CAHIER D'ÉTUDES
WORKING PAPER

N° 148

BORROWING CONSTRAINTS, OWN LABOUR AND HOMEOWNERSHIP: DOES IT PAY TO PAINT YOUR WALLS?

PETER LINDNER THOMAS Y. MATHÄ
GIUSEPPE PULINA MICHAEL ZIEGELMEYER

AUGUST 2020

BANQUE CENTRALE DU LUXEMBOURG
EUROSYSTÈME

Borrowing constraints, own labour and homeownership: Does it pay to paint your walls?*

Peter Lindner♦, Thomas Y. Mathä♥, Giuseppe Pulina♠ and Michael Ziegelmeyer♣

August 2020

Abstract:

Using a dedicated set of questions in the 2014 Luxembourg Household Finance and Consumption Survey (LU-HFCS), we show that a substantial share of households contributes their own labour to the acquisition of their main residence. These contributions help households faced with credit constraints, since they reduce the need for external financing. We develop a simple theoretical model and show that own labour contributions decrease with the level of financial resources available, while they increase with the mortgage interest rate. These theoretical results are supported by empirical analysis, which also shows that own labour contributions vary by household characteristics (age, gender, profession) and by type of dwelling (house, apartment).

JEL Codes: D14, E43, G21, R21

Keywords: Borrowing constraints, down payment, own labour, sweat equity, homeownership, household, survey.

* This paper should not be reported as representing the views of the Banque centrale du Luxembourg, the Oesterreichische Nationalbank or the Eurosystem. The views expressed are those of the authors and may not be shared by other research staff or policymakers in the Banque centrale du Luxembourg, the Oesterreichische Nationalbank or the Eurosystem. We would like to thank our colleague Bob Kaempff for his help in designing and distributing the questionnaire for Luxembourg banks, Paolo Guarda for his detailed comments, Denitsa Stefanova and participants at the 6th Household Finance and Consumption Workshop at the Central Bank of Luxembourg, as well as participants the annual meeting of the Nationalökonomische Gesellschaft (NoEG) in Graz and the 6th conference on Household Finance and Consumption in Dublin.

♦ Oesterreichische Nationalbank, Economic Analysis Division, peter.lindner@oenb.at.

♥ Banque centrale du Luxembourg, Economics and Research Department, thomas.mathae@bcl.lu

♠ Banque centrale du Luxembourg, Economics and Research Department, giuseppe.pulina@bcl.lu.

♣ Banque centrale du Luxembourg, Economics and Research Department; Munich Center for the Economics of Aging; michael.ziegelmeyer@bcl.lu.

Résumé non technique

Pour devenir propriétaire de leur logement, la plupart des ménages doivent souscrire à un emprunt immobilier d'un montant considérable. Le patrimoine de l'emprunteur, ses derniers bulletins de salaire, ainsi que ses antécédents de crédit ne permettent pas aux prêteurs d'évaluer de manière parfaite le risque de crédit auquel ils sont exposés. En conséquence, les prêteurs limitent leur exposition au risque de défaut, en exigeant des garanties ou un apport personnel de la part de l'emprunteur. Ces mesures réduisent les pertes des prêteurs en cas de défaut, mais représentent aussi des contraintes de crédit pour l'emprunteur.

Ce cahier analyse l'apport personnel en main-d'œuvre, une solution adoptée par de nombreux ménages face aux contraintes de crédit. En effet, ces ménages contribuent avec leur propre main-d'œuvre à la construction de leur logement ou à sa rénovation. L'apport personnel en main-d'œuvre peut influencer la décision d'accorder un crédit, car il signale que l'emprunteur est prêt à fournir un investissement additionnel pour l'acquisition du logement. Ainsi, ces contributions peuvent aider les ménages à répondre aux exigences des prêteurs ou à acheter un logement plus cher.

Nous fournissons une analyse théorique de la décision de contribuer au financement d'un logement au travers d'un apport personnel en main-d'œuvre, ainsi qu'une analyse empirique à partir d'une série de questions spécifiques posées dans le cadre de l'enquête de 2014 sur le comportement financier et de consommation des ménages résidant au Luxembourg.

Nous trouvons qu'environ 60 % des ménages résidant au Luxembourg ont fourni un apport personnel en main-d'œuvre pour financer l'achat de leur logement. En outre, nous trouvons que le rôle des apports personnels en main-d'œuvre est plus important pour les ménages qui disposent de ressources financières limitées (revenus et fonds propres initiaux) ou qui font face à des taux hypothécaires élevés. D'autres facteurs déterminants concernent les caractéristiques des ménages, telles que le niveau d'instruction, la profession, l'âge et le sexe, ainsi que les caractéristiques du logement. L'apport personnel en main-d'œuvre est plus répandu chez les jeunes ménages et les personnes ayant des compétences en construction.

Les réponses issues d'une autre enquête auprès des principaux prêteurs hypothécaires au Luxembourg confirment que les apports personnels en main-d'œuvre peuvent influencer la décision d'accorder un crédit. Les banques interrogées ont indiqué qu'elles étaient généralement prêtes à considérer des apports personnels en main-d'œuvre couvrant de 5 à 10 % de la valeur totale de l'investissement. Par conséquent, les apports personnels en main-d'œuvre réduisent le montant du financement externe nécessaire, mais aussi le ratio prêt-valeur et les versements prévus au titre du service de la dette. Ainsi, les apports personnels en main-d'œuvre aident les ménages à faire face aux contraintes de crédit, ces dernières étant particulièrement importantes pour ceux dont les ressources financières sont limitées.

Non-technical summary

For most households, becoming a homeowner involves taking out a sizeable mortgage. Lenders can only imperfectly assess the credit risk associated with potential borrowers from the information they provide on their assets, past income and credit history. Therefore, lenders may limit their exposure to default risk by requiring a down payment or collateral. This reduces the lender's potential loss in case of default, but also represents a borrowing constraint for households seeking a loan.

This paper analyses own-labour contributions, a solution adopted by many households faced with borrowing constraints. Many households contribute their own labour to build or renovate their home, reducing the amount they need to borrow. Importantly, own labour contributions can influence the financing decision of lenders, because they signal that the borrower is providing an additional investment in the acquisition of the dwelling. These contributions may thus help households to meet lender requirements or to purchase a more expensive property.

We develop a theoretical framework for the decision to contribute own labour and provide an empirical investigation based on a set of dedicated questions in the 2014 Luxembourg Household Finance and Consumption Survey. First, we find that about 60% of Luxembourg households contributed own labour when they acquired their home. Second, the role of own labour is more important for households with limited financial resources (income and own initial funds) and facing higher mortgage rates. Other determining factors include household characteristics, such as educational attainment, profession, age and gender, as well as dwelling characteristics. Own labour contributions are more widespread among young households and those with skills from construction industry.

Results from a separate survey among the main mortgage lenders in Luxembourg confirm that own labour contributions may affect lenders' decisions in granting a mortgage. The surveyed banks reported that they are typically willing to consider own labour contributions of 5 to 10% of the total investment cost. Own labour contributions reduce the amount of external financing needed, and therefore the loan-to-value ratio and the monthly debt service payments. In this sense, own labour contributions help households faced with borrowing constraints, which are particularly relevant for those with limited financial resources.

1 Introduction

For most households, buying their own home involves taking out a sizeable mortgage. However, the ability of households to borrow against their future income is limited by lenders, which can only imperfectly assess the credit risk associated with potential borrowers. Hence, they may refuse a mortgage or impose conditions that restrict access to homeownership (e.g., Duca and Rosenthal, 1994). To evaluate credit risk, lenders will require households to provide evidence of sufficient resources, such as existing wealth, current and expected income (commonly proven by past income statements), as well as a good credit history. In addition, to limit their exposure to default risk lenders may require a down payment or collateral for the loan. For the borrower, a down payment reflects a borrowing constraint (e.g., Artle and Varaiya, 1978), while for the lender, a down payment reduces adverse selection and moral hazard (e.g., Stiglitz and Weiss, 1981), as well as the risk of not recovering the full amount of the outstanding mortgage in case of default. Therefore, households' available resources are a critical factor in determining loan eligibility and access to homeownership.

There exist different ways for households faced with credit constraints to meet lenders' eligibility requirements. Some will forego current consumption to accumulate the required down payment, while others might rely on transfers and gifts from family, relatives and friends (e.g., Engelhardt and Mayer, 1998; Guiso and Jappelli, 2002; Benito, 2006). These transfers increase the household's own financial funds available for the investment, helping to convince lenders that the borrower can repay the mortgage. This paper contributes to this literature by analysing another popular, yet little researched, solution for households faced with borrowing constraints: own labour contributions. In fact, many households contribute their own labour, also known as *sweat equity*, when building their new home or renovating their purchased home. We use the terms "own labour" and "sweat equity" interchangeably and define them as any labour contribution of a household member that increases the value of the own home.[1] These are separate from any repair and maintenance contributions. Crucially, there is no market transaction.

In the financing decision, own labour contributions increase own funds for the acquisition of the home. Thus, they provide households with a possible avenue to meet the required down payment, to ask for a larger mortgage or to acquire a more expensive property.

This paper analyses the relevance of own labour contributions for homeownership. We provide both a theoretical rationale for the decision to provide own labour, as well as an empirical investigation based on a set of dedicated questions in the 2014 Luxembourg Household Finance and Consumption Survey (LU-HFCS). These indicate how many households contributed own labour, the extent of these contributions, how they vary across household characteristics and how they change the financing composition. To obtain otherwise unavailable information on lenders' view of own labour in the

[1] McGrattan and Prescott (2005) consider sweat equity in a standard business cycle model, and use it to analyse productivity in the United States during the 1990s boom. According to the Wikipedia entry, sweat equity is "… a party's contribution to a project in the form of effort and toil, as opposed to financial equity such as paying others to perform the task. Sweat equity has an application in […] real estate where owners can do D.I.Y. improvements and increase the value of the real estate […]" (Wikipedia: https://en.wikipedia.org/wiki/Sweat_equity [accessed 05/02/2018]).

mortgage application (the supply side), we sent a short questionnaire to the main mortgage providing banks in Luxembourg.

We find that about 60% of households in Luxembourg contributed own labour to finance the acquisition of their home. However, both the prevalence and the share of own labour in total resources use decreases with financial resources (income and own initial funds) and with lower mortgage rates. Furthermore, the extent of own labour contributions is affected by characteristics of the household (educational attainment, profession, age, gender) or the dwelling (type, size, location). Own labour is more widespread among young households and those with skills from the construction industry (e.g., bricklayers, electricians, plumbers, architects, planners, surveyors, etc…). Banks responding to the questionnaire indicated that they do not formally consider own labour contributions in the mortgage application process, but that they may affect the decision to lend. Financial institutions are typically willing to consider between 5-10% of own labour contributions to the investment cost. In fact, such contributions decrease households' need for external funds, therefore reducing the loan-to-value ratio and the monthly instalment. Thus, own labour helps households faced with borrowing constraints. In particular, own labour may allow households with otherwise insufficient financial resources to obtain a mortgage. We provide a theoretical framework for this mechanism, which is supported by our empirical analysis.

We structure the remainder of the paper as follows: Section 2 reviews the existing literature to provide the set-up for the following analysis. Section 3 formalises the household decision problem to illustrate the main mechanisms at work. Section 4 presents the data used in the empirical part and some descriptive statistics. Section 5 presents the econometric estimation results. Section 6 concludes the paper.

2 On borrowing constraints, down payments and own labour provision – the background

2.1 Mortgage financing and borrowing constraints

The decision whether to rent or own the main residence is often modelled as comparing user costs (e.g., Henderson and Ioannides, 1983), with households choosing the cheaper alternative. This decision may also be affected by (favourable) tax treatments for homeowners (Rosen, 1985; Poterba, 1992) or externalities in the rental market (Henderson and Ioannides, 1983). In fact, the tax system in many OECD countries encourages homeownership via tax deductibility of interest payments as well as subsidies targeted at first-time buyers, younger or poorer households (Andrews et al., 2011). According to Engelhardt (1996), this is one reason why the urban economics literature often assumes households experience a net gain in utility when becoming homeowners.

