

# The Credit Channel of Monetary Policy Transmission: Evidence From the Chonsei System\*

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## Abstract

This paper analyzes the credit channel of monetary policy transmission in a unique institutional setting: the Chonsei system in the Korean housing market, where rental tenants make interest-free loans to landlords in exchange for paying no rent. As Chonsei interest rates approach zero, the size of Chonsei loans grows unboundedly, exerting strong upwards pressure on house prices. We verify the model's predictions empirically. Calibrating the model to the data, we find that a simple policy – imposing a proportional tax on Chonsei deposits – substantially dampens the passthrough of interest rate changes to deposit size and house prices, potentially improving financial stability.

Keywords: Credit Channel, Monetary Policy, Chonsei, Mortgage

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# 1 Introduction

When central banks lower interest rates, credit becomes more widely available, stimulating consumption and increasing asset prices. The magnitude and incidence of the credit channel within any specific episode depends crucially on the unique institutional details and regulations within the given credit market. For example, monetary policy passthrough in housing markets depends crucially on various institutional details of mortgage markets, such as average mortgage terms and the relative prevalence of fixed- versus variable-rate mortgages (Calza, Monacelli and Stracca, 2013). Interest rate changes may interact with factors such as large-scale securitization and associated moral hazard issues in the 2006 US housing boom (Keys et al., 2010), or the elastic supply of construction in the Spanish property bubble (Jimeno and Santos, 2014), to magnifying the effect of stimulative policy on house prices. Banks may have deposit market power, as in the US, causing rate increases to induce outflows from the banking system into other risky assets (Drechsler, Savov and Schnabl, 2017).

The analysis of monetary passthrough in a variety of institutional settings helps in elucidating which general features of policy passthrough are consistent across countries, and also can potentially guide policymakers in redesigning credit markets, borrowing features from institutions across countries, to modulate the nature of monetary passthrough. This paper contributes to the literature on how credit market institutions affect monetary passthrough in the context of a unique setting: the Chonsei system in the Korean housing market.

In a Chonsei arrangement, a tenant gives a large, interest-free deposit to her landlord, in exchange for paying zero rent payments. Chonsei arrangements are very prevalent,

with roughly equal shares of the population using Chonsei arrangements compared to standard rental agreements. The availability of Chonsei credit also fluctuates significantly over the business cycle: the median ratio between Chonsei deposits and annual rents rose from roughly 12.9 in 2012 to 21.8 in 2020. A natural conjecture is that the Chonsei system is an important conduit through which monetary policy influences outcomes in housing markets; however, the factors determining equilibrium availability of Chonsei credit, and their interaction with monetary policy, are still poorly understood.

This paper analyzes the credit channel of monetary policy in the context of the Chonsei system. We construct a simple model illustrating how Chonsei credit availability, and thus house prices, depend on interest rates. Our model is able to rationalize a large fraction of the cross-sectional and time-series variation in the size of Chonsei deposits. We show that the Chonsei system produces an extremely strong credit channel: Chonsei credit and thus house prices are very sensitive to small changes in interest rates, especially when rates are close to zero. Our model can quantitatively explain why a relatively small decrease in central bank policy rates from 2012 to 2020 led the ratio of Chonsei deposit size to rents to increase by 69%, and the price-rent ratio to increase by 52%, from 2012 to 2020. In our fitted model, we find that simple policies which impose proportional taxes on Chonsei deposits can substantially lower the passthrough of rate changes to Chonsei deposit size and house prices, which have the potential to improve financial stability in the Korean housing market.

We begin our analyses by describing some history and institutional details of the Chonsei system. Chonsei deposits are often very large, at around 70% of house prices, and Chonsei arrangements generally have two-year terms, implying that deposit sizes are reset frequently in response to market conditions. Chonsei arrangements are popular partly

due to the fact that the residential mortgage market in Korea is unusually underdeveloped: mortgages have very short terms, and loan-to-value ratios generally below 40%. It is common for tenants to fund Chonsei deposits by borrowing from banks; thus, Chonsei arrangements essentially involve tenants making interest-free loans to landlords in lieu of paying rent.

We construct a simple model of equilibrium in Chonsei and housing markets. In the model, overlapping generations of renters choose between purchasing housing services by paying rent, or borrowing from banks to fund Chonsei deposits. Overlapping generations of potential landlords choose whether to buy houses outright, or using credit from Chonsei deposits. In equilibrium, renters must be indifferent between Chonsei deposits and paying rent, so the annual interest payments that Chonsei tenants make to their banks must equal rents.

Monetary policy influences outcomes in our model through its effect on Chonsei credit availability. When interest rates decrease, Chonsei deposit sizes must increase, in order for renters to be indifferent between paying rents and paying interest on Chonsei deposits. The greater availability of Chonsei credit thus increases house prices, by relaxing landlords' liquidity constraints and increasing landlords' willingness-to-pay for houses. Our model implies that interest rate changes have a quantitatively very large effect on Chonsei deposit size, especially as interest rates decrease towards zero. Chonsei deposits effectively behave like infinite-maturity assets, which must have interest payments equal to rents each period. Thus, when interest rates decrease towards zero, Chonsei deposit size increase unboundedly.

The model makes three qualitative predictions which we bring to the data. First, cross-sectionally, Chonsei-rent ratios and price-rent ratios should be higher in areas where

*tenants* are more creditworthy, since they can borrow from banks at lower interest rates. Second, in the time series, decreases in interest rates should associate with increases in Chonsei-rent and price-rent ratios. Third, the passthrough of interest rates to house prices should be higher in areas where Chonsei arrangements are more prevalent, and the credit channel is stronger. We verify all three predictions empirically.

We then calibrate our model to data on Korean housing market, in order to evaluate whether the model can quantitatively rationalize the paths of Chonsei deposit size and house prices. Our fitted model attributes roughly 60% of the rise in Chonsei deposit size, from 2012-2016, to the effects of monetary policy. We are also able to rationalize the time series of price-rent ratios, separately for high- and low-Chonsei prevalence areas, with reasonable parameters for landlords' preferences and housing supply elasticities.

We then analyze two counterfactuals showing how policy changes would influence outcomes in housing markets. First, we propose a simple way to limit the passthrough of interest rates to housing markets: the government could impose a proportional tax on Chonsei deposits. This would decrease the equilibrium size of Chonsei deposits, and thus also the passthrough of interest rate changes to house prices. In the data, the Chonsei-rent ratio increases by 7-9 times annual rents, and house prices increase by 7-11 times rents, from 2012-2019. Using our calibrated model, we find that an annual tax of 3% of deposit size would cause the Chonsei-rent ratio to increase by only 5-7 times annual rents, and would limit house price growth to around 4-7 times annual rents over the same time period.

Central banks worldwide are considering raising interest rates; in our second policy counterfactual, we analyze how rate increases would influence Chonsei deposit size and house prices. We find that an increase of the Korean base rate from 0 to 2.5% would

decrease Chonseil deposit size by approximately 30-35%, and would cause a large drop in price-rent ratios, of approximately 24-28%. This further emphasizes that policies that limit Chonseil size and interest rate passthrough, such as our proposed tax on Chonseil deposits, may have benefits for financial stability in the Korean housing market.

Narrowly, our results have direct implications for understanding how monetary policy affects the predominant form of credit provision in the Korean housing market. More broadly, our results contribute to understanding how different credit market institutions shape the passthrough of monetary policy. The Chonseil system is a particularly extreme setting, in which historical circumstances have created an unusually strong credit channel, through a form of housing credit provision which displays very high interest rate dependence when the level of rates is low. The institutional details of the Chonseil system are not solely the result of the market's "invisible hand" – they are the result of numerous policy choices made throughout history, in times where the extreme passthrough of interest rates clear to the zero lower bound was a much less relevant concern. It is not clear that regulators should allow this status quo to persist. Our results inform how regulators could intervene to redesign Korean housing credit markets, stabilizing house prices and limiting the possibility of large housing busts induced by monetary policy tightening.

## **1.1 Literature Review**

Our paper is most related to a literature which studies how institutions affect the credit channel of monetary policy transmission. Greenwald (2018) argues that the lack of payment-to-income constraints played an important role in increasing the transmission of monetary policy in the 2006 housing boom. Greenwald and Guren (2021) argues that the

effect of credit on house prices depends on the degree of segmentation between rental and housing markets. LaPoint (2021) uses a natural experiment to show how the relaxation of land-related collateral constraints increased borrowing and real estate prices in Japan in the 1980s. Calza, Monacelli and Stracca (2013) discuss how differences in housing finance systems, such as the duration of mortgage contracts, the relative prevalence of FRMs and ARMs, and the existence of “equity release” products affect monetary passthrough. Badarinza, Campbell and Ramadorai (2016) surveys the field of international comparative household finance.

A particular area of focus in this literature analyzes how mortgage design affects monetary policy passthrough. A number of papers show that FRM refinancing plays a large role in the transmission of monetary policy to households in the United States (Wong, 2019; Berger et al., 2021; Fisher et al., 2021; Eichenbaum, Rebelo and Wong, 2022; Zhang, 2022). Other papers analyze more broadly how monetary policy passthrough is influenced by the prevalence of adjustable-rate versus fixed-rate mortgages, influence the passthrough of monetary policy to consumption, savings, and asset prices (Calza, Monacelli and Stracca, 2013; Garriga, Kydland and Šustek, 2017; Di Maggio et al., 2017; Holm, Paul and Tischbirek, 2021; Flodén et al., 2021). Also related are a number of papers considering possible redesigns of mortgage markets (Campbell, Clara and Cocco, 2021; Guren, Krishnamurthy and McQuade, 2021).

More broadly, this paper is related to a literature on how credit conditions move house prices. Mian and Sufi (2009) and Favilukis, Ludvigson and Van Nieuwerburgh (2017) argue that an increase in mortgage credit availability was an important driver of the 2006 housing boom. Kaplan, Mitman and Violante (2020) argues that expectations, rather than credit conditions, were the main driver of the 2006 housing boom and bust. Mian

and Sufi (2018) show that credit supply expansion drove an increase in speculative activity, leading to an amplified housing boom and bust. Our paper also fits into a literature analyzing how government policy shapes the structure of housing finance markets (Jiang, 2019; Cherry et al., 2021; Liu, 2022; Jiang and Zhang, 2022).

Our paper is also related to a literature on the Chonsei system. Yoon (2003) is an overview and history of the Chonsei system. Ambrose and Kim (2003) discuss the history and development of the Chonsei system, and analyze the put option for the renter embedded in the Chonsei contract. Choi and Lee (2009) construct a model of equilibrium house prices, taking as given Chonsei deposit sizes. Kim (2013) constructs a model in which “mixed Chonsei” arrangements are possible, and shows conditions under which full Chonsei arrangements emerge as the Pareto-optimal outcome. Shin, Kim et al. (2013) compares Chonsei deposits to repo contracts, and constructs a model in which disintermediation of the banking industry through the Chonsei system improves overall efficiency. A number of other papers analyze determinants of the equilibrium ratio between Chonsei deposit size and house prices (Cho, 2007; Moon, 2018a).

A closely related paper to ours is Park and Pyun (2020). The core object of the model and empirical analysis in Park and Pyun (2020) is the ratio of deposits to rents, for individual housing units which have some deposit and some rental payments. Park and Pyun (2020) argue that deposit-rent ratios are higher, and deposit-only contracts are more likely – that is, deposit-rental ratios at the individual unit level can approach infinity – for areas where renters’ cost of capital is lower, and provide evidence that this prediction holds in the cross-section of counties. One core difference between our paper and Park and Pyun (2020) is that we focus on the ratio of average rents on rent-only buildings, to Chonsei deposits on comparable deposit-only buildings. This is a different ratio to



that studied in Park and Pyun (2020). Our model argues that this ratio is also driven by renters' cost of capital, and we analyze how cross-sectional variation in renter' cost of capital as well as time-series variation in monetary policy affect this ratio.

## 1.2 Outline

The paper proceeds as follows. Section 2 describes institutional background around the Chonsei system. Section 3 presents our model, and Section 4 presents empirical tests of the model's predictions. Section 5 calibrates our model to data, and section 6 contains our policy counterfactuals. We conclude in Section 7. A description of datasets we use and cleaning steps is in Appendix A, and model proofs are in Appendix B.

## 2 Institutional Background

Renters in the Korean housing market who wish to purchase housing services, without owning houses, essentially have two options. The first is to enter into a standard rental contract, paying a landlord periodic rent payments. The second is to enter into a Chonsei agreement. Chonsei tenants deposit a large sum of money with homeowners, in exchange for paying zero rental payments. Once the Chonsei contract ends, the homeowner pays the Chonsei deposit back to the tenant without any interest.<sup>1</sup> Chonsei tenants generally cannot afford the entirety of the Chonsei deposit upfront, so many tenants will fund the deposit by borrowing from a bank, with positive interest rates. From the perspective of

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<sup>1</sup>Note that a Chonsei arrangement, in our data, is defined as a deposit which has zero rent payments. "Mixed Chonsei" arrangements, involving a security deposit and reduced rent, also exist. However, these are classified as rent agreements in our data.

a potential tenant, the choice between renting and using a Chonseil deposit can thus be thought of as a tradeoff between paying rent to a homeowner, versus facing the effective cost of funds locked in zero-interest Chonseil deposits; this cost may be a literal interest payment to banks, or an opportunity cost from not being able to invest funds in assets with positive expected returns. Our model will focus on this tradeoff and show how it pins down the equilibrium size of Chonseil deposits.

