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Influence of a Mortgage Interest Deduction on Homeownership Attainment of European Households

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This article provides new European evidence about the relation between the much discussed mortgage interest deduction (MID) and homeownership. We also examine which household-group, based on income or marital status, is (mainly) encouraged via this fiscal relief to own a home. To do so, we estimate multilevel mixed-effects logistic regressions by using Eurostat EU-statistics on income and living conditions data in twelve countries over 2003-2018. Our quantitative study shows that an MID generally fails to advance its purpose of promoting homeownership, likely due to price capitalization. However, our results underscore that there is (substantial) variation across household groups. From the odds ratios, we conclude that the intended positive effect of an MID on homeownership probability occurs only for the highest-income households; those who need the most help with good-quality affordable housing are the most discouraged via this relief to become a homeowner. Since the continuation of an MID remains one of the contested issues in many national debates, our empirical findings provide useful insights for governments around the world that wish to promote homeownership through tax incentives.

Keywords

Homeownership, Marital status group, Mortgage interest deduction, Multilevel mixed-effects logistic regression, Income group

1. Introduction

Tenure choice (the choice between renting and owning a home) is one of the major decisions that households will make throughout their life (Špalková and Špalek, 2013). Owning a home is preferred by most governments around the world. Indeed, increasing homeownership rates is a desirable goal in numerous countries (Mikolai and Kulu, 2019). A frequently heard argument in favor of homeownership is the existence of positive externalities (such as better outcomes for children, or higher social trust (Huber and Montag, 2020)); for a literature review on homeownership benefits see Dietz and Haurin (2003). Slintáková and Klazar (2018) illustrate, however, that there is mixed (empirical) evidence about these externalities. However, this paper does not aim to address or verify the potential benefits of homeownership. This study is about the impact of mortgage interest deduction (MID), a tax deduction based on interest payments for mortgages (Tallevi, 2018), on homeownership attainment. The vast majority of households are, after all, obliged to borrow in order to acquire a house or apartment, and borrowing for this purpose is often fiscally stimulated via an MID. While an MID is a widely used tool to promote homeownership, this tax relief is not without criticism (Stansel and Randazzo, 2011).

Despite the many opinions and discussions in Europe about mortgage interest policy, up until now, there have been few European empirical studies in the field (for a single-country (Danish) study see Gruber et al., (2021)). Furthermore, although there are more studies about fiscal instruments and owner-occupied housing in the United States (U.S.) (Glaeser and Shapiro, 2002; Hanson, 2012), as far as we know, none of them have explicitly sought to compare the impact of MID on homeownership attainment among multiple groups of households (such as income¹ and marital status groups). Although it is often argued – both in Europe and the U.S. – that this fiscal stimulus: (1) benefits (mainly) the wrong people (those who would also (be able to) own a home in the absence of the subsidy) (Ventry, 2014), and (2) fails to promote affordable housing (or else, increase homeownership rates) (Hoebeek and Inghelbrecht, 2017), eventually because of the capitalization effect of the MID into higher housing prices (see for e.g., Berger et al. (2000) and Capozza et al. (1999) who show that interest rate subsidies are capitalized into housing prices, and other studies in the literature section). According to the economic theory, capitalization via spurring housing demand (as housing costs decline; see also the literature section) – which is the widespread message conveyed – can only happen when supply is inelastic² (Vangeel et al., 2022; Verbruggen et al., 2005). Partly because of these two arguments (since also being costly for the

¹ Hilber and Turner (2014) also explore how MID influences homeownership decisions across different income groups (see literature section).

² “Caldera and Johansson (2013) indicate that supply elasticities vary widely across (and within) countries, but that they are usually low (<1) for European countries” (Vangeel et al., 2023).

government in terms of forgone tax revenue (McCabe 2018), an MID has been limited or even abolished in a number of countries over the last decades.

To support or refute the above claims, the relation between MID and homeownership is empirically assessed in this paper, both in general and across household groups (i.e., in our study, groups based on household income and marital status of the household head). We highlight that this is the first study: (1) to directly measure the effect of MID on homeownership probability based on such a large number of (European) countries, and (2) to compare this effect explicitly among various household groups. We contribute as such to the ongoing debate on housing policy by creating more insight into the effects and effectiveness of the most common fiscal instrument of a country to boost homeownership. After all, the continuation of an MID remains one of the contested issues in many national debates. Thus, if an MID proves to be inefficient in its stated goal of boosting homeownership, we might suggest countries to review their housing policy/tax incentives for promoting homeownership. Additionally, our dataset and method make it possible to control for a broad set of homeownership determinants. Moreover, in contrast to most housing studies (that focus on the U.S.), we focus on Europe, which allows us to include various MID systems in our sample. After all, different countries have different approaches to MID. As we investigate the effect of an MID in general, we therefore consider our multi-country (European) approach as an advantage.

The rest of the paper is organized as follows. We review the relevant homeownership literature in the next section. Thereafter, a detailed description of the data and method is presented. The paper continues by discussing the (robustness of the) results from the empirical analyses. Finally, the paper closes with some concluding comments.

2. Literature

Homeownership is the result of a large number of determinants (Tan, 2008). Hence, there is a substantial body of literature on the influence of various factors on housing tenure choice. The U.S. has received the most attention (Bourassa and Yin, 2008; Chambers et al., 2009), but some European homeownership studies do exist. Bazyl (2009), for example, compares multiple European countries based on microeconomic factors that influence housing tenure choice. Other European (single-country) homeownership studies include Lauridsen and Skak (2007), Špalková and Špalek (2013), and Xhignesse et al. (2014). The control variables, inserted in our analyses (see methodology section), are predominantly based on all of these determinant studies. However, for our study, we are particularly interested in the influence of an MID on homeownership attainment. Several relevant previous studies in this area are summed up in the following paragraphs, starting with evidence from the U.S.

Glaeser and Shapiro (2002) estimate the relation between an MID and homeownership rates in the U.S. They argue that this fiscal stimulus is a poor instrument to encourage homeownership. Hanson (2012), who uses data from the American Housing Survey (AHS), also finds no significant relation between the two. He further adds that the relief stimulates the purchase of larger homes: via an MID, the size of the purchased home increases by 10.9 to 18.4% (or one average extra room). His observation indicates, in other words, that the relief increases the amount of housing consumption.

An explanation as to why an MID could be an ineffective instrument to boost homeownership may be offered in the fact that it is commonly associated with increased house prices (Poterba, 1984; Ryckewaert, 2019; Vangeel et al., 2022). After all, an MID allows for lower mortgage payments. The ability of a homebuyer to pay is consequently higher, which ultimately translates into higher house prices (Damen et al., 2014; Verbruggen et al., 2015), especially in a supply-inelastic market. With regard to the latter, we note that in a housing market, an MID may only affect homeownership if supply can react as it otherwise mainly affects prices (see also Stadelmann and Billon (2012) and Stadelmann and Billon (2015)³ who address the supply constraints/elasticity issue in their studies around the capitalization effects of fiscal variables). Bourassa et al. (2013) who review international evidence, document that two U.S. homeownership studies take into account the capitalization effect of MID. First, Bourassa and Yin (2008), who use AHS microdata from 1998 for eleven metropolitan areas, conclude that an MID has an adverse impact on the homeownership attainment of young adults since it inflates house prices. Their study therefore suggests that the tax saving effect of the relief is dominated by its house price effect. Second, Hilber and Turner (2014) research whether, and confirm that, the positive effect of an MID on homeownership is offset by its capitalization into house prices within and across U.S. states, on the basis of longitudinal data from the Panel Survey of Income Dynamics (PSID) over the period of 1984-2007. They find, like the overall U.S. evidence, that the impact of an MID on homeownership attainment is rather negligible in aggregate. Moreover, another important study that we add here is that of Sommer and Sullivan (2018), who build a theoretical model and estimate the effect of the removal of MID on house prices and homeownership (as well as on mortgage debt and welfare). They find that eliminating MID causes house prices to decline, and homeownership to increase.

However, primarily for the reason described in the introduction section (i.e., exploiting variation across the MID approaches of (European) countries), we focus on Europe in this paper. Moreover, according to Hilber (2007), observations for the U.S. may not be directly applicable to Europe because both have a different institutional setting. Hilber (2007) gives the example of

³ As summarized by Morger (2013), the two studies indicate that, in the Zurich metropolitan region, the elasticity of land supply is not high enough to bring capitalization to 0 in the long run.

(differences in the) immigrant population, which is – based on the results – questioned to be equally relevant in Europe and the U.S. (Coulson, 2002) for housing tenure outcomes.

There is little European evidence of the impact of fiscal stimuli on homeownership (rates). Two homeownership studies are nonetheless worth mentioning, as the authors somehow controlled for the effect of an MID: Andrews and Caldera Sánchez (2011) and Hilber (2007). Using data of fifteen Organisation for Economic Co-operation and Development (OECD) countries (twelve European countries plus Australia, Canada and the U.S.) over roughly the decade of 1994-2004, Andrews and Caldera Sánchez (2011) conclude that more generous mortgage interest tax subsidies are associated with a smaller impact of relaxing down-payment requirements on homeownership rates. The latter outcome suggests, consistent with results and deductions from Bourassa and Yin (2008), Hilber and Turner (2014) and Sommer and Sullivan (2018), that the capitalization of an MID into house prices offsets its potential ‘benefit’ (i.e., elevating homeownership attainment). Nevertheless, their data do not allow direct estimation of the impact of a tax policy on homeownership. Hilber (2007)⁴ used European Community Household Panel (ECHP) microdata to identify the main determinants of homeownership across fifteen European countries. Hilber (2007) finds that major tax policy reforms (among which the abolition of an MID in France and the United Kingdom (UK) have had relatively minor effects on homeownership attainment between 1994 and 2001.

Given the limited (European) evidence on the effects of an MID, as well as the increased attention that this relief receives (as the most common fiscal provision) in fiscal debates⁵, our study aims to provide clarity about the effectiveness of an MID in promoting homeownership. Therefore, based on the above described studies, we hypothesize the following:

Hypothesis 1: An MID generally does not result in higher homeownership attainment.

In addition to its ineffectiveness in stimulating homeownership (which is tested across European countries in Hypothesis 1), an MID is also – rightly or wrongly

⁴ We focus specifically and solely on an MID (and thus not on other housing policies), and we directly assess the general influence of an MID on homeownership attainment (instead of assessing the influence of a country-specific reform). Our study further differs from Hilber (2007) in terms of data and methodology: (1) we study a longer and more recent time period; i.e., 2003-2018, which allows us to include more policy changes; i.e., having an MID or not (see data section); (2) we also control for additional and other variables (such as tax systems; see the additional analysis section); and (3) to analyze homeownership determinants, we use multilevel mixed-effects logistic models that take into account the interdependency of households within countries (see the methodology section).

⁵ In recent decades, and in multiple (European) countries, there has been much discussion about whether, how and when to abolish or limit/reform their current MID.

– criticized for being a subsidy to wealthy homeowners (Glaeser and Shapiro, 2002; Stansel and Randazzo, 2011). Households in higher income groups are indeed more likely to own a home (and thus to benefit from an MID), and the tax relief is often worth more to this group than households in lower income groups (although for the U.S. - see Prante (2006)). After all, the highest income group pays the highest tax rate when a country has a progressive tax system. This implies that the highest income group has the greatest benefit from deducting interest from their income. In addition, households in higher income groups can borrow more to purchase a home, as they have a higher income. When holding larger mortgage loans, the total interest to be paid is higher and therefore more can be deducted.

