

Credit, Income and Inequality

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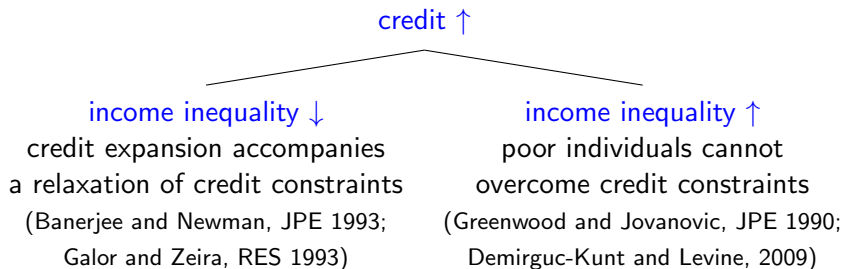
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In the last decades **income inequality has increased** in most OECD countries (OECD, 2015).

Rising income inequality poses serious concerns for

- **social cohesion** (Putnam, 2000; Stiglitz, 2012; Larsen, 2013)
- **economic growth** (Galor and Zeira, RES 1993; Alesina and Rodrick, QJE 1994; Galor and Moav, RES 1994; Persson and Tabellini, AER 1994)
- **economic mobility** (Corak, 2013; Kearney and Levine, 2016; Chetty, Grusky, Hendren, Manduca, and Narank, 2017)

This yielded a lively debate on the potential causes of this trend and the proper measures to tackle the problem. The role of credit availability is at the forefront.



Objective of The Paper

We study the relation between credit and income from a micro perspective
We investigate how access to credit affects individuals' income and its distribution

- endogeneity issue: income is a driver of bank credit decisions (loan origination or denial)
- micro data enable robust identification.

We use a unique dataset of business loan applications to a single large European bank

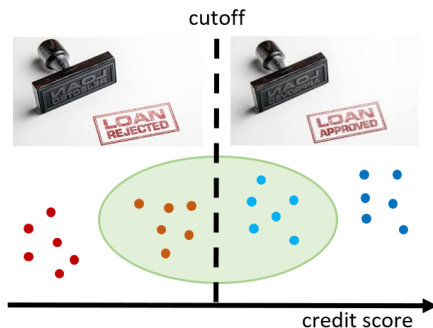
- 61,863 loan applications during 2002-2016
- small/micro firms (located in the country of the bank) that are majority-owned by individuals and have an exclusive relationship with the bank
- we know the cutoff rule adopted by the bank, the credit score of the firm, and whether the loan is approved or denied
- we have information on the owner's income for at least five years before and after the loan application.



Methodology

We exploit the cutoff rule as a source of exogenous variation in the credit decision

- the bank cutoff rule based on the applicant's credit score creates a sharp discontinuity in the decision to originate the loan
- regression discontinuity design (RDD)
- we compare future income of accepted and rejected applicants that are close to the cutoff.



- ① **access to credit has a positive and statistically significant effect on individuals' income**
 - a loan origination increases the recipient's income five years onward by more than 10% compared to denied applicants
- ② the positive effect of credit origination on income is driven by the use of the borrower funds to **make investments and expand the business**, and it is stronger
 - in **low-income regions** compared to high-income regions
 - during **a crisis period** compared to normal times
 - when **a loan acceptance is more likely based on soft information** held by the bank.

