Does Location Matter?
Evidence on Differential Mortgage Pricing in Israel

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Motivation and relation to inequality

- Households' ability to accumulate wealth depends on availability and affordability of mortgage credit
  - High rate of home ownership (71.8% in 2017)
  - High share of mortgage financing (85% of purchases)
  - Large share of household's investment portfolio
- Given the size and duration of mortgage, even small interest rate differentials make difference
- Are there persistently "discriminated" groups of population in the mortgage market?
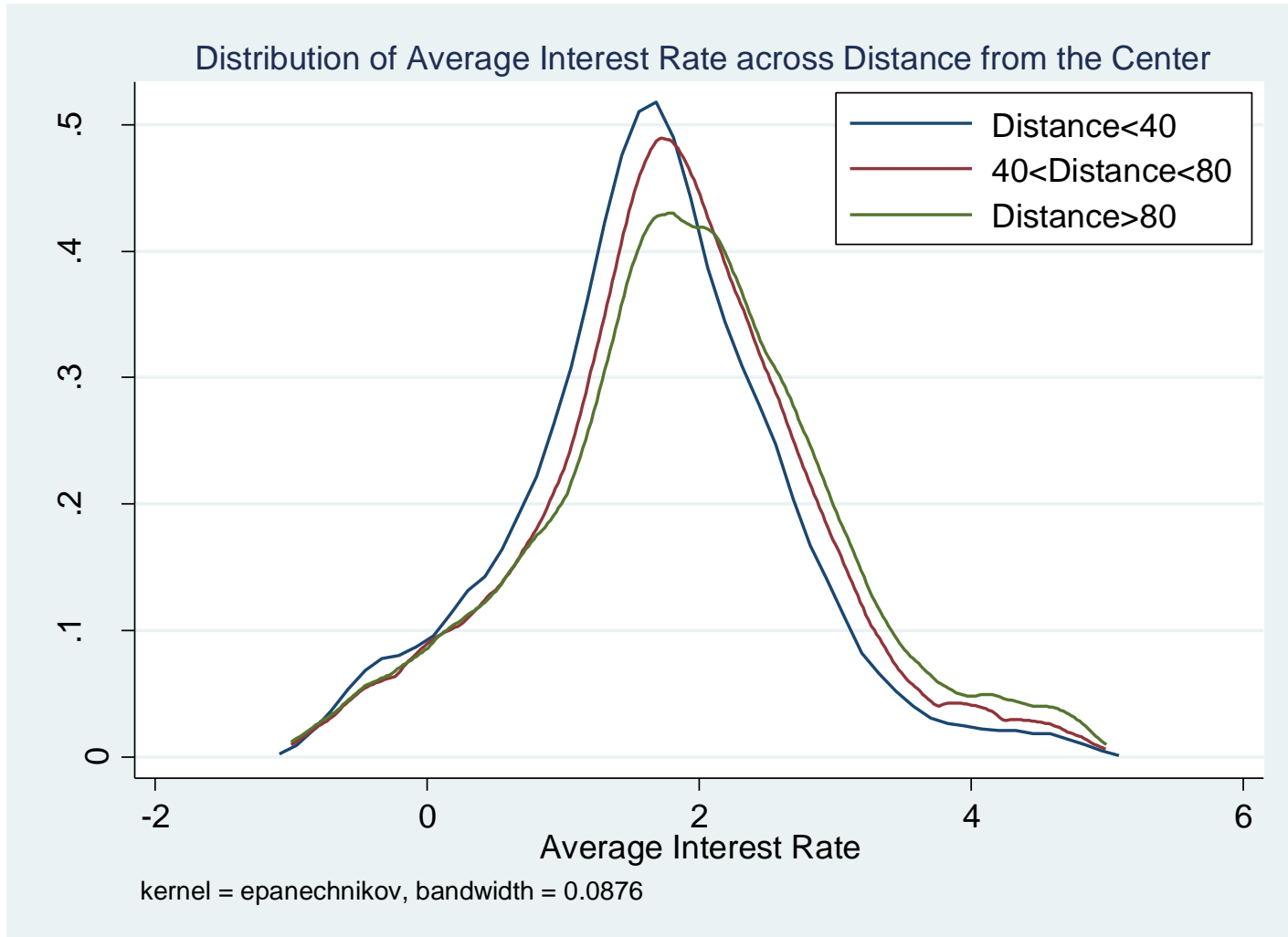
Our research