Married couples are often eligible to claim an amount twice that of an unmarried individual. To illustrate, in some MID approaches (such as in Belgium (2005-2014)), the benefit is per person and not per dwelling. In other approaches (such as in France (2007-2010)), limits to the deductible amount are doubled for couples (European Commission, 2014). This is however not always the case as there are several approaches to an MID, each with its own specifications.

To continue on these specifications, both (1) between countries, and (2) within countries over time and across groups, (the details of) MID approaches differ (Van der Hoek and Radloff, 2007; European Commission, 2014). In the Netherlands, mortgage interest is almost fully deductible. However, across countries, mortgage interest payments are often deductible only up to a certain maximum that varies from a few hundred to a few thousand Euros. In a number of countries (such as France (2007-2010) and Ireland (2004-2012)), the maximum deductible amount also depends on the type of taxpayer (married versus single, those who have dependent children versus those who do not, etc.). Also, the deductible amount might further vary over years of entitlement (such as in Belgium (2005-2014) and Ireland (2004-2012)). Other examples regarding approaches to an MID include the following: there may be limits on the allowed period of deduction (such as in the Netherlands (2001-2018)); in some countries (such as in the Nordic ones (early 1990s-2018)), mortgage interest payments are solely deductible from a certain income category (i.e., capital income) (Vangeel et al., 2022); and in Belgium (2005-2014), next to interest payments, capital payments and mortgage insurance premiums can also be deducted from taxable income (Vangeel et al., 2020). However and unfortunately, to provide a complete table of the particular MID conditions by country over time, and/or for a more elaborate discussion of how MID policies vary across countries, more reliable fiscal information is needed. We do not have all/sufficient information about the detailed MID policy of each studied country – which varies over time – for the entire investigated period. However, as an illustration, Table 1 provides a simple and non-exhaustive overview of differences across countries.

Table 1 Country Comparison: Mortgage Interest Deduction

Country \ MID	Mortgage insurance and capital payments (1)	Time limit (2)	Deductible up to a ceiling (€) ^e (3)	Ceiling (€) depends on 'type' of taxpayer/ dependent children (4)	Ceiling (€) depends on time (5)	Deductible from a certain income category ^f (6)
Belgium (2005-2014)	X ^a		X	X	X ^e	
Denmark (2003-2018)						X
Finland (2004-2018)			X	X		X
France (2007-2010)			X	X		
Greece (2003-2018)			X			
Italy (2004-2018)			X			
Ireland (2004-2012)		X ^b	X	X		
Norway (2003-2018)						X
Portugal (2004-2011)			X			
Spain (2004-2012)			X			
Sweden (2004-2018)						X

Notes: This table presents a simple comparison between the MID of the countries in our sample. We provide an overview on whether: (1) mortgage insurance and capital payments are also deductible from taxable income, (2) there is a time limit on the granted relief, (3) mortgage interests are deductible up to certain maximum, (4)-(5) this maximum might vary, and (6) mortgage interest payments are only deductible from a certain income category. A cross (X) shows that this is applicable. The years between brackets represent the applicable period (in our sample). ^aThe mortgage interest and capital deduction scheme in Belgium can be defined as rather complex (Vangeel et al., 2020): capital and interest costs can be jointly deducted and the benefit of a fixed interest mortgage does not diminish over time. ^bIn Ireland, there is a tax credit on qualifying loans for seven years (European Commission, 2014). ^cNext to varying rates (%) on the interest cost over time within countries, the ceiling also differs between countries. ^dIn a number of countries, the maximum depends on the 'type' of taxpayer. For example, in Ireland, mortgage interest relief is doubled for widowed/married taxpayers. Furthermore, limits might be increased based on having dependent children. In France, for example, the limit increases by US\$532.65 (Euro to USD on April 19, 2024) for each dependent child. ^eIn Belgium, during the first ten years, limits are increased with US\$809.63 (Vangeel et al., 2020). ^fIn the early 1990s, the Nordic countries moved to a dual income tax (DIT). Due to the tax reform, the value of the tax relief is lowered. **Source:** European Commission (2014).

However, to fully understand and evaluate the efficiency effects of an MID, we believe that it is necessary to determine whether an MID has a disparate impact on consumers of housing. Nevertheless, the empirical literature has neglected to thoroughly investigate the impact of this fiscal relief on homeownership attainment across various (European) household groups. To the best of our knowledge, this is the first study in the field to explicitly focus on marital status (i.e., whether the household head is married or not). Although we might expect the impact of an MID to differ between the married and the unmarried for the reason mentioned above; i.e., the (maximum) deductible amount differs between couples and singles in a sufficient number of countries over the studied period (such as Belgium, Finland, France and Ireland; see above). There are, however, two studies about MID that mention differences with regard to income groups: Matsaganis and Flevotomou (2007) and Hilber and Turner (2014). Matsaganis and Flevotomou (2007) apply the simulation model EUROMOD to show the regressive effects of an MID in five European countries (Finland, Greece, Italy, the Netherlands and Sweden): the benefit is disproportionately captured by higher income groups in all of the countries considered. Hilber and Turner (2014) focus on the impact of MID across local housing supply conditions in the U.S. They find that the impact varies across both locations and income groups⁶. According to Hilber and Turner (2014), the fiscal relief boosts homeownership attainment only of wealthy households in less tightly regulated housing markets. For lower income households, the benefit is too small to encourage them to acquire a house, regardless of regulatory status.

As part of estimating efficiency and effectiveness of an MID, we want to test: (1) which specific groups of households are (mostly) favored and (2) whether an MID (also) reaches the people who most need help with good-quality affordable housing (i.e., in our study, households in the lowest income groups and unmarried households). Given the discussions above, we construct the following hypotheses:

Hypothesis 2a: The homeownership of mainly higher income groups is increased via an MID.

Hypothesis 2b: The homeownership of mainly married couples is increased via an MID.

⁶ Next to quantifying the effect of an MID also across marital status groups, our research further and considerably differs from Hilber and Turner (2014) in terms of data and methodology: (1) we focus on multiple and European countries (see data section) which allow us to take into account more MID approaches; (2) we study a more recent time period; i.e., 2003–2018 (see data section); (3) we also control for additional variables (such as tax systems; see the additional analysis section); and (4) to analyze homeownership determinants, we use multilevel mixed-effects logistic models that take into account the interdependency of households within countries (see the methodology section). Moreover and more importantly, our outcomes for certain income groups differ in terms of significance (see the results section).

3. Data

This study greatly relies on the European Union Statistics on Income and Living Conditions (EU-SILC) longitudinal dataset (see Table A1 in the Appendix for an overview of the original EU-SILC variables that are selected to perform our analyses), compiled by Eurostat⁷. The EU-SILC provides data on income, education, labor, health, housing conditions, material deprivation, social exclusion, and living conditions that are comparable across countries. The dataset, based on survey data, is a rotational panel of four years. This means that households (and individuals) are (usually⁸) observed for a maximum period of four years. Also, the longitudinal data are provided in overlapping waves. As such, in each longitudinal wave, there are household (and individual) data that go back a couple of years into the past before the most recent year observed (Lehwess-Litzmann and Nicaise, 2020). Engbom (2017) clarifies for individuals in the 2006 wave: the 2006 wave contains all previous years for all individuals who participated in this wave (i.e., for an individual who entered the survey in 2004: years 2004 to 2006). A given individual-year is thus present in multiple waves. For example, the 2004 response of an individual who entered the survey in 2004 is included in the 2004–2007 waves. Hence, pooling across multiple waves of survey data in our study (see below) requires filtering out duplicate household-years.

The survey is carried out on a yearly basis since 2003/2004; first conducted in six member states (Belgium, Denmark, Greece, Ireland, Luxembourg and Austria) and Norway, and now also covering all of the other EU countries plus Iceland and Switzerland. However, we only examine countries in the EU-SILC dataset for which all pre-selected variables (see Table 3) are present (knowing that not all countries include all of the recommended questions of Eurostat in their survey), and for which sufficient reliable fiscal information (i.e., whether a country permitted the deduction of mortgage interest payments in a particular year or not) is available to us. The twelve investigated countries therefore include Belgium, Denmark, Finland, France, Greece, Italy, Ireland, Norway, Portugal, Spain, the UK and Sweden. We are aware that there is no uniform approach to an MID across Europe (see the literature section), but our sample allows a broad range of approaches to be represented. Our time period ranges from 2003 to 2018. We choose this time period since the EU-SILC project was launched in 2003, and 2018 is the most recent wave (at the time of writing). We are, however, not able to include all countries in the dataset for this entire period (as not all countries have observations in each EU-SILC wave); and, by consequence, our panel dataset is unbalanced. A country overview is given in Table 2, along with their mortgage interest policy (i.e., whether an MID is applied throughout the sample period). As can be seen in this table, all but one country (i.e., the UK) in the sample either have or used an MID for the larger

⁷ We would like to thank Eurostat for providing access to the EU-SILC microdata. Note that the results and conclusions are ours and not those of Eurostat.

⁸ France and Norway have longer panels i.e. nine and eight years, respectively.

part of the period examined (with the exception of France). In this respect, i.e., there is an unbalanced panel: Germany, economically the largest European country and characterized by one of the lowest ownership rates in Europe, does not use MID. Unfortunately, we could not include Germany in our analyses since the EU-SILC does not provide longitudinal data for this country.

Table 2 Country Overview

Country	Years included in dataset	Total No. of Obs. ^a	No. of married people	Homeownership rates	MID Granted
Belgium	2004-2014 ^b	59,305	31,174 (53%)	2004: 69.12% 2014: 68.41%	Yes
Denmark	2003-2018	77,779	48,659 (63%)	2003: 70.36% 2018: 65.80%	Yes
Finland	2004-2018	122,967	70,165 (57%)	2004: 74.69% 2018: 77.45%	Yes
France	2004-2018	154,443	76,592 (50%)	2004: 60.37% 2018: 67.14%	2004-2006: No 2007-2010: Yes 2011-2018: No
Greece	2003-2018	142,955	91,703 (64%)	2003: 74.25% 2018: 81.00%	2003-2013: Yes 2014-2018: No
Italy	2004-2018	284,025	166,874 (59%)	2004: 73.75% 2018: 73.98%	Yes
Ireland	2004-2018	62,585	32,263 (52%)	2004: 81.92% 2018: 77.78%	2004-2012: Yes 2013-2018: No
Norway	2003-2018	84,308	45,361 (54%)	2003: 81.85% 2018: 84.08%	Yes
Portugal	2004-2017	83,600	52,467 (63%)	2004: 75.85% 2017: 75.83%	2004-2011: Yes 2012-2017: No
Spain	2004-2018	199,046	125,859 (63%)	2004: 82.54% 2018: 82.23%	2004-2012: Yes 2013-2018: No
UK	2005-2017	117,882	58,660 (50%)	2005: 71.43% 2017: 70.83%	No
Sweden	2004-2018	79,122	33,452 (42%)	2004: 68.34% 2018: 70.09%	Yes

Notes: This table presents an overview for each country in our sample. In addition to showing the total observations of a country (i.e., the number of observations in the total sample of households), the number of married observations in this sample, and the homeownership rate of a country for its first and last years in our sample, the table shows whether and when an MID is granted over the years that the country is studied. The percentage of married observations to total observations is given between the brackets. UK = United Kingdom. ^aThe number of household observations of a country differs for each year. ^bWe only included Belgium in our dataset up to and including 2014. After all, fiscal competence has been regionalized in this country since 2015 (Vangeel et al., 2020), which has led to an adaptation/abolishing of the so-called ‘woonbonus’ (i.e., the Belgian approach to an MID) in each of its three regions (i.e., Flanders, Wallonia and the Brussels-Capital Region).

