The Effect of Credit Constraints on Housing Choices: The Case of LTV Limit

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Motivation

- The general objective of Loan-To-Value (LTV) limits, a common macroprudential policy (MPP) tool, is to reduce the systemic risk in financial systems.
- The LTV limit was designed by the BOI to protect the banking system and the borrowers from risks associated with excessive leveraging.
- LTV limitations may also influence the housing choices of affected individuals.
- There is very limited existing research on such effects.
- This paper uses rich data to examine a topic that is important to policy makers and that supports policy design.

Literature

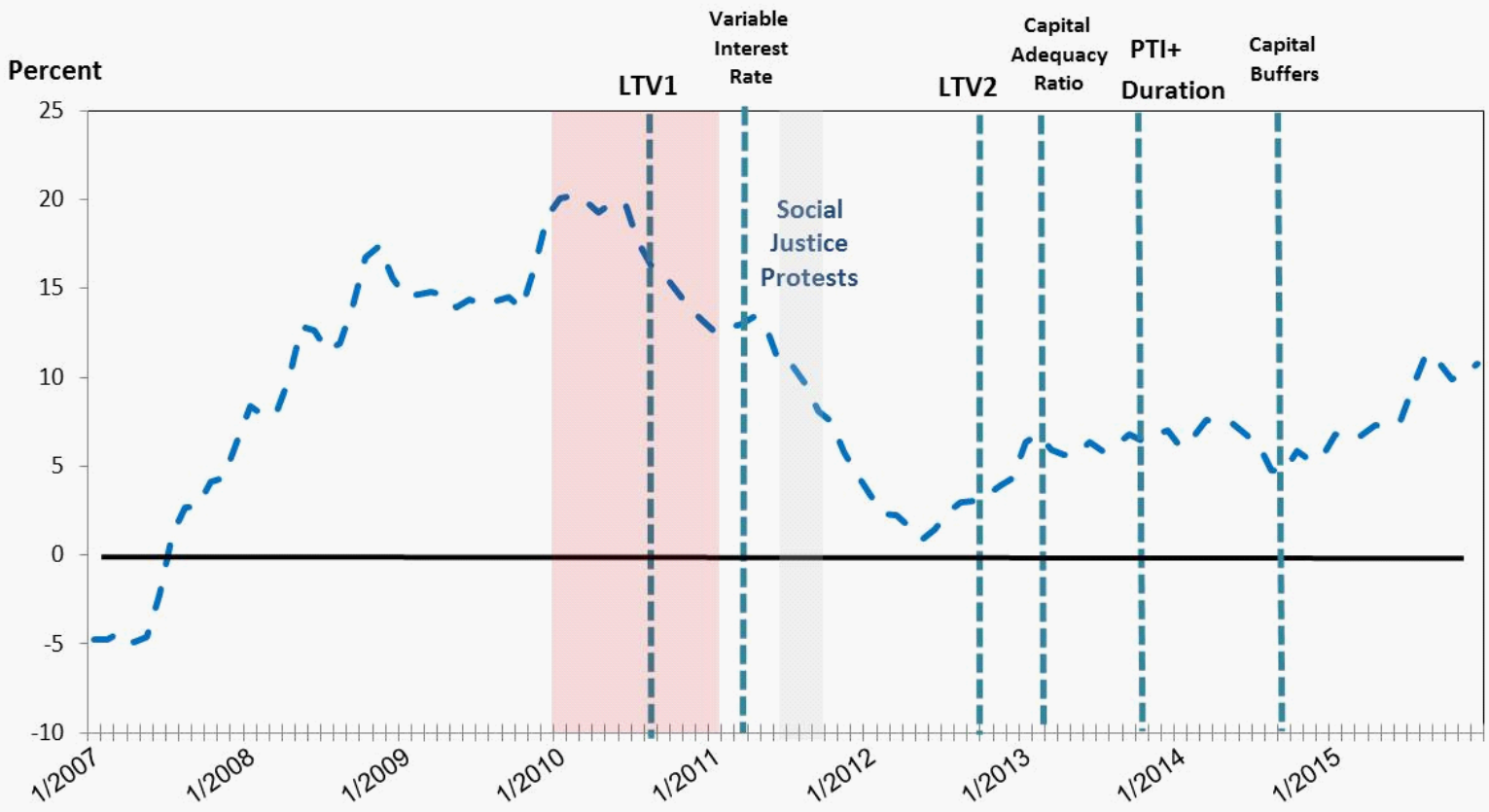
- Mainly focuses on the effect of MPPs on banks' stability.
  - LTV limits reduce bank losses in downturns (Krznar and Morsink 2014, Lim et al 2011)
- But, the transmission mechanisms of credit constraints at the borrower level are not well explored.
  - Previous studies mainly focussed on the delinquency ratio. (Elul et al, 2010)
- Mixed evidence of the effect of credit constraints on the housing market.
  - Mainly on home prices: Cross-sectional studies - Kuttner and Shim (2013), Country-Specific "Case" Studies -Igan and Kang (2011), Han et al. (2015)

