Presale, Credit Constraints and Housing Supply*

Nikita Kotsenko†

January 8, 2026

Click here for most recent version

Abstract

Homebuilders finance projects using bank loans and presales, making presale timing and pricing relevant to credit frictions, housing supply, and affordability. Data from Israel in the 2010s indicates a 5.6% average cost premium for presale funding relative to bank loans, indicating credit frictions. A new model captures the key tradeoffs faced by builders and buyers. Calibration shows that relaxing credit frictions increases housing supply and welfare but also raises standard price indexes that ignore sale timing. This occurs because builders substitute away from presales toward bank borrowing, reducing the share of early (typically lower-priced) transactions in observed sales.

Keywords: Affordability, Financial Frictions, Intertemporal Firm Choice, Building, Residential Real Estate, Cost of Capital

JEL code: D25, G31, L74, R31

*I thank David Genesove, Boyan Jovanovic and Dan Waldinger for many helpful comments and discussions. I also thank Jess Benhabib, Danny Ben Shahar, Tom Cui, Morris Davis, Tomer Ifergane, Alexey Khazanov, Alessandra Peter, Peleg Samuels, Stijn Van Nieuwerburgh and Jinglin Wang for helpful discussions. I also thank participants of the IO workshop at NYU Stern, at the macro lunch at NYU Economics, and at the Furman Center fellows meeting at NYU Wagner. This research was supported by the Israel Science Foundation (grant No.50/23), by Israel Scholarship Education Foundation (ISEF) and by The Alrov Institute for Real Estate Research at Coller Faculty of Management at Tel Aviv University. All mistakes are my own.

†Visiting Scholar, Tel Aviv University. Contact: kotsenko@gmail.com

1 Introduction

Home builders primarily rely on a mix of loans and presales to fund their projects.[1] This practice introduces a novel interaction among residential production, credit markets and housing prices, with potential implications for housing supply and affordability. Presale offers buyers an affordable path to buying a new home. However, builders' reliance on presale funding hints at the existence of credit constraints, which may restrict overall housing supply, ultimately exacerbating affordability challenges. Although this study focuses on Israel, presale is a widespread phenomenon in major economies. For example, in the United States during 2022–2023, only 36.7% of the 1.3 million new residences sold (480,000 units) were sold after construction was completed, while 17.5% (228,000 units) were sold before construction even began.[2] Despite its prevalence, little is known about how presale financing influences housing supply and housing affordability.

This study introduces and quantifies the "presale premium": the additional cost builders incur to secure funding through presale compared to bank credit. Using detailed transaction data from the Israeli housing market between 2010 and 2019, the analysis reveals that presale premia are positive in 62% of cases with a mean of 5.6%.[3] To explore the implications of presale premia, it then develops the first quantifiable equilibrium model of the home ownership market that incorporates presale transactions.

Calibrated to Israeli data, the model rationalizes presale prices that imply substantial premia as a result of borrowing limits faced by builders. Counterfactual experiments illuminate the roles of presale and credit constraints in the housing market. For each 1% reduction in the share of residences sold in presale caused by a binding ceiling on the the share of residences that can be sold in presale, housing supply declines in the short term by 0.03% and residence prices in all categories increase by between 0.09% and 0.12%. These results demonstrate how presale, by increase the builders' access to early funding, increases housing supply and reduces prices.

I calculate the presale premium by subtracting the builder's cost of funds from an implied presale interest rate. This implied rate is determined similarly to the Yield-To-Maturity on a bond: it is the rate at which the net present value of the sum of all transfers resulting from the presale transaction equals zero. The primary challenge

[1]Housing presale is the practice of selling residential units at any time before they are ready for occupancy. See 2 for more details.

[2]Source: https://www.census.gov/construction/nrs/pdf/newressales.pdf

[3]Comparable to an interest rate in yearly terms.

in measuring the presale premium lies in the fact that presale involves transferring ownership of a finished housing unit that does not have an observable market value at the time of transfer. This is because the unit is traded only on the presale date.[4]

To estimate the market value of the finished housing unit at the time of completion, I rely on detailed transaction-level data from Israel spanning the years 2010–2019. This dataset includes standard information for each transaction, such as the date, price, location, and unit characteristics. Crucially, it is augmented with a presale indicator that identifies transactions where a builder sells a unit before an occupancy permit is issued.

Using this data, I estimate the value-at-completion of presold residences using a three-step approach. First, I employ hedonic regressions to estimate the value of various characteristics of completed residences, excluding presale transactions to ensure that the estimated prices reflect only the intrinsic value of these characteristics. Second, I apply these hedonic estimates to infer the value of presold residences as if they had been completed at the time of sale. Finally, I adjust these inferred values to account for changes in local average housing prices between the presale date and the expected completion date, ensuring that the estimates reflect market dynamics over time.

I find that the presale premium is positive in 62% of the transactions in my data, suggesting credit constraints are usually binding.[5] The monthly average presale premium is 5.6% and the monthly median is 3.0%, suggesting funding through presale carries substantial costs for the builders. I also find there is no trend in the average level of the presale premium over my sample period, which is not too surprising given the fairly stable growth rate of housing prices in Israel in the period 2010-2019.[6]

Next, to investigate the equilibrium implications of presale in the home ownership market, I develop a model incorporating overlapping generations of short-lived builders

[4]The presale price should not equal the value of a completed unit because, while agreements to sell finished housing units usually settle within a few weeks, presale agreements may take months of even years to settle.

[5]Even if credit constraints were always binding, a 100% occurrence of positive premiums would not be expected. This is because prices in presale transactions are determined through bilateral bargaining, where buyers often lack information about the builder's specific financial conditions, leading to variation in the negotiated outcomes.

[6]This study focuses on presale as a method of funding, as alternative motivations for presale appear to be negligible in the Israeli context. For instance, the practice of diverting presale income to other projects, identified by Chen et al. (2024) as a key driver of presale in China, is effectively ruled out in Israel due to the widespread use of externally supervised, project-specific bank accounts. Additionally, the data does not support the presence of adverse selection into presale transactions and suggests only a modest network externality, which is accounted for in the reported presale premia. Further details on these considerations are provided in Appendix B.

who fund lengthy construction projects by optimizing their mix of borrowing and presale. Builders determine both the total number of units to construct and how many to sell through presale versus after completion, where unsold units are offered at potentially higher spot market prices.

To fund the costs of land and construction, I assume builders borrow at a fixed interest rate up to some limit and thereafter their rate increases as a function of leverage.[7]

Both the presale and spot markets are competitive, with builders acting as price takers. Consequently, the presale premium is determined in equilibrium by the endogenous interaction of presale and spot market prices. The overlap between successive cohorts of builders ensures competition between those selling presale units and those selling completed homes.

Housing demand arises from households that consume housing services and a numeraire good. Each household is characterized by an idiosyncratic endowment of wealth and an idiosyncratic preference for completeness, which summarizes the various factors affecting the disutility for presale relative to buying a completed residence, whether old or new.

Residence are considered new if purchased from a developer and old otherwise. The stock of second-hand housing is determined by production minus depreciation. A market for second-hand homes is crucial to capturing the empirical structure of housing markets, where roughly two-thirds of transactions involve existing residences. These residences compete with both presales and new spot sales. By integrating both household and builder considerations, the model offers rich micro-foundations for the emergence of a presale market in equilibrium.

I calibrate the model to the Israeli housing market. I externally calibrate most parameters using publicly available statistics and previous research. The builder's interest rate and presale installments are set based on accounts of industry experts. The other parameters, which include the builder's cost curvature parameter and borrowing limit, household preferences for residence types, as well as the depreciation rate, are calibrated to match endogenous model variables to data moments. The data moments are calculated based on transaction data for the year 2015. The builder's parameters are calibrated to match the data moments for average project size and average presale share.

Calibration results imply a borrowing limit of 25.3 million New Israeli Shekel (NIS)

[7] Project funding from banks is largely insensitive to project characteristics and is cheaper than project funding through bonds.

per project, with another 9.3 million funded from the first installment on presales, suggesting presale plays a major role in funding construction.[8] External information on builder returns and borrowing limits that was not used in the calibration is nontheless largely consistent with it.

After calibrating the model, I turn to study two counterfactual policy experiments. In each counterfactual experiment I distinguish beween three time frames: in the short term, both the quantity of old housing and land available for residential use are fixed. The latter means that entry cannot increase relative to the baseline. In the medium term, new land can be made available for residential use but the quantity of old housing is still fixed. In the long term, old housing also adjusts. Project size, presale share and prices are always free to adjust. I am assuming that new residential land cannot increase immidiately because in reality, a lengthy regulatory process is required to designate land for residential development.[9]

In the first counterfactual experiment, I consider the restriction of presale as a share of project size. When a binding ceiling reduces the share of residences a project is allowed to presell by 1%, builder capacity diminishes, resulting in a decline of new units per project (-0.1%). In the short term, the decline in project size results in a decline in aggregate housing supply, leading to higher residence prices in all three housing categories. This highlights the role presale plays in mitigating the effects of credit frictions in housing production. In the medium term, an increase in new projects alleviates most of the reduction in aggregate supply and reverses much of the price increases. In the long term, the stock of old housing declines (-0.1%) but further entry (0.16%) mitigates most of the negative effects on aggregate supply (-0.105%) and prices (0.017%-0.037%). This highlights how production finance interacts with the supply of land to affect the equilibrium supply of housing.

Second, I consider the alleviation of builders' borrowing constraints. Such an outcome can plausibly be achieved by various interventions such as subsidizing bank loans to builders. A 1% increase in the bank credit available at a fixed interest rate causes increased project size (0.3%). Aggregate housing supply increases and prices in all housing categories decline. In addition, there is a disproportial increase in the sale of completed units as builders substitute away from presale. The tendencies of increased project size

[8] Each US dollar is worth between 3-4 NIS during the study period.

[9] The Bank of Israel estimates this process takes an average of 8 years (Bank of Israel 2014). According to Genesove (2021), popluation growth in Israel exceeded dwelling completions in every year between 2004 and 2015.

to increase aggregate supply and to reduce prices is enhanced in the medium term by an increase in the number of projects (0.071%) and in the long term by an increase in the stock of old housing (0.016%). Nevertheless, the reduction in the availability of presale (-2.6%) causes a slight reduction in average affordability. This highlights the dual role presale plays in housing affordability - both as a source of cheaper housing and as a source of funding for production.

Related Literature The main contribution of this study is to show the implications of credit constraints for housing supply and the role of presale in mitigating them. The main related literatures are those on constraints to housing supply, in particular on financial frictions constraining housing supply, and on the housing production function.

This study contributes to the literature on constraints to housing production. From the seminal contributions of Gyourko, Saiz and Summers (2008), Glaeser and Ward (2009) and Saiz (2010) and as recently surveyed in Molloy (2021), this literature has focused on regulatory and geographic constraints on housing production. My contribution is to consider how credit constraints may limit housing supply, and the large but partial role presale plays in mitigating such constraints.

This study also contributes to a small cohort of recent studies investigating financial frictions in housing supply. Studies by Levy (2022) and Samuels (2024) focus on geographic frictions to the supply of capital to the rental market by household investors while studies by Kim (2023) and Van Straelen (2024) focus on how housing demand shocks are transmitted between local markets through construction firm's balance sheet considerations. All four studies provide detailed evidence that is incompatible with frictionless access to capital in the supply of housing. My two main contributions to this literature are: 1) to highlight how presale data can be used to quantify credit constraints by measuring the presale interest rate premium; 2) to provide a model that quantifies the role of presale in mitigating credit constraints.

Another relevant literature is on the housing production function. This literature, which includes the seminal contribution of Epple, Gordon and Sieg (2010) and of which a prominent recent example is Combes, Duranton and Gobillon (2021), typically aims at identifying the physical production function of single family homes, modelling construction as an event rather than as a process. Two recent working papers, Ben-Moshe and Genesove (2022) and Genesove, Levy and Snir (2023), extend this literature to multi-family homes. My contribution is to consider how financing constraints, time to build and presale shape production decisions and equilibrium residence prices.

2 Institutional Context

Presale, as commonly practiced in Israel since 2008, involves a binding agreement between a builder and a buyer. The builder commits to delivering a completed housing unit with predetermined specifications by a specific date, while the buyer agrees to a schedule of payments tied to project milestones. In multi-unit developments, presales typically begin shortly after the land is acquired and continue until just before an occupancy permit is issued. The whole presale period usually spans about four to six years.

2008 Reforms Reforms introduced after the collapse of a major developer in 2007 have significantly improved the transparency and structure of Israel's presale market, facilitating this research and enhancing its international relevance. These reforms align Israeli presale practices more closely with those in other countries, broadening the applicability of this study's findings. Three key aspects of the 2008 reforms are particularly important.

First, builders are now required to report all presale transactions to a newly established regulator (Ministry of Construction and Housing, 2022). This enables precise identification of presale transactions, overcoming data limitations from earlier periods. While transaction dates are publicly available, building completion dates are not, and the pre-reform reliance on the "building year" variable often yielded unreliable results. This data improvement is a primary reason the study focuses on the post-reform period.

Second, the reforms introduced bank supervision of project accounts for most developers. Under this system, both credit from banks and income from presales are deposited into a dedicated account for the project. Funds can be withdrawn only for approved project expenses, with final balances released to the developer only after an occupancy permit is issued (Ministry of Construction and Housing, 2022). This prevents the diversion of presale funds (and any project specific loans) to unrelated uses and closely mirrors U.S. practices, where project-specific accounts are subject to strict regulatory oversight (Chen et al., 2024).

Third, the reforms imposed limits on the proportion of the presale price that can be collected from buyers at various stages of project completion. This change prohibits upfront full payment, a practice common in China, and aligns Israel's installment-based system with standard U.S. practices (Chen et al., 2024). Further details about these payment schedules are discussed in Section 4.

Table 1: Milestones and Installments

	Milestones	Max Installment Share
0		7%
1	The frame of the ceiling of the ground floor of the building is completed	40%
2	The frame of the ceiling of the floor of the sold residence is complete	60%
3	Plastering of the entire building is complete	75%
4	Exterior finishes are complete	90%
5	The key to the residence is delivered to the buyer	100%

Timing of payments Each payment's due date is defined in the presale contract, and is subject to regulation. The regulation limits the share of the presale price the builder can receive before reaching each of several specified milestones in the project. Thus, the entire schedule of payment on presale depends on the last project milestone reached before the sale is made and on when the next milestones are reached.

For example, before the first milestone is completed, the builder can receive up to 7% of the presale price. After the first milestone is reached, the builder can receive up to 40%. Thus, in presales that occur before the first milestone, the buyer pays up to 7% up front and an additional 33% when the first milestone is reached. In presales that occur after the first milestone, the buyer pays up to 40% up front.

The milestones and corresponding shares are 1) The frame of the ceiling of the ground floor of the building is completed (40%); 2) The frame of the ceiling of the floor of the sold residence is complete (60%); 3) Plastering of the entire building is complete (75%); 4) exterior finishes are complete (90%); 5) the key to the residence is delivered (100%). The milestones and installment shares are summarized in Table 1.