Graphical Evidence

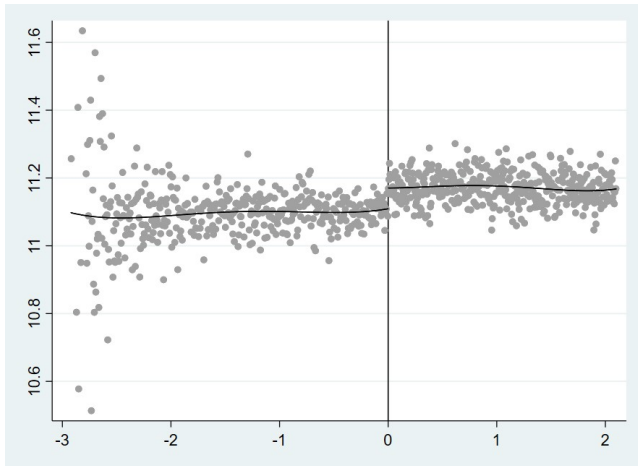


Figure: The figure depicts applicants' $Income_{t+5}$ (y-axis) against the $Credit\ score$ (x-axis). The points represent local sample means of the applicant's income for a set of disjoint bins of control and treatment units spanning the full sample. The continuous line is a fourth order polynomial fit used to approximate the conditional mean of applicants' income below and above the cutoff. The credit score is normalized to be around the cutoff value of 0.

Local linear regression

Local linear regression (Imbens and Lemieux, 2008; Calonico, Cattaneo and Titiunik, ECMA 2014)

$$\begin{aligned} \textit{Treatment effect} &= \lim_{\varepsilon \downarrow 0} \mathbb{E} [\textit{Income}_{i,t+n} \mid \textit{Credit score}_{i,t} = \textit{Cutoff} + \varepsilon] \\ &\quad - \lim_{\varepsilon \uparrow 0} \mathbb{E} [\textit{Income}_{i,t+n} \mid \textit{Credit score}_{i,t} = \textit{Cutoff} + \varepsilon] \end{aligned}$$

- the two expectations are estimated by fitting linear regression functions to the observations on either side of the cutoff
- a bandwidth is defined to consider only observations close enough to the cutoff (Calonico, Cattaneo and Titiunik, ECMA 2014)
- higher weights are assigned to observations closer to the cutoff (triangular kernel smoother)
- there is no statistical evidence of manipulation of the credit score around the cutoff.

Non-parametric RDD

	(1)	(2)	(3)
	Income t+1	Income t+3	Income t+5
Robust	0.0649*** (0.0150)	0.0564*** (0.0172)	0.112*** (0.0194)
Loan controls	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes
Obs.	53,585	45,333	37,210
Eff. obs. left of cutoff	8,274	6,171	4,061
Eff. obs. right of cutoff	8,670	6,398	4,232
BW estimate	62.61	54.76	44.08
BW bias	97.82	88.67	79.28

Table: The table reports the results of the non-parametric RDD. Estimation method is the local linear regression with triangular kernel. For each specification, we report the bias-corrected RD estimates with robust variance estimator.

- 1 Bandwidth: results are robust to different bandwidth-selection methods
- 2 Two-stage selection model: results are confirmed when we control for sample selection.

Economic Channels

Panel A. Small vs large loans, new vs old firms				
	Small loans (1)	Large loans (2)	New firms (3)	Old firms (4)
Dependent variable	Income t+5	Income t+5	Income t+5	Income t+5
Robust	0.105*** (0.0171)	0.118*** (0.0216)	0.167*** (0.0386)	0.0623*** (0.0162)
Obs.	8,226	3,507	2,727	13,245
Eff. obs. left of cutoff	1,499	403	662	2,015
Eff. obs. right of cutoff	2,022	416	679	2,026
BW estimate	14.69	8.67	10.07	14.55
BW bias	16.52	10.11	12.81	17.39
Panel B. Firm outcomes				
	(1)	(2)	(3)	(4)
Dependent variable	Corporate purpose t+5	Debt repay t+5	ROA t+5	Firm growth t+5
Robust	0.131*** (0.019)	0.048** (0.022)	0.048** (0.0207)	0.035*** (0.0118)
Obs.	27,628	7,311	41,391	41,391
Eff. obs. left of cutoff	5,211	1,361	4,815	4,927
Eff. obs. right of cutoff	5,440	1,407	5,003	5,093
BW estimate	20.6	13.24	61.27	67.91
BW bias	22.46	15.72	95.16	107.18

Income Inequality

	Income _t	Income _{t+5}
<u>Credit is granted</u>		
Gini coefficient	0.224	0.200
Theil index	0.080	0.065
<u>Credit is denied</u>		
Gini coefficient	0.193	0.214
Theil index	0.058	0.073

Table: The table reports the Gini coefficients and the Theil indices at time t and time $t + 5$ for the samples of accepted and rejected applicants around the cutoff (credit score $< |0.1|$).