Literature: Main Challenges

- A major obstacle in this literature is that the MPPs are used in combination with other policies and macroeconomic events, leading to a challenge in attributing outcomes to specific MPP tools.
- Most rely on macro data/cross-country analyses, and are unable to assess the distributional effect.
  - (Claessens et al, 2015, IMF, 2011, Lim et al, 2011) – Problem of identification, controlling for country characteristics.
- Little evidence regarding the effect of MPPs on consumer behavior in the credit and housing markets.

Background: The Housing Market in Israel

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



Source: Israel Central Bureau of Statistics.

[1] MPP tools are shown on the vertical lines. The dotted line represents the monthly change in home prices (in annual terms).

The Regulatory Change

- In October 2010, the Bank of Israel required banks to increase the capital provision for mortgages with LTV greater than 60%.
- This guideline did not apply to housing loans originally amounting to less than NIS 800,000.

Data

1. Loan-level data from the Bank of Israel - mortgage contracts and borrower characteristics (90K obs. from Jan 2010 to May 2011).
2. Housing unit characteristics from the Israel Tax Authority - (Merged: 27K obs.)
   ⇓
   Detailed information on the **mortgage** (interest rate, LTV, etc.), on the **borrower** (age, income) and on the **housing unit** (size, location etc.)

Data - Sample Statistics

Summary Statistics

		Before the LTV Limit		After the LTV Limit		Difference	
Dataset	Variable	Mean	S.D.	Mean	S.D.	Coef	S.E.
Mortgage contracts	LTV (%)	56.7	19.7	55.9	18.9	**-0.8*** **	0.2
	Average interest rate (%)	2.41	0.67	2.71	0.97	**0.3*** **	0.01
Home Purchase	Real home prices (NIS thousand)	1,026	572	968	537	**-58*** **	6.8
Transactions	Rooms	3.98	1.09	3.97	1.1	**0.0**	0.0
	Area (square meters)	97.3	48.7	96.9	79.3	**-0.4**	0.8
	Distance from Tel Aviv (KM)	45.2	45.7	47.8	45.8	**2.6*** **	0.5
	Neighborhood Ranking	11.9	3.61	10.4	3.5	**-1.5*** **	0.0

*** p<0.01, ** p<0.05, *p<0.1

Sources: Data on mortgages from the Bank of Israel, Data on purchase transactions (Karmen Database) are from The Israel Tax Authority.

Number of observations: 27,324 (16,100 before the LTV limit, 11,224 after the LTV limit).

Note: Real home prices were deflated by the monthly change in the Index of Home Prices.

Identifying Affected Borrowers

- LTV limit required banks to set aside more capital against risky loans.
- Hence, the LTV limit changed the terms of the loan contract.
- I focus on the effect of the policy on the subset of borrowers constrained by the policy- Average Treatment Effect on the treated (ATT).
  But:
- The treatment status is observed only before the policy.
- The borrower could have taken LTV$>$60% and paid a higher interest rate.
- Also, the borrower could have chosen LTV$<$60% and bought a different asset.
- **2 main methods of identification**