Tenure status ('Homeownership') is treated as the dependent variable of our analyses with the aim to identify the relation between an MID and homeownership. As can be seen in Table 3 (which presents our dependent and control variables), this variable was sourced from the above-described EU-SILC dataset, so we dichotomized Homeownership into ownership and non-ownership. We do not distinguish further because the answer categories of Tenure Status differ over the EU-SILC waves (Table A1). A country that allows an MID, for which information was derived from – among others – the OECD and EU reports (European Commission, 2014), is modelled via a dummy variable (1 if an MID is granted in the country where the household lives, 0 otherwise). We utilized a reasonable number of control variables, which vary at the household-level, to operationalize our hypotheses. For these household-level variables, we also draw on the EU-SILC data. Our set of control variables, as well as their expected influence (i.e., positive or negative) on homeownership attainment, (mainly) follow previous studies in the field (Bazyl, 2009; Xhignesse et al., 2014)

After cleaning the initial sample (removing both duplicates (which can be explained by pooling multiple waves of survey data; see above) and households with missing values), our final (and total) sample comprises 1,468,017 households to test Hypothesis 1. To detect the potential differential effect across income and marital status groups, we make use of split samples⁹: the total sample is split into smaller sub-samples to test Hypotheses 2a and 2b. One advantage of doing so is that one can immediately see whether the control variables have different effects depending on marital status and income. In the two following paragraphs, some added information about (the construction of) the income and marital status samples is given.

⁹ As an alternative, regressions with an interaction effect between the dummy variable 'Tax Benefit' (see methodology section) and continuous variable 'Income' (methodology section) or dummy variable 'Marital' (methodology section) can be used to test Hypothesis 2a or 2b, respectively. The findings are described in Footnotes (20) and (21) under the results. Note that we do include the main effects in these regressions.

Table 3 Variable Overview

	Type	Description	Source: EU-SILC variable ^a	Exp. Sign ^b
Dependent variable Homeownership	Dummy	1 if owner, 0 otherwise	HH020/HH021 ^d : Tenure status	/
Independent variable (Household-level)				
Size	Continuous	Number of household members	HX040: Household size	+
Urbanization	Categorical	1 – densely populated area	DB100: Degree of urbanization	ref.
		2 – intermediate area		+
		3 – thinly populated area		+
Activity	Dummy	1 if at work, 0 otherwise	RB210: Basic activity status	+
Age	Continuous	Age at time the interview	RX010: Age at time interview	+
Marital	Dummy	1 if married, 0 otherwise	PB190: Marital status	+
Education ^c	Categorical	0 – pre-primary education	PE040: Highest ISCED level attained	ref.
		1 – primary education		+
		2 – lower secondary education		+
		3 – upper secondary education		+
		4 – post secondary, non-tertiary education		+
		5 – tertiary education		+
Income	Continuous	Income quintiles (1 to 5)	HY020: Total disposable household income	+

Notes: This table presents an overview for our dependent (i.e. ‘Homeownership’) and household-level control variables. EU-SILC = European Union Statistics on Income and Living Conditions; ISCED = International Standard Classification of Education; ref. = reference variable. ^aWe refer to the EU-SILC code and name of the original variable (see also Table A1), which is used for constructing the variable that is included in our regressions. Source: Eurostat – EU-SILC. ^bExpected sign with relation to the dependent variable ‘Homeownership’. ^cThe variable is related towards ‘Person 1 responsible for the accommodation’ (EU-SILC variable: HB080). ^dFrom 2010/2011 onwards, the variable HH020 has been replaced by HH021.

Tenure status ('Homeownership') is treated as the dependent variable of our analyses with the aim to identify the relation between an MID and homeownership. As can be seen in Table 3 (which presents our dependent and control variables), this variable was sourced from the above-described EU-SILC dataset, so we dichotomized Homeownership into ownership and non-ownership. We do not distinguish further because the answer categories of Tenure Status differ over the EU-SILC waves (Table A1). A country that allows an MID, for which information was derived from – among others – the OECD and EU reports (European Commission, 2014), is modelled via a dummy variable (1 if an MID is granted in the country where the household lives, 0 otherwise). We utilized a reasonable number of control variables, which vary at the household-level, to operationalize our hypotheses. For these household-level variables, we also draw on the EU-SILC data. Our set of control variables, as well as their expected influence (i.e., positive or negative) on homeownership attainment, (mainly) follow previous studies in the field (Bazyl, 2009; Xhignesse et al., 2014)

After cleaning the initial sample (removing both duplicates (which can be explained by pooling multiple waves of survey data; see above) and households with missing values), our final (and total) sample comprises 1,468,017 households to test Hypothesis 1. To detect the potential differential effect across income and marital status groups, we make use of split samples¹⁰: the total sample is split into smaller sub-samples to test Hypotheses 2a and 2b. One advantage of doing so is that one can immediately see whether the control variables have different effects depending on marital status and income. In the two following paragraphs, some added information about (the construction of) the income and marital status samples is given. To test Hypothesis 2a, the total sample of households is split into five smaller samples. How are these five samples constructed? Given the heterogeneity of the countries and their household income levels, we start with defining income groups at the country-level: for each EU-SILC wave, the sample of households of each country is divided into five income group samples (with 1 being the lowest, and 5 being the highest income group) based on the indicated total disposable income of a household (EU-SILC variable: HY020)¹¹. Then all of the associated samples (i.e., each income group) are combined into five new samples. As such, 293,607 (for Income Groups 1, 2, 3 and 4) to 293,589 (Income Group 5) households are included for each income group (to test Hypothesis 2a).

¹⁰ As an alternative, regressions with an interaction effect between the dummy variable 'Tax Benefit' (see methodology section) and continuous variable 'Income' (methodology section) or dummy variable 'Marital' (methodology section) can be used to test Hypothesis 2a or 2b, respectively. The findings are described in Footnotes (20) and (21) under the results. Note that we do include the main effects in these regressions.

¹¹ All of the EU-SILC income data refer to the income reference period, which is a fixed 12-month period and usually the previous calendar year (Mack and Lange, 2015). However, in the UK, the income reference period is the year of the survey, and in Ireland, the income reference period is the previous 12 months.

To test Hypothesis 2b, the total sample of households is split into two smaller samples: a married sample and an unmarried sample. The former includes all of the household heads who are married (EU-SILC variable: PB190 = married)¹²; the unmarried sample includes all of the household heads who are not married (EU-SILC variable: PB190 = never married, separated, widowed, or divorced). Finally, the sample of married couples covers 833,229 households, whereas the sample of unmarried persons 634,788 (to test Hypothesis 2b).

Some of the descriptive statistics for each sample are given in Table 4.

Table 4 Sample Descriptive Statistics

Sample	Total o. of observations	No. of MID observations	MID Percentage (%)	Homeownership rate (%)
Total	1,468,017	1,008,902	68.73%	75.51%
Income				
1	293,607	201,784	68.73%	59.19%
2	293,607	201,784	68.73%	68.72%
3	293,607	201,784	68.73%	76.48%
4	293,607	201,784	68.73%	83.29%
5	293,589	201,768	68.72%	89.86%
Marital Status				
Married	833,229	583,257	70.00%	84.27%
Not Married	634,788	425,645	67.05%	64.01%

Notes: This table presents a number of descriptive statistics for all of our samples; i.e., one total sample, five income samples and two marital status samples. For each sample, the total number of observations, number of MID observations, percentage of MID observations (i.e., total number of observations divided by number of MID observations), and homeownership rate are presented.

4. Methodology

Multilevel mixed-effects logistic¹³ regressions (estimated in Stata 16.0 by using the ‘meqrlogit’ command that uses QR decomposition of the variance components matrix to improve convergence) are designed to predict the likelihood of being homeowner as a function of a set of household-level

¹² Answer categories of EU-SILC variable ‘Marital Status’ (PB190) do not allow us to analyze single versus double households (Table A1 in the Appendix) – which would have

¹³ As our dependent variable ‘Homeownership’ is binary (1 if owner (i.e., outright owner or owner paying mortgage), 0 otherwise), a logistic model is appropriate.

variables and a country-level variable¹⁴. In this type of regression, the hierarchical structure of our data is taken into account. Our models have two levels: household characteristics (Level 1) are nested within countries (Level 2) by year. After all, a priori, we expect the observations within a country to be correlated. Moreover, our expectation is justified in STATA 16.0 by using the ‘estat ICC’ post-estimation command: all of our regressions have a residual intraclass correlation coefficient larger than zero, which indicates the existence of clustering effects. Failing to recognize these existing hierarchical structures in our data causes underestimation of the standard errors of the regression coefficients, and ultimately leads to an overstatement of statistical significance (Hsueh, 2017). In addition to recognizing the existence of multiple levels of predictor variables and accounting for the dependence of observations within the same country, multilevel models allow both fixed effects (FEs) and random coefficients to be estimated at the same time – which is another advantage over single-level models (Bu and Cuervo-Cazurra, 2020). Finally, we also use the likelihood ratio (LR) test to determine if the multilevel mixed-effects logistic regressions are a better fit than an ordinary logistic regression. All regressions have a significant LR test versus logistic model ($p < 0.01$), which supports the use of multilevel models.

Since we test three hypotheses (Hypotheses 1, 2a and 2b; see literature section), there are multiple regressions. All of the regressions are originally based on the same sample of 1,468,017 households from twelve countries over the period of 2003–2018, but this total sample is – depending on the hypothesis to be tested – divided into a number of smaller samples (see data section). For Hypothesis 1, one regression is performed; i.e., one on the total sample of households; for Hypothesis 2a, five regressions are performed; i.e., one for each income group sample; and for Hypothesis 2b, two regressions are performed; i.e., one for each marital status group sample. All of the analyses provide the empirical basis to determine: (1) whether an MID generally has a significantly positive effect on homeownership attainment (Hypothesis 1) and (2) whether there are differences in the effect of an MID on homeownership across household groups (Hypotheses 2a and 2b).

Our models include a random intercept, and can be expressed as two separate equations (Brady and Burroway, 2012). First, the log odds for being a homeowner ($\log(p_{ijt} / 1 - p_{ijt})$) for the i^{th} household in the j^{th} country in year t is a function of country intercepts (β_{0jt}), a set of fixed household-level characteristics ($\beta \mathbf{X}_{ijt}$), and year fixed-effects (δ_t) (to control for aggregate trends):

$$\log(p_{ijt} / 1 - p_{ijt}) = \beta_{0jt} + \beta \mathbf{X}_{ijt} + \delta_t \quad (1)$$

¹⁴ Several papers exist where both household-level (or individual-level) and country-level variables are combined in a multilevel mixed-effects logistic regression model (Holzner and Jestl, 2015; Filandri and Bertolini, 2016). However, to the best of our knowledge, this is the first mortgage interest relief study to do so.

