by one hundred therefore gives the percentage change of advertised house prices or rental prices from year 2012 to 2013 for the each respective postal code region. The same procedure then is repeated for the years 2013 and 2014, 2014 and 2015 as well as 2015 and 2016 to ultimately derive the average yearly change of regional rental and house prices respectively. In specification 4, a larger set of control variables can be included in vector  $X$ . Unlike in specification 3 the employed control variables do not need to be included in the *SOEP* data set (see Table 1), as the aim of the estimation of this second specification is purely to obtain regional estimates of house price and rent developments

over the period of interest.

Table 2: Average Yearly Percentage Change of Rents and House Prices

Variable	Mean	Min.	Max.	Standard Deviation	N
House Price per sqm	5.45	-6.24	14.15	0.036	93,706
Rental Price per sqm	2.92	-1.90	7.95	0.0177	166,543

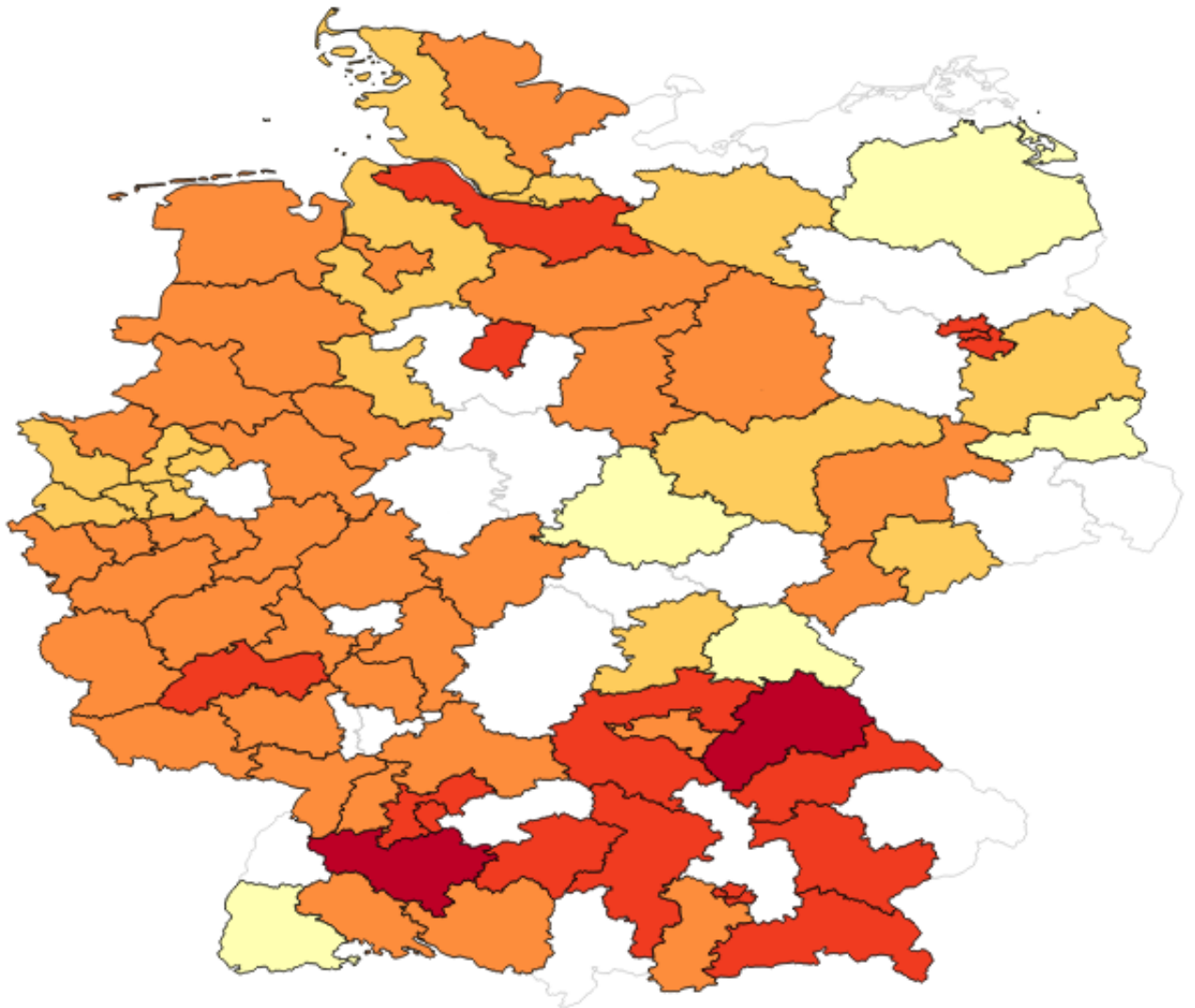
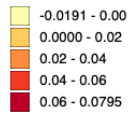
Source: Empirica Data Bank 2012 -2016, own calculations

Table 2, Figure 1 and 2 depict summary statistics and the regional variation of the estimated average yearly rental and house price increases across the observed postal code regions. Postal code regions are regions whose postal code starts with the same two digits. In Germany there are 99 postal code regions in total, ranging from 01 to 99. 95 of these codes pertain to residential areas, the remaining codes are utilised for governmental and administrative usage. The available data set contains listings of 75 out of these 95 postal code regions (see Figure 1).<sup>7</sup> Considering that in order to estimate the specifications illustrated above one region needs to serve as a baseline and hence is to be excluded, ultimately information for 74 regions are provided. There was an approximate yearly rental price increase of, on average, 2.9 percent across these 74 regions. House prices approximately rose by, on average, 5.5 percent (see Table 2). Generally, when assessing Figures 1 and 2 there appears to be a strong regional variation of the average yearly price and rent changes. Especially in postal code regions being part of or including large cities such as Munich and its surroundings, Stuttgart and neighbouring regions, Leipzig and its surroundings as well as parts of Berlin house prices and rents rose strongly. However, there also are substantial price and rent increases in areas with medium to smaller sized cities such as Brunswick and Wolfsburg, and smaller university towns such as Tübingen. The region with the largest average yearly rent increase of almost eight percent is postal code region 92 which includes Schwandorf and areas in the Oberpfalz, all places in commuting distance to Nuremberg. In contrast, other areas have experienced below-average rent and house price increases. Predominantly in rural regions and/or areas in eastern Germany, the estimated yearly average rental price change was even negative<sup>8</sup>. These findings in turn confirm the price and rent change estimates presented in other studies. Further, they echo the patterns of strong regional variations stressed in the German housing market literature (Kholodilin, Mense, and Michelsen, 2016; BMF, 2017).

<sup>7</sup>For a full list of postal code regions in Germany please see Table 15 in the Appendix.

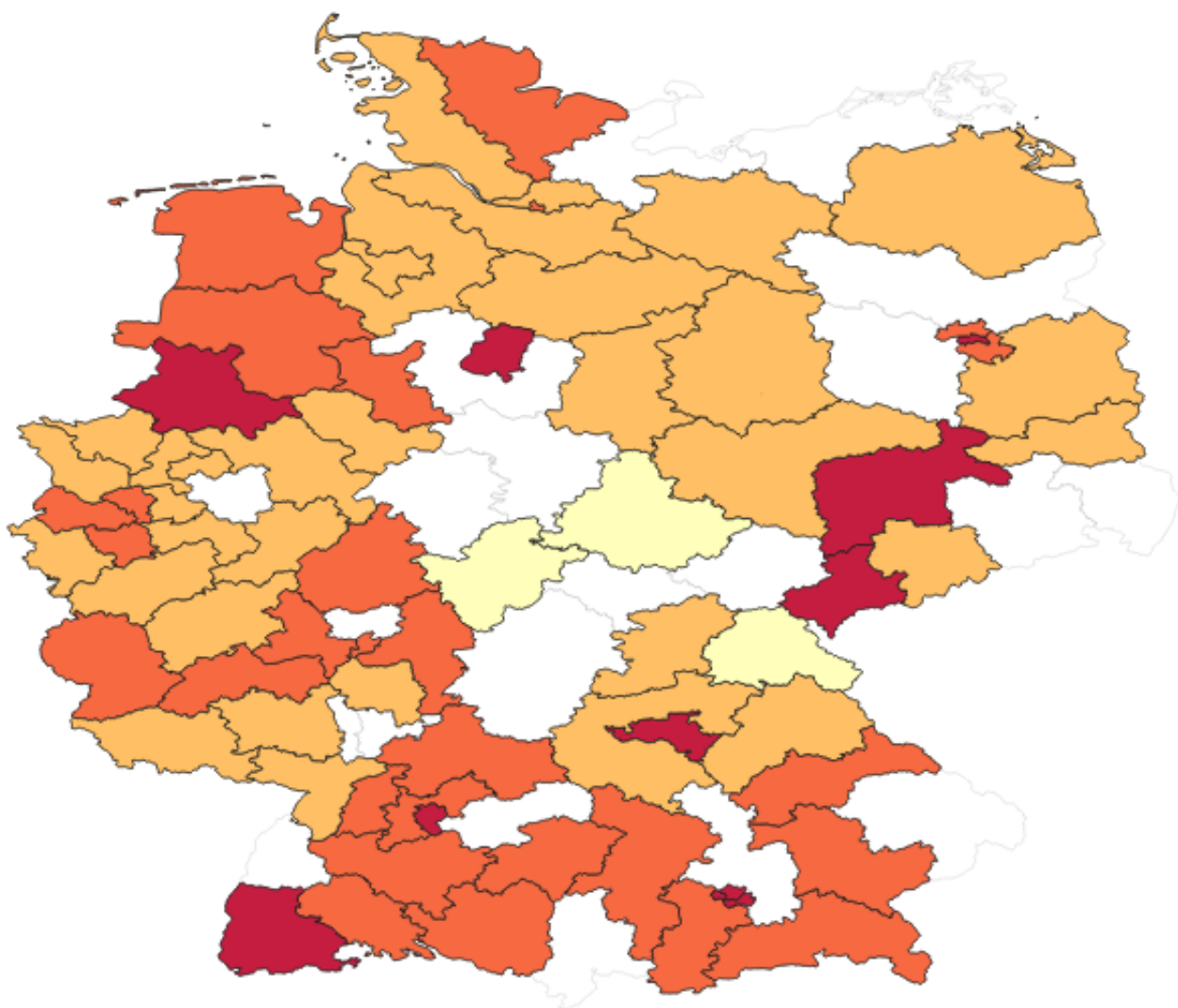
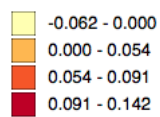
<sup>8</sup>See for example postal code areas 17 and 03 including Neubrandenburg, Neustrelitz and Cottbus, i.e. coloured in light yellow.