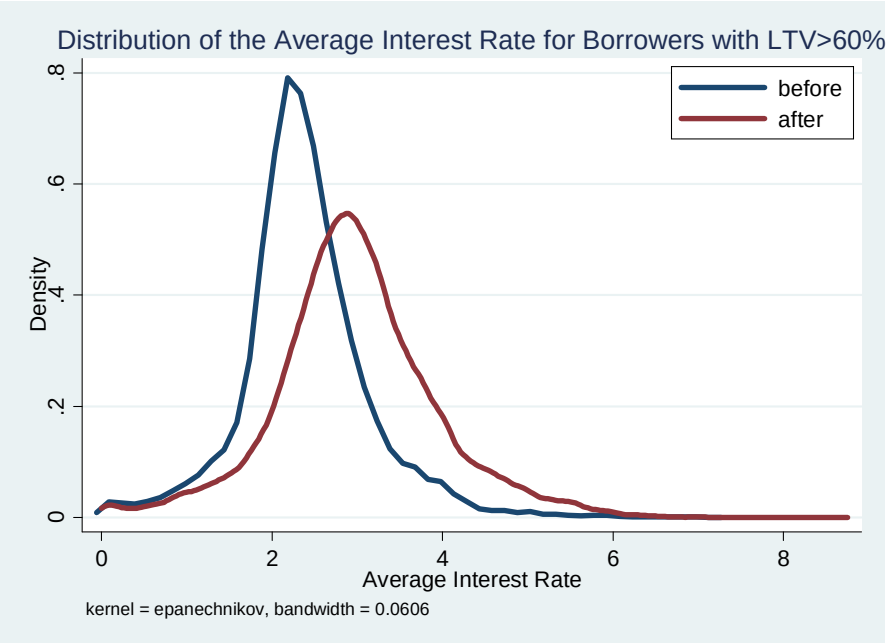
#1 Empirical Approach – Cross-Period Matching

Similar Households Before and After the Regulatory Change

- Matching households with similar characteristics before and after the LTV limit and examining the differences in their behavior in the credit and housing markets.
- ATT: $E(Y_1 - Y_0 \mid T = 1, X)$
  - Abadie-Imbens (2002): Mahalanobis distance, with replacement, bias-correction
- Matching is done using total income and average age per household.
- Outcome variables: home prices, size, number of rooms, distance from Tel Aviv, and quality of neighborhoods.
- Weaknesses: time varying, other macroeconomic events can have an effect (will be addressed later in the second matching approach).

LTV Limit was Effective: Mortgages Became More Expensive

- The LTV limit required banks to set aside more capital against risky loans.
- Increased the average interest rate for the risky borrowers (LTV$>$ 60%).



Kolmogorov-Smirnov test: statistically significant difference between the groups

LTV Limit was Effective – Interest Rate Above vs. Below Went Up

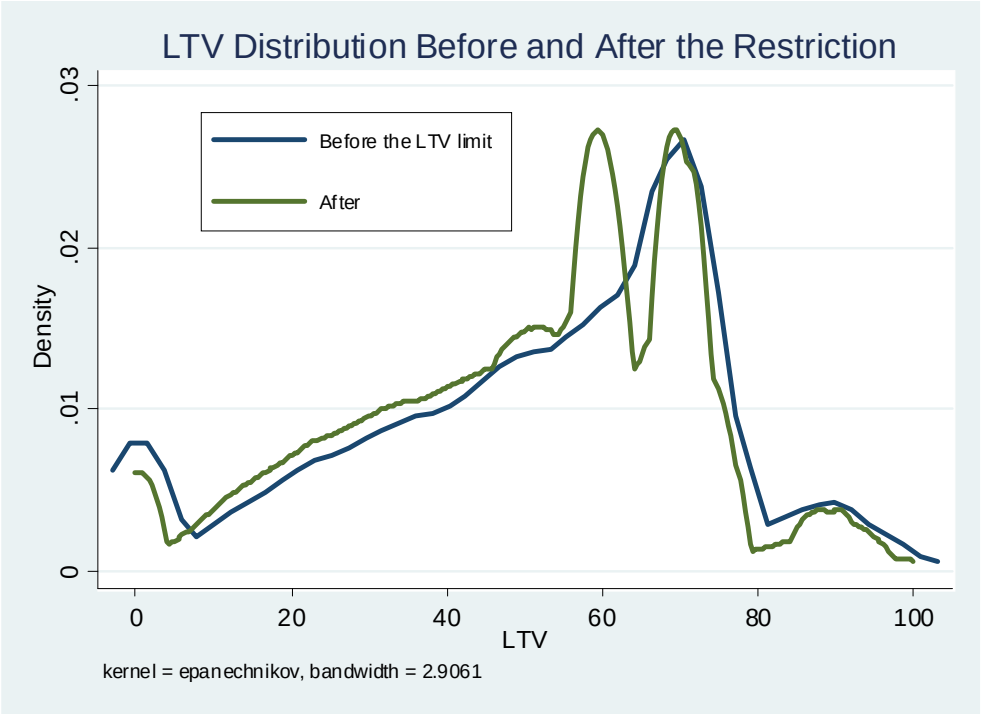
- Comparison of 2 identical borrowers above and below the 60% limit.
- Before the regulation- no difference between the 2 borrowers (0.01-0.03 percentage points)
- After the regulation, the interest rate paid by the borrower with LTV>60% is 0.21-0.36 percentage points higher than the similar borrower below the LTV limit