Chonseil deposits arrangements are very common in the Korean housing market. Figure 1 shows that, besides the roughly 55-60% of households who are owner-occupants, Chonseil tenants and renters constitute similar shares of the population at roughly 15-20% of households each. The prevalence of Chonseil arrangements has decreased somewhat over time, but remains at approximately 15% in 2020 at the end of our sample period. Appendix Tables A.1 and A.2 characterize features of Chonseil tenants and units. Chonseil tenants tend to have wealth and incomes that are higher on average than renters, but lower than owner-occupants. Consistent with this, Chonseil-deposit housing units tend to be larger than rental units, and smaller than owner-occupied units. Until June 2021, Chonseil deposits generally lasted 2 years, as the Housing Lease Protection Act guaranteed the minimum Chonseil contract term of 2 years. An amendment to the Housing Lease Protection Act, which took effect after June 2021, gave Chonseil tenants the right to request an additional two years.

The literature has argued that the Chonseil system historically emerged as essentially a peer-to-peer mortgage system, resulting from under-development of the Korean banking system, and the under-development of housing finance in particular. Korean housing policy from approximately the 1960's onwards largely focused on increasing the supply of housing units, rather than housing finance. Access to residential mortgage credit

remains extremely poor in Korea even in modern times. Mortgage terms are short – as of 2003, 87% of mortgages have maturities less than 5 years – and the national average of mortgage LTVs ranged from 26-36% in the period 1997-2008, far lower than Chonseil LTVs of around 40-70% (Ronald and Jin, 2010; Kim and Park, 2016).<sup>2</sup>

Tenants using Chonseil deposits face credit risk: the landlord may fail to return the Chonseil deposit at the end of the term. If the landlord defaults, the house is auctioned (with the tenant allowed to bid in the auction), and the proceeds from the auction are used to pay the tenant. Tenants also have some ability to seize landlords' other financial assets if the landlord defaults and the proceeds from the auction do not cover the Chonseil deposit, but this tends to be a long and costly process. To avoid this possibility, Chonseil tenants can purchase Chonseil insurance from a number of insurance providers, which guarantees that tenants are paid their Chonseil deposits back if the landlords default. The largest three insurance providers are the Korea Housing & Urban Guarantee Corporation (HUG) and the Korea Housing Finance Corporation (HF), which are state-owned enterprises, and the Seoul Guarantee Insurance (SIG), which is a private enterprise. However, default rates on Chonseil transactions were fairly low over the time period in our sample: only 0.1% of landlords refused to return the deposit in 2016, and this figure was never greater than 1%, even in 2019 and 2020, when housing speculation using the Chonseil system was fairly widespread.

Banks generally lend no more than 80% of the Chonseil deposit to tenants. In contrast to Chonseil transactions, banks' loans to Chonseil tenants are generally recourse loans:

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<sup>2</sup>The literature has proposed a few other explanations for the continued popularity of the Chonseil system besides the unusually poor state of Korean housing finance. For example, Shin, Kim et al. (2013) argues that Chonseil essentially "nets out" credit risk: by making foregone interest on Chonseil deposits play the role of rent, the risk of rental nonpayment from the tenant to the landlord and the risk of interest nonpayment from the landlord to the tenant are essentially netted.

if the homeowner defaults, the tenant is still on the hook for the entire loan amount to the bank. However, banks generally only lend to tenants who have purchased Chonsei insurance, meaning that banks do not generally bear risks from homeowner default. Thus, the main risk that a bank takes from making a loan to a Chonsei tenant is the risk that the tenant cannot make the interest payments on their loans. Banks thus have an incentive to care about the creditworthiness of the Chonsei tenants that they lend to. Logistically, funds from lending banks are sent directly to homeowners, so lenders have no opportunity to redirect the funds lent by the bank.

The ultimate result of the Chonsei system is that middle-income households essentially provide financing for high-income households to engage in speculative homebuying. Chonsei-funded homebuying is necessarily speculative, since landlords attain neither the housing services flows from owner-occupancy nor the rental income flows from standard lease agreements; any returns to landlords from engaging in Chonsei transactions must come from house price appreciation.

### **3 Model**

We construct a model that shows how monetary policy influences the equilibrium size of Chonsei deposits and the level of house prices. There are two kinds of agents in the model: tenants and homebuyers. Tenants choose between renting and using Chonsei deposits. Tenants' indifference condition pins down Chonsei deposit size, by requiring that the foregone interest on Chonsei loans is equal to equilibrium rent. Landlords choose between saving, buying-to-rent, and buying-to-Chonsei. Landlords' demand for housing creates a credit channel in the housing market: when Chonsei deposits are larger, landlords have

higher willingness-to-pay, increasing house prices in equilibrium. Housing is supplied imperfectly elastically, so changes to housing demand can affect house quantities as well as prices.

There are an infinite number of periods,  $t = 0, 1 \dots \infty$ . There are overlapping generations of renters and homeowners. There is a measure  $H_0 < 1$  of houses available for purchase; we will endogenize  $H_0$  below, by assuming an elastic supply function for housing. There is a unit measure of potential homebuyers in each period, who buy houses, and either rent them, or use Chonseï to rent them to tenants. There is a unit measure of rental tenants, who can choose between renting and Chonseï. We assume that rent  $n_t$  is exogeneously determined, by factors such as local job opportunities and wages.  $n_t$  is expected to grow at a constant rate  $g$  per period:

$$n_t = (1 + g)^t n_0$$

We assume there is a negligible measure  $\epsilon$  of houses which are owned by perfectly inelastic landlords, who set rents at  $n_t$  and never sell. This is a modelling device which ensures that renters must be indifferent between using Chonseï and renting in equilibrium.

We aim to solve for a balanced growth path, where house prices, rents, wealth, and the size of Chonseï deposits grow at rate  $g$ . Let  $p_t$  represent the price of purchased housing; prices in period  $t$  are thus:

$$p_{t+1} = (1 + g)^t p_0$$

Thus, on a balanced growth path, there will be a time-invariant price-rent ratio:

$$\frac{p_0}{n_0}$$

**Homebuyers.** There is a unit measure of potential homebuyers. We assume all potential buyers in period  $t$  have some monetary wealth:

$$W_t = (1 + g)^t W_0$$

where  $W_0$  is an exogeneous constant. Buyers discount utility at rate  $\beta$ , and have CRRA utility over consumption each period:

$$u(c) = \frac{c^{1-\eta}}{1-\eta}$$

Hence, buyers' utility over period  $t$  and  $t + 1$  consumption is:

$$u(c_t) + \beta u(c_{t+1})$$

Buyers can save an arbitrary amount at exogeneous rate  $r_S$ ; we think of  $r_S$  as a composite good representing all non-housing forms of saving, such as stocks, bonds, and other investments. Buyers cannot borrow unsecured.

Homebuyers thus have three choices: save in non-housing investments, buy a house with cash and rent out the house, or buy a house and borrow using a Chonse deposit. If a homebuyer does not buy, she chooses savings  $s_0$  to maximize:

$$V_S(W_0) = \max_{s_0 \geq 0} u(W_0 - s_0) + \beta u(s_0(1 + r_S)) \quad (1)$$

where  $r_S$  is the interest rate on one-period bonds. If a homeowner buys a house outright at price  $p_0$ , she pays  $p_0$  in the first period and receives  $n$  in rent, and  $p_0(1 + g)$  from the

sale of the house, in the second period. The homeowner thus chooses savings  $s_0$  to solve:

$$V_B(p_0, W_0) = \max_{s_0 \geq 0} u(W_0 - s_0 - p_0) + \beta u(s_0(1 + r_S) + p_0(1 + g) + n_0) \quad (2)$$

If the homeowner buys using Chonsei, she does not receive rent, but she only needs to pay  $p_0 - L_0$  upfront for the house, and receives  $p_0(1 + g) - L_0$  in the second period. She thus chooses savings to solve:

$$V_C(p_0, L_0, W_0) = \max_{s_0 \geq 0} u(W_0 - s_0 - (p_0 - L_0)) + \beta u(s_0(1 + r_S) + (p_0(1 + g) - L_0)) \quad (3)$$

We assume that homebuyers have some idiosyncratic preference shocks for saving, buying, and Chonsei, which we represent by type-1 extreme value error terms  $\xi_{Si}$ ,  $\xi_{Bi}$ ,  $\xi_{Ci}$ . Household  $i$ 's utility for saving in period  $t$  is thus:

$$U_{Si}(W_t, \xi_{Si}) = hV_S(W_t) + (1 + g)^{(1-\eta)t} \xi_{Si}$$

where  $h$  is a parameter determining how sensitive  $U$  is to  $V$ . Likewise,  $U_{Bi}$  and  $U_{Ci}$  are the sum of  $V_B$ ,  $V_C$  and the corresponding error terms. The normalization term  $(1 + g)^{(1-\eta)t}$  multiplying the error terms ensures that there exists a balance growth path on which the market shares of each of the three options are constant. We include idiosyncratic preference shocks because they smoothen the model, allowing demand for Chonsei and house purchases to be imperfectly sensitive to house prices.

From properties of logit demand systems (Train, 2009), the share of consumers choos-

ing to buy homes with cash in the initial period 0 is:

$$\pi_{B0}(W_0, p_0, L_0) \equiv P(U_{Bi} > U_{Si}, U_{Bi} > U_{Ci} | W_i = W_0, p_0, L_0) = \frac{\exp(hV_B(W_0))}{\exp(hV_S(W_0)) + \exp(hV_B(W_0, p_0)) + \exp(hV_C(W_0, p_0, L_0))}$$

We define  $\pi_{C0}(W_0, p_0, L_0)$  and  $\pi_{S0}(W_0, p_0, L_0)$  analogously. The demand for Chonsei deposits is simply  $\pi_{C0}(W_0, p_0, L_0)$ , the fraction of consumers for whom the utility from Chonsei is higher than purchasing or saving. The demand for housing is the sum of demand from Chonsei buyers and all-cash buyers:

$$D_{H0}(p_0, L_0) = \pi_{B0}(W_0, p_0, L_0) + \pi_{C0}(W_0, p_0, L_0) \quad (4)$$

The intuition behind the home buyer's problem is the following. Housing is an indivisible investment, so when house prices are high relative to buyers' wealth, buyers will be liquidity constrained if they buy houses: buyers' borrowing constraint will be binding. Thus, the marginal buyer will demand a higher return than the risk-free rate  $r_S$  to hold housing, since housing distorts the buyer's consumption Euler equation. Chonsei deposits are attractive because they allow households to smooth consumption by borrowing part of the cost of the house.

**Housing supply.** We assume housing is supplied by through an imperfectly elastic supply function. Housing supply in each period  $t \geq 1$  is specified as

$$H_t = (1 - \delta) H_{t-1} + I_t$$



where  $H_{t-1}$  is the stock of existing housing in the previous period,  $I_t$  is the amount of new housing constructed in period  $t$ , and housing depreciates at rate  $\delta$ . In each period, the supply of new construction is  $I_t = \left(\frac{p_t}{c_t}\right)^\alpha$ , where  $p_t$  is the equilibrium house price in period  $t$  and  $c_t$  is the unit cost of construction in period  $t$ . To ensure a balanced growth path with constant housing supply exists, we assume the cost of construction grows at the same rate as other variables:

$$c_t = (1 + g)^t c_0$$

We set the initial housing stock to  $H_0 = \frac{1}{\delta} \left(\frac{p_0}{c_0}\right)^\alpha$ , which allows us to solve for a balanced growth path where  $H_t = H_0$  in all periods  $t \geq 0$ . We will thus write  $H_0(p_0)$  to denote period-0 housing supply as a function of  $p_0$ ; this is increasing in  $p_0$ .

**Tenants.** Tenants in period 0 choose between paying rent  $n_0$  in order to rent a house, or lending the homeowner  $L_0$  interest-free. As we discussed above, we assume that the rent price  $n_0$  is exogenous; for example, it may be pinned down by broader labor market and productivity conditions. If the tenant chooses to use a Chonsei deposit to rent the house, we assume she funds the entire deposit by borrowing from a bank: she borrows  $L_0$ , and repays  $(1 + r_C) L_0$  in period 1. In practice, some tenants may be able to fund Chonsei deposits partially through their own funds; however, these tenants still face an opportunity cost of capital, equal to the interest they would have earned from saving their Chonsei deposit in assets with positive yields. Thus,  $r_C$  can more generally be thought of as capturing tenants' cost of capital.

We allow  $r_C$ , the interest rate borrowers pay on Chonsei loans from banks, to differ from  $r_S$ , the interest rate that owners receive on savings. Since landlords do not pay

interest on Chonsei deposits, a Chonsei deposit costs the tenant a net amount  $r_C L_0$  in period 1. Tenants use Chonsei if and only if the present value of Chonsei is lower than the cost of paying rent, that is:

$$\beta L_0 r_C \leq n_0 \quad (5)$$

In equilibrium, there are exactly enough total properties to satisfy demand from all tenants. However, some tenants will rent and some will use Chonsei deposits, so the Chonsei deposit size must make tenants indifferent between Chonsei and rental.

### 3.1 Equilibrium

Equilibrium requires that the markets for Chonsei deposits and housing both clear. Since renters have the option to either use Chonsei deposits, or rent from inelastic landlords, renters must be indifferent between renting and using Chonsei deposits. This implies that:

$$\beta L_0 r_C = n_0 \quad (6)$$

That is, the periodic interest payment on Chonsei loans must equal the exogeneous rent  $n_0$ . Equilibrium in the housing market requires that housing supply and demand are equalized:

$$D_{H,0}(p_0, L_0) = H_0(p_0) \quad (7)$$

We search for balanced growth path equilibria of the model, characterized by time-invariant price-rent and Chonsei-rent ratios which satisfy market clearing in all periods. The next proposition states that, if a Chonsei-rent ratio  $\frac{L_0}{n_0}$  and price-rent ratio  $\frac{p_0}{n_0}$  solve (6) and (7), then stationary ratios  $\frac{L_t}{n_t}$ ,  $\frac{p_t}{n_t}$  are determined by  $\frac{L_0}{n_0}$ ,  $\frac{p_0}{n_0}$  respectively.