Second, each country intercept (β_{0jt}) is estimated as a function of an intercept (γ_{00}), a country-level variable (γC_{jt}), and an error term (u_{0jt}):

$$\beta_{0jt} = \gamma_{00} + \gamma C_{jt} + u_{0jt} \quad (2)$$

The algebraic substitution of Equation (2) into Equation (1), together with implementing our set of predetermined independent variables¹⁵, gives:

$$\begin{aligned} \log(p_{ijt} / 1 - p_{ijt}) = & \gamma_{00} + \gamma_1 \text{Tax Benefit}_{jt} + \beta_1 \text{Size}_{ijt} \\ & + \beta_2 \text{Urbanization}_{ijt} + \beta_3 \text{Activity}_{ijt} \\ & + \beta_4 \text{Age}_{ijt} + \beta_5 \text{Marital}_{ijt} \\ & + \beta_6 \text{Education}_{ijt} + \beta_7 \text{Income}_{ijt} + \delta_t \\ & + u_{0jt} \end{aligned} \quad (3)$$

As Equation (3) shows, the following independent variables¹⁶ at the country-level and household-level are considered to analyze whether a household is stimulated to homeownership (see also Table 3 for an overview of the household-level control variables, and Table A1 in the Appendix for the original EU-SILC variables, used to construct these variables included in our dataset):

Country-level variable

- Tax Benefit: a dummy variable that takes the value ‘1’ when an MID is granted in the country where the household lives, and ‘0’ otherwise.

Household-level variables

- Size: the number of household members (at time of the interview).

¹⁵ To check for multicollinearity among our predictor variables, a variance inflation factor (VIF) is used. Variables with VIFs > 10 are considered to be indicative of multicollinearity. However, in the variables included in the model, there is no evidence of multicollinearity found: all of the variables pass the test with VIF values < 2 .

¹⁶ We would like to also consider supply-side effects/variables. Unfortunately, most of these variables (such as elasticity of the housing supply or housing stock) are not available to us for all of the investigated countries and/or over the entire observed period. However, one other factor which might be controlled for is country legal system (see for e.g., Fisher and Jaffe (2002)). In our regressions, a categorical variable is introduced for the origin of the legal system of a country as a kind of robustness check. In particular, and inspired by the classification in La Porta et al. (1997), we include a time-invariant variable ‘Legal’ that equals 1 if the system is of Scandinavian (or Nordic) origin (i.e., Denmark, Finland, Norway and Sweden), 2 if the system is of English (or Anglo-Saxon) origin (i.e., Ireland and UK) and 3 if the system is of French origin (i.e. Belgium, France, Greece, Italy, Portugal and Spain). In our analyses, Scandinavian-based countries are the base case. However, for coefficients on the categorical variable (i.e., often in multiple regressions) that are not significant and do not change the results for MID, we leave ‘Legal’ out of Eq. (3).

- Urbanization: a categorical variable that takes the value ‘1’ when the household lives in a densely populated area; ‘2’ in an intermediate populated area; and ‘3’ in a thinly populated area.
- Activity: a dummy variable that takes the value ‘1’ when the main activity status of the household head¹⁷ during the income reference period is at work and ‘0’ otherwise.
- Age: the age of the household head (at the time of the interview).
- Marital: a dummy variable that takes the value ‘1’ when the household head is married and ‘0’ otherwise. This variable is – logically – omitted from the regressions performed on the married and unmarried samples (to test Hypothesis 2b), because of collinearity.
- Education: a categorical variable that takes the value ‘0’ when pre-primary education is the highest level of an educational program that the household head has successfully completed; ‘1’ when it is primary education; ‘2’ when it is lower secondary education; ‘3’ when it is upper secondary education; ‘4’ when it is post-secondary, non-tertiary education; and ‘5’ when it is the first or second stage of tertiary education.
- Income: income quintiles. Values range from 1 to 5 (see data section). This variable is – logically – omitted from the regressions performed on the income quintile samples (to test Hypothesis 2a), because of collinearity.

Country is treated as a random effect. γ_1 is of particular interest to test our hypotheses as it indicates whether an MID has had a significant influence on homeownership attainment. However, we also check whether our control variables have the expected signs, as indicated in Table 3. Since there are plenty of degrees of freedom in the regressions, we prefer to include ‘Urbanization’ and ‘Education’ in the regressions as categorical instead of continuous variables – as brought up above. This will more accurately capture the relationship between the variables and homeownership, which will improve the accuracy of the estimate effects for our variable of interest (‘Tax Benefit’). In the next section, we report our findings¹⁸.

¹⁷ We consider ‘Person 1 responsible for the accommodation’ (EU-SILC variable: HB080) as the household head, as in Papadopoulos and Tsakloglou (2016). This person is defined in the EU-SILC guidelines as follows: “The person responsible for the accommodation is the person owning or renting the accommodation. If the accommodation is provided free, the person to whom the accommodation is provided is the responsible person”. Also, “... If the person owning the accommodation is a child or if the person owning or renting the accommodation does not belong to the household, then the person who is ‘financially responsible’ for the accommodation will be taken to be the person who is responsible for the purpose of the survey.” For Sweden, however, ‘Person 1 responsible for the accommodation’ is not available since wave 2012. As such, from 2012 onwards, we use the ‘Person responding to the household questionnaire’ (EU-SILC variable: HB070) as head of household for Sweden, which is – by priority – also the person responsible for the accommodation.

¹⁸ As a robustness check, additional regression analyses are performed after winsorizing our continuous variables at the 1 and 99 percentile levels to minimize the influence of outliers. Nevertheless, winsorizing at the 1% level does not change our results –

5. Results

In this section, we turn to the results of our analyses to evaluate our hypotheses. The results are presented in terms of adjusted¹⁹ odds ratios (ORs) and their 95% confidence intervals (CIs), which are shown in Tables 5 (for Hypothesis 1), 6 (for Hypothesis 2a) and 7 (for Hypothesis 2b). A positive relationship is indicated if the coefficient >1 ; otherwise a negative relationship if the coefficient <1 . We will discuss our main findings in the following paragraphs, with a strong emphasis on the effect of MID. Given the purpose of this study, we will not compare the results for the control variables between income or marital status groups.

5.1 Main Variable

Table 5 shows the results on the total sample of households. We see that the option to benefit from an MID (the main variable in our study) is associated with lower odds of households being a homeowner. When an MID is granted in the country where they reside, households are generally 6% (OR = 0.94, $p < 0.01$) less likely to be a homeowner. In line with conclusions drawn in numerous (single-country) U.S. studies (Glaeser and Shapiro, 2002; Hanson, 2012), additional – but European – evidence is provided that an MID is an ineffective instrument for encouraging homeownership. Hypothesis 1 (based on earlier (U.S.) studies in the field) is thus not rejected. As for the significantly negative relation, we refer to Andrews and Caldera Sánchez (2011), among others, who suggest in their study that the effect of a mortgage interest subsidy on homeownership might be negative if the subsidy is factored into (real) housing prices. After all, such price capitalization effects may crowd-out some down-payment-constrained households from homeownership at the margin. Given European evidence of the price increasing effect of an MID (Vangeel et al., 2022), we speculate that this side-effect of increasing housing prices has more than offset the income effect of the relief in Europe over the observed period. We further test the link between price effect and ownership in the additional analysis section.

5.2 Control Variables

A multilevel logistic regression of the FE shows that all of the variables are significantly related to Homeownership (except for second category of ‘Education’ – lower secondary education; see Table 5); and that almost all of

described in the next section – meaningfully (and therefore these robustness results are omitted for brevity).

¹⁹ They are adjusted for the effects of the other variables in the model.

Table 5 Multilevel Mixed-effects Logistic Regression OR (95% CI) - Total Sample

	Total Homeownership
Tax Benefit (ref.: No MID)	
MID	0.94*** (0.93- 0.96)
Size	0.99*** (0.99 – 0.996)
Urbanization (ref.: Densely populated)	
Intermediate	1.54*** (1.53 – 1.56)
Thinly populated	2.14*** (2.12 – 2.17)
Activity (ref.: Other ^a)	
At work	1.28*** (1.27– 1.29)
Age	1.05*** (1.05 – 1.05)
Marital (ref.: Other ^b)	
Married	1.76*** (1.75 – 1.78)
Education (ref.: Pre-primary)	
Primary	1.14*** (1.10 – 1.17)
Lower secondary	1 (0.97 – 1.03)
(Upper) secondary	1.38*** (1.34 – 1.42)
Post-secondary non-tertiary	1.58*** (1.51 – 1.65)
Tertiary	1.68*** (1.63 – 1.74)
Income	1.56*** (1.55 – 1.56)
Identity: Country	
Variance (constant)	0.16
Year fixed effects	Yes
No. of observations	1,468,017
No. of groups	12

Notes: This table presents the multilevel mixed-effects regression results for the total sample of households (see data section). 95% CI for estimates in brackets. *** denotes $p < 0.01$, ** denotes $p < 0.05$, * and denotes $p < 0.1$. ‘Tax Benefit’ is a dummy variable that represents whether an MID is permitted. As such, it takes the value ‘1’ when an MID is granted, and ‘0’ otherwise. For a description of the other variables, see Table 2 and the methodology section. CI = confidence interval; OR = odds ratio; and ref. = reference category.^aOther means: basic activity status = unemployed, in retirement or early retirement, or other inactive person (see Table A1). ^bOther means: marital status = never married, separated, widowed, or divorced (see Table A1).

the control variables²⁰ have the expected signs, as indicated in Table 3. In the following paragraphs, we briefly explain these (expected) signs, based on the literature review.

The number of household members does not contribute much to the decision to purchase a house. After all, the odds ratio of ‘Size’ is 0.99, which is almost one. One explanation for the expected positive effect of ‘Size’ on ‘Homeownership’ could be that more persons in a household increase the financial capacity of the household, and in turn, the probability of purchasing a home (Lauridsen and Skak, 2007). However, we learn from Jayantha and Oladinrin (2020) that larger families are also subjected to financial constraints with increased day-to-day expenses.

‘Activity Status’ has a positive impact on homeownership probability. The odds of homeownership for households with a head whose basic activity status is ‘at work’, are 1.28 times ($p < 0.01$) higher compared to households whose head is ‘inactive’. We speculate that this also has to do with financial capacity.