Most households wishing to become homeowners must rely on external credit to finance the acquisition of their home. Lenders restrict access to credit due to information asymmetries (e.g., Stiglitz and Weiss, 1981). To mitigate moral hazard and adverse selection they will generally require households to invest their own financial funds in the form of a down payment. According to Engelhardt (1996), households

compare the discounted sum of utility foregone by saving for the down payment while still renting to the discounted sum of the utility increase from consuming housing services subject to the lower user cost when owning. Evidently, there is a dynamic trade-off: the longer a household must save before purchasing a home, the smaller the discounted benefit from consuming at the lower user cost once it becomes a homeowner. Empirical evidence has shown that borrowing constraints, in form of income and wealth requirements, reduce homeownership rates (e.g., Linneman and Wachter, 1989). Saving for the down payment affects the life cycle pattern, by compressing consumption while saving (e.g., Engelhardt, 1996). This increase in saving is larger the higher the down payment requirement and the lower the initial wealth of the household (e.g., Guiso and Jappelli, 2002). To reduce waiting time, many households rely on bequests, gifts and other inter vivo transfers from family and friends, as suggested by empirical results for Italian households (Guiso and Jappelli, 2002), British households (Benito, 2006) or U.S. first-time homebuyers (Engelhardt and Mayer, 1998). Similarly, results from the 2014 Luxembourg Household Finance and Consumption Survey indicate that 41% of homeowners received help from family and friends, mostly in form of credit, but also guarantees and loans without repayment obligation (i.e. gifts).

Countries differ in the complexity, depth of their markets and institutions for household mortgage and consumer debt (e.g., form of mortgage, revolving credit laws, lender's conditions and constraints). In the past, Caplin et al. (1997) reviewed the US mortgage market and concluded "it is almost impossible to buy a home without available liquid assets of at least 10% of the home's value". Similarly, Engelhardt and Mayer (1998) stated that the typical down payment in the U.S. ranged between 5-20% and that lenders offering mortgages with down payments low(er) than 20% may also require some sort of insurance (private mortgage insurance, life insurance etc.). However, in the 2000s down payments were driven to zero in the U.S. partly through the securitisation activities of Fannie Mae and Freddie Mac and the use of piggy-back second mortgages (Kiff and Mills, 2007). Using the most recent data available for the Survey of Consumer Finances (SCF), Acolin et al. (2016) report that credit constraints are still relevant and significantly affect homeownership rates. According to the American Housing Survey reports, the median down payment was 11-15% in 2017.

In other countries also, the down payment restriction was relaxed prior to the Great Financial Crisis. Andrews et al. (2011) report that, in a selected number of OECD countries, the relaxation of down payment constraints is one reason for the increased homeownership rates among credit-constrained households. Earlier work by Chiuri and Jappelli (2003) already suggested that down payments declined substantially between the 1970s and 1990s, averaging about 7.5 percentage points for 14 OECD countries. Chiuri and Jappelli (2003) show that this type of credit constraint is particularly important for the young. In countries with relatively high down payment ratios, the proportion of owner-occupiers among the young is relatively low. In countries with down payment ratios of 40%, this share is 5-8 percentage points lower than in countries with down payment ratios of 20%.

2.2 Own labour and mortgage financing

The economic importance of own labour is difficult to quantify and there are few reliable estimates. As such, own labour is part of the shadow economy, meaning that, despite being legal, it is not reported and therefore difficult to measure. The national accounts calculation of GDP[2] attempts to include estimates, sometimes in "satellite" accounts.[3] Some information is provided by 1) various trade associations and 2) online platforms advising potential mortgagees about the ins and outs of the mortgage application process and various hidden issues.

1) For many home improvement projects, the main question is Do-it-yourself (DIY) or Do-it-for-me (DIFM). According to the European Home Improvement Monitor published by the Dutch marketing consultancy USP, the proportion of home improvement projects realised as do-it-yourself, rather than hiring a professional tradesman, was 67% in 2017.[4] Also, painting your home is still pretty much a DIY matter. According to the same data source, on average in Europe, households carried out 71% of projects involving painting their home instead of hiring professionals. When it comes to outside walls, however, painting work is more often awarded to professionals.[5] One possible explanation why DIY is popular compared to DIFM may be widespread knowledge, especially among the older population, on how to do it oneself. Some households may know how to paint their own walls, lay carpet, parquet flooring or tile bathrooms while others do more extensive DIY jobs, such as electrical wiring, plumbing or roofing. The extent of own labour contributions generally varies across households, possibly reflecting differences in ability as well as information gathered through social networks. For example, a tradesman in the construction industry may be able to contribute more own labour than a person unfamiliar with these tasks. People working in the construction industry may additionally benefit from an implicit wage if they are allowed to use their employer's equipment (tools and machinery) free of charge or at a low cost. A person with an extensive social network may also find it easier to enlist helpers with the right skills free of charge.

2) Various online platforms provide useful information to potential mortgagees regarding listing own labour in the mortgage application and its pros and cons. Own labour is generally a formalised component of the mortgage application in Germany. In the mortgage application, banks ask how much of the total cost of the construction the household would contribute with their own labour. According to these websites, banks usually seem to be willing to accept own labour up to 15% of the total construction cost.[6] Figures in the range of 5-10% seem more realistic though.[7] These websites also warn households not to overestimate the amount of own labour they are able to contribute.[8] In the U.S., the Department of Housing and Urban Development publishes a compendium for the

[2] McGrattan and Prescott (2005) focus on this aspect of corporate finance.
[3] In Germany, the own labour contribution ranges according to expert information between 31% for single-family houses to 5% for dwellings with three or more apartments. See Braakmann (2004).
[4] See http://www.diyinternational.com/home/news/article/do-it-yourself-share-of-home-improvement-increases/
[5] See http://www.diyinternational.com/home/news/article/painting-remains-a-diy-matter-for-europeans/
[6] See for example https://www.immonet.de/service/redaktionsservice-eigenleistung.html or https://www.immobilienscout24.de/bauen/haus-suchen/baupartner/haus-selber-bauen.html.
[7] See https://www.kreditcoaching.de/artikel/eigenleistung-beim-hausbau-eigenkapital-muskelhypothek.php.
[8] See https://www.financescout24.de/kredite-finanzierung/baufinanzierung.aspx.

mortgage credit analysis for mortgage insurance (HUD 4155.1). Within this compendium, section B details the precise conditions under which "sweat equity" can used within the mortgage application. In Luxembourg such information is not publicly available. Hence, we asked major mortgage providing banks to participate in a small survey and provide us with such information. This is discussed further below.

The economics literature on own labour of homeowners is scarce; the prevalence and magnitude of such contributions are largely unknown. This paper attempts to fill this gap in the literature. Own labour is mostly discussed in the context of renovation and repair expenditures or home improvement expenditures. Bogdon (1996), for example, argues that renovation and repair expenditures are an important component of the U.S. housing market that has grown in importance relative to new constructions as a source of housing supply. She investigates households' decision whether to contract out renovation and repair expenditure or to undertake it themselves and finds that households with higher income, better education and married couples are associated with more contracting out. Boehm and Ihlanfeldt (1986) report that factors external to the individual homeowner, such as input prices and neighbourhood quality, affect maintenance and improvement expenditures. One of the few contributions including sweat equity is Soaita (2013) who undertakes a qualitative assessment of sweat equity in Romania. Although own labour seems significant, no estimates on the level are provided and she concludes that it decreased over time. Most of the literature studying countries in Eastern Europe does not mention own labour in the valuation of real estate (e.g., Égert and Mihaljek, 2007).

2.3 Own labour in the mortgage applications in Luxembourg – the lenders view

Lenders may consider own labour contributions in the mortgage application process. However, it remains unclear how exactly lenders treat such contributions. Do own labour contributions increase the likelihood of getting a positive review of the mortgage application? Do lenders recognise that these contributions increase the funds available for the home acquisition? If so, own labour contributions may affect the loan-to-value (LTV) ratio by reducing the amount of external funding needed, and possibly the interest rate charged by lenders.

To gather information on how such contributions are considered in mortgage applications, we contacted the five main mortgage banks in Luxembourg and asked them to complete a short questionnaire. In 2014, their market share for the outstanding stock of mortgages to Luxembourg residents was 90%.[9] The results can be summarised as follows: Own labour is typically considered of little relevance for the mortgage application (Q1 & Q2). According to lenders' estimate, only about 3% of all mortgage applications in 2014 included own labour contributions (Q9). Of these, the average share of own labour contributions in the total investment cost ranged from marginal to 15% (Q3). Having said this, such contributions may help lenders – in particular at the margin – to grant the requested mortgage (Q2 &

[9] More information on the survey of the banks including the questionnaire is included in the Appendix E.

Q4). However, own labour contributions seem barely to influence the down payment requirement. Similarly, they barely influence the loan-to-value ratio applied by lenders. Concerning the maximum mortgage amount offered to the mortgagee, own labour has a heterogeneous effect. One bank reported that it may actually be perceived as a negative signal and that contributing too much may reduce the probability of getting a mortgage. Interestingly, the mortgage interest rate seems unaffected by the offer to provide own labour.

While these results seem sobering at first sight, it is clear that own labour could only act as a top up to own resources committed to the investment – and this is precisely what the results show. Lenders reported that they are willing to accept own labour contributions that amount to at most 10-15% of the total investment. Despite some exceptions, mortgage application forms in Luxembourg do not formally consider these contributions. For most lenders, the mortgage application form does not allow the household to quantify its own labour input, as detailed cost proposals for various manual tasks are not required, (e.g. painting walls, wiring and plumbing) and ex-post checks on the own labour provided (e.g. by inspecting the site) are not performed. Lenders also indicated that the decision to accept own labour contributions depends on profession, income, wealth, own (financial) funds committed and the total cost of the investment (Q5). In particular, own funds committed, as well as existing revenue and wealth, tend to increase the probability that the lender will recognise own labour contributions. This is not surprising, as committing own financial funds results in a lower default risk.

Even if lenders do not consider the provision of own labour as a means to increase the value of the home, the mortgage amount needed to finance the home acquisition will decrease. This mechanically reduces the LTV ratio. This reduction in the LTV is stronger in cases where households already provide substantial own financial funds to the acquisition of the household main residence (HMR) (see Appendix B for an illustrative hypothetical example). Furthermore, a lower mortgage reduces debt service instalments (repayment and interest). This might be appealing for households, especially those who are credit-constrained, as it may allow them to increase consumption or to accumulate precautionary savings. If own labour is not used to reduce the mortgage amount, it still is a form of investment intended to raise the value of the home (and therefore household net wealth).

Answers to Question 7 on the characteristics that influence a household's decision to contribute own labour are directly relevant to the empirical analysis later in the paper. Most lenders reported that households are more likely to contribute own labour if they have low income, low own financial funds, and if their members have skills from the construction industry. The type of dwelling, house or apartment, also affects the likelihood of such contributions. Households with low revenue and financial funds are likely be credit constrained and for them providing or not providing own labour may make the difference between renting and becoming a homeowner. Information from the survey of banks shows that on-site inspection of the value of own labour contribution is rare, but we assume that households truthfully report own labour (e.g., Cabrales et al., 2003).

3 A simple model

Next, we formalise how providing own labour may help acquiring a main residence. The main aim is to motivate the empirical analysis by highlighting how households' own labour contributions change with their resources (i.e., initial wealth and the present value of future income) and the cost of credit, assuming that they affect the probability of receiving a mortgage. In contrast to much of the standard literature (e.g., Henderson-Ioannides, 1983; Rosen, 1985; Poterba, 1992) we do not aim at describing the homeownership decision of households. Instead, we start from the assumption that homeownership benefits all households. We focus on how households can become homeowners when available financial resources are insufficient and show that own labour contributions may be one possible avenue to achieve this. However, for some households the costs associated with these contributions are too high and therefore they keep renting. Despite the simplicity of the formal description, we show that heterogeneity in resources is enough to induce some households to provide own labour on condition that mortgage lenders accept it as an additional down payment. As we will see below, these are not households at the bottom of the distribution of financial resources, but rather those with close-to or even sufficient funds to receive a mortgage.

For simplicity, let us assume that there exists a population of households heterogeneous in available resources I_i. Available resources can include both some initial wealth and the present value of future income, and are distributed along a continuum between l and h (where l and h are respectively the lowest and the highest level) according to the density function $f(I)$, where $F(\cdot)$ is the associated distribution function. Since we focus on the mechanism of own labour contributions, we do not explicitly model the real estate market and related housing prices. Therefore, we simply assume that all available dwellings have the same value and therefore price.