Figure 1: Regional Average Yearly Rent Increase



Source: *Empirica* Data Bank, Quality-controlled Average Yearly Rent Change, own calculations

Figure 2: Regional Average Yearly House Price Increase



Having estimated hedonic average price and rent changes for the time period 2012 - 2016 and having obtained measures of how each quality and equipment characteristic for each year influences the rent per square-metre, the treatment group can be identified. In its main analysis, the study identifies a treatment group of private market tenants living in areas which have experienced an average yearly rent increase of four percent and higher. Four percent here are equivalent to the 75th percentile of the estimated average yearly regional rent increases. Therefore only regions of the upper 25 percent of the distribution are included in the treatment group. In addition, individuals selected into the treatment group live in households that have a residency discount, i.e. a difference between their current rent and their potential new rent, of at least 30 percent. The difference of 30 percent here is exogenously determined. Net rental payments of tenant households on average constitute roughly 27 percent of a household's expenses and are the single largest item of households' private consumption (Kholodilin, Mense, and Michelsen, 2016, p. 4). An increase of 30 percent thus would have a significant and immediate impact on a household's well-being and spending behaviour. In its sensitivity analyses, the study will allow the size of the residency discount to vary and will provide estimates for alternative specifications of a residency discount of 20 and 40 percent respectively. The imputed new rent for each household is calculated by utilising the obtained coefficients of the regressions estimated by equation 3. For example, for the year 2016 the study employs the estimates presented in Table 13, shown in the Appendix. Using these estimates and the information provided about the current dwelling of the household contained in the SOEP data set, the rent a household would need to pay for an equivalent dwelling within its postal code region if the move took place in 2016 is calculated. For example, in 2016, a household living in central Berlin including popular quarters such as Kreuzberg (i.e. postal code region 10) residing in a 100 square-metre, rented flat with four rooms, a balcony and access to a cellar compartment would approximately pay an imputed rent of 11 Euro and 12 cents per square-metre, excluding expenses for heating and electricity. This implies a *cold* rent of 1112 Euro per month. In contrast, a household living in postal code region 17 which includes locations such as Neubrandenburg and Neustrelitz<sup>9</sup> would need to pay 5 Euros and 47 cents per square-metre for a flat with the same structural features. This implies a 'cold' rent of 547 Euros per month.

Using the outlined procedure above, the study identifies 5,123 individuals that live in households that are identified as part of the treatment group. In total individuals of the treatment group come from 13 different postal code regions across Germany. Treatment

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<sup>9</sup>See Table 15 in the Appendix for a full list of postal code regions.

group areas include regions in southern Germany, in particular Munich and Stuttgart, but also postal code regions of Berlin, Kiel and surrounding areas, south eastern Hamburg and neighbouring areas as well as the wider Hanover region. Figure 3, contained in the Appendix of this study, provides a full overview of the identified regions by illustrating all postal code regions that experienced an average yearly rent change of four percent and above between 2012 and 2016.

Table 3: Overview - Mean Characteristics by Tenure Status

	Owner-Occupier	Social Housing	Private Rental Tenant*	Treatment Group
Number of Observations	44,861	4,146	40,159	5,123
Variable	Mean Values			
Tenure Duration	19.973	11.269	10.195	11.711
Residential Move	0.027	0.070	0.102	0.076
Dwelling too small	0.098	0.326	0.254	0.240
Dissatisfied with Dwelling	0.054	0.278	0.182	0.198
Personal Risk Attitude	4.499	4.263	4.568	4.640
German	0.951	0.814	0.895	0.884
Age	51.553	45.678	46.202	45.612
Years of Education	12.807	10.946	12.181	12.347
Equivalent HH Income	2040.71	1110.28	1541.22	1528.63
Married	0.728	0.460	0.475	0.450
Recent Job Change	0.084	0.130	0.143	0.152
Retired	0.202	0.145	0.152	0.135
Large City	0.179	0.534	0.327	0.504

Source: SOEP Panel Data 2012-2016, \* Note that subletting tenants and residents of care facilities, as well as individuals to whom accommodation is provided free of charge are excluded, the definition used in this study focuses only on main tenants.

Table 3 depicts sociodemographic characteristics and variables of interest by tenure status over the given sample period. Note that the sample used in this study focuses on individuals over the age of eighteen. Individuals of households of the treatment group appear to move less frequently than other renters in the private rental market, and so-

cial housing tenants. Further, they appear to have a longer average tenure duration than other individuals in the private rental market. As suggested by empirical findings of other studies owner-occupiers, on average, have the longest duration of tenure and the smallest observed frequency of changing dwellings. Further, tenants of the treatment group are proportionally more often dissatisfied with their dwelling than other tenants in the private rental market. Lastly, there is a higher proportion of individuals of the treatment group residing in large cities in comparison to owner-occupiers, and other tenants of the private rental market. With regards to the other listed variables there appear to be no stark differences between the mean values of the treatment group and other tenants in the private rental market. Nonetheless, controlling for a range of relevant variables such as socioeconomic controls, the tenure status and duration as well as regional differences will be crucial for the estimation of mobility patterns as will be shown in the following section.

## 4.2. Estimating Spatial Mobility

Following the identification of the treatment group, the study seeks to analyse the mobility patterns displayed by tenants living in households of the treatment group. It will estimate the following regression, using the *Socio – Economic Panel* data in a Linear Probability framework.

$$M_i = \beta_0 + Y_i' \beta_1 + X_i' \beta_2 + \beta_3 T_i + \beta_4 S_i + \beta_5 S_i * T_i + u_i \quad (5)$$

$M_i$  is a dichotomous variable taking the value one if the individual has moved in the following year of the survey, thereby measuring the propensity to move.  $Y_i$  is a vector containing year indicators for the years 2013 to 2016 respectively. Note that in order to avoid the 'dummy variable trap' the year 2012 is excluded.  $X_i$  is a vector containing a range of control characteristics that are likely to impact the decision to move. It contains socioeconomic variables such as the net household equivalent income, the level of education of the individual, the individuals' age, retirement status and risk attitude, the amount of children under the age of 14 in the household but also equipment variables of the individual's current dwelling. A full list of included control variables will be provided in Section 5 when the estimated results are presented (see Table 4).  $S_i$  is an

indicator variable showing the individual's level of dissatisfaction with the dwelling. The measurement whether individuals are dissatisfied with their current dwelling of residence is approximated by two variables given in the *SOEP* data alternately. Firstly, survey participants are asked to rank their dwelling on a scale of one to five. Five indicates a *much too large dwelling*, one a *much too small dwelling* and three a perfectly adequate size. From this ranking an indicator variable is generated that equals one if the interviewee states an answer lower than three. Secondly, the participants are asked to rank their dwelling on a scale of zero to ten, where ten equals perfect satisfaction and zero utter dissatisfaction with the dwelling. Again taking this ranking as a baseline, an indicator variable is generated that equals one if the respondent stated a satisfaction lower than or equal to five.  $T_i$  is an indicator showing whether the household is part of the identified treatment group.  $u_i$  is the error term. The coefficients of interest are  $\beta_3$ ,  $\beta_4$  and  $\beta_5$ . One would expect  $\hat{\beta}_3$ , the estimated coefficient of the treatment group variable, to be negative. Living in an area of rising rental prices and enjoying a residency discount of 30 percent and higher, should decrease the propensity to move. In contrast, being dissatisfied with one's dwelling is likely to increase the propensity to move.  $\hat{\beta}_4$  is hence expected to be positive. If individuals's of the treatment group are indeed locked in, then even when they are dissatisfied with their dwelling, they may find it difficult to move houses. A negative value of  $\hat{\beta}_5$  would therefore suggest that they are, ceteris paribus, less likely to move houses than other individuals that are dissatisfied with their dwelling. The estimated coefficient of the interaction term,  $\hat{\beta}_5$ , therefore serves as a suggestive measure of whether households of the treatment group are indeed locked in.