3 Data

The primary data source for this study is a database of nearly all arms-length (excluding gifts) residential sales in the 43 larges cities in Israel between January 2008 and October

2021 (inclusive). Each transaction record contains its price, date, location (parcel number), number of rooms, residence area in square meters, year of construction and floor number. This database, maintained by the Survey of Israel, is augmented by a presale indicator and a project name that are drawn from Ministry of Construction and Housing (MCH) records. These MCH records are compiled from reports by developers to MCH regarding each sale of a residence in an unfinished building. Such reports are mandated by the 2008 amendment to the Law of Sale.

I also use the Israeli deeds database, maintained by the Tax Authority, which contains (nearly) the universe of arms length transactions in real estate in Israel between 1998-2022. On each transaction I observe the price, date, location and property details such as type, area, rooms (bedrooms + living room), building year, floor(s).

Throughout the study I focus on transactions in buildings with at least 2 floors and at least 4 housing units. I do so because I expect low density construction such as single family houses to face financial considerations that are substantially different from those of high density construction. In particular, a single family house can go from land acquisition to occupancy permit much more quickly than a multi-family building, for several reasons: planning is much simpler and faces less regulation, building does not require work at an altitude, several nearby buildings can be built fully in parallel, and underground parking is rare. For all these reasons, finance is for a shorter term and the usually cheaper land makes credit constraints less likely to be binding.

As noted in the Introduction, all prior empirical research about presale has been from south Asia. Thus, this data, being from a different geographic region with distinct institutions, has the advantage of broadening the scope of evidence available to researchers. It also includes a presale indicator which allows me to know the precise length of presale in each project.

That said, this data has an important limitation that should be addressed. The limitation stems from the fact that the reporting requirements for presales to the Ministry of Construction and Housing are different from the reporting requirements for deeds to the Tax Authority. For this reason it is difficult to link them, which results in my data containing two non-identical records of some transactions, where one record is indicated correctly as presale and the other is incorrectly indicated as non-presale. I take several measures to address this problem: First, I drop from my data all transactions indicated as non-presale with a negative age at sale (transaction year minus building year). Second, I drop all transactions indicated as non-presale that occur before a presale transaction in the same building. Third, I conduct an analysis (see Appendix A.4) that shows that about 74% of age zero, about 19% of age one and about 6% of age two transactions that are indicated as non-presale are in fact presales. I thus drop an appropriate percentage of such observations from the data. To the extent that presales indicated as non-presale are still present, this should cause my estimates of value at completion to be biased downward (because presales tend to be sold at a discount). This should bias my estimates of the presale premium downward as well.

Tables 2 and 3 present transaction level summary statistics for spot sales and presales respectively (I refer to transactions in completed residences as spot sales). Presales and spot sales are not very dissimilar, but they are not identical either, as one would expect. One reason for the difference is that presales naturally tend to occur in newer buildings, compared with sales of finished residences, which include second-hand housing. In my data, newer builders tend to have more stories and larger residences. The average floor of a presold residence is 5.5 out of an average of 11.6 floors, while for a spot sale it is 3.93 out of an average of 7.8 floors. The presold residences are nearly 1/5 larger: spot sales have on average 4.05 rooms on an area of 97.2 square meters while presales have on average 4.35 rooms on an area of 112.6 meters. In the next section I discuss how I account for these differences when calculating the presale premium.

Table 2: Spot Sales Summary

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
year sold	122,075	2,015	2.790	2,010	2,019
rooms	122,075	4.056	0.874	1	10
square meters	122,075	97.19	27.68	21	800
floor	122,075	3.933	3.660	-1	47
building floors	122,075	7.795	5.269	2	42
building year	122,075	2,001	8.495	1,982	2,019
age at sale	122,075	14.30	8.634	0	37

Notes: year sold is the year that appears on the deed record as year of sale; rooms is the number of rooms in the asset, sqm is asset size in square meters, age is year of sale minus building year.

Table 3: Presale Summary

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
year sold	57,608	2,014	2.577	2,010	2,019
rooms	57,608	4.349	0.927	1	10
square meters	57,608	112.6	28.50	21	785
floor	57,608	5.467	4.128	-1	47
building floors	57,608	11.58	11.38	2	78

Notes: year sold is the year that appears on the deed record as year of sale; rooms is the number of rooms in the asset, sqm is asset size in square meters, age is year of sale minus building year.

4 Presale Premium

In section I derive and estimate the presale premium, Δr_p.

4.1 Definitions

To derive Δr_p, I first define the presale interest rate r_p, so that the presale premium can be defined as

$$\Delta r_p = r_p - r_b$$

, where $1 + r_b$ the interest rate the builder pays per year on its bank loans.

Presale Interest Rate Each presale transaction results in stream of money transfers from the buyer to the seller and ends in the transfer of a finished residence from the seller to the buyer. I define the presale interest rate in a presale transaction as the interest rate that, if used to discount each of the transfers, would cause the sum of the discounted transfers to equal zero.

To make this definition both more formal and more concrete, denote the presale price by $p > 0$, the value of the finished residence by $s > 0$, the share of the presale price due at each date $t_n \in \mathbb{N}$, $n \in \{0, 1, ..., N\}$ by $\iota_n \in (0, 1)$. Thus, the net present value of the transaction from the builder's perspective is:

$$V(r) \equiv \sum_{n=0}^{N} \frac{p\iota_n}{(1+r)^{t_n}} - \frac{s}{(1+r)^{t_N}}$$

and the presale interest rate, denoted r_p, is r such that $V(r) = 0$:

$$r_p \equiv \{r \mid V(r) = 0\}$$

[10]

4.2 Estimation

There are two main challenges involved in calculating the presale interest rate r_p: the expected timing of payments and the expected value of the finished residence are both unobservable. In addition, to obtain Δr_p a value for r_b is required. Those challenges are addressed as follows:

Timing of payments Recall that each payment's due date is defined in the presale contract, and is subject to regulation. The regulation limits the share of the presale price the builder can receive before reaching each of several specified milestones in the project. Because I do not observe actual presale contracts, I assume that the buyer is required to pay as much as regulation would allow. If this is not true, this would cause me to underestimate presale interest rates. Because I do not observe each builder's estimates of when each milestone would be reached, I use a heuristic provided by an industry expert to calculate, based on the number of floors in the building and the residence's floor number, the average time until each milestone is reached. Further details about the heuristic are provided in Appendix E.1.

Value at completion To overcome the challenge of inferring the value of the completed residence I first use hedonic pricing to measure the value of various characteristics of completed residences. I exclude presales from the sample of observations used to calculate the values of characteristics because their price reflect a combination of values of characteristics and of other considerations. I regress the natural log of transaction

[10] Another way of thinking about r_p is as the interest rate such that, if the builder could funds all project costs at the rate r, and no lower rate was available to it, it would be indifferent between selling a unit at price p at time t_N (presale) and selling it at price s at time t_0 (spot).

price on the natural logs of residence rooms and of area in square meters, as well as on the residence floor number, a third degree polynomial of building age at sale, building fixed effects and year by neighborhood fixed effects. I find that running the regressions separately in each district improves out of sample prediction while using separate years does not, so I do the former but not the latter.

Second, I use the resulting hedonic values to infer the counterfactual value of the presold residence if it was completed by the time it was sold, setting the residence age at sale to zero. The third degree district specific polynomial in the hedonic regression helps make sure that I can accurately fit the price of hypothetical transactions at age zero. For more details on the hedonic estimation see Appendix A.2.

Finally, I account for changes in the local average prices of residences between the date of actual sale and the expected date of completion. I do so by calculating monthly average prices of spot sales in each neighborhood and assuming builders know the price trends between sale and completion.[11] For more details on adjusting for local time trends see Appendix A.3.

Bank interest rate According to market experts, the interest rate on the builder's bank credit always falls within the narrow range of prime plus 1.25% and prime plus 2.5%, where prime is the interbank benchmark lending rate published by The Bank of Israel and regularly reported in the business press. Lending from other sources appears to be insignificant. Due to lack of access I am forced to ignore other sources. This may cause the presale premium Δr_p to be biased slightly upward.[12]

[11] Using the change in year by neighborhood fixed effects from the hedonic regression instead of monthly price trends ignore seasonal effects which are important in housing markets. Using neighborhood by month FE in the hedonic regression but they both performed poorly in terms of out-of-sample R^2. The downside of using realized monthly appreciation rates is that it results some extremely large positive and negative expected appreciation rates. This is problematic because if it was common knowledge that prices would change so fast in a neighoborhood over the next year, spot prices would adjust immidiately. I handle this by capping I cap the price changes by 10% per year in absolute value. The above argument does not apply to moderate appreciation rates due to transaction costs. I also tried using forecasted price trends by estimating an ARIMA process on past monthly neighborhood trends (instead of using realized price trends) but this made the problem of extreme appreciation rates even worse.

[12] While some builders issue bonds to the public, these offerings tend to raise a small share of their funding needs and to come at a cost that exceeds their cost of bank credit. For example, the biggest builder, with a 16% market share, raised with its 2015 offering only enough to fund 2.9% of its construction costs. The YTM at issuance was 4.9% while the rate on bank credit was at most 4.5%.

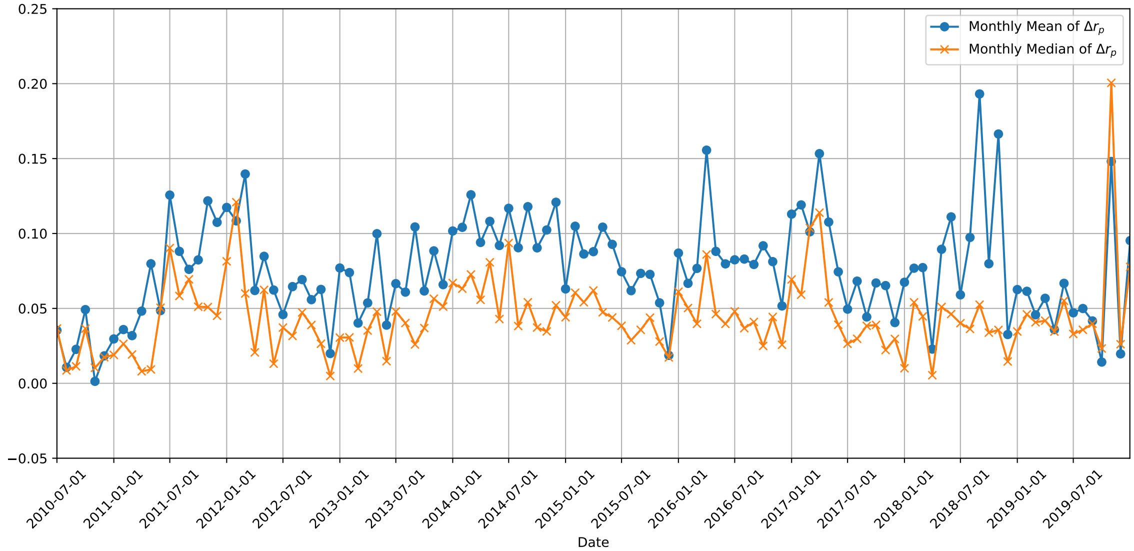
4.3 Results

Figure 1 plots the monthly mean and median of the presale premium. Both are always positive and mostly quite economically meaningful with most monthly values falling between 5%-10%. A premium of 5% implies that a builder pays a rate that is more than double its lending rate to obtain funds through presale, while a 10% premium implies the builder pays a rate that is more than triple. This naturally raises the question of why a builder would agree to sell at prices that imply such rates. As noted above, funds obtained through presale cannot be diverted to any use outside the project until the project's completion (bank loans obtained for the project also cannot be diverted). In Appendix B I discuss two other potential reasons for positive presale premia other than credit constraints. I find that the data is not consistent with adverse selection into presale and that it is only consistent with a small network externality, by which I mean that demand for presales in a project seems to increase only slightly with previous sales in that project. I account for this externality in the results presented here.

The median of the monthly presale premium is usually below the mean, which implies a right skewed distribution. This makes sense because very constrained sellers may agree to sell at very low prices, which would cause very high presale premia. On the other hand, buyers are unlikely to agree to very high prices because they always have other options, which would limit the frequency of very low presale premia. Neither the mean nor the median display a strong trend in their central tenancy. However, both become more volatile towards the later part of the data. This is probably the result of truncated projects caused by the end of the data in 2021, which causes me to be more likely to underestimate time to completion in the later part of the data. This, in turn, causes the premium to reflect large differences between presale prices and expected spot values, resulting in extreme observations, both high and low.

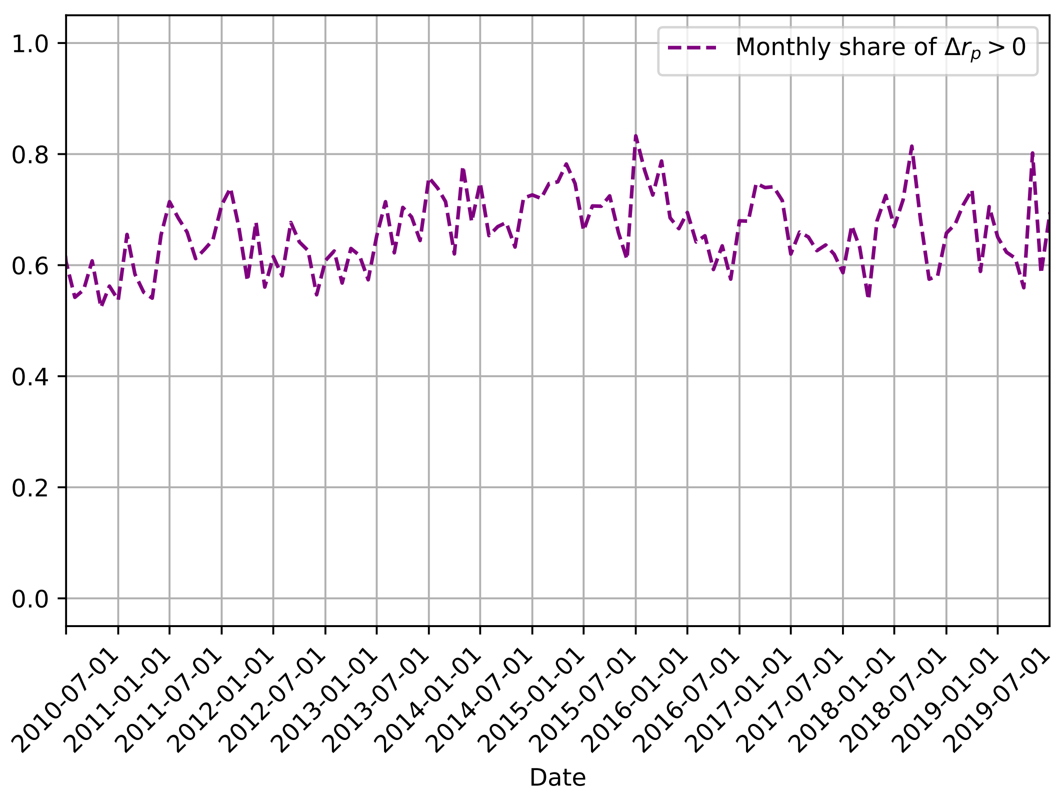
Figure 2 plots the share of presales with a positive premium in each month. The share fluctuates around 60% in until 2013 and then around 70% for the rest of the sample. The volatility is quite low, with the shares never coming close to either 90% or 40%. One should not expect all presales to carry a positive premium because prices are determined in bilateral bargaining where the buyer is uninformed about the builder's financial position and therefore cannot always appropriate a sufficiently large share of the surplus to cause a positive presale premium.