**Proposition 1.** *Equilibrium is described by a Chonsei-rent ratio  $\frac{L_t}{n_t}$  and a price-rent ratio  $\frac{p_t}{n_t}$  which are constant for all  $t$ :*

$$\frac{L_t}{n_t} = \frac{L_0}{n_0}, \frac{p_t}{n_t} = \frac{p_0}{n_0}$$

*such that period-0 tenants are indifferent between renting and using Chonsei deposits:*

$$\beta L_0 r_C = n_0 \tag{8}$$

*and period-0 housing supply equals housing demand:*

$$D_{H,0}(p_0, L_0) = H_0(p_0) \tag{9}$$

*Any values of  $\frac{L_0}{n_0}, \frac{p_0}{n_0}$  which satisfy period-0 tenants' indifference condition and the housing market clearing condition will also satisfy the equilibrium conditions of Chonsei and housing markets in all future periods.*

The intuition behind proposition 1 is as follows. The core equilibrium condition of the model is (8). Renters in period  $t$  must be indifferent between paying flow rent  $n_t$ , and borrowing  $L_t$  from a bank, lending it interest-free to the homeowner as a Chonsei deposit, and repaying  $L_t(1 + r_C)$  next period, which has a net present value cost of  $\beta L_t r_C$ . Rearranging (8), we have:

$$\frac{L_t}{n_t} = \frac{1}{\beta r_C} \tag{10}$$

In words, the ratio of Chonsei deposit size to rent payments is a function of renters' discount rates and interest rates. Chonsei deposits are larger relative to rents when renters are less patient, and when interest rates are lower. Since  $\beta$  is close to 1 and  $r_C$  is close to 0, generally the majority of variation in (10) will be driven by changes in interest

rates.

Expression (9) states that the size of Chonsei deposits then affects house prices through a standard credit channel. In order for housing markets to clear, landlords must be indifferent between saving using bonds and purchasing housing using Chonsei deposits. If landlords are liquidity-constrained, the levered rate of return on housing will exceed the risk-free rate, to compensate landlords for sacrificing consumption in period 1 to purchase housing. Increasing the size of Chonsei deposits relaxes landlords' liquidity constraints. The equilibrium price-rent ratio must then increase, causing homeowners' levered returns to decrease, in order to maintain landlords' indifference between housing and bonds in (9).

Our model makes a number of predictions about how interest rates affects Chonsei-rent and price-rent ratios in the cross-section and in the time series.

**Prediction 1.** *Chonsei-rent ratios and price-rent ratios are higher in areas where renters have higher credit scores, and lower Chonsei interest rates.*

Prediction 1 follows from varying the Chonsei interest rate  $r_C$  in the equilibrium conditions. The Chonsei-rent ratio is always equal to  $\frac{1}{r_C}$ . In areas where  $r_C$  is lower, the market-clearing Chonsei deposit size is larger. Since homeowners can borrow more, this generates upwards pressure on house prices, increasing the price-rent ratio. Note that, a unique feature of this mechanism, relative to mortgages, is that it is *renters'* creditworthiness, rather than homeowners' creditworthiness, which determines the equilibrium size of mortgages. This is because of the peculiar feature of the Chonsei deposit that the homeowner pays no interest to the renter, but renters pay interest to banks who they use to fund the Chonsei deposit.

**Prediction 2.** *When the monetary policy rate decreases, Chonsei-rent and price-rent ratios increase.*

Prediction 2 follows similarly to Prediction 1: when the central bank decreases policy rates, both  $r_S$  and  $r_C$  will decrease. When aggregate rates change, there are in fact two channels through which monetary policy affects house prices in our model. The first is a *valuation* or *substitution* channel, through homeowners' housing demand: homeowners receive lower rates on their savings  $r_S$ , so demand lower returns on their houses, driving prices for houses upwards. The second, which plays a larger role in our analysis, is the credit channel: decreasing the rate  $r_C$  at which tenants can borrow from banks to fund Chonsei deposits increases equilibrium Chonsei deposit sizes  $L_0$ . Since homeowners have more credit, this increases willingness-to-pay for houses, driving house prices upwards.

An important feature of our model, which we will analyze further in our calibration and policy counterfactuals, is that the sensitivity of Chonsei deposit size to interest rates is quantitatively very high, relative to loan formats familiar in other countries, such as 30-year term mortgages. When renter-facing interest rates half, from 3% to 1.5%, the equilibrium size of Chonsei deposits *doubles* relative to rents. In comparison, if a homebuyer faces a binding payment-to-income constraint, and the interest rate on a 30-year mortgage decreases from 3% to 1.5%, the maximum mortgage the homebuyer can afford increases by only 22%. Intuitively, this is because fixed-term mortgage payments largely go towards paying down principal when interest rates are low, so mortgage payments are nonzero even as interest rates approach zero. In contrast, under the Chonsei deposit size formula:

$$\frac{L_t}{n_t} = \frac{1}{\beta r_C} \quad (11)$$

when interest rates decrease towards 0, Chonsei deposits must become unboundedly large in order for renters to be indifferent between renting and using Chonsei deposits. The large increase in Chonsei deposit size then increases demand for housing, and pushes house prices upwards.

Finally, our model makes predictions about how the passthrough of interest rate changes to house prices depends on Chonsei prevalence.

**Proposition 2.** *The passthrough of Chonsei rate changes to house prices is:*

$$\frac{\partial p_0}{\partial r_C} = \frac{-\frac{\partial V_C(W_0, p_0, L_0)}{\partial L_0} \pi_{C,0} (1 - \pi_{C,0})}{\left( \frac{\partial V_C(W_0, p_0, L_0)}{\partial p_0} \pi_{C,0} + \frac{\partial V_B(W_0, p_0, L_0)}{\partial p_0} \pi_{B,0} \right) (1 - \pi_{C,0} - \pi_{B,0}) - \frac{\alpha}{\delta h_C^\alpha} p_0^{\alpha-1}} \cdot \frac{-n_0}{r_C^2} \quad (12)$$

Proposition 2 implies that areas with higher Chonsei prevalence will tend to have higher passthrough of interest rate changes into house prices. We will first state this prediction, and then explain how it is derived from the expressions in Proposition 2.

**Prediction 3.** *House prices are more sensitive to interest rates in areas where Chonsei deposits are more prevalent.*

The intuition behind Prediction 1 is as follows. The passthrough of Chonsei loan rates to prices is determined by the ratio of two factors: the effect of Chonsei rates on Chonsei demand, and then the effect of prices on total demand for housing, across Chonsei and housing purchases. In most demand models, if the elasticity of demand does not vary too much with the level of demand, the slope of demand will tend to be higher when the level of demand is higher, meaning that a given change in Chonsei deposit size will tend to increase Chonsei demand by a larger amount. Thus, house prices must rise by more, in order to decrease Chonsei and cash purchasing demand, so that markets for housing

clear. This intuition does not hold exactly in all possible demand models, since most models have demand elasticities which vary somewhat according to parameter ranges. Expression (12) shows what passthrough is in the logit model. We can rearrange this expression to:

$$\underbrace{\frac{\frac{\partial V_C}{\partial L} \pi_C}{\left(-\frac{\partial V_C}{\partial p}\right) \pi_C + \left(-\frac{\partial V_B}{\partial p}\right) \pi_B}}_A \cdot \underbrace{\frac{1 - \pi_C}{\left(1 - \pi_C - \pi_B + \frac{\frac{\alpha}{\delta h c_0^\alpha} p_0^{\alpha-1}}{\frac{\partial V_C}{\partial p} \pi_C + \frac{\partial V_B}{\partial p} \pi_B}\right)}}_B \cdot \frac{-n_0}{r_C^2} \quad (13)$$

The first two terms of expression (13) originate from  $\frac{\partial p_0}{\partial L_0}$ . Observe that term A in (13) is a ratio of  $\pi_C$  over  $\pi_C + \pi_B$  weighted by elasticity of value functions. For common parameter ranges where home buyers are credit constrained, we have:

$$\frac{\partial V_C}{\partial L} > -\frac{\partial V_C}{\partial p} > 0, \quad -\frac{\partial V_B}{\partial p} > 0$$

Hence the weighted ratio of Chonsei prevalence, (13) is larger where Chonsei deposits are more prevalent, i.e.  $\pi_C$  is higher. Term B in (13) is an adjustment term which arises from the fact that, in the logit demand system, demand slopes for any given product get smaller as the market share of the product increases. Thus, an interpretation of (13) is that, in the logit demand system, when Chonsei and housing demand is not too large, so  $\pi_C$  and  $\pi_B$  are both small, the passthrough of Chonsei loan rates to house prices is larger where Chonsei is more prevalent.

## 3.2 Discussion of Model Assumptions

Our model is purposefully stylized in order to illustrate the main intuitions behind our results. We briefly discuss possible extensions here.

In the baseline model, homeowners and renters are undifferentiated. This allows us to state the equilibrium conditions, (8) and (9), in terms of the representative homeowner or renter's indifference condition. If potential homeowners were differentiated by wealth, there would be potentially three kinds of buyers: the poorest buyers would opt out of the market, buyers with moderate wealth would purchase using Chonsei deposits, and high-income buyers would purchase houses using cash. The equilibrium condition in the housing market, (9), would then depend on the indifference condition of the marginal homebuyer, who is just indifferent between buying a house using a Chonsei deposit, and saving using bonds.

Renters may also be differentiated: certain tenants may have better credit and lower interest rates from banks than others. Tenants might also have some exogenous disutility from borrowing, perhaps due to the impact on their credit score, or the effect of Chonsei deposits on tenants' ability to access other kinds of consumer credit. Similarly, the equilibrium condition (8) in the Chonsei market would then depend on the marginal renter's Chonsei loan rate, and her disutility of borrowing. A realistic model of renters would allow us to make predictions about the relative prevalence of Chonsei, versus pure rental, on the tenant side. Since we are primarily interested in homeowners' demand and the passthrough of monetary policy to house prices, we disregard this effect for simplicity.

We also abstract away from owner-occupancy, and as a result, regular mortgages and owner-occupants' creditworthiness. This is a reasonable approximation in the



Korean setting; as we discuss in Section 2, the Korean mortgage market is unusually underdeveloped, as mortgages tend to be very short-term and have very low LTVs, so mortgages are likely to contribute relatively little to monetary policy passthrough in the Korean housing market relative to Chonseid deposits.

## 4 Results

### 4.1 Cross-Sectional Predictions

We proceed to test the predictions of our model. Details of the datasets we use, and how we construct variables, are in Appendix A. First, we test Prediction 1, regarding the cross-sectional relationship between renters' credit scores, Chonseid-rent ratios, and price-rent ratios. In Figure 2, we plot binscatters of Chonseid-rent ratios and price-rent ratios against average credit scores at the city-month level. Consistent with prediction 1, city-months in which renters have higher average credit scores have higher Chonseid-rent ratios and price-rent ratios. We estimate specifications of the following form:

$$\text{ChonseidRent}_{ipt} = \beta_1 \text{CreditScore}_{i,2011} + \mu_p + \eta_t + \epsilon_{ipt} \quad (14)$$

$$\text{PriceRent}_{ipt} = \beta_2 \text{CreditScore}_{i,2011} + \mu_p + \eta_t + \epsilon_{ipt} \quad (15)$$

where  $i$  indicates city,  $p$  indicates province, and  $t$  indicates month.  $\text{ChonseidRent}_{ipt}$  and  $\text{PriceRent}_{ipt}$  are respectively the Chonseid-rent and price-rent ratios defined in Appendix A.  $\text{CreditScore}_{i,2011}$  is the average credit score of renters in July 2011, and  $\mu_p$  and  $\eta_t$  are province and year-month fixed-effects. In the richest specification, we add province-

year-month fixed effects, using variation across cities within provinces to identify the coefficient of interest  $\beta$ .

The results are shown in Table 1. Again, across all specifications, the coefficient on credit scores is positive and significant both for Chonsei-rent and price-rent ratios, and the magnitude of the coefficients is stable across specifications. The magnitude is fairly large: a one standard deviation increase in credit score is associated with a 1.51 increase in Chonsei-to-rent ratio, and a 2.74 increase in price-to-rent ratio. The Chonsei-rent ratio has a mean of 18.5 and a standard deviation of 4.2, and the price-rent ratio has a mean of 26.3 and an SD of 7.2, so both effects are fairly large.

## 4.2 Time Series Predictions

Next, we test Prediction 2, regarding the effect of monetary policy on Chonsei-rent and price-rent ratios. Figure 3 shows the Bank of Korea's base interest rate, the primary monetary policy target rate in Korea, against the Chonsei-rent ratio and the price-rent ratio. The lines display very similar patterns. As interest rates fell from 2012 to 2016, Chonsei-rent and price-rent ratios rose. All three series were fairly flat from 2016 to 2020, and then Chonsei-rent and price-rent ratios rose.

To show how monetary policy differentially affected cities with different renter credit scores, Figure 4 separately plots Chonsei-rent and price-rent ratios for three quantile buckets of cities, sorted by average renter credit score in 2011. We see that the lines move essentially in parallel, so the changes in Chonsei-rent ratios over time were fairly uniform across cities: higher credit score cities had higher Chonsei-rent ratios throughout, and the entire distribution of Chonsei-rent ratios shifted upwards over time as interest rates

decreased. The findings for price-rent ratios are similar.