The acquisition of the main residence typically requires access to credit. Lenders' decision to grant credit usually takes into account personal information of the mortgage applicants embedded in indices, such as the loan-to-value ratio (LTV) or the debt-to-income ratio. In this simple model, these rules translate into a certain amount of minimum resources (α) required to be eligible for a mortgage. We thus assume that lenders consider own labour contributions as a sort of down payment, and that they know a household's total resources by performing a costly background credit check.[10]

The lender, knowing $f(I)$, chooses and announces the minimum level of required resources α. Each household, knowing its available resources I_i, chooses the value s_i of own labour contributions it intends to provide if the mortgage is granted. Each household is fully aware that it will only be granted a mortgage if its total resources $I_i + s_i$ are at least equal to the level α.

[10] The value of own labour contributions is truthfully reported. In other words, households will perform the contributions they declare.

3.1 The household decision problem

The households' problem consists of choosing how much own labour s_i to provide in order to maximize their utility function. Households are distributed on the $[l, h]$ segment according to their available resources. Each household has preferences that can be described by the following utility function:

$$u_i(s_i) = I_i - c_r + b_i[H + c_r - \theta s_i - r_i] \quad (1)$$

where I_i is household $i's$ financial resources, $c_r \in R^+$ is rental cost, $H \in R^+$ is the additional benefit related to owning the dwelling, $s_i \in [0, +\infty)$ is the amount of household $i's$ own labour contributions , $b_i \in \{0,1\}$ is an indicator function describing the credit rule and defined as:

$$b_i = \begin{cases} 0 \; if \;\; I_i + s_i < \alpha \rightarrow household \; i \; does \; not \; receive \; credit \\ 1 \; if \; I_i + s_i \geq \; \alpha \rightarrow household \;\; i \; receives \; credit \end{cases} \quad (2)$$

$r_i \in R^+$ represents the financial cost each household bears if it gets the credit, and $\theta \in R^+$ is the marginal cost of its own labour contribution, which reflects the household's skill in providing own labour. The better the households are at providing own labour, the lower the value of parameter θ. For the moment let us further assume homogeneity in the household's credit cost, $r_i = r \;\; \forall i$. We will relax this assumption later on and consider that available resources and own labour contributions may affect the cost of credit to see how this changes the main results.

Household's i problem is to maximise (1) choosing s_i, given its available resources I_i. Since there is no uncertainty, the optimal own labour contribution will be a function of the household's available resources I_i. Once the bank's rule α is announced, two different cases can be distinguished: (i) household's available resources are sufficient to meet the bank's requirement, i.e. $I_i \geq \alpha$ (unconstrained households), or (ii) they are insufficient, i.e. $I_i < \alpha$ (credit constrained households). In both cases, households decide how much own labour to contribute.

The first case is straightforward, unconstrained households (i.e., $I_i \geq \alpha$) always choose not to contribute own labour, since contributing is costly and these households can access credit without this cost.[11] In the second case, the benefit that credit constrained households (i.e., $I_i < \alpha$) get when they contribute exactly $s_i = \alpha - I_i$ (minimum contribution to obtain credit) is always greater than the benefit of a higher contribution, $u_i^{s_i=\alpha-I_i} = I_i + H - s_i - r > u_i^{s_i>\alpha-I_i}$. This follows from the cost of credit r being constant and depending neither on the amount of own labour contributions, nor on available resources. Moreover, lenders grant credit according to a simple credit rule, the lowest own labour contribution the bank is willing to accept is the minimum contribution. It follows that no household will apply for credit

[11] Unconstrained households ($I\_i \geq \alpha$) always choose not to contribute with own-labour, since they can access credit without this contribution, i.e. $s\hat{}* (I\_i, \alpha) = 0 \; \forall I\_i \in [\alpha, h]$. This follows from the comparison of the utilities an unconstrained household ($I\_i \geq \alpha$) gets when its own-labour contribution is less than $\alpha - I\_i$, (i.e. $u\_i\hat{}(s\_i < \alpha - I\_i) = I\_i + H - r$) or otherwise (i.e. $u\_i\hat{}(s\_i \geq \alpha - I\_i) = I\_i + H - s\_i - r = u\_i\hat{}(l\_i < \alpha - I\_i) - l\_i$).

proposing own labour contributions lower than $s_i = \alpha - I_i = s_i^{min}$, which is the minimum contribution.[12]

Therefore, becoming a homeowner by contributing the minimum amount of own labour is only preferred if the utility of owning is larger than the cost associated with the own labour contributions required to be granted credit. It follows that credit constrained households will decide by comparing the utility of renting (no contribution) to the utility of becoming a homeowner by contributing the minimum amount of own labour to qualify for a mortgage. Formally,|

$$s^*(I_i, \alpha \mid I_i < \alpha) = \begin{cases} if\ I_i < \bar{I} \\ \\ if\ I_i \geq \bar{I} \end{cases} \quad (3)$$

where $\bar{I} := \alpha - \frac{(H-r)+c_r}{\theta}$ is the household which is indifferent between the two options. The solution to the household problem, can be summarized as follows,

While households at the bottom (renters) and the top of the distribution (unconstrained households) do not provide any own labour, the optimal own labour contribution decreases in the available resources for credit constrained households (i.e., those in the middle of the resource distribution),

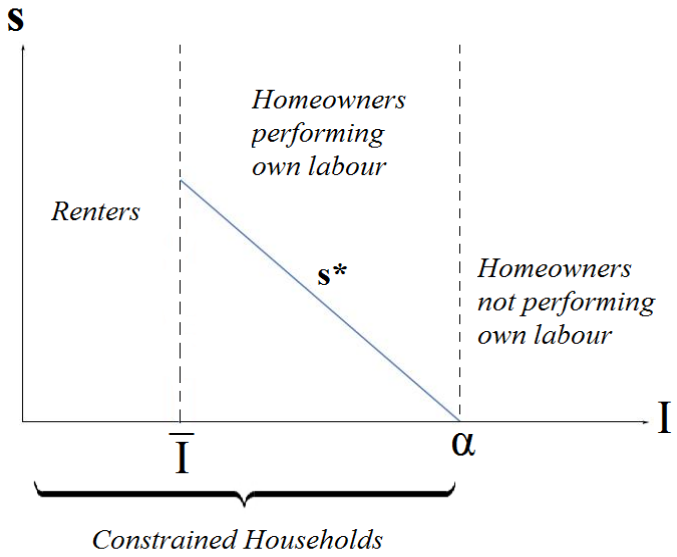
$$\frac{\partial s^*(I_i,\alpha)}{\partial I_i} = \begin{cases} < 0\ if\ \ I_i \in (\bar{I}, \alpha) \\ = 0\ otherwise \end{cases} \quad (4)$$

This follows from the utility of unconstrained households ($I\_i \geq \alpha$) and direct inspection of equation 3, and results from the fact that $\bar{I}$ is identical across households.

In Figure 1, we illustrate how own labour contributions vary according to differences in the level of available resources. Intuitively, unconstrained households do not provide any own labour since they can access credit without it. Instead, credit constrained households are split in two groups: (i) those who are unwilling to provide the own labour necessary to obtain credit and therefore remain renters and (ii) those that are willing to provide the own labour necessary to access credit and therefore become homeowners. In fact, there exists a level of available resources, $\bar{I}$, below which households prefer to rent since the contribution of own labour required to finance the acquisition of their dwelling would be too costly. Above this point, households will become homeowners either because they are unconstrained or by providing the minimum contribution $s_i = \alpha - I_i$. This implies that own labour contributions are (strictly) decreasing in households' available resources $I_i \in [\bar{I}, \alpha)$ in the middle of the resources distribution and zero otherwise (i.e. $I_i \in [l, \bar{I})$ and $I_i \in (\alpha, h]$).

[12] Please note that the minimum contribution is household specific, as it depends on the available resources.

Figure 1: Own labour contributions



Finally, from the previous analysis we can derive the aggregate value of own labour contributions,

$$S = \int_{\underline{I}}^{\alpha} (\alpha - I)\, dF(I)\,.$$

However, to better understand how available resources, the cost of credit, the dwelling value, and skills in manual work may affect the aggregate level of own labour contribution, we have to make some assumptions on the distribution of available resources. For example, assuming that available resources are uniformly distributed, $I_i \sim U(l, h)$, the total value of contributions is,

$$S = \frac{(H - r + c_r)^2}{2(h - l)\theta^2}.$$

Thus, if available resources are uniformly distributed, overall contributions are increasing in the additional benefit of homeownership $\left(\frac{\partial S}{\partial H} > 0\right)$, the cost of renting $\left(\frac{\partial S}{\partial c_r} > 0\right)$, and households manual skills (i.e. decreasing with the marginal cost $\left(\frac{\partial S}{\partial \theta} < 0\right)$), while they are decreasing in the difference between the highest and lowest level of resources $\left(\frac{\partial S}{\partial (h-l)} < 0\right)$ and in the cost of credit $\left(\frac{\partial S}{\partial r} < 0\right)$. Note that we empirically observe the opposite (Figure 7 and subsection 5.2), namely an increasing effect of the cost of credit on own labour contributions. In fact, this result is contingent on the assumption that the cost of credit is homogenous across households. To better understand how the cost of credit affects the contributions of own labour, we relax this assumption below. In this way, we account for fact that this cost may be affected by the amount of available resources and the value of own labour contributions.

Own labour and the cost of credit

It is reasonable to assume that the cost of credit decreases with own labour contributions. The more a household contributes own labour, the fewer external funds are needed to finance the acquisition of a given dwelling. Asking for a smaller mortgage will reduce the household's LTV ratio, which in return reduces the bank's exposure to default risk, allowing it to offer better credit conditions. In this way, the cost of credit could be a decreasing function of own labour contributions. Clearly, this reduction cannot be unlimited, and we can imagine that there exists a minimum cost of credit, $r_{min} \in R^+$, below which the bank is unwilling to grant a mortgage. In a similar way, there must exist a maximum cost of credit, $r_{max} \in R^+$, charged to households that do not contribute own labour.

Assuming that the cost of credit is a function of own labour contributions $r(s_i)$ with: (i) $r'(s_i) \leq 0$, (ii) $\lim_{s_i \to 0} r(s_i) = r_{max}$, and (iii) $\lim_{s_i \to \infty} r(s_i) = r_{min}$, it follows that, compared to the benchmark model, own labour contributions become a more attractive option. In fact, households will contribute own labour until the marginal cost of their contributions matches the marginal benefit obtained from cheaper credit. This level is the same for every household, and it is the interior solution to household i's problem s° (see equation 8 in Appendix A). It is clear that unconstrained households will provide this optimal level of contribution s° (marginal contribution). However, only those whose minimum contribution is lower than s° will choose to provide this level. It is the case for all constrained households whose available resources are close enough to the bank's requirement, i.e. $s^* = s^\circ \; \forall I_i \in [\underline{\underline{I}}, \alpha]$ (see Figure 2).

Figure 2: Own labour and the cost of credit

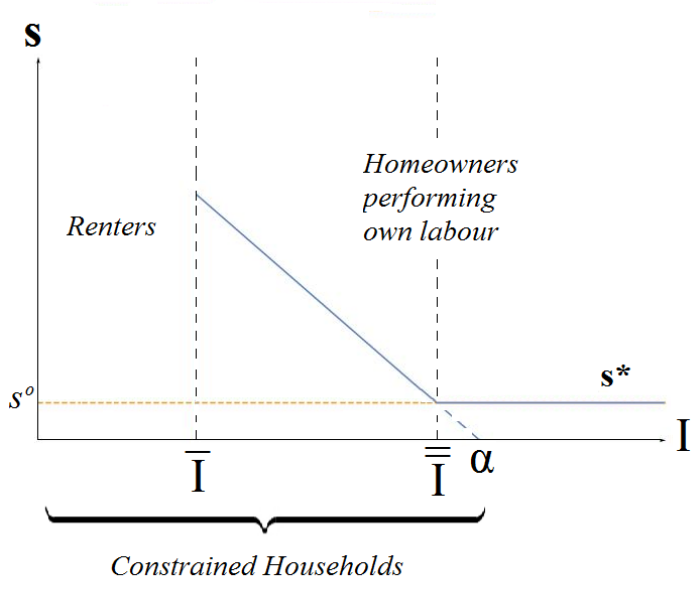
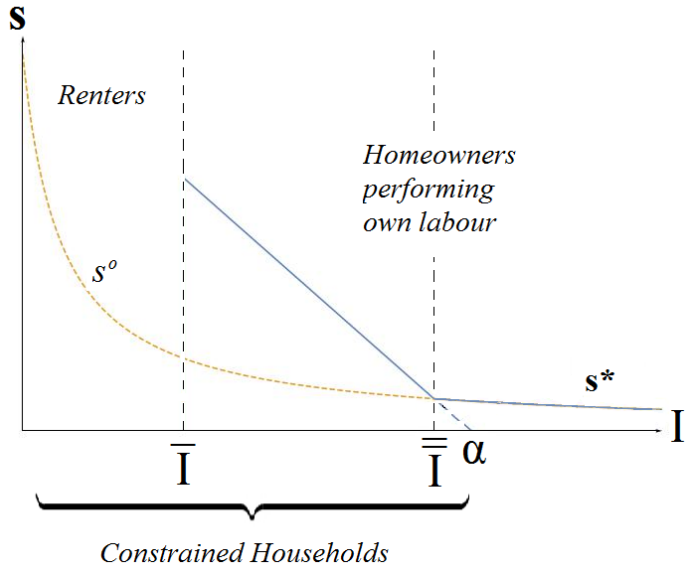


Figure 2 shows how the population of households is partitioned according to their available resources. We can identify three different types of households: renters, homeowners providing the minimum contribution, and homeowners providing the marginal contribution. In this scenario, unconstrained households may also provide own labour contributions if these reduce the cost of credit.