Figure 1: Monthly average and median presales premium



Notes: In each presale transaction I calculate the presale premium as detailed in the text. I then calculate, for each month, the mean and median of the premia.

Figure 2: Monthly share of presales with a positive premium



Notes: In each presale transaction I calculate the presale premium as detailed in the text. I then calculate, for each month, the share of transactions with a strictly positive premium.

5 Quantitative Model

The previous sections presented empirical evidence indicating that presale premia are substantial, pervasive and persistent. Now I turn to examining the implications of presale as a funding method for the housing market. In particular, I focus on builder credit constraints as the reason for builders to presell at prices implying positive presale premia. I discuss other potential reasons for such behavior in Appendix B and find their contribution to explaining presale premia to be minor at most. The model I develop is designed to deliver endogenous presale quantities and prices along with prices and quantities for completed new residences and second hand residences. It is intended to answer two main questions: First, how does the extent of the presale market affect the relationship between credit constraints and housing supply? Second, how does the extent of credit constraints affect the housing market in the presence of presale?

Environment The economy operates in discrete time: $t = 0, 1, ...$ There are two types of agents: builders and households. In each period t, a mass $B_t > 0$ of builders and a mass $n_t > 0$ of households are added to the market. Builders live for two periods, while households live for 1 period.

Households choose housing type from 4 options, indexed by $j \in \{Rent, Presale, Old, New\}$. Both builders and households are price takers and the law of one price holds in the market for each housing option. The supply of old residences is determined by the number of new residences produced by builders in all past periods net of depreciation. Thus, it is unaffected by the price of old residences P_{Old} but rather by the prices of new residences $P_{Presale}$ and P_{Old}. The supply of rental residences is assumed to be unlimited and the rental price is exogenous.

The model is deterministic. Participants can calculate prices as far into the future as they require. Because I restrict my analysis to steady state conditions, I omit the subscript t whenever it is not required for clarity.

5.1 Households

Households live for one period. At the start of life (period) each household i draws wage y_i and a preference for buying a completed versus an incomplete residence κ_i. Both y_i and κ_i are drawn iid from continuous Uniform distributions f_y, f_κ with parameters $y_{min}, y_{max}, \kappa_{min}, \kappa_{max}$ respectively. $1/\kappa$ captures the non pecuniary utility costs of presale, including renting while the residence is completed and postponing the arrival of better housing consumption.

After the draws are realized each household i chooses among the four housing options of renting, buying an old complete home, buying a new complete home or buying a new incomplete home.

Option $j \in \{Rent, Old, New, Presale\}$ provides household i with housing services as follows, with $\omega > 1$ and $\nu > 1$ parameters that indicate the relative preference for ownership versus rent and for living in a new versus an old residence:

$$h_j(\kappa) = \begin{cases} 1 & j = Rent \\ \omega\kappa & j = Old \\ \omega\nu\kappa & j = New \\ \omega\nu & j = Presale \end{cases}$$

The lifetime expenditure for each type of housing service is e_j.[13] At the end of its life (period), each household consumes utility $u(y, \kappa, j) = (y - e_j)^{\gamma} h_j(\kappa)^{1-\gamma}$, with $\gamma \in (0, 1)$.

Household Problem Each household chooses whether to buy a residence, and if so, which type of residence, subject to its income. The household consumes the remainder of its income, which must be strictly positive. Thus the problem of a household with income y and completeness preference κ can be written as:

$$max_j u(y, \kappa, j) = max_j (y - e_j)^{\gamma} h_j(\kappa)^{1-\gamma} \quad (1)$$
$$s.t. y > e_j$$

[13]Lifetime expenditures e_j are functions of prices that facilitate comparison among buying a complete residence, presale and rent. Because buying presale involves first renting and then owning a complete residence, presale price and the price of a complete residence are not directly comparable from the household's point of view. For completed residences (Old and New), $e_j = 0.25P_j + 0.75P_j(1 + r_m)^{20}$, where 0.25 is the minimum down-payment requirement in Israel and 20 is the average mortgage duration. For rent $e_{Rent} = 40Rent$, where $Rent$ is the yearly average rent. For presale $e_{Presale} = 5Rent + 0.25P_{presale} + 0.75P_{Presale}(1 + r_m)^{20}$. It is safe to ignore discounting in the expenditure formulas because the risk free interest rate is close to zero throughout the study time frame (the risk free interest rate is the correct rate because the investing in housing is also riskless in this model).

Household Trade-offs All households prefer New to Old to Presale to Rent but the intensity of the relative preference for Presale varies with κ and the utility cost of the consumption foregone for the sake of housing expenditure differs with y. The definition of $h_j()$ assumes that renting yields neither the benefit of newness nor of completeness. I believe this is realistic because it is uncommon for a newly built residence to be rented out and because the choice of presale usually entails renting while the residence is completed.

I further assume that $\nu < \kappa_{min}$, which allows for the following unambiguous ranking: at a given level of κ, the richest households buy New, the next richest buy Old, the next buy Presale and the poorest rent. At higher levels of κ, fewer households prefer presale and rent and more prefer Old. Calibration suggests assuming $\nu < \kappa_{min}$ is without loss of generality as ν is calibrated to be close to the middle of the interval $[1, \kappa_{min}]$.

5.2 Builders

Entry I assume there is a large mass $\overline{B}$ of builders born each period. Upon birth, each builder n born in period t must choose a probability $\eta_{n,t} \in [0,1]$ to enter the market, so the mass of entrants is given by $B = \overline{B} \int_0^{\overline{B}} f_t(\eta) d\eta$ where f_t is the PDF of entry probabilities.[14]

Those that do not enter, disappear. Those that enter pay a sunk land cost $c_L > 0$ immediately and participate in the model for two periods: $t, t+1$.

The cost of land is determined as follows: a continuum of land owners, distributed uniformly according to their alternative use value for the land λ, from $\underline{\lambda}$ to $\overline{\lambda}$. The price of land is determined by the alternative value of the marginal owner, so for 0 entrants $c_L(0) = \underline{\lambda}$ and for $\overline{B}$ entrants $c_L(\overline{B}) = \overline{\lambda}$. So for any $B \in [0, \overline{B}]$, $c_L(B) = \underline{\lambda} + (\overline{\lambda} - \underline{\lambda}) \frac{B}{\overline{B}}$.

Production A builder that chooses to enter, then chooses a quantity of housing units to produce, q, subject to a convex variable cost function:

$$C(q) = \frac{c_V}{c_E} q^{c_E}$$

$c_V > 0$ is a variable cost shifter and $c_E > 1$ is a cost curvature shifter. Building costs are paid along with sunk costs at the start of period t, while construction is completed at the start of period $t+1$.

[14] Because builders are identical, all PDFs $f_t(\eta)$ which yield the same B_t result in the same allocation.

Presale A builder that enters in period t may choose to sell share $\phi \in [0, 1]$ of units in presale in period t. The units are sold at an endogenous price $P_{Presale}$ and generate a cash flow consisting of $\iota P_{Presale}$ in period t and $(1 - \iota)P_{Presale}$ in period $t + 1$, where $\iota \in [0, 1]$ is a parameter. The rest of the units will be sold in period $t + 1$ at an endogenous price P_{New}.

Borrowing The builder must borrow any funds required in period t that are not covered by the immediate income from presale. Thus, a builder borrows in its first period:

$$Loan(q, \phi) = C(q) + c_L - q\phi\iota P_{Presale}$$

Borrowing carries a per period interest rate of $1 + r_b$ up to a bank borrowing constraint $\overline{Loan}$. Credit in excess of $\overline{Loan}$ is obtained from the bond market at an interest rate modelled as a linear function of project leverage. The builder repays the loans with interest in the second period of life. Total repayment is given by *Repay*:

$$Repay(q, \phi) = \begin{cases} Loan(q, \phi)(1 + r_b) & Loan(q, \phi) \leq \overline{Loan} \\ Loan(q, \phi)(1 + r_b) + (Loan(q, \phi) - \overline{Loan})^2 r_s & Loan(q, \phi) > \overline{Loan} \end{cases}$$

The Builder's Problem The builder's profit therefore can be written as second period income, from spot sales and from the second installment on presale, minus the second period outstanding loans, which is just the first period borrowing b_0 times the interest, minus a fixed cost of internal funds $c_I > 0$:[15]

$$\pi(q, \phi) = q(1 - \phi)P_{New} + q\phi(1 - \iota)P_{Presale} - Repay(q, \phi) - c_I$$

The builder's problem is therefore to choose total quantity and presale quantity to maximize profit subject to the borrowing constraint and subject to earning non-negative profits (otherwise the firm would not enter):

$$max_{q,\phi}\{\pi(q, \phi)\} \quad s.t. \quad \pi(q, \phi) \geq 0 \tag{2}$$

Builder Trade-offs Builders have a trade off between presale and borrowing - the more they presell, the less they need to borrow. When the presale interest rate is high

[15] c_I is a fixed cost shifter that does not affect builder optimization, which is useful in calibration.

relative to the cost of credit, they prefer to borrow and sell less in presale and more after completion. When the presale interest rate is low relative to the cost of credit, they prefer to sell more in presale and less after completion and to borrow less. The presale interest rate is determined by equilibrium prices of presale and new spot sale, which are affected by the builders' choices regarding quantity to build and to sell in presale.

The model allows for multiple discrete supply regimes, each of which results in a distinct set of supply functions for presale and spot sales. The regimes can be categorized by a combination of two factors: difference between presale and spot sale prices and the builder's funding needs relative to the borrowing limit, both as a function of quantity choices. A builder may choose i) to not sell presales at all, or ii) to sell just enough presales to equate marginal costs of presale credit and borrowing credit, or iii) to sell just enough presales to avoid borrowing at all, or iv) sell all the residences as presales. The existence of overlapping generations of builders allows for a positive supply of presales and new spot sales in every period, but does not enforce it.

5.3 Aggregate Housing Supply

The solution to the builder's problem delivers the number of builders who enter B, the quantity each builds q and the presale share ϕ. Aggregate supply of new residences is thus given $Q_B \equiv qB$, which is divided into residences sold in presale $Q_{Presale} = Bq\phi$ and those sold after completion $Q_{New} = Bq(1-\phi)$.

The supply of old residences in each period is given by the total stock of units in the previous period minus depreciation (I am assuming that residences become old after a single period). Alternatively, one can express the same quantity as the sum of all new buildings constructed from the start of time until the previous period, depreciated by the time elapsed:

$$Q_{O,t} = \sum_{i=1}^{\infty} Q_{B,t-i}(1-\delta)^i \tag{3}$$

Assuming steady state so $Q_{B,t} = Q_{B,t-1}$ for all t, we get

$$Q_O = Q_B \frac{1-\delta}{\delta} \tag{4}$$

5.4 Solution

Given parameters, a steady state market equilibrium is: prices of residence purchase types $(P_{New}, P_{Old}, P_{Presale})$, builder entry and quantity choices (B, q, ϕ), and an allocation which is a mapping from household characteristics to housing choice, such that households and builders optimize, builders get zero profit whenever $B < \overline{B}$, markets for all three residence purchase types clear, and the prices and allocations are identical for any two subsequent periods. See Appendix C.3 for more details.

6 Model Calibration

In this section I present a numerical calibration of the above model. The purpose of the numerical calibration is to quantify the effects of presales and credit constraints on the housing market equilibrium, using Israel in 2015 as the case study. The following can be divided into several parts: First, I describe the calibration of model parameters for which there exists credible information outside the present work. Second, I internally calibrate some parameters on which no external information is available. These parameters are fitted numerically by searching for the parameter values that minimize an objective function (see C.4). I do this separately for parameters affecting the supply of new residences and for those affecting demand. I calibrate the model based on the Israeli economy in the year 2015. I choose 2015 because, being in the middle of my data, it minimizes the risk of projects getting truncated by the extent of the data.[16]

6.1 Independently Calibrated Parameters

In this subsection I explain how I arrive at values for the parameters on which external sources are available. Table 4 details the chosen parameter values.

[16] I am using transaction data from the same year for all categories. Thus, for the early presales I need observations from as for forward as possible to price the presales at completion; For the latest presales and spot sales, I need observations as far back as possible to know that those transactions are in projects with at least 4 presales in the same building over at least 1 year. Thus, truncation should be minimized at the midpoint of the data.

[17] Convert to 5 year terms to arrive at $\tilde{r}_m$

[18] Convert to 5 year terms to arrive at $\tilde{r}_b$

[19] To arrive at $\tilde{r}_s$, which is the per period slope as a function of thousands of NIS in debt, this value is converted to 5 yearly terms and then divided by the present value of baseline builder profit.

Table 4: Independently Calibrated Parameters

Parameter	Value	Source
lifetime expenditure on rent	1783.20	Average monthly rent on a standard dwelling in 2015 000s New Israeli Shekel (NIS), CBS (3.715) times 12 times 40 years
Mortgage interest rate ($\hat{r_m}$)[17]	0.023	Weighted average rate on non-indexed newly originated mortgages in 2015 in yearly terms, BOI
Builder's interest rate on bank credit ($\hat{r_b}$)[18]	0.036	Mid points of prime plus premium of 1.25%-2.5%, industry experts
Slope of builder's annual interest rate as a function of leverage ratio when exceeding borrowing limit ($\hat{r_s}$)[19]	0.0383	Calculated based on the effect an increase of 1 in the leverage ratio on a builder's borrowing interest rate in Seohee Kim (2023).
Mortgage term	20	Average mortgage term at origination in 2015, BOI
Minimum mortgage down-payment share	0.25	Regulatory minimum down-payment, BOI
Household consumption share ($\tilde{\gamma}$)	0.75	One minus expenditure share on housing, Hoffman and Khazanov (2024)
Minimum and maximum lifetime income ($\tilde{y}_{min}, \tilde{y}_{max}$)	$2902.51, 74049.60$	y_{min} is set to 1.05 times lifetime expenditure on a new complete residence. y_{max} is set to 10 times annual income multiplied by 40 (working years).
New households per period ($\tilde{n}$)	59401.90	Derived from the total number of households as described in the text.
Installment shares ($\tilde{\iota}_0, \tilde{\iota}_1$)	$0.47, 0.52$	Sum of max installment shares, discounted w.r.t milestone's typical TTB, industry experts

Notes: CBS is the Israeli Central Bureau of Statistics. BOI is the Bank of Israel.

Table 5: Prices and Quantities in the Data

Variables	Values
$\tilde{P}_{Presale}, \tilde{P}_{New}, \tilde{P}_{Old}$	$1128.5, 1308.5, 1255$
$\tilde{Q}_{Presale}, \tilde{Q}_{New}, \tilde{Q}_{Old}$	$7622, 9878, 37500$

Notes: P is price, Q is supply.

