

# The Effect of LTV-based Risk Weights on House Prices: Evidence from an Israeli Macroprudential Policy

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# Introduction: Motivation

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- Mortgages secured by residential real estate make up a significant fraction percent of bank assets so macroprudential policies (MAP) aimed at promoting financial stability often focus on reducing losses on these mortgages.
- Strict LTV caps and higher risk weights on risky mortgages are among the most common MPP
  - 40 percent of advanced countries with MPP use strict LTV caps (Cerutti, et al. 2015).
- LTV caps slow accumulation of household debt and reduce bank losses during housing bust (Krznar and Morsink 2014, Lim et al 2011).
- Open question whether can also reduce size/likelihood of bust by slowing house price growth.
- Goal of this paper is to get cleaner identification of effect of LTV caps on house prices by studying policy that only affects part of market.

# The effect of LTV Limit on House Prices - Mix evidence

- 1 PP decrease in LTV is associated with a:

Authors	Year	Findings	Country
Igan and Kand	2011	<b>1.25 PP</b> decline in house price appreciation rate.	Korea
Duca, Muellbauer, and Murphy	2011	<b>1 PP</b> decline in house price appreciation rate (for first-time buyers).	US
Wong, Fong, Li, and Choi	2011	No effect on house prices.	Hong-Kong
Crowe, Dell’Ariccia, Igan, and Rabanal	2013	<b>0.8-1.3 PP</b> decline in house price appreciation rate.	19 advanced countries
IMF Country Report No. 14/48	2014	No effect on house prices.	Israel
Krznar and Morsink	2014	<b>2.5 PP</b> decline in house price appreciation rate.	25 countries
Akinci and Olmstead-Rumsey	2015	<b>1.5 PP</b> decline in house price appreciation rate.	57 advanced and emerging economies
Vandenbussche, Vogel, and Detragiache	2015	No effect on house prices.	16 countries

- Identification challenges: endogeneity due to the feedback loop between credit and house-price movements, controlling for country characteristics, use and intensity of MPPs, controlling for other macro-economic events and data availability.

# Background: The Housing and Credit Markets in Israel

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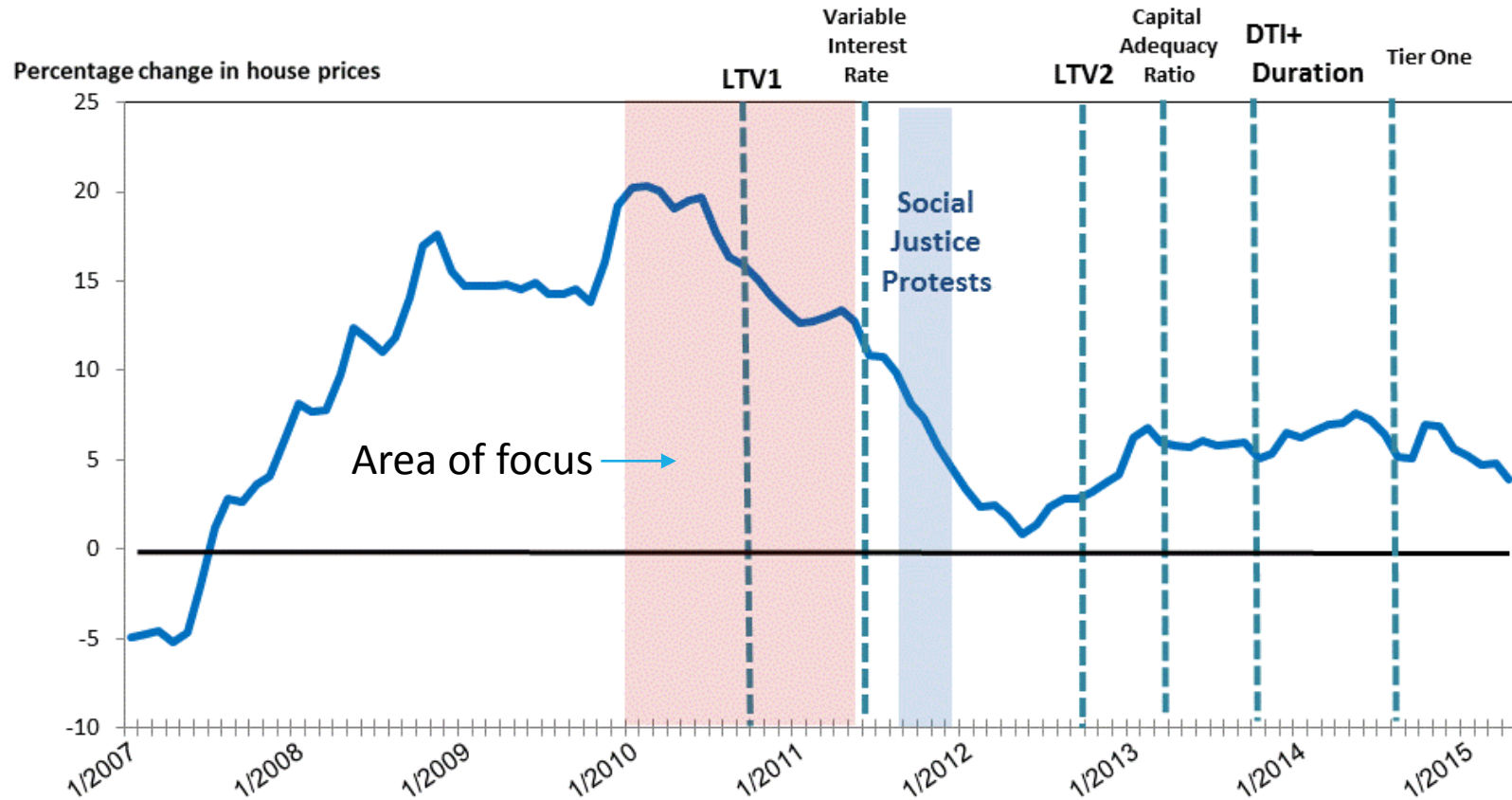
- Rapid increase in house prices starting in 2008
  - **Tight supply:** space constraints, slow processes for land planning and building permit issuance.
  - **Strong demand:** rapid population growth, low interest rates
- Increase in the demand for mortgages.
- BoI passed series of MAPs between 2010 and 2014, in order to contain household leverage and to lower risks in the financial system.

