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## Immigration and Rental Prices of Residential Housing: Evidence from the Fall of the Berlin Wall

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# Immigration and Rental Prices of Residential Housing: Evidence from the Fall of the Berlin Wall\*

February 16, 2017

The fall of the Berlin Wall on 9<sup>th</sup> November 1989 sparked a mass exodus of East Germans to West Germany. This paper exploits the natural experiment provided by the unexpected disintegration of socialist East Germany to study the impact that immigration has on residential housing rents in recipient regions. Using a spatial correlation approach, annual district-level migration data for 1991 and 1992 and unique rental price indicators from Germany's major regional property market information system, we find strong evidence for a positive and sizeable effect of immigration on rental prices of residential housing in West German urban districts. A one percent population increase due to immigration is associated with an approximate increase in minimum and average category rents by 4.8 and 3.3%, respectively. Additional explorations that employ an IV approach based on various exogenous origin-region push factors related to the deteriorating economic conditions in East Germany yield estimates of even larger magnitude. These results suggest that immigration has important economic effects outside the labour market, traditionally the prime domain of economic enquiries into the consequences of immigration. Our findings cast doubt on the appropriateness of this bias in focus and provide first indications to surmise how the recent refugee crisis, analogously featuring a sizeable exogenous migrant inflow to Germany, may likewise affect local residential property markets. Albeit related empirical evidence on the latter migration phenomenon is still scarce, the present study points towards a crucial channel through which the mass arrival of refugees may affect local residents in destination regions.

Keywords: Migration, Rents, Natural Experiment, Metropolitan Area, Germany, Reunification.

JEL: J61, R21, R23, R31.

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\*PRELIMINARY VERSION - WORK IN PROGRESS.

# 1 Introduction

On 9<sup>th</sup> November 1989, the fall of the Berlin Wall marked a momentous event in German history which brought the previously split country at the forefront of global attention. Today, roughly 25 years after the unexpected disintegration of socialist East Germany, it prevails that this historical episode had far reaching consequences for both the former Eastern and Western part of the country. More precisely: on the one hand, the introduction of the *Social, Economic and Monetary Union (SEMU)* induced an abrupt currency appreciation as well as a rapid price convergence process (to West German levels) in the East. The present analysis exploits this scenario and its repercussions for the local economies in Eastern Germany to develop a novel instrumental variable, which will be applied in a standard 2SLS procedure. On the other hand, and inherently connected to the former development, the sudden release of the migration potential that built up over the preceding decades induced a mass exodus of East Germans to the western part of the country, with potentially large effects on the economy and residents of West Germany. Thence, the purpose of this paper is to utilise the natural experiment provided by German reunification to identify and quantify the impact that intra-German East-West migration exhibited on the West German residential property market, with a particular focus on rental prices of residential housing in metropolitan areas. Employing data on 72 West German metropolitan districts from 1990 to 1992<sup>1</sup> in a spatial correlation framework, we provide empirical evidence for a significant positive impact of immigration on rents: A one percent population increase due to immigration is associated with an approximate increase in minimum and average category rents by 4.8 and 3.3%, respectively. Moreover, the parallel results of the corresponding IV estimation are of even larger magnitude, suggesting a downward bias in the OLS estimates in focus. Namely, the suggested causal impact of a one percent population increase arising from immigration is associated with an increase in rents by roughly 8 and 4.1%, respective for minimum and average category. Our findings are in line with related studies in that we observe the most pronounced impact in the lower bound market segment, while the results for the top level rents are inconclusive.

This investigation is of particular interest since traditional analyses of the effects of immigration on destination regions are largely confined to the investigation of labour market outcomes, yielding however, results that are predominantly inconclusive or much lower in magnitude than suggested on theoretical grounds.<sup>2</sup> Moreover, rents account for a large proportion of natives' cost of living expenses and real estate constitutes an important part of personal wealth. Furthermore, the exploitation of the natural experiment at hand is highly advantageous to identify a causal impact of immigration on rental outcomes in designated destination areas, as it rules out anticipation effects that usually complicate identification.

The study at hand relates to a small but growing strand of literature on the impact of immigration on local housing markets. As argued above, the empirical literature studying the effects of immigration on destination areas has been intensely slanted towards the investigation of the suggested adverse labour market effects that immigration is suggested to yield on natives, hardly providing perspicuous results. In order to address this issue, recent research endeavours pointed toward the necessity to incorporate a larger variety of factors when analysing the impact of immigration on the well-being of natives. For instance, how

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<sup>1</sup>The data were kindly provided by Germany's major regional property market analyst bulwiengesa AG, RIWIS.

<sup>2</sup>See for instance Pischke and Velling (1997) and Frank (2009) for related studies on local labour market outcomes in Germany.

immigrant demand affects destination economies is an important issue that allows to draw a more concise picture of the factors driving migration as well as the associated consequences for the local economy and natives' welfare. Thus, recent studies have been directed at an examination of the effect of immigration on prices of traded and non-traded goods and services in destination economies.<sup>3</sup> Altogether, the analyses of immigrants' influence on pricing dynamics have shown that the effects differ largely among traded and non-traded goods and services and particularly the consideration of the non-traded goods sector attracted further attention, which has been expressed in research endeavours on migrants' impact on housing price dynamics. Indeed, this relatively unexplored field of research attracted first attention in the 1980s. Although, the initial studies were mostly of descriptive nature, a strong relationship between immigration and property prices has been suggested, which provided a profound fundament for subsequent empirical research endeavours (see Muller and Espenshade (1985) and Ley and Tuchener (2001), among others). Motivated by David Card's analysis of the Mariel Boatlift in 1990, which explores the labour market impact of migration in a natural experiment setting, Susin (2001) and Saiz (2003) were the first to conduct empirical analyses of associated housing market impacts.<sup>4</sup> In a more generalised consideration of the joint income and rental price development in response to migrant inflows, Greulich et al. (2004) find no significant change in the average rent to income ratio, that is, the so called *rental burden* on natives. Furthermore, conducting a first general equilibrium approach, Ottaviano and Peri (2007) suggest a causal relationship between immigration and housing rents across states and metropolitan areas and provide evidence for differential impacts on natives with different schooling attainment. It is argued that immigration had a significantly positive impact on rents of the highly and less educated. At the same time, the highly educated benefitted from increasing wages due to complementarities in production, while the less educated faced small but negative wage effects.<sup>5</sup>

It prevails that, the seminal contributions to this strand of literature have been largely involved with analyses of the U.S. housing market and other traditional migrant destinations; however, the corresponding results differ largely. For instance, the study on rental price dynamics in U.S.-MSAs between 1985 and 1998 by Saiz (2007), suggests that a one percent increase in the surveyed cities' population due to immigration is associated with a one percent increase in average rents. Moreover, in a recent research contribution on the Canadian housing market, it is argued that there was a significant positive, yet restrained, impact of immigration on rents (Akbari and Aydede, 2012). In contrast, a study of local housing market dynamics in New Zealand, between 1986 and 2006, does neither provide empirical evidence for a positive causal effect of foreign-born immigration on local property prices nor rents (Stillman and Maré, 2008).<sup>6</sup>

More recent studies have explored the impact of immigration on housing markets in European countries. Precisely, a seminal research contribution focused on the immigration wave to Spain, between 2000

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<sup>3</sup>See Cortes (2008) for a primary study on the pricing dynamics of non-traded goods across U.S. cities, employing local CPI data and Frattini (2008) for a similar study on the price impact of immigration in the UK.

<sup>4</sup>The sudden mass arrival of approximately 125,000 Cuban immigrants increased Miami's tenant population by an additional 9%, which was bound to have an effect on wages and rental prices. However, the local labour market apparently absorbed the additional supply of low-skilled labour very well, affecting wages only moderately (Card, 1990); whereas the opposite was observed for the development of rental prices: the application of a difference in differences approach to this historical event produced empirical evidence of a rental price increase, which exceeded the ones of the respective control groups by 8-11% (Saiz, 2003).