The above specification is estimated by a Linear Probability model. Alternatively, in order to estimate specifications with a binary dependent variable, Probit or Logit models regularly are employed. Linear Probability models, Logit and Probit models mostly differ in their respective underlying distributional assumptions (uniform, standard normal, standard logistic). The results and inferences of the different models, however, rarely diverge and coefficient estimates in a Linear Probability model can be interpreted directly as they do not require the separate computation of marginal effects. Further, as shown in the above equation one key interest of the paper is modelled by including interaction terms. It should be noted that interpreting interaction effects in non-linear models such as Probit or Logit models is highly difficult and cumbersome, as the effect is not simply given by the estimated coefficient of the interaction term as is the case in a Linear Probability Model. In nonlinear models it is necessary to derive the cross-partial derivative of the expected value of the dependent dichotomous variable (Norton, Wang, and



Ai, 2002). Such approaches are relatively complex and current statistical tools with the aim of deriving interaction effects in the setting of Probit or Logit models are highly contested (Williams, 2012). This study will therefore solely adopt a Linear Probability model. It should, however, be noted that a potential shortcoming of Linear Probability models is that, unlike in Probit or Logit models, the estimated coefficients can lie outside the interval of zero and one.

Another potential shortcoming of the methodological approach and data adopted in this paper is that due to data limitations it is not capable of using quasi-experimental variation. Hence it cannot employ techniques such as a Difference-in-Difference estimator or a Regression Discontinuity Design in order to measure the causal impact of housing prices on the propensity to move (Diamond, McQuade, and Qian, 2017). Further, due to a lack of convincing instruments for the derived treatment group, an instrumental variable approach occasionally chosen in studies seeking to analyse the impact of homeownership on spatial mobility (Wolf and Caruana-Galizia, 2015) is not feasible. Controlling for potential sources of bias is therefore one of the key challenges in the chosen approach. In particular one feature of the described identification approach is of concern: The selection of the treatment group is not random. Selection bias, i.e. potential systematic differences between tenants of the treatment group and other tenants on the private rental market also influencing the decision to move, is therefore likely to impact the obtained results of the regression approach depicted above. More precisely, there are two key sources that could lead to selection bias. Firstly, the residency discount calculated to identify the treatment group increases with tenure duration (Fitzenberger and Fuchs, 2017). Hence, the individuals in the treatment group are more likely to have lived in their dwelling for a longer period of time in comparison to other private tenants. At the same time, the duration of tenure has been shown to negatively influence the propensity to move (Thomas, Stillwell, and Gould, 2016). The absolute size of the coefficient estimate,  $\hat{\beta}_4$ , therefore might be too high and thus biased. Secondly, households of the treatment group by definition live in regions with high rent price increases. As mentioned in the introduction and confirmed by the estimated hedonic price developments, rents and house prices have predominantly surged in urban areas with tight housing markets. Individuals in urban and more rural areas, however, also might differ significantly in terms of their propensity to move. Individuals in rural areas, for example, might be more traditional, settle down earlier and might be more likely to built up a long-term home. In contrast, urban households and their members might be more likely to change houses more frequently. This

in turn could lead to an upward bias of the estimated coefficient <sup>10</sup>. Alternatively, it is also possible that individuals in urban areas face tougher competition when searching for adequate dwellings, as housing markets in urban regions tend to be tighter than in rural regions. This in turn would, *ceteris paribus*, imply a downward bias of the estimated coefficient of the treatment group. Lastly, aside from the two likely sources of selection bias there might be other unobservable factors that impact households being *selected* into the treatment group that also influence an individual's propensity to move. For example, individuals selected into the treatment group might in general foster an innate dislike towards moving and therefore have a lower propensity to move.

One way of controlling for the described observable as well as unobservable sources of bias would be to estimate a Fixed Effect model including individual fixed effects. Such an approach in turn would exploit the within variation of the panel data, thereby allowing to control for all time-invariant, unobserved differences across individuals. However, as the variables of interest, i.e. the identified treatment group,  $T_i$  and the interaction term  $S_i * T_i$ , do not vary strongly over time, the estimated standard errors of such an approach would likely be too large for the estimated size of the coefficients, ultimately implying insignificant estimates. Further, exploiting the cross-sectional variation in this study is crucial since the examination of mobility patterns across regions and across individuals in these regions are a key goal of the study. Nonetheless, the paper will present results obtained from a Fixed Effect model controlling for personal as well as household fixed effects respectively (see Tables 14 and 8). Due to the aforementioned concerns, however, the estimated significance levels of the results, and their consequent interpretation value will be limited.

Another alternative to control for potential selection bias would be to estimate a Heckmann selection model. This procedure in turn would allow to estimate the propensity to move conditional on being in the treatment group. However, such an approach requires that at least one variable must be included in the selection equation and excluded in the main equation. This so called *exclusion restriction* is difficult to fulfil in the empirical and analytical setting of this study, as there appears to be no plausible variable that in accordance with economic foundations solely influences the selection into the treatment group and not the decision to move.

Considering the limitations of the methods described above, the main approach adopted in this study is to estimate a pooled OLS regression. The main model will include a variable controlling for the tenure duration of each individual, an indicator variable that

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<sup>10</sup>i.e. the estimated coefficient in absolute terms is too small

equals one if the individual lives in a densely-populated urban area, and the set of postal code area, regional fixed effects. By the inclusion of these variables in addition to an extensive range of further control variables, the study seeks to address potential endogeneity issues, and in particular the two potential sources of selection bias outlined above. Nonetheless, there might remain unobserved factors that impact both the decision to move and the selection into the identified treatment group. Due to data limitations and the methodological concerns with alternative identification strategies outlined above, however, the inclusion of this extensive set of control variables is the main approach adopted in this study. Further, in order to account for heteroskedasticity and to allow for correlation of errors within clusters, the standard errors are clustered at the household level.<sup>11</sup> The following section will present the results of the baseline estimation and the main estimation approach which seeks to control for the described sources of endogeneity.

## 5. Results

Table 4 shows the results of the baseline estimation. Standard errors are reported in parentheses. Specification (1) regresses the dependent variable, i.e. whether the observed individual moved in the following year or not, on a set of control variables. The control variables chosen in the specification are based on existing research in the field of spatial mobility analysis, and largely confirm previous findings. For example, the study controls for the mode of tenure. As also shown by Lui and Suen (2011) and Caldera Sanchez and Andrews (2011), owner-occupiers and social tenants, *ceteris paribus*, are indeed less likely to move dwellings than tenants in the private rental market. As previously illustrated in Section 2, life-cycle events are also likely to influence the decision to move. For example, the results show that a recent job change is associated with a higher propensity to move. Further, being retired is significantly correlated with a lower propensity to move, as retired individuals are more likely to have settled down permanently in a retirement location (Coulter and Scott, 2015, p. 3). Additionally, other individual characteristics appear to play a significant role. Individuals living in former West Germany, *ceteris paribus*, tend to move more frequently than individuals in the east. Further, an age older than

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<sup>11</sup>Since some individuals might leave respective households due to divorce or other reasons, an alternative specification including standard errors at the personal level will be presented in Table 12 in the Appendix. However, this is solely for illustrative purposes. As the observations and residuals are likely to be correlated at the household level, household clusters are the preferred choice of clustering.

forty <sup>12</sup>, being married as well as the amount of individuals living within one's household are all negatively correlated with the propensity to move. In contrast to what theory and findings of other studies suggest (see Section 2), children under the age of fourteen living in the same household as the observed individual appear to be associated with a higher propensity to move. Individuals residing in households with younger children might therefore move more frequently in order to adapt to their children's needs and to find the best location and dwelling for their children. It is also possible that individuals with smaller children are more likely to have additional children, therefore adapting their space requirements more frequently, ultimately culminating in a higher observed propensity to move. Further, each additional year of education received by an individual is associated with a small but significantly higher propensity to move, as predicted by theory. In contrast, the equivalent net household income does not show an estimate significantly different from zero. The estimation also controls for a variable measuring the self-assessed personal risk attitude of an individual on a scale of 0 to 10. The results show that a higher stated risk attitude is associated with a higher propensity to move.