	61% VS 59%				61-65% VS 55-59%			
	Average Rate	Average Rate	Spread	Spread	Average Rate	Average Rate	Spread	Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ATT	.358***	.251***	0.213*	0.258**	.312***	.297***	0.251***	0.259***
	(.078)	(.081)	(.110)	(.129)	(.065)	(.063)	(.086)	(.079)
Total income	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Duration	No	Yes	No	Yes	No	Yes	No	Yes
No. of obs. used	349	349	349	349	1,937	1,937	1,937	1,937

Note: Heteroskedasticity-consistent standard errors are in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively.
Spread - the interest rate over the PRIME. ATT is the Abadie-Imbens bias corrected average treated effect matching estimator.
Treated- who borrow above 60% LTV threshold. Borrowers were Matched, after the LTV limit, by income, age, bank and duration of the loan.

LTV Limit is Effective – LTV Goes Down

- Incentivize risky borrowers (LTV>60%) to reduce leverage:

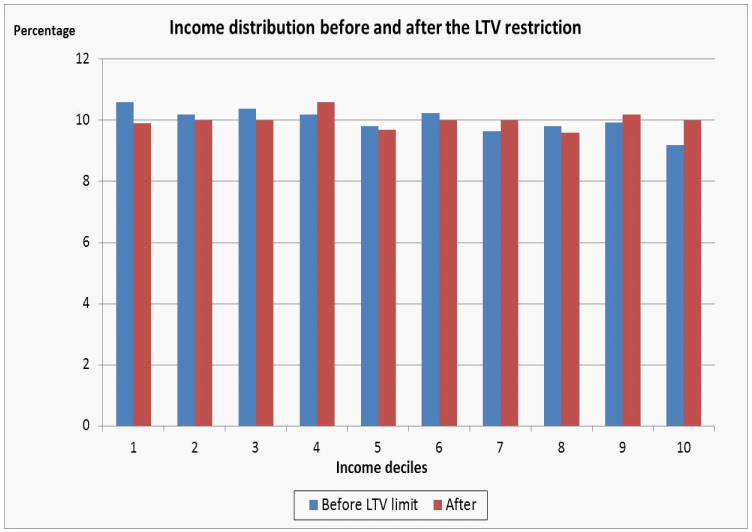


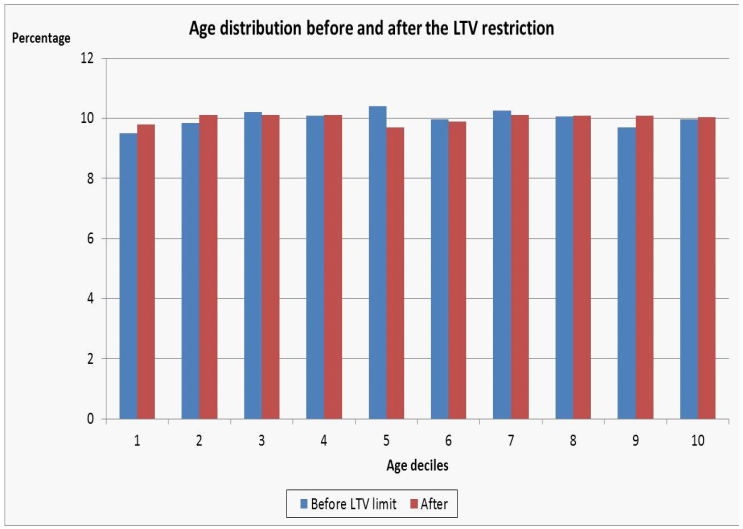
- Less credit for the purchase of a housing unit.

Test for Credit Rationing

Did the LTV Limit Change the Distribution of Borrowers?

- Distribution of borrowers' characteristics before and after the LTV limit:





- No significant change in the distribution of the borrowers' characteristics.

Results - Cross-Period Matching

- Matching similar households before and after the LTV limit
- Examining the differences in their choices in the housing market.