A densely populated area is associated with less likelihood of homeownership, compared with other areas (intermediate or thinly populated areas). Our result is consistent with that of Xhignesse et al. (2014) who find that urban areas have a lower rate of owners than suburban or rural areas. They explain this by using

²⁰ We also control for the possible influences of: (1) type of housing, (2) yearly housing prices, (3) yearly country unemployment rates, and (4) gross domestic product (GDP) (growth). For type of housing, the EU-SILC variable ‘Dwelling type’ (HH010), with answer categories that range from 1 (detached house) to 5 (some other kind of accommodation), is used. We code this information into a dummy variable that takes the value ‘1’ when it is a detached, semi-detached or terraced house, and ‘0’ otherwise (i.e., when it is an apartment or flat, or some other kind of accommodation). In all of the regressions, a strong, positive and significant relation is found between housing type and homeownership. For instance, our results on the total sample of households indicate that the odds of households being a homeowner are about four times as high when they live in (ordinary) houses (OR = 3.97, $p < 0.01$) versus when they live in other types of housing. However, we do not include this housing type dummy into our (main) analyses, since it is reasonable to expect that type of housing is endogenous to the decision of being a homeowner (i.e., not an independent control). After all, the negative association between being in a non-single-family detached and homeownership is not surprising given most multifamily or non-detached single-family households are renters. We believe that it is unlikely that they are renters “because” of being in this type of housing. For yearly housing prices, we use nominal house price indices (2015 = base year), obtained from the OECD database. A measure for country unemployment rates is also obtained from OECD data. However, since the influence of both previously mentioned variables is not found to be significant in several regressions, we do not include them as control variables in our regressions. Finally, for GDP growth, an index (2015 = base year) is developed based on World Bank Data. Since its odds ratio is very close to one in each executed regression, and the results for our variable(s) (of interest) are not altered, we also do not include this variable in our regressions.

the urban economic theory that develops an existing trade-off between commuting costs (and time) and expenditures in housing.

When the age of the head advances, the probability of owning increases (OR = 1.05, $p < 0.01$). Previous research provides a number of reasons for this (Hendershott, 1988; Hood, 1999; Xhignesse et al., 2014; Figueira, 2018). Young households are more mobile: they are more often single and more likely to change their job. Furthermore, young households have less certainty of income, and are less wealthy.

As in Bazyl (2009), among others, marriage is a significant incentive to buy a house. In fact, the variable ‘Marriage’ has among the largest effects on homeownership probability in our study: households who are married have 1.76 times ($p < 0.01$) greater likelihood of being a homeowner than those who are not married. There are three potential reasons as follows (Hood, 1999; Huang and Clark, 2002; Lauridsen and Skak, 2007; and Figueira, 2018). First, married couples are often more willing to “settle down” than single individuals (who are less mobile). Second, married couples may have increased financial capacity. Third, married couples often have the desire for children and, as such, aim to provide a stable environment while raising them.

Overall, the probability of owning a house increases with educational achievement of the household head. Chua and Miller (2009) and Constant et al. (2009) establish that a household with a higher level of education is associated with a good job, which is likely to generate a higher income in the future. Hood (1999) states that a person with more education has more knowledge about the factors that are needed to buy and maintain a dwelling. In addition, a person with a higher level of education knows more about future living expenses, and as such often saves more. Finally, the creation of capital will increase the likelihood of having a loan approved.

Higher household income increases the probability of owning (OR = 1.56, $p < 0.01$), notably (and plausibly) as it would determine the budget constraint of the household (Xhignesse et al., 2014).

5.3 Groups of Households

Table 6 is used to compare the regression results between income groups. From this table, we learn first and foremost that there is (substantial) variation in the influence of an MID on ownership probability across these groups. Furthermore, we observe that households in higher income groups generally have higher odds of being a homeowner compared to households in the lower income groups²¹. The results are further specified below.

²¹ The results from the robustness model with the interaction effect between ‘Tax Benefit’ and ‘Income’ (Footnote 9): (1) confirm the significantly negative effect of an MID on

Households in the two lowest income groups (Income Groups 1 and 2) are considerably less stimulated to purchase a home when an MID is in effect. When a country allows an MID, the probability of a household being a homeowner decreases by (about) 10% (Income Group 1: OR = 0.91, $p < 0.01$; Income Group 2: OR = 0.90, $p < 0.01$). For households in the third (Income Group 3) and fourth (Income Group 4) income groups, we observe a less (or a non-)significant negative influence of an MID on the probability of homeownership. The likelihood that households in the middle income group (Income Group 3) become owner-occupier decreases by ‘only’ 4% ($p < 0.05$) when an MID is granted. Households in the second highest income group (Income Group 4) – unlike households in the three lower income groups – are not significantly affected (OR = 0.97; $p > 0.1$) by an MID in their decision to become a homeowner. In contrast, an MID does create incentives to become a homeowner for households in the highest income group (Income Group 5): when a country permits an MID, the probability of a household being an owner increases by a factor of 1.07 ($p < 0.01$).

We summarize that mortgage interest relief solely benefits the highest income earners. Meanwhile, for low and middle income households, our findings suggest that an MID makes homeownership financially unfeasible instead of promoting it. Therefore, Hypothesis 2a is supported.

Table 7, finally, presents the results for regressions on the marital status group samples. Above all, we note that an MID does not motivate households in either group to acquire a dwelling. On the contrary, negative relations are found between the relief and homeownership probability. The table further shows that an MID discourages unmarried households/individuals to purchase a home slightly more than married households²². More specifically, the odds for being homeowner when an MID is granted are 0.97 ($p < 0.01$) for married households and 0.93 ($p < 0.01$) for unmarried ones. As the difference between the groups is rather minimal, and a negative sign is found for both groups, Hypothesis 2b is rejected.

homeownership attainment, and (2) reveal a significantly positive interaction effect, thus indicating that MID boosts ownership more for high income groups.

²² The results from the robustness model with the interaction effect between ‘Tax Benefit’ and ‘Marital’ (Footnote 9) confirm: (1) the significantly negative effect of an MID on homeownership attainment (OR = 0.95, $p < 0.01$), and (2) that the difference between the two groups is rather limited. However, the odds of homeownership via an MID are – surprisingly – slightly lower when households are married (OR = 0.93, $p < 0.01$). That is why we also perform this regression with the interaction effect (‘Tax Benefit’*‘Marital’) on the newly-built sample (with 711,660 observations) that is described in the robustness check section. The result is given in Footnote 24 under robustness check.

Table 6 Multilevel Mixed-effects Logistic Regression OR (95% CI) - Income Samples

Income group	1 (lowest) Homeownership	2 Homeownership	3 Homeownership	4 Homeownership	5 (highest) Homeownership
Tax Benefit (ref.: No MID)					
MID	0.91*** (0.88 – 0.94)	0.90*** (0.87 – 0.93)	0.96** (0.93 – 0.998)	0.97 (0.93 – 1.01)	1.07*** (1.02 – 1.12)
Size	1.06*** (1.05 – 1.07)	0.92*** (0.91 – 0.93)	0.91*** (0.90 – 0.92)	0.95*** (0.94 – 0.96)	1.05*** (1.04 – 1.06)
Urbanization (ref.: Densely populated)					
Intermediate	1.47*** (1.44 – 1.50)	1.53*** (1.50 – 1.57)	1.56*** (1.52 – 1.59)	1.62*** (1.58 – 1.66)	1.52*** (1.48 – 1.57)
Thinly populated	2.06*** (2.02 – 2.10)	2.15*** (2.11 – 2.20)	2.24*** (2.19 – 2.29)	2.22*** (2.16 – 2.28)	1.77*** (1.71 – 1.83)
Activity (ref.: Other ^a)					
At work	1.38*** (1.35 – 1.41)	1.23*** (1.20 – 1.35)	1.21*** (1.18 – 1.24)	1.10*** (1.07 – 1.13)	1.01 (0.97 – 1.04)
Age	1.06*** (1.05 – 1.06)	1.05*** (1.05 – 1.05)	1.05*** (1.05 – 1.05)	1.04*** (1.04 – 1.04)	1.04*** (1.04 – 1.04)
Marital (ref.: Other ^b)					
Married	1.71*** (1.67 – 1.76)	1.79*** (1.76 – 1.83)	1.85*** (1.81 – 1.89)	1.84*** (1.80 – 1.89)	1.90*** (1.84 – 1.95)

(Continued...)

(Table 6 Continued)

Income group	1 (lowest) Homeownership	2 Homeownership	3 Homeownership	4 Homeownership	5 (highest) Homeownership
Education (ref.: Pre-primary)					
Primary	1.28*** (1.22 – 1.33)	1.27*** (1.20 – 1.35)	1.42*** (1.32 – 1.54)	1.24*** (1.11 – 1.38)	1.35*** (1.15 – 1.59)
Lower secondary	1.19*** (1.14 – 1.25)	1.27*** (1.20 – 1.35)	1.40*** (1.29 – 1.51)	1.30*** (1.17 – 1.45)	1.44*** (1.23 – 1.69)
(Upper) secondary	1.57*** (1.49 – 1.64)	1.71*** (1.62 – 1.82)	1.92*** (1.78 – 2.08)	1.84*** (1.65 – 2.05)	1.95*** (1.67 – 2.28)
Post-secondary non-tertiary	2.05*** (1.87 – 2.24)	1.89*** (1.73 – 2.06)	2.17*** (1.96 – 2.40)	1.87*** (1.64 – 2.12)	2.20*** (1.84 – 2.63)
Tertiary	2.17*** (2.06 – 2.28)	2.11*** (1.98 – 2.24)	2.10*** (1.94 – 2.28)	1.96*** (1.75 – 2.18)	2.10*** (1.80 – 2.46)
Identity: Country					
Variance (constant)	0.28	0.27	0.27	0.35	0.35
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	293,607	293,607	293,607	293,607	293,589
No. of groups	12	12	12	12	12

Notes: This table presents the multilevel mixed-effects regression results for the income samples (see data section). 95% CI for estimates in brackets. *** denotes $p < 0.01$, ** denotes $p < 0.05$, * and denotes $p < 0.1$. ‘Tax Benefit’ is a dummy variable that represents whether an MID is permitted. As such, it takes the value ‘1’ when an MID is granted, and ‘0’ otherwise. For a description of the other variables, see Table 2 and the methodology section. CI = confidence interval; OR = odds ratio; and ref. = reference category. ^aOther means: basic activity status = unemployed, in retirement or early retirement, or other inactive person (see Table A1). ^bOther means: marital status = never married, separated, widowed, or divorced (see Table A1).

Table 7 Multilevel Mixed-effects Logistic Regression OR (95% CI) - Marital Status Samples

Marital Status	Married Homeownership	Not Married Homeownership
Tax Benefit (ref.: No MID)		
MID	0.97*** (0.94 – 0.99)	0.93*** (0.91 – 0.96)
Size	0.98*** (0.98 – 0.99)	1.02*** (1.01 – 1.02)
Urbanization (ref.: Densely populated)		
Intermediate	1.62*** (1.60 – 1.65)	1.47*** (1.45 – 1.49)
Thinly populated	2.22*** (2.19 – 2.26)	2.06*** (2.03 – 2.09)
Activity (ref.: Other ^a)		
At work	1.20*** (1.18 – 1.22)	1.35*** (1.33 – 1.37)
Age	1.05*** (1.05 – 1.05)	1.05*** (1.05 – 1.05)
Education (ref.: Pre-primary)		
Primary	1.43*** (1.36 – 1.50)	1.10*** (1.06 – 1.14)
Lower secondary	1.31*** (1.24 – 1.37)	0.96** (0.92 – 0.996)
(Upper) secondary	1.75*** (1.67 – 1.84)	1.31*** (1.26 – 1.36)
Post-secondary non-tertiary	1.88*** (1.76 – 2.02)	1.56*** (1.47 – 1.65)
Tertiary	2.04*** (1.94 – 2.14)	1.65*** (1.58 – 1.72)
Income	1.53*** (1.52 – 1.54)	1.56*** (1.55 – 1.56)
Identity: Country		
Variance (constant)	0.18	0.19
Year fixed effects	Yes	Yes
No. of observations	833,229	634,788
No. of groups	12	12

Notes: This table presents the multilevel mixed-effects regression results for the marital status group samples (see data section). 95% CI for estimates in brackets. *** denotes $p < 0.01$, ** denotes $p < 0.05$, * and denotes $p < 0.1$. 'Tax Benefit' is a dummy variable that represents whether an MID is permitted. As such, it takes the value '1' when an MID is granted, and '0' otherwise. For a description of the other variables, see Table 2 and the methodology section. CI = confidence interval; OR = odds ratio; and ref. = reference category. ^aOther means: basic activity status = unemployed, in retirement or early retirement, or other inactive person (see Table A1).