As expected in Section 4.2, being dissatisfied with one's dwelling or stating that the current dwelling is too small, is associated with a higher propensity to move. Individuals stating that they are dissatisfied with their dwelling, *ceteris paribus*, have an approximately 6.2 percentage point higher propensity to move than satisfied individuals. Further, individuals stating that they reside in a dwelling too small for their needs, all other things being equal, have an approximately 2.8 percentage point lower propensity to move. In contrast, if the interviewee states that the building of the current dwelling is in a good condition, there appears to be a lower propensity to move. Lastly, including variables measuring the calculated regional price change variation for rents and house prices aims to control for differences across local housing markets. A one percent increase in the regional, average yearly rental price change between 2012 and 2016 is associated with a lower propensity to move of roughly 0.168 percentage points. <sup>13</sup> The estimated coefficient here is significant at the 5 percent level. When including, both the treatment group variable as well as the rental price variable, the estimated coefficient of the average rental price change variable becomes insignificant, as multicollinearity between the two variables is likely to exist. Note that the estimate of the coefficient of the average yearly, regional

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<sup>12</sup>Including an indicator variable equalling one for an age below 30 or 40 respectively, or alternatively including a variable measuring the exact age in alternative specifications all confirm that the propensity to move decreases with age.

<sup>13</sup>The variables measuring the average rental and price changes are coded from 0 to 1, the estimated coefficient hence needs to be divided by 100 in order to obtain the associated percentage point change.

house price change is not statistically different from zero in any of the specifications.<sup>14</sup>

Specifications (2), (3) and (4) focus on the variables of interest. Specification (2) includes the key variable of interest, i.e. the treatment group, whilst controlling for the same set of control variables included in specification (1). Individuals residing in households of the treatment group, *ceteris paribus*, show a smaller propensity to move of around 3.05 percentage points than other tenants in the private rental market. This point estimate is significant at the one percent level. Specification (3) and (4) seek to estimate the regression model outlined in equation 5.  $S_i$ , the indicator whether an individual is dissatisfied with his or her current dwelling of residence, is approximated by the two indicator variables first described in section 4.2. As in specification (2) the estimated coefficient of the treatment group is significant at all conventional levels in both specifications. However, it decreases in absolute size. The point estimate of the coefficient of *Treatment Group\*Dissatisfied with Dwelling* is negative and significant at the ten percent level. It implies that, *ceteris paribus*, dissatisfied individuals in the treatment group approximately have a 2.7 percentage point lower propensity to move than other dissatisfied tenants. Additionally, the point estimate of the interaction term between the *Too small* indicator and the treatment group variable is significant at the five percent level, and implies a roughly 2.9 percentage point lower observed propensity to move for treatment group tenants stating that they reside in a dwelling too small for their needs, than other tenants making the same statement.

As illustrated in section 4.2 there are potential sources of bias that are not controlled for in the baseline estimation output contained in Table 4. The specifications presented in Table 5 seek to control for these sources of bias. A variable controlling for each individual's tenure duration is included. Additionally, a variable indicating whether an individual lives in a densely-populated *Large City* seeks to control for potential systematic differences between rural and urban tenants. In order to account for regional effects beyond the differences captured by this indicator variable, 74 out of the 75 postal code regions are included as regional fixed effects. Tenure duration as well as residing in a large, densely-populated city both appear to be negatively correlated with the propensity to move. The obtained estimates are highly significant in all three specifications. The estimate of the coefficient of the treatment group variable remains negative and highly

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<sup>14</sup>The sensitivity analysis presented in the following section will analyse the role of house price changes in more detail.

Table 4: Propensity to Move: Baseline Regression Results

Dependent Variable: Residential Move following Year				
	(1)	(2)	(3)	(4)
<b>Variables of Interest</b>				
Treatment Group		-0.03054*** (0.006)	-0.02527*** (0.006)	-0.02313*** (0.007)
Dissatisfied with Dwelling	0.06208*** (0.005)	0.06217*** (0.005)	0.06445*** (0.005)	0.06235*** (0.005)
Dwelling too small	0.02787*** (0.004)	0.02778*** (0.004)	0.02787*** (0.004)	0.02994*** (0.004)
Treatment Group*Dissatisfied with Dwelling			-0.02703* (0.015)	
Treatment Group*Dwelling too small				-0.02905** (0.014)
<b>Tenure Choice</b>				
Homeowner	-0.05031*** (0.003)	-0.05365*** (0.003)	-0.05339*** (0.003)	-0.05338*** (0.003)
Social Housing	-0.03806*** (0.006)	-0.04163*** (0.006)	-0.04184*** (0.006)	-0.04178*** (0.006)
<b>Socioeconomic Controls</b>				
Years of Education	0.00095*** (0.000)	0.00097*** (0.000)	0.00097*** (0.000)	0.00096*** (0.000)
High Equivalent HH Income	-0.00304 (0.003)	-0.00311 (0.003)	-0.00315 (0.003)	-0.00309 (0.003)
Older than 40	-0.05917*** (0.003)	-0.05895*** (0.003)	-0.05883*** (0.003)	-0.05888*** (0.003)
German	0.00458 (0.004)	0.00451 (0.004)	0.00457 (0.004)	0.00459 (0.004)
Child under 14	0.01307*** (0.003)	0.01313*** (0.003)	0.01311*** (0.003)	0.01314*** (0.003)
Number of Individuals in HH	-0.01336*** (0.001)	-0.01332*** (0.001)	-0.01335*** (0.001)	-0.01333*** (0.001)
Married	-0.00597** (0.003)	-0.00620** (0.003)	-0.00621** (0.003)	-0.00624** (0.003)
West	0.01614*** (0.003)	0.01543*** (0.003)	0.01546*** (0.003)	0.01535*** (0.003)
Recent Job Change	0.03049*** (0.004)	0.03049*** (0.004)	0.03048*** (0.004)	0.03048*** (0.004)
Retired	-0.01860*** (0.002)	-0.01868*** (0.002)	-0.01870*** (0.002)	-0.01865*** (0.002)
Personal Risk Attitude	0.00142*** (0.000)	0.00142*** (0.000)	0.00142*** (0.000)	0.00142*** (0.000)
<b>Assessment Dwelling</b>				
Dwelling in good Condition	-0.00504* (0.003)	-0.00540** (0.003)	-0.00531** (0.003)	-0.00532** (0.003)
Number of Rooms	0.00200*** (0.001)	0.00196*** (0.001)	0.00196*** (0.001)	0.00198*** (0.001)
Balcony	0.00486 (0.004)	0.00537 (0.004)	0.00533 (0.004)	0.00534 (0.004)
Average Regional Yearly Price Change	0.01284 (0.035)	0.02003 (0.034)	0.02013 (0.034)	0.02126 (0.034)
Average Regional Yearly Rent Change	-0.16817** (0.074)	-0.05321 (0.075)	-0.05363 (0.075)	-0.05559 (0.075)
Year Dummies	x	x	x	x
Constant	0.11469*** (0.010)	0.11415*** (0.010)	0.11362*** (0.010)	0.11355*** (0.010)
R2	0.06799	0.06877	0.06888	0.06832
N	66,426	66,426	66,426	66,426

\* p&lt;0.10, \*\* p&lt;0.05, \*\*\* p&lt;0.010

Table 5: Propensity to Move : Controlling for Endogeneity

Dependent Variable: Residential Move following Year	(1)	(2)	(3)
Treatment Group	-0.02250*** (0.007)	-0.01711** (0.007)	-0.01583** (0.007)
Dwelling too small	0.02984*** (0.004)	0.02991*** (0.004)	0.03182*** (0.004)
Dissatisfied with Dwelling	0.06133*** (0.005)	0.06367*** (0.005)	0.06150*** (0.005)
Treatment Group*Dissatisfied with Dwelling		-0.02798* (0.015)	
Treatment Group*Dwelling too small			-0.02713* (0.014)
Tenure Duration	-0.00045*** (0.000)	-0.00045*** (0.000)	-0.00045*** (0.000)
Large City	-0.00961** (0.004)	-0.00960** (0.004)	-0.00954** (0.004)
Tenure Choices	x	x	x
Socioeconomic Controls	x	x	x
Assessment Dwelling	x	x	x
Urban Indicator	x	x	x
Regional Fixed Effects	x	x	x
Year Dummies	x	x	x
Constant	x	x	x
R2	0.07246	0.07258	0.07260
N	66,088	66,088	66,088

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Household Level

significant, however, decreases in absolute size in comparison to specification (2) in Table 4. Members of the treatment group, *ceteris paribus*, show a 2.25 percentage point lower propensity to move than other private tenants. Specifications (2) and (3) include the interaction effects of interest. The coefficient of the treatment group remains negative, again decreases in absolute size in comparison to the estimate presented in Table 4, and is significant at the five percent level. The estimate of the interaction term between the treatment group variable and the *Too small* indicator decreases in absolute size and is now only significant at the 10 percent level. The estimate of the interaction term's coefficient between the treatment group and the dissatisfaction indicator, in contrast, slightly increases in absolute size and remains significant at the ten percent level. The changes in absolute size as well as the slight losses of significance of the estimated direct and interaction effects in the respective specifications suggest that there indeed was bias caused by not controlling for potential systematic differences between the treatment

group and other tenants in the private rental market. However, the obtained estimates of the relevant coefficients largely appear to be robust to the inclusion of the described variables seeking to account for endogeneity, as they remain significantly different from zero.