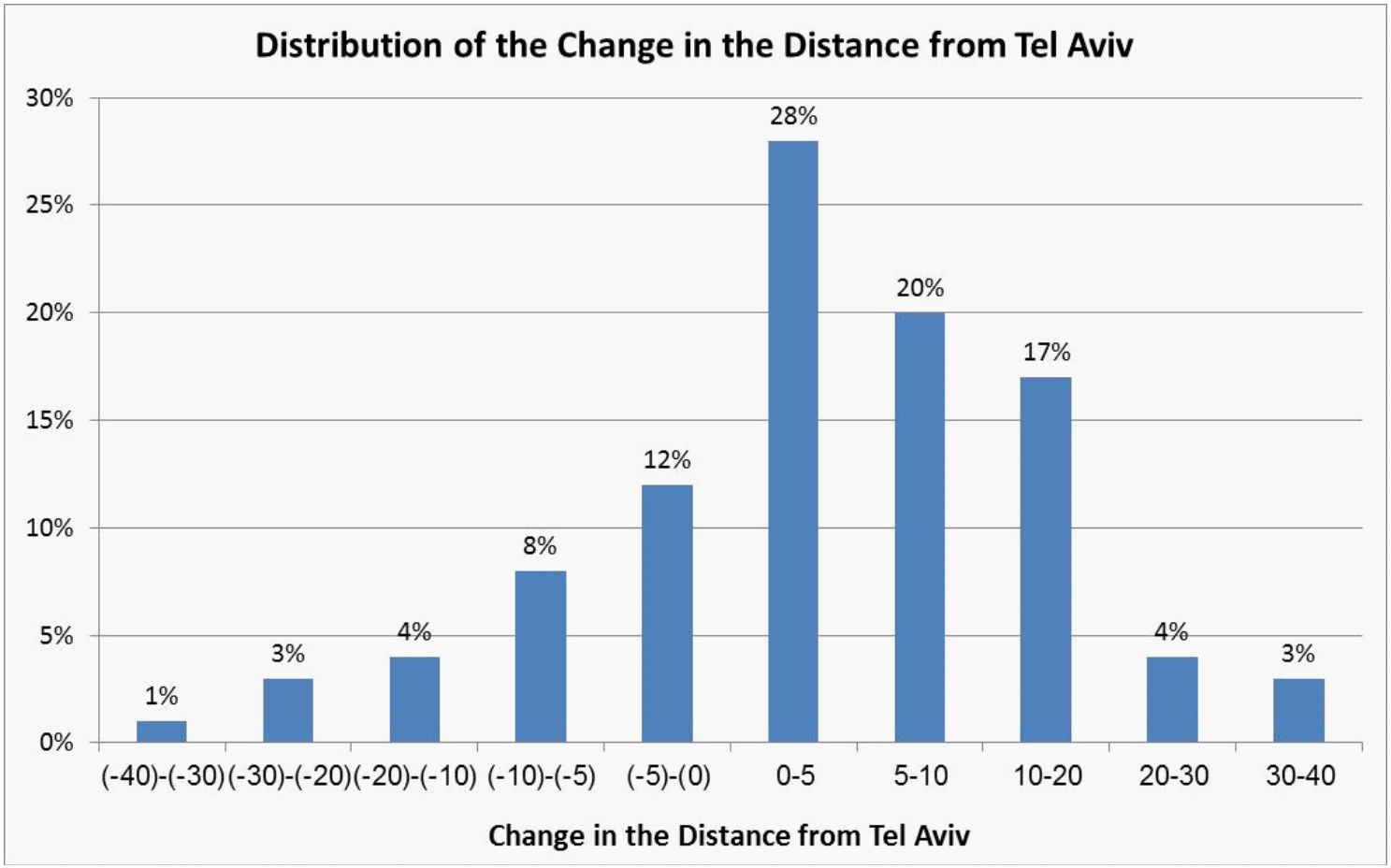
Dep. Variable:	Nominal Home Prices (NIS)	Real Home Prices (NIS)	Size (sq.m.)	Rooms	Distance from Tel Aviv (KM)	Neighborhood Ranking
ATT	**1,397**	**-83,401*** **	**-1.52**	**-0.04*** **	**3.8*** **	**-1.8*** **
	(8,947)	(8,193)	(1.1)	(0.01)	(0.7)	(0.4)
ATT (%)	**0.1%**	**-8.1%**	**-1.6%**	**-1.0%**	**8.4%**	**-9.1%**

Note: Heteroskedasticity-consistent standard errors are in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively. Number of observations: 11,224. ATT is the Abadie-Imbens bias corrected average treated effect matching estimator. Treated-housholds who borrow after the LTV limit (October 2010).