- Research questions:
  - What factors affect mortgage interest rate formation?
  - What is the role of combination of distance from the center and socioeconomic status of neighborhood in determining mortgage interest rates?
- Unique dataset
- Main results
  - Location does matter
  - Observable measures of risk and banking competition explain up to two thirds of the regional and socioeconomic differences in mortgage interest rates found in the raw data
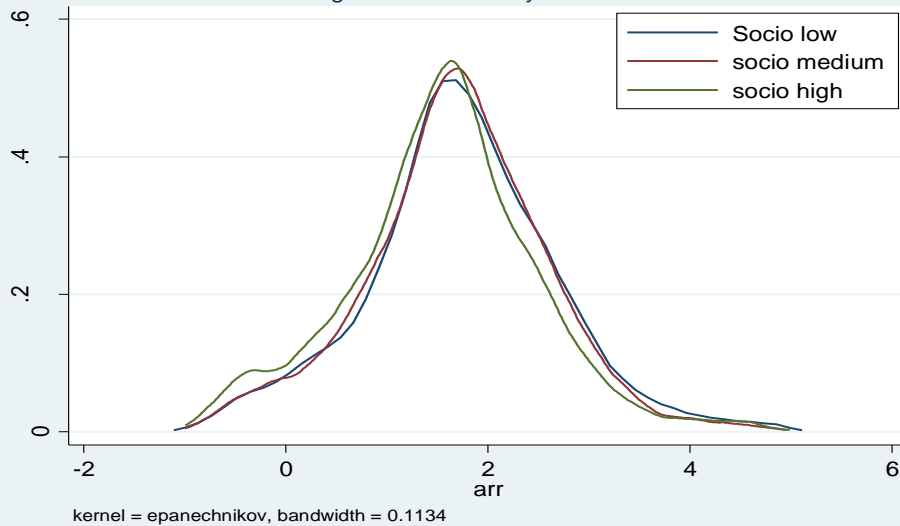
Data

- Mortgage originations, 2010-2013
- Data on purchased housing assets (CARMEN)
- Merge: 88,914 observations
- Calculated average real weighted interest rates:
  - Subtract inflation expectation rate at date of mortgage origination from all CPI non-adjusted rates (banks' expectations for 1, 2, 5, 10 years)
  - Calculate weighted average on all parts of the mortgage
- External calculated variables:
  - Real estate market turnover (num. of transactions divided by housing units stock, by locality of purchased asset; 4.6% missing)
  - Banking competition (num. of different banking corporations in the locality of mortgage origination and in the locality of purchased asset; 4.1% missing)
  - Building starts relative to existing housing stock

Stylized facts

Distribution of Average Interest Rate across Distance from the Center

kernel = epanechnikov, bandwidth = 0.0876

Stylized facts, cont.

Distribution Average Interest Rate by Distance from Tel-Aviv <40

kernel = epanechnikov, bandwidth = 0.1134

Distribution of Average Interest Rate (Distance from Tel-Aviv between 40 and 80 KM)

kernel = epanechnikov, bandwidth = 0.1249

Distribution of Average Interest Rate (Distance from Tel-Aviv>80 KM)