Generally, there appears to be a negative relation between the treatment group and the propensity to move. Individuals living in postal code regions that have experienced an average yearly increase of rental prices above four percent and that live in households with a residency discount of more than 30 percent, *ceteris paribus*, have a lower propensity to move dwellings than other private market tenants. Controlling for the expected endogeneity caused by selection bias issues outlined in section 4.2, causes the estimates of the treatment variable coefficient to decrease in absolute size. However, they remain significantly different from zero. Additionally, the findings show that dissatisfied individuals of the treatment group are less likely to move than other dissatisfied individuals. Further, individuals that state that the place they reside in is too small and that are part of the treatment group, have a smaller propensity to move than other private tenants residing in apartments too small for their needs. The findings are robust in the sense that the relevant estimates remain significant upon inclusion of variables controlling for potential sources of endogeneity, if however, only at the ten percent level in case of the interaction effects. Thus there appears to be support for the notion the described individuals indeed suffer from lock-in effects. Individuals with a high residency discount living in areas with high rental price increases are less likely to move than other individuals in the private rental market even when they are dissatisfied with their current dwelling, a feature that has been shown to be significantly correlated with a higher propensity to move. This in turn supports the notion that they are not capable of moving house or apartment, as they are locked in. The following section will briefly assess the heterogeneity of the results. Further, it will test the validity of the findings by conducting a sensitivity analysis.



## 6. Sensitivity and Heterogeneity Analysis

To begin with, the analysis focuses on assessing and modelling the heterogeneity of the results. In the context of social inequality, it is especially interesting to assess whether individuals from poor households that are part of the treatment group, have a lower propensity to move than other poor individuals, and whether treatment group individuals living in relatively poor households are less likely to move than other individuals of the treatment group. Table 6 presents estimation outputs assessing moving patterns across different income groups aiming to account for heterogenous effects across these different groups.

The main specification, presented in Table 5, included a dichotomous variable that equalled one if the observed individual was living in a household with a relatively high equivalent net income.<sup>15</sup> However, the estimated coefficient of this income indicator variable was not statistically different from zero. Nevertheless, the effect of living in a relatively poor household on the propensity to move might differ significantly between members of the treatment group and other private market tenants. For example, individuals living in relatively poor households might suffer more severely from lock-in patterns, as due to budgetary restrictions and rising rental prices it is more difficult for these households to forego a given residency discount and find suitable and affordable alternative accommodation. In order to test this notion, Table 6 includes interaction terms between the treatment group variable and a dichotomous variable that equals one if the individual lives in a household with a relatively low equivalent net income. In specification (1) a household was classified as having a low equivalent net income if it earned an income below the 25th percentile of the equivalent net income distribution of SOEP households in the respective year of the observation. In specification (2) this threshold was reduced, now including only the lowest decile of the equivalent net household income distribution. The estimated coefficients on both interaction terms are negative and significant at the ten and five percent level, respectively. Note that the estimated coefficient of the interaction term in specification (2) in comparison to specification (1) gains in significance and increases in absolute size. The results show that relatively poor individuals of the treatment group appear to have a lower propensity to move than other individuals of the treatment group. Further, poor individuals of the treatment group appear to be less likely to move than other relatively poor private market tenants. The effects appear to be stronger, the lower the net equivalent household income is.

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<sup>15</sup>The equivalent net household income was calculated based on the OECD modified scale. A household was classified as having a high equivalent income when it earned an income above the 75th percentile of the equivalent income distribution across SOEP households in the respective year of observation.

Table 6: Propensity to Move: Heterogeneity Analysis

<b>Dependent Variable: Residential Move following Year</b>		
	(1)	(2)
Treatment Group	-0.01419* (0.008)	-0.01287 (0.008)
Low Equivalent HH Income	-0.00418 (0.003)	0.00208 (0.005)
Treatment Group*Low Equivalent HH Income	-0.02189* (0.012)	-0.02630** (0.012)
Satisfaction Indicator	x	x
Dwelling too small	x	x
Tenure Duration	x	x
Tenure Choices	x	x
Socioeconomic Controls	x	x
Assessment Dwelling	x	x
Urban Indicator	x	x
Regional Fixed Effects	x	x
Year Dummies	x	x
Constant	x	x
R2	0.07296	0.07292
N	64,634	64,634

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Household Level

The remainder of this section focuses on analysing and assessing the sensitivity of the obtained results when parameters and estimation procedures of the main approach are changed. The sensitivity analysis presents four additional robustness checks. Firstly, it will repeat the main estimation focussing only on the respective heads of each observed household. Secondly, in order to account for potential sources of unobservable endogeneity, results of Fixed Effect models are presented. However, as previously illustrated these results serve mainly as an indicative and suggestive reference as there is little within variation of the variable of interest, i.e. the identified treatment group. Thirdly, it will allow for varying sizes of the residency discount used to identify the treatment group. Theory would suggest that a larger residency discount, *ceteris paribus*, implies a lower propensity to move as individuals would need to forego a higher price differential when moving dwellings. Lastly, it will analyse how the inclusion of high house price increases as part of the definition used to identify the treatment group, influences the obtained results.

The estimations so far have included all household members individually in order to estimate the individual propensity to move. This has been done with the aim to account for households splitting up and going separate ways, and to exploit the personal informa-

tion of each individual household member to explain individual moving patterns. Quite frequently the decision to move, however, remains a household level decision and housing units are consumed by all household members simultaneously (Lui and Suen, 2011). In the main approach chosen above larger households therefore potentially are given more weight than smaller households (Lui and Suen, 2011). Other studies such as Lui and Suen (2011) seek to account for this caveat by only focusing on the respective head of each household when analysing the propensity to move. Repeating the main estimation procedure focussing solely on the household heads of each SOEP household shows that the main results do not change (see Table 7). Household heads of the treatment group have a lower propensity to move than other household heads in the private rental market. Further, dissatisfied household heads of the treatment group have a lower propensity to move than other dissatisfied household heads in the private rental market, all else being equal.

Table 7: Propensity to Move of SOEP Household Heads

<b>Dependent Variable: Residential Move following Year</b>			
	(1)	(2)	(3)
Treatment Group	-0.02533*** (0.006)	-0.01741*** (0.007)	-0.01916*** (0.007)
Treatment Group*Dissatisfied with Dwelling		-0.03865** (0.014)	
Treatment Group*Dwelling too small			-0.02661* (0.011)
Tenure Duration	x	x	x
Tenure Choices	x	x	x
Socioeconomic Controls	x	x	x
Assessment Dwelling	x	x	x
Urban Indicator	x	x	x
Regional Fixed Effects	x	x	x
Year Dummies	x	x	x
Constant	x	x	x
R2	0.07433	0.07459	0.07459
N	39,987	39,987	39,987

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Personal Level

The estimation procedures employed in the previous section all seek to control for potential sources of endogeneity. Nonetheless, there might remain unobservable factors that impact both the decision to move and the selection into the identified treatment group. As previously outlined one way of controlling for such unobservable components would be to estimate a Fixed Effect model. Since Fixed Effect models solely exploit the within variation, time-constant variables are excluded from the estimation. Therefore control variables included in the previous specifications, such as indicator variables

showing whether the individual is German, can no longer be included. Table 8 presents estimates of a model including personal fixed effects. The estimated coefficients in relation to the main specification in Table 5 decrease in absolute size, however, in specification (1) and (2) remain significant at the five percent level respectively. Individuals living in households of the treatment group, ceteris paribus, appear to have an approximately 1.74 percentage point lower propensity to move dwellings in the following year than individuals not residing in households of the treatment group. Additionally, the estimated coefficients of both interaction terms decrease in absolute size and are no longer significant at any of the conventional levels. Thus when including personal fixed effects there remains at least some support for the notion that individuals that are part of the treatment group have a smaller propensity to move. Similar results are obtained when using household fixed effects (See Appendix Table 14). However, due to the aforementioned reasons (see above and Section 4.2), the results solely serve as an indicative feature.