Income Inequality: Geographic Heterogeneity

	Low income			High income		
	(1)	(2)	(3)	(4)	(5)	(6)
	Income t+1	Income t+3	Income t+5	Income t+1	Income t+3	Income t+5
Robust	0.0642** (0.0279)	0.0710*** (0.0230)	0.1203*** (0.0380)	0.0605*** (0.0191)	0.0597** (0.0182)	0.0926*** (0.0263)
Obs.	28,883	24,757	20,696	28,883	24,757	20,695
Eff. obs. left of cutoff	4,220	3,412	2,311	4,113	3,347	2,290
Eff. obs. right of cutoff	4,355	3,504	2,384	4,160	3,416	2,297
BW estimate	58.6	56.28	43.28	55.69	55.11	41.18
BW bias	94.3	88.25	75.61	92.5	88.26	72.16

Income Inequality: Heterogeneity during Crisis

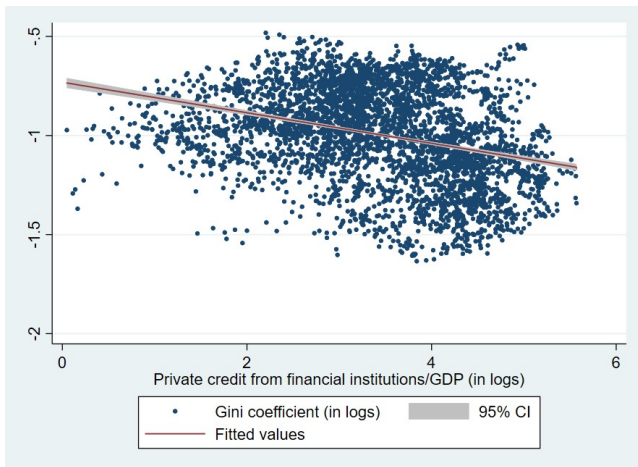
	Crisis and post-crisis			Pre-crisis		
	(1) Income t+1	(2) Income t+3	(3) Income t+5	(4) Income t+1	(5) Income t+3	(6) Income t+5
Robust	0.0610** (0.0249)	0.0700*** (0.0258)	0.112*** (0.0229)	0.0639*** (0.0172)	0.0395* (0.0207)	0.104*** (0.0291)
Obs.	20,850	20,850	20,850	32,735	24,483	16,360
Eff. obs. left of cutoff	3,509	2,977	2,992	5,613	3,886	1,778
Eff. obs. right of cutoff	3,657	3,099	3,110	5,876	4,040	1,874
BW estimate	68.69	58.09	58.34	69.29	63.39	43.29
BW bias	109.9	87.97	103.87	106.17	108.54	72.05

Concluding Remarks

- Using data from business loan applications to a single large European bank, we study the effect of access to credit on individuals' income and income inequality
- we document that access to credit has a positive effect on individuals' income
- the impact is stronger in low-income regions, during a crisis period (negative finance-inequality nexus), and when a loan acceptance is favored by soft information
- our findings suggest that credit provision to small businesses (having good investment opportunities) is pivotal to foster entrepreneurship and economic mobility.

Thank you for the attention

Figure: Income Inequality Against Credit on Aggregate



The graph depicts the Gini index in logs (y-axis) against the ratio of private credit to GDP (x-axis) for 150 countries over 1960-2015. Data on the Gini index are from the Standardized World Income Inequality Database (SWIID); data on credit and GDP per capita are from the World Development Indicators.