6. Additional Analysis

We test again the link between price effect and homeownership given the significance (and consistency; see further in this paper) of our main result (the influence of an MID on ownership). Inspired by Vangeel et al. (2022), we additionally control for the effect of an MID on homeownership across distinct tax systems; i.e., dual income tax (DIT) which combines a low flat tax rate on all capital income with a high progressive tax rate on labor income (Sørensen, 1994; Cnossen, 1999; Vangeel et al., 2022), versus other tax systems. After all, Vangeel et al. (2022) empirically show that an MID has been generally capitalized into European housing prices over the period of 1990-2015, but this has not been the case in countries where a DIT is applied; i.e., Finland, Norway and Sweden. Based on this study, in countries that apply a DIT, we do not expect a negative impact of MID on homeownership attainment, but the opposite. Thus, on the total sample of households, we estimate a variation of our empirical model (Eq. (3)), as described next.

As in the study of Vangeel et al. (2022), an interaction term between our main variable of interest ‘Tax Benefit’ and a dummy variable ‘DIT’ (1 if a country applies a DIT in that specific year, 0 otherwise) is added to our ‘original’ model (Eq. (3)). By doing so, we allow an MID to have a dissimilar impact on homeownership probability between different tax systems. The main effect of ‘DIT’ is however not included in the regression since it is perfectly collinear with the interaction term. Our ‘new’ model (Eq. (4)) thus looks as follows:

$$\begin{aligned}
 \log(p_{ijt} / 1 - p_{ijt}) = & \gamma_{00} + \gamma_1 \text{Tax Benefit}_{jt} \\
 & + \gamma_2 \text{Tax Benefit}_{jt} * \text{DIT}_{it} + \beta_1 \text{Size}_{ijt} \\
 & + \beta_2 \text{Urbanization}_{ijt} + \beta_3 \text{Activity}_{ijt} \quad (4) \\
 & + \beta_4 \text{Age}_{ijt} + \beta_5 \text{Marital}_{ijt} \\
 & + \beta_6 \text{Education}_{ijt} + \beta_7 \text{Income}_{ijt} + \delta_t + u_{0jt}
 \end{aligned}$$

The results for Eq. (4) are shown in Table 8. Inspection of the table reveals that in countries where no DIT is applied, an MID has a significantly decreasing effect on homeownership probability (OR = 0.94; $p < 0.01$), whereas in countries where a DIT is applied, an MID has an increasing but insignificant effect on homeownership probability (OR = 1.33; $p > 0.1$). The latter coefficient and significance are accomplished by using the Stata command ‘lincom’. As such, these observations confirm that it is precisely the price effect that results in a negative impact of an MID on achieving ownership. We also notice that the effects of our control variables on homeownership – which are discussed in the results section – remain the same after inclusion of the interaction term.

Table 8 Multilevel Mixed-effects Logistic Regression OR (95% CI) - Tax Systems

	Total Homeownership
Tax Benefit (ref.: No MID)	
MID	0.94*** (0.93 – 0.96)
Tax Benefit * DIT	1.41 (0.87 – 2.28)
Size	0.99*** (0.99 – 0.996)
Urbanization (ref.: Densely populated)	
Intermediate	1.54*** (1.53 – 1.56)
Thinly populated	2.14*** (2.12 – 2.17)
Activity (ref.: Other ^a)	
At work	1.28*** (1.27 – 1.29)
Age	1.05*** (1.05 – 1.05)
Marital (ref.: Other ^b)	
Married	1.76*** (1.75 – 1.78)
Education (ref.: Pre-primary)	
Primary	1.14*** (1.10 – 1.17)
Lower secondary	1 (0.97 – 1.03)
(Upper) secondary	1.38*** (1.34 – 1.42)
Post-secondary non-tertiary	1.58*** (1.51 – 1.65)
Tertiary	1.68*** (1.63 – 1.74)
Income	1.56*** (1.55 – 1.56)
Identity: Country	
Variance (constant)	0.15
Year fixed effects	Yes
No. of observations	1,468,017
No. of groups	12

Notes: This table presents the multilevel mixed-effects regression results for the total sample of households (see data section), after inclusion of the interaction term ‘Tax Benefit * DIT’ (see results section). 95% CI for estimates in brackets. ***

denotes $p < 0.01$, ** denotes $p < 0.05$, * and denotes $p < 0.1$. ‘Tax Benefit’ is a dummy variable that represents whether an MID is permitted. As such, it takes the value ‘1’ when an MID is granted, and ‘0’ otherwise. ‘DIT’ is a dummy that takes the value ‘1’ if a country applies a DIT, and ‘0’ otherwise. For a description of the other variables, see Table 2 and the methodology section. CI = confidence interval; OR = odds ratio; and ref. = reference category. ^aOther means: basic activity status = unemployed, in retirement or early retirement, or other inactive person (see Table A1). ^bOther means: marital status = never married, separated, widowed, or divorced (see Table A1).

7. Robustness Check

In order to determine the robustness of our results, we conduct additional multilevel mixed-effects logistic regressions. We replicate our regressions (the methodology section) on newly-built samples that have the same number of observations²³ for each country so that the greater influence of the dominant countries²⁴ is reduced. For these new samples, the households are selected from the original samples via random sampling (without replacement) for each country. Each household from a particular country has as such equal chance of being selected. The new number of observations drops to 711,660 in total (Table 9); 142,332 per income group (Table 10); and 374,088 for married households and 337,572 for the unmarried ones (Table 11). We start with checking the result for Hypothesis 1 which is not rejected in the previous section.

As can be seen from Table 9, the results on the sample of total households remain basically unchanged. The table reinforces the results of Table 5: granting an MID generally decreases the likelihood of a household being a homeowner (OR = 0.93, $p < 0.01$). In the last paragraph of this section, we check the results for both Hypotheses 2a and 2b.

²³ This number equals the number of observations of the country that has the fewest; i.e., Belgium (Table 2).

²⁴ That is, countries that have a large number of observations in our samples (such as Italy and Spain; see Table 2).

Table 9 Robustness Check OR (95% CI) - Total Sample

	Total Homeownership
Tax Benefit (ref.: No MID)	
MID	0.93*** (0.90 – 0.95)
Size	0.999 (0.993 – 1.01)
Urbanization (ref.: Densely populated)	
Intermediate	1.60*** (1.58 – 1.63)
Thinly populated	2.28*** (2.24 – 2.31)
Activity (ref.: Other ^a)	
At work	1.40*** (1.38 – 1.42)
Age	1.05*** (1.05 – 1.05)
Marital (ref.: Other ^b)	
Married	1.84*** (1.81 – 1.86)
Education (ref.: Pre-primary)	
Primary	1.03 (0.99 – 1.08)
Lower secondary	0.95** (0.91 – 0.999)
(Upper) secondary	1.28*** (1.22 – 1.34)
Post-secondary non-tertiary	1.43*** (1.34 – 1.53)
Tertiary	1.54*** (1.47 – 1.62)
Income	1.59*** (1.58 – 1.60)
Identity: Country	
Variance (constant)	0.16
Year fixed effects	Yes
No. of observations	711,660
No. of groups	12

Notes: This table presents the multilevel mixed-effects robustness results for the new total sample of households (see robustness check section). 95% CI for estimates in brackets. *** denotes $p < 0.01$, ** denotes $p < 0.05$, * and denotes $p < 0.1$. ‘Tax Benefit’ is a dummy variable that represents whether an MID is permitted. As such, it takes the value ‘1’ when an MID is granted, and ‘0’ otherwise. For a

description of the other variables, see Table 2 and the methodology section. CI = confidence interval; OR = odds ratio; and ref. = reference group.^aOther means: basic activity status = unemployed, in retirement or early retirement, or other inactive person (see Table A1).^bOther means: marital status = never married, separated, widowed, or divorced (see Table A1).

Tables 10 and 11 provide additional evidence that there is a significant difference in the effect of an MID on homeownership probability across groups of households. Table 10 confirms our previous findings that the tax incentive has: (1) a significantly positive effect on homeownership probability for households in the highest income group, (2) an insignificant effect on homeownership probability for households in the second highest income group, and (3) a significantly negative effect on homeownership probability for households in the three lowest income groups. Table 11 strengthens our original conclusion that unmarried households/individuals (OR = 0.92 $p < 0.01$) are slightly more discouraged to buy a home through an MID than married couples (OR = 0.94, $p < 0.01$)²⁵.

7.1 Global Financial Crisis

We additionally control whether and the extent that our results in Table 5 are sensitive to the Global Financial Crisis (GFC) period (December 2007 – June 2009)²⁶, both from descriptive and analytical points of view. After all, our study period overlaps this crisis, and precisely because of the GFC, a drop in the percentage of households who own their house can be expected (Duncan and Costantino, 2011; Clark, 2013). As per Table 2, all of the countries that go from having an MID policy in place to not having one do so following the GFC. Figure 1 allows us to see how (and if) an MID policy is reacting (i.e., being abolished (or introduced)) to homeownership rates. This figure shows for each country the homeownership rates over 2004-2018, and whether an MID is in effect during this period of time.

²⁵ Results from the robustness model with the interaction effect between ‘Tax Benefit’ and ‘Marital’ on the newly-built sample (Footnotes 9 and 21): (1) confirm that an MID has a significantly negative effect on homeownership attainment; and – interestingly here – (2) reveal again that married households (OR = 0.97, $p < 0.05$) are less discouraged than unmarried households/individuals (OR = 0.89, $p < 0.01$).

²⁶ This period is based on the ‘US Business Cycle Expansions and Contractions’ reference dates of the National Bureau of Economic Research (NBER (2024); where shading denotes NBER-dated recessions).

Table 10 Robustness Check OR (95% CI) - Income Samples

Income group	1 (lowest)	2	3	4	5 (highest)
	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership
Tax Benefit (ref.: No MID)					
MID	0.85*** (0.81 – 0.89)	0.86*** (0.82 – 0.91)	0.96* (0.93 – 0.998)	1.003 (0.95 – 1.06)	1.09*** (1.02 – 1.17)
Size	1.09*** (1.07 – 1.11)	0.90*** (0.89 – 0.91)	0.91*** (0.90 – 0.92)	0.96*** (0.95 – 0.97)	1.07*** (1.06 – 1.09)
Urbanization (ref.: Densely populated)					
Intermediate	1.50*** (1.46 – 1.55)	1.59*** (1.54 – 1.64)	1.60*** (1.55 – 1.66)	1.69*** (1.64 – 1.76)	1.61*** (1.54 – 1.68)
Thinly populated	2.09*** (2.03 – 2.16)	2.23*** (2.16 – 2.30)	2.42*** (2.34 – 2.51)	2.49*** (2.40 – 2.59)	1.93*** (1.83 – 2.02)
Activity (ref.: Other ^a)					
At work	1.61*** (1.56 – 1.66)	1.37*** (1.32 – 1.41)	1.29*** (1.25 – 1.34)	1.18*** (1.13 – 1.23)	1.04 (0.98 – 1.09)
Age	1.06*** (1.06 – 1.06)	1.05*** (1.05 – 1.05)	1.05*** (1.05 – 1.05)	1.04*** (1.04 – 1.04)	1.04*** (1.03 – 1.04)
Marital (ref.: Other ^b)					
Married	1.80*** (1.73 – 1.87)	1.91*** (1.85 – 1.97)	1.88*** (1.83 – 1.94)	1.88*** (1.82 – 1.94)	1.99*** (1.91 – 2.08)

(Continued...)