Table 8: Propensity to Move: Fixed Effect Model

<b>Dependent Variable: Residential Move following Year</b>			
	(1)	(2)	(3)
Treatment Group	-0.01738** (0.007)	-0.01823** (0.008)	-0.01304 (0.007)
Treatment Group*Dissatisfied with Dwelling		0.00451 (0.013)	
Treatment Group*Dwelling too small			-0.01742 (0.013)
Tenure Duration	x	x	x
Tenure Choices	x	x	x
Socioeconomic Controls	x	x	x
Assessment Dwelling	x	x	x
Urban Indicator	x	x	x
Personal Fixed Effects	x	x	x
Year Dummies	x	x	x
Constant	x	x	x
R2	0.18497	0.184908	0.18501
N	66,088	66,088	66,088

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Household Level

The size of the residency discount used to identify the treatment group might be another factor impacting the estimated effects. The following section will therefore present results obtained from differing residency discount specifications. The presented results estimate the same model as the main specification in Table 5. However, instead of identifying the treatment group based on a residency discount of 30 percent, now thresholds of 20 and 40 percent are used respectively. Firstly, based on an identification approach of a 20 percent residency discount as well as regional, average yearly rent increases above 4 percent, 6,426 individuals are identified as members of the treatment group. The estimates of the coefficients of interest, namely the estimated coefficients of the treatment group variable and the respective interaction terms, presented in Table 9 decrease in absolute size compared to those in Table 5. The estimate of the treatment group coefficient in specification (1) remains significant at the five percent level. Additionally, the point estimate of the interaction term coefficient in (2) remains significant at the ten percent level but slightly decreases in absolute size in comparison to Table 5. The estimate of the interaction term's coefficient in specification (3) is insignificant. The obtained results are in line with what theory would predict. A lower residency discount implies a lower price differential that needs to be foregone in case of moving and hence ultimately a higher propensity to move. Coefficient estimates that are smaller in absolute value therefore are plausible in this scenario. In the same vein, rising the residency discount threshold used to identify the treatment group to 40 percent should lead to, in absolute values, larger as well as significant point estimates. This indeed appears to be the case. The treatment group now consists of 4,012 individuals and the estimates of the respective direct effects of the treatment group presented in Table 10 are larger in absolute size and highly significant. However, the estimated coefficient of the interaction term between the treatment group and the variable indicating dissatisfaction with the current dwelling now is insignificant and decreases in absolute size in comparison to the main estimation presented in Table 5. In contrast, the interaction term between the *Too small* indicator and the treatment group is now significant at the ten percent level. Further, the estimate increases in absolute size. In conclusion, at least when assessing the direct effect of being in the treatment group on the propensity to move, the results appear to be in line with expectations and theoretical foundations, as they support the notion that, at least to a certain extent, a higher residency discount, *ceteris paribus*, is associated with a lower propensity to move. Individuals living in households with a higher residency discount therefore appear to move less frequently, as they would need to forego a more substantial price differential than individuals with a smaller residency discount.

Table 9: Residency Discount of 20 Percent and Above

Dependent Variable: Residential Move following Year	(1)	(2)	(3)
Treatment Group	-0.01461** (0.007)	-0.01104 (0.007)	-0.00960 (0.007)
Treatment Group*Dissatisfied with Dwelling		-0.02656* (0.014)	
Treatment Group*Dwelling too small			-0.01416 (0.013)
Tenure Duration	x	x	x
Tenure Choices	x	x	x
Socioeconomic Controls	x	x	x
Assessment Dwelling	x	x	x
Urban Indicator	x	x	x
Regional Fixed Effects	x	x	x
Year Dummies	x	x	x
Constant	x	x	x
R2	0.07227	0.07240	0.07232
N	66,088	66,088	66,088

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Household Level

Table 10: Residency Discount of 40 Percent and Above

Dependent Variable: Residential Move following Year	(1)	(2)	(3)
Treatment Group	-0.02414*** (0.007)	-0.01624** (0.008)	-0.02160*** (0.007)
Treatment Group*Dissatisfied with Dwelling		-0.01348 (0.017)	
Treatment Group*Dwelling too small			-0.03363** (0.015)
Tenure Duration	x	x	x
Tenure Choices	x	x	x
Socioeconomic Controls	x	x	x
Assessment Dwelling	x	x	x
Urban Indicator	x	x	x
Regional Fixed Effects	x	x	x
Year Dummies	x	x	x
Constant	x	x	x
R2	0.07245	0.07247	0.07261
N	66,088	66,088	66,088

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Household Level

The second criterion used to identify individuals of treatment group is the yearly, regional hedonic rental price change. Individuals residing in areas with high average rental price increases, i.e. rent increases above four percent, are selected into the treatment group. However, not all individuals that move out of a rented apartment seek to relocate to other rented accommodation, as some consider purchasing a property instead. House and real estate price changes are therefore likely to also impact the decision to move. Similar to high rental price increases, high house price increases might serve as a deterring factor when moving, as individuals would need to forego a substantial price differential when giving up their current dwelling. However, rising house prices also might have another impact on the decision to move. Unlike moving within the rental sector, purchasing a house also involves a long-term investment decision. For example, if house prices are expected to rise, purchasing a home can be a profitable investment option. Individual house price expectations in turn have been shown to be positively correlated to past experiences of rising house prices within one's region (Armona, Fuster, and Zafar, 2018). Living in areas of high house price increases therefore potentially influences the decision to invest (Armona, Fuster, and Zafar, 2018). Especially in times of low interest rates, this outlined relationship could potentially imply surges in the propensity to buy a house, in particular amongst individuals and households that live in areas of high house price increases and that can afford the required initial deposit to secure a mortgage. During the period of interest between 2012 and 2016 interest rates within the Eurozone were indeed very low (ECB, 2018). The following sensitivity check hence additionally imposes the criterion that households of the treatment group must reside in areas with high house price changes. High house price changes here are defined as price changes in excess of five percent which equals the average estimated German-wide yearly change of house prices between 2012 and 2016. Figures 1 and 2 show that there is a certain correlation between house and rental prices, as areas with high increases in rents are also likely to have experienced substantial increases in housing prices. However, imposing the additional criterion for selection, reduces the number of individuals in the treatment group by almost 1,600 to a total of 3,531. The results depicted in Table 11 show that the estimated direct effects of the treatment group on the propensity to move decrease strongly in absolute size and are no longer significant. However, the estimated interaction effects in specifications (1) and (2) are significant and relatively large in comparison to previous estimates. Hence there remains support for the notion that dissatisfied individuals of the treatment group have a lower propensity to move than other private tenants with similar dissatisfaction levels, all else being equal. One potential way of explaining the in absolute size lower estimated direct effect of being in the treatment group are the mechanisms outlined

above. Individuals that live in areas of high house price increases might be proportionally more inclined to purchase a house. However, here it should be noted that the decision to buy or not buy a house is a highly complex and important decision over the course of the life-cycle. In order to fully understand the patterns of how house prices and house price expectations impact moving decisions, a more detailed analysis that goes beyond the scope of this paper would be needed. The remainder of the study will conclude and portray avenues for future research.

Table 11: Including House Prices as Criterion for Treatment Group

<b>Dependent Variable: Residential Move following Year</b>			
	(1)	(2)	(3)
Treatment Group	-0.01177 (0.009)	-0.00372 (0.010)	-0.00306 (0.009)
Treatment Group*Dissatisfied with Dwelling		-0.03995** (0.018)	
Treatment Group*Dwelling too small			-0.03283* (0.017)
Tenure Duration	x	x	x
Tenure Choices	x	x	x
Socioeconomic Controls	x	x	x
Assessment Dwelling	x	x	x
Urban Indicator	x	x	x
Regional Fixed Effects	x	x	x
Year Dummies	x	x	x
Constant	x	x	x
R2	0.07216	0.07234	0.07231
N	66,088	66,088	66,088

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Household Level



## 7. Conclusion

The main line of interpretation adopted in this paper is that having a high residency discount and living in areas with high rental price changes indeed implies lower levels of spatial mobility and lock-in effects. This is supported by the main finding of the study that households of the treatment group have a lower propensity to move. However, one could argue that these households are not involuntarily locked-in as they live in relatively popular urban gentrified/gentrifying areas and might not want to move at all (Freeman and Braconi, 2007). Unfortunately, the employed SOEP data does not contain information on the intention to move. The study, however, seeks to address this shortcoming by focussing on individuals that state that they are dissatisfied with their dwelling and that their current home is too small - two factors likely to increase the propensity to move. The results confirm that individuals who are dissatisfied with their current dwelling or state that their current home is too small, in general, show a higher propensity to move. However, dissatisfied tenants of the treatment group have a lower propensity to move than other dissatisfied tenants. Additionally, tenants of the treatment group who state that they reside in a dwelling too small for their needs move less frequently than other tenants who live in a dwelling too small for their needs. The study hence proposes that the main reason for the observed differences in mobility patterns are indeed involuntary lock-in effects. Moving homes for households of the treatment group would be costly, imply giving up a substantial residency discount and/or require a long-distance move to areas with cheaper house and rental prices. Long-distance moves, however, imply high monetary as well as non-monetary cost which based on theoretical foundations illustrated in this study reduces the propensity to move. Therefore dissatisfied households of the treatment group indeed appear to show signs of being locked-in. This in turn can lead to allocative inefficiencies on the housing market as households that reside in dwellings that are too small, or more generally do not satisfy their needs, cannot adapt by changing their residence which under regular circumstances they would do. Further, the heterogeneity analysis of the study shows that treatment group individuals living in relatively poor households have a lower propensity to move than other tenants in the treatment group. Thus there might be interesting social implications of the observed patterns that challenge existing research and merit the attention of future research, as will be illustrated below.