The cost of credit and household resources

Let us assume now that the bank decides to charge different credit costs depending on the household's total available resources. Intuitively, banks may recognise that households with higher resources have a lower probability of defaulting. If this was the case, then the cost of credit would be a function of households' available resources, (i) $r(s_i, I_i)$ with $r_{I_i} \leq 0$, (ii) $\lim_{I_i \to 0} r(s_i, I_i) = r_{max}$, and (iii) $\lim_{I_i \to \infty} r(I_i) = r_{min}$.[13] Figure 3a illustrates the optimal own labour contribution in such a case. Since now the cost of credit depends on available resources, the marginal contribution $s_i^{\circ}(I_i)$ is household-specific. Households compare their specific marginal contribution (yellow line) to the minimum contribution. We can again identify the same three different types of households: (i) renters, (ii) homeowners providing the minimum contribution, and (iii) homeowners providing the marginal contribution. However, since the benefit entailed by own labour contributions is decreasing in household available resources, the optimal contribution is decreasing for all homeowners.

Figure 3a: Own labour when the cost of credit depends on available resources



Finally, we can compute the aggregate value of own labour contributions when the cost of credit depends on resources and own labour contributions,

$$\tilde{S} = \int_{\overline{I}}^{\overline{\overline{I}}} (\alpha - I)\, dF(I) + \int_{\overline{\overline{I}}}^{h} s^o(I)\, dF(I)\,.$$

If we assume that **resources** are uniformly distributed, the previous equation yields:

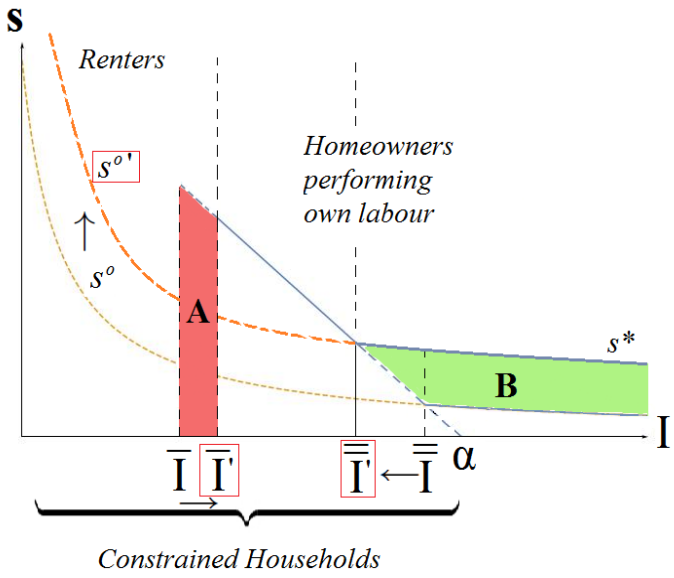
$$\tilde{S} = S + \frac{1}{2(h-l)}\left(\overline{\overline{I}}\,(2\alpha - \overline{\overline{I}}) - \alpha^2 + 2\int_{\overline{\overline{I}}}^{h} s^o(I)\, dI\right).$$

[13] where $r_{I_i} = \frac{\partial r(s_i, I_i)}{\partial I_i}$.

Where S is the aggregate level of own labour contributions in the benchmark model, and s^o is the "marginal contribution". Therefore, it is now evident that an increase in the cost of credit r can have both positive and negative effects on the aggregate level of own labour contributions (see Figure 3b). In fact, an increase in r decreases both S and $\bar{\bar{I}}$, but increases $s^o(I)$, thus increasing $2\int_{\bar{\bar{I}}}^{h} s^o(I)\, dI$.

To provide the intuition behind this result, Figure 3b represents the possible effects entailed by an increase in the cost of credit. On the one hand, an increase in the cost of credit makes renting a more attractive option. Therefore, some households decide not to become homeowners. These decisions have a negative effect on the total amount of own contributions, S decreases (see the red shaded area A in Figure 3b). However, on the other hand, the increase in the cost of credit also induces larger own labour contributions by homeowners with mid-to high level of resources in an attempt to reduce their cost of credit (see the green shaded area B in Figure 3b).

Figure 3b: Own labour when the cost of credit increases



4 Data and descriptive statistics

4.1 LU-HFCS Data

To analyse the questions at hand, we use representative data from the 2014 Luxembourg Household Finance and Consumption Survey (LU-HFCS). This survey collects data on households' assets and liabilities, as well as on income and consumption. The 2014 edition contained a dedicate set of one-off questions related to the acquisition of the household main residence (HMR). The survey asked how much of the purchase or the construction contract was financed by internal funds (financial wealth including gifts and inheritances), own labour (sweat equity) and external funds (mortgages). Together,

these three components should theoretically be close to the value of the main residence at the time of acquisition.[14] The exact wording of questions is detailed in the Appendix D.

This data set contains information on 1,601 households. For a detailed methodological report of the survey, see Girshina, Mathä and Ziegelmeyer (2017). We use state of the art procedures in weighting the answers and Bayesian multiple imputation procedures to correct for the survey structure as well as unit- and item-non response. Below we focus on homeowners, who correspond to 1,175 unweighted observations. Standard errors are based on a bootstrapping procedure using 1000 replicate weights constructed by the data producer. The LU-HFCS is a representative sample of the Luxembourg population and is the best available dataset for our analysis for several reasons. First, it contains detailed balance sheet information along with a rich set of socio-demographic, economic, investment attitudes and financial knowledge variables. Second, it contains specific details on the residence, i.e. whether it is a detached or semi-detached house, apartment, farm, etc., whether it is located in the centre of town, in the outskirts, rural area. In addition to the information in the survey, we use other aggregate information such as interest rates or regional house prices were appropriate.

4.2 The Luxembourg real estate market

In Luxembourg, 67.6% of households own their HMR. As in other countries, the HMR makes up the largest share (around 60%) of total real wealth. According to the data from the 2014 LU-HFCS, across homeowners the median value of the HMR was €555,600, while the corresponding mean was €647,900. The average surface of the home was 159m^2. Distinguishing between houses and apartments, houses averaged €707,100 and 179m^2, while apartments averaged €460,500 and 96m^2. These valuations are close to those reported by other sources; see Girshina, Mathä and Ziegelmeyer (2017) for details. About 30% of all households acquired their current HMR before 1991, 19% between 1991 and 2000, 35% between 2001 and 2010 and 15% after 2010.

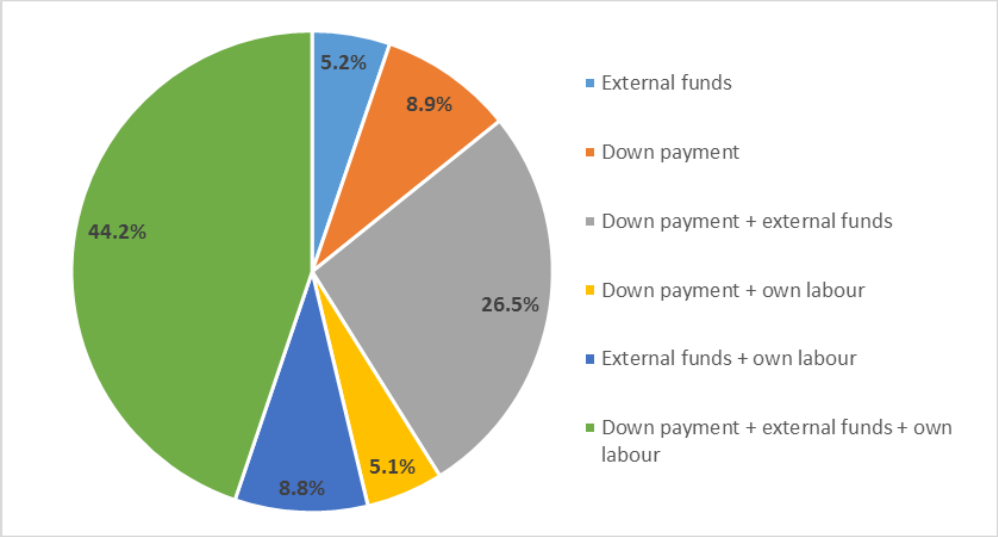
Concerning household debt, the 2014 LU-HFCS indicates that 54.6% of Luxembourg households held some type of debt. The largest debt category in terms of outstanding amounts was mortgage debt, held by 35.2% of households. The share of mortgage debt in total liabilities was 91.1% and its conditional median value was €200,000. Regarding past loan applications (within the last three years), 5.7% of all households reported that their applications were fully or partially rejected, while 6.2% did not apply for credit as they thought they would be rejected. In total, given multiple answers are possible, 10.2% of the total population consider themselves credit constrained, in so far as they either reported or anticipated a rejection.

[14] The sum of the three different financing sources is on average €22,100 larger than the initial value of the HMR, which might reflect transaction costs. The difference at the 25th percentile, the median and the 75th percentile is €-400, €0 and €34,500, respectively.

4.3 Descriptive statistics

Basic summary statistics reveal that own labour is very prevalent among homeowners. Figure 4 shows how the three different financing sources (down payment, external funds and own labour) are combined to fund the acquisition of the HMR. Combined, they characterise the sum of all financing sources employed by the household, which we will henceforth refer to as total resources. Almost half of all households (45%) rely on all three financing sources: down payment (own financial funds), external funds and own labour. 27% rely on own and external funds without providing own labour. 9% provide external funds in combination with own labour and 5% rely on own funds and own labour only. Few households rely on one financing source only: 9% on own funds only and 5% on external funds only.[15] Hence, 59% of Luxembourg's homeowners contributed own labour to their home before moving in or immediately after (Figure 4).

Figure 4: Combination of different financing sources



Source: Own calculations based on the 2nd wave of the LU-HFCS, data are multiply imputed and weighted.

Table 1 reports various statistics with respect to the contribution of each financing source, expressed as a share of the total resources at the time when the HMR was acquired. Own labour represented 11% of total resources on average, ranging from 0% at the 25th percentile (41% of HMR owners contributed no own labour) to 2% at the median, and up to 15% at the 75th percentile. If we restrict the sample to HMR owners who contributed own labour, the mean increases to 19% and the median to 12%.

[15] Eleven households indicated that they used no financing source or own labour only. These were considered unreliable and are excluded.