kernel = epanechnikov, bandwidth = 0.1409

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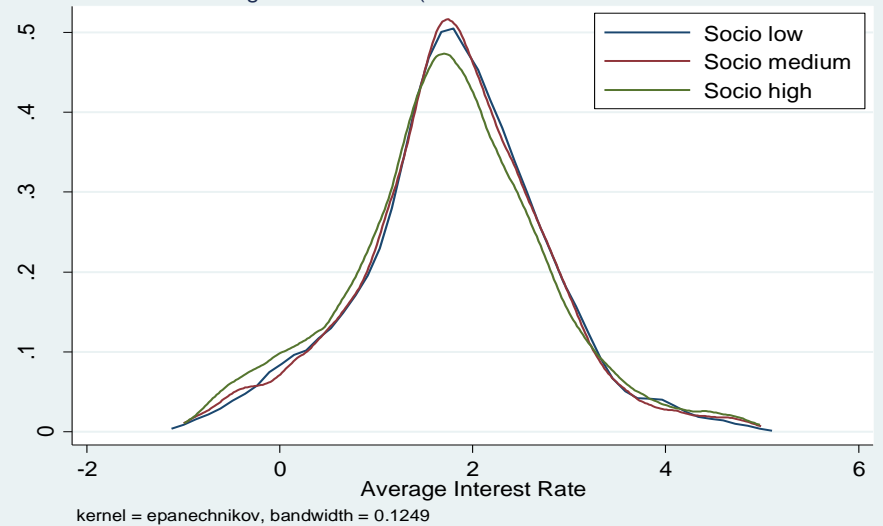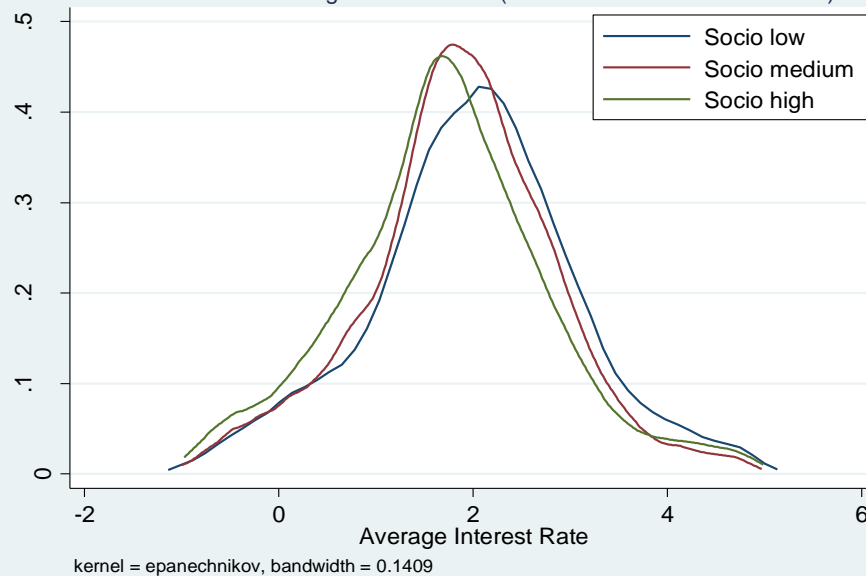
Stylized facts, cont.

Median values of main mortgage and borrower characteristics, broken by combinations of distance and socioeconomic status of neighborhood