Installments In reality builders can receive presale income in up to 6 installments depending on the time of purchase relative to project progress. To accommodate this in a two period setting, I divide the 6 installments equally between the two periods in terms of shares, so that about 50% of the price is due immediately and about 50% at completion. To better account for the net present value of the installments in each case, I adjust the 50% by the relevant interest rates. This results in the sum of the two installments not equaling exactly 100%. See Appendix D.3 for more details.

New Households I focus on new households to be consistent with the model assumptions about homogenous life-span and mortgage terms for households. The number of new households added in 2015 is not available in public statistics. Thus, I derive it from the total number of households in 2015 assuming a constant population growth rate and a fixed household lifespan.

6.2 Internally Calibrated Parameters

The parameters which I calibrate internally are: (1) the builder cost parameters $(c_V, c_E, c_I, \overline{\lambda}, \underline{\lambda}, b_{lim})$; (2) household preferences for ownership, newness and completeness $(\omega, \nu, \kappa_{min}, \kappa_{max})$; and the depreciation rate of new to old residences (δ). The parameter values resulting from the calibration are presented in Table 6. The calibration is conducted as follows.

Data Moments First, I calculate the average prices of presales, new spot sales, and second hand sales in 2015 and use them to set the model prices. I use a similar calculation for quantities of such sales in 2015 to set the targets for aggregate demand and supply. Further details are provided in subsection 6.3. The results of these calculations are presented in Table 5.

Second, I calculate from my transaction data that the average number of units in a new building of at least 3 floors in 2015 to be $\tilde{q} = 40.5$, which implies there are

432 projects due to $\tilde{B} = \frac{\tilde{Q}_{Presale}+\tilde{Q}_{New}}{\tilde{q}} = 432$. This should be interpreted as 432 new buildings are built each year, each with 40.5 units.

Depreciation The definition of Q_O implies that given baseline empirical quantities of new and old residences sold, one can calibrate delta as

$$\tilde{\delta} = \frac{\tilde{Q}_{New} + \tilde{Q}_{Presale}}{\tilde{Q}_{Old} + \tilde{Q}_{New} + \tilde{Q}_{Presale}}.$$

Demand There are four demand parameters $\kappa_{min}, \kappa_{max}, \omega, \nu$ and only three moments to target $\tilde{Q}_{Old}, \tilde{Q}_{New}, \tilde{Q}_{Presale}$. In addition, the parameters need to match the following restrictions to ensure demand functions are well defined: $\nu \in (1, k_{min})$, $\kappa_{max} > k_{min}$, $\omega > 1$ (see Appendix C.2 for a discussion of the restrictions and the derivation of demand functions). In practice, good results in terms of speed and regularity of convergence are obtained when setting $\tilde{\kappa}_{min} = 1.01$ and then using a solver to search for values of $\kappa_{max}, \omega, \nu$ that match demand to the targets subject to the restrictions.

Builder Costs To calibrate builder cost parameters $(c_V, c_E, c_I, \overline{\lambda}, \underline{\lambda}, b_{lim})$ I do the following:

First, I use data from a report on housing construction costs (Ministry of Construction and Housing 2015) to estimate the per unit land cost $A\tilde{L}C$ and the per unit non-land cost $A\tilde{V}C$ in a multi-family building in 2015. See Appendix D.2 for further details. on these calculations.

Second, I multiply land costs per units by $\tilde{q}$ to get the baseline cost of land $\tilde{c}_L = A\tilde{L}C \cdot \tilde{q}$. I use $\tilde{c}_L$ and the fact that it is customary to set the reservation price to 1/2 the expected price to determine $\overline{\lambda}, \underline{\lambda}$ so that $c_L(\tilde{B}) = \tilde{c}_L$ and $c_L(0) = \tilde{c}_L/2$.

Third, setting $q^* = \tilde{q}$ and $\phi^* = \tilde{\phi}$, I use the builder's first order conditions (see Appendix C.1) and the identity $AVC = \frac{c_V}{c_E} q^{c_E - 1}$ to solve numerically for c_V, c_E, b_{lim}.[20] Finally, I set c_I such that $\pi(\tilde{B}, \tilde{q}, \tilde{\phi}; c_I) = 0$.

The results are presented in Table 6.

6.3 Targeted Data Moments

In what follows, I provide additional details about how I arrived at the targets for each data moment.

[20] see 6.3 for the calculation of $\tilde{\phi}$

Table 6: Internally Calibrated Parameters

Parameter	Value	Moment	Data	Model
Variable cost shifter($\tilde{c}_V$)	36.0185	Average non-land cost per unit	507.80	507.80
Cost curvature shifter and borrowing limit ($\tilde{c}_E, \widetilde{\overline{Loan}}$)	1.88634, 25295.8	Builder quantity choices ($\tilde{q}, \tilde{\phi}$)	$40.50, 0.435$	$40.50, 0.435$
Builder sunk cost parameters ($\tilde{\overline{\lambda}}, \tilde{\underline{\lambda}}, \tilde{c}_I$)	16546.6006, 12405.1693, 7122.3193	Average land cost per unit, land auction reserve price, excess profit at baseline	$408.55, 204.28, 0.00$	$408.55, 204.28, 0.00$
Housing preferences ($\tilde{\kappa}_{max}, \tilde{\omega}, \tilde{\nu}$)	1.0223, 1.5042, 1.0057	Household housing choices ($\tilde{Q}_0, \tilde{Q}_1, \tilde{Q}_2$) to observed quantities	7622.00, 9878.00, 37500.00	7622.00, 9878.00, 37500.00
Depreciation rate of new to old residences ($\tilde{\delta}$)	0.3181	Supply of 2nd-hand residences (Q_2)	37500.00	37500.00

Notes: P is price, D is demand, Q is supply, q is the total supply of a single builder: presale plus spot. C(q) is the builder's variable cost function.

Average Project Size The average number of residences in a building built in 2015 was 40.5, and the average in the following 5 years was similar. This is not very different from the average number of residences in a building built between 2007 and 2020, which was 42.5. I start from 2007 because up until that year, the average building height was increasing. Between 2007 and 2020 it stabilized at around 10. I focus on buildings of at least 4 residences and of no more than 200 residences. The former is intended to abstract from low density construction while the latter is intended to avoid inflating the mean by the inclusion of unusually large buildings or of multiple buildings which are mistakenly identified as a single building.

Prices Because in the present framework, residences are assumed to be identical and the market conditions are fixed, I need to net out price differences in my data that are the result of different apartment locations, characteristics and time of sale. I do so by using hedonic regressions to estimate the effects of such differences and to net them out. This results in quality adjusted prices that are internally comparable but that are not comparable to other prices in the economy such as wages and rents. Therefore, I first calculate the ratios of the adjusted prices of presales to spot sales and of spot sales to old sales, and then multiple the ratios by the median unadjusted second hand residence price in my data. See Appendix D.1 for more details.

Presale Share To determine the division between presale and spot sales by the typical developer, I do the same as in determining the ratio of presale to spot sale price, but instead of calculating the ratio of prices, I calculate the share of observations that are in the early group. Namely, for each pair of ages between -4 and 8 that are 4 years apart, I count the number of early presales relative to the sum of early and late presales.[21] Then I take the average of the resulting shares, which is 43.5%.

Aggregate Quantities According to the report by the Chief Economist at the Ministry of Finance (Ministry of Finance, 2016), there were about 100,000 residences sold in 2015. However, about 30% of the sales were to investors and 15% were to households who were postponing the sale of their previous home. As there should be no overlap between the two previous groups, this implies that about 55,000 residences were purchased by households that did not previously own a residence, which I set as my target moment for the sum of all residence purchase types. I target the calibration to

[21] For ages below -4 and above 8 presales are uncommon.

residences purchased by new owners because in the model a household buys a residence at most once.

According to CBS data 31,700 new residences were sold in 2015. Assuming, that as with all residences, 55% of sales were to new households, I infer that 17,500 new residences were sold to new households while the remaining 37,500 new households who purchased residences bought old residences.

6.4 Discussion

Project funding

External information sources on the funding of residential projects align tolerably well with the results from calibration. Calibration implies that the borrowing limit is 25.3 million NIS with an additional 2.5 million NIS raised from bonds and 9.3 million raised from the first installement on the sale of 17.64 residential units in presale. The sum raised from bonds can be compared with the 2015 bond issuance of the largest Israeli developer by market share, which raised enough funds to fund about 2.9% of its yearly construction costs. The 2.5 million NIS found in calibration is 6.2% of the builder's construction costs. Thus, it is likely that my calibration underestimates the cost of funding through the bond market.

The borrowing limits imposed by banks on developers are closely guarded trade secrets. In one highly redacted contract between a bank and a developer which was presented to me in private, and which was said to be standard, the total credit line available for the project was set at 42 million NIS for a project of 84 units, or exactly 0.5 million NIS per unit. In my calibration, the borrowing limit is 25.3 million for a 40.5 unit project which is 0.624 per unit. Thus, the calibration result is similar in magnitude to the observation and more conservative.

Another source of reassurance can be obtained by calculating project returns net of enterpreneurial profit, which was not targeted in the calibration, and comparing them to an official guidance document for land appraisal. The returns in the calibration, calculated as $\frac{\pi - c_F}{b_1}$, are 20.7%. The guidance sets enterpreneurial returns for residential housing at 15%-18%, a number it describes as "based on a concensus of appraisers and enterpreneurs" (Ministry of Justice 2020).

Preference for new relative to old housing

Calibration results also provide reassurance regarding the assumption that completeness is more important than newness to all households: $\nu < \kappa_{min}$. Recall that ν, the parameter that determines the extra flow of housing services from new residences, is restricted in the calibration to $(1, \kappa_{min})$. In economic terms, this means that the extra benefit from purchasing a new versus an old residence is smaller than the benefit from purchasing a complete relative to an incomplete residence for the household who is least sensitive to completeness. While there is no a priori reason to suppose that $\nu < \kappa_{min}$ should necessarily hold in reality, it is reassuring that there is no difficulty matching the data moments with this restriction in place. Furthermore, at 1.0057, ν is almost exactly halfway between it's lower bound of 1 and it's upper bound of $\kappa_{min} = 1.01$, which implies the restriction $\nu < \kappa_{min}$ is not binding.

7 Counterfactuals

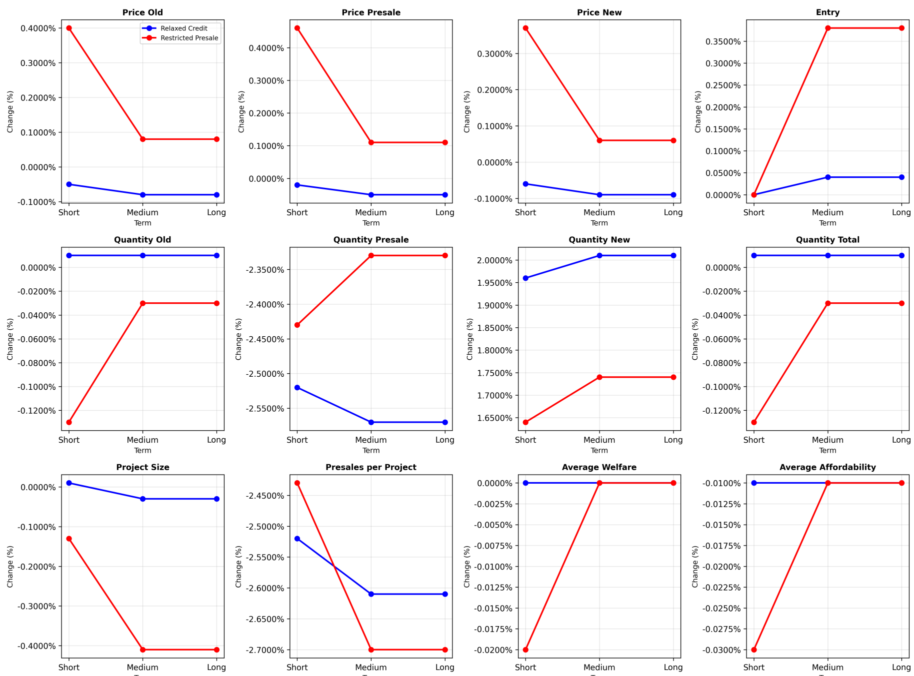
After calibrating the model, I turn to study two counterfactual policy experiments:

In the first, I impose a binding maximum presale share that results in a decrease of 1 percentage point in the equilibrium presale share. This is a useful counterfactual for understanding the role presale plays in the housing market. The effects of a binding maximum presale share should be informative about the likely effects of various policy measures that may limit the use of presale by developers.

In the second experiment, I increase the maximum line of credit available to developers at a fixed interest rate. By allowing builders to borrow more without causing their interest rate to increase, this counterfactual is useful in understanding the role credit frictions play in the housing market. Policy may achieve a similar effect through various schemes such as subsidizing bank loans to developers.

In each counterfactual experiment I distinguish beween three time frames: in the short term, both the quantity of old housing and land available for residential use are fixed. The latter means that entry is cannot increase relative to the baseline although it can decrease. In the medium term, new land can be made available for residential use but the quantity of old housing is still fixed. In the long term, old housing also adjusts. Project size, presale share and prices are always free to adjust. I am assuming that new residential land cannot increase immidiately because in reality, a lengthy regulatory process is required to designate land for residential development. The Bank of Israel

Figure 3: Counterfactual effects across over time



Notes: This figure presents the change brought about in endogenous variables as a result of the two counterfactual experiments over the short, medium and long term. Each point represents an equilibrium and changes are computed relative to the baseline equilibrium. In the short term, old quantity is fixed and entry is cannot increase relative to the baseline. In the medium, entry is free to increase but old quantity is still fixed. In the long term, both are free to adjust.

estimates this process takes an average of 8 years (Bank of Israel 2014). According to Genesove (2021), popluation growth in Israel exceeded dwelling completions in every year between 2004 and 2015.

The results are presented in Figure 3 in terms of the change in each endogenous variable relative to the baseline.

7.1 Restricted presale share

In this experiment, I constrain the presale quantity produced by each of the builders to one percentage point below their equilibrium level. The direct effect is an immidiate reduction in the funding capacity of entering builders . This cannot be fully mitigated by increased borrowing because, due to the binding constraint on bank borrowing, all extra borrowing must come the bond market, where the interest rate increases with leverage (recall that interest rate does not increase with leverage for bank lending or for the implied interest rate on presale). Thus, project size declines along with the presale share. At the same time, increased borrowing and lower marginal costs due to smaller size allow spot sales of new residences to increase in absolute terms . Aggregate quantity declines at all time horizons because increased entry can only partially compensate for the decrease in project size. As a result of the decrease in aggregate quantity, all three prices increase and welfare and affordability decline.

Prices As a result of the decrease in aggregate quantity, all three prices increase. To see why, note that in all equilibria studied here, all households above a certain endowment cutoff purchase a residence, with the lowest endowment buyers buying presale, the highest endowment buyers buying new completed residences and those in between those two groups buying old residences. Now, when the aggregate quantity of housing available for sale decreases, some households who buy presale in the baseline now must rent, which can only occur if the price of presale increases. The same logic holds for the prices of old residences: because some previous buyers of old residences now must prefer presale, the price of presale must decline relative to the price of old residences. And because we already established that the price of presale must increase, the price of old residences must also increase. Finally, because the share of households who buy old residences must remain the same, the indifference curve between old and new completed residences must decline at the same rate as the indifference curve between old and presale. However, if the price of new complete residences did not increase, the price differential between new and old would increase sharply and cause the indifference curve to decline too much. Thus, the price of new residences must also increase.

