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Endogeneity in household mortgage choice☆

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ABSTRACT

We show that failing to correct for both sample selection and endogeneity bias leads to an under-estimate of the importance of mortgage price in determining the mortgage product a household selects. With proprietary, loan-level data from a major Australian mortgage provider we study interest rate determination, loan size and mortgage product choice. The level of mortgage indebtedness varies with the value and characteristics of the property, while individual mortgage interest rates depend on borrower characteristics. Our results show that borrowers consider the initial interest rate and implicitly the loan amount they can access when choosing a mortgage product.

1. Introduction

Owner-occupiers choosing to finance their properties with a home loan face a series of mortgage decisions which reflect binding constraints and preferences: the choice of lender, mortgage product (fixed-rate, variable-rate or other), loan size and term, and in some jurisdictions public or private mortgage insurance. Once the mortgage has been contracted, and through the life of the loan, borrowers will decide on refinancing, prepaying or defaulting options. These decisions may be jointly determined or conditional on each other.

This paper explores mortgage pricing and loan size determination in the mortgage product choice process and illustrates their impact using loan-level data from one of the major mortgage providers for the Australian housing market. We extend earlier literature on mortgage product choice by allowing for simultaneous determination between two crucial features of the loan contract: the loan size and the interest rate. Most of the literature has ignored the simultaneity in the determination of mortgage products, price and terms in the mortgage choice.

Individual mortgage interest rate determination is rarely studied as it is usually assumed that all borrowers contracting the same mortgage product at a point in time and with the same financial institution will face the same interest rate. However, in our dataset, described in Section 3, the average individual variable-rate mortgage issued by the bank is on average 418 basis points lower than the bank's advertised variable rate – see columns 2 and 5 in Table 1, while the distribution can range from between 8 percentage points above and below the advertised rate. Fig. 1 shows the variability in the spread between individual interest rate for a mortgage product at application time and the advertised interest rate for that mortgage product by the bank. The Figure shows that the actual interest rate charged to the mortgage borrower differs from the advertised or market rate. It is natural to think that differing loan sizes may account for some of the heterogeneity in pricing strategies between households. However, the plot of interest rates against loan size across time in Fig. 2 demonstrates that loan size is not sufficient to explain the variability of interest rates for individual mortgage contracts. Some of the differences will be due to differing household characteristics; Dungey et al. (2015a) establishes clear mortgage borrower profiles in the Australian housing market, and we also control for those here.

Practical obstacles for individual interest rate prediction are issues of selection bias and endogeneity. Usually, the interest rates reported are those associated with the mortgage product contracted and not

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Table 1
Average annual interest rates by mortgage type.

Year	VRM	SFRM	HM	VRM (advertised)	SFRM (advertised)	Cash Rate
2003	6.35% (0.29%)	6.38% (0.44%)	5.70% (0.38%)	6.65% (0.16%)	6.33% (0.41%)	4.83% (0.16%)
2004	6.72% (0.29%)	6.86% (0.29%)	6.22% (0.36%)	7.07% (0%)	6.84% (0.19%)	5.25% (0%)
2005	6.88% (0.29%)	6.80% (0.17%)	6.51% (0.32%)	7.28% (0.09%)	6.79% (0.14%)	5.46% (0.09%)
2006	7.13% (0.37%)	7.08% (0.25%)	6.84% (0.37%)	7.64% (0.27%)	7.08% (0.27%)	5.81% (0.26%)
2007	7.65% (0.36%)	7.67% (0.31%)	7.42% (0.29%)	8.23% (0.20%)	7.72% (0.32%)	6.40% (0.19%)
2008	8.44% (0.70%)	8.53% (0.47%)	8.17% (0.75%)	8.90% (0.82%)	8.40% (0.93%)	6.66% (0.89%)
2009[a]	5.89% (0.88%)	6.81% (1.16%)	5.64% (0.75%)	6.05% (0.40%)	6.19% (0%)	3.36% (0.43%)
Total	7.12% (0.84%)	7.34% (0.78%)	6.63% (1%)	7.55% (0.90%)	7.15% (0.83%)	5.60% (0.94%)

[a] Average for the period January–May 2009. (Standard deviations). Sources: RBA F1 Interest Rates and Yields – Money Market – https://www.rba.gov.au/statistics/historical-data.html.

the ones for the mortgage products discarded, which generates a non-random sample. Generally the selection bias correction results in prediction of unobservable interest rates. However, in the empirical literature, these predictions omit relevant endogeneous variables such as the loan size (LTV) and the maturity of the loan. Ignoring this potential simultaneity may underestimate or overestimate the importance of the role that borrower characteristics or other factors play in the choice of mortgage product.