Table 1: Share of different financing sources at time of acquisition, in %

		conditional on HMR ownership				conditional on contribution by source			
	Prevalence	Mean	P25	Median	P75	Mean	P25	Median	P75
Down payment	85.8	35.5	9.6	27.1	51.8	41.4	16.4	33.3	59.5
Own labour	58.9	11.1	-	2.0	14.8	18.8	4.2	11.7	27.2
External funds	85.8	53.5	30.4	57.5	80.0	62.3	42.6	66.5	83.3

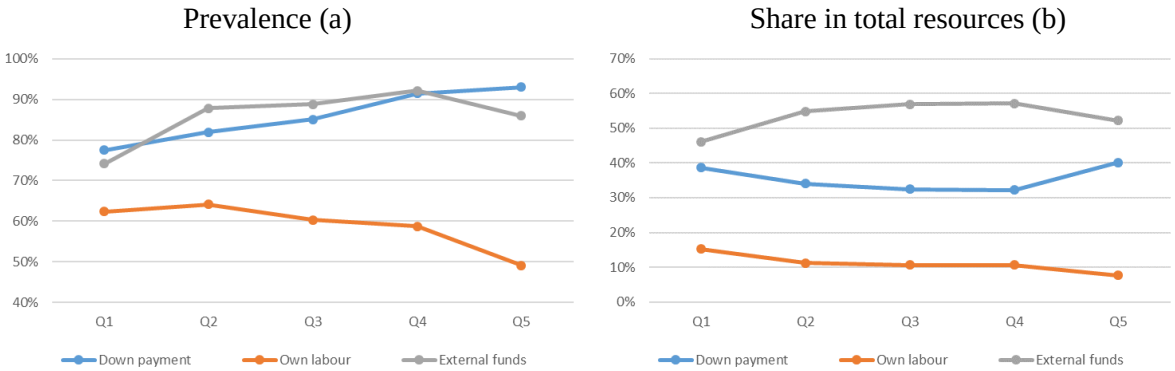
Source: Own calculations based on the 2nd wave of the LU-HFCS, data are multiply imputed and weighted. Calculated as statistic over individual ratios.

Table 1 also shows that around 86% of homeowners made down payments to finance the HMR and the same share used external funds. Unsurprisingly, external funds are the most important source of financing. The mean contribution of external funds to the total, based on individual ratios, is estimated to be 53%. Down payments rank second with 35%. The theoretical model in section 3 identifies own financial resources and external financing costs as determining the decision to contribute own labour and the amount contributed.

In this subsection, we focus on how the role of own labour differed across households with different levels of gross income[16], households providing larger or smaller down payments or households facing higher or lower mortgage rates. Figure 5a confirms that the prevalence of own labour contributions decreases with income, as suggested by our model in section 3.1. Own labour contributions are most common in the 2nd income quintile (64%) and least common in the highest quintile (49%). The correlation coefficient of -0.12 between income and providing own labour is significant at the 1% level. The same figure shows that committing own financial funds increases almost linearly from 77% in the lowest income quintile to 93% in the highest quintile. In contrast, the use of external funds follows a humped-shaped pattern. At the lowest income quintile, only 74% of homeowners rely on external funds, in part reflecting limited access to the mortgage market for low-income households. In the fourth income quintile, 92% of homeowners rely on external funds, but this share declines to 86% in the highest income quintile, presumably because richer households have less need for external funding. The share of external funds in total resources also follows a hump-shaped pattern across gross income quintiles (Figure 5b). In lowest income quintile, external funds represent 46% of total resources. In the 3rd and 4th income quintiles this increases to 57%, before declining to 52% in the highest quintile. Instead, the share of own financial funds (the down payment) in total resources follows a u-shape pattern across income quintiles. The share of own labour is highest in low-income households, given their more limited access to the mortgage market. This share declines from 15% in the lowest income quintile to 8% in the highest quintile. The correlation coefficient of -0.097 is significant at the 1% level.

[16] Results are qualitatively unchanged when we use net household income instead of gross income.

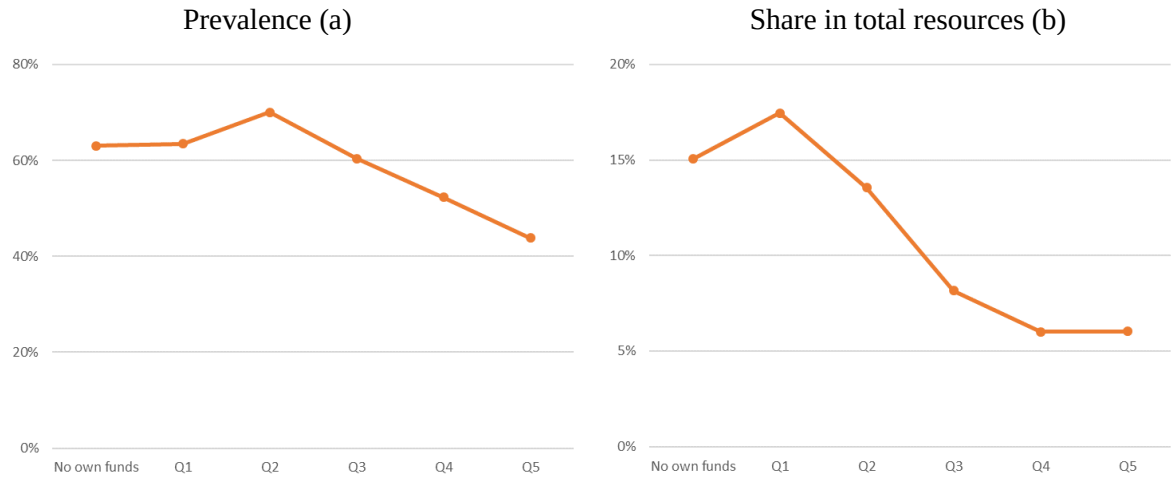
Figure 5: Main financing sources: prevalence and share, by gross income quintile



Source: Own calculations based on the 2nd wave of the LU-HFCS, data are multiply imputed and weighted. The figures depict the prevalence of each financing source (left panel) and their shares in the total resources (right panel) at the time of the HMR acquisition. Gross income quintiles only refer to HMR owners in sample.

Figure 6a illustrates how own labour varies with the share of the down payment in total resources at the time of acquisition of the main residence. Own labour was only provided by 49% of households in the highest quintile, where the down payment represented a large share of total resources. Own labour was provided by 70% of households in the second quintile, by 63% of households in the first quintile, where the down payment represented the lowest share of total resources, and by a similar percentage of households with no down payment. There is also a negative correlation between the share of own labour in total resources and the share of the down payment in funds used (see Figure 6b). In the lowest quintile, where the down payment was relatively small, own labour represented 17% of total resources on average. This share declines to 6% in the top two quintiles, where the down payment contributed a large share to total resources. Own labour represented 15% of total resources among households with no down payment.

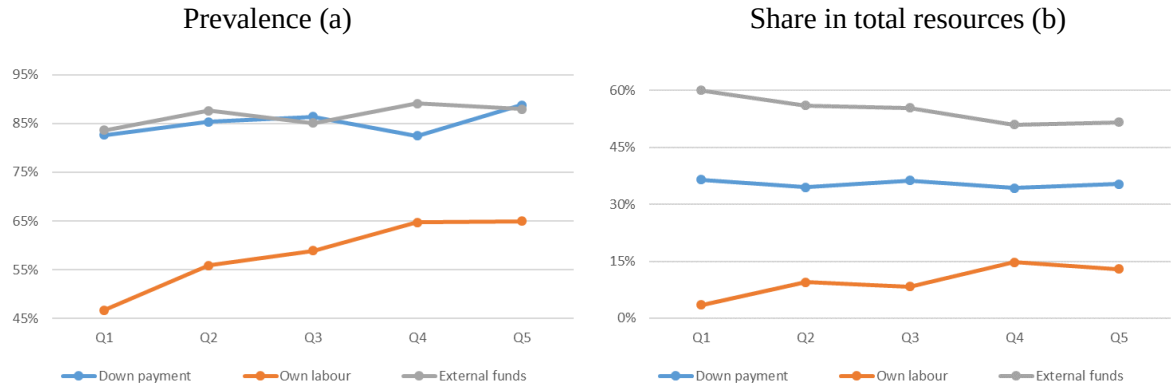
Figure 6: Contribution of own labour: prevalence and share, by quintile of down payment share



Source: Own calculations based on the 2nd wave of the LU-HFCS, data are multiply imputed and weighted. *The figures depict the prevalence of own labour (left panel) and its share in the total resources (right panel) at the time of the acquisition of the main residence. HMR owners are grouped by the share of their down payment to total resources.*

Lastly, Figure 7 reports how the main sources of financing differed across households facing higher or lower mortgage rates at the time they acquired the main residence. In the LU-HFCS, households were not asked to report the mortgage rate at loan origination, so we use the annualised agreed rate of lending for dwellings in Luxembourg at the year of acquisition of the main residence.[17] We find a positive correlation between the mortgage rate at loan origination and the share of households that provided own labour (Figure 7a). In the lowest quintile of the mortgage rate, only 47% of households provided own labour. In the top two quintiles of the mortgage rate, 65% of households provided own labour. The correlation coefficient is 0.11 and significant at the 1% level. In Figure 7b, the correlation between the share of own labour in total resources and the mortgage rate at the year of acquisition is even higher (above 0.19, also statistically significant). The share of own labour in total resources is 3% in the lowest mortgage rate quintile, rises to 15% in the fourth quintile and then declines to 13% in the top quintile. In Figure 7a, the share of households using down payments or external funds is relatively stable across mortgage rate quintiles. However, in Figure 7b the share of external funds in total resources decreases at higher mortgage rate quintiles, which is to be expected.

Figure 7: Main financing sources - prevalence and share, by mortgage rate quintile



Source: Own calculations based on the 2nd wave of the LU-HFCS, data are multiply imputed and weighted. The figures depict the prevalence of each financing source (left panel) and its share in the total resources (right panel) at the time of the HMR acquisition. The quintiles of the mortgage rate are based on the annualised agreed rate of lending for dwellings in Luxembourg in the year the main residence was acquired.

5 Empirical Analysis

5.1 The empirical model

The theoretical model provides several testable hypotheses, which we compare to the data in this section.[18] To estimate the probability of contributing with own labour to the acquisition of the HMR, we use a linear probability model [henceforth LPM].[19] To explain the amount of own labour contributions, we estimate a tobit model using two different functional forms for the dependent variable: (i) the share

[17] In Luxembourg, most outstanding mortgage debt is at adjustable rates, so we use the mortgage rate up to 1 year for dwellings bought after 1993. For older dwellings, we use the overall average rate, as no better measure is available.

[18] All empirical models estimated with final population weights. Variance estimation is based on 1,000 replicate weights.

[19] The probit model provides very similar results, which are presented in the Appendix (Table A2).

of own labour in total resources; (ii) the logarithm of the amount of own labour. For both these variables, the distribution is censored at zero, which would bias ordinary least squares estimates. Since there is no censoring at the upper tail (shares are always below one), we estimate a left-censored tobit, in which the unobserved latent variable, y^*, is defined by the following regression:[20]

$$y_i^* = x_i'\beta + \varepsilon_i, i = 1, \dots, N$$

where $\varepsilon_i \sim N(0, \sigma^2)$ and x_i' is a vector of (1×K) explanatory variables. The observed variable y_i follows the rule:

$$y = \begin{cases} 0 & if\ y^* \leq 0 \\ y^* & if\ y^* > 0 \end{cases}$$

We include a set of core explanatory variables in the vector x_i' based on our theoretical model: own resources (gross income[21] and down payment) and external financing costs plus some other controls.

The variables in our regression are either time-invariant, unlikely to change over time or directly reflect the household situation at the time of the acquisition. The only exception is gross income. Banks infer future income from all information available at the time of the mortgage application. These include income, age, education, occupation and other relevant household characteristics. In the LU-HFCS survey, gross income at the time of the HMR acquisition is not available. However, we consider current income a good proxy for income at the time of the HMR acquisition given the controls we included. This is because current and past income are both correlated with household characteristics. We expect estimates of the income coefficient to be biased towards zero due to attenuation bias[22] (see Cameron and Trivedi, 2010, section 26). Presumably, the effect of income at the time of acquisition would be even more negative given the observed negative correlation between income and own labour contributions.[23] While gross income is collected in current prices, own labour and the down payment (i.e. the variables in euro amounts) are inflation adjusted to 2014 euros using the national index of consumer prices (NICP).

[20] See also Cameron and Trivedi (2010), section 16.

[21] Own labour contributions carry opportunity costs presumably linked to one's wage level, so they will be less attractive for high-income households. However, Section 3 shows that heterogeneous opportunity costs are not necessary for own labour contributions to decrease with household income. Even if costs are homogeneous, benefits will be higher for households that need own labour contributions to acquire their main residence. The estimates in Table 2, showing a significantly negative link between income and own labour contributions, remain qualitatively unchanged if we control for differences in opportunity cost by including separate dummy variables proxying differences in manual skills (Specifications 2, 3, 5, 6, 8 and 9).

[22] The measurement error in the income variable introduces noise, which attenuates the estimate of the marginal effect of income towards zero.