<sup>5</sup>Notably, the proposition that the rental outcomes of the highly skilled were highly sensitive to immigration is somewhat outstanding among this branch of literature.

<sup>6</sup>It is merely argued that an overall population increase by one percent is associated with a rental price increase of 0.2 to 0.5%.

and 2010, which was accompanied by a boom in regional housing prices. Gonzalez and Ortega (2013) find that immigration accounted for approximately 25% of the observed housing price increase throughout the surveyed decade as well as 50% of the construction activity. The evidence suggests that an average 1.5% annual increase in the working population due to immigration induced a rental price rise of roughly two percent and increased construction activity by 1.2 to 1.5%. Moreover, a study of the Italian housing market by Kalantaryan (2013) focuses on the recently observed immigration phenomenon to the country, exploring data from 1996 to 2007. In this analysis, evidence for a positive, yet declining impact on price growth has been suggested: A ten percent increase in the local foreign-born population is associated with a 0.6% increase in average property prices. In line with previous studies the corresponding results of the related IV estimation suggest a significant impact of slightly larger magnitude. In addition, a study on the Swiss property market has been conducted with the aim to provide further evidence for the existence of the elaborated immigration impact on property price dynamics, in the presence of fundamentally low house price inflation and modest immigration.<sup>7</sup> The respective scholars find that an increase in the local population by one percent due to immigration is associated with a 2.7% increase in prices of single-family dwellings (Degen and Fischer, 2010). Contrarily, Sá (2014) provides evidence for a negative impact of immigration on local property prices in the UK, which is suggested to be driven by an outflow of natives at the upper bound of the wage distribution, predominantly in areas where low skilled immigrants settled.

Altogether, the presented studies indicate that the presence of an immigration impact on housing markets is a global phenomenon. Nevertheless, this area of expertise is still relatively unexplored and there has been no general consensus on the magnitude and/or direction of the proposed effect. Consequently, the present study adds to this emerging branch of literature by contributing one of but few studies to exploit a natural experiment. In addition (and to the best of our knowledge), this paper presents the first study to utilise the fall of the Berlin Wall in this context and, at the same time, the first study for the German housing market. Moreover, a fundamental component at the very center of this investigation is manifested in the development and application of a novel IV for identification. With respect to the latter contribution, the seminal instrumentation approach by Frank (2009) has been modified<sup>8</sup> to generate an adequate IV for the present investigation.<sup>9</sup>

The paper proceeds as follows: in section 2, a brief representation of the historical setting will be provided, which establishes the foundation for the ensuing investigation. The methodological approach to encounter the topic will be depicted in section 3: departing from an introduction of the underlying empirical model in section 3.1, the explored data sources are presented in section 3.2. Section 4 serves to present the results of the empirical analysis. The study will be concluded in part 5.

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<sup>7</sup>The Swiss property market is well suited for this research endeavour, as it features rental controls on a nationwide basis, low occupancy turnover- as well as comparably low homeownership rates. In addition, immigration to the country throughout the surveyed period from 2001 to 2006 has been moderate, accounting for an approximate annual inflow worth 0.3% of the native population.

<sup>8</sup>He utilises available data on labour market characteristics (i.e. unemployment rates and indicators for the quality of available jobs) for 25 East German employment office districts (EODs) and interacts the respective pushing forces with four distance categories to potential destinations in the West. In comparison, the present study explores 35 EODs and pushing forces related to the dramatic production decline in the East German export sector following reunification.

<sup>9</sup>Accordingly, the underlying investigation also touches upon a third complex branch of migration literature that emerged in the wake of German reunification, a detailed elaboration of which is, however, beyond the scope of this paper.

## 2 Background

Following the German defeat in WWII, the country had been split among the allied forces into four occupation zones. In a prompt reaction to the differentiate prosecution strategies of the Soviets, the establishment of the former Soviet occupation zone was immediately accompanied by an initial wave of refugees thereof. Indeed, this development transformed into a persistent outflow of political refugees that lasted beyond the foundation of the GDR on 7<sup>th</sup> October 1949 (Schumann, 1996).

The implementation of centrally planned economic structures in this newly founded republic was characterised by expropriations and the introduction of economy wide production plans, initially covering a two year period and five years thereafter. Apart from the fact that the GDR was obliged to pay the largest reparations among all defeated combatants of WWII, its precarious establishment was rapidly followed by several economic challenges as well as political repressions, which drove up citizens' flight from the republic that culminated in the construction of the Berlin Wall on 13<sup>th</sup> August in 1961. The political motivation of this extraordinary measure rested upon the prevalent human capital flight from the GDR. On the one hand, the massive outflow of the young and highly skilled posed further challenges to the future economic development that would likely translate into a continued malfunctioning of the centrally planned economy. On the other hand, it was tantamount to the benefit of the Federal Republic of Germany. In spite of the fact that this radical measure lend some degree of protection to those in power and essentially put a halt to the flight from the republic, it did not help to overcome the profound economic problems of the GDR (Steiner, 2013). Conversely, the associated political repressions induced an enormous accumulation of migration potential, over more than 25 years, which was released with the fall of the Berlin Wall on 9<sup>th</sup> November 1989. In fact, towards the end of the 1980s, the joint sentiment of the population regarding dissatisfaction with the eroded political apparatus, enduring economic hardship and suppressed freedom, found its expression in the peaceful mass protests throughout the summer and fall of 1989. At the same time, a loosening of the established travel restrictions triggered a resubmission wave of formerly rejected emigration and travel applications, which escalated in the occupation of German embassies in Hungary and the former CSSR as well as a wave of illegal mass emigration via those gateway countries. This dramatic series of events ultimately led to the regime collapse, which was followed by the reunification of the two German countries (Schumann, 1996; Steiner, 2013).

It prevails, that much of this rapid transformation is attributable to the pioneering efforts and sacrifices of the former East German political refugees and protesters. Notwithstanding, emigration did not come to a halt with the opening of the former zonal border. It has rather been accompanied by a release of the cumulated migrant pressure from past decades. Initially, the fear and uncertainty that this new window of opportunity to flee the country might close again likely drove up migration figures (Heiland, 1996). In fact, following the first free elections since 1932, on 18<sup>th</sup> March in 1990, emigration started to show first tendencies of decline. The intension of the newly elected government to establish a fundament for the aspired reunification has been manifested in the introduction of the *social, economic and monetary union (SEMU)* on 1<sup>st</sup> July as well as the political reunification on 3<sup>rd</sup> October 1990. However, it did not take much time to discover that the German economy was in worse conditions than initially expected. In the wake of unification the economy was hardest hit by soaring wages, due to the bargaining efforts of western labour unions, hence, increasing

production cost, accompanied by a rapid decline in demand for East German products, which followed the vast appreciation of the currency. As a consequence, East German GDP declined from 1989 to 1992 by approximately 30% and unemployment rates shot up from zero to over 15% of registered unemployed. If the individuals who transited into training schemes, early retirement and other newly introduced labour market schemes are taken into account, the fraction of jobless citizens even increased to 33% (Burda and Hunt, 2001). The deteriorating economic conditions exerted a consistent push on East German citizens to leave the country. The present analysis utilises this outstanding historical episode alongside its consequences for the East German economy to study the immigration impact through 1991 and 1992 on the West German property market.