Time Horizons In the short term, before entry and the old housing stock adjust, aggregate quantity decreases by about 0.07%, resulting in higher prices and higher profits.[22] In the medium term, the increase in entry that results from higher profits alleviates most of the initial effect so that aggregate quantity is only 0.02% lower than the baseline. In the long term, the stock of old housing adjusts downwards, which tends to causes higher prices and higher profits. But since entry is free to adjust, it mitigates most of the resulting effect. At all time horizones, the effects on welfare and affordability are inversely proportional to the effects on prices - both decline the most in the short term, then rebound most of the way in the medium term, and then decline slightly in the long term.

7.2 Relaxed credit constraint

In this experiment, I relax the credit constraint by increasing b_{max} by 1% over the baseline. Builders can now borrow more at the constant bank rate. This allows them to substitute away both from presale and from issuing bonds. As a result, production increases and the quantity of new complete units increases even more than production. The resulting increase in aggregate supply causes all three housing prices to decline, due to the logic described in the Restricted Presale case above. The increase in aggregate supply and the resuling decline in prices is magnified both in the medium and in the long term. In the medium term, increased entry results from the combined effect of cheaper borrowing and higher share of units sold at spot prices, which dominate the counterveiling effects of larger project size and lower prices. In the long term, larger and more numerous projects result in a larger steady state stock of old residences.

Affordability Despite the reduction in prices and the increase in the home-ownership rate, average affordability declines with the worst affected losing 12.9% of lifetime consumption. This occurs because of the lower availability of presale, which is the most

[22] Prices increase more than costs because the constraint increases the curvature of costs so that optimal quantity decreases more than it would in the case of an increase in the marginal cost. The curvature increases because builders shift from a factor of production with approximately constant marginal costs (presale) to one with increasing marginal costs (bonds, whose interest rate increases in firm leverage). Presale marginal costs are approximately constant because of two balancing effects - higher presale reduces presale prices but also reduces bond financing.

affordable home-ownership option. Affordability declines for households who swtich from presale to old residences. The affordability losses in the model likely underestimate the likely losses because of two simplifying assumptions. First, affordability in the model is calculated in terms of lifetime earnings, which ignores the stylized fact that households tend to purchase homes at a time when they are relatively resource constrained for other reasons. Second, the model assumes a uniform distribution of endowments while more realistic distributions tend to assign a greater density to the area of the endowment distribution where the indifference curve between presale and old residences lies. While in this model, nobody can be made worse off when all prices decline, the decline in affordability may indicate that in a richer model, welfare would decline for some households as well.

8 Conclusion

This study demonstrates that builders pay a substantial premium on presale transactions in order to obtain additional funding for construction. The equilibrium implications of credit constraints and presale for the homeownership market are explored through the lens of a new model. In the model, builders with time to build face a borrowing limit and choose the optimal combination of presale and debt funding. Households with heterogeneous incomes sort into four types of residences: rent, presale, newly completed residences and second hand residences. The residential choice of households is shaped by their preference for ownership over rent, for ownership of new over second hand residences, and for purchasing a completed residence over an incomplete one.

By calibrating the model to the Israeli economy, I explore how all these forces combine to give rise to endogenous prices and quantities in the three housing markets. Counterfactual experiments provide insights into the effects of presale and credit constraints on the housing market. When credit constraints are alleviated by increasing the borrowing limit, the number of residences per unit of land increases while the quantity of presales decreases. Overall housing quantity increases and residence prices decrease but affordability declines for households who switch from presale to completed residences.

When, on the other hand, a binding ceiling is imposed on the share of presales in a residential project, builders' face diminished capacity due to a funding shortfall which cannot be cheaply filled through the bond market. Consequently, prices of all three housing options increase. These results demonstrate how the production trade-offs between presale and borrowing and between building up or building out, shape equilibrium outcomes in the housing market.

References

[1] Armoni, Eshel. "Components of housing construction costs and their weights in house prices". Ministry of Construction and Housing. 2015.

[2] Baum-Snow, Nathaniel, and Lu Han. "The microgeography of housing supply." Journal of Political Economy 132, no. 6 (2024): 1897-1946.

[3] Ben-Moshe, Dan, and David Genesove. "Regulation and Frontier Housing Supply." arXiv preprint arXiv:2208.01969 (2022).

[4] Bank of Israel. "Annual Report 2014". (2014)

[5] Central Bureau of Statistics (CBS). (2022) `https://www.cbs.gov.il/he/mediarelease/DocLib/2022/375/24_22_375b.pdf`

[6] Central Bureau of Statistics (CBS). (2020) `https://www.cbs.gov.il/he/publications/LochutTlushim/2020/mb_years.xlsx`

[7] Central Bureau of Statistics (CBS). (2017) `https://www.cbs.gov.il/en/publications/Pages/2017/Household-Income-and-Expenditure.aspx`

[8] Central Bureau of Statistics (CBS). (2015) `https://www.cbs.gov.il/he/DocLib/presentations/atar_madadperiph2015.pptx`

[9] Chen, Ziyang, Maggie Rong Hu, Ginger Zhe Jin, and Qiyao Zhou. Haste or Waste? The Role of Presale in Residential Housing. No. w32013. National Bureau of Economic Research, 2024.

[10] Combes, Pierre-Philippe, Gilles Duranton, and Laurent Gobillon. "The production function for housing: Evidence from France." Journal of Political Economy 129, no. 10 (2021): 2766-2816.

[11] Sergio Correia, 2017. reghdfe: Stata module for linear and instrumental-variable/gmm regression absorbing multiple levels of fixed effects. Statistical Software Components s457874, Boston College Department of Economics. https://ideas.repec.org/c/boc/bocode/s457874.html

[12] Davis, Morris A., and Jonathan Heathcote. "Housing and the business cycle." International Economic Review 46, no. 3 (2005): 751-784.

[13] Eini, Ohad, Sigalit Shoshan, Daniela Paz, Yifat Rozolio, Shay Shimon, Vasili Tolkantz, Tal Alush. “Guidance. Chapter 18: Use of the Cost Method and choice of Entrepreneurial Profit (Update Number 1)”. Ministry Of Justice, Land Appraisal Department. (January 2020)

[14] Epple, Dennis, Brett Gordon, and Holger Sieg. "A new approach to estimating the production function for housing." American Economic Review 100, no. 3 (2010): 905-924.

[15] Favilukis, Jack, Sydney C. Ludvigson, and Stijn Van Nieuwerburgh. "The macroeconomic effects of housing wealth, housing finance, and limited risk sharing in general equilibrium." Journal of Political Economy 125, no. 1 (2017): 140-223.

[16] Gandal, Neil. "Hedonic price indexes for spreadsheets and an empirical test for network externalities." the RAND Journal of Economics (1994): 160-170.

[17] Genesove, David. "Chapter in Lights and Shadows in the Market Economy: The Israeli Economy 1995-2017" Ben-Bassat A. and R. Gronau, A. Zussman (eds.), Cambridge: Cambridge University Press. (2021)

[18] Genesove, David, Daniel Levy and Avichai Snir, 2023, “The Elasticity of the Substitution of Land for Capital in Multi-Unit Housing”.

[19] Glaeser, Edward L., and Bryce A. Ward. "The causes and consequences of land use regulation: Evidence from Greater Boston." Journal of urban Economics 65, no. 3 (2009): 265-278.

[20] Goolsbee, Austan, and Peter J. Klenow. "Evidence on learning and network externalities in the diffusion of home computers." The Journal of Law and Economics 45, no. 2 (2002): 317-343.

[21] Goolsbee, Austan, and Chad Syverson. The strange and awful path of productivity in the us construction sector. No. w30845. National Bureau of Economic Research, 2023.

[22] Gyourko, Joseph, Albert Saiz, and Anita Summers. "A new measure of the local regulatory environment for housing markets: The Wharton Residential Land Use Regulatory Index." Urban studies 45, no. 3 (2008): 693-729.

[23] Ilek, Alex, Nimrod Cohen, and Yaakov Chen Zion. "Assessing the Impact of Monetary and Macroprudential Policies on Israel's Housing Market: A DSGE Model Approach." Available at SSRN 5013620 (2024).

[24] Kim, Seohee. "Financial Frictions and Geographical Diversification of National Homebuilders." Working Paper (2023)

[25] Kotsenko, Nikita. "Essays on demand uncertainty in the real estate market." PhD Dissertation, (2023)

[26] Kutai, Ari. "Measuring the effect of forward guidance in small open economies: the case of Israel." Israel Economic Review 21, no. 1 (2023): 75-142.

[27] Levy, Antoine. "Housing Policy with Home-Biased Landlords: Evidence from French Rental Markets." Working Paper (2022)

[28] Livingston, Jeffrey A., David L. Ortmeyer, Patrick A. Scholten, and Wilson Wong. "A hedonic approach to testing for indirect network effects in the LCD television market." Applied Economics Letters 20, no. 1 (2013): 76-79.

[29] Midrigan, Virgiliu, and Daniel Yi Xu. "Finance and misallocation: Evidence from plant-level data." American economic review 104, no. 2 (2014): 422-458.

[30] Ministry of Construction and Housing. "General information regarding protection of home buyers". (2022) `https://www.gov.il/he/pages/hagana_al_rochshey_dirot`

[31] Ministry of Finance, Chief Economist. "Weekly report, 28 February 2016". Ministry of Finance. (2016)

[32] Ministry of Justice, Land Appraisal Department. "Guidance, Chapter 18: Use of the costs method and choice of the enterpreneurial profit". (2020)

[33] Molloy, Raven. "The effect of housing supply regulation on housing affordability: A review." Regional Science and Urban Economics. no. 80 (2020)

[34] Park, Sangin. "Quantitative analysis of network externalities in competing technologies: The VCR case." Review of Economics and Statistics 86, no. 4 (2004): 937-945.

[35] Peter, Alessandra, Monika Piazzesi, and Martin Schneider. Houses and families across countries. Mimeo, columbia university, 2020.

[36] Saiz, Albert. "The geographic determinants of housing supply." The Quarterly Journal of Economics 125, no. 3 (2010): 1253-1296.

[37] Samuels, Peleg Ronen. "The Effect of Local Landlords on Rental Housing Prices and Returns." Working Paper (2025)

[38] Sayag, Doron. "Measuring local house price movement in Israel and estimating price elasticity." Israel Economic Review 10, no. 1 (2012).

[39] Setty, Ofer and Ido Shlomo. "From Unemployment Benefits to Employment Insurance Accounts" The Economic Quarterly 62, no. 3/4 (2018): 73–108.

[40] Van Straelen, Eileen. "Desperate house sellers: Distress among developers." The Review of Financial Studies 37, no. 3 (2024): 802-836.

A Data Processing

A.1 Neighborhood Descriptive Statistics

Some of the analyses in this study are done at the "area" level (officially called Statistical Area and sometimes referred to informally as neighborhood). Area is a statistical category developed by the Israeli Central Bureau of Statistics to divide cities with more than ten thousand residents into small areas that are as close as possible to homogeneous in terms of demographics, land use patterns and year of initial construction. I am using the 2011 division into areas which has about two thousand five hundred statistical areas with positive residential populations.

Tables 7 and 8 present summary statistics for areas, based on the number of spots or presales in each area, respectively. Note that the number of observations is slightly smaller than in the transaction records. This occurs because I was unable to match some of the observations with a statistical area. I only use such observations when area does not play a role.

Table 7: Spot Sales Areas Summary

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
population	116,928	6,042	3,876	78	44,333
socio-economic status	116,928	6.577	2.131	1	10
distance to CBD	116,928	40.40	43.24	0.305	281.5
periphery indicator	116,928	0.258	0.438	0	1

Notes: population is the total population of an area in the year 2020; socio-economic cluster is based on demographic characteristics as described in CBS (2022); distance to CBD is the average distance in kilometers from the location of each deed in an area to the Tel Aviv HaShalom station, a central transport hub that is also located roughly at the center of Tel Aviv, which is the main business center of Israel. Periphery indicator is defined by CBS based on the distance of an area to all other areas, weighted by population and on distance to Tel Aviv, as defined in CBS (2015).

Table 8: Presale Areas Summary

	(1)	(2)	(3)	(4)	(5)
VARIABLES	N	mean	sd	min	max
population	55,022	6,762	4,370	565	23,691
socio-economic status	55,022	6.609	2.079	1	10
distance to CBD	55,022	43.29	44.50	0.332	281.6
periphery indicator	55,022	0.232	0.422	0	1

Notes: population is the total population of an area in the year 2020; socio-economic cluster is based on demographic characteristics as described in CBS (2022); distance to CBD is the average distance in kilometers from the location of each deed in an area to the Tel Aviv HaShalom station, a central transport hub that is also located roughly at the center of Tel Aviv, which is the main business center of Israel. Periphery indicator is defined by CBS based on the distance of an area to all other areas, weighted by population and on distance to Tel Aviv, as defined in CBS (2015).

A.2 Adjusting for Residence Quality

To facilitate comparison among residences with different characteristics and locations and sold at different times, I run a standard hedonic regression on all transactions excluding presales. I exclude presales because they may have different demand and supply characteristics than completed residences. This is useful for calculating the value of a presold residence in the counterfactual event in which it was sold after completion. I run a separate regression for each district and include year by neighborhood fixed effects, as well as building fixed effects.[23]

$$\begin{aligned} ln(Price_{nta}) = \beta_0 + \beta_1 ln(Rooms_n) + \beta_2 ln(SQM_n) + \beta_3 Floor_n \\ + \alpha_1 Age_{nt} + \alpha_2 Age_{nt}^2 + \alpha_3 Age_{nt}^3 + BuildingFE_n + w_{ta} + \epsilon_{nta} \end{aligned} \tag{5}$$

Spot transactions are indexed by n, $ln(Price_{nta})$ is the natural log of the sale price in spot transaction n at time t in area a, $Rooms_n$ is the number of rooms, SQM_n is

[23]Running a separate regression in each district makes sense because of the differences among districts in term of geography and patterns of development. It also improves the fit as was also found by Sayag (2012). I also try running separate regressions for different years but this seems not to make a different so I opt for the simpler option of pooling all the years and including fixed effects.