Magnitude

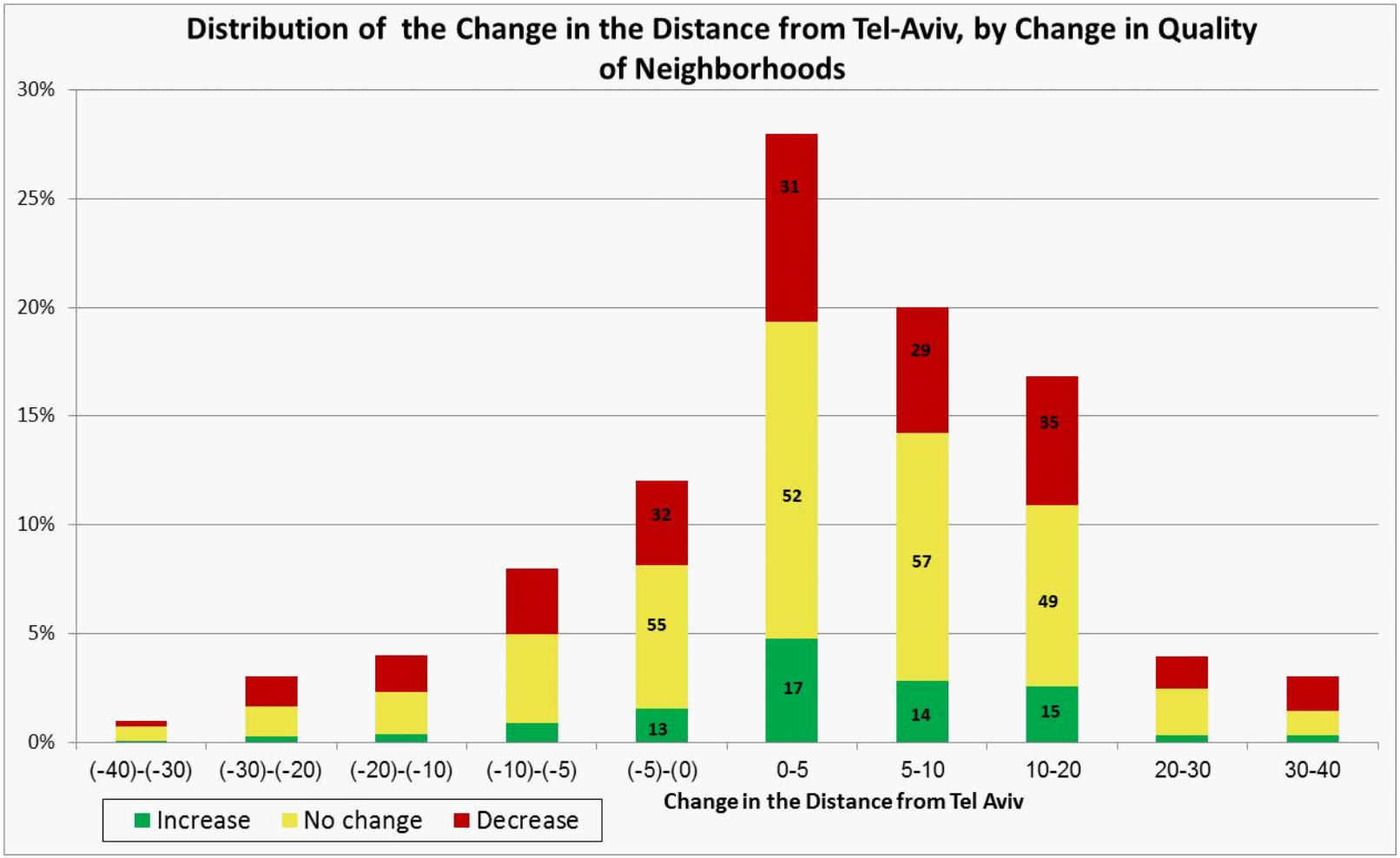
- 55% of Israel's population lives in the center (radius of 40 KM from TLV), Within 6 months the treatment group moved 4 KM farther from TLV.
- To a significantly lower graded neighborhood.
- So borrowers adjusted their housing choices in response to the LTV limitation.

Where Did They Move to?



- 70% of the borrowers moved farther from the center.

Which Kind of Neighborhood Did They Move To?