### 3 Empirical Strategy and Data

#### 3.1 Empirical Strategy

In order to identify the impact of immigration on residential property prices, particularly rents in regional housing markets of western Germany, the following spatial correlation model is applied:

$$\Delta \log(\text{rent}_{jc1990-92}) = \beta_0 + \beta_1 m_{j1991-92} + \beta_2 u_{j1990} + \beta_3 \frac{\text{arr}_{j1990}}{\text{pop}_{j1990}} + \mu_j + \varphi_j + \varepsilon_{j1990-92} \quad (1)$$

where the dependent variable is the change in the log of rents between 1990 and 1992, observed for each metropolitan area  $j$  and rental category  $c$ , respectively. Rental prices refer to the end of year value on 31<sup>st</sup> December of each year and the three surveyed rental categories are the minimum, maximum and average first-use letting prices of newly built or renovated flats in Euro per square metre, henceforth referred to as *primary letting prices*. The main explanatory variable  $m_{j1991-92}$  is total immigration from East Germany received by destination  $j$  throughout 1991 and 1992, divided by metropolitan area  $j$ 's initial population in 1990, that is, prior to the surveyed immigration treatment. Due to the log-linear set up of this model, the coefficient of main interest,  $\beta_1$ , captures the effect of a one percentage point increase in the migrant share of the local population between any two points in time, on the change of rental prices over the surveyed time period, expressed in terms of percent. Since the immigration impact to destination  $j$  is measured as the total migrant inflow throughout 1991 to 1992 in relation to the *a priori* population stock in 1990, the marginal effect may analogously be interpreted as a percentage change in rental prices due to an increase in destination  $j$ 's population by one percent arising from immigration.

In line with previous studies, the migration variable is in fact lagged in time,<sup>10</sup> assuming that rental prices adjust rapidly to fundamental shifts in demand, due to, for instance, extraordinarily high immigration (Smith et al., 1988). Moreover, in the present study of primary let flats, the price setting power of landlords is supposedly even higher than that of the ones offering consecutively let flats in any one housing market.<sup>11</sup>

<sup>10</sup>Related studies on the development of internal migration following German reunification have shown that the largest proportion of the studied annual migrant streams relocated during the spring and summer period. Predominantly, peak migration months coincided with regular school breaks throughout each year (Grundmann, 1996).

<sup>11</sup>Amongst other reasons, this is due to the fact that overall demand for newly constructed dwellings is usually higher and prices of newly-built are more difficult to evaluate by prospective tenants.

Due to the first-difference character of the regression equation, in which long-differences of the dependent rental price variables over a period of two subsequent years are investigated, that is, the entire time-span surveyed in the present study, destination specific time-invariant characteristics, which determine rental levels and are potentially correlated with migrants' location choices are differenced out (Wooldridge, 2013). Additionally, lagged values of time-variant location specific attributes and region specific dummy variables have been added as control variables. That is, the unemployment rate  $u_j$  in 1990 is included as a wealth indicating measure, as it is commonly argued that initial labour market conditions play an important role in determining migrants relocation patterns (Saiz, 2007). In contrast to seminal studies which explore several time-invariant characteristics, such as weather and other local amenities, in spite of the first difference set up of the respective models (Saiz, 2007; Gonzalez and Ortega, 2013), the underlying study exploits a single variable that factually condenses a variety of those characteristics and arguably captures factors beyond the traditionally explored amenity measures. The variable in perspective,  $arr_{j1990}$ , is a tourism related indicator for attractiveness of a destination, and thus, an essential determinant of the corresponding housing market conditions and property prices therein. More precisely, it covers the number of guest arrivals at local hospitality providers throughout the year 1990, and is further normalised by the destinations' population of the same year. This measure comprises a multitude of popularity features, as it summarises the total number of people with a purpose to visit an area, including both, professionally as well as privately motivated visits. Hence, it mirrors on the one hand the scale of business activity, and on the other hand, amenities such as weather, surrounding landscape, architecture and sights among others. Last, two types of dummy variables are included: The first set  $\mu_j$  draws from the inference of four market type categories (bulwiengesa AG, RIWIS, 2014b), and the second, denoted by  $\varphi_j$ , is a region specific dummy, capturing metropolitan areas, which are situated in the former inner German zonal border area. The expected sign of the coefficient estimate on the main explanatory variable (i.e.  $\beta_1$ ) is assumed to be positive, due to the fact that a migrant inflow raises the local population and, thus, demand for residential properties, as long as the immigration impact does not induce an outflow of natives to the same extent or even over-proportionate outmigration.<sup>12</sup>

Despite the first-difference nature and the inclusion of the above mentioned controls, the estimation of model equation (1) may still suffer from endogeneity bias, due to the self-selection of migrants into destination areas that show, under otherwise equal conditions, slower rental price growth, causing a downward bias in OLS estimates. Analogously, a merely coincidental influx of migrants to a certain area, which had recently gained considerable attractiveness for some reason and experiences high rental price growth, attributable to the boost in attractiveness, would overstate the effect of migration on rents, which may cause OLS estimates to be upward biased (Gonzalez and Ortega, 2013). Putting it differently, the potential correlation between  $m_{j1991-92}$  and  $\varepsilon_{j1990-92}$  violates the assumption of strict exogeneity of  $m_{j1991-92}$  rendering OLS estimates of the presented model biased, however, the direction of the bias is indeterminate without any further assessment (Wooldridge, 2013).

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<sup>12</sup>Interestingly, outmigration figures from West Germany to the rest of the world experienced a dramatic increase in the years following reunification, whereas the surge may also have been accounted for by East-West migrants who further moved on internationally, subsequent to relocating to West Germany. Both effects mentioned are supportive of theories on potential spill-over effects of migration. However, such redistributive effects do presumably not instantly follow the arrival of immigrants in any specified market, and the likelihood that the outflow of inhabitants outweighs the preceding inflow is assumed to be low (Card, 2001; Gonzalez and Ortega, 2013).



To circumvent this potential endogeneity problem, the present study employs an instrumental variable estimation approach, in which an instrument  $\hat{m}_{j1991-92}$  is constructed for  $m_{j1991-92}$ , based on various origin region push factors that are plausibly exogenous to the observed rental outcome in the surveyed destination areas as well as the other variables in model equation (1). Following an approach employed in previous studies, a separate regression analysis of origin area characteristics, pushing migrants out of the surveyed origin regions, will be conducted in order to predict exogenous migration (Saiz, 2007; Frank, 2009). Thence, an instrument will be constructed for the purpose of conducting the underlying analysis, which features a causal association with the immigration variable; however, has no effect on the error term, such that, the only effect of the instrument on the log change in rents is exerted via an extraction of the causal effect of immigration on rents. Moreover, the causal effect will be identified in performing a standard two-stage least squares estimation, using  $\hat{m}_{j1991-92}$  as an instrument for  $m_{j1991-92}$ , the results of which will be presented alongside the results of the OLS estimation in section 4.

### 3.2 Data and Descriptive Statistics

**Geography** From a geographical point of view, the two major units of analysis which are distinguished in the underlying investigation relate, on the one hand, to the East German territory of the former GDR, sending migrants, and on the other hand, to the West German region, receiving migrants. The recipient areas in the West encompass 72 metropolitan units. That is, out of the data on 127 German cities, provided by bulwiengesa AG, RIWIS, solely those West German cities that were classified as *Kreisfreie Staedte* (urban districts) throughout the surveyed period were chosen. These are separate entities, featuring self-contained municipal structures and clear cut borders at the district level. The selection criterion stems from two reasons: First, the sole analysis of those independent urban municipal unions allows a highly precise matching of the underlying migration data to the destination areas, since the smallest entity common to both data sets is the district level. Any matching of immigration streams on the district level to metropolitan units that do not constitute urban districts, however, are merely part of a rural district, would lead to an overestimation of the immigration impact to the metropolitan unit. Second, the intension of restricting the destination sample to urban districts is further motivated by the consistent provision of secondary data among those investigative units. Notwithstanding, the secondary data were also provided by RIWIS and are an essential prerequisite to the proceeding analysis of the West German property market.