	Distance<40			40<=Distance<80			Distance>=80		
socioeconomic	low	medium	high	low	medium	high	low	medium	high
interest rate (%)	1.72	1.70	1.57	1.83	1.80	1.75	2.04	1.89	1.71
LTV (%)	58.3	59.0	51.9	60.0	59.8	55.0	60.0	60.9	57.0
duration (months)	260	274	251	253	264	245	240	240	240
PTI (%)	27.9	27.5	28.0	26.0	27.0	27.0	23.1	24.4	24.5
loan size (000' NIS)	480	582	700	417	500	530	260	370	450
net monthly income (NIS)	12,000	13,200	16,500	11,800	12,706	14,805	11,900	12,380	14,900
age	36.3	38.5	40.1	35.2	38.6	40.3	38.6	39.4	41.0
LTI	3.4	3.7	3.5	3.2	3.3	3.1	2.0	2.7	2.6
investors' share (%)	15	13	15	15	13	14	29	17	16
investors' interest rate (%)	1.61	1.55	1.50	1.76	1.79	1.73	1.93	1.90	1.68
first-time home buyers' interest rate (%)	1.90	1.85	1.69	1.96	1.91	1.92	2.26	2.00	1.88
mortgage outside asset location	55.7	51.9	58.7	57.6	43.8	68.4	50.2	37.5	46.1
mortgage outside asset location for investors	59.7	55.5	59.1	60.0	51.0	62.5	59.2	49.6	47.6
mortgage outside asset location for first-time home buyers	56.4	52.9	62.3	59.5	45.2	73.4	49.5	38.7	47.3
mortgage outside asset location for upgraders	53.2	49.6	55.7	54.0	40.2	66.0	42.2	31.5	44.7
mortgage outside asset location in localities 100,000+ residents (%)	45.5	41.2	48.6	27.9	23.2	26.4	36.7	22.1	16.4
number of observations	11,833	13,366	20,608	7,507	7,984	5,380	8,201	9,022	5,013

Empirical Strategy

Mortgage interest rate reflects:

- Bank's cost of funds (deposits + money market)

- Bank's operating costs

- Profit margin on capital

- Individual risk premium (borrower, loan and collateral risk, according to bank's risk evaluation model)

  – Differential treatment?

Empirical Strategy, cont.

Borrower risk:
Number of borrowers
Age, Age squared
Log of net income
Wage account
Upgrader
Investor
Guarantor

Collateral risk:
Socioeconomic (1 to 20)
Distance, Distance squared
Distance*Socioeconomic status interactions
Turnover
Potential Accessibility Index
Building starts

$$R_i = \alpha + \beta_1 A_{1i} + \beta_2 A_{2i} + \beta_3 A_{3i} + \beta_4 Competition_i + \beta_5 LenderID_i + \beta_6 Time_i + \varepsilon$$

Loan risk:
Log of loan amount
LTV60
PTI30
Dur20

Competition measures:
Bank in the same location
Number of banks in mortgage location
Number of banks in property location

Basic Results

Variable	Expected sign	Coef.	Standard error
number of borrowers	-	0.046***	(0.009)
age	-	0.029***	(0.002)
age squared	?	-0.000***	(0.000)
log of net income	-	-0.225***	(0.009)
wage account	-	-0.126***	(0.008)
upgrader	-	-0.030***	(0.008)
investor	?	-0.069***	(0.010)
guarantor	+	0.058***	(0.012)
log of loan amount	-	-0.075***	(0.006)
LTV60	+	0.059***	(0.007)
PTI30	+	0.003	(0.007)
Dur20	+	0.219***	(0.008)
distance	+	0.001*	(0.001)
distance squared	?	0.000	(0.000)
socioeconomic	-	-0.003***	(0.001)
INTERACTIONS		TO BE CONTINUED	
turnover	-	-0.007***	(0.002)
building starts	+	-0.002	(0.002)
potential accessibility index	-	0.001***	(0.000)
bank in the same location	?	0.076***	(0.007)
number of banks in mortgage location	-	-0.009***	(0.002)
number of banks in property location	-	-0.016***	(0.002)
Banks fixed effects		+	
Month & Year fixed effects		+	
Constant		3.343***	(0.120)
Observations no.		80,539	
R-squared		0.283	
*** p<0.01, ** p<0.05, * p<0.1			

Basic results, cont. - interactions

Variable	Coefficient	Standard error
Dclose_SElow	0.075***	(0.013)
Dclose_SEmid	0.056***	(0.011)
Dmid_SElow	0.089***	(0.019)
Dmid_SEmid	0.109***	(0.017)
Dmid_SEhigh	0.054***	(0.020)
Dfar_SElow	0.248***	(0.026)
Dfar_SEmid	0.175***	(0.026)
Dfar_SEhigh	0.125***	(0.026)
*** p<0.01, ** p<0.05, * p<0.1		

So, how much of the unconditional differentials can we explain?