# MAP Measures Implemented

MPPs	Date	Type of MAP
<b>MAP1</b>	<b>October 2010</b>	<b>Increase capital provision for high LTV ratio loans (for housing loans of above 800,000 NIS)</b>
MAP2	May 2011	Limit share of adjustable interest rate loans to one third for 5 years
MAP3	November 2012	Limit LTV to 75% for first time buyers, 50% for investors and 70% for upgrading homes
MAP4	February 2013	Raise risk weights for capital adequacy requirements for mortgages with LTV>45%
MAP5	August 2013	<ul style="list-style-type: none"> <li>• PTI limited to 50% of HH income</li> <li>• Raise risk weights for capital adequacy requirement for PTI&gt;40%</li> <li>• Limit share of variable-interest loan to two thirds</li> <li>• Limit loan period to 30 years</li> </ul>
MAP6	September 2014	Additional Tier One capital requirement equal to 1% of total outstanding housing credit portfolio.

# Background: The Housing Market in Israel and MPPs

- The Rate of Change in Housing Prices in Israel, 01/2007-12/2015:



Source: Israel Central Bureau of Statistics.

<sup>1</sup> The line represents the monthly change in home prices (in annual terms). MPP tools are shown on the vertical lines.

# LTV-based risk weights limit

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- October 2010: risk-weight factor for mortgages **with an LTV of at least 60 percent**, and a **mortgage value higher than NIS 800,000** (~USD 220,000) was raised from 35 to 100 percent.
- Regulation increased interest rates on high-LTV loans by **0.21-0.36 PP** (Tzur-Ilan, 2017).

# Data

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- Property-level data from the Israel Tax Authority on the universe of household purchases of residential properties.
- Detailed information on each property: date, location, price, size and building year.
- These data are used by the Israeli CBS to construct the housing price index.
- Our analysis focuses on the period between **Jan 2010 to May 2011 (90K obs.)**.