Another important geographical consideration is related to the manifestation of the former zonal border area, prior to reunification. In particular, the urban districts that were located closely to this region may require different treatment in the analysis. This is mainly due to the fact that these areas were major recipients of subsidies prior to, and in many instances, also after reunification (Frank, 2009). In addition, the proximity to the origin regions presumably entailed substantial commuter inflows from the East, partly replacing immigration. Likewise, emigration streams out of these areas may have been disproportionately high in comparison to the non-border zone districts.<sup>13</sup> The selection of the respective investigative units fol-

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<sup>13</sup>On the one hand, the latter effect may be driven by traditional pull factors, such as relatively low living costs in the East and other motives of West German natives to emigrate. On the other hand, increased competitive pressures due to the participation of East Germans on, for instance, the local labour market may have likewise exhibited a push effect on natives out of the western border region.

lows from a study on the economic development in the zonal border region by Redding and Sturm (2008).<sup>14</sup> Since the 72 urban districts examined in the present investigation represent a subsample of this study, out of the 20 cities they identified to be situated in border area location, 13 investigative units are represented.<sup>15</sup>

Turning to migrants' origin areas in the East, following reunification the establishment of the five newly formed German states and the merge of East with West Berlin went hand in hand with major redistricting activities and the imposition of 38 employment office districts, each of which encompasses several urban and rural districts. The present analysis exploits the introduction of the EODs, since the elementary grouping of districts that are adjacent to each other does not alter the district level borders. It rather implies aggregated investigative entities, featuring a combination of clear cut borders on the district level. Thence, the district level emigration data can be precisely determined, combined and allocated to distinct *EOD origin regions*. In result, this approach allows to most precisely analyse and describe where migrants originate from, conducting both the OLS and IV approach, since the smallest unit for which consistent secondary data on origin characteristics are provided is the EOD level. The composition of the EODs in the present analysis builds upon a detailed study on the characteristics of the newly formed local labour markets in eastern Germany, by Rudolph (1990). However, the four separate EODs of former East Berlin have been merged to one, reducing the number of migrant sending regions on the EOD level to 35 investigative units.<sup>16</sup>

In addition, certain origin units have been marked as border regions, which may analogously require special treatment for the reasons discussed above and beyond.<sup>17</sup> That is, all EODs adjacent to West Germany as well as East Berlin have been allocated border region status.

Finally, since part of the underlying IV estimation strategy exploits the suggested effect that proximity yields on the magnitude of migrant streams between any origin and destination region (Ravenstein, 1885), the respective distances<sup>18</sup> have been determined, using data on coordinates of the geographical centres of the 72 destination cities in the West as well as geographical reference points of the 35 origin areas in the East.<sup>19</sup> Table 1 lists the summary statistics on origin and destination region characteristics in perspective.

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<sup>14</sup>Redding and Sturm (2008) survey a balanced panel dataset composed of 119 West German cities with a population of over 20,000 inhabitants in 1919, covering the time period from 1919 up until 2002 and identify 20 cities located in the inner German border region. More precisely, the 20 border area cities are defined as being located within 75 kilometre of Great Circle Distance from their nearest point along the former internal border.

<sup>15</sup>After careful consideration, Hamburg was excluded from the suggested list due to its status as an independent state and important hub for international trade, which reduces the number of observation units that are classified as border region districts to twelve.

<sup>16</sup>Crucial to the present analysis of the entire range of EODs is that major district reforms have been introduced from 1993 onwards reducing the number of East German districts from 215 to 111 in 1996. Since these reforms did not come into effect during the time period studied, the migration data can be matched with the EODs without any further requirement to merge districts and reduce the number of surveyed origin areas, as presented in a similar study by Frank (2009).

<sup>17</sup>The various overlaying effects in the origin locations close to the former border area, pose a challenge to predicting whether border location exerts an overall dampening or accelerating effect on emigration, if any at all. For instance, these areas benefitted from an enormous increase in centrality, thus, increased investment activity and likely better perspectives for the labour market development than other origin areas in perspective. At the same time, increased centrality was followed by a transportation surge, while much of the traffic was directed at the rural roads, reducing life quality in villages and small towns located at those gateways to the West.

<sup>18</sup>Ellipsoidal distances are applied in the present study.

<sup>19</sup>Determining the geographical reference centres of the 35 EODs, the coordinates of the respective urban or rural district with the highest initial population have been obtained (which was in most instances equal to the administrative centre of the EODs).

TABLE 1: SUMMARY STATISTICS (ORIGIN AND DESTINATION REGIONS)

	Obs	Mean	Std. Dev.	Min	Max
<i>Destination Regions</i>					
$\Delta \log rent_{minimum, 1990-92}$	72	.0749038	.0386303	0	.1760913
$\Delta \log rent_{average, 1990-92}$	72	.0679738	.0272086	.019641	.1522128
$\Delta \log rent_{maximum, 1990-92}$	72	.0634117	.0350843	0	.1763745
$m_{j1991-92}$	72	.0061475	.003342	.0013453	.0234371
Population (1990)	72	261162.7	271192	44246	1652363
$\Delta \log pop_{1990-92}$	72	.0162083	.0106051	-.0040548	.0439844
$\Delta \log pop_{1987-90}$	72	.0225263	.0659813	-.0008576	.5719146
Immigrants (1991-'92)*	72	1494.444	1833.697	160	11121
Arrivals '90 / Population '90	72	1.125823	.8708429	.0835448	4.320887
Unemployment rate '90	72	.0898194	.0297427	.04	.156
Zonal Border Area	12				
<i>Origin Regions</i>					
Initial working population**	35	253825.2	127806.3	87445	721325
Area (sqkm)	35	3095.457	2141.5	404	8482
Emigrants (1991-'92)***	35	12160.91	5328.313	4292	25091
Emigration impact <sup>+</sup>	35	0.049533	0.010117	0.028306	0.090304
Distance to West German urban district (km) <sup>++</sup>	2520	357.8256	116.6091	42.92701	792.3284

NOTES: \* Cumulated immigration from East Germany as of 1991 & '92. \*\* Working population prior to reunification, precisely 30/09/1989. \*\*\* Cumulated outmigration as of 1991 & '92 from each EOD to West Germany, i.e. to the surveyed metropolitan areas and beyond. + Emigrants 1991-'92 / working population (30/09/1989). ++ Ellipsoidal distances between any pairwise combination of origin and destination geographic (reference) centre.

**German East-West Migration** The dramatic series of political events in the late history of the GDR, which resulted in the fall of the Berlin Wall on 9<sup>th</sup> November 1989, immediately induced an enormous exodus of former GDR citizens to West Germany. More precisely, the huge build-up of migration potential has become evident in the outflow of approximately 1,232,652 emigrants from 1989 to 1992, whereat the migrant population was mainly represented by working age migrants (German Federal Statistical Office, 2000).

Focusing at the migration corridors of East-West migration since unification, that is, where migrants originated from as well as their distribution across the west, a main challenge to a consistent analysis is posed by a feature of the regime change itself, which was expressed in the collapse of the former GDR administrative structures. Accordingly, the break down of the GDR institutional framework was followed by a transition period, throughout which the respective duties were reassigned to the corresponding West German officiating bodies. Hence, particularly during the early transition process in 1989 and 1990, analytical documentation lacks multitudinous inconsistencies, which is equally applicable to internal migration data. Thus, for the purpose of this analysis, data from the German Federal Statistical Office, which collects the district level migration data for entire Germany, including the new states in the East, from 1991 onwards, have been analysed.<sup>20</sup> The data refers to all German inhabitants throughout any year in perspective, as it

<sup>20</sup>The present study applies data from the district level migration matrices (*Kreiswanderungsmatrizen*) of the years 1991 and 1992, provided by the German Federal Statistical Office (2014).

is a legal requirement to any German citizen to register any change of residency with the local officiating authorities. Due to the fact that the remaining analysis builds upon an investigation of factors, exogenous to rental prices in West Germany, that potentially drove emigration from the Eastern part of the country and allow to most accurately describe the migrant streams between the surveyed origin and destination regions, the individual district level streams have been extracted from the migration matrices and aggregated over time and space.<sup>21</sup>

**West German Property Market** In order to analyse the response of residential rental prices in West Germany to the sudden and extraordinarily high immigrant inflow from the eastern parts of the country, data have been obtained from bulwiengesa AG, RIWIS (2014a), henceforth RIWIS. RIWIS is a commercial property price analyst, engaging for over 30 years in extensive data collection and analysis of property markets, in order to provide indices for various residential and commercial market segments throughout Germany. The data provided by RIWIS constitutes an exceptional collation of consistent information on German regional property markets, and is therefore a widely accepted source of information, exploited by various established institutions to create internationally comparable indices for the purpose of monitoring the development of the country-wide housing market over time (Kholodilin et al., 2014).