Differences in unconditional means

	distance<40	40<=distance<80	distance>80
socio high	base	0.205	0.183
socio middle	0.148	0.263	0.330
socio low	0.194	0.271	0.480

Estimated coefficients

	distance<40	40<=distance<80	distance>80
socio high	omitted	0.054	0.125
socio middle	0.056	0.109	0.175
socio low	0.075	0.089	0.248

Explained by other factors (unconditional means – estimated coefficients)

	distance<40	40<=distance<80	distance>80
socio high	omitted	0.151	0.058
socio middle	0.092	0.154	0.155
socio low	0.119	0.182	0.232

Exclusion of the endogenous variables
(LTV, PTI, Duration, Loan size)

Variable	Coefficient	Standard Error	Coefficient	Standard Error
	with endogenous variables		without endogenous variables	
Dclose_SElow	0.075***	(0.013)	0.091***	(0.013)
Dclose_SEmid	0.056***	(0.011)	0.075***	(0.011)
Dmid_SElow	0.089***	(0.019)	0.092***	(0.019)
Dmid_SEmid	0.109***	(0.017)	0.118***	(0.017)
Dmid_SEhigh	0.054***	(0.020)	0.048**	(0.020)
Dfar_SElow	0.248***	(0.026)	0.246***	(0.026)
Dfar_SEmid	0.175***	(0.026)	0.175***	(0.026)
Dfar_SEhigh	0.125***	(0.026)	0.110***	(0.026)
Observations	80,539		80,539	
R-squared	0.283		0.273	
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Propensity-score matching estimation results

- Logistic model to predict propensity score
- Using covariates: *number of borrowers*, *age*, *age squared*, *log of net income*, *wage account*, *upgrader*, *investor*, *guarantor*, *log of loan amount*, *LTV*, *PTI30*, *Dur20*, *socioeconomic*, *turnover*, bank identity, month & year

Comparison categories	Coefficient	Std. Err.	z	P>|z|	Number of obs.
40<=Distance<80 vs Distance<40	0.103	0.010	10.18	0.000	66,678
Distance>=80 vs Distance<40	0.202	0.012	16.42	0.000	68,043
Distance>=80 vs 40<=Distance<80	0.098	0.013	7.29	0.000	43,107

Conclusions

- Location does matter
- Other things equal, households purchasing assets in the geographic and social periphery pay more for mortgages
- Observable characteristics of the borrower, the mortgage and the underlying asset risk, and banking competition explain up to two thirds of the regional and socioeconomic differences in mortgage interest rates

Discussion

What can explain the unexplained interest rate differentials?

- Characteristics that we don't know:
  - Borrower's credit history
  - Wealth
  - Employment characteristics (occupation, tenure, stability, etc.)
- Unobservable characteristics
  - Financial literacy
  - Bargaining ability
- Expected costs of foreclosure
  - Higher in regions with lower housing demand and slower price appreciation
- Discrimination?
  - Apparently not prejudiced discrimination
 - Possible statistical discrimination

Discussion, cont.

Percentage of mortgages in arrears, by distance from the center and socioeconomic status,

for mortgages originated in 2010-2013 (%)

Distance<40			40<=Distance<80			Distance>=80		
SE low	SE middle	SE high	SE low	SE middle	SE high	SE low	SE middle	SE high
2.34	1.55	1.30	3.13	2.61	2.12	2.65	1.66	1.52