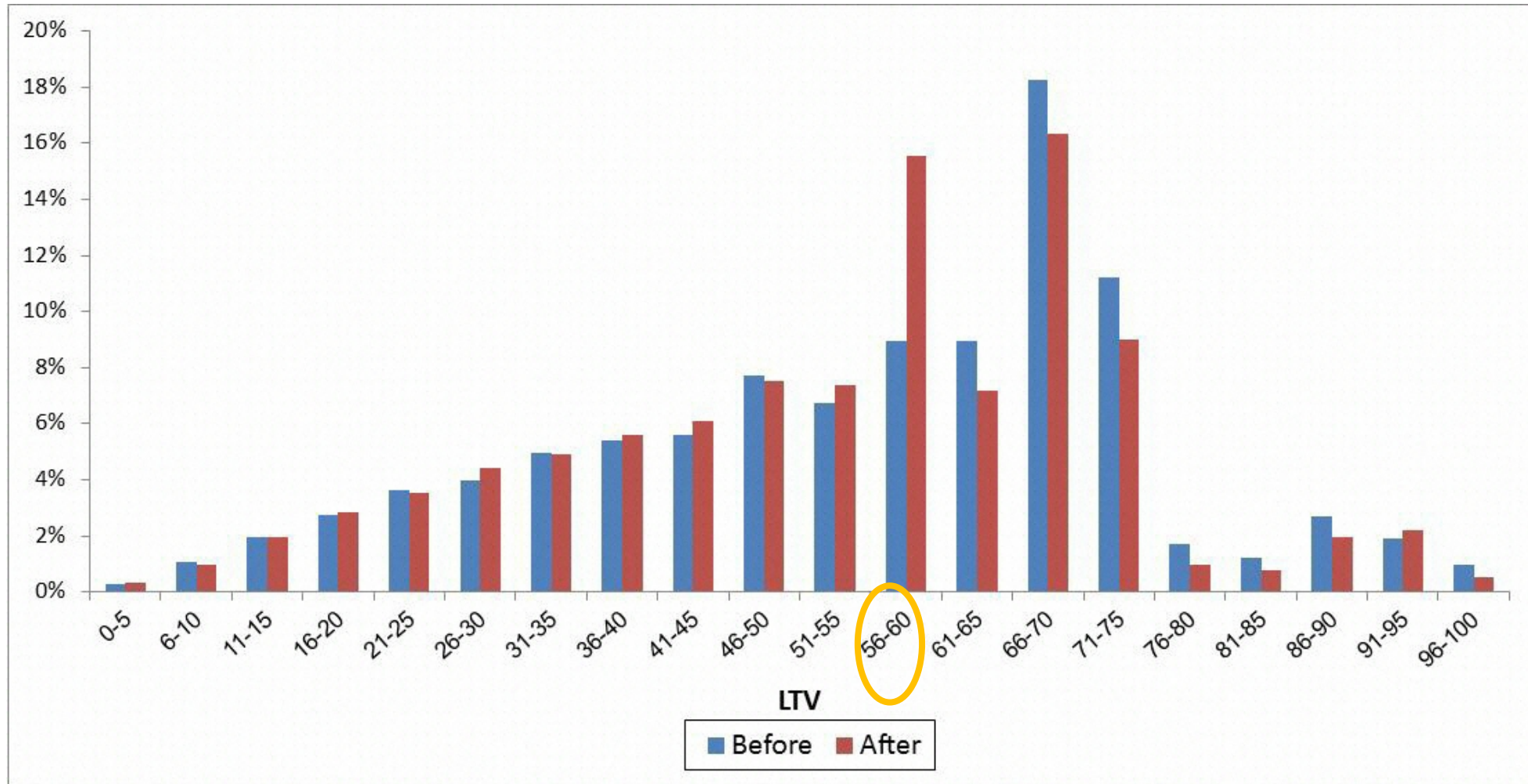


# Identification Strategy

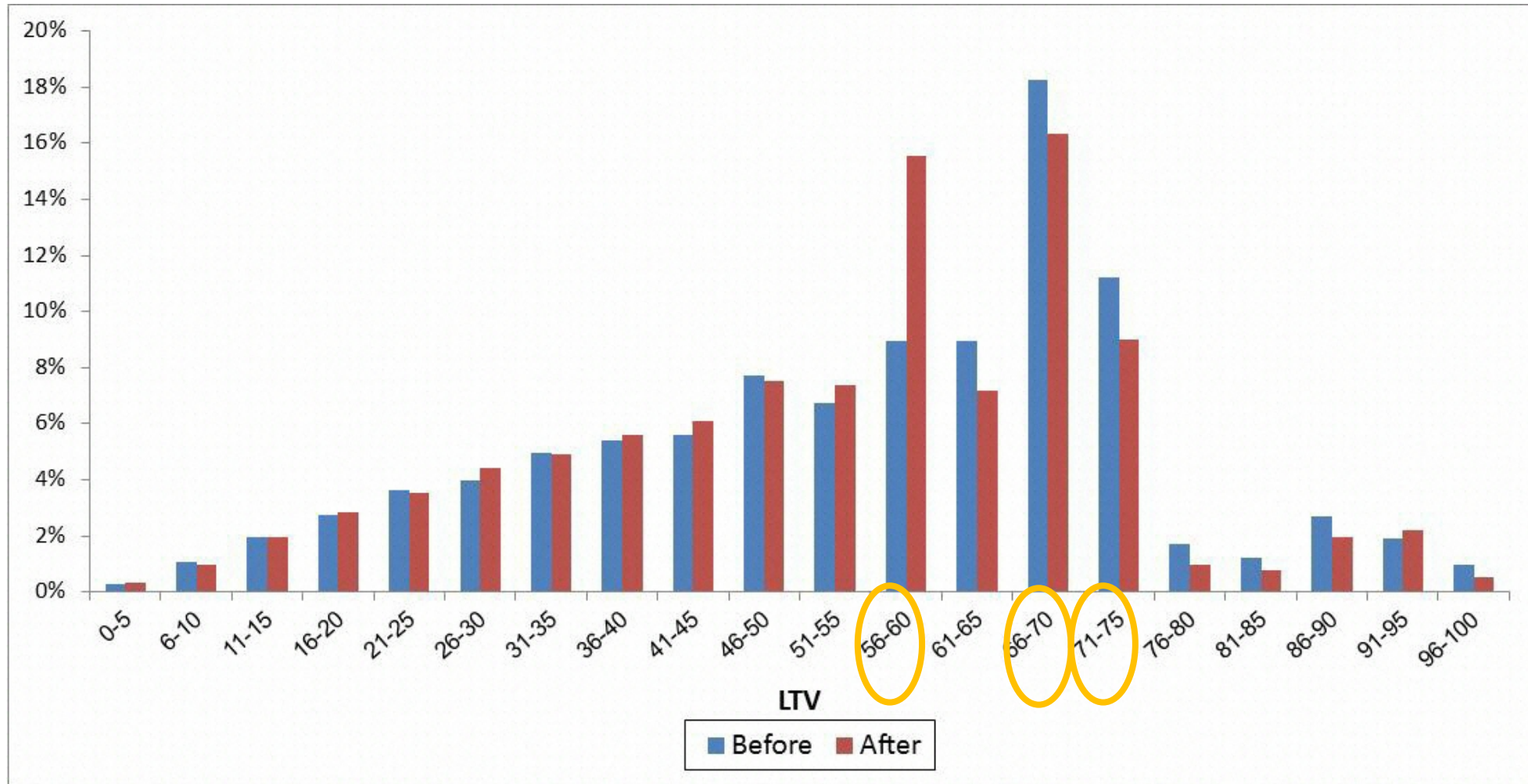
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- Regard transactions above  $\text{NIS } 800,000/0.6 = \text{NIS } 1.33\text{M}$  as affected by the policy.
- Diff in Diff: Compare purchases before and after the policy, between treated and non-treated apartments.
- Same approach as Adelino, Schoar and Severino (2014), who use changes in GSE conforming loan limits
- **However**, the Israeli housing market is not dominated by a single LTV ratio:
  - Mortgages with 70 and 75 percent LTV very common.
  - Subject to policy if prices are over  $\text{NIS } 800,000/0.70 = \text{NIS } 1.14\text{M}$  and  $\text{NIS } 800,000/0.75 = \text{NIS } 1.07\text{M}$ , respectively.