To test prediction 2 in regression form, we estimate the following specifications:

$$\Delta\text{ChonseRent}_{it} = \beta_1\Delta\text{BaseRate}_t + \mu_i + \epsilon_{it} \quad (16)$$

$$\Delta\text{PriceRent}_{it} = \beta_2\Delta\text{BaseRate}_t + \mu_i + \epsilon_{it} \quad (17)$$

In (16),  $\Delta\text{ChonseRent}_{it}$  is the year-over-year difference in the Chonse-rent ratio for city  $i$ ,  $\Delta\text{PriceRent}_{it}$  is the year-over-year difference in prices,  $\Delta\text{BaseRate}_t$  is the year-over-year difference in the cost of fund index (COFIX) rate, which is used as a benchmark interest rate for the mortgage and Chonse loans, and  $\mu_i$  are city fixed effects. The results are shown in Table 2. Again, consistent with prediction 2, increases in the base interest rate are associated with decreases in Chonse-rent and price-rent ratios.

Next, we estimate the impulse response functions of the Chonse-rent and price-rent ratios using the local projection method (Jordà, 2005) and show how different lags of interest rates affect price-rent and Chonse-rent ratios. Specifically, we estimate specifications of the form:

$$\Delta\ln(\text{PriceRent})_{i,t+k} = \beta^k\Delta\text{BaseRate}_t + \mu_i^k + \epsilon_{it} \quad (18)$$

for lags  $k = 0, 1, \dots, 48$ , where  $i$  indicates city,  $t$  indicates month, and:

$$\Delta X_{i,t+k} \equiv X_{i,t+k} - X_{i,t+k-12}$$

is the year-over-year first difference in variable  $X_{i,t+k}$ . Similarly, for Chonse deposits, we

estimate:

$$\Delta \ln(\text{ChonseiRent})_{i,t+k} = \beta^k \Delta \text{BaseRate}_t + \mu_i^k + \varepsilon_{it} \quad (19)$$

We show the results from estimating specifications (18) and (19) in Figure 5. Consistent with the panel regression results, we find that an interest rate increase is associated with a decrease in Chonsei-rent and price-rent ratios. The effect is somewhat stronger for Chonsei-rent ratios. The effect is fairly persistent, peaking in magnitude at around 13 months for the both ratios.

### 4.3 House Price Predictions

Finally, we test Prediction 3, concerning the passthrough of interest rates to house prices. We calculate Chonsei prevalence for each city by dividing the number of Chonsei transactions in each year from 2012-2021, by the total number of apartments in 2010, then taking the average ratio over 2012-2021. We split cities into two groups, with above-median and below-median Chonsei prevalence, after controlling for province fixed effects. Figure 6 shows how house prices changed relative to interest rates, for high and low Chonsei prevalence cities. High Chonsei prevalence cities – the red line – experienced larger price increases from 2012 until July 2020, compared to low Chonsei prevalence cities. Quantitatively, prices in high-prevalence cities rose approximately 25% from 2016 to 2020, whereas low-prevalence areas increased only by 15%.

We formally test the prediction 3 by estimating the following cross-sectional regression specification:

$$\text{PriceGrowth}_{ip} = \beta \text{ChonseiPrevalence}_{ip} + \gamma X_{ip} + \mu_p + \varepsilon_{ip} \quad (20)$$

In (20),  $\text{PriceGrowth}_i$  is price-rent ratio growth for city  $i$  in province  $p$  over some time period; 2013-2017, and 2017-2020.  $\text{ChonseiPrevalence}_i$  is Chonsei prevalence for city  $i$ , which is defined as the number of apartment Chonsei transactions in 2012 or 2016 divided by the number of apartments in 2010.  $X_i$  is a vector of controls, which includes average income, the share of population in a city living in an urban area, the number of businesses in the region, and the share of mortgage loans constrained by LTV regulation. The average income is measured as of 2011 from the KCB data, and all other control variables are measured as of 2012 (see Appendix A for details).<sup>3</sup>  $\mu_p$  represents province fixed effects.<sup>4</sup>

The results are shown in Table 3. Columns (1) through (4) show results where the dependent variable is price growth from 2013-2017, and the independent variable is the number of Chonsei transactions in 2012 divided by the number of apartments in 2010. Columns (1) and (2) show that  $\beta$  is not significantly different from 0 in the overall specification; however, columns (3) and (4) show that  $\beta$  is significantly positive when controlling for province fixed effects, with and without controls for characteristics of cities. In columns (5) through (8), we use price growth from 2017-2020 and Chonsei transactions in 2016 divided by the number of apartments in 2010 as the dependent and independent variables, respectively, with various combinations of controls for city demographics and

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<sup>3</sup>This is the share of mortgage loans which are within 2% of regulatory LTV limits. Data is from one of the largest commercial banks.

<sup>4</sup>We estimate the coefficient of interest separately for two different periods---a period when interest rates went down (i.e., 2013-2017) and a period when interest rates went up (i.e., 2013-2017)---but end the sample in 2020 because the amended Housing Lease Protection Act was passed in the National Assembly in July 2020. The new law substantially changed Chonsei policies and allowed Chonsei tenants to extend the Chonsei contract of 2 years by 2 more years at the end of the contract. As it also limited the amount by which landlords could increase the Chonsei deposit to 5%, the new law negatively affected house prices in areas with high Chonsei prevalence. Consistent with this, Appendix Table A.3 estimates the regression specification in 20 for 2020-2021, and finds that house price growth was lower in high Chonsei prevalence areas from the period.

province fixed effects. In all columns, we find that  $\beta$  is positive and significant. The magnitude is fairly large: annualized price growth over 3-4 years was around 1.4-2.7% higher in areas with one standard deviation higher Chonsei prevalence.

## 5 Calibration

Next, we calibrate our model to match rents, Chonsei deposit size, and house prices observed in the data. We show that our simple model can quantitatively explain the rise in the size of Chonsei deposits over time. We then fit the model to the path of house prices, attempt to explain what fraction of the change in house prices can be explained by Chonsei deposits. We will calibrate the model to fit the data in two parts. First, we match the time series of the Chonsei-rent ratio. Then, using Chonsei-rent ratios, we will match the time series of house price-rent ratios, in high and low Chonsei prevalence areas. Let  $\alpha \in \{H, L\}$  index high- and low-Chonsei prevalence areas.

### 5.1 Chonsei Deposit Size

To map our theory to the data, we assume that Chonsei deposit sizes in the data are generated by the following process:

$$\frac{L_{\alpha t}}{n_{\alpha t}} = \underbrace{\frac{1}{\beta r_{C\alpha t}}}_{\text{Tenant indifference condition}} + \underbrace{\mu_{\alpha t}}_{\text{Time-varying unobservables}} \quad (21)$$

Expression (21) simply decomposes variation in Chonsei-rent ratio in the top panel of Figure 7 into a component  $\frac{1}{\beta r_{Ct}}$  which is explained by our model, and a residual

component  $\mu_{at}$  which captures all other factors which may affect deposit size, such as time-varying bank credit conditions, aggregate shocks to tenants' creditworthiness, and other such factors. The residual  $\mu_{at}$  is allowed to differ for high- and low-Chonseil prevalence areas. We do not have time series data on the Chonseil interest rate of tenants; hence, we assume that there is a time-invariant spread  $\chi_{Ca}$ , between Chonseil rates  $r_{Cat}$  and the Korean base interest rate  $r_{Mat}$ :

$$r_{Cat} = r_{Mat} + \chi_{Ca} \quad (22)$$

The spread  $\chi_{Ca}$  is allowed to differ for high- and low-Chonseil prevalence areas. We estimate  $\chi_{CH}$  and  $\chi_{CL}$  through GMM, by minimizing the sum of squared residuals  $\mu_{at}$  in each case. We find time-invariant Chonseil interest spreads of  $\chi_{CH} = 3.55\%$  and  $\chi_{CL} = 4.17\%$ . These numbers are within the range of empirical Chonseil spreads.

In the top panel of Figure 7, we plot the empirical Chonseil-rent ratios in the data, as well as the predicted values from the model,

$$\frac{L_{at}}{n_{at}} = \frac{1}{\beta (r_{Mat} + \chi_{Ca})}$$

separately for high- and low-prevalence areas. The top panel of Figure 7 quantifies the extent to which our theory can explain the time trends in the Chonseil-rent ratio. In 2016, this predicts a Chonseil-rent ratio of 19.79 and 17.64 for high- and low-Chonseil prevalence areas, which are in the middle of range of Chonseil-rent ratios in 2016. The plot shows that the model-predicted Chonseil-rent ratio matches the data fairly closely. The model is able to explain roughly 60% of the rise in the Chonseil-rent ratio from 2012-2016, as well as the relative flattening from 2016 to 2019. However, our model predicts a sharp further

increase in the Chonsei-rent index in 2019, as the central bank base rate dropped sharply; this did not materialize in the data.<sup>5</sup>

## 5.2 House Prices

Next, we attempt to match the model to data on house prices, and the average Chonsei market share within a region, through a combination of calibrated and estimated parameters. We fit two cases of the model, for high- and low-Chonsei prevalence areas. We calibrate the intertemporal elasticity of substitution to  $\eta = 2$ , the discount rate  $\beta$  to 0.971, the growth rate to  $g = 0.02$ , and index rent to  $n = 1$ , jointly for high- and low-prevalence cases. We then estimate the remaining parameters through fitting moments.

Analogous to (22), we assume that non-housing savings pays a return equal to the Korean base rate, plus a time-invariant spread, which is equal for high- and low-prevalence areas:

$$r_{St} = r_{Mt} + \chi_S \quad (23)$$

We assume the housing supply elasticity  $\alpha$  and the savings spread  $\chi_S$  are constant across high- and low-prevalence cases of the model. We also estimate a parameter  $h$  that measures the value function of choosing savings or housing relative to the size of the variance of the relative utility shock, which is held constant across high- and low-prevalence area. We allow wealth  $W$  and the housing cost  $c$  to vary across the high- and low-prevalence scenarios. We calibrate the model statically to match every month in

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<sup>5</sup>Note that the residuals  $\mu_{at}$  imply that (21) perfectly matches the paths of  $\frac{L_{at}}{n_{at}}$  in the data. That is,  $\mu_{at}$  is exactly equal to the gap between the solid and dashed lines in the top panel of Figure 7. We will hold  $\mu_{at}$  fixed in all our policy counterfactuals in Section 6.1; this corresponds to varying the model-explained component of Chonsei deposit size, while holding fixed any other factors which may influence the size of Chonsei deposits.



our data; in each month, we plug in the empirical Chonsei-rent ratio as  $\frac{L_{at}}{n_{at}}$ ,<sup>6</sup> and interest rates as  $r_{Mt}$ , and solve for the equilibrium price-rent ratio  $\frac{p_t}{n_t}$  and equilibrium market shares of Chonsei, purchase, and savings. We then attempt to minimize the squared distance between these model quantities to their counterparts in the data: the two sets of empirical moments we match are the monthly time series of the price-rent ratio and the market share of Chonsei relative to rental in the data.<sup>7</sup>

The intuition of the moment matching is as follows. The cost of housing supply  $c$  governs the level of house prices, and the house supply elasticity  $\alpha$  governs the responsiveness of prices to changes in Chonsei deposit size. Wealth  $W$ , and the savings rate spread  $\chi_S$ , determine the average market shares of Chonsei, buying, and saving. Since we target the relative Chonsei-rent market shares,  $\frac{\pi_{Ca}}{\pi_{Ba} + \pi_{Ca}}$ , in the estimation, only the share of savings  $1 - \pi_{Ca} - \pi_{Ba}$  is allowed to vary. The savings share influences the passthrough of Chonsei deposit size to house prices, through its effect on the elasticity of Chonsei and housing demand. Intuitively, the house supply elasticity  $\alpha$  allows us to vary the average level of price passthrough, whereas the market share of the savings option influences how passthrough varies across the high- and low-prevalence cases of the model.<sup>8</sup>

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<sup>6</sup>Note that we use the empirical series for  $L_t$ , not the model-predicted series; this is equivalent to using the model-predicted series, but adding the error terms  $\mu_t$  in (21), allowing us to perfectly fit the time series of the Chonsei-rent ratio.

<sup>7</sup>We match the average market shares, because the Korean housing survey does not have detailed time series information on market shares.

<sup>8</sup>We show this formally in Proposition 2 of Section 3.

### 5.3 Model Fit

The bottom panel of Figure 7 shows price-rent ratios from the data and the fitted model. The model is able to capture the increase in house prices from 2012-2020, and also the stylized fact that prices increased more in high-prevalence areas. Table 5 shows the values of fitted parameters. Our estimated housing supply elasticity is relatively more inelastic than ranges suggested by the literature.<sup>9</sup> We estimate a relatively large savings spread of  $\chi_S$ , around 9%, implying that savings is generally preferred to buying-to-rent or buying-to-Chonsei in our model. Mechanically, this occurs because Chonsei prevalence affects price passthrough in the model most in the range where the savings share is quite large, so substitution from savings to buying or Chonsei is fairly elastic, as Proposition 2 of Section 3 shows. Practically, the high spread  $\chi_S$  could be thought of as capturing in reduced-form other costs, such as marketing, labor time, and specialized skills acquisition, for being a rental or Chonsei landlord, relative to saving in simpler instruments such as stocks and bonds.