(Table 10 Continued)

Income group	1 (lowest)	2	3	4	5 (highest)
	Homeownership	Homeownership	Homeownership	Homeownership	Homeownership
Education (ref.: Pre-primary)					
Primary	1.31*** (1.22 – 1.40)	1.23*** (1.13 – 1.34)	1.52*** (1.35 – 1.71)	1.07 (0.90 – 1.28)	1.08 (0.84 – 1.40)
Lower secondary	1.24*** (1.16 – 1.34)	1.26*** (1.15 – 1.38)	1.52*** (1.35 – 1.72)	1.16* (0.97 – 1.37)	1.26* (0.98 – 1.63)
(Upper) secondary	1.63*** (1.51 – 1.75)	1.68*** (1.54 – 1.84)	2.06*** (1.83 – 2.32)	1.68*** (1.42 – 1.99)	1.68*** (1.31 – 2.16)
Post-secondary non-tertiary	2.11*** (1.87 – 2.39)	1.80*** (1.58 – 2.04)	2.17*** (1.87 – 2.52)	1.87*** (1.53 – 2.28)	1.84*** (1.39 – 2.43)
Tertiary	2.22*** (2.06 – 2.41)	1.99*** (1.81 – 2.19)	2.22*** (1.96 – 2.50)	1.73*** (1.46 – 2.06)	1.80*** (1.40 – 2.31)
Identity: Country					
Variance (constant)	0.28	0.24	0.26	0.35	0.35
Year fixed effects	Yes	Yes	Yes	Yes	Yes
No. of observations	142,332	142,332	142,332	142,332	142,332
No. of groups	12	12	12	12	12

Notes: This table presents the multilevel mixed-effects robustness results for the new income samples (see the robustness check section). 95% CI for estimates in brackets. *** denotes $p < 0.01$, ** denotes $p < 0.05$, * and denotes $p < 0.1$. ‘Tax Benefit’ is a dummy variable that represents whether an MID is permitted. As such, it takes the value ‘1’ when an MID is granted, and ‘0’ otherwise. For a description of the other variables, see Table 2 and the methodology section. CI = confidence interval; OR = odds ratio; and ref. = reference group. ^aOther means: basic activity status = unemployed, in retirement or early retirement, or other inactive person (see Table A1). ^bOther means: marital status = never married, separated, widowed, or divorced (see Table A1).

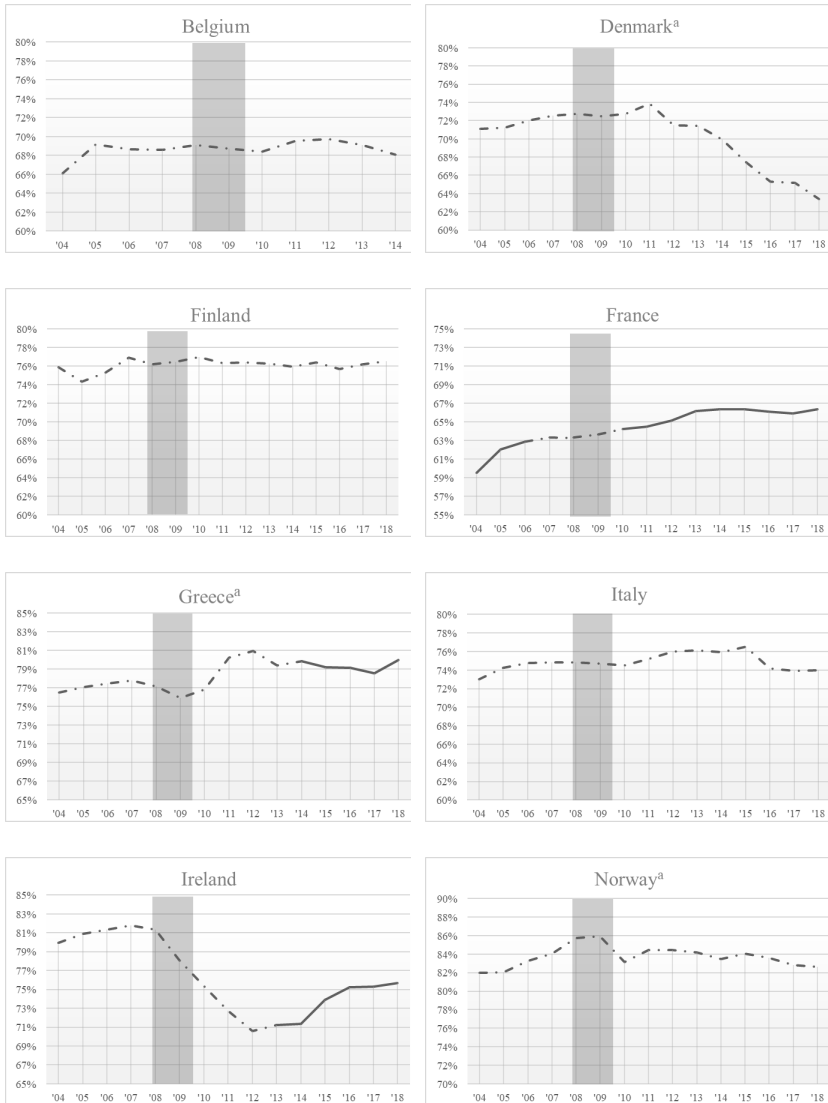
Table 11 Robustness Check OR (95% CI) - Marital Status Samples

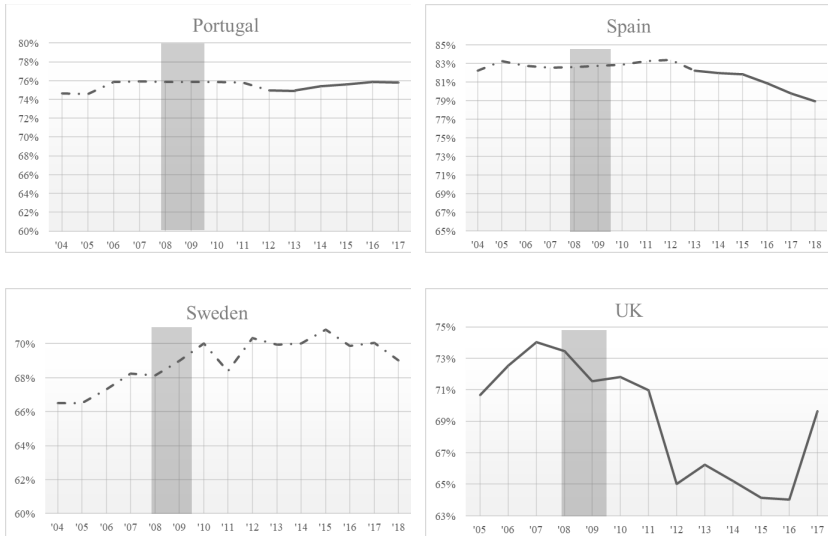
Marital Status	Married Homeownership	Not Married Homeownership
Tax Benefit (ref.: No MID)		
MID	0.94*** (0.91 – 0.98)	0.92*** (0.89 – 0.95)
Size	0.98*** (0.97 – 0.99)	1.02*** (1.01 – 1.03)
Urbanization (ref.: Densely populated)		
Intermediate	1.75*** (1.71 – 1.79)	1.53*** (1.50 – 1.56)
Thinly populated	2.51*** (2.44 – 2.57)	2.15*** (2.11 – 2.19)
Activity (ref.: Other ^a)		
At work	1.35*** (1.32 – 1.39)	1.47*** (1.44 – 1.50)
Age	1.05*** (1.05 – 1.05)	1.05*** (1.05 – 1.05)
Education (ref.: Pre-primary)		
Primary		
Primary	1.39*** (1.28 – 1.50)	1.02 (0.97 – 1.08)
Lower secondary	1.33*** (1.23 – 1.44)	0.90*** (0.85 – 0.95)
(Upper) secondary	1.77*** (1.64 – 1.92)	1.20*** (1.13 – 1.27)
Post-secondary non-tertiary	2.01*** (1.80 – 2.23)	1.41*** (1.31 – 1.53)
Tertiary	2.07*** (1.91 – 2.24)	1.44*** (1.36 – 1.52)
Income	1.58*** (1.57 – 1.59)	1.57*** (1.56 – 1.59)
Identity: Country		
Variance (constant)	0.19	0.19
Year fixed effects	Yes	Yes
No. of observations	374,088	337,572
No. of groups	12	12

Notes: This table presents the multilevel mixed-effects robustness results for the new marital status samples (see robustness check section). 95% CI for estimates in brackets. *** denotes $p < 0.01$, ** denotes $p < 0.05$, * and denotes $p < 0.1$. ‘Tax Benefit’ is a dummy variable that represents whether an MID is permitted. As such, it takes the value ‘1’ when an MID is granted, and ‘0’ otherwise. For a description of the other variables, see Table 2 and the methodology section. CI

= confidence interval; OR = odds ratio; and ref. = reference category.^aOther means: basic activity status = unemployed, in retirement or early retirement, or other inactive person (see Table A1).

Figure 1 Homeownership Rates by Country





Notes: This figure shows the homeownership rates by investigated country over the period of 2004–2018. The x-axis represents the year, abbreviated to the final two digits (e.g., 2004 is represented as '04); and the y-axis represents the homeownership rate (in percentage). A dashed line indicates when an MID is in effect, while a solid line indicates when an MID is not in effect. The gray-shaded area (or rectangle) in the graphs represents the Global Financial Crisis (December 2007 to June 2009; see NBER (2024)). Denmark, Greece and Norway are included in our sample since 2003 (see Table 1). However, the cross-sectional waves of the countries are not available for that year.

Sources: Eurostat – EU-SILC, cross-section database, author’s calculations.

Based on the above figure which also shows the period of the crisis (approximately), we cannot conclude with conviction that the MID policy of each country clearly changed as a result of the housing market turmoil that the markets experienced at that time. Nevertheless, for empirical evidence and in order to avoid potential endogeneity issues, we construct two extra models (Eqs. (5) and (6)) – based on the literature – in which we control for the GFC (and its aftermath). We next describe these models.