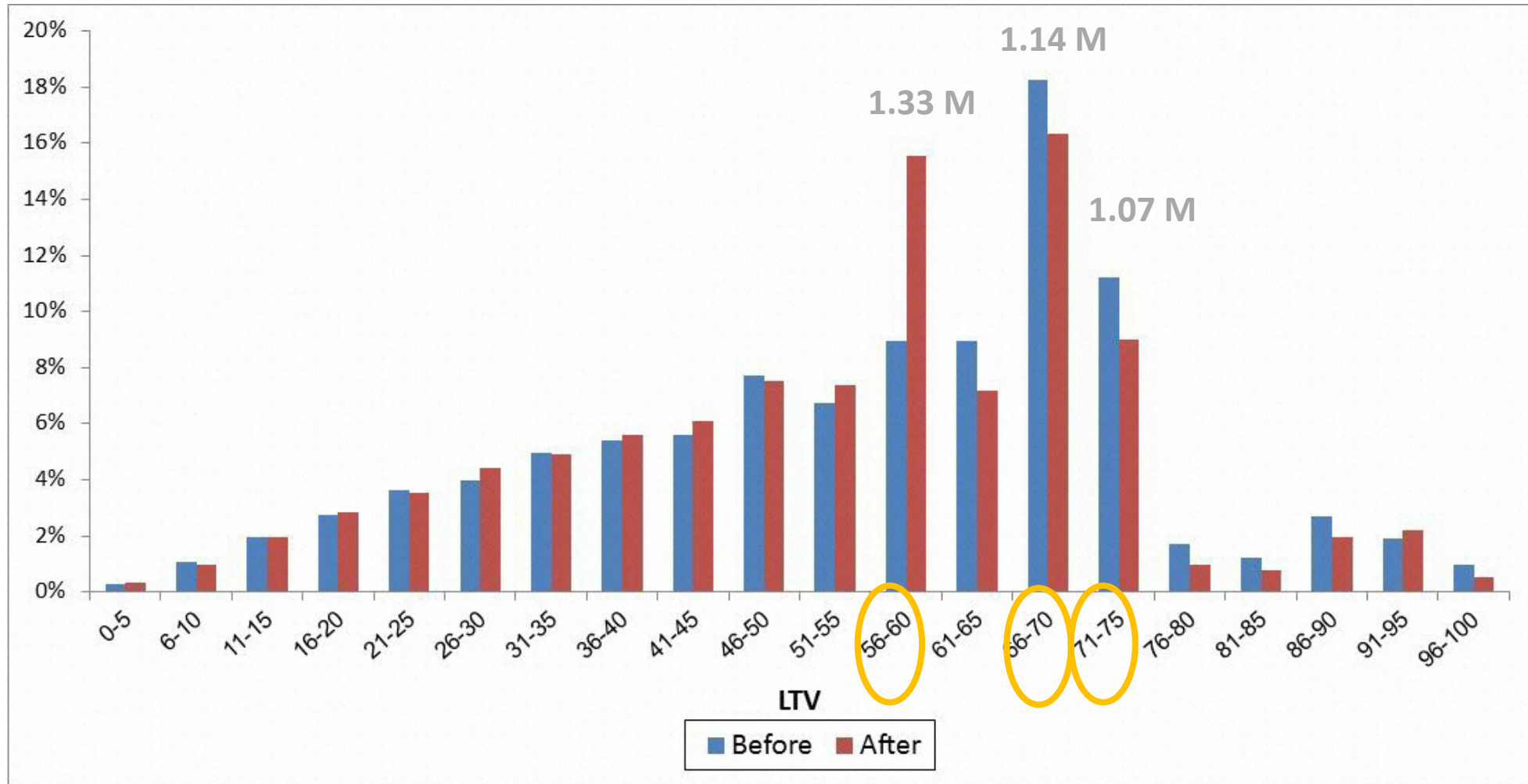
# Change in LTV distribution



# Change in LTV distribution



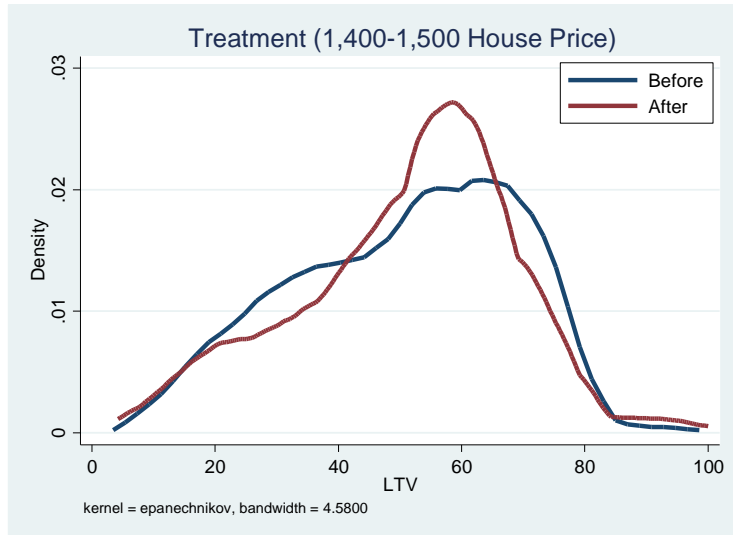
# Change in LTV distribution



# Suggestive Evidence - Changes in LTV distributions

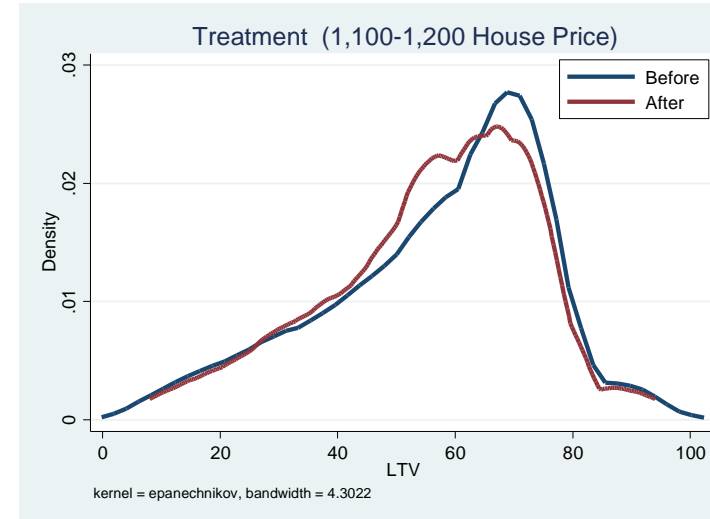
NIS 800k/0.6=NIS 1.33M:

**D:**

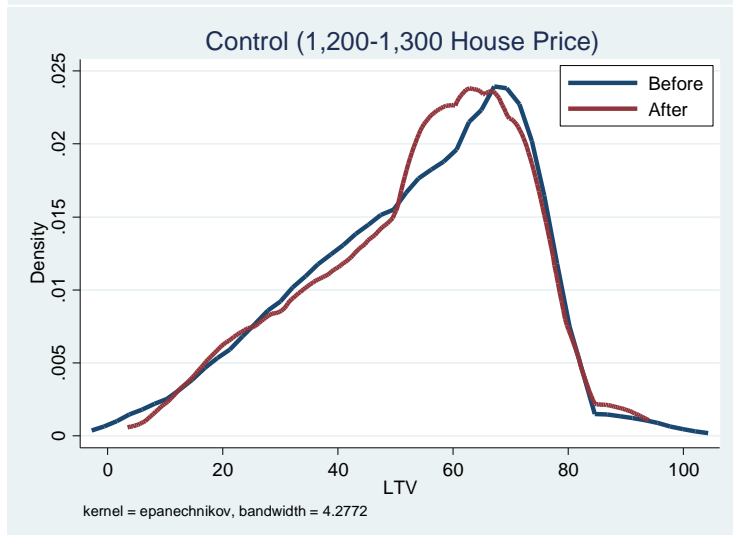


NIS 800k/0.75=NIS 1.07M

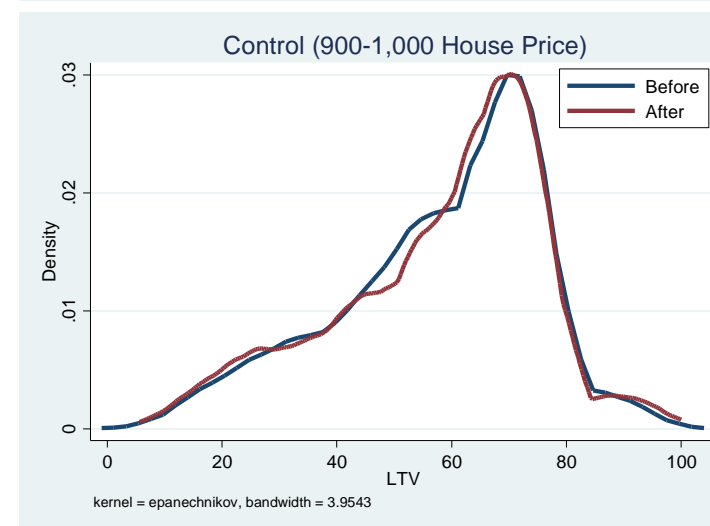
**B:**



**C:**



**A:**



# Identifying Affected Transactions

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- Using the observed LTV distribution one year before the policy was enacted.
- Treatment: probability that the unit would be purchased with a mortgage that had both a value above NIS 800,000 and an LTV ratio above 60 percent.
- For a transaction at price  $p$ :  $\text{Treat}(p) = \sum_{LTV=0.6}^1 I(p \cdot LTV > \text{NIS } 800,000) \cdot f(LTV)$

- Where:

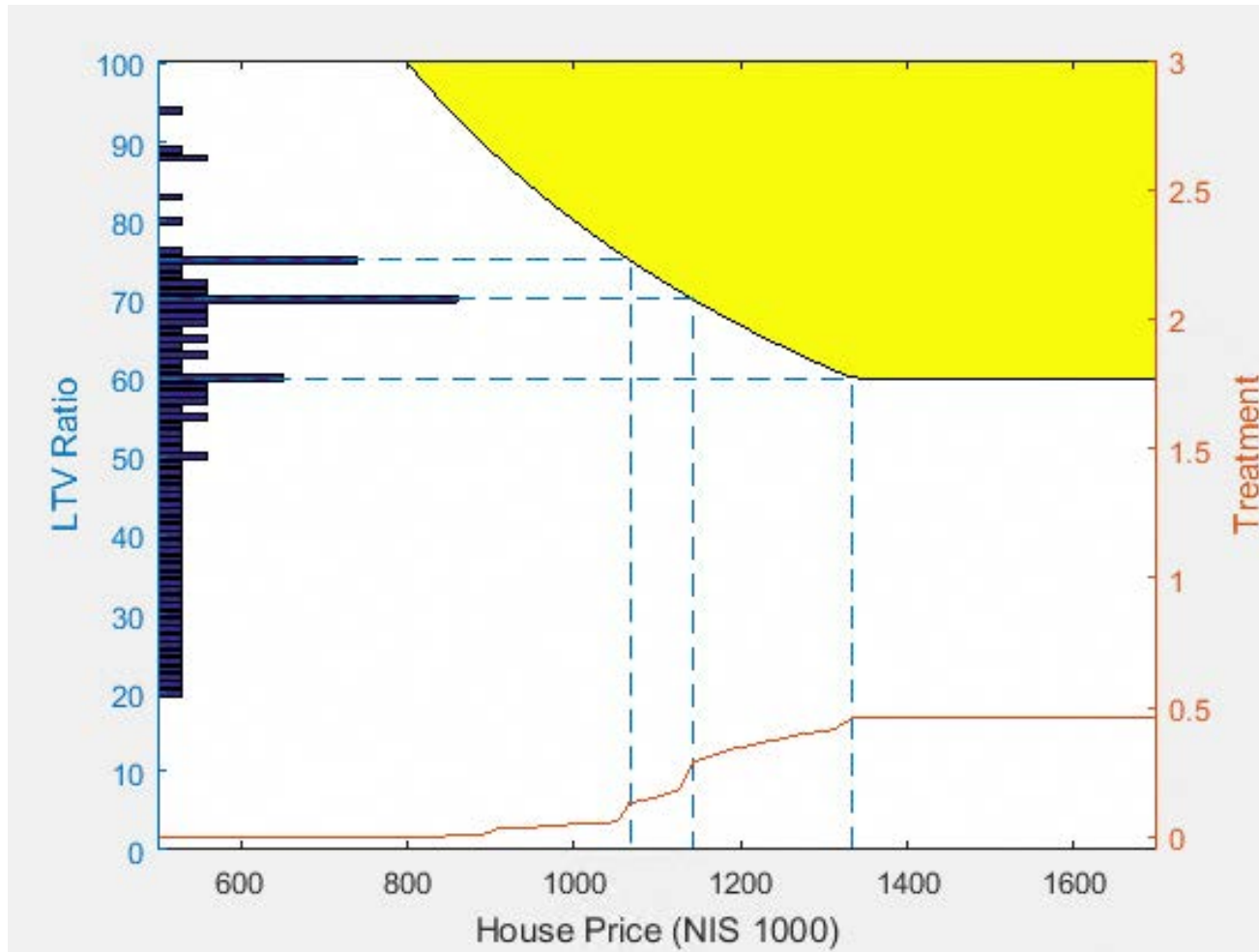
$I$  - indicator function

$p \cdot LTV > \text{NIS } 800,000$  -condition that a mortgage with LTV ratio “LTV” would be larger than NIS 800,000 for price  $p$

$f(LTV)$  - the fraction of units purchased in the previous year using a mortgage with that LTV ratio.

# Combined Credit Availability Measure

Joint Distribution of House Prices and LTV Ratios:



# Empirical Specification

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We estimate the following hedonic equation:

$$\ln(PPSM_{it}) = \alpha + \beta' X_i + \gamma * \theta_t + \delta * Treat(p) + \sigma * Treat(p) * \theta_t + \varepsilon_{it}$$

Where:

- $\ln(PPSM_{it})$  - log Price per Square Meter for apartment  $i$  in period 01/2010-10/2010 ("Before") and 11/2010-05/2011 ("After").
- $X$  -vector of property characteristics: number of rooms (in groups: 1.5-2, 2.5-3, 3.5-4, 4.5-5), log age of the building and location fixed effects.
- $\theta_t$  -time dummy equal to 1 after the limitation.
- $Treat(p)$  - function of the transaction price .
- $\varepsilon_{it}$  is a well-behaved error term clustered at the locality-statistical area level.



# Main Results

The Estimated Effect of LTV  
limit on Housing Prices:

	(1)	(2)	(3)	Narrower price range (NIS 700-1400K) (5)
3.rooms_group	-0.0953*** (0.00609)	-0.183*** (0.00598)	-0.226*** (0.00547)	-0.346*** (0.00237)
4.rooms_group	-0.163*** (0.00754)	-0.345*** (0.00775)	-0.434*** (0.00665)	-0.671*** (0.00232)
5.rooms_group	-0.197*** (0.00778)	-0.490*** (0.00851)	-0.605*** (0.00703)	-0.874*** (0.00250)
ln_age	0.00371*** (0.000810)	0.00210*** (0.000586)	0.00485*** (0.000492)	0.0105*** (0.000129)
price		0.000435*** (1.03e-05)	0.00106*** (3.04e-05)	
price sq'			-1.46e-07*** (8.14e-09)	
Treatment	0.254*** (0.00735)	0.156*** (0.00623)	0.0320*** (0.00680)	0.0975*** (0.00203)
After	0.104*** (0.00422)	0.0812*** (0.00360)	0.0616*** (0.00297)	0.00788*** (0.00213)
<b>Treatment#After</b>	<b>-0.0406***</b> (0.00503)	<b>-0.0545***</b> (0.00393)	<b>-0.0463***</b> (0.00336)	<b>-0.0608***</b> (0.00245)
Constant	2.351*** (0.00721)	2.113*** (0.00977)	1.813*** (0.0168)	2.088*** (0.00341)
Observations	90,332	90,332	90,332	52,504
R-squared	0.850	0.898	0.917	0.873