## 6 Policy Counterfactuals

We use our calibrated model to analyze two policy counterfactuals. First, we show that a simple policy, which imposes a proportional tax on Chonsei deposits, would substantially decrease Chonsei-rent ratios, and the passthrough of interest rates to Chonsei deposit size. Secondly, we show that the Korean Central Bank's plan to raise interest rates has the potential to rapidly decrease the size of Chonsei deposits and house prices, presenting

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<sup>9</sup>Saiz (2010) estimates that population weighted average supply elasticity in US metropolitan areas to be 1.75, prior literature suggests that a reasonable range is 1~3. (review by Gyourko (2009))

potential risks to financial stability.

## 6.1 Taxing Chonseil Deposits

The two series from Figure 7 show that Korea experienced a large increase in the size of Chonseil deposits from 2010-2020, and an accompanying large increase in house prices. Regulators may view the extremely high passthrough of interest rates into Chonseil deposits as undesirable. A simple way to reduce the size of Chonseil deposits, and also the passthrough of interest rates to Chonseil deposits, is to introduce an additional tax wedge that Chonseil tenants must pay, on top of the Chonseil interest rate  $r$ . Suppose, for example, that the government simply charges a proportional tax on Chonseil deposits at annual rate  $s$ : when renters borrow  $L$  from banks, they must make an annual payment of  $Ls$  to governments, in addition to the interest payment of  $Lr$  to banks. Tenants' indifference condition then becomes:

$$\frac{L_{at}}{n_{at}} = \frac{1}{\beta (r_{Cat} + s)} \quad (24)$$

Comparing (24) to (11), the tax reduces the size of Chonseil deposits; moreover, even when  $r_{Cat}$  decreases towards 0, deposit sizes converge towards the finite quantity  $\frac{n_{at}}{\beta s}$ .

There are a number of ways to implement similar outcomes to this proportional tax. For example, policymakers could require Chonseil deposits to be accompanied by side payments to landlords, which serve as reduced rental payments, of at least a fraction  $s$  of the Chonseil deposit size. Policymakers could also require banks to charge interest rates on loans to fund Chonseil deposits at a certain spread above the central bank base rate, setting the spread so that equilibrium loan rates are above the minimum rates banks are willing to accept. These policies differ from the tax in terms of their distributional

implications: the side-payment scheme causes the tax revenue to effectively accrue to landlords, and setting minimum loan rates effectively allows banks to collect some rents from making loans at rates above their marginal costs. However, the impact of both policies on the equilibrium size of Chonsei deposits sizes is still described by (24).

We proceed to quantitatively estimate how much such a policy could have decreased the passthrough of interest rates to Chonsei deposit size. To do so, we assume that Chonsei deposit sizes in the data are generated by the process:

$$\frac{L_{at}}{n_{at}} = \underbrace{\frac{1}{\beta (r_{Cat} + s)}}_{\text{Tenant indifference condition}} + \underbrace{\mu_{at}}_{\text{Time-varying unobservables}} \quad (25)$$

Where the unobservables  $\mu_{at}$  are set equal to their values in (21), which exactly fit the observed path of Chonsei-rent ratios. We then take different values of the Chonsei tax wedge  $s$ , and calculate counterfactual paths for the Chonsei-rent ratio, holding  $\mu_{at}$  fixed (25). Effectively, this exercises modifies the the tenant indifference component of (21), which is the component of Chonsei deposit size explained by our data, while holding fixed the path of  $\mu_{at}$ , which represent factors outside of the scope of our model that may affect Chonsei deposit size.

We show results from this exercise in Figure 8. The top panel shows Chonsei-rent ratios. The solid lines show the baseline empirical Chonsei-rent ratio, which we match perfectly using (21). The dashed lines show the counterfactual Chonsei-deposit ratio with  $s = 1\%$ , and the dotted lines show  $s = 3\%$  for the high- and low-Chonsei prevalence areas respectively. The left plot shows that imposing small taxes on Chonsei loans can substantially decrease the size of Chonsei deposits, as well as the passthrough of interest rates. At a spread of 1%, the Chonsei-rent ratio decreases to 18.97 (17.18) on average

in 2019 for high- (low-) Chonseï prevalence areas. Moreover, Chonseï deposit size only increases by  $8.24\times(6.10\times)$  annual rents from 2012-2019, compared to  $9.35\times(6.94\times)$  times in the original data. At a larger tax of 3%, the Chonseï-rent ratio decreases to 15.14 (13.94) in 2019, and only increases by  $7.03\times(5.14\times)$  times annual rents from 2012-2018.

We can also estimate how such policies would have influenced the path of house prices over time. To do this, we feed our counterfactual estimates for the Chonseï-rent ratio  $\frac{L_t}{n_t}$ , under various taxes  $s$ , into the fitted model for house prices. The bottom panel of Figure 8 shows the effect of these policies on house prices. The solid lines show the baseline empirical price-rent ratio, and the dashed lines show the counterfactual price-rent ratio with  $s = 1\%$ , and the dotted lines show counterfactuals with  $s = 3\%$ . At a spread of 1%, price-rent ratio decreases to 27.58 (22.94) on average in 2019 for high- (low-) Chonseï prevalence areas, and house price increases by  $7.53\times(5.02\times)$  annual rents from 2012-2019, compared to  $10.92\times(7.74\times)$  times in the original data. At a spread of 3%, price-rent ratio increases by  $6.27\times(4.28\times)$  times annual rents from 2012-2019.

We note that these policies are not designed to make housing more affordable to tenants. In our model, tenants are always indifferent between renting and Chonseï deposits; imposing taxes on Chonseï deposits does not change renters' welfare. Instead, the goal of these policies is to decrease the amount of credit that homeowners can access through Chonseï deposits, and how sensitive this credit source is to overall interest rates. This has the potential to limit Chonseï-credit-induced booms in house prices, which may be valuable from a financial stability perspective.

## 6.2 Interest Rate Increases and House Price Crashes

Interest rates in Korea, and most other countries, have generally trended downwards over the past decade, but worldwide interest rates are starting to rise. Our model implies that increases in interest rates should decrease the equilibrium size of Chonsei deposits, potentially leading to a crash in house prices. In Figure 9, using our calibrated model, we quantitatively evaluate how the Korean Central Bank's projections for future interest rates would affect Chonsei-rent and price rent ratios. To do this, we hold time-varying unobservables affecting Chonsei deposit size,  $\mu_t$ , fixed at the 2021 value; we then calculate counterfactual deposit size over time, and use this to calculate counterfactual house prices.

The plot shows that, if the Korean central bank raises rates from essentially 0 to 2.5%, this will decrease Chonsei deposit size approximately 35.28% (31.88%) in the high- (low-) Chonsei prevalence areas respectively. The model predicts that this would cause a drop in price-rent ratios of approximately 28.13% (24.06%). Our model thus suggests that the high passthrough of interest rates into house prices through the Chonsei system presents a financial stability concern. Besides the effects in our model, in practice, rapid decreases in the equilibrium size of Chonsei deposits may create substantial rollover risk for Chonsei landlords: if a landlord's Chonsei deposit is due, after a period of time where the market Chonsei-rent ratio has decreased substantially, the landlord may not have the cash to repay the Chonsei deposit, presenting significant potential risks to financial stability.

## 7 Conclusion

This paper analyzed the credit channel of monetary policy transmission in the setting of the Chonsei system in the Korean housing market. We constructed a simple model showing how Chonsei deposit size and house prices depend on interest rates. The model makes predictions about the cross-sectional and time-series behavior of Chonsei-rent ratios, which are verified in the data, and the calibrated model quantitatively fits Chonsei deposit sizes and house prices fairly well under reasonable parameter settings. Using the fitted model, we explored simple policy counterfactuals aimed at reducing the size of Chonsei deposits, and analyzed how rate increases would affect house prices through the Chonsei system. Our findings have implications for understanding the behavior of Chonsei deposits, and also for policymakers aiming to regulate credit provision within the Korean housing market. More broadly, our findings contribute to a literature on how the specific institutional details of credit markets influence the magnitude and incidence of the credit channel of monetary policy transmission.

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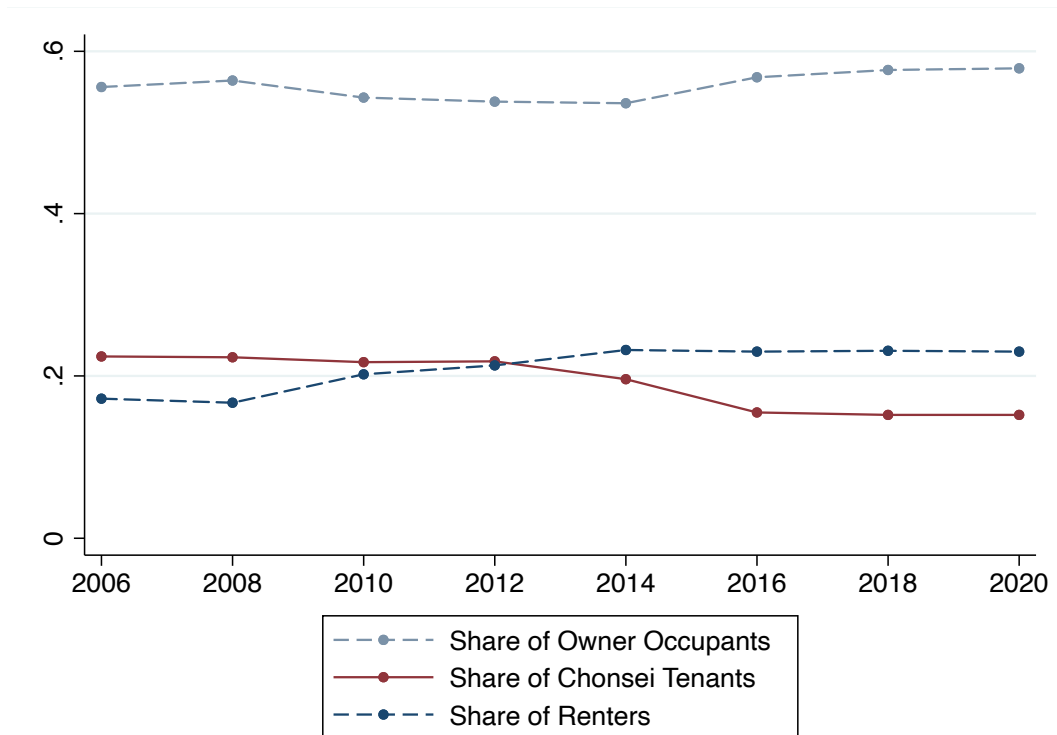
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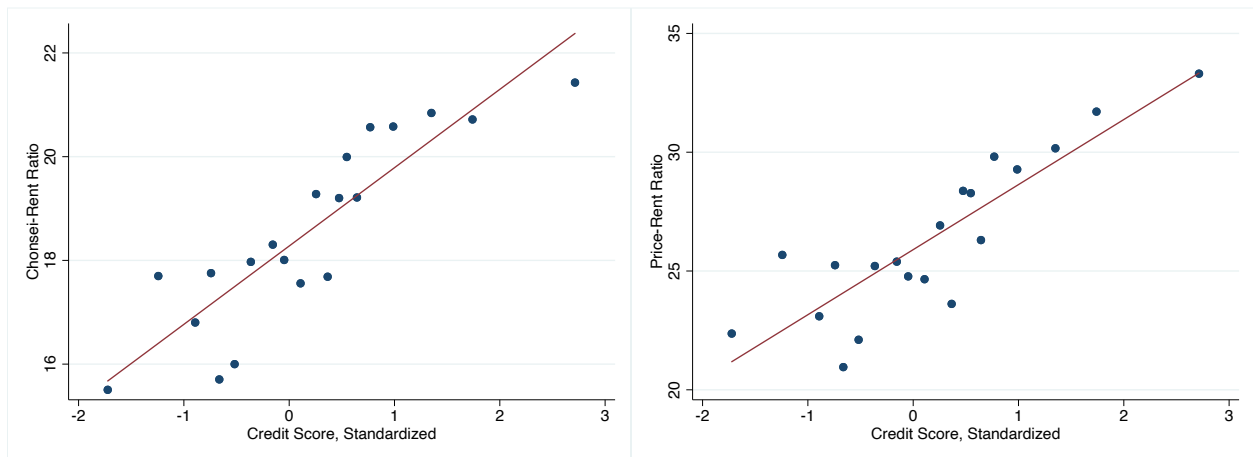
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Figure 1: Chonsei deposit prevalence



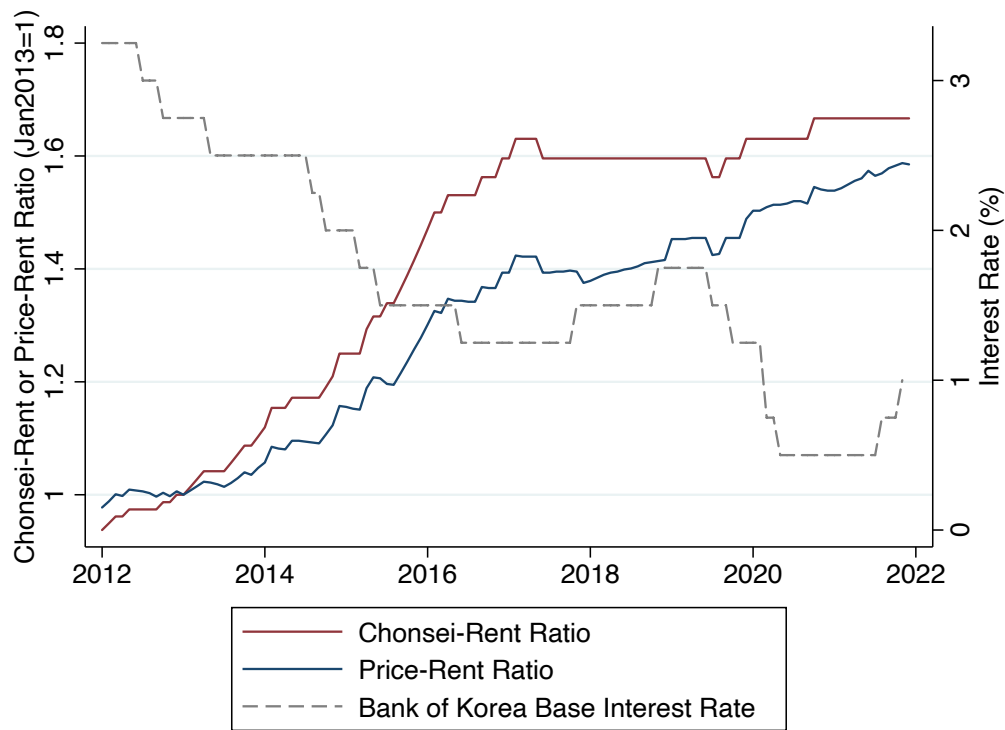
**Notes.** Share of households who are owner-occupants, Chonsei tenants, and renters by year. The data source is the Korean Housing Survey.