[23] We do not attempt to estimate income at the time of HMR acquisition, because we lack life-earning profiles for different groups. The use of income today and available household characteristics at the time of acquisition to proxy income at time of acquisition should sufficiently minimise omitted variable bias of not having a direct measure of income at the time of HMR acquisition. As a robustness test, we calculated household income at the time of the acquisition of the main residence by simply using the NICP. This adjustment for inflation changes neither the qualitative nor the quantitative interpretation of our results.

We present two main specifications: Specification (a) controls for the share of down payment in total resources; specification (b) controls instead for down payment quintiles. As we will see, it is relevant to control for the size of the investment. However, to address potential concerns about parameter constraints we use down payment quintiles instead of the actual value of the down payment in the tobit specifications. These concerns may affect the tobit model, as the total resources at the time of acquisition is determined by its three components down payment, external funds and own labour.

For each specification, we start out with the most parsimonious set of covariates, which in Specification 1 includes the household resources and the mortgage rate.[24] This specification is closest to the benchmark theoretical model and assumes that the marginal cost of providing own labour θ is equal across all households. Next, we control for the household skills to capture variations described by θ_i in the theoretical model (Specification 2). We proxy the skills of the reference person in each household[25] through a set of dummies. First, two dummies based on the International Standard Classification of Occupations (ISCO) identify those with skills from the construction industry[26] and individuals who are neither employed nor self-employed[27] (the reference group is all others). Second, we include two dummies for the level of educational attainment (the reference group is low education). We additionally control for two characteristics of the main residence: the type of dwelling (house or apartment) and the year of acquisition. Finally, we add a vector of explanatory variables related to other personal characteristics of the household's reference person: gender, civil status (single, couple, divorced, widowed) and age[28] at the time of the acquisition (Specification 3).

5.2 Main results

First, we discuss estimated coefficients for the main explanatory variables from the benchmark specification of the three different models (Table 2). Then, we discuss estimated coefficients of other explanatory variables (shown in the Appendix C, Table A1). For the tobit model, the tables report weighted average marginal effects of the latent expected value of y^*. Overall, qualitative conclusions of the four regression models are comparable and in line with the results of our theoretical model. As Figure 5 already suggested, there is a significant negative relationship between gross income and the probability of contributing own labour to the HMR acquisition. An increase in the yearly gross income by €10,000 decreases the probability of own labour contributions by about 0.5-0.6 percentage points, depending on the specification used. The share of own labour in total resources is reduced by 1.5-1.8% and the amount of such labour contributions by 7-8%.

[24] The time series on mortgage rates starts in 1980. To avoid dropping households who acquired their main residence beforehand, we include a dummy variable for acquisitions before 1980 (146 households in our sample).

[25] This is the Financially Knowledgeable Person (FKP).

[26] Individuals with skills from the construction industry are identified according to the following ISCO codes: 214, 215, 216, 312, 711, 712, 713, 721, 723, 741, 821, 931, 962.

[27] The regression includes a specific dummy variable for reference persons who are neither employed nor self-employed, such as students, the unemployed or people in retirement for whom the ISCO code is not available. The dummy is suppressed in Table 2.

[28] The age dummy is based on the following categories, [16-34], [35-44], [45-54], [54-65], [65+].

Consistent with the theoretical model, the down payment (share) has a negative effect. A 1-percentage point increase in the down payment share reduces the probability of providing own labour by 0.3-0.4 percentage points (Spec. 1a-3a) and the own labour share by 0.2 percentage points (Spec 4a-6a). In Specification (b), the estimated down payment quintile coefficients are significant for the top quintile (see Spec. 1b-3b) and the higher quintiles 3-5 (Spec. 4b-6b) only. This may be related to the specification (b) not controlling for the heterogeneity in the value of the HMR. Specification (a) implicitly controls for this aspect by considering the relative importance of down payment contribution to total resources. Controlling for individual skills and education, as well as some dwelling characteristics (Spec. 2) and other household characteristics (Spec. 3) tends to reduce somewhat the coefficients and marginal effects of the down payment variable. However, these effects remain remarkably robust and retain their significance. In Specifications (1b) and (2b), the dummy on the top down payment category is significantly negative. Additional controls in Specification (3b) render this coefficient estimate insignificant. This is probably due to the correlation these additional controls have with the down payment and the fact that, contrary to 1a, this specification does not properly control for the relative importance of the down payment in the HMR acquisition.

Our theoretical model tells us that higher mortgage rates should encourage households that become homeowners to contribute more own labour. This is indeed borne out in the data. The initial mortgage rate is positively correlated with own labour contributions.[29] If the mortgage rate increases by 1%, the probability of providing own labour increases by around 0.1-0.2 percentage points, the share of own labour in total resources increases by 0.5 percentage points and the amount of own labour by 1.3%-2.1%.

Furthermore, the probability of contributing own labour is 13-19 percentage points higher for those with skills from the construction industry, which is as expected. In addition, this probability is 12-17 percentage points lower for households with a high level of educational attainment (compared to those with low educational attainment). The significance of these two coefficients extends to the specifications using the share of own labour as dependent variable (Spec. 4-6) as well as those using the amount of own labour as dependent variable (Spec. 7-9). The type of dwelling is also relevant. Own labour contributions are 11-17 percentage points more likely for a house than for an apartment. This may reflect the fact that property developers often control the construction of new apartments until completion, while individual households may be more closely involved in the process of planning and building new houses. There is some evidence that own labour contributions are more likely if the HMR was acquired in recent years (see specification 3). This may be linked to the general increase in property prices in Luxembourg over the last twenty years, which requires households to contribute more own resources to finance the acquisition.

[29] The interest rate is included in logarithmic form, as this functional form is better supported by the data.

Table 2: Models for contributing own labour – main explanatory factors

	Probability of providing own labour (LPM)						Share of own labour in total resources (Tobit)						Log of own labour (Tobit)		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)	(4a)	(5a)	(6a)	(4b)	(5b)	(6b)	(7b)	(8b)	(9b)
Down payment / total funds used	-0.407***	-0.379***	-0.294***				-0.162***	-0.155***	-0.157***						
	(0.055)	(0.056)	(0.068)				(0.019)	(0.020)	(0.026)						
Down payment: Q1 (d)				-0.0283	-0.0199	-0.0161				-0.0191	-0.0160	-0.0182	-0.627	-0.515	-0.473
				(0.069)	(0.064)	(0.064)				(0.023)	(0.022)	(0.021)	(0.816)	(0.749)	(0.716)
Down payment: Q2 (d)				0.0784	0.0908	0.0976				-0.00184	0.00574	0.00380	0.906	1.078	1.064
				(0.065)	(0.067)	(0.064)				(0.024)	(0.023)	(0.023)	(0.806)	(0.820)	(0.765)
Down payment: Q3 (d)				-0.0605	-0.0426	-0.0163				-0.0509**	-0.0424**	-0.0409**	-0.865	-0.604	-0.295
				(0.066)	(0.066)	(0.067)				(0.021)	(0.019)	(0.020)	(0.794)	(0.778)	(0.777)
Down payment: Q4 (d)				-0.0213	-0.0135	0.0226				-0.0412*	-0.0364*	-0.0337*	-0.193	-0.0733	0.312
				(0.065)	(0.066)	(0.065)				(0.022)	(0.021)	(0.020)	(0.815)	(0.811)	(0.782)
Down payment: Q5 (d)				-0.158**	-0.124*	-0.0196				-0.0745***	-0.0645***	-0.0543***	-1.732**	-1.296	-0.0896
				(0.069)	(0.068)	(0.069)				(0.020)	(0.019)	(0.020)	(0.848)	(0.841)	(0.877)
Gross income (in €10,000)	-0.00538***	-0.00456***	-0.00515***	-0.00515***	-0.00490***	-0.00565***	-0.00184**	-0.00146*	-0.00170*	-0.00161*	-0.00154*	-0.00176*	-0.0705**	-0.0719**	-0.0814**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.031)	(0.034)	(0.036)
Mortgage rate (ln)	0.110***	0.150**	0.144**	0.0938***	0.165**	0.156**	0.0524***	0.0474**	0.0473**	0.0467***	0.0529**	0.0515**	1.332***	2.092**	1.972**
	(0.033)	(0.066)	(0.066)	(0.034)	(0.071)	(0.069)	(0.009)	(0.023)	(0.023)	(0.010)	(0.024)	(0.024)	(0.416)	(0.925)	(0.919)
Skills from the construction industry		0.188***	0.136**		0.194***	0.133**		0.0477***	0.0340*		0.0521***	0.0333*		2.513***	1.548**
		(0.056)	(0.055)		(0.058)	(0.056)		(0.018)	(0.018)		(0.019)	(0.018)		(0.753)	(0.671)
Education: middle (d)		-0.0100	-0.0451		-0.0223	-0.0703		-0.00863	-0.0142		-0.0103	-0.0197		-0.184	-0.753
		(0.043)	(0.042)		(0.046)	(0.044)		(0.015)	(0.016)		(0.016)	(0.017)		(0.561)	(0.545)
Education: high (d)		-0.119**	-0.141***		-0.125**	-0.166***		-0.0426***	-0.0444***		-0.0427***	-0.0487***		-1.478**	-1.917***
		(0.050)	(0.049)		(0.053)	(0.052)		(0.016)	(0.016)		(0.016)	(0.017)		(0.649)	(0.643)
Type of HMR: house (d)		0.154***	0.117**		0.172***	0.113**		0.0502***	0.0458***		0.0588***	0.0488***		2.452***	1.773***
		(0.047)	(0.046)		(0.048)	(0.046)		(0.015)	(0.014)		(0.016)	(0.015)		(0.614)	(0.603)
Year of HMR acquisition		0.00457	0.00680*		0.00592	0.00907**		0.000413	0.000484		0.000906	0.00144		0.0654	0.105*
		(0.004)	(0.004)		(0.004)	(0.004)		(0.001)	(0.002)		(0.002)	(0.002)		(0.053)	(0.054)
Other household characteristics	no	no	yes	no	no	yes	no	no	yes	no	no	yes	no	no	yes
Observations	1164	1164	1164	1164	1164	1164	1164	1164	1164	1164	1164	1164	1164	1164	1164
Wald test of overall significance	21.76	14.55	10.94	5.2	7.06	7.59	25.47	12.76	7.76	7.8	6.71	4.8	4.61	7.04	5.77
R2 adjusted mean	0.094	0.127	0.149	0.043	0.085	0.128									
R2 adjusted min	0.090	0.121	0.139	0.039	0.079	0.113									

*Source: Own calculations based on the 2nd wave of the LU-HFCS, data are multiply imputed and weighted. Variance estimation based on 1,000 replicate weights. Standard errors in ( ). *** p<0.01, ** p<0.05, * p<0.1. (d) indicates a dummy variable. The Linear Probability Model includes a constant (suppressed). Tobit estimates report weighted average marginal effects of the latent expected value of y*. Variables in euro amounts are inflation adjusted to 2014 euros. Other household characteristics include: gender, civil status (single, couple, divorced, widowed) and the age (provided in age categories: [16-34], [35-44], [45-54], [54-65], [65+]) at the time of the acquisition (see Appendix C, Table A1).*

Table A1 in the Appendix C reports the coefficient estimates for other household controls, which are constant over time for most households. Own labour contributions are more likely among households whose financially knowledgeable person is male or was younger at the time of the HMR acquisition. These results support previously known findings in the literature showing that borrowing constraints are often more relevant for young people.

5.3 Robustness section

Some households acquire their HMR without external funds. Our results are robust to including an additional dummy identifying these households (not tabulated).

Households often receive financial support from family or friends for the acquisition of the HMR. In our sample, 45.6% received some kind of support, out of which 7.1% received their HMR as gift or inheritance, 9.0% received a loan guarantee, 6.8% received financial support without any repayment obligation, 26.0% received informal credit and 2.4% cited other support from relatives or other persons (multiple responses possible). We included a dummy variable for any kind of financial support or included five separate dummy variables distinguishing the different kinds of support. The only significant effect stems from the dummy variable on "financial support without repayment obligation". These additional controls only marginally affect our results (not tabulated), so we omitted them from our main specification.

We also used the 2011 Census data to add the population density of the municipality in which the HMR is located. Furthermore, we proxy differences in real estate prices across municipalities by including the 2014 average house price per square metre from adverts.[30] Our results are robust to the addition of these two variables.