In this paper we emphasize that the type of mortgage contract, the loan size, and the interest rates are jointly determined in the course of negotiations between the lender and the borrower.

We show that allowing for price and loan terms to be jointly determined is necessary to identify the mortgage product choice model, and understand the mortgage process along with the determination of interest rates and loans sizes. The study uses a unique loan-level database from a large Australian bank for the period between January 2003 and August 2008 to analyse the factors that determine the probability of choosing a variable-rate mortgage (VRM) addressing sample selection bias and endogeneity issues.

We show that the role of borrower characteristics is significant in determining mortgage choice directly and indirectly, through loan size and interest rate determination. We find that the interest rates offered to borrowers for the same mortgage contract by the same financial institution and at the same point in time are not the same across borrowers, and vary with their individual characteristics – presumably with the aim to assess risks rather than discriminating among consumers. The level of borrower indebtedness varies with the value of the property, property characteristics and also with borrower characteristics. We show that the explanatory power of the mortgage costs – but not the role of borrower characteristics – is affected by the consideration of endogeneity between interest rate and loan size and the selection bias addressed in the mortgage choice specification. We demonstrate that in selecting a mortgage contract borrowers jointly consider the lowest initial interest rate available and the loan amount they can access. That is, borrowers take the mortgage product that offers them the lowest interest rate given the loan size they are after and the risk their individual borrower characteristics reveal.

We find that when selection bias and endogeneity corrections are considered in the mortgage product choice specification, borrowers' choice of variable-rate mortgages is more responsive to differences in mortgage interest rates than when these corrections are omitted.

We also find evidence of borrower negotiation power and lender risk assessment in the mortgage interest rate pricing as some borrowers pay lower interest rates than the average borrower while others pay higher rates. For example, we find that borrowers in their thirties with high level of liquid assets consistently pay lower mortgage interest rates than the average borrower. Moreover, we confirm previous results in Dungey et al. (2015b) that variable-rate mortgages are held by relatively mobile borrowers with high income and wealth levels who expect equity gains. As expected, young and relatively mobile borrowers with high income levels take larger loans than the average borrower, while risk averse, income-constrained and wealthy borrowers take smaller loans.

The implications of our findings are relevant for understanding household risk management and the design of mortgage products. Low income risk, mobile borrowers take larger loans. Generally, lower interest rates are offered to borrowers with larger loans; however we observe risk assessment, market power and negotiation power in the loan-level interest rate determination. Moreover, lower loan sizes are self-selected or a consequence of credit constraints based on risk assessments.

More importantly, our findings reveal the potential effects of monetary policy transmission coupled with macro- and micro-prudential regulation. We show that borrowers' mortgage risk choices although mainly determined by mortgage prices, are also determined by mortgage terms – such as loan size, market conditions and borrower characteristics. We find that a 100 basis point increase in the interbank interest rate decreases the loan size by 9.5 percent, and actual individual mortgage interest rates increase by 1.05–1.33 percent. Changes in the interest rate spread between mortgage contracts offered to applicants alter their choice of mortgage risk exposure, particularly when considering the accessible loan amount. Macro- and particularly micro-prudential regulations, from an individual's perspective, restrict or limit the access to credit based on LTVs and other measures determined by borrower characteristics (such as payment-to-income ratios, borrower risk, etc); see for example Gross and Población (2017), and Havranek et al. (2016) and Bernhofer and van Treeck (2013). This in turn affects their mortgage choices and the risk they bear. Ultimately, borrower's behaviour and risk choices affects monetary policy transmission and financial stability.

The remainder of the paper is organised as follows. Section 2 presents the existing literature on mortgage product choice and interest rate determination. Section 3 presents an overview of the particular institutional setting of the Australian mortgage market, which contextualises the data set described later in that Section. Section 4 introduces the empirical specification and the estimation procedure. Results are discussed in Section 5. Section 6 concludes.

2. Existing literature

The literature on mortgage choice indicates that the main determinant of mortgage product selection is price; see Dhillon et al. (1987),