Table 9: Hedonic Regressions

VARIABLES	(1) District JLM	(2) District North	(3) District Haifa	(4) District Center	(5) District TA	(6) District South
$ln(rooms)$	0.375***	0.390***	0.242***	0.269***	0.244***	0.312***
	(0.0116)	(0.0159)	(0.0118)	(0.00676)	(0.0112)	(0.00827)
$ln(sqm)$	0.413***	0.422***	0.475***	0.462***	0.641***	0.375***
	(0.0122)	(0.0162)	(0.0123)	(0.00696)	(0.0107)	(0.00866)
$ln(floor)$	0.000181	0.00167*	0.00516***	0.00594***	0.00716***	0.00284***
	(0.000798)	(0.000959)	(0.000488)	(0.000230)	(0.000408)	(0.000327)
age	0.0137***	0.00714**	-0.00197	-0.000114	0.00529	0.00216
	(0.00357)	(0.00344)	(0.00293)	(0.00147)	(0.00345)	(0.00201)
age^2	-0.000718***	-0.000525***	-0.000188	-0.000260***	-0.000458***	-8.14e-05
	(0.000188)	(0.000175)	(0.000127)	(6.69e-05)	(0.000148)	(0.000112)
age^3	1.28e-05***	1.06e-05***	6.06e-06**	5.78e-06***	9.90e-06***	-1.22e-07
	(3.42e-06)	(3.31e-06)	(2.38e-06)	(1.23e-06)	(2.74e-06)	(2.23e-06)
Constant	11.88***	11.24***	11.50***	11.81***	11.37***	11.75***
	(0.0541)	(0.0686)	(0.0568)	(0.0301)	(0.0534)	(0.0367)
Observations	17,209	13,561	18,060	68,013	31,568	39,035
R-squared	0.851	0.827	0.867	0.848	0.822	0.854
MicroFE	Building	Building	Building	Building	Building	Building
AreaXYearFE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: I use the STATA command reghdfe to obtain OLS estimates for the coefficients of interest for each district separately (Correia 2017).

residence size in square meters, $Floor_n$ is the floor number of the residence; Age_{nt} is building age at the time of the transaction, $BuildingFE_n$ is a building fixed effect (I use parcel fixed effects which usually is a attributable to a single building), w_{ta} is a year by area fixed effect; ϵ_{nta} is a mean zero error term.

Table 10 is intended to assess the prediction quality of Equation 5 for spot sales (in sample). The variable of interest is the ratio of the absolute value of the residual to the actual price.

I construct the counterfactual spot value s_{ita} of a presale i sold in period t, in area a as

$$ln(s_{ita}) = \beta_0 + \beta_1 ln(Rooms_i) + \beta_2 ln(SQM_i) + \beta_3 Floor_i + BuildingFE_i + w_{ta} \quad (6)$$

Table 10: Hedonic Prediction Quality

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
|residual|/Price	116,775	0.0854	0.201	0	26.64

Notes: $|residual|/Price = Abs(\epsilon_{nta})/Price_{nta}$ where Abs() is the absolute value function, $\epsilon_{nta}, Price_{nta}$ are defined in Equation 5

A.3 Adjusting for Local Price Trends

To estimate the counterfactual spot price of a presold residence s, I need to adjust for the local price trends that occur between the actual time of presale and the time of completion. This is especially important because many areas in my sample experience rapid changes in average prices. To do so, whenever time to completion is greater than 6 months at sale, I apply the following correction: I multiply the predicted spot price (obtained by applying the estimates from the hedonic regression in A.2 to a presold residence) by a factor A_{taj}.

$$A_{taj} \equiv max(min(\frac{\overline{s_{Ta}}}{\overline{s_{ta}}}, 1.1^{(T-t)/12}), 0.9^{(T-t)/12}) \tag{7}$$

Where $\overline{s_{ta}}$ is the mean of quality controlled spot sales in month t and area a: $\overline{s_{ta}} = w_{ta} + N_{ta}^{-1} \sum \epsilon_{nta}$, ϵ_{nta} is defined in Equation 5; and $\overline{s_{Ta}}$ is the same in month T.[24] I restrict expected appreciation to ±10% because beliefs outside this range are inconsistent with the conservatism required of the assessors who are hired to value residences before they are sold . T is the date of the last presale in the building, which I take to be a conservative estimate of actual completion date.

A.4 Error in Presale Indicator

A.4.1 The error

My main dataset has two types of observations that raise concerns:

[24]Getting an appreciation rate directly from the hedonic regression that is monthly and area specific would require me to add month by area fixed effects to the hedonic regression, which would sharply reduce the number of observations available to estimate each fixed effect.

Negative aged spot sales: Such observations have a presale indicator $p = 0$ and a "building year" that is after the year of sale. I posit that this is caused by a mistake in the presale indicator due to failure to link the presale record with the deed record. Whenever a deed could not be linked with a presale, it was assigned $p = 0$, even if it had negative age.[25]

Positive aged presales: Such observations have presale indicator $p = 1$ and a building year that is before the year of sale. This implies that building year does not refer to the occupancy permit, but rather to an earlier event such as the construction permit or the start of construction. [26]

Separately, these mistakes are easy to deal with: I can just drop the negative aged spot sales because they are duplicates of presales. I can also leave the positive age presales as they are, and treat them as regular presales, because from the perspective of hedonic pricing, all presales can be seen as forward contracts to buy a new residence, i.e., a residence with age 0.

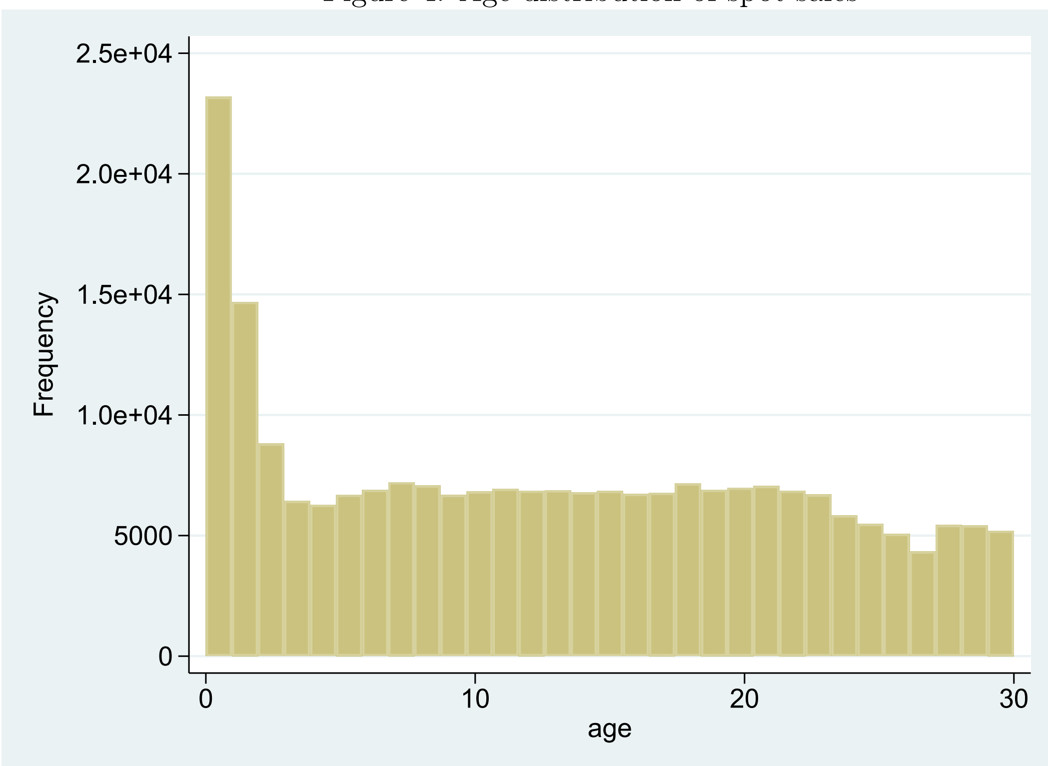
However, a difficulty arises when both errors coincide in the same observation: A building year refers to an event prior to an occupancy permit and some of the deeds are not linked to a presale record (perhaps due to a discrepancy in the exact price). This may result in observations classified as spot sales with positive ages but that are in-fact presales. Although they are impossible to identify with certainty, some observations may be more suspect of being such double-mistakes, such as those with very low ages.

Figure 4 gives a sense of the likely magnitude of this problem. For ages above 5, the frequency of spot sales in the data is roughly constant, as it should be if the quantity of new construction is constant over time and the sale probability of second-hand residences is independent of their age. But there are more than 5 times as many spot sales with age 0 as with any age above 5. This is the age distribution after removing spot sales with negative ages and those that occur in buildings with later presales.

[25]I am using the results of a linking conducted by the Survey for Israel. I cannot replicate this linking because my version of the presale dataset does not contain the variable sub-parcel which refers to apartment number in a residential building.

[26]The alternative is a false positive in the presale indicator, which is unlikely. For a false positive to occur, the presale record would have to match the spot record in lot, parcel, sub-parcel, price, date of sale, floor and size. So, a mistaken link requires a very unlikely coincidence.

Figure 4: Age distribution of spot sales



Notes: Age distribution of spot sales after removing spot sales with negative ages and those that occur in buildings with later presales. Age is defined as year of sale minus the observed building year.

A.4.2 The correction

In this part I will try to estimate the probability that some transactions that appear to be positive aged spot sales are in fact presales. The way this is done is summarized in Figure 5.

Define p as the observed presale indicator, p^* as the true presale indicator, y_b as the observed building year, y_s as the sale year, s as numeric date of sale (number of days since 1960), b as unobserved (numeric) building date, δ as the probability that building date refers to some event prior to the occupancy permit ($b = b_-$) and $1-\delta$ that it refers to the occupancy permit ($b = b^*$), and ϕ the probability that an occupancy permit arrives in a given day conditional on it not arriving on any prior day.

Focus first on the strictly positive age case: $y_b < y_s$

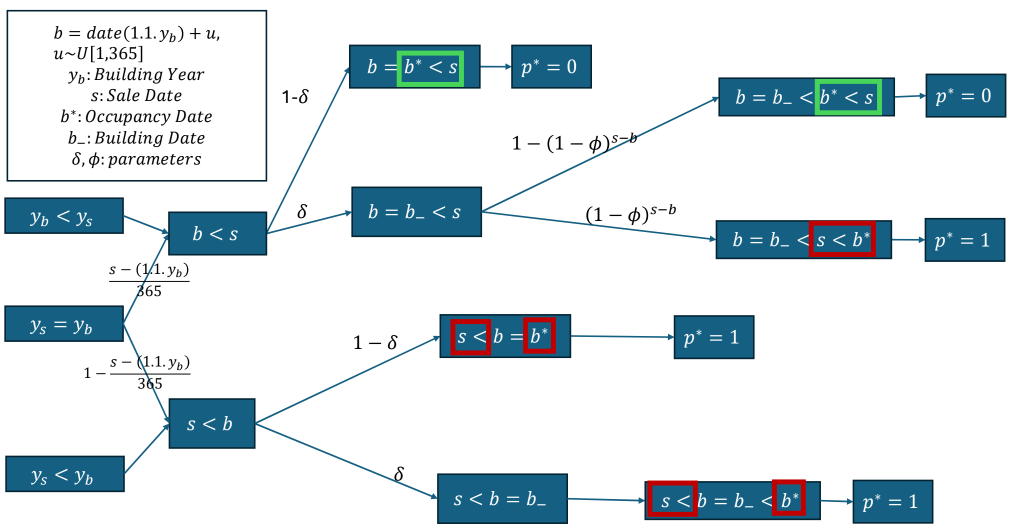
$$
\begin{aligned}
&Pr(p^* = 1|p = 0, y_b < y_s)\\
&\quad =_1 (1-\delta) \cdot Pr(b^* > s|b^* = b) + \delta \cdot Pr(b^* > s|b^* > b)\\
&\quad =_2 (1-\delta) \cdot 0 + \delta \cdot Pr(b^* > b + (s-b)|b^* > b)\\
&\quad =_3 \delta \cdot Pr(b^* > s - b)\\
&\quad =_4 \delta(1-\phi)^{s-b}
\end{aligned}
$$

$=_1$ is from the definition of δ as the probability that $b \neq b^* \Rightarrow b = b_- < b^*$ and the complement $1-\delta$ the probability that $b = b^*$; $=_2$ is because $y_b < y_s \Rightarrow b < s$; $=_3$ is from the memorylessness of the geometric and $=_4$ is from the definition of the CDF of the geometric.

For the zero age case, define b_{min} the first day of y_b and note that if b is as likely to occur in any day of the year, then $Pr(b < s) = \frac{s-b_{min}}{365}$, which implies:

$$
\begin{aligned}
&Pr(p^* = 1|p = 0, y_b = y_s)\\
&\quad = Pr(s < b) + Pr(b < s) \cdot \delta \cdot Pr(b^* > s|b^* > b)\\
&\quad = 1 - \frac{s - b_{min}}{365} + \frac{s - b_{min}}{365}\delta(1-\phi)^{s-b}
\end{aligned}
$$

Figure 5: Correcting the presale indicator



A.4.3 Estimation

Now it remains to estimate δ, ϕ. First, note that in all positive aged presales, $b = b_-$. Thus, the ratio of positive to negative aged presales gives a lower bound on the probability δ.[27] Then assuming this probability δ is the same for all observations, I can apply these probabilities to spot sales. I can then test the robustness of my conclusions to different values of δ between it's lower bound and 1.

To estimate ϕ is propose that:

$$\phi \equiv E_t[\frac{n_t - n_{t+1}}{n_t}]$$

Where n_t is the number of presales with age t in the main dataset for $t \geq 1$. The underlying assumptions are that the probability to get an occupancy permit (starting the second year of construction) is fixed an memory-less, and that the decline in the frequency of presales among positive ages is entirely due to projects getting completed.

A.4.4 Results

I apply a correction as follows: For each age in $0, 1, 2$, in every sale month, I drop a share of the presales equal to the average probability that spot sales in this group are presales.

[27]Because presales are included in my dataset whether they were linked or not, this ratio in my sample should be an unbiased estimate of the population ratio.

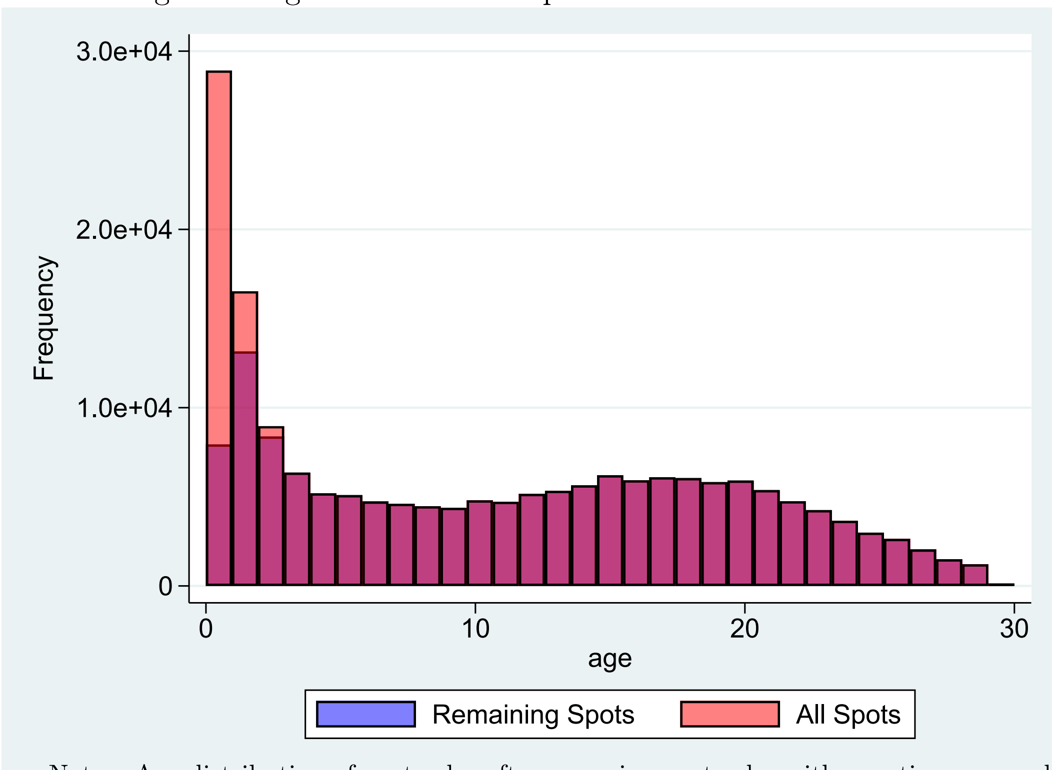
Table 11: Share of spot sales removed by age and sale month

month	age0	age1	age2
1	0.997	0.305	0.0980
2	0.983	0.278	0.0890
3	0.957	0.254	0.0810
4	0.919	0.231	0.0740
5	0.870	0.209	0.0670
6	0.813	0.191	0.0610
7	0.752	0.174	0.0560
8	0.680	0.157	0.0500
9	0.610	0.144	0.0460
10	0.526	0.130	0.0410
11	0.447	0.118	0.0380
12	0.361	0.107	0.0340

Notes: Share of spot sales removed by age and sale month.