Figure 2: Credit scores, Chonsei-rent ratios, and price-rent ratios



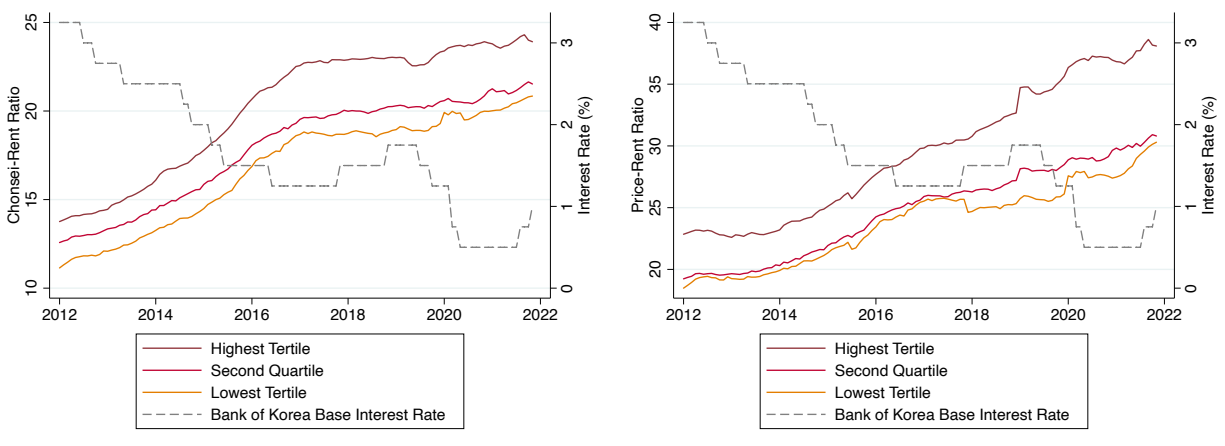
**Notes.** This figure uses the Korea Real Estate Board (KREB)'s city-level monthly Chonsei-rent (left panel) and price-rent (right panel) ratios and plots the binscatters of ratios against the average credit score. The sample period of the Chonsei-rent and price-rent ratios spans from January 2012 to November 2020. The average credit score is provided by the Korea Credit Bureau (KCB) and is measured as of July 2011. The binscatter plots include the year-month fixed effects to explore the cross-sectional relationship.

Figure 3: Interest rates, Chonsei-rent ratios, and price-rent ratios



**Notes.** This figure shows the Bank of Korea base interest rate (dashed grey line, right axis) and indexed Chonsei-rent (red, left axis) and price-rent (blue, left axis) ratios. The national-level Chonsei-rent and price-rent ratios are collected from the KREB.

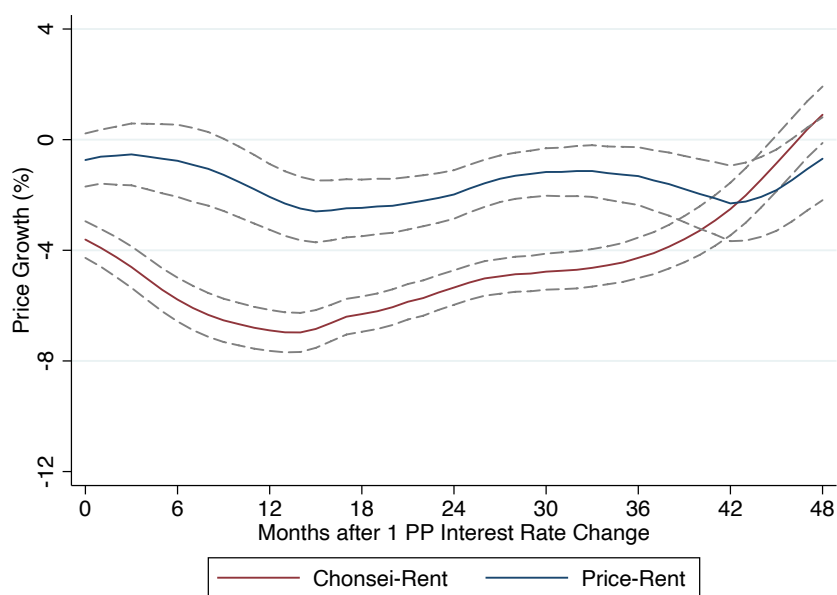
Figure 4: Chonsei-rent ratios and price-rent ratios over time, by average credit score



**Notes.** The left panel of this figure shows the Bank of Korea base interest rate (dashed grey line, right axis) and Chonsei-rent ratios (solid lines, left axis) separately for three quantile buckets of cities, sorted by the average credit score of renters in 2011. The right panel shows the base interest rate and price-rent ratios (solid lines, left axis) separately for three quantile buckets of cities by 2011 credit score. The city-level Chonsei-rent and price-rent ratios are from the KREB.

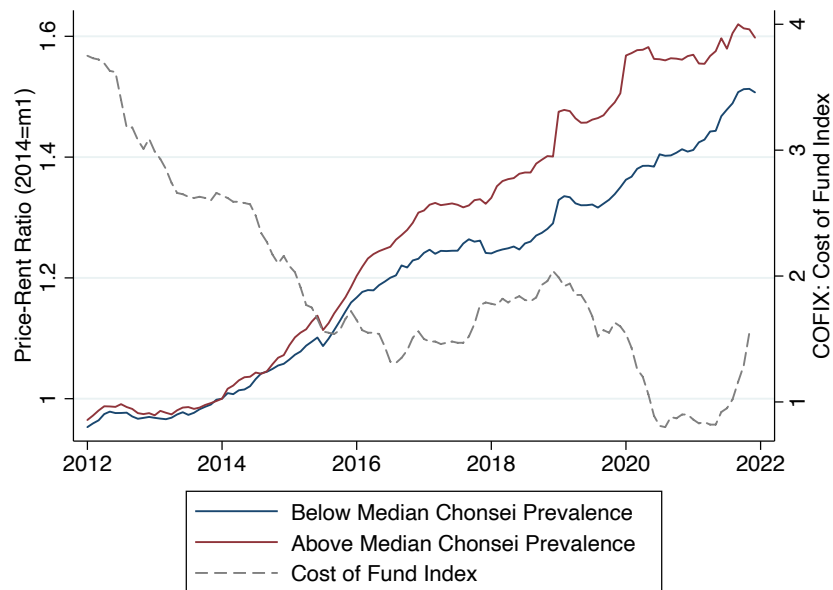


Figure 5: Chonsei-rent ratios, price-rent ratios, and interest rates: Jorda projections



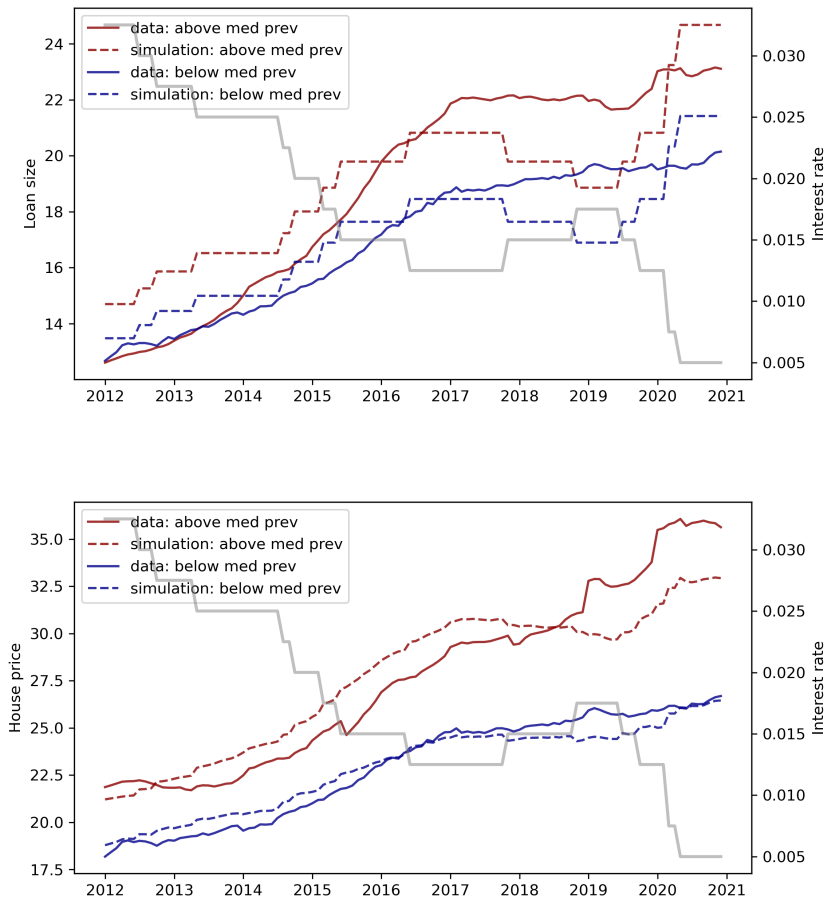
**Notes.** This figure shows the impulse response functions of Chonsei-rent (solid red) and price-rent (solid blue) ratios to the 1 percent point interest rate shock. The functions are computed using the local projection method in specifications (18) and (19). The city-level Chonsei-rent and Price-rent ratios are from the KREB. The interest rate is the COFIX rate, which is a base interest rate for mortgage and Chonsei loans. Standard errors are clustered at the city level.

Figure 6: House prices, interest rates, and Chonsei prevalence



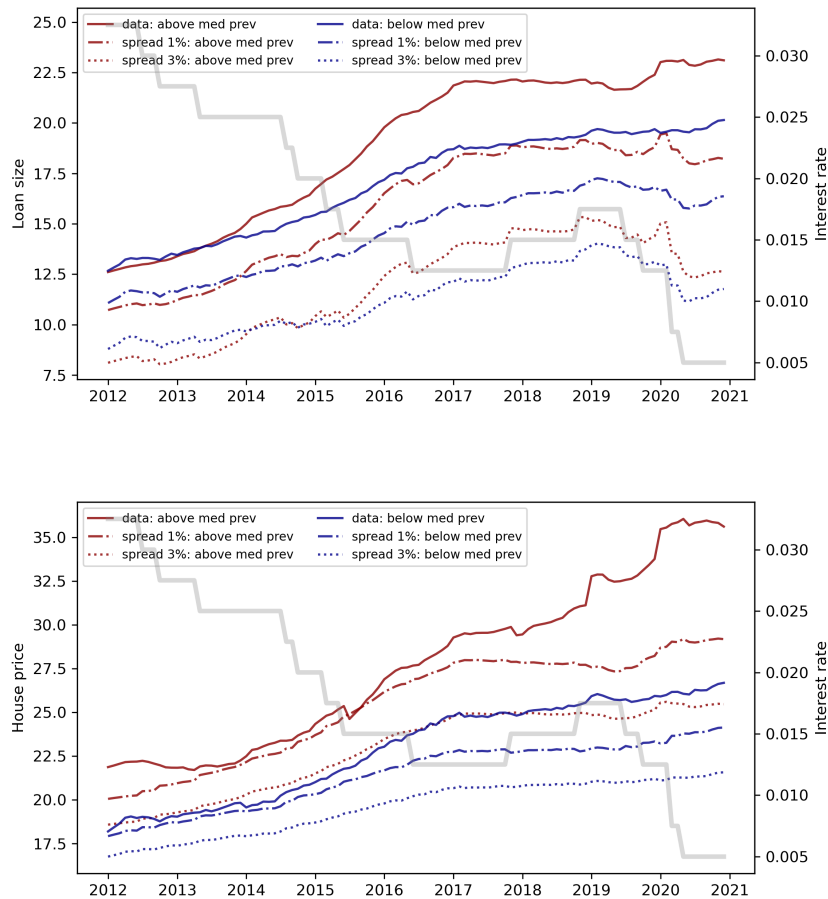
**Notes.** This figure plots the cost of fund index (COFIX) and within-province price-rent ratio by the value of Chonsei prevalence. The COFIX is computed based on the cost of funding for the eight largest domestic banks in Korea and is mainly used as the base rate for mortgage and Chonsei loans. The within-province price-rent ratio is computed by demeaning the price-rent ratio at the province level, and averaging across cities. The Chonsei prevalence measure is defined as the average number of Chonsei transactions in 2012-2022 divided by the number of apartments in 2010. We divide cities in two groups by demeaning Chonsei prevalence at the province level, and then splitting into cities above and below the median value of the province-level Chonsei prevalence residual.