6 Concluding remarks

This paper analyses the relevance of own labour (sweat equity) for becoming a homeowner. Using a dedicated set of questions in the 2014 Luxembourg Household Finance and Consumption Survey, we analyse own labour contributions by households, how they vary across household characteristics, and how they affect the composition of financing in the acquisition of the main residence. We find that about 60% of homeowners provided own labour contributions when acquiring their home. Representing on average 11% of the total resources for the home acquisition, these contributions are not negligible and may help households facing borrowing constraints – a solution that has been largely overlooked in the economics literature. A survey among the main mortgage lenders in Luxembourg shows that while own labour contributions are not considered explicitly in the mortgage application process, they do affect

[30] House prices from adverts provide estimates for all the municipalities. We thank the Luxembourg Observatoire de l'Habitat for data covering all municipalities.

lenders' decisions. In fact, own labour contributions decrease the need of external funds and can reduce the size of the mortgage, lowering the LTV ratio and the monthly instalment.

Estimates in this paper suggest that households are more likely to provide own labour to acquire their residence if they have low financial resources (i.e., own financial resources and income), mortgage rates are high and if their reference person is young or skilled in the construction industry. These results support those in the economics literature that found that borrowing constraints are often more relevant to young people and those with low financial resources. Own labour contributions may be an important tool helping such households to become homeowners.

Our theoretical model highlights that own labour contributions affect the population of homeowners through two opposing effects. First, they allow additional households to qualify for a mortgage and these tend to become homeowners with high LTV ratios. Second, they allow households who would have anyway qualified for a mortgage to reduce their LTV ratios by borrowing less. To gauge which of these two effects dominates, one has to consider the distribution of household characteristics across the population and identify the additional home buyers. This is beyond the scope of this paper and left for future research. Such future research could inform macro-prudential policy, since own labour contributions affect the population of borrowers, their LTV, and consequently banks' exposure at default.

7 References

Acolin, A., J. Bricker, P. Calem and S. Wachter (2016): Borrowing constraints and homeownership, *American Economic Review: Papers & Proceedings* ***106***(5): 625-629.

Andrews, D. and A. Caldera Sánchez (2011): Drivers of homeownership rates in selected OECD countries, Economics Department Working Papers No. 849, OECD: Paris.

Artle, R. and P. Varaiya (1978): Life-cycle consumption and home ownership, *Journal of Economic Theory* ***18***: 38-58.

Benito, A. (2006): The down-payment constraint and the UK housing market: Does the theory fit the facts? *Journal of Housing Economics* ***15***: 1-20.

Boehm, T.P. and K. Ihlanfeldt (1996): The improvement expenditures of urban homeowners: An empirical analysis, *American Real Estate Urban Economics Association Journal*, ***50***(3): 467-494.

Bogdon, A.S. (1996): Homeowner renovation and repair: the decision to hire someone else to do the project, *Journal of Housing Economics* ***5***: 323:350.

Braakmann, A. (2004): Schattenwirtschaft und Messung des Wirtschaftswachstums - Zur Vollständigkeit der Volkswirtschaftlichen Gesamtrechnungen, Working Paper 43, Universität Rostock, Wirtschafts- und Sozialwissenschaftliche Fakultät, Institut für Volkswirtschaftslehre.

Cabrales, A., A. Calvó-Armengol, and M. O. Jackson (2003): La Crema: A Case Study of Mutual Fire Insurance, *Journal of Political Economy* ***111***(2): 425-458.

Cameron, A. C. and P. K. Trivedi (2010): Microeconometrics using Stata, revised edition, Stata Press, Taxas.

Caplin, A., S. Chan, C. Freeman, and J. Tracy (1997): *Housing Partnerships: A New Approach to Markets at a Crossroads*, MIT Press: Cambridge, Mass.

Chiuri, M.C. and T. Jappelli (2003): Financial market imperfections and homeownership: A comparative study, *European Economic Review* ***47***: 857-875.

Duca, J.V. and S.S. Rosenthal (1994): Borrowing constraints and access to owner-occupied housing, *Regional Science and Urban Economics* ***24***: 301-322.

Égert, B., and D, Mihaljek (2007): Determinants of house prices in central and eastern Europe, *Comparative Economic Studies* ***49***(3): 367–388.

Engelhardt, G.V. (1996): Consumption, down payments, and liquidity constraints, *Journal of Money, Credit and Banking* ***28***(2): 255-271.

Engelhardt G.V. and C.J. Mayer (1998): Intergenerational transfers, borrowing constraints, and saving behavior: Evidence from the Housing Market, *Journal of Urban Economics* ***44***: 135-157.

Girshina, A., T.Y. Mathä and M. Ziegelmeyer (2017): The Luxembourg Household Finance Consumption Survey: Results from the 2nd wave. BCL Working Paper 106, Banque centrale du Luxembourg.

Guiso, L. and T. Jappelli (2002): Private transfers, borrowing constraints and the timing of homeownership, *Journal of Money, Credit and Banking*, ***34***(2):315-339.

Henderson, J.V. and Y.M. Ioannides (1983): A model of housing tenure choice, *American Economic Review*, ***73***(1): 98-113.

Jaffee, D. and J. Stiglitz (1990): Credit rationing, in Friedman, B.M. and F.H. Hahn (eds.) *Handbook of Monetary Economics*, Vol. II, Elsevier Science Publishers (Amsterdam: The Netherlands).

Kiff, J. and P. Mills. (2007): Money for Nothing and Checks for Free: Recent Developments in U.S. Subprime Mortgage Market, IMF Working Paper, Western Hemisphere Department and Monetary and Capital Markets Department.

Linneman, P.D. and S.M. Wachter (1989): The impacts of borrowing constraints on homeownership, *Journal of the American Real Estate and Urban Economics Association* (AREUEA), ***17***(4): 389-402.

McGrattan, E.R., and E.C. Prescott (2005): Expensed and sweat equity, Working Papers 636, Federal Reserve Bank of Minneapolis, https://ideas.repec.org/p/fip/fedmwp/636.html.

Poterba, J.M. (1992): Taxation and Housing Markets in Shoven, J.B. and J. Whalley (eds.): *Canada-U.S. Tax Comparisons*, Chapter 9, pp. 275-94 (Chicago: Chicago University Press).

Rosen H.S. (1985): Housing subsidies, in Auerbach, A.J. and M. Feldstein (eds.): *Handbook of Public Economics*, ***1***, Chapter 7, pages 375-420. Elsevier Science Publishers B.V. (North-Holland).

Soaita, A.M. (2013): Romanian Suburban Housing: Home Improvement through Owner-building. *Urban Studies* ***50***(10): 2084-2101, https://doi.org/10.1177/0042098012471980.

Stiglitz, J. and A. Weiss (1981): Credit rationing in markets with imperfect information, *American Economic Review* ***71***: 393-410.

8 Appendix A

Household problem

Consider the model described in section 3.2. When the cost of credit depends on own labour contributions, households preferences are described by the following function,

$$\boldsymbol{u_i(s_i) = \begin{cases} I_i + H - \theta \;\; s_i - I_i \; if \;\; s_i \geq \alpha - I_i \\ I_i - c_r \qquad\qquad\qquad otherwise \end{cases}} \tag{5}$$

Therefore, each household i problem is to maximize 5 by choosing s_i. In other words, household i compares the utility it gets from renting (i.e. $u(0)$), to the solution it gets by solving the following problem,

$$\boldsymbol{\max_{s_i} \; I_i + H - \theta \;\; s_i - r(s_i)} \text{ subject to } \boldsymbol{s_i \geq \alpha - I_i} \tag{6}$$

A local maximum (s_i°) to the problem 6 is guaranteed under the following conditions,

$$\boldsymbol{\theta \;\; = -r'(s_i)} \;\; , \tag{7}$$

$$\boldsymbol{r''(s_i) > 0} \; . \tag{8}$$

From equation 7 one can see that the interior solution to the household's problem is the same for every household. We refer to this solution as to the marginal contribution. When equation 8 is not satisfied the solution to 6 is a corner solution $s_i = 0$.

In the second scenario described in section 3.2, the cost of credit also depends on available resources, i.e. $r(s_i, I_i)$. In this case, the first order condition of the household's problem becomes $r'(s_i, I_i) = -\theta$. Therefore, the marginal contribution s_i° is not the same for every household and it is a decreasing function of its available resources, $s_i^\circ(I_i)$ with $\frac{\partial s^\circ(I_i)}{\partial I_i} \leq 0$.

9 Appendix B

Examples how own labour changes the LTV without increasing the value of the HMR for banks

Value of dwelling incl. own labour	500,000	500,000	500,000	500,000	500,000	500,000
Value of dwelling (bank)	500,000	480,000	460,000	440,000	420,000	400,000
Down payment	100,000	100,000	100,000	100,000	100,000	100,000
Mortgage	400,000	380,000	360,000	340,000	320,000	300,000
Own labour: amount	-	20,000	40,000	60,000	80,000	100,000
Own labour in %	0%	4%	8%	12%	16%	20%
LTV (bank)	**80%**	79%	78%	77%	76%	75%
Interest payment first year	8,000	7,600	7,200	6,800	6,400	6,000
Monthly interest payment	667	633	600	567	533	500

Value of dwelling incl. own labour	500,000	500,000	500,000	500,000	500,000	500,000
Value of dwelling (bank)	500,000	480,000	460,000	440,000	420,000	400,000
Down payment	50,000	50,000	50,000	50,000	50,000	50,000
Mortgage	450,000	430,000	410,000	390,000	370,000	350,000
Own labour: amount	-	20,000	40,000	60,000	80,000	100,000
Own labour in %	0%	4%	8%	12%	16%	20%
LTV (bank)	**90%**	90%	89%	89%	88%	88%
Interest payment first year	9,000	8,600	8,200	7,800	7,400	7,000
Monthly interest payment	750	717	683	650	617	583

Value of dwelling incl. own labour	500,000	500,000	500,000	500,000	500,000	500,000
Value of dwelling (bank)	500,000	480,000	460,000	440,000	420,000	400,000
Down payment	150,000	150,000	150,000	150,000	150,000	150,000
Mortgage	350,000	330,000	310,000	290,000	270,000	250,000
Own labour: amount	-	20,000	40,000	60,000	80,000	100,000
Own labour in %	0%	4%	8%	12%	16%	20%
LTV (bank)	**70%**	69%	67%	66%	64%	63%
Interest payment first year	7,000	6,600	6,200	5,800	5,400	5,000
Monthly interest payment	583	550	517	483	450	417

10 Appendix C

Table A1: Table 2 continued

	Probability of providing own labour (LPM)		Share of own labour in total resources (Tobit)		Log of own labour (Tobit)
	(3a)	(3b)	(6a)	(6b)	(9b)
Gender: male (d)	0.0955**	0.0925**	0.0271**	0.0266**	1.126**
	(0.038)	(0.038)	(0.012)	(0.012)	(0.472)
Civil status: couple (d)	0.0817*	0.0843*	0.0218*	0.0234*	1.056**
	(0.043)	(0.044)	(0.013)	(0.013)	(0.520)
Civil status: divorced (d)	0.0836	0.0759	0.0232	0.0224	1.103
	(0.069)	(0.068)	(0.020)	(0.020)	(0.839)
Civil status:: widowed (d)	-0.0293	-0.0413	-0.0000314	-0.00437	-0.447
	(0.091)	(0.092)	(0.030)	(0.030)	(1.119)
Age at the time of acquisition: 35-44 (d)	-0.0632	-0.0952**	-0.00986	-0.0216*	-1.224**
	(0.041)	(0.041)	(0.012)	(0.013)	(0.504)
Age at the time of acquisition: 45-54 (d)	-0.123*	-0.188***	0.00534	-0.0210	-2.099**
	(0.073)	(0.072)	(0.025)	(0.024)	(0.857)
Age at the time of acquisition: 55-64 (d)	-0.133	-0.283**	0.0346	-0.0292	-3.321***
	(0.113)	(0.112)	(0.051)	(0.041)	(1.202)
Age at the time of acquisition: 65+ (d)	-0.334***	-0.531***	-0.0519	-0.102*	-5.759***
	(0.122)	(0.114)	(0.109)	(0.056)	
Constant	-13.17*	-17.80**			
	(7.491)	(7.844)			
Observations	1164	1164	1164	1164	1164
Wald test of overall significance	10.94	7.59	7.76	4.8	5.77
R2 adjusted mean	0.149	0.128			
R2 adjusted min	0.139	0.113			