The findings of the paper contribute to existing literature in four ways. Firstly, they add to the relatively scarce empirical literature on the German housing market by analysing and portraying potential implications of the German legal rental system on spatial mo-

bility patterns. Secondly, the study confirms previous findings that partially-controlled rental markets imply inefficient allocations and lower levels of spatial mobility for tenants residing in the controlled dwellings. Additionally, in contrast to the majority of economic studies in the field of housing and mobility research, the paper focuses on the private rental market and shows that similar mechanisms as previously found for social housing tenants and homeowners are at play within the private rental market, as housing and rental prices appear to play a crucial role in impacting spatial mobility patterns. Lastly, it contributes to a predominantly qualitative geographical and sociological field of research that focuses on analysing the impacts of gentrification in the context of displacement patterns and effects. The paper by providing detailed quantitative evidence offers a potential alternative explanation for the observed phenomenon that poor households in gentrifying areas have lower spatial mobility rates than other poor individuals (Freeman and Braconi, 2007, p. 48). Different to Freeman and Braconi (2007) <sup>16</sup> it suggests that lower mobility rates observed amongst (poor) individuals in gentrifying areas are not necessarily voluntary, as individuals, in areas with stark rental price increases appear to suffer from substantial lock-in effects.

Future research should seek to discern the long-term impacts of rising housing prices and lock-in effects. In areas of rising rental and house prices the pressure for landlords to dispose of incumbent sitting tenants and to conclude new more lucrative initial rental contracts, for example, is likely to rise. Further, in the long-term tenants that are dissatisfied with their dwelling but not capable to afford a new place within their region might decide to leave the area and move to cheaper more rural/suburban areas. Therefore potential displacement effects and patterns of segregation are one crucial concern worth analysing. This in turn might have interesting implications for regional inequality patterns as well as social mobility (Wrede and Borck, 2018) and could be one key avenue for future research.

In addition, the observed patterns have implications for political decision-making. Policies focussing on affordable housing are on the agenda of the vast amount of political parties in Germany (Bündniss 90 Die Grünen, 2018; SPD, 2018). Existing, relatively recent measures, such as the 'Mietpreisbremse' so far, however, have been criticised for their lack of efficiency and leave room for improvement such as the actual enforcement of its stipulated tenant rights (Kholodilin, Mense, and Michelsen, 2016). Further, measures that only restrict rent prices for initial contracts such as the rental brake cannot be the sole, long-term solution in order to guarantee affordable living in all regions of Germany. One key issue contributing to sharply rising rents and house prices in urban

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<sup>16</sup>see Section 2.2

areas is a substantial shortage of available construction land. Municipalities should hence focus on providing more land for new residential construction (Kholodilin, Mense, and Michelsen, 2016). Assessing existing as well as potential instruments to address quickly rising housing prices and their implications hence are a key challenge for academia and policy-makers alike.

In summary, this paper through the use of hedonic price regressions calculated postal code region specific changes in house prices and rents for the period 2012 - 2016. Further, using hedonic methods, it calculated regional-specific rent price levels for initial rental contracts across different housing segments. The information then was used to identify individuals living in households that enjoy a residency discount of 30 percent and reside in areas of high average yearly rent increases. Ultimately, in the setting of a Linear Probability model, the paper showed that there indeed is a negative relationship between high rent price changes and the level of spatial mobility. Households of the treatment group have a lower propensity to move dwellings. Further, dissatisfied individuals in households of the treatment group, *ceteris paribus*, have a lower propensity to move than other dissatisfied households. Hence, there is evidence for lock-in effects amongst individuals of households residing in high-rent areas and enjoying substantial residency discounts. Especially, relatively poor households appear to suffer the strongest from these involuntary lock-in mechanisms. The results are robust to several different approaches controlling for endogeneity and parameter changes as shown in the sensitivity analysis of the paper. Models including regional, household and personal fixed effect all find a significant relationship between the propensity to move in the following year and being part of the treatment group.

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## A. Appendix

Table 12: Propensity to Move : Controlling for Endogeneity, Standard Errors clustered at Personal Level

<b>Dependent Variable: Residential Move following Year</b>			
	(1)	(2)	(3)
Treatment Group	-0.02250*** (0.005)	-0.01711** (0.006)	-0.01583** (0.006)
Dwelling too small	0.02984*** (0.003)	0.02991*** (0.003)	0.03182*** (0.003)
Dissatisfied with Dwelling	0.06133*** (0.004)	0.06367*** (0.004)	0.06150*** (0.004)
Treatment Group*Dissatisfied with Dwelling		-0.02798** (0.013)	
Treatment Group*Dwelling too small			-0.02713** (0.011)
Tenure Duration	-0.00045*** (0.000)	-0.00045*** (0.000)	-0.00045*** (0.000)
Large City	-0.00961*** (0.003)	-0.00960*** (0.003)	-0.00954*** (0.003)
Tenure Choices	x	x	x
Socioeconomic Controls	x	x	x
Assessment Dwelling	x	x	x
Urban Indicator	x	x	x
Regional Fixed Effects	x	x	x
Year Dummies	x	x	x
Constant	x	x	x
R2	0.07246	0.07258	0.07260
N	66,088	66,088	66,088

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Personal Level

Table 13: Hedonic Regression, Coefficient Estimates 2016

Variable	Coefficient Estimate
Living Space in sqm	0.00551
Number of Rooms	-0.3760
Detached/Semi-Detached	0.9455
Built before 1972	-0.3274
Cellar	-0.0612
Garden	0.2110
Balcony	0.2510
ZIP Code Region	74 different estimates
Intercept	6.9761

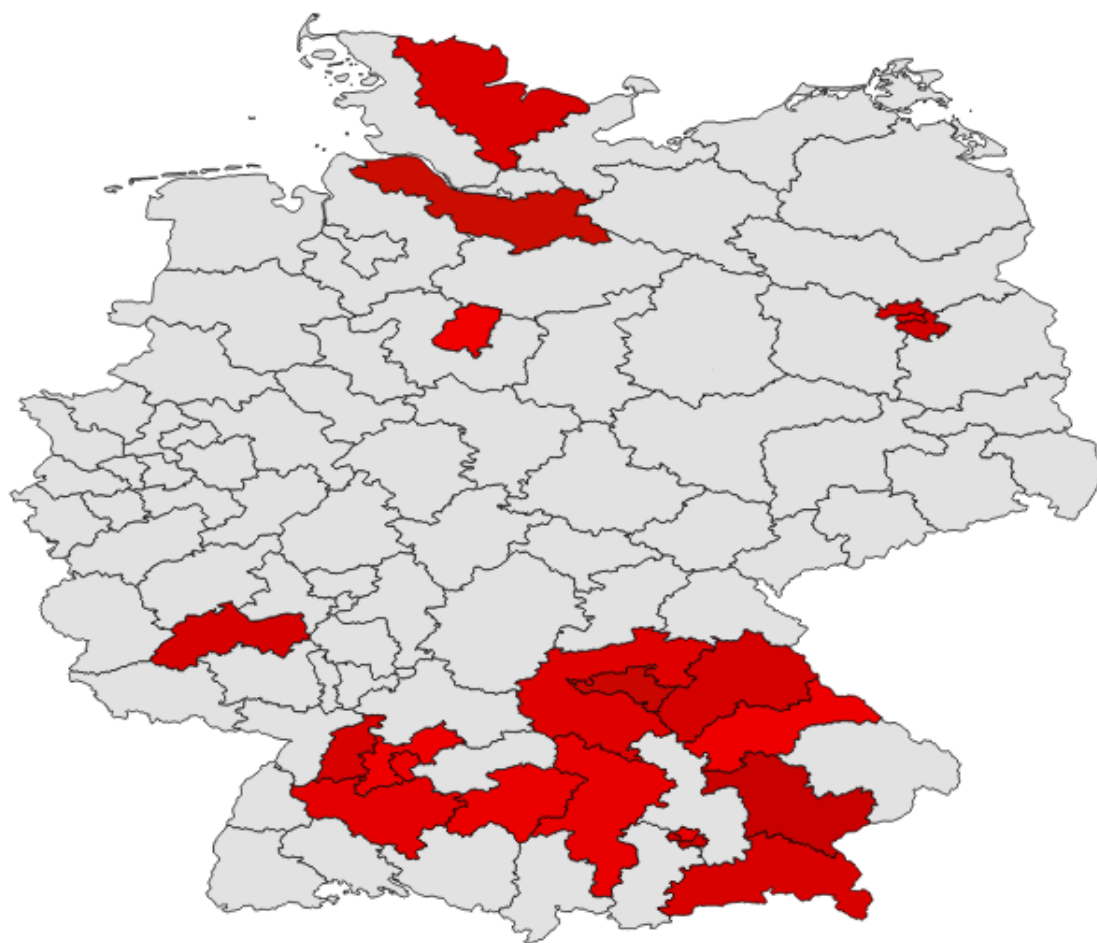
Source: Empirica Data Bank 2012-2016, own calculations