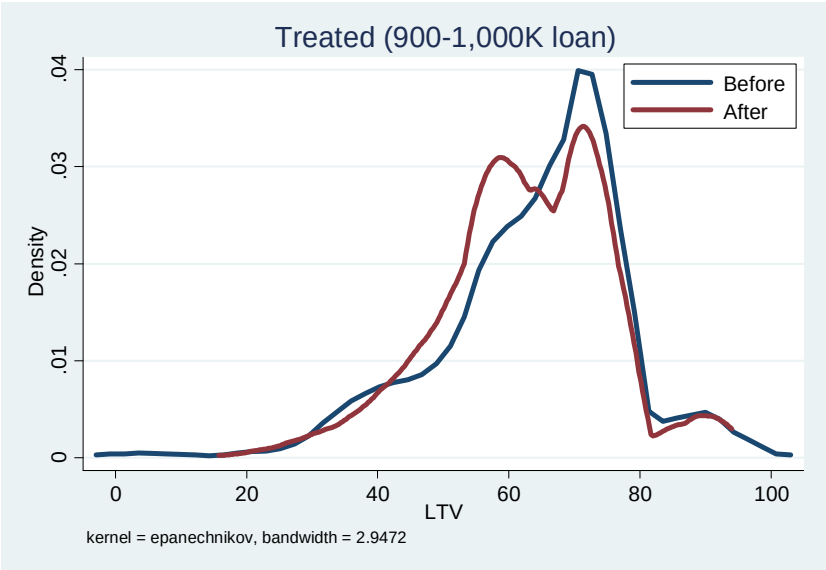


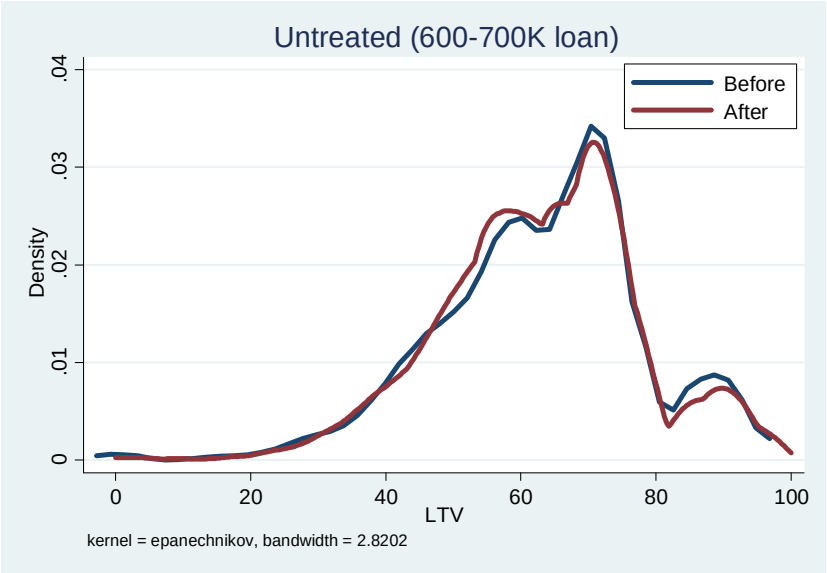
- For each sub-group of distance from Tel Aviv - significant decrease in the socioeconomic rating of neighborhoods.

#2 - Alternative Approach - Difference-in-Differences Matching (Within Periods)

- Do borrowers choose different assets because of the LTV limit or because of the increase in home prices?
- According to the October 2010 LTV limit, the banks were required to increase the capital provision for loans with LTV higher than 60% exceeding NIS 800K.
- Examined two groups:
  - Untreated group- borrowed between NIS 600K and 700K
  - Treatment group- borrowed between NIS 900K and 1,000K
- Then, matching between these two groups by observable characteristics.
- While the impact of macro variables applies to both groups, only one group is affected by the LTV limit.

Change in the LTV Distribution





Results Difference-in-Differences Matching (Within Periods)

Change in Real Home Prices (NIS)

	Before	After	Difference
Treated	1,456,884***	1,382,296***	**-74,728*** **
	(15,896)	(15,520)	(22,242)
Untreated	1,210,884***	1,179,178***	**-31,706**
	(15,296)	(20,044)	(24,855)
Difference in Mean	246,000***	203,118***	-43,022*
	(22,592)	(24,577)	(23,714)
DID Matching (by observable characteristics)			**-67,789***
			(36,135)

Note: Heteroskedasticity-consistent standard errors are in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively. treated borrowers are defined as those that borrowed from 900,000 to 1,000,000 NIS. The untreated borrowers are those that borrowed 600,000 to 700,000 NIS. There are 1,498 treated borrowers and 3,462 untreated borrowers. Control borrowers are a subset of the untreated borrowers selected as the closest match to the treated borrowers based on a set of borrower characteristics: Age and income. There are 1,498 borrowers in the control group. ATT is the Abadie-Imbens bias corrected average treated effect matching estimator.