The technique RIWIS employs with regards to data collation builds upon a continuously updated and revised data base, empirical research, test purchases, surveys and questionnaires as well as independent auditing processes, among others (bulwiengesa AG, RIWIS, 2015). RIWIS provided annual housing market and secondary data from 1990 to 1995, where the respective data for 1990 to 1993 have been explored in the regression analysis. Moreover, the available rental prices are classified according to newly built or refurbished flats, that is a *primary let*, and flats that have been previously let (*secondary let*). The average size of a typical surveyed unit corresponds to a two bedroom apartment, referred to as a three room flat according to German estate terminology, which comprises approximately 65 to 95 square metres of living space. The corresponding prices are expressed as gross nominal rental values per square metre and moreover distinguished between minimum, average and maximum rents.<sup>22</sup> All annual property price levels represent the values on 31<sup>st</sup> December of the respective year. Accordingly, the secondary data on market characteristics, refer to either annual average values or annual total values of the calendar year in perspective. The population figures relate to annual values on 31<sup>st</sup> December, unemployment rates replicate the annual average and the tourism control variable refers to the sum of guest arrivals throughout the surveyed year. In addition, RIWIS defined four property market type categories, in terms of size and functionality of the surveyed locations. These categories are time-invariant throughout the surveyed period, allowing to cluster the metropolitan areas according to their importance as functional centres on a local, regional, national or international scale (bulwiengesa AG, RIWIS, 2014b).

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<sup>21</sup>Precisely 2520 individual streams, that is one stream for each pairwise combination of origin and destination units, were obtained by aggregating district level emigration to EOD level. Furthermore, the respective values for 1991 and '92 were added and matched with their respective destination.

<sup>22</sup>Notably, the minimum and maximum values do not refer to the ultimate top- or bottom-rents *per se*, however, illustrate an average value of the observation units in the top or bottom three to five percent quantile, accordingly. Likewise, the average rental price does not replicate an arithmetic average, median or modus in mathematical terms. It rather illustrates typical average level rents, commonly observable in the particular market.

**Origin Characteristics and Instrument Construction** The underlying study constructs an instrumental variable following the seminal approaches of Saiz (2007), who conducts a panel random effects estimation in order to account for immigration to the United States based on various origin country characteristics; and Frank (2009), who applies a similar approach to predict migration from East German origin areas using labour market indicators for unemployment and quality of available jobs.

Analogously, the present analysis attempts to predict migration employing a separate regression model that exploits exclusively origin characteristics of the surveyed 35 EODs, which constitute driving forces in pushing out migrants from East Germany. As discussed in Section 2, the East German economy was in various aspects negatively affected by the transition process from a centrally planned economy to an open market economy. Apart from inefficient production processes, an obsolete capital stock and rapidly rising production costs in the wake of wage convergence to West German levels, the East German export industry, a major economic driving force of the GDR, suffered substantially. A possible explanation for the latter development is that just before the introduction of the SEMU the proportion of GDR exports to the COMECON (*Council for Mutual Economic Assistance*) states amounted to approximately 75% (German Council of Economic Experts, 1991). With the introduction of the economic and monetary union on 1<sup>st</sup> July 1990, the East German Mark was replaced by the West German D-Mark with a specified 1:1 adjustment rate for prices and wages, which however, led to an actual estimated appreciation of the currency by approximately 350% within a few days and induced an abrupt decline in demand for East German export goods (Heiland, 1996; Akerlof et al., 1991).<sup>23</sup>

The present study exploits this characteristic shock to the East German export industry via the construction of indicators, measuring the impact to the migrant sending regions arising from sectors that were amongst the hardest hit by the export related production declines.<sup>24</sup> In order to calculate comparable indices, which measure the impact of each sector specific production decline on the sending district level, data on the sectoral workforce distribution of the 35 EODs have been obtained from a study of the regional labour market compositions, which is based on the *Berufstaetigenerhebung (BTE)* by the former GDR central administration office for statistics, from 30<sup>th</sup> September 1989. The data replicate the status quo sectoral structure in each EOD prior to unification, and therewith, preceding the shock to the export industry. Since the sector shares are inferred from the relative employment concentration across sectors for each EOD (Rudolph, 1990), the shock indicators may be interpreted as a hazard rate or push factor for labour migration out of the area in perspective.<sup>25</sup>

For each sector and investigated origin region the export industry shock indicators are calculated as

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<sup>23</sup>The COMECON states were unable to maintain the trading partnership previously established with the GDR due to the regime change from an internal clearing system for foreign trade among those states based on the inconvertible Valuta Mark or transfer Rouble to convertible currencies (Ahrens, 2013).

<sup>24</sup>The majority of export goods was concentrated in the manufacturing sector, particularly processed goods thereof as well as the chemical industry. The respective sectors have experienced dramatic declines in net production since the introduction of the SEMU. From mid-1990 to 1991 net production in the chemical sector declined by 21.9%, whereas production in the machinery and vehicle manufacturing sector declined by 48.4% and in the electro-technical sector by 52.3%. These declines were further facilitated in 1992, with the exception of the electro-technical sector, for which production remained resilient from 1991 to 1992.

<sup>25</sup>Due to the character of the centrally planned economy and the GDR's specialisation in the production of export goods, the sectoral distribution was highly slanted towards specific regions. In fact, many districts with very high sector concentration were classified as mono-structured labour market regions (Rudolph, 1990). Thence, the shock impact varied significantly across sectors as well as EODs.

follows:

$$impact_{ki} = sector\ share_{ki} \times production\ decline_k \times \frac{working\ pop_{i1990}}{working\ pop_{GDR1990}} \quad (2)$$

where  $impact_{ki}$  denotes the shock impact to sending district  $i$ , arising from local concentration of sector  $k$ , with  $k \in machine, electro, chemical$ , weighted by affected working population in terms of total GDR working population. The corresponding figures for sector share (Rudolph, 1990) and production decline (German Council of Economic Experts, 1993) are expressed in terms of percent. Notably, the population data refers to the working population in November 1990 (Koller and Jung-Hammon, 1993), that is, short before the dramatic production decline was triggered by the break down in demand for export goods see Figure A-1 in the Appendix). The interpretation of the suggested relationship between the calculated sector impact indicators and migration is intuitive: the higher the value of  $impact_{ki}$  for any sector  $k$  in sending district  $i$ , the higher emigration from that origin region.

In order to predict exogenous migration,  $\hat{m}_{ij1991-92}$ , the following regression model is estimated:

$$m_{ij1991-92} = \gamma_0 + \gamma_1 \frac{1}{D_{ij}} \left[ \begin{array}{c} impact_{machine_i} \\ impact_{electro_i} \\ impact_{chemical_i} \\ \frac{area_i}{working\ pop_{i1990}} \cdot 1000 \end{array} \right] + \omega_i + v_{ij1991-92} \quad (3)$$

with  $m_{ij1991-92}$  denoting cumulated actual migration from origin district  $i$  to metropolitan destination district  $j$  throughout 1991 and 1992. The vector of explanatory variables includes the calculated sector-specific impact indices and the ratio  $\frac{area_i}{working\ pop_{i1990}}$  as an additional measure of circuitousness of sending area  $i$ . The latter measure is expressed as the EODs area in terms of square kilometre normalised by the corresponding working population in 1990. It is a proxy for the origin areas relative agglomerative character, capturing the composition trade-off between urban and rural components.<sup>26</sup> All explanatory variables are interacted with the inverted distance  $D_{ij}$  between each sending district  $i$  and recipient metropolitan area  $j$ , with  $\gamma_1$  denoting the corresponding vector of regression coefficients thereof.<sup>27</sup> In analogy to model equation (1), a border dummy variable  $\omega_i$  is included to distinguish the EODs that are adjacent to the former zonal border from the remaining sending districts. The descriptive statistics of the variables used to construct the instruments are provided in Table 2.