Figure 6 describes the change in the age distribution of spot sales.

Figure 6: Age distribution of spot sales - before and after correction



Notes: Age distribution of spot sales after removing spot sales with negative ages and those that occur in buildings with later presales. Age is defined as year of sale minus the observed building year.

B Alternative Accounts of Presale Premia

Before measuring the presale premium, I try to account for various factors that may make it worthwhile for builders to presell at lower prices other than credit constraints. By accounting for such factors in the calculation of the presale premium I can ensure that it is indeed a premium from the builder's perspective, in the sense that it captures the economic cost to the builder of selling at a given price. For example, if all units sold in presale have lower unobserved quality compared with units sold in the spot market, and I ignored this in the calculation of the premium, I would be overestimating the true premium. Of course it is impossible to perfectly account for all possible such factors. Nevertheless, it is worthwhile to account as well as possible for the most obvious and most substantial factors.

B.1 Adverse Selection Into Presale

Table 12 presents evidence that presold residences probably tend to have higher unobserved quality compared with residences sold in the spot market. I match presale to spot transactions by residence and compare the means and medians of their hedonic residuals.[28] I find that while presales tend to sell at a discount relative to their expected price, when they are resold in the spot market, they tend to do so at a premium relative to their expected price.

The expected price is calculated only from spot sales so the discount in presale prices does not factor into it. Because I can match only very few such residences by a full address, I try more permissive match rules that use residence stats and land parcel numbers. Lower rows of Table 12 correspond to more permissive match rules. Both the mean and the median of the presale residuals is always negative except for a single case where the mean is positive but this is a case with only 9 observations. The means of the spot residuals are always positive, while the medians are positive in the three cases where the match rule is most stringent and practically zero in the fourth most stringent.

B.2 Network Externality

Suppose demand for residences in a project is increasing with the number of previous residences sold in that project. For example, this could be the case if some buyers only

[28]For more details on the hedonic calculation see Section 4 and Appendix A.2

Table 12: Repeat sales

Match	N	Median Spot	Mean	N	Median Presale	Mean
Parcel + Apt. Num	92	3894	70787	9	-66634	82249
Address + Apt. Num	301	1729	31303	43	-80168	-58186
Address + Apt. Stats	25730	1311	22588	24970	-49574	-39578
Parcel + Apt. Stats	35375	-28.81	17672	25263	-49542	-39154
Address	111829	-2408	15398	38829	-49256	-38797
Parcel	114623	-2383	15316	39113	-49175	-38598

Notes: Address includes city, street and building number. Apartment stats includes the number of rooms, area in square meters and floor number. Spot statistics are calculated based on hedonic residuals over all matched transactions that occured after the last presale within each match. Presale statistics are calculated based on the hedonic residuals over all matched presale transactions.

start arriving once some number of residences is sold because until enough units are sold, such buyers' perceived probability of project failure is too high. A seller anticipating such behavior from buyers, may find it optimal to sell the first residences for very low prices to stimulate demand. Importantly, if I ignored this, my estimates of the presale premium would be biased upwards.

I refer to this case as a network externality because demand for a seller's product is increasing in the quantity the seller has previously sold or in its previous market share. A famous example of network externalities is fax-machines. The standard approach for testing for the presence of network externalities is as follows: a hedonic regression is used to estimate willingness to pay for the product in consecutive periods, with fixed effects for each particular seller (or a group of sellers with compatible products). If a higher market share of a seller in previous periods is associated with higher willingness to pay for its product in subsequent periods, all else equal, this is evidence of a network externality.[29]

In the present setting, I test for the effect of the quantity of units sold in a project during early presale on the willingness to pay in late presale. Willingness to pay is captured by the residualized income of a project. Regressing late income on early quantity raises endogeneity concerns, for example from failing to account for project specific demand. To address this, I use an instrumental variable strategy.

Interest rate surprises are defined by The Bank of Israel as deviations of interest rate decisions from the forward guidance in place at the time (Kutai 2023). Intuitively, the

[29]For examples, see Gandal 1994, Goolsbee and Klenow 2002, Park 2004, Livingston et al 2012

decisions of potential buyers and sellers in the housing market, including developers, are affected by current interest rates and also by their expectations for future interest rates (about which they care because both can choose to transact now or later). To the extent that the current forward guidance reflects future interest rates, it should affect those decisions. Thus they are affected by an interest rate surprise, and also by the new guidance that is always issued at the same time as the new interest rate is announced. Thus, interest rate surprises that occur at the time when a project is in its early stage affects contemporaneous outcomes. However, future outcomes in that project should not be directly affected by interest rate surprises in the past.[30] Thus, surprise changes to the interest rate during early presale should have immediate effects on early quantity, but late income should only be affected through early quantity.[31]

I define early presale as the first half of presale length. For each presale project in my sample, I calculate the rate surprise variable as the sum of the surprises that occurred during the early period and use it as an instrument for early quantity.

Table 13 presents the result of three regressions. In all three, early presales are defined as presale that occur before the median date of all dates that fall between the first and last presale. The rest are defined as late. The first column presents the result of regressing early quantity, that is, the number of presales during early presale in a project, on the total residualized income from late presales in that project. It implies that each early presale increases the total residualized income by about 30,000 NIS (New Israeli Shekel), equivalent to about 2.9% of the average presale price.

The second column is the first stage regression in which I regress early quantity on the BOI rate surprise as explained above. The third column is the two stage least square regression where the rate surprise is used to IV for early quantity. It results in almost exactly the same coefficient as the OLS. A Hausman test cannot reject the hypothesis that the OLS is consistent. Thus, when calculating presale premia, I multiply the presale price by 1.029. This adjusts the presale price to account for the average benefit of selling early, thus reducing the presale premium.

[30] This is unless participants care about past surprises as those may be informative about potential future surprises but this seems unlikely in this case because both sides appear to not be sufficiently sophisticated.

[31] One may be concerned that an interest rate surprise during early presale may affect late income by affecting the time path of financial condition of buyers and sellers who had no intention of transacting in the early period but their incentive to transact in the late period is affected. However, while past interest rates affect the future time path of financial conditions of participants in this market, an interest rate **surprise** should only affect them if they are involved in sophisticated hedging operations, which seems unlikely.

Table 13: Early Quantity and Later Income

VARIABLES	(1) OLS Late Income QC	(2) 1st-stage IV Early Quantity	(3) 2nd-stage IV Late Income QC
Early Quantity	30.82***		28.13
	(6.635)		(84.98)
BOI Rate Surprise		-57.81**	
		(23.83)	
Constant	-628.8***	17.88***	-578.6
	(186.3)	(0.746)	(1,592)
Observations	963	963	963
R-squared	0.022	0.006	0.022
F-test		5.883	
Hausman chi2-stat			0.00101
Hausman pval			0.975

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Notes: OLS and first stage estimates are obtained using the Stata command "reg", second stage estimates are obtained using the Stata command "ivregress gmm".

C Model Details

C.1 Builder First Order Conditions

Optimal Quantity Optimal builder quantity q^* is given by the solution to the following equation:

$$\underbrace{(1 + r_{bond}(q^*, \phi))C'(q^*)}_{\text{marginal cost}} = \underbrace{(1 - \phi)P_{New} + \phi P_{Presale}(1 + \iota r_{bond}(q^*, \phi))}_{\text{marginal revenue}}$$

With

$$r_{bond}(q^*, \phi) = \begin{cases} r_b + 2r_s(b_0(q^*, \phi) - b_{max}) & b_0(q^*, \phi) \geq b_{max} \\ r_b & b_0(q^*, \phi) < b_{max} \end{cases}$$

Optimal Presale Share Optimal presale share ϕ^* is given by the solution to the following equation:

$$\underbrace{\frac{P_{New} - (1-\iota)P_{Presale}}{\iota P_{Presale}} - (1+r_b)}_{\text{presale premium}} = \underbrace{2r_s(b_0(q,\phi^*) - b_{max})}_{\text{marginal bond premium}}$$

C.2 Derivation of Demand Functions

A household i is indifferent between options $j, l \in \{Rent, Presale, Old, New\}$ when

$$u(y_i, \kappa_i, j) = u(y_i, \kappa_i, l) \Leftrightarrow (y_i - e_j)^\gamma h_j(\kappa_i)^{1-\gamma} = (y_i - e_l)^\gamma h_l(\kappa_i)^{1-\gamma} \tag{8}$$

$$\Leftrightarrow \frac{h_j(\kappa_i)}{h_l(\kappa_i)} = \left(\frac{y_i - e_l}{y_i - e_j}\right)^{\frac{\gamma}{1-\gamma}} \tag{9}$$

The left hand side of the last term simplifies as follows:

$$\frac{h_j(\kappa_i)}{h_l(\kappa_i)} = \begin{cases} \nu & j = New, l = Old \\ \kappa & j = New, l = Presale \\ \omega\nu\kappa & j = New, l = Rent \\ \kappa/\nu & j = Old, l = Presale \\ \omega\kappa & j = Old, l = Rent \\ \omega\nu & j = Presale, l = Rent \end{cases} \tag{10}$$

I now simplify the analysis by assuming the following:

1. $y_{min} > e_{New}$
2. $\kappa_{min} > \nu > 1$

Assumption 1 implies that I remove from consideration households that are unable to afford an average new completed residence at any positive level of consumption. In practical terms, this means that households draw their income from a distribution with minimum at 40% of the true average income. Assumption 2, implies that the overall housing services obtained from an old residence are more than those obtained from a residence bought on presale. Recall that the notion of presale in this model captures very early presale and that housing quality is assumed to be the same up to a newness premium. This assumption is consistent with the fact that the average old residence costs substantially more than the average early presale in my data (this is true both before and after accounting for observable differences in housing quality excluding age at sale).

Then we can rewrite the indifference conditions $\frac{h_j(\kappa)}{h_l(\kappa)} = (\frac{y-e_l}{y-e_j})^{\frac{\gamma}{1-\gamma}}$ as

$$y_l^j(\kappa) = e_l + (e_j - e_l)\Gamma(\frac{h_j(\kappa)}{h_l(\kappa)}), \quad \Gamma(x) \equiv \frac{(x)^{\frac{1-\gamma}{\gamma}}}{(x)^{\frac{1-\gamma}{\gamma}} - 1} \tag{11}$$

And using the functions $y_l^j(\kappa)$ for $j, l \in \{Rent, Presale, Old, New\}$ we can define the boundries of the subspaces where one choice is prefered above others in the space of y, κ:

$$j^*(y,\kappa) = \begin{cases} New & y \in [y_{max}, max\{y_{Old}^{New}, y_{Presale}^{New}(\kappa), y_{Rent}^{New}(\kappa)\}) \\ \\ Old & y \in [y_{Old}^{New}, max\{y_{Presale}^{Old}(\kappa), y_{Rent}^{Old}(\kappa)\}) \\ \\ Presale & y \in [min\{y_{Presale}^{New}(\kappa), y_{Presale}^{Old}(\kappa)\}, y_{Rent}^{Presale}) \\ \\ Rent & y \in [min\{y_{Rent}^{New}(\kappa), y_{Rent}^{Old}(\kappa), y_{Rent}^{Presale}\}, y_{min}) \end{cases} \tag{12}$$

Thus, demand functions are simply the area of each subspace:

$$D_j(P) = \begin{cases} \int_{y=max\{y_{Old}^{New}, y_{Presale}^{New}(\kappa), y_{Rent}^{New}(\kappa)\}}^{y_{max}} \int_{\kappa=\kappa_{min}}^{\kappa_{min}} f_y(y) f_\kappa(\kappa) d\kappa dy & j = New \\ \\ \int_{y=max\{y_{Presale}^{Old}(\kappa), y_{Rent}^{Old}(\kappa)\}}^{y_{Old}^{New}} \int_{\kappa=\kappa_{min}}^{\kappa_{min}} f_y(y) f_\kappa(\kappa) d\kappa dy & j = Old \\ \\ \int_{y=y_{Rent}^{Presale}}^{min\{y_{Presale}^{New}(\kappa), y_{Presale}^{Old}(\kappa)\}} \int_{\kappa=\kappa_{min}}^{\kappa_{min}} f_y(y) f_\kappa(\kappa) d\kappa dy & j = Presale \\ \\ \int_{y=y_{min}}^{min\{y_{Rent}^{New}(\kappa), y_{Rent}^{Old}(\kappa), y_{Rent}^{Presale}\}} \int_{\kappa=\kappa_{min}}^{\kappa_{min}} f_y(y) f_\kappa(\kappa) d\kappa dy & j = Rent \end{cases} \tag{13}$$

Where $f_y(y)$ and $f_\kappa(\kappa)$ are the pdfs of the distributions of y and κ and P is the vector of housing type prices.

C.3 Steady State Market Equilibrium

A steady state market equilibrium is defined by the set $\{B_t, q_t, \phi_t, P_t, j_t^*(y,\kappa)\}_{t=0}^{\infty}$, $P_t = (P_{Presale,t}, P_{New,t}, P_{Old,t})$ and $j_t^*(y,\kappa)$ is a mapping of houshold types to housing choices, such that the following conditions hold:

First, given prices, each builder n of the $\overline{B}$ builders born in period t chooses an entry probability $\eta_{n,t}$ such that, letting $f_t(\eta)$ denote the PDF of entry probabilities, the number of builders that enter is:[32]

$$B_t \equiv \overline{B} \int_0^{\overline{B}} f_t(\eta) d\eta \tag{14}$$

Second, each builder who enters, chooses total production quantity q_t. Together, the entry and quantity choices determine the aggregate supply of new residences:

$$Q_{Total,t} \equiv B_t q_t \tag{15}$$

Third, each entering builder also chooses the presale share ϕ_t, which, together with the entry choice, determines the aggregate supply of presale in period t.

$$Q_{Presale,t} \equiv B_t q_t \phi_t \tag{16}$$

Fourth, the choices of entry, quantity and presale together determine the supply of completed new residences in the next period. Similarly, the supply of new completed residences in the current period is determined by choices in the previous period:

$$\begin{aligned} Q_{New,t+1} &\equiv B_t q_t (1-\phi_t) \\ Q_{New,t} &\equiv B_{t-1} q_{t-1} (1-\phi_{t-1}). \end{aligned} \tag{17}$$

Fifth, the quantity of old housing is given by the depreciated stock of housing completed in the past:

$$Q_{Old,t} = \sum_{l=0}^{t-1} B_l q_l (1-\delta)^{t-l} \tag{18}$$

Sixth, given prices, the demand functions in equation (13) determine aggregate

[32]Because builders are identical, all PDFs $f_t(\eta)$ which yield the same B_t result in the same allocation.

demand for each housing choice.