Thank you

Percentage of home ownership in deciles of households, by net income per standard person, 2017
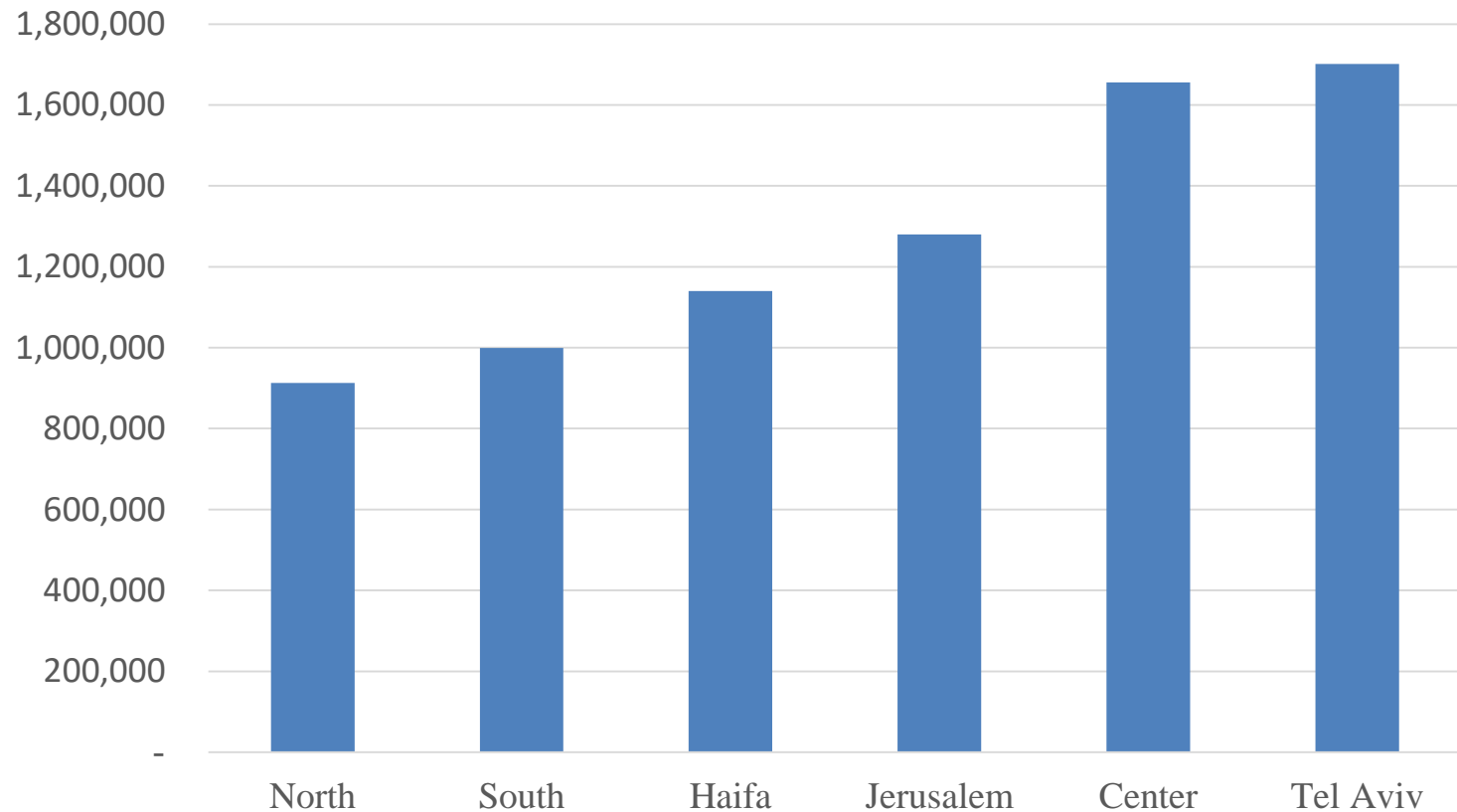

