Where $\overline{\mathrm{B}}$ is the vector of mean consumer preferences and Π maps demeaned consumer demographic characteristics such as income and house prices $(D_{ict} - \overline{D})$ to individual consumer preferences. For example, higher-income borrowers can have different price sensitivities than lower-income borrowers, and their preferences over mortgage size can differ. Σ scales normal i.i.d. shocks $\nu_i \sim N(0, I)$. Thus, even borrowers with the same observable characteristics, such as income, can differ in their price elasticity or ideal mortgage size. The demand parameters to be estimated are then $\theta_d = (\overline{\mathrm{B}}, \Pi, \Sigma)$. [12]

Consumers choose the mortgage that maximizes their utility by choosing between offered mortgages, subject to an LTV constraint. If they do not choose a mortgage, they choose an outside good with a fixed utility, u_{i0}. In other words, given product characteristics for each mortgage offered in the market $jctg$ (including interest rate, mortgage type, lender type, statutory size limits, and service quality), and demand parameters θ_d, the set of borrower characteristics (including product-borrower match utilities $\epsilon_{ijc..}$), such that borrowers with these characteristics in market ct choose a mortgage of type g from lender j is:

$$A_{jctg}(r_{\cdot ct \cdot}, g_{\cdot ct \cdot}, \bar{F}_{ct}, q_{\cdot t}, \xi_{\cdot ct}; \theta_d) = \left\{ \left(D_i, \epsilon_{i0ctg}, \dots, \epsilon_{ijctg} \right) \mid u_{ijctg} \geq u_{ikctl}, \forall k, l \right\} \tag{D.4}$$

$A_{jctg}(\cdot)$ denotes the set of demographic characteristics D_i and idiosyncratic shocks $\epsilon_{i\cdot ctg}$ such that given loan characteristics $(r_{\cdot ct \cdot}, g_{\cdot ct \cdot}, \bar{F}_{ct}, q_{\cdot t}, \xi_{\cdot ct})$ and parameters θ_d, consumers with those demographics and preference shocks obtain more utility from choosing the loan from lender j of type g, u_{ijctg}, than from all other lenders and loan types, u_{ikctl} among loans satisfying the borrower-specific LTV constraint. Integrating over demographics and shocks yields the market share of mortgage lender j offering product g in market ct:

$$s_{jctg}(r_{\cdot ct \cdot}, g_{\cdot ct \cdot}, \bar{F}_{ct}, q_{\cdot t}, \xi_{\cdot ct}; \theta_d) = \int_{A_{jctg}} \frac{\exp\left(u_{ijctg}(\mathrm{B}_i)\right)}{\sum_{k,l} \exp\left(u_{ikctl}(\mathrm{B}_i)\right)} dB(B_i) \tag{D.5}$$

Note that the size of mortgages a consumer chooses is implicitly captured in expression D.4. If a consumer prefers a jumbo-sized mortgage and chooses a jumbo mortgage, she does so at the ideal size or at the LTV constraint. If instead this consumer chooses a conforming mortgage, she will choose the largest conforming mortgage possible subject to the LTV constraint, which implies bunching at the conforming loan limit.

IV.B Mortgage Supply

There are N_{bct} banks, N_{nct} non-fintech shadow banks, and N_{fct} fintech shadow banks in market ct. Lenders choose simultaneously which mortgages to originate across all markets and how to finance them. A lender j who originates m_{jctg} dollars of mortgage type g in market ct has to decide how many

[12] We directly draw log F_i, log house prices and log income from normal distributions. In consequence, the distribution of log F_i is normal, so F_i is lognormal.