Seventh, the market for each housing type clears:

$$Q_{t,j} = D_{t,j} \tag{19}$$

Eighth, whenever $B_t < \overline{B}$, builders achieve zero profit, and positive profit otherwise:

$$\pi(q_t, \phi) = \begin{cases} 0 & B_t < \overline{B} \\ \pi_{\overline{B}} > 0 & B_t = \overline{B} \end{cases} \tag{20}$$

In addition, a steady state equilibrium also requires that there exists $\underline{t} \geq 0$ such that, for all $t > \underline{t}$, prices, entry, quantities and household choices are the same:

$$B_t, q_t, \phi_t, P_t, j_t^*(y, \kappa) = B_{t+1}, q_{t+1}, \phi_{t+1}, P_{t+1}, j_{t+1}^*(y, \kappa). \tag{21}$$

C.4 Solving for Equilibrium

The solution requires solving for the zero of a system of 4 equations in 4 unknowns $\chi(P, B) = 0$: the equations are 3 excess demand equations and zero profit equation, the unknowns are the 3 endogenous prices and entry: $P_{New}, P_{Presale}, P_{Old}, B$

1. Initialization: provide parameter values and initial guesses of the endogenous vector $P_{New}, P_{Presale}, P_{Old}, B$.

2. Demand: compute demand for each housing type $D_{New}, D_{Presale}, D_{Old}$ at given prices using eq (13)

3. New construction: compute optimal builder choices of project size and presale share q, ϕ using eq (2) given prices and land costs (determined by B)

4. Builder profit: compute builder profit at optimal q, ϕ.

5. Old construction: compute old construction assuming new construction in all previous periods equals qB using eq (18)

6. Deviation from zero: compute the sum of the absolute values of the relative deviations (using normalizing constants $\hat{\chi_1}, \hat{\chi_2}, \hat{\chi_3}, \hat{\chi_4}$) of equilibrium conditions

from zero:

$$
\begin{aligned}
\chi_1 &= (D_{New}(P) - Bq(P)(1-\phi(P)))/\hat{\chi}_1 \\
\chi_2 &= (D_{Presale}(P) - Bq(P)\phi(P))/\hat{\chi}_2 \\
\chi_3 &= (D_{Old}(P) - Bq(P)\sum_{l=0}^{t-1}(1-\delta)^{t-l})/\hat{\chi}_3 \\
\chi_4 &= (\pi(q(P), \phi(P), B))/\hat{\chi}_4
\end{aligned}
$$

7. If the system $\chi(P, B)$ is close enough to zero, stop. Otherwise, update guess and repeat.

Solver I use a global evolutionary algorithm to narrow down the range of possible vectors to the most likely candidate. Then I proceed to local refinement by way of an iterative ensemble of the methods Nelder-Mead, Powell and Limited-memory Broyden–Fletcher–Goldfarb–Shanno with bounds, where at each round, the starting guess is obtained from a slight perturbation of the best solution from the three methods in the previous round.

Normalizations and stopping criterion I normalize the equations in $\chi(P, B)$ to make them comparable. I do so by dividing each RHS by the appropriate normalizing constant. The constants are chosen so that demand at baseline prices divided by the constant equals 1, and so that the variance of χ_4 roughly matches that of the others. The stopping criterion I use is $|\chi_1| + |\chi_2| + |\chi_3| + |\chi_4| \leq 10^{-3}$.

D Calibration Details

D.1 Price Moments in the Data

Because the model assumes that all residences are identical and that market conditions are fixed, the empirical calibration must remove price variation arising from differences in unit characteristics, location, or sale timing. I therefore estimate hedonic regressions to isolate and remove the contribution of these factors, yielding quality-adjusted (residualized) prices that are internally comparable across transactions. These adjusted prices are then scaled back to the level of observed prices by anchoring them to the median unadjusted price of second-hand transactions in 2015, which equals 1.255 million NIS and serves as the empirical value of $\tilde{P}_O$.

To obtain the price of newly completed residences, I compute the ratio of quality-adjusted prices of new (spot) to old (second-hand) transactions. This ratio corrects for the downward bias in recorded presale ages by shifting presale ages backward by one to three years and comparing the resulting presale prices with spot prices for the same corrected ages (2–4). Averaging across these adjustments gives 1.043, implying a completed-new price of $\tilde{P}_N = \tilde{P}_O \times 1.043 \approx 1.309$ million NIS.Averaging across overlapping age pairs serves to smooth out random mismeasurement in the building year variable, ensuring that the resulting five-age-step ratio reflects genuine price dynamics rather than data noise.

Next, to calibrate the price of early presales, I measure how quality-adjusted presale prices change as projects progress toward completion. For each calendar year from 2010 to 2019, I collapse presale transactions by building age and compute the mean residualized price at each age. Within each year, I then form the ratio of the mean price of age presales to the mean price of presales with ages 5 years smaller and average these ratios across ages and years. Here too, averaging across adjacent age pairs reduces the sensitivity of the estimate to noise in the recorded building completion year, which can otherwise distort the computed building ages. The resulting quantity, 1.156, captures the typical five-year price appreciation between early presales and units sold at completion. Using this factor, the implied presale price five years before completion is $\tilde{P}_I = \tilde{P}_N/1.156 \approx 1129$ thousand NIS.

In summary, the empirical price levels used for calibration are:

$$[\tilde{P}_O = 1255, \quad \tilde{P}_N = 1309, \quad \tilde{P}_I = 1129 \text{ (thousand NIS).}]$$

These values correspond to, respectively, the observed second-hand price, the completed-new price implied by the spot-to-old ratio, and the early-presale price implied by the five-age-step presale-to-spot ratio.

D.2 Builder Costs Estimation

In calibrating builder costs I rely on the 2015 Ministry of Construction and Housing report (Armoni 2015) that examines building costs of residential projects that were completed between 2010 and June 2012. The authors surveyed builders in Israel and received answers for 110 projects, out of which 73 were carried out by developers, while the rest were carried out by purchase groups. The report contains in Appendix B itemized data for each project. This includes the final cost of land per sqm of residence space in the project, and allows me to calculate the total non land cost (not including entrepreneurial profit and VAT) per sqm. To preserve respondent's privacy, the table does not include the total area of residences, nor the total number of units, but only the area of the average unit. It also does not include the precise number of floors, but only whether the project has 1-2 floors, 3-8 floors, 9-15 floors or 16+ floors. I focus on projects that were carried out by developers and that were in buildings of at least 3 floors.

Multiplying average sqm per residence by average land and non-land costs per sqm, I get the average land and non-land costs per residence in each project. To aggregate this across projects in a way that is applicable to 2015, I weight each project's costs by the share of residences built in 2015 within floor number group and district. The results are 538,300 NIS for non land costs per unit and 259,300 for land costs per unit.

I then correct for the changes in land and non-land costs over time. I obtain changes in non-land costs over time from the builder's cost index tracked by the Israeli Central Bureau of Statistics (CBS), which does not include land costs and which increased 13.6% between Jan 2010 and Jan 2015.

Regarding land costs, I take my baseline as the year 2007 because as the report notes, the land for buildings completed in 2010 - Jun 2012 was purchased in 2007 - 2008. There are no official statistics for the increase in residential land prices over that time period. Therefore, I use data on land auctions from the Israeli Land Administration. I build a panel of district by year in which at least 3 successful residential auctions occurred in each of the years 2007 and 2015. In each district year pair I calculate the average and median total land cost (winning bid plus development costs) per residential unit and per sqm residential area. Because the average price within district year tends to extremes, I use the median price. I then regress the final total land cost on district and year fixed effects. I do this separately for costs by area and costs by unit. I find that per unit costs increased by 40% while per sqm costs increased by 60%. I take the average of the two to arrive at 50%.

Finally, I correct for the fact that the average project finished in 2015 may contain more units, which should affects total land costs. To check if this is the case, I use my presale data to calculate the average floor number of a residential building with at least

3 floors finished in 2015 conditional on belonging to one of the above floor groups. The averages are about 4.5, 10.5 and 20.5. When each project is weighted as above by the share of its group in new residences built in 2015, I find that the average number of floors is 8, while the actual average of floors in a building built in 2015 was about 10.5. So I further multiply the resulting costs by 10.5/8 to arrive at $16,527.5$ which is about 518.4 per unit (assuming 4 units per floor).

D.3 Installments Calibration

Regulation sets out the maximum shares of the total price that can be paid before a specific milestone in construction is reached: up to 7% before construction starts, the next 33% when the first floor roof is laid, the next 20% upon completion of the frame for the floor on which the apartment is located, the next 15% when the internal plaster-work on the walls is completed, the next 15% when external covering on the building is completed, and the last 10% when the occupancy permit is issued.[33]

Because in the model there are no distinctions among different stages of construction and only two distinct periods, I must make a judgment call about how to set installments in my model.

To faithfully recreate the economic equivalent of the above schedule in a two period setting, one must first make judgments about the average correspondence between time to completion and the stage of construction, and then to discount the payments appropriately. Note that because discount rates between builders and households differ, the installments would differ as well. Furthermore, the sum of the first and second installment will not sum to 1. I assume that when presale is 5 years before completion, 7% is paid immediately, 33% is paid 3 years before completion, the next 20% is paid 2 years before completion, 15%, a year and a half before completion, 15% a year before completion and the final 10% is paid upon completion. I further assume that the first 50% is included in the first installment (that is, the first two installments plus half of the third), and that the rest will be included in the second.

Finally, I make assumptions about the interest rates used to discount each part. For the builder it is r_b, while for the household the first 25% is discounted by r_f while the

[33] One may wonder how presale can be used as an effective means of overcoming credit constraints if only 7% of already discounted prices are received before building starts. The answer is that it greatly it greatly limits the extent to which the line of credit for the project needs to expand in order to complete construction.

rest is discounted by r_m.[34] This yields the following formulas for the installments:

$$\iota_{b,0} = 7\% + \frac{33\%}{(1+r_b)^2} + \frac{10\%}{(1+r_b)^3}$$
$$\iota_{b,1} = 10\%(1+r_b)^2 + 15\%(1+r_b)^{1.5} + 15\%(1+r_b)^1 + 10\%$$
$$\iota_{h,0} = 7\% + \frac{18\%}{(1+r_f)^2} + \frac{15\%}{(1+r_m)^2} + \frac{10\%}{(1+r_m)^3}$$
$$\iota_{h,1} = 10\%(1+r_m)^2 + 15\%(1+r_m)^{1.5} + 15\%(1+r_m)^1 + 10\%$$

In the model, for each presale sold, the builder receives $P_0\iota_{b,0}$ immediately and $P_0\iota_{b,1}$ at completion. The buyer pays $P_0\iota_{h,0}$ immediately and $P_0\iota_{h,1}$ at completion.

E Institutional Details

E.1 Milestones and Installments

Because I do not observe each builder's estimates of when each milestone would be reached, I use a heuristic provided by an industry expert to calculate, based on the number of floors in the building and the residence's floor number, the average time until each milestone is reached.

There are 5 milestones, which are indexed by $n = \{0, 1, 2, 3, 4\}$, and detailed in Table 14.

The heuristic is as follows: The period after the land is purchased but before the building permit is issued lasts about 3 years. Once a building permit is issued, it takes about 6 months to start the framing of the building. So I am assuming that the expected time from the start of presale to the start of framing is 3 years, assuming about six months to start presale once land is purchased.

Each underground floor takes about 1 month. The number of underground floors equals the number of residences divided by 15 parking spaces per underground floor, rounded up. Thus, from the start of framing to the completion of the underground floors is $ug = \frac{1}{12} roundup(\frac{floors \cdot 4}{15})$ years, where $floors$ is the number of floors in the

[34] The first 25% of the residence value is discounted by risk free rate because the households needs to save up this amount, while the rest is discounted by the mortgage rate. This also implies that the effective minimum down-payment for the household who buys in presale is slightly below 25% (although due to the nearly zero risk free environment, the benefit from this is very small).

Table 14: Milestones

n (index)	Milestones	Time to build
4	The frame of the ceiling of the ground floor of the building is completed	$3+\frac{1}{12}roundup(\frac{floors\cdot 4}{15})+\frac{1}{24}$
3	The frame of the ceiling of the floor of the sold residence is complete	$3+\frac{1}{12}roundup(\frac{floors\cdot 4}{15})+\frac{floor}{25}$
2	Plastering of the entire building is complete	$3+\frac{1}{12}roundup(\frac{floors\cdot 4}{15})+\frac{4}{25}floors$
1	Exterior finishes are complete	$3+\frac{1}{12}roundup(\frac{floors\cdot 4}{15})+\frac{4}{25}floors+\frac{9}{25}$
0	The key to the residence is delivered to the buyer	$3+\frac{1}{12}roundup(\frac{floors\cdot 4}{15})+\frac{4}{25}floors+\frac{9}{25}+\frac{1}{12}$

Notes: floors is the number of floors in the building. floor is the floor number of the sold residence.

building of the presale and assuming an average of 4 housing units per floor.

Each floor above ground takes about two weeks, so $\frac{1}{25}$ of a year. This determines three key stages: First, the first milestone, frame of the ceiling of the ground floor of the building, can be expected to be completed $3+ug+\frac{1}{25}$ years from the start of presale. Second, the second milestone, the frame of the ceiling of the floor of the sold residence is complete, can be expected to be reached $3+ug+\frac{floor}{25}$ years from the start of presale, where $floor$ is the floor number of the presale. Third, frame of the building is completed $3+ug+\frac{floors}{25}$ from the start of presale. This is important because plastering usually doesn't start before the frame is completed.

All the plastering and finishing takes about 6 weeks per above-ground floor, which is $\frac{3}{25}$ of a year. They are done concurrently with finishing, lagging by 1-2 floors at each time. So plastering and finishing are completed $3+ug+\frac{4}{25}floors$ and $3+ug+\frac{4}{25}floors+\frac{9}{25}$ years after presale starts, respectively. It takes about 1 month after finishing for the occupancy permit to be issued, so the expected length of presale is $3+ug+\frac{4}{25}floors+\frac{9}{25}+\frac{1}{12}$. For the average new project in my data, which has about 10 floors and about 4 units per floor, this comes out to about 5.29 years from land purchase to occupancy permit.