# Results: Separation by Local SES

- LTV limits are occasionally criticized for preventing groups needing more access to credit markets from obtaining a loan.
- The socioeconomic index of neighborhoods quality was divided into two groups:
  - Neighborhoods that are graded from 1 to 10
  - Neighborhoods that are graded from 11 to 20.
- The results show that the LTV limit affects the low-graded areas more suggesting that **more credit constrained households may be more affected by the policy.**

	Low-Quality Areas (1)	High-Quality Areas (2)
3.rooms_group	-0.319*** (0.00314)	-0.325*** (0.00296)
4.rooms_group	-0.611*** (0.00345)	-0.636*** (0.00293)
5.rooms_group	-0.866*** (0.00435)	-0.857*** (0.00321)
ln_age	0.0131*** (0.000288)	0.00914*** (0.000179)
Treatment	-0.129*** (0.00397)	0.129*** (0.00289)
After	0.0291*** (0.00239)	0.0188*** (0.00275)
<b>Treatment#After</b>	<b>-0.0558***</b> (0.00397)	<b>-0.0286***</b> (0.00321)
Constant	1.306*** (0.00420)	1.855*** (0.00382)
Observations	38,585	51,747
R-squared	0.857	0.875

# Robustness checks

	Narrower price range (NIS 700-1400K)			
	(1)	(2)	(3)	(4)
3.rooms_group	-0.0953*** (0.00609)	-0.257*** (0.00554)	-0.237*** (0.0185)	-0.229*** (0.00533)
4.rooms_group	-0.163*** (0.00754)	-0.495*** (0.00619)	-0.457*** (0.0206)	-0.444*** (0.00633)
5.rooms_group	-0.197*** (0.00778)	-0.654*** (0.00669)	-0.640*** (0.0177)	-0.615*** (0.00677)
ln_age	0.00371*** (0.000810)	0.00617*** (0.000362)	0.00679*** (0.00113)	0.00504*** (0.000480)
price			0.00128*** (0.000168)	0.00528*** (0.000460)
price sq'			-1.99e-07*** (4.56e-08)	-1.49e-07*** (8.30e-09)
Treatment	0.254*** (0.00735)	-0.178*** (0.00244)	-0.0257 (0.0399)	-1.60e-07*** (7.41e-09)
1.after	0.104*** (0.00422)	0.00190 (0.00374)	0.158*** (0.0197)	0.147*** (0.00775)
<b>1.Treatment#1.after</b>	<b>-0.0406***</b> (0.00503)	<b>-0.0158***</b> (0.00235)	<b>-0.0255**</b> (0.0108)	<b>-0.0294***</b> (0.00242)
1.after#c.price			-0.000227*** (4.77e-05)	-0.000219*** (1.59e-08)
1.after#c.price2			5.44e-08*** (4.56e-08)	1.01e-06 (1.22e-06)
Geographic FE	NO	YES	NO	NO
Constant	1.813*** (0.0168)	1.898*** (0.0284)	1.717*** (0.0972)	1.717*** (0.0972)
Observations	90,332	81,600	90,332	52,504
R-squared	0.850	0.861	0.898	0.829

# Additional tests

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## Placebo Tests:

- The probability of having a mortgage over NIS 700K or over NIS 900K (as opposed to over NIS 800K).
- The probability of having a mortgage over NIS 750K or over NIS 850K.

## Robustness checks:

- Each buyer uses a specific LTV ratio (3 different cutoffs: 800K/0.6, 800K/0.7 and 800K/0.75).
- Dummy variable for month and year addresses the changes in housing prices over time resulting from macroeconomic factors.
- Examine a broader time period around the LTV limitation.
- Use the exact same specification as in the Adelino et al. (2012).
- Direct observation of high-LTV mortgages.

# Conclusions

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- Under a range of model specifications, we find that after the MPP, units that were affected by the policy sell for **2 ½ - 6 percent lower** than unaffected units.
- Estimate semi-elasticity of house prices to interest rates: combining with earlier research showing that interest rates on affected mortgages were higher by 0.21-0.36 PP, the semi-elasticity **is in the range of 3-14**, consistent with the literature.
- Look at MPP that only affects part of market to better identify effect on house prices:
  - Hong Kong: LTV limits based on price and size of mortgage. (Wong et al., 2011)
  - Canada: Restrictions on government backed mortgage insurance for properties over \$1M. (Han et al., 2011)

# Change in LTV distribution