- A decline of NIS 68K (4.7%) in real home prices after the LTV limit in the treatment group

Results Difference-in-Differences Matching (Within Periods)

Distance from Tel Aviv (KM)

	Before	After	Difference
Treated	28.3***	31.5***	**3.2****
	(1.15)	(1.54)	(1.9)
Untreated	41.2***	40.5***	**-0.7**
	(1.63)	(1.41)	(1.2)
Difference in Mean	-12.9***	-9***	3.9***
	(1.6)	(2.1)	(1.5)
DID Matching (by observable characteristics)			**4.3*****
			(1.7)

Note: Heteroskedasticity-consistent standard errors are in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively. Treated borrowers are defined as those who borrowed from NIS 900,000 to 1,000,000. The untreated borrowers are those who borrowed NIS 600,000 to 700,000. There are 1,498 treated borrowers and 3,462 untreated borrowers. Control borrowers are a subset of the untreated borrowers selected as the closest match to the treated borrowers based on a set of borrower characteristics: Age and income. There are 1,498 borrowers in the control group. ATT is the Abadie-Imbens bias corrected average treated effect matching estimator.

- The treatment group moves 4.3 KM (15%) farther from the center after the LTV limit.

Results Difference-in-Differences Matching (Within Periods)

Neighborhood Ranking (scale of 1-20)

	Before	After	Difference
Treated	12.7***	10.3***	**-2.4*** **
	(1.1)	(1.8)	(0.7)
Untreated	10.6***	10.1***	**-0.5**
	(1.51)	(1.5)	(0.5)
Difference in Mean	2.1**	0.2	-1.9**
	(0.9)	(0.8)	(0.8)
DID Matching (by observable characteristics)			**-2.2*** **
			(0.8)

Note: Heteroskedasticity-consistent standard errors are in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively. Treated borrowers are defined as those who borrowed from NIS 900,000 to 1,000,000. The untreated borrowers are those who borrowed NIS 600,000 to 700,000. There are 1,498 treated borrowers and 3,462 untreated borrowers. Control borrowers are a subset of the untreated borrowers selected as the closest match to the treated borrowers based on a set of borrower characteristics: Age and income. There are 1,498 borrowers in the control group. ATT is the Abadie-Imbens bias corrected average treated effect matching estimator.

- The treatment group moves to lower ranked neighborhoods

Is there a sub-group that is more affected by the LTV limit?

Matching - by type of buyer

Average		Nominal Home Prices (NIS)	Real Home Prices (NIS)	Size (sq.m.)	Rooms	Distance from Tel Aviv (km)	Quality of Neighborhoods
First-time home buyers	Control	13,337	-60,179***	-2.28*	-0.04*	1.85***	-0.6**
	Treated	[10,928]	[9,984]	[1.23]	[0.02]	[1.1]	[0.3]
	Change (%)	1%	-8%***	-3%*	-1%*	4%***	-6%**
Upgraders	Control	5,344	-93,021***	-1.43*	-0.02	3.9***	-1.1***
	Treated	[13,311]	[12,165]	[1.1]	[0.02]	[1.1]	[0.3]
	Change (%)	0%	-8%***	-1%*	0%	9%***	-11%***
Investors	Control	-49,656**	-122,680***	-0.13***	-0.08*	5.57***	-1.5***
	Treated	[25,014]	[22,940]	[0.04]	[0.04]	[1.9]	[0.41]
	Change (%)	-5%**	-12%***	0%***	-2%*	9%***	-15%***

Note: Heteroskedasticity-consistent standard errors are in parentheses. ***, **, * indicate significance at the 1, 5, and 10 percent levels, respectively. Treated borrowers are defined as those that borrowed after the LTV limit (October 2010). The untreated borrowers are those who borrowed before the LTV limit. Control borrowers are a subset of the untreated borrowers selected as the closest match to the treated group of borrowers based on a set of borrower characteristics: Age and income. ATT is the Abadie-Imbens bias corrected average treated effect matching estimator. Number of observations: First-time home buyer, control 3,081

- Investors were affected more by the LTV limit - more flexible.

Conclusions

- Provides a credible estimation of the impact of the first MPP implemented in Israel.
- Key finding:
  1. LTV limit affects the mortgage contract terms (interest rate, loan amount).
  2. Borrowers adjusted their housing choices in response to the LTV limitation: bought cheaper homes, farther from the center, in lower graded neighborhoods.
  3. Investors are influenced more by the LTV limit.
- Policy implication: Understanding how the market participants respond to the MPP is crucial for developing an appropriate policy response framework.