*Source: Own calculations based on the 2nd wave of the LU-HFCS, data are multiply imputed and weighted. Variance estimation based on 1,000 replicate weights. Standard errors in ( ). *** p<0.01, ** p<0.05, * p<0.1. (d) indicates a dummy variable. Tobit estimates report average marginal effects of the latent expected value of y*. Variables in euro amounts are inflation adjusted to 2014 euros.*

Table A2: Probit estimates of own labour contributions – complete table

	Probit			Probit		
	(1a)	(2a)	(3a)	(1b)	(2b)	(3b)
Down payment / total funds used	-0.389***	-0.362***	-0.280***			
	(0.051)	(0.053)	(0.065)			
Down payment: Q1 (d)				-0.0280	-0.0207	-0.0166
				(0.070)	(0.067)	(0.066)
Down payment: Q2 (d)				0.0801	0.0908	0.0976
				(0.066)	(0.069)	(0.067)
Down payment: Q3 (d)				-0.0587	-0.0449	-0.0185
				(0.067)	(0.067)	(0.067)
Down payment: Q4 (d)				-0.0196	-0.0144	0.0201
				(0.066)	(0.068)	(0.067)
Down payment: Q5 (d)				-0.154**	-0.121*	-0.0194
				(0.070)	(0.070)	(0.071)
Gross income (in €10,000)	-0.00582***	-0.00487**	-0.00539**	-0.00557***	-0.00529**	-0.00602**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Mortgage rate (ln)	0.109***	0.149**	0.142**	0.0936***	0.162**	0.151**
	(0.033)	(0.068)	(0.069)	(0.034)	(0.071)	(0.070)
Skills from the construction industry		0.189***	0.149**		0.188***	0.145**
		(0.058)	(0.063)		(0.057)	(0.064)
Education: middle (d)		-0.0113	-0.0457		-0.0209	-0.0669
		(0.045)	(0.044)		(0.047)	(0.045)
Education: high (d)		-0.116**	-0.138***		-0.124**	-0.161***
		(0.052)	(0.052)		(0.055)	(0.054)
Type of HMR: house (d)		0.150***	0.115***		0.168***	0.111**
		(0.045)	(0.044)		(0.046)	(0.045)
Year of HMR acquisition		0.00470	0.00689*		0.00582	0.00886**
		(0.004)	(0.004)		(0.004)	(0.004)
Gender: male (d)			0.0952***			0.0923**
			(0.037)			(0.038)
Civil status: couple (d)			0.0854*			0.0883*
			(0.044)			(0.045)
Civil status: divorced (d)			0.0793			0.0728
			(0.068)			(0.068)
Civil status: widowed (d)			-0.0256			-0.0358
			(0.097)			(0.097)
Age at the time of acquisition: 35-44 (d)			-0.0611			-0.0932**
			(0.043)			(0.043)
Age at the time of acquisition: 45-54 (d)			-0.121			-0.185**
			(0.076)			(0.075)
Age at the time of acquisition: 55-64 (d)			-0.128			-0.275**
			(0.119)			(0.115)
Age at the time of acquisition: 65+ (d)			-0.411**			-0.544***
			(0.202)			(0.131)
Observations	1164	1164	1164	1164	1164	1164
Wald test of overall significance	22.51	14.45	8.8	4.89	6.41	5.74

*Source: Own calculations based on the 2nd wave of the LU-HFCS, data are multiply imputed and weighted. Variance estimation based on 1,000 replicate weights. Standard errors in ( ). *** p<0.01, ** p<0.05, * p<0.1. (d) indicates a dummy variable. Coefficient estimates show average marginal effects. Variables in euro amounts are inflation adjusted to 2014 euros.*

11 Appendix D

Research related questions from the 2014 Luxembourg HFCS

2.07A HLB0500 *Filter if HB0600==1 or HB0600==2*

At the time [you/someone in your household] acquired your main residence, what amount of the initial value did you pay with your own capital/funds (incl. gifts and intergenerational transfers).

Filter if HB0600==3 or HB0600==4:

You told us that you <inherited your HMR/ received your HMR as gift>. At this time, what was the (part of) HMR worth you <inherited/ received as gift>? Please include also additional amounts you invested with your own capital/funds?

INTERVIEWER: ALSO CONSIDER THE VALUE OF THE LAND.
IF NO CONTRIBUTION, ENTER 0.

Numerical value in EUR, 9 digits.

-1 - Don't know
-2 - No answer

If 2.06= 1 or 2, continue with point 2.07B ; if not go to point 2.07C

2.07B HNB0910x

When you (purchased/constructed) your house/flat, did you receive any kind of support from relatives or other persons such as a loan guarantee, financial support without a repayment obligation (gift), a credit or any other?

1 - Yes, guarantees
2 - Yes, financial support without repayment obligation/ gift
3 - Yes, credits by relatives
4 - Yes, others (please explain)
5 - No

-1 - Don't know
-2 - No answer

Series of 4 variables
a - main help
b to d - secondary assistance

2.07C HLB0600

At the time of acquistion of your household main residence, in terms of euro amounts how much did [you/someone in your household] contribute to the value by your own labour / work or the labour / work of unpaid relatives and friends and helpers?

INTERVIEWER :
PLEASE TAKE INTO ACCOUNT THE VALUE OF THE WORK BEFORE MOVING IN OR IMMEDIATELY AFTER TO MAKE YOUR HOME HABITABLE.
IF NO WORK, ENTER 0.

Numerical value in EUR, 9 digits.

-1 - Don't know
-2 - No answer

2.07D HLB0601 *Filter if HB0600==1 or HB0600==2*

At the time [you/someone in your household] acquired your main residence, what amount of the initial value did you pay using any kind of mortgage/loan?

Filter if HB0600==3 or HB0600==4:

You told us that you <inherited your HMR/ received your HMR as gift>. At this time, additional funds might have been necessary (e.g. to renovate the HMR or pay out other heirs). What amount of the initial value did you pay using any kind of mortgage/loan? If you did not take out any mortgage, fill in zero.

INTERVIEWER :

DO NOT TAKE INTO ACCOUNT AMOUNTS BORROWED AT A LATER DATE.

INFORM THE RESPONDENT THAT THIS QUESTION CONCERNS THE INITIAL LOAN AT THE TIME OF ACQUISITION BUT THAT IN THE FOLLOWING SECTION MORE DETAILS WILL BE REQUESTED ON THE CURRENT LOAN.

IF NO AMOUNT IS PAID WITH A LOAN: ENTER 0.

Numerical value in EUR, 9 digits. *-1 - Don't know*
-2 - No answer

2.08 HB0800

How much was the residence worth at the time [you/someone in your household] acquired it)? (< If 2.03=2 [only partly owned by the household] > Please consider the price of the entire residence, not just your/your household's share)?

INTERVIEWER :

PLEASE TAKE INTO ACCOUNT THE VALUE OF THE WORK DONE BY YOU OR BY FAMILY/FRIENDS/UNPAID PERSONS.

IF THE HOUSING HAS BEEN BUYED IN SEVERAL STEPS: Please indicate the total value at the time when (you/a member of your current household first acquired a portion of the property.

IF THE DWELLING WAS INHERITED/RECEIVED AS A GIFT, TRY TO OBTAIN AN ESTIMATE OF THE MARKET VALUE OF THE PROPERTY AT THE TIME THE INHERITANCE OR GIFT WAS MADE.

ALSO TAKE INTO ACCOUNT THE VALUE OF THE LAND.

Numerical value in EUR, 9 digits. *-1 - Don't know*
-2 - No answer

12 Appendix E

The introduction to the survey was as follows:

"*We seek to understand to what extent your bank takes into account the contribution of own labour ("or sweat equity") provided by households when applying for a mortgage in order to build, buy or renovate their main residence. To be more precise, we are interested in private households residing in Luxembourg who participate in the construction of their main residence without receiving a salary for this work (this may include family members, friends and relatives). This provision of own labour can reduce the need for external financing or increase the share of own funds for the borrowing household, which can affect your bank's decision to offer a mortgage, as well as the conditions under which this mortgage is offered. From a macroeconomic point of view, the importance that banks attach to own labour can affect the share of the population with access to ownership, modify the socio-demographic and economic characteristics of owners and thus have consequences for financial stability.*"

The complete questionnaire is provided below:

QUESTIONNAIRE

Own labour or sweat equity and mortgage application for the purchase of a household main residence.

Question 1

Generally speaking, when a household requests a mortgage for the acquisition (construction or purchase) of a main residence, what is the importance of own labour ("or sweat equity")?

	not important	of little importance	important	very important
Own labour is considered as	☐	☐	☐	☐

Question 2

In particular, does own labour input affect:

Please treat each option separately from the other options indicated.

	not important	of little importance	important	very important
Your bank's decison to grant the mortgage	☐	☐	☐	☐
The contribution of own funds required from households	☐	☐	☐	☐
The loan-to-value ratio applied to the total amount	☐	☐	☐	☐
The maximum mortgage amount offered by your bank	☐	☐	☐	☐
The interest rate offered by your bank	☐	☐	☐	☐
Fees (other than interest) charged by your bank	☐	☐	☐	☐

Question 3

In relation to the total investment cost, what is the maximum share of own labour that your bank is willing to accept?

	0 % à < 5 %	5 % à < 10 %	10 % à < 15 %	15 % à < 20 %	>20 %
The share of own labour in the total investment cost is at the most:	☐	☐	☐	☐	☐

Question 4

How can own labour input influence your bank's decision?

Please treat each option separately from the other options indicated.

	no influence	slight	moderate	strong	very strong
Increases the likelihood that your bank will a offer mortgage	☐	☐	☐	☐	☐
Increases the amount of mortgage offered by your bank	☐	☐	☐	☐	☐
Reduces the interest rate offered by your bank for the mortgage	☐	☐	☐	☐	☐

Question 5

In your opinion, is your bank's decision to accept own labour influenced by the household characteristics listed below?

Please treat each option separately from the other options indicated.

	Decreases the probability of accepting a personal labour input from the bank		no influence	Increases the probability of accepting a personal labour input from the bank	
	slighlty	strongly		slighlty	strongly
The income of the household	☐	☐	☐	☐	☐
The wealth of the households	☐	☐	☐	☐	☐
The contribution of own funds by the household	☐	☐	☐	☐	☐
The level of the interest rate offered	☐	☐	☐	☐	☐
The total amount of the project	☐	☐	☐	☐	☐
A craft profession	☐	☐	☐	☐	☐
The age of the applicant	☐	☐	☐	☐	☐

Question 6

How is own labour treated in the mortgage application?

Please treat each option separately from the other options indicated.

	Yes	No
Does the mortgage application form allow the household to quantify its own labour input (including that provided by other family members, relatives and/or friends)?	☐	☐
Does your bank require detailed cost proposals for various manual tasks (e.g. painting walls, wiring and plumbing)?	☐	☐
Does your bank check ex-post the own labour provided (e.g. by inspecting the site)?	☐	☐

Question 7

In your opinion, what influence do the following characteristics have on the household's decision to provide own labour?

Please treat each option separately from the other options indicated.

	Decreases the probability		no influence	Increases the probability	
	slighlty	strongly		slighlty	strongly
Low income	☐	☐	☐	☐	☐
Low own funds	☐	☐	☐	☐	☐
Building / buying a house (compared to an apartment)	☐	☐	☐	☐	☐
Private sector employment	☐	☐	☐	☐	☐
A craft profession	☐	☐	☐	☐	☐
Low level of education	☐	☐	☐	☐	☐
Young households (<35 years)	☐	☐	☐	☐	☐

Question 8

Are there any other important questions regarding own labour in the mortgage application that were not raised in this questionnaire?

Mortgages granted by your bank in 2014

Question 9

The share of principal residence mortgage credits granted in 2014 that include a personal labour input

	%
The share of mortgage loans granted that include a contributio of own labour was	
The average share of own labour in the total investment was	

Question 10

General information on mortgages granted by your bank in 2014

In 2014, the share of new mortgage contracts for the main residence	**%**
in the number of mortgage contracts was	
in the total value of mortgage contracts was	

Thank you for your participation

	Yes	No
Would you like to receive a copy of the publication resulting from this study?	☐	☐

BANQUE CENTRALE DU LUXEMBOURG

EUROSYSTÈME

2, boulevard Royal
L-2983 Luxembourg

Tél.: +352 4774-1
Fax: +352 4774 4910

www.bcl.lu • info@bcl.lu