income decile

Source: Central Bureau of Statistics
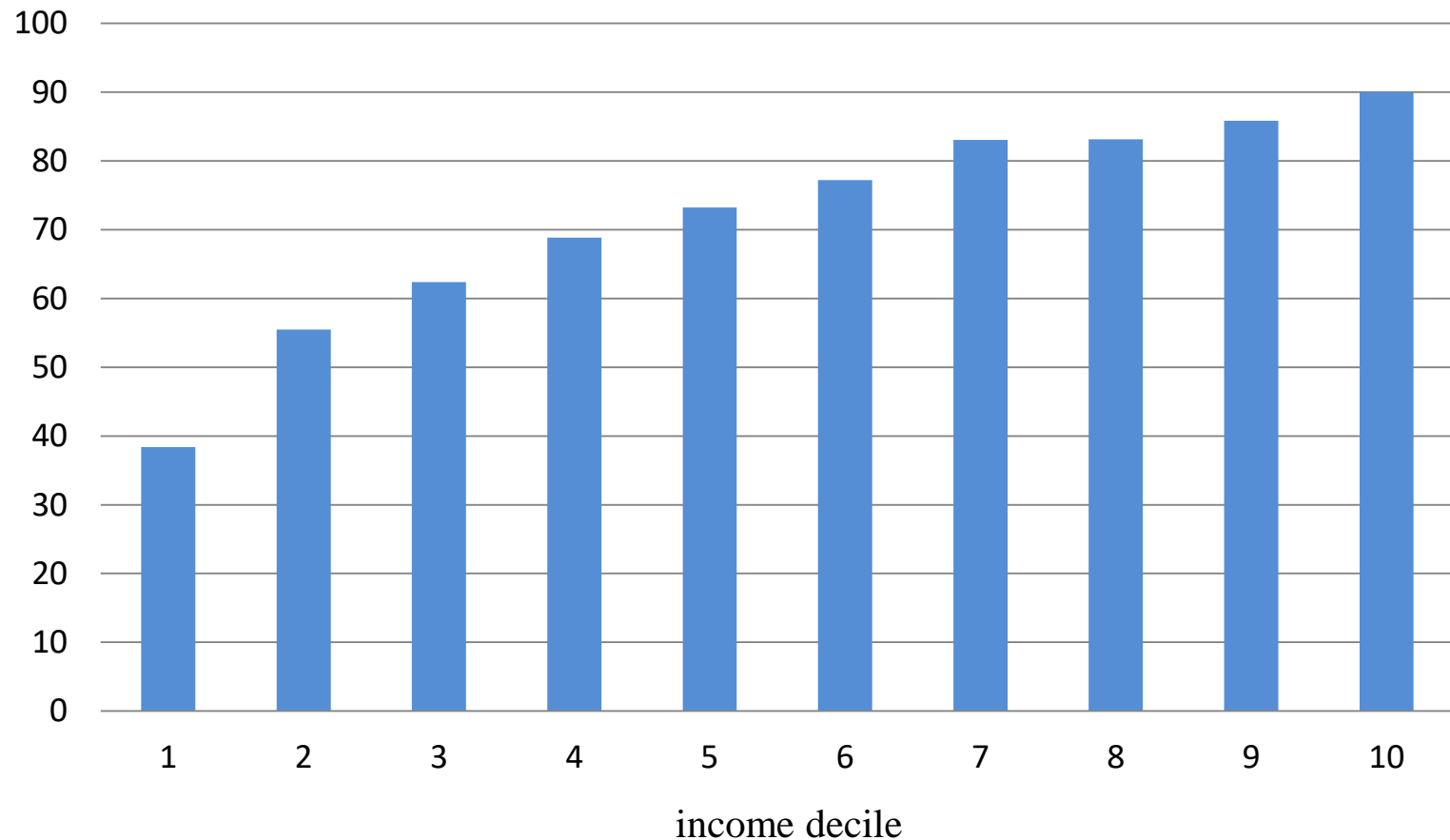
Net equity from real estate in deciles of households, by net income per standard person, NIS, 2017
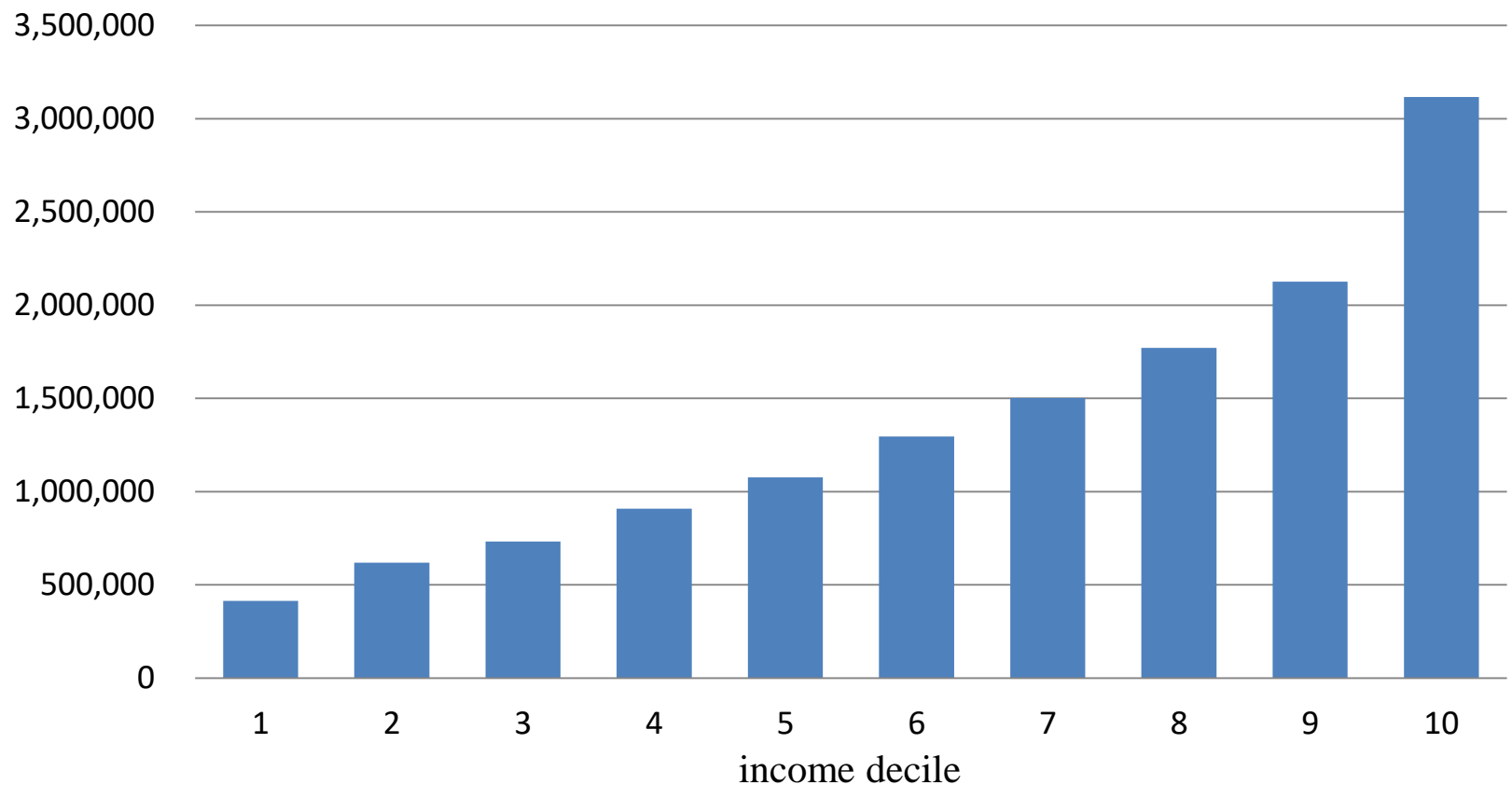
Net equity from real estate = evaluation by homeowner – CBS estimate of outstanding housing debt

Source: Central Bureau of Statistics

Net equity from real estate, by district, NIS, 2017

Net equity from real estate = evaluation by homeowner – CBS estimate of outstanding housing debt

Source: Central Bureau of Statistics