Figure 7: Cross-sectional Chonsei-rent and price-rent ratios: model and data



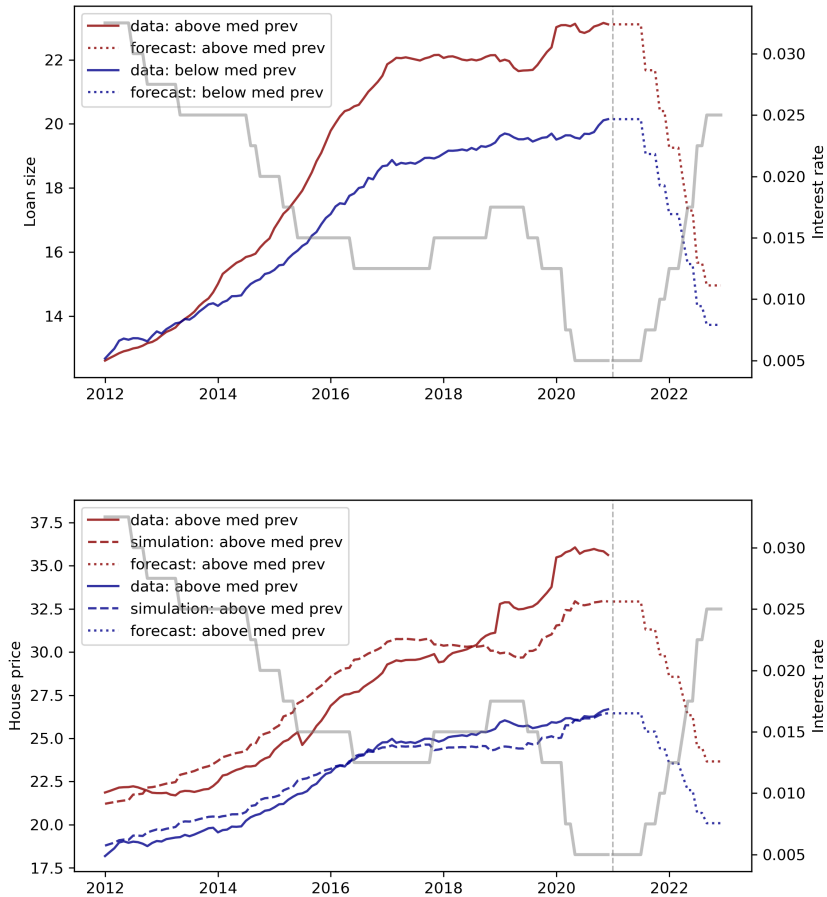
**Notes.** The top panel of this figure shows Chonsei-rent ratios, and the bottom panel shows price-rent ratios, in the data (solid) and in the fitted model (dashed). We show the high Chonsei prevalence (red) and low prevalence (blue) cases of the model separately.

Figure 8: Cross-sectional Chonsei-rent and price-rent ratios: counterfactual policy simulations



**Notes.** This figure presents the counterfactual Chonsei-rent ratios and price-rent ratios. Solid lines present the empirical ratios, while dashed and dotted lines show ratios predicted by our model under counterfactual policy  $s = 1\%$  and  $3\%$  respectively. In the top panel, Chonsei-rent ratios are calculated as  $\frac{l_{at}}{n_{at}} = \frac{1}{\beta(r_{Cat}+s)} + \mu_{at}$ , where  $r_{Cat}$  is the sum of Korean Central Bank base rate and a time-invariant spread between Chonsei loan rates and the base rate estimated by GMM. Residuals are calculated with our baseline model predictions,  $\mu_t = \frac{l}{n_{index,t}} - \frac{1}{\beta r_{Cat}}$ . In the bottom panel, price-rent ratios are obtained by simulating the calibrated model with inputs as the Korean Central Bank base rates and counterfactual Chonsei loan rates under  $s$  set to 0, 1% and 3% respectively.

Figure 9: Cross-sectional Price-rent ratios: forecast



**Notes.** This figure presents the model forecasts of price-rent ratio. We use 21 to predict deposit sizes, holding fix  $\mu_t$  at the end period Dec 2020. Projected interest rates are obtained from the Goldman Sach's report "Korea Views: An Earlier and Moderately Higher Terminal Rate".

Table 1: Renter creditworthiness, Chonsei-rent ratios, and price-rent ratios

Panel A: Chonsei-Rent Ratio					
	(1)	(2)	(3)	(4)	(5)
Credit Score, Standardized	1.5104*** (0.1471)	1.5102*** (0.1476)	1.2040*** (0.1262)	1.2039*** (0.1267)	1.2039*** (0.1341)
Year-Month FE		Yes		Yes	
Province FE			Yes	Yes	
Province x Year-Month FE					Yes
Adjusted R <sup>2</sup>	0.1353	0.7011	0.2576	0.8249	0.8401
# Obs	15,716	15,716	15,716	15,716	15,716
Panel B: Price-Rent Ratio					
	(1)	(2)	(3)	(4)	(5)
Credit Score, Standardized	2.7383*** (0.3840)	2.7380*** (0.3854)	2.0588*** (0.3415)	2.0586*** (0.3427)	2.0586*** (0.3627)
Year-Month FEs		Yes		Yes	
Province FEs			Yes	Yes	
Province x Year-Month FEs					Yes
Adjusted R <sup>2</sup>	0.1530	0.4777	0.3808	0.7075	0.7469
# Obs	15,716	15,716	15,716	15,716	15,716

**Notes.** This table reports the cross-sectional relationship between renter's credit scores, Chonsei-rent ratios, and price-rent ratios. The dependent variable in Panel A is the city-level Chonsei-rent ratio, and the dependent variable in Panel B is the price-rent ratio. The independent variable in both panels is the average credit score. The city-level Chonsei-rent and price-rent ratios are collected from the KREB. The average credit score is provided by the KCB and measured as of July 2011. The unit of observation in this analysis is the city-year-month. The sample period spans from January 2012 to November 2020. Standard errors are clustered at the city level.

Table 2: Monetary policy, Chonsei-rent ratios, and price-rent ratios

	Chonsei-Rent Ratio Growth			Price-Rent Ratio Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
Interest Rate Growth	-4.0376*** (0.3495)			-0.6770 (0.4860)		
L12.Interest Rate Growth		-7.1019*** (0.3768)			-2.0421*** (0.5946)	
L24.Interest Rate Growth			-3.0506*** (0.2643)			-3.0637*** (0.3432)
City FEs	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R <sup>2</sup>	0.05821	0.1373	0.04519	0.03073	0.03817	0.05466
# Obs	14,212	14,212	14,212	14,212	14,212	14,212

**Notes.** This table shows the time-series relationship between monetary policy rates, Chonsei-rent ratios, and price-rent ratios. The dependent variable in the first three columns is the year-over-year difference of log median Chonsei-rent ratio in a city. The dependent variable in the fourth, fifth, and sixth columns is the year-over-year difference in the log median price-rent ratio. “Interest growth” is the year-over-year difference in the COFIX rate, which is used as a benchmark interest rate for the mortgage and Chonsei loans. The city-level Chonsei-rent and price-rent ratios are collected from the KREB. The COFIX rate is collected from the Korea Federation of Banks. The unit of observation in this analysis is a city-year-month. The sample period spans from January 2012 to November 2020. Standard errors are clustered at the city level.

Table 3: House prices, interest rates, and Chonsei prevalence

	Price-Rent Ratio Growth, 2013-2017			Price-Rent Ratio Growth, 2017-2020				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Chonsei Prevalence, Standardized	0.0006 (0.0041)	-0.0011 (0.0055)	0.0158** (0.0068)	0.0144** (0.0065)	0.0274*** (0.0048)	0.0201*** (0.0057)	0.0159** (0.0062)	0.0141** (0.0064)
Share of Mortgage Loans Constrained by LTV Limits, Standardized		0.0008 (0.0062)		0.0001 (0.0077)		-0.0148** (0.0065)		-0.0043 (0.0080)
Share of Urban Population, Standardized		0.0079 (0.0054)		0.0045 (0.0052)		0.0123** (0.0058)		0.0132* (0.0072)
Average Income, Standardized		0.0047 (0.0040)		0.0020 (0.0042)		-0.0018 (0.0031)		-0.0018 (0.0040)
Number of Businesses, Standardized		0.0012 (0.0015)		0.0002 (0.0017)		0.0008 (0.0022)		-0.0012 (0.0027)
Constant	0.0728*** (0.0039)	0.0706*** (0.0042)			0.0460*** (0.0037)			
Province FEs			Yes	Yes			Yes	Yes
Adjusted R <sup>2</sup>	-0.007813	-0.003916	0.2309	0.2100	0.2650	0.3515	0.4793	0.4928
# Obs	126	126	126	126	126	126	126	126

**Notes.** This table reports estimates from specification (20), where we regress house price growth on Chonsei prevalence. The dependent variable is annualized city-level price-rent ratio growth from 2013-2017 (columns (1)-(4)) and 2017-2020 (columns (5)-(8)). The Chonsei prevalence measure is defined as the number of apartment Chonsei transactions in 2012 (Column (2)-(5)) or 2016 (Column (6)-(9)) divided by the number of apartments in 2010. Control variables include the share of mortgage loans constrained by LTV regulation, the share of the urban population, average income, and the number of establishments measured. The average income is measured as of 2011 and all other control variables are measured as of 2012. All righthand side variables are standardized.



Table 4: Calibration of model parameters

Parameter	Calibrated value
$\eta$	2
$\beta$	0.971
$g$	0.02
$n$	1

**Notes.** This table shows the calibrated parameters of the simulated model.

Table 5: GMM estimates of model parameters

Parameter	GMM estimate	
	Above median prevalence	Below median prevalence
$\alpha$	0.076	
$h$	$1.74 \times 10^3$	
$\chi_s$	8.97%	
$W$	91.33	110.43
$c$	$1.14 \times 10^5$	$1.68 \times 10^4$

**Notes.** This table shows the GMM estimates for model parameters. The second and third columns show estimates of parameters in regions with above median Chonsei prevalence and below median Chonsei prevalence respectively.

# Appendix

## A Data Sources

**Housing market data.** We collect housing market data from the Korea Real Estate Board (KREB). The KREB is a government agency under the Ministry of Land, Infrastructure and Transport (MOLIT) that monitors the real estate markets in South Korea. Among their public data, we mainly use the monthly Chonseito-rent (i.e.,  $\text{ChonseitoRent}_{ipt}$ ) and price-to-Chonseito ratios for apartments at the nation and city level.<sup>10</sup> We obtain the price-to-rent ratio (i.e.,  $\text{PriceRent}_{ipt}$ ) by multiplying the two ratios and define price growth (i.e.,  $\text{PriceGrowth}_i$ ) as a percentage growth of the price-to-rent ratio.

To estimate the Chonseito-rent ratio at the nation and city level, the KREB uses rental and Chonseito transaction data and collects rent and Chonseito price information for apartments of the same floor plan in the same block. If the KREB observes multiple rents and Chonseito prices for the apartment of the same floor plan due to a large volume of Chonseito and rental transactions, they use the median Chonseito price and compute the Chonseito-rent ratio for each rental transaction. They then take the median value of the ratios to estimate the Chonseito-rent ratio at the city level. The nation-level Chonseito-rent ratio is computed by averaging the city-level Chonseito-rent ratios weighted by the city-level apartment stocks. The price-to-Chonseito ratio is computed in the same manner.

We focus on the Chonseito-rent and price-to-Chonseito ratios for apartments rather than those for single houses and other types of multiplex because apartments are crucial

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<sup>10</sup>Gu is the smallest administrative division in Korea for which housing market data is available. Most cities do not have Gu in them, but some cities are divided into multiple Gus. We take the Gu as the unit of analysis in this paper but call it a city for simplicity.

for understanding housing markets in South Korea. They account for the largest share of housing stocks (78.3% as of 2021 Census) and have been the main target of important housing market regulations (Jung and Suh, 2010; Igan and Kang, 2011; Moon, 2018*b*). Apartments in South Korea are also highly standardized, and thus, the Chonseil-to-rent and price-to-Chonseil ratios are credibly measured compared to the ratios for the other housing types.

**Credit report data.** To compute the average renter's credit scores for different areas, we use a snapshot of credit report microdata from the Korean Credit Bureau (KCB), as of July 2011. The microdata contains individual-level credit ratings, which range from 1 (lowest) to 10 (highest), covering 98% of the population.<sup>11</sup> We define renters as individuals without mortgage loans, and aggregate the data to calculate the average credit scores of all renters in each city (i.e.,  $\text{CreditScore}_{i,2011}$ ). While we do only observe a snapshot of credit report data, the relative income levels of different cities by income is quite stable over our time period, suggesting that the relative credit scores of different areas also should not shift substantially over time.

**Household characteristics.** We use the Korean Housing Survey (KHS) microdata to examine the household characteristics by housing tenure. The KHS is conducted by the MOLIT and interviews around 30,000 households to investigate housing conditions by housing tenure and household income. It has been a biannual survey until 2016 and then conducted annually since. We use the 2012, 2014, 2016, 2017, and 2018 waves of the survey and restrict the sample to households living in the apartment.

**Other data sources.** We collect the central bank policy rates, and the average interest

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<sup>11</sup>Higher values of KCB credit ratings indicate that the subject is less creditworthy. In our results, for ease of interpretation, we rescale credit ratings so that the lower values indicate lower creditworthiness.

rates for mortgage loans, from the Bank of Korea (BOK). We exploit the Korea Federation of Banks (KFB) database to collect data for the cost of fund index (COFIX)—a base interest rate for household loans. To compute the city-level Chonseil prevalence measure for each year (i.e.,  $ChonseilPrevalence_i$ ), we use the MOLIT and Korean Statistical Information System (KOSIS) database. The MOLIT data records all Chonseil transactions, so we first aggregate apartment Chonseil transactions at the city level for each year from 2012 to 2021. We then divide them by the KOSIS's city-level apartment stock in 2010 to measure the Chonseil prevalence at the city level annually.