The corresponding OLS regression results of model equation (3) are attainable in Table 3. Specifications (1) to (3) show the coefficient estimates of the explanatory variables if the border area dummies are included. All variables apart from the proximity interacted impact of the chemical sector are significant in explaining emigration from the 35 EODs. However, if the border dummy variable is excluded, solely the effect of proximity interacted circuitousness as well as the shock impact of the machinery construction sector retain

<sup>26</sup>The agricultural sector was also negatively affected by unification, due to the formerly established *agricultural production cooperative (LPG)*, as it lacked efficiency on many counts. Hence, a rural exodus was triggered and particularly remote locations experienced severe depopulation over the following decades (Sander, 2014).

<sup>27</sup>The distance variable is inverted to provide a measure for proximity, in order to avoid interaction distortions with the individual explanatory variables.

TABLE 2: SUMMARY STATISTICS (AUXILIARY REGRESSION)

	Obs	Mean	Std. Dev.	Min	Max
$m_{ij1991-92}$	2520	42.69841	98.39362	0	2104
$\frac{1}{D_{ij}} \times impact_{machine_i}$	2520	.0535353	.0455525	.0077363	.6495075
$\frac{1}{D_{ij}} \times impact_{electro_i}$	2520	.0291043	.0335543	.0017331	.3774212
$\frac{1}{D_{ij}} \times impact_{chemical_i}$	2520	.0087413	.0108651	.0005741	.1008234
$\frac{1}{D_{ij}} \times \frac{area_i}{working\ pop_{i1990}} \cdot 1000$	2520	.0467175	.0368755	.0009121	.5010107
Area (sqkm)	35	3095.457	2141.5	404	8482
Zonal Border Region	11				

NOTES: Observations based on  $(35 \times 72) = 2520$  pairwise combinations of origin and destination districts.

significant explanatory power of the observed emigrant outflows. The corresponding coefficient estimates of the model specifications excluding border dummies are denoted in column (4) to (6). Furthermore, the estimated constant term of the model is significant in all six specification and the  $F$ -statistics'  $p$ -value for the joint significance of all coefficient estimates is  $p = 0.0000$  throughout model specifications (1) to (6). The overall association between the dependent variable and all explanatory variables is strongest in specification (1), displaying an adjusted  $R^2$  of 0.128.

Based on the acquired coefficient estimates of model equation (3) the predicted migration values  $\hat{m}_{ij1991-92}$  for specifications (1) to (6) are obtained. The correlations of the predicted migration variables with the actual migration variable do not vary by much across the specifications, however, specification (1) of model (3) is chosen for the IV construction. Notably, since model (3) rests upon a theory of origin specific push factors of migration, the predicted values of migration are linear combinations of factors that are exogenous to migrants' destination areas.<sup>28</sup>

The purpose of this procedure is to generate the required IV for immigration to the 72 urban districts, presented in model (1); however,  $m_{j1991-92}$  and the variable  $\hat{m}_{ij1991-92}$  feature different levels of aggregation. Thence, adding the corresponding 35 individually estimated migrant inflows per metropolitan area:

$$\hat{m}_{j1991-92} = \sum_i \hat{m}_{ij1991-92} \quad (4)$$

yields the forecasted number of immigrants for each of the 72 urban districts (i.e. the IV  $\hat{m}_{j1991-92}$  introduced in Section 3.1). The generated instrument is highly correlated with the endogenous explanatory variable of the main regression model, showing a correlation coefficient of .6261. The created instrument for observed migration  $m_{j1991-92}$  will be applied to model (1) in a 2SLS procedure, the results of which are presented in Section 4.2.

<sup>28</sup>As argued and practised by several scholars, no standard error correction is necessary in applying a generated instrument, which is a function of estimated parameters, to a standard two-stage least squares procedure (Wooldridge, 2010).

TABLE 3: AUXILIARY REGRESSION RESULTS

	(1)	(2)	(3)	(4)	(5)	(6)
	$m_{ij1991-92}$	$m_{ij1991-92}$	$m_{ij1991-92}$	$m_{ij1991-92}$	$m_{ij1991-92}$	$m_{ij1991-92}$
$\frac{1}{D_{ij}} \times impact_{machine_i}$	539.5*** (54.49)	521.9*** (51.12)	589.7*** (40.99)	560.9*** (54.57)	543.6*** (51.17)	571.1*** (40.94)
$\frac{1}{D_{ij}} \times impact_{electro_i}$	151.3** (71.61)	157.9** (71.25)		55.15 (69.27)	61.71 (68.90)	
$\frac{1}{D_{ij}} \times impact_{chemical_i}$	-171.5 (183.7)			-168.9 (184.5)		
$\frac{1}{D_{ij}} \times \frac{area_i}{working\ pop_{i1990}} \cdot 1000$	536.1*** (52.82)	533.0*** (52.71)	512.9*** (51.96)	462.8*** (50.96)	459.8*** (50.85)	455.1*** (50.57)
Zonal Border Area	-21.31*** (4.285)	-21.30*** (4.258)	-18.72*** (4.127)			
Constant	-7.433** (3.644)	-8.043** (3.585)	-6.944* (3.553)	-9.082** (3.646)	-9.681*** (3.586)	-9.134*** (3.534)
Observations	2520	2520	2520	2520	2520	2520
Origin areas	35	35	35	35	35	35
Adj- $R^2$	0.128	0.128	0.127	0.110	0.110	0.110

NOTES: Observations based on  $(35 \times 72) = 2520$  pairwise combinations of origin and destination districts. Standard errors are reported in parentheses. \*\*\*, \*\*, \* denote statistical significance at the 1%, 5%, and 10% level.

## 4 Results

### 4.1 OLS Results

The starting point for our regression analysis is the application of a standard Ordinary Least Squares procedure to model equation (1). Table 4 summarises the regression results for the three outcomes in perspective. The immigration impact on rental prices varies largely across the specified minimum, average and maximum rental categories. A consistently significant impact of immigration on the minimum level rental prices of primary let flats prevails across all six specifications of model (1). Precisely, specification (1) is based on a regression of the rental outcome on solely the main explanatory variable of interest, yielding a highly statistically significant impact of migration at the one percent level: a one percent population increase in the observed cities' housing markets due to East German immigration is suggested to yield an increase in minimum category rental prices by 4.831%. Moreover, adding controls alters the magnitude of the coefficient estimates within a range of  $-1.08$  to  $+0.94$  percentage points: Controlling for time-variant characteristics in specification (2) reduces the magnitude of the coefficient estimate to 3.8% at the five percent significance level. In specifications (3) through (5) dummy variables are added. The consideration of border area location increases the migration impact on rents to 5.479%; however, the standard error increases as well. In contrast, controlling for market type yields a reduction in the estimated marginal migration impact as well as the standard error by 0.36 and 0.11 percentage points, respectively. Accordingly, the estimated impact in specification (4) is also highly significant at the one percent level. Finally, specification (5) suggests a 3.75% increase in rental prices due to a one percent migration impact if all controls are jointly applied.