Table 14: Propensity to Move: Including Household Fixed Effects

Dependent Variable: Residential Move following Year			
	(1)	(2)	(3)
Treatment Group	-0.01546** (0.007)	-0.01565** (0.007)	-0.01252* (0.007)
Treatment Group*Dissatisfied with Dwelling		0.00102 (0.011)	
Treatment Group*Dwelling too small			-0.01173 (0.011)
Tenure Duration	x	x	x
Tenure Choices	x	x	x
Socioeconomic Controls	x	x	x
Assessment Dwelling	x	x	x
Urban Indicator	x	x	x
Household Fixed Effects	x	x	x
Year Dummies	x	x	x
Constant	x	x	x
R2	0.52556	0.52556	0.52557
N	66,088	66,088	66,088

\* p<0.10, \*\* p<0.05, \*\*\* p<0.010, Standard Errors clustered at Household Level

Figure 3: Regions with High Average Yearly Rent Increases



Source: *Empirica* Data Bank, Quality-controlled Average Yearly Price Change above 3.95 percent, own calculations

Table 15: Overview Postal Code Regions in Germany

00	wird nicht vergeben
01	Dresden, Riesa, Meißen, Bischofswerda
02	Görlitz, Bautzen, Hoyerswerda, Zittau
03	Cottbus, Finsterwalde, Forst (Lausitz), Spremberg
04	Leipzig, Altenburg, Eilenburg, Torgau, Grimma
05	Reserve
06	Halle (Saale), Dessau-Roßlau, Quedlinburg, Zeitz
07	Gera, Jena, Saalfeld/Saale, Greiz
08	Plauen, Zwickau, Aue, Klingenthal
09	Chemnitz, Annaberg-Buchholz, Zschopau, Freiberg
10	Berlin Innenstadt
11	Bundesinstitutionen in Berlin
12	Südliches und südöstliches Berlin
13	Nördliches Berlin
14	Potsdam und südwestliches Berlin, Rathenow, Luckenwalde, Brandenburg an der Havel
15	Frankfurt (Oder), Eisenhüttenstadt, Fürstenwalde/Spree, Königs Wusterhausen
16	Oranienburg, Eberswalde, Pritzwalk, Schwedt/Oder
17	Neubrandenburg, Greifswald, Neustrelitz, Usedom
18	Rostock, Stralsund, Güstrow, Bergen auf Rügen
19	Schwerin, Ludwigslust, Wittenberge, Parchim
20	Hamburg Mitte
21	Südliches und östliches Hamburg und Umland, Lüneburg & Buxtehude, Stade, Reinbek
22	Hamburg Nord/West, Norderstedt, Ahrensburg, Wedel
23	Lübeck, Bad Segeberg, Wismar, Mölln
24	Kiel, Flensburg, Schleswig, Neumünster
25	Westküste (Elmshorn, Itzehoe, Sylt)
26	Oldenburg, Wilhelmshaven, Emden, Aurich
27	Großraum Bremen Bremerhaven, Cuxhaven, Delmenhorst, Helgoland, Neuwerk
28	Bremen, Ottersberg, Schwanewede, Syke, Stuhr, Weyhe
29	Celle, Uelzen, Salzwedel, Soltau, Löchow
30	Hannover, Garbsen, Langenhagen, Laatzen

31	Hannover Umland, Hameln, Hildesheim, Peine, Schaumburg
32	Herford, Minden, Detmold, Löhne
33	Bielefeld, Paderborn, Bad Driburg, Gütersloh
34	Kassel, Hannoversch Münden, Korbach, Warburg
35	Gießen, Wetzlar, Marburg, Dillenburg, Frankenberg
36	Fulda, Bad Hersfeld, Bad Salzungen, Alsfeld
37	Göttingen, Höxter, Eschwege, Osterode am Harz
38	Braunschweig, Salzgitter, Wolfsburg, Halberstadt, Gifhorn
39	Magdeburg, Stendal, Oschersleben, Staßfurt
40	Düsseldorf, Hilden, Mettmann, Ratingen
41	Mönchengladbach, Neuss, Viersen, Erkelenz
42	Wuppertal, Velbert, Solingen, Remscheid
43	Reserve
44	Dortmund, Lünen, Herne, Bochum
45	Essen, Mülheim an der Ruhr, Recklinghausen, Gelsenkirchen
46	Oberhausen, Bottrop, Bocholt, Wesel
47	Duisburg, Krefeld, Moers, Kleve, Wesel
48	Münster, Rheine, Nordhorn, Coesfeld
49	Osnabrück, Melle, Ibbenbüren, Lingen (Ems)
50	Köln (linksrheinisch plus Deutz), Frechen, Brühl, Bergheim
51	Köln(rechtsrheinisch ohne Deutz), Leverkusen, Bergisch Gladbach, Gummersbach
52	Aachen, Eschweiler, Düren, Heinsberg
53	Bonn, Remagen, Siegburg, Euskirchen
54	Trier, Wittlich, Daun, Prüm, Bitburg
55	Mainz, Simmern/Hunsrück, Bad Kreuznach, Idar-Oberstein
56	Koblenz, Neuwied, Mayen, Andernach
57	Siegen, Lennestadt, Olpe, Altenkirchen (Westerwald)
58	Hagen, Witten, Iserlohn, Lüdenscheid
59	Hamm, Unna, Soest, Arnsberg
60	Frankfurt am Main Mitte
61	Bad Homburg, Friedberg, Bad Vilbel, Oberursel
62	Reserve
63	Aschaffenburg, Hanau, Offenbach am Main, Miltenberg
64	Darmstadt, Bensheim, Heppenheim, Groß-Gerau
65	Wiesbaden, Limburg an der Lahn,

	Rüsselsheim am Main, Frankfurt am Main-West
66	Saarbrücken, Neunkirchen, Homburg, Pirmasens, Zweibrücken
67	Kaiserslautern, Ludwigshafen am Rhein, Worms, Speyer
68	Mannheim, Schwetzingen, Lampertheim, Viernheim
69	Heidelberg, Weinheim, Leimen, Mannheim
70	Stuttgart, Fellbach, Leinfelden-Echterdingen, Filderstadt
71	Stuttgarter Umland, Böblingen, Waiblingen, Backnang, Ludwigsburg
72	Tübingen, Reutlingen, Sigmaringen, Freudenstadt, Balingen, Nörtingen
73	Göppingen, Esslingen am Neckar, Schwäbisch Gmünd, Aalen
74	Heilbronn, Bietigheim-Bissingen, Schwäbisch Hall, Crailsheim
75	Pforzheim, Eppingen, Calw, Mühlacker
76	Karlsruhe, Baden-Baden, Landau in der Pfalz, Bruchsal
77	Offenburg, Lahr, Kehl, Achern, Bühl
78	Villingen-Schwenningen, Donaueschingen, Singen (Hohentwiel), Konstanz, Tuttlingen, Rottweil
79	Freiburg im Breisgau, Lörrach, Titisee-Neustadt, Waldshut-Tiengen, Emmendingen
80	München Mitte-Nordwest
81	München West, Süd, Ost
82	Münchener Umland (Süd, West), Fürstenfeldbruck, Starnberg, Garmisch-Partenkirchen
83	Rosenheim, Traunstein, Freilassing, Bad Tölz
84	Landshut, Waldkraiburg, Dingolfing, Pfarrkirchen, Mühldorf am Inn
85	Münchener Umland (Nord, Ost), Ingolstadt, Dachau, Freising, Eichstätt
86	Augsburg, Donauwörth, Landsberg am Lech, Neuburg a.Donau
87	Kempten, Kaufbeuren, Memmingen, Marktoberdorf

88	Friedrichshafen, Lindau (Bodensee), Ravensburg, Biberach an der Riß
89	Ulm, Neu-Ulm, Heidenheim an der Brenz, Ehingen (Donau)
90	Nürnberg, Fürth, Zirndorf
91	Nürnberger Umland, Erlangen, Schwabach, Ansbach, Dinkelsbühl
92	Amberg, Neumarkt in der Oberpfalz, Weiden in der Oberpfalz, Schwandorf
93	Regensburg, Cham, Kelheim, Abensberg
94	Passau, Landau an der Isar, Regen, Straubing
95	Hof, Bayreuth, Kulmbach, Marktredwitz
96	Bamberg, Lichtenfels, Coburg, Sonneberg
97	Würzburg, Schweinfurt, Bad Kissingen, Wertheim
98	Suhl, Hildburghausen, Ilmenau, Meiningen
99	Erfurt, Weimar, Mühlhausen/Thüringen, Eisenach
17	

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<sup>17</sup>Quelle: Statistisches Bundesamt 2017