Figure: Probability density of the assignment variable *Credit score*

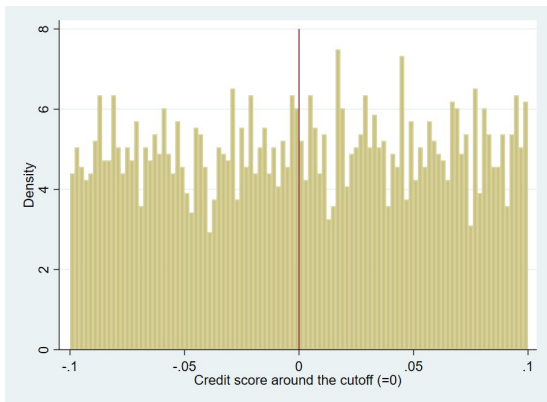


Figure: Sensitivity analysis for the RDD

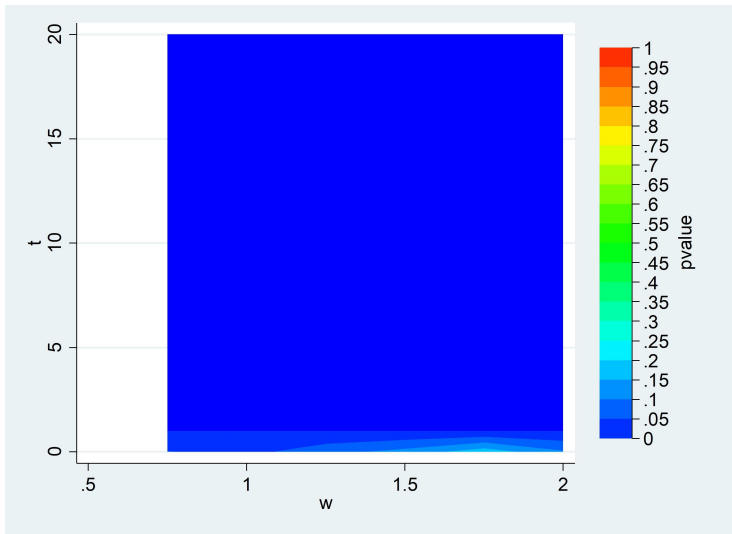


Figure: Applicants' income and lending rate around the cutoff

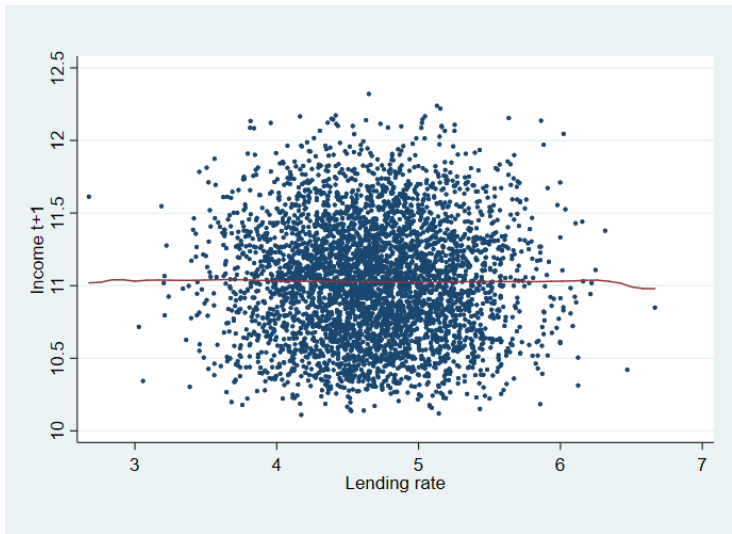


Table: Summary statistics

	Obs.	Mean	St. dev.	Min.	Max.
Income	61,863	11.01	0.376	9.852	12.29
Income t-1	57,682	10.58	0.406	9.804	12.62
Income t+1	57,766	11.1	0.388	9.866	12.58
Income t+3	49,514	11.14	0.373	9.987	12.57
Income t+5	41,391	11.16	0.363	10.04	12.62
Granted	61,863	0.867	0.498	0	1
Credit score	61,863	0.103	1.205	-2.921	2.1
Education	61,863	2.975	1.018	0	5
Firm size	61,863	12.821	0.806	2.5	16.12
Firm leverage	61,863	0.207	0.0249	0.143	0.917
Firm age	61,863	14.2	14.87	0	182
Loan amount	61,863	2.323	0.845	0.679	7.48
Maturity	61,863	34.35	10.14	7	103
Wealth	61,863	12.14	0.556	8.564	14.05
Initial wealth	40,953	12.09	0.406	7.952	14.2
Working capital loan	61,863	1.925	0.714	0.679	5.825
ROA	61,863	0.094	0.16	-0.711	0.836
Firm growth	61,863	0.193	0.386	-1.938	6.484

Table: Manipulation test of Cattaneo, Jansson and Ma (2018). The null hypothesis consists in no manipulation.

	T-stat	P-value
Conventional	1.5861	0.1127
Robust	1.2064	0.2277

Table: Parametric RDD

	(1)	(2)	(3)	(4)	(5)	(6)
	Income t+1	Income t+3	Income t+5	Income t+1	Income t+3	Income t+5
Granted	0.0512*** (0.0062)	0.0730*** (0.0064)	0.0699*** (0.0069)	0.0536*** (0.0063)	0.0754*** (0.0066)	0.0718*** (0.0072)
Credit score	-0.0015 (0.0038)	0.006 (0.0039)	0.0120*** (0.0042)	-0.0056 (0.0039)	0.0027 (0.0041)	0.0084* (0.0044)