Turning to the regression results for the average rental price category furthermore suggest a consistently significant positive impact of migration on the change in rents. The results of this outcome variable are of particular interest to the analysis at hand, as the commensurate average rental values replicate the develop-



TABLE 4: OLS RESULTS - MINIMUM, AVERAGE AND MAXIMUM RENTS

	Coefficients Reported: $m_{j1991-92}$				
	(1)	(2)	(3)	(4)	(5)
<i>Dependent Variable:</i>					
$\Delta \log rent_{minimum}$	4.831*** (1.784)	3.848** (1.823)	5.479** (2.259)	4.471*** (1.676)	3.750** (1.715)
$\Delta \log rent_{average}$	3.328*** (1.127)	2.514** (1.059)	4.005*** (1.485)	3.241*** (1.161)	2.903** (1.337)
$\Delta \log rent_{maximum}$	2.753 (1.774)	3.126 (1.903)	4.031** (1.952)	2.766 (1.813)	5.410*** (1.894)
Time-variant controls	No	Yes	No	No	Yes
Border area	No	No	Yes	No	Yes
Market type	No	No	No	Yes	Yes
Observations	72	72	72	72	72

NOTES: The endogenous variable is the change in the log of rents of minimum, average and maximum category primary let flats. Regression coefficients are reported for the main explanatory variable  $m_{j1991-92}$  (i.e. immigration per initial population in 1990). All regressions are weighted by initial population. \*\*\*, \*\*, \* denote statistical significance at the 1%, 5%, and 10% level. Heteroskedasticity robust standard errors are reported in parentheses.

ment of the entire West German metropolitan housing market to the largest part. Accordingly, specification (1) implies a 3.328% increase in average rents due to East German immigration equal to one percent of the initial population. The significance level of the marginal effect of migration is marked at the one percent level. Adding time-variant controls in specification (2) and additionally the full set of dummies in specification (5) reduces the estimated marginal migration impact by 0.81 and 0.43 percentage points, whereat the corresponding coefficient estimates remain significant at the five percent level. In addition, controlling for border area location across metropolitan areas yields a highly significant increase of the estimated change in rents to roughly four percent per one percent immigration treatment. Notwithstanding, the inclusion of market type dummies in specification (4) yields a fairly robust and highly significant result in comparison to the marginal effect determined by means of specification (1). Altogether, compared to the minimum category rental outcome, the reported regression coefficients applicable to average rents are relatively smaller in magnitude. Nevertheless, the propounded migration impact is still sizeable.

Intuitively, the impact of the analysed East-West migration on the upper bound market segment was conceivably low, since the vast majority of migrants arrived with relatively poor financial endowment alongside precarious employment prospects, thence, targeting the lower bound to mid-level rental categories. Indeed, this effect is likewise replicated in the corresponding results for the OLS regressions of the maximum rental price category of primary let dwellings on immigration. Focusing on the third row of Table 4, it becomes apparent that there is no clear association between immigration and the development in the upper level rental segment. The baseline specification as well as specifications (2) and (4) yield a comparably low and insignificant estimated marginal effect of immigration on rents. Likewise, from the inclusion of the border dummy variable follows an impact of immigration that is in line with the reported marginal effects in the minimum rental category and significant at the five percent level. Finally, specification (5) yields a coefficient estimate of 5.4 at the one percent significance level, which is among the largest suggested marginal

effect of immigration as of yet in the consideration at hand. Nevertheless, the results for the maximum rental category are imprecise and highly volatile.

As discussed in the previous chapter, the respective results are potentially biased due to problems associated with the endogeneity of the main explanatory variable. Accordingly, the regression results essentially provide a baseline for a comparison with the IV estimation results presented in the subsequent section.

## 4.2 IV Results

Departing from the discussion of the OLS results, this section turns to the application of the dedicated instrumental variable estimation technique to the three investigated rental price outcomes. Table 5 depicts the first- and second-stage regression estimates of the 2SLS procedure. Specifications (1) through (5) are the accordant specifications presented in the discussion of the OLS results. Focusing at the results from the first stage regression, the resulting coefficient estimates show that the constructed instrument is highly significant in the presented setting. Moreover, the associated critical value of the  $F$ -test for the excluded instrument is consistently above 10, lending additional support to the exploitation of the IV in the analysis at hand. Analogously, all specifications feature high  $t$ -statistics, altogether indicating that predicted immigration based on origin area characteristics constitutes a well-defined IV for  $m_{j1991-92}$ .<sup>29</sup>

The results are less concise than the corresponding OLS estimates and deviate largely from the baseline results across specifications and rental outcomes. Notably, specification (3) produced comparably consistent and statistically significant estimates in the OLS application; however, in applying the IV the coefficient estimates substantially, yet statistically insignificantly with regards to the minimum category rental outcome, over- or understate the effects. Anyway, those estimates that are significant at the ten, five or one percent level, across outcomes and specifications, are much larger in magnitude than their OLS counterparts. Interestingly, the analysed average rental category produces the most concise and robust results. Moreover, the astonishing jump in the estimated impacts of the minimum rental category provides support of the argument that migrants tend to settle where rental prices grow at a relatively lower rate, causing a downward bias in the corresponding OLS estimates.

On the one hand, the deviations among the OLS and IV coefficients suggest that the OLS results of the presented analysis are indeed downward biased. On the other hand, due to the restricted sample surveyed in the present analysis, the IV coefficient estimates are potentially also severely biased (Wooldridge, 2013).

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<sup>29</sup>At a first glance it may seem unclear why the present study exploits an IV of predicted immigration for actual immigration divided by the destinations' initial population, instead of an instrument of predicted immigration that is analogously divided by initial population. The answer results from the fact that initial population of destination  $j$  poses an essential pull factor of migration (Karemera et al., 2000). That is, a city which is characterised by a relatively large population among the surveyed destination areas exhibits a stronger pull effect on migrants to the area. Since the underlying instrumentation technique rests entirely on push factors associated with origin area characteristics, the considered destination pull is an effect the generated instrument simply cannot account for. Thence, the predicted values of exogenous migration consistently underestimate observed migration to large cities and in aggregating the detailed migrant streams the deviations from the true observations further increase. In addition, the main explanatory variable of model (1), per definition, already corrects for the described pull effect in normalising immigration by initial population. Thus, further dividing  $\hat{m}_{j1991-92}$  by initial population would yield an instrument, which first, includes a destination specific component, conflicting with our intention to construct an instrument based on exclusively origin specific attributes; and second, features an association with  $m_{j1991-92}$  that predominantly arises from the large variations in population among observations in the present sample, as opposed to the covariation between actual and predicted migration.

TABLE 5: 2SLS RESULTS - MINIMUM, AVERAGE AND MAXIMUM RENTS

	(1)	(2)	(3)	(4)	(5)
<b>First Stage</b>					
	Coefficients Reported: $\hat{m}_{j1991-92}$				
$m_{j1991-92}$	$2.89e^{-06***}$ (5.44)	$3.20e^{-06***}$ (7.47)	$2.32e^{-06***}$ (3.94)	$2.92e^{-06***}$ (5.49)	$2.58e^{-06***}$ (4.72)
Partial $R^2$	0.34	0.447	0.177	0.34	0.25
F-excluded instrument	29.56	55.80	15.52	30.62	22.59
<b>Second Stage</b>					
	Coefficients Reported: $m_{j1991-92}$				
$\Delta \log rent_{minimum}$	7.950* (4.192)	7.123** (3.317)	13.18 (8.422)	6.737*** (2.230)	8.118** (3.221)
$\Delta \log rent_{average}$	4.089* (2.179)	8.118** (3.221)	7.121* (4.124)	3.929** (1.786)	5.922** (2.921)
$\Delta \log rent_{maximum}$	3.383 (2.829)	2.652 (2.672)	8.324** (4.204)	3.228 (2.943)	7.343* (3.862)
Time-variant controls	No	Yes	No	No	Yes
Border area	No	No	Yes	No	Yes
Market type	No	No	No	Yes	Yes
Observations	72	72	72	72	72

NOTES: The endogenous variable is the change in the log of rents of minimum, average and maximum category primary let flats. In the first stage the potentially endogenous explanatory variable  $m_{j1991-92}$ , is regressed on the generated instrument of predicted immigration  $\hat{m}_{j1991-92}$  as well as the remaining control variables of main regression model (1). In the second stage fitted values from the first stage regressions are employed to attain coefficient estimates for the endogenous explanatory variable  $m_{j1991-92}$ . All regressions are weighted by initial population. \*\*\*, \*\*, \* denote statistical significance at the 1%, 5%, and 10% level. First stage regressions:  $t$ -statistics are reported in parentheses. Second stage regressions: heteroskedasticity robust standard errors are reported in parentheses.