First, in Eq. (5), like De Haas and Van Lelyveld (2014), we add a financial crisis dummy ‘GFC’ (1 if year is 2008 or 2009, 0 otherwise)²⁷ to our ‘original’ model (Eq. (3)); see methodology section). This financial crisis dummy highlights the effect of the GFC on homeownership rates. In this ‘new’ model (Eq. (5)), 2009 is omitted because of collinearity. We additionally incorporate a cross term between our main variable of interest ‘Tax Benefit’ and the financial crisis

²⁷ As a robustness check, we re-ran Eq. (5) with a financial crisis dummy ‘GFC’, now taking the value ‘1’ for 2007, 2008 and 2009, and ‘0’ for all other years (Wong, 2020). The results are, however, not appreciably different.

dummy ‘GFC’ to test whether there is a differential impact of an MID on homeownership probability during the crisis period. As such, Eq. (5) looks as follows:

$$\begin{aligned} \log(p_{ijt} / 1 - p_{ijt}) = & \gamma_{00} + \gamma_1 \text{Tax Benefit}_{jt} + \gamma_2 \text{GFC}_t \\ & + \gamma_3 \text{Tax Benefit}_{jt} * \text{GFC}_t + \beta_1 \text{Size}_{ijt} \\ & + \beta_2 \text{Urbanization}_{ijt} + \beta_3 \text{Activity}_{ijt} \\ & + \beta_4 \text{Age}_{ijt} + \beta_5 \text{Marital}_{ijt} \\ & + \beta_6 \text{Education}_{ijt} + \beta_7 \text{Income}_{ijt} + \delta_t + u_{0jt} \end{aligned} \quad (5)$$

Second, in Eq. (6), like Ferreiro et al. (2017) and Begovic et al. (2019), we include a different financial crisis dummy ‘GFC2’ (1 for years 2009-2015, 0 otherwise) to our ‘original’ model (Eq. (3)). The advantage of this dummy variable is that it allows both the crisis and (longer) post-crisis periods to be controlled. In this ‘new’ model (Eq. (6)), 2015 is omitted because of collinearity. As such, Eq. (6) looks as follows:

$$\begin{aligned} \log(p_{ijt} / 1 - p_{ijt}) = & \gamma_{00} + \gamma_1 \text{Tax Benefit}_{jt} + \gamma_2 \text{GFC2}_t \\ & + \beta_1 \text{Size}_{ijt} + \beta_2 \text{Urbanization}_{ijt} \\ & + \beta_3 \text{Activity}_{ijt} + \beta_4 \text{Age}_{ijt} + \beta_5 \text{Marital}_{ijt} \\ & + \beta_6 \text{Education}_{ijt} + \beta_7 \text{Income}_{ijt} + \delta_t + u_{0jt} \end{aligned} \quad (6)$$

The results for Eqs. (5) and (6) on the total sample of households are not shown, as their results for the control variables are the same as those in Table 5 (and Table 8). In the following, we specify the results for ‘Tax Benefit’ and the financial crisis dummies.

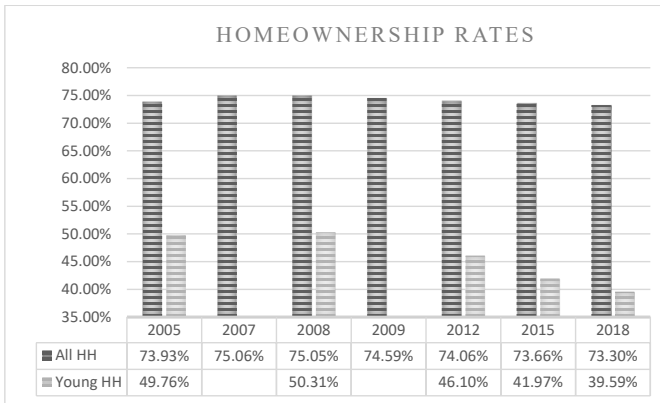
Contrary to our expectations, the results for Eq. (5) provide evidence that the GFC has a positive effect on homeownership (OR = 1.22, $p < 0.01$). However, as can be seen in Figure 2, the highest average homeownership rates from the twelve countries studied over the observed period are indeed in 2007-2009.

By using the Stata command ‘lincom’, we further learn from the results of Eq. (5) that an MID generally had a slightly more negative effect on homeownership during the GFC (OR = 0.91, $p < 0.01$). Despite the significance of the cross term between ‘Tax Benefit’ and ‘GFC’ ($p < 0.1$), the significance and sign of our main variable of interest (‘Tax Benefit’) remains unaffected (OR = 0.94, $p < 0.01$).

The results for Eq. (6) also confirm a significant and negative impact of an MID (OR = 0.94; $p < 0.01$) on homeownership, while revealing a non-significant influence (OR = 0.997; $p > 0.1$) of the crisis and its aftermath (2009-2015). At first sight, the latter finding contrasts Lennartz et al. (2016) who show that access to homeownership has become more difficult for young adults in Europe,

and particularly after the start of the GFC. However, Figure 2 further shows that homeownership rates of younger households (households headed by someone younger than 36 years old) have indeed lowered since 2008, whereas homeownership rates for ‘all’ households (regardless of age of household head) have stayed more or less constant over the observed period. As such, our found insignificant relation between ‘GFC2’ and ‘Homeownership’ is not illogical.

Figure 2 Homeownership Rates by Age Group



Notes: This figure shows the average homeownership rates from twelve (European) countries (i.e. Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Norway, Portugal, Spain, Sweden and the United Kingdom) over 2005-2018. Homeownership rates are shown for (1) all households (i.e. no matter what age the households’ heads are) and (2) only young households (i.e. households headed by someone younger than 36). HH = household.

Source: Eurostat – EU-SILC, cross-section database, author’s calculations.

8. Conclusion

Our article makes three major contributions to the existing housing literature. First, it provides further evidence of the influence of an MID on homeownership attainment. Second, it goes one step further by investigating whether there is a significant difference in influence across groups between income groups and people with a distinct marital status (married or not married). Third, it focusses on Europe, whereas most studies in the field have directed their attention to the U.S. Our multi-country (European) study offers as such the possibility to test the effect of an MID on homeownership attainment in general, by taking into account multiple MID approaches. This is more difficult with a single-country (U.S.) study.

Additionally, the roles of common homeownership determinants are captured. As far as we know, this is the first study: (1) to directly measure the effect of an MID on homeownership probability based on such a large number of

European countries, and (2) to compare this effect explicitly among various household groups. In fact, the latter might be considered as our main contribution to the literature. In the following paragraph, our main findings are summarized.

Our results show that an MID does not achieve its goal of boosting homeownership attainment in general and for almost all of the groups studied. Actually, when an MID is permitted, only the highest income earners are more likely to commit to homeownership. Also, the degree of discouragement varies (considerably) among the other household groups. Households in the two lowest income groups are most strongly discouraged from becoming homeowners via an MID. Also, the fiscal relief worsens incentives to buy a house somewhat more for unmarried households/individuals than for married couples. Drawing on these observations, we argue that an MID is inefficient in its stated goal of boosting homeownership, and certainly because the tax relief exclusively benefits better-off households. Given the uncertainty that surrounds the continuation of an MID in many national policy debates (Rouwendal, 2007), we therefore recommend that countries review and reform (or abolish and replace), if necessary (see also the last paragraph of this section), their MID system. In the following, we address some of the limitations of our study and offer a recommendation for future research.

It should be noted that the EU-SILC is a sample-based survey. As such, the survey does not cover the entire population. However, the sample is representative for each participating country (Arora et al., 2015). To check for the effect of an MID on homeownership attainment, we further include in the regressions a continuous variable/the tax rate at which the mortgage is fiscally deductible (or else, the deductible amount) – ideally differentiated according to the law for different (income) groups – rather than using a dummy to measure the deductibility of mortgage interest. After all, the details of MID approaches might vary over time and between countries. The existence of a rich set of intra-country/year variations would have allowed a standard panel with time and country, and even time x country fixed effects, which would have provided powerful identification of the impact of an MID. However, like in Vangeel et al. (2022), more reliable fiscal information is needed to do so; and/or we would have to make multiple assumptions (such as the dwelling size of the Greek (Matsaganis and Flevotomou (2007))). Furthermore, as Tan (2008) indicates, homeownership is the result of many determinants and thus a rather complex issue. Bear in mind then, that other variables (such as culture, or (other) supply-side factors) may also have an impact on homeownership. It would, for example, also be useful to consider the role of parental support in accessing homeownership (Köppe, 2018; Druta and Ronald, 2021). However, we cannot test all of these influences, mainly due to the lack of data. For a similar reason, we cannot test all countries that have (longitudinal) information on all pre-selected variables, and cannot include a number of European countries (such as the Netherlands) – covered by the EU-SILC – in our regressions. This also

contributes to having a very unbalanced panel – with reference to the number of countries in our sample that have an MID (see data section).

As mentioned several times throughout the paper, different countries implement different MID systems. As such, the MID systems of one or more countries may reach the (overall) goal of promoting homeownership. When provided more international fiscal information (see also the data section that gives attention to this limitation), further research might therefore focus on how MID policies differ across countries and groups (see literature section), and even on policy changes within countries, in order to determine if and why a particular type of MID does (not) boost homeownership attainment and ultimately indicate what an MID should look like to promote homeownership (for all household groups). The contrast between the experiences of these countries and the remainder of the sample would therefore have been instructive. For this, we recommend using smaller samples of countries (those with a similar approach to an MID).

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Appendix

Table A1 EU-SILC Source Codes

Variable name	SILC Code	Category
Tenure status	HH020	<ol style="list-style-type: none"> 1. Owner 2. Tenant or subtenant paying rent at prevailing or market rate 3. Accommodation is rented at reduced rate (lower price than the market price) 4. Accommodation is provided free
	<i>From 2010/2011^a:</i> HH021	<ol style="list-style-type: none"> 1. Outright owner 2. Owner paying mortgage 3. Tenant or subtenant paying rent at prevailing or market rate 4. Accommodation is rented at reduced rate (lower price than the market price) 5. Accommodations are provided for free
Household size	HX040	1 – 99
Degree of urbanisation	DB100	<ol style="list-style-type: none"> 1. Densely populated area 2. Intermediate area 3. Thinly populated area
Basic activity status	RB210	<ol style="list-style-type: none"> 1. At work 2. Unemployed 3. In retirement or early retirement 4. Other inactive person
Age at the date of interview	RX010	0 – 80 ^b
Marital status	PB190	<ol style="list-style-type: none"> 1. Never married 2. Married 3. Separated 4. Widowed 5. Divorced

(Continued...)

(Table A1 Continued)

Variable name	SILC Code	Category
Highest International Standard Classification of Education (ISCED) level attained	PE040	0. Pre-primary education 1. Primary education 2. Lower secondary education 3. (Upper) secondary education 4. Post-secondary non-tertiary education 5. First stage of tertiary education (not leading directly to an advanced research qualification) and second stage of tertiary education (leading to an advanced research qualification)
	<i>From 2014^c:</i>	000. Less than primary education 100. Primary education 200. Lower secondary education 300. Upper secondary education 400. Post-secondary non-tertiary education 500. Short cycle tertiary 600. Bachelor or equivalent 700. Master or equivalent 800. Doctorate or equivalent -99999999.99 – 99999999.99
Total disposable household income	HY020	

Notes: This table reports the original EU-SILC variables that are selected to perform our empirical analysis. Source: Eurostat – EU-SILC.^aFrom 2010/2011 onwards, the variable HH020 has been replaced by the variable HH021.^b80 is the maximum number coded in the EU-SILC dataset. In other words, when the respondent is over 80 years old, his or her age is still coded 80.^cUp to 2013, classification was based on ISCED-1997. From 2014 onwards, classification was based on ISCED-2011.