We use various sources to construct control variables for some analyses in this paper. Particularly, we exploit the KOSIS database to collect the city-level share of the urban population and the number of businesses as of 2012. To measure each city's credit-constrainedness, we use proprietary data from one of the largest commercial banks in Korea and compute the city-level share of mortgage loans within 2% of loan-to-value (LTV) ratio limits in 2012. Lastly, we use the KCB data to measure the average income at the city level as of 2011.

**Stylized facts on owner-occupants, Chonseil tenants, and renters.** Appendix Table A.1 uses the Korean Housing Survey (KHS) and shows descriptive statistics of owner-occupants, Chonseil tenants, and renters. Owner-occupants tend to have the highest levels of income and wealth, followed by Chonseil tenants, followed by renters. Appendix Table A.2 uses the housing and Chonseil transaction data from the MOLIT and shows descriptive statistics of owner-occupied, Chonseil-deposit, and rented housing units. Consistent with Table A.1, owner-occupied units tend to be largest, followed by Chonseil units, followed by rental units.

Table A.1: Characteristics of Chonsei tenants

	Income		Net Wealth	
	(1)	(2)	(3)	(4)
Chonsei	-80.08*	-79.46*	-92.31***	-91.76***
	(42.42)	(42.65)	(27.53)	(27.59)
Rent	-1442.4***	-1440.7***	-293.2***	-294.9***
	(59.87)	(59.55)	(40.52)	(40.81)
Own (Base)	3884.3***	3883.9***	379.4***	379.5***
	(12.35)	(12.31)	(9.519)	(9.595)
Year FEs	Yes		Yes	
Province FEs	Yes		Yes	
Year x Province		Yes		Yes
Adjusted R <sup>2</sup>	0.0666	0.0677	0.1889	0.1935
# Obs	74,094	74,094	74,094	74,094

**Notes.** This table uses the Korean Housing Survey (KHS) for 2012, 2014, 2016, 2017, 2018 and shows the characteristics of Chonsei tenants relative to those of homeowners and renters. The unit of observation is a household. Monthly income is in 1,000 KRW, and net wealth is in 1,000,000 KRW. Standard errors are clustered at the province level.

Table A.2: Characteristics of Chonsei units

	Area of Apartment (SQM)			
	(1)	(2)	(3)	(4)
Chonsei	-0.000742 (0.367)	-1.178*** (0.216)	-1.803*** (0.176)	-0.563*** (0.0767)
Rent	-11.15*** (0.509)	-11.53*** (0.375)	-10.60*** (0.307)	-2.562*** (0.153)
Own (Base)	75.95*** (0.676)	76.44*** (0.118)	76.50*** (0.0943)	74.64*** (0.0470)
City x Year-Month FEs		Yes		
Dong x Year-Month FEs			Yes	
APT Block x Year-Month FEs				Yes
Adjusted R <sup>2</sup>	0.02540	0.1174	0.2807	0.7047
# Obs	11,432,746	11,432,746	11,432,746	11,432,746

**Notes.** This table uses MOLIT's housing transaction data from 2011 to 2020 and reports the average apartment area for Chonsei, rental, and owner-occupant apartments. Dong is the smallest administrative division in South Korea. Standard errors are clustered at the City level.

Table A.3: House prices, interest rates, and Chonsei prevalence for 2020-21

	Price-Rent Ratio Growth, 2020-2021			
	(1)	(2)	(3)	(4)
Chonsei Prevalence, Standardized	-0.0312*** (0.0108)	-0.0238** (0.0112)	-0.0401*** (0.0121)	-0.0355** (0.0136)
Share of Mortgage Loans Constrained by LTV Limits, Standardized		-0.0077 (0.0133)		-0.0080 (0.0210)
Share of Urban Population, Standardized		0.0055 (0.0143)		0.0162 (0.0166)
Average Income, Standardized		-0.0280*** (0.0095)		-0.0237** (0.0106)
Number of Businesses, Standardized		-0.0216** (0.0092)		-0.0118 (0.0072)
Constant	0.0556*** (0.0091)	0.0534*** (0.0099)		
Province FEs			Yes	Yes
Adjusted R <sup>2</sup>	0.07915	0.1471	0.2451	0.2822
# Obs	126	126	126	126

**Notes.** This table reports estimates from specification (20), where we regress house price growth on Chonsei prevalence. The dependent variable is annualized city-level price-rent ratio growth from 2020-2021. The Chonsei prevalence measure is defined as the number of Chonsei transactions in 2019 divided by the number of apartments in 2010. Control variables include the share of mortgage loans constrained by LTV regulation, the share of the urban population, average income, and the number of establishments measured as of 2012. All righthand side variables are standardized.

## B Supplementary Material for Section 3

### B.1 Proof of OLG Equilibrium

In this appendix, we show that, if equilibrium conditions hold for period 0, they hold for all future periods. In period  $t$ , wealth and rents grow by a factor  $(1 + g)^t$ :

$$W_t = (1 + g)^t W_0, \quad n_t = (1 + g)^t n_0$$

We seek an equilibrium in which prices and deposit size also scale by  $(1 + g)^t$ :

$$p_t = (1 + g)^t p_0, \quad L_t = (1 + g)^t L_0$$

**Tenants.** If  $\beta L_0 r_C = n_0$ , and

$$\frac{L_t}{n_t} = \frac{L_0}{n_0} \quad \forall t$$

then we have  $\beta L_t r_C = n_t$  for all  $t$ . Thus, rental market clearing in period  $t = 0$  implies rental market clearing for all future periods.

**Homeowners.** We will also think of savings in period-0 equivalents. Thus, the households chooses  $s_t$  by choosing  $s_0$  in:

$$s_t = (1 + g)^t s_0$$

Plugging these into the three value functions (1), (2), and (3), we get:

$$V_S \left( W_0 (1 + g)^t \right) = \max_{s_0 \geq 0} \frac{\left( W_0 (1 + g)^t - s_0 (1 + g)^t \right)^{1-\eta}}{1-\eta} + \beta \frac{\left( s_0 (1 + g)^t (1 + r_S) \right)^{1-\eta}}{1-\eta}$$



$$V_B \left( W_0 (1+g)^t, p_0 (1+g)^t \right) = \max_{s_0 \geq 0} \frac{\left( W_0 (1+g)^t - s_0 (1+g)^t - p_0 (1+g)^t \right)^{1-\eta}}{1-\eta} + \beta \frac{\left( s_0 (1+g)^t (1+r_S) + p_0 (1+g)^{t+1} + n_0 (1+g)^t \right)^{1-\eta}}{1-\eta}$$

$$V_C \left( W_0 (1+g)^t, p_0 (1+g)^t, L_0 (1+g)^t \right) = \max_{s_0 \geq 0} \frac{\left( W_0 (1+g)^t - s_0 (1+g)^t - \left( p_0 (1+g)^t - L_0 (1+g)^t \right) \right)^{1-\eta}}{1-\eta} + \beta \frac{\left( s_0 (1+r_S) (1+g)^t + \left( p_0 (1+g)^{t+1} - L_0 (1+g)^t \right) \right)^{1-\eta}}{1-\eta}$$

We can factor out  $(1+g)^{t(1-\eta)}$  from each formula, to get:

$$V_S \left( W_0 (1+g)^t \right) = \max_{s_0 \geq 0} (1+g)^{t(1-\eta)} \left[ \frac{(W_0 - s_0)^{1-\eta}}{1-\eta} + \beta \frac{(s_0 (1+r_S))^{1-\eta}}{1-\eta} \right] = (1+g)^{t(1-\eta)} V_S(W_0) \quad (26)$$

$$V_B \left( p_0 (1+g)^t, W_0 (1+g)^t \right) = \max_{s \geq 0} (1+g)^{t(1-\eta)} \left[ \frac{(W_0 - s_0 - p_0)^{1-\eta}}{1-\eta} + \beta \frac{(s_0 (1+r_S) + p_0 (1+g) + n_0)^{1-\eta}}{1-\eta} \right] = (1+g)^{t(1-\eta)} V_B(W_0, p_0) \quad (27)$$

$$\begin{aligned}
V_C \left( p_0 (1+g)^t, L_0 (1+g)^t, W_0 (1+g)^t \right) = \\
\max_{s \geq 0} (1+g)^{t(1-\eta)} \left[ \frac{(W_0 - s_0 - (p_0 - L_0))^{1-\eta}}{1-\eta} + \beta \frac{(s_0 (1+r_s) + (p_0 (1+g) - L_0))^{1-\eta}}{1-\eta} \right] = \\
(1+g)^{t(1-\eta)} V_C (W_0, p_0, L_0) \quad (28)
\end{aligned}$$

In words, the above expressions state that, if prices and deposit size grow at rate  $g$ , then value functions in period  $t$  are equal to time-0 value functions multiplied by  $(1+g)^{t(1-\eta)}$ . Now, we then have:

$$U_{Sit} \left( W (1+g)^t \right) = (1+g)^{t(1-\eta)} hV_S (W_0) + (1+g)^{t(1-\eta)} \xi_{Si}$$

Dividing by  $(1+g)^{t(1-\eta)}$ , we have:

$$\frac{U_{Sit} \left( W_0 (1+g)^t \right)}{(1+g)^{t(1-\eta)}} = hV_S (W_0) + \xi_{Si}$$

If consumers choose the option which maximizes utility, market shares are thus:

$$\pi_{St} \left( W_0 (1+g)^t, p_0 (1+g)^t, L_0 (1+g)^t \right) = \pi_{S0} (W_0, p_0, L_0)$$

and likewise for  $\pi_{Bt}, \pi_{Ct}$ . Thus, the Chonsei demand function satisfies:

$$\pi_{Ct} (W_t, p_t, L_t) = \pi_{C0} (W_0, p_0, L_0)$$

And the housing demand function satisfies:

$$D_{H,t} \left( p_0 (1 + g)^t, L_0 (1 + g)^t \right) = D_{H,0} (p_0, L_0) \quad (29)$$

**Housing supply.** Recall that housing supply in each period  $t \geq 1$  is specified as

$$H_t = (1 - \delta) H_{t-1} + I_t$$

where  $I_t = \left( \frac{p_t}{c_t} \right)^\alpha$  and  $c_t = (1 + g)^t c_0$ . We have assumed that  $H_0 = \frac{1}{\delta} \left( \frac{p_0}{c_0} \right)^\alpha$ . Observe that by induction, assuming that  $H_{t-1} = H_0$ , we have

$$H_t = (1 - \delta) H_{t-1} + \left( \frac{p_t}{c_t} \right)^\alpha = (1 - \delta) H_0 + \left( \frac{p_0}{c_0} \right)^\alpha = (1 - \delta) H_0 + \delta H_0 = H_0$$

which allows us to solve for a balanced growth path where  $H_t = H_0$  in all periods  $t \geq 0$ .

Equilibrium in the housing market in period  $t$  is determined by  $D_{H,t} (p_t, L_t) = H_t (p_t, c_t)$ , we have shown that this condition is equivalent to  $D_{H,0} (p_0, L_0) = H_0 (p_0, c_0)$ . Thus, if the housing market clearing condition (7) holds in period  $t = 0$ , then it holds in every future period.

Together, we have shown that if the housing and rental market clearing conditions hold in time 0, (9) and (8), and the ratios  $\frac{p_0}{n_0}, \frac{L_0}{n_0}$  they hold in every future period, completing our characterization of equilibrium.

## B.2 Price Passthrough in the Model

For price passthrough, under logit functional forms, we first compute the derivatives of each value function:

$$\frac{\partial \pi_{C0}}{\partial L_0} = \frac{\partial V_C}{\partial L} h \pi_{C0} (1 - \pi_{C0})$$

$$\frac{\partial \pi_{C0}}{\partial p_0} = \pi_{C0} \left[ \frac{\partial V_C}{\partial p} (1 - \pi_{C0}) - \frac{\partial V_B}{\partial p} \pi_{B0} \right] h$$

$$\frac{\partial \pi_{B0}}{\partial p_0} = \pi_{B0} \left[ \frac{\partial V_B}{\partial p_0} (1 - \pi_{B0}) - \frac{\partial V_C}{\partial p_0} \pi_{C0} \right] h$$

Hence,

$$\begin{aligned} \frac{dp_0}{dr_C} &= \frac{\partial p_0}{\partial L_0} \frac{\partial L_0}{\partial r_C} = - \frac{\frac{\partial \pi_{C0}}{\partial L_0}}{\frac{\partial \pi_{C0}}{\partial p_0} + \frac{\partial \pi_{B0}}{\partial p_0} - \frac{\partial H_0}{\partial p_0}} \frac{\partial L_0}{\partial r_C} \\ &= \frac{\frac{\partial V_C(W, p_0, L_0)}{\partial L_0} \pi_{C,0} (1 - \pi_{C,0})}{\left( \frac{\partial V_C(W, p_0, L_0)}{\partial p_0} \pi_{C,0} + \frac{\partial V_B(W, p_0, L_0)}{\partial p_0} \pi_{B,0} \right) (1 - \pi_{C,0} - \pi_{B,0}) - \frac{k\alpha}{\delta h c_0^\alpha} p_0^{\alpha-1}} \cdot \frac{n_0}{r_C^2} \end{aligned}$$