Nonetheless, the results from the 2SLS analysis provide a first indication of an empirically evident causal impact of immigration on rental prices in housing markets of Western Germany.

### 4.3 Robustness Checks

Since overall changes in the local population may likewise play an important role in the determination of local rental prices and the degree of rental price growth, further robustness checks are conducted in order to assess the validity of the presented results. Precisely, Table 6 summarises the corresponding OLS and IV regression results if overall population growth is controlled for. Panel A of Table 6 reveals that taking into account pre-trends in local population dynamics between 1987 and 1990, has hardly any impact on the results presented in section 4.1 and 4.2.

TABLE 6: ROBUSTNESS CHECKS: CONTROLLING FOR POPULATION GROWTH

		Coefficients Reported: $m_{j1991-92}$				
		(1)	(2)	(3)	(4)	(5)
		(OLS)	(IV)	(OLS)	(IV)	(OLS)
PANEL A: PRE-POPULATION GROWTH (1987-1990)						
<i>Dependent Variable:</i>						
$\Delta \log rent_{minimum}$	4.809*** (1.801)	7.906* (4.201)	3.863** (1.839)	7.190** (3.332)	13.13 (8.438)	4.313** (1.693)
$\Delta \log rent_{average}$	3.245*** (1.119)	3.841* (2.168)	2.472** (1.060)	3.641** (1.763)	6.792* (4.103)	3.093** (1.169)
$\Delta \log rent_{maximum}$	2.619 (1.775)	2.983 (2.804)	3.034 (1.914)	2.318 (2.644)	7.792* (4.178)	2.581 (1.841)
F-excluded instrument		28.24	54.62	14.82	28.32	20.19
PANEL B: OVERALL POPULATION GROWTH (1990-1992)						
<i>Dependent Variable:</i>						
$\Delta \log rent_{minimum}$	3.255* (1.788)	8.034** (3.982)	2.995* (1.634)	6.805** (3.015)	13.12 (8.617)	3.535** (1.738)
$\Delta \log rent_{average}$	2.464** (1.224)	4.145** (2.087)	2.159** (1.071)	3.653** (1.737)	7.054* (4.188)	2.430* (1.287)
$\Delta \log rent_{maximum}$	2.956 (1.802)	3.362 (2.788)	3.091 (1.903)	2.623 (2.695)	8.671* (4.508)	2.971 (1.837)
F-excluded instrument		31.82	50.82	15.21	35.37	23.43
Time-variant controls	No	No	Yes	No	No	Yes
Border area	No	No	No	Yes	No	Yes
Market type	No	No	No	No	Yes	Yes
Observations	72	72	72	72	72	72

NOTES: The endogenous variable is the change in the log of rents of minimum, average and maximum category primary let flats. Regression coefficients are reported for the main explanatory variable  $m_{j1991-92}$  (i.e. immigration per initial population in 1990). All regressions are weighted by initial population. \*\*\*, \*\*, \* denote statistical significance at the 1%, 5%, and 10% level. Heteroskedasticity robust standard errors are reported in parentheses.

In addition, controlling for overall population growth in the observed metropolitan regions throughout the surveyed period yields moreover fairly robust and consistent results across specifications, suggesting that immigrant inflows are likely more exogenous than other types of population movements, which is in line with the findings of Saiz (2003). Nevertheless, the magnitude of the OLS coefficient estimates has diminished across specifications by up to 1.6 percentage points except for the top market segment; whereas the corresponding IV estimates are in most instances even more pronounced.

## 5 Conclusion

The fall of the Berlin Wall sparked a mass exodus of East Germans to the Western part of the country, giving rise to the suspicion of large multifaceted effects on the destination economy in perspective. Accordingly, empirical evidence for a causal impact of immigration on rental prices in West German housing markets has been provided: A one percent population increase due to immigration is associated with an approximate increase in minimum and average rents by 4.8 and 3.3%. Moreover, controlling for border area location the effects become even larger. Unsurprisingly, the results of the top end market segment are fairly inconclusive, which is likely due to the presumably modest increase in demand for those relatively expensive rental units, in the light of the underlying case of German East-West migration. The parallel results of the IV estimation suggest stronger impacts on rental price growth, however, accompanied by larger standard errors. Namely, rental prices of minimum and average category dwellings increase by roughly eight and 4.1% due to a one percent population increase caused by immigration. Controlling for border area situation raises those figures to 13.2% (yet statistically insignificant) and 7.1%. Moreover, a significant effect for the upper market segment, worth 8.3%, is indicated when this special area is considered. The results are in line with most related studies; however, at a much larger magnitude, apart from the study by Saiz (2003), which also explores a natural experiment setting, suggesting that the degree to which migration is unpredictable or unexpected may play an important role in this consideration. Both of the considered natural experiments most obviously incorporated a large degree of unpredictability, as they allow to study the response of housing markets to shifts in demand, caused by an unexpected mass inflow of migrants, triggered by abrupt political regime changes in their home countries.

The findings of this investigation support the proposition that immigration affects the native population of recipient areas on various grounds. Thus, a consideration of the multifaceted impact beyond the sheer consideration of labour market outcomes establishes a basis for further research endeavours in this field, which constitute an essential precondition to the formulation of appropriate policy responses regarding immigration as well as housing market regulation.

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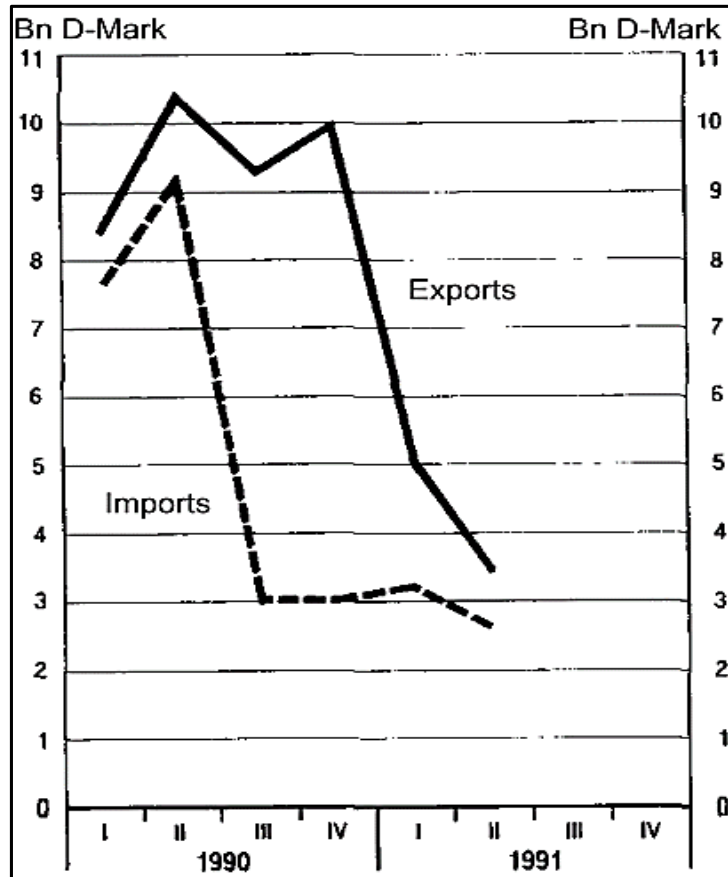
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## A Appendix

Figure A-1: East German Foreign Trade, 1990-'91



Source: German Council of Economic Experts (1991)