Granted x Credit score	-0.0013 (0.0052)	-0.0122** (0.0053)	-0.0216*** (0.0057)	0.0026 (0.0053)	-0.0087 (0.0056)	-0.0168*** (0.0060)
Income t-1				0.0958*** (0.0041)	0.0653*** (0.0043)	0.0452*** (0.0045)
Education				0.0023 (0.0016)	-0.0017 (0.0017)	0.0004 (0.0019)
Firm size				-0.0004 (0.0021)	0.003 (0.0022)	-0.0015 (0.0024)
Firm leverage				0.1872*** (0.0672)	0.2877*** (0.0745)	0.2435*** (0.0778)
Loan amount				-0.0008 (0.0020)	-0.0023 (0.0021)	-0.0014 (0.0023)
Maturity				0.0004** (0.0002)	0.0001 (0.0002)	0.0002 (0.0002)
Constant	11.0740*** (0.0045)	11.1044*** (0.0047)	11.1301*** (0.0051)	9.9753*** (0.0517)	10.3098*** (0.0535)	10.5980*** (0.0558)
Observations	57,766	49,514	41,391	53,585	45,333	37,210
Adjusted R-squared	0.004	0.01	0.01	0.015	0.015	0.013
Clustering	Individual	Individual	Individual	Individual	Individual	Individual

Table: Non-parametric RDD

	(1)	(2)	(3)	(4)	(5)	(6)
	Income t+1	Income t+3	Income t+5	Income t+1	Income t+3	Income t+5
Robust	0.0632*** (0.0150)	0.0572*** (0.0159)	0.113*** (0.0188)	0.0649*** (0.0150)	0.0564*** (0.0172)	0.112*** (0.0194)
Obs.	57,766	49,514	41,391	53,585	45,333	37,210
Eff. obs. left of cutoff	8,731	7,510	4,487	8,274	6,171	4,061
Eff. obs. right of cutoff	9,186	7,855	4,686	8,670	6,398	4,232
BW estimate	61.37	61.3	44.03	62.61	54.76	44.08
BW bias	98.59	97	79.73	97.82	88.67	79.28

Table: Controlling for “initial” wealth

	(1)	(2)	(3)
	Income t+1	Income t+3	Income t+5
Conventional	0.0646*** (0.0148)	0.0491*** (0.0171)	0.112*** (0.0227)
Bias-corrected	0.0681*** (0.0148)	0.0450*** (0.0171)	0.121*** (0.0227)
Robust	0.0681*** (0.0175)	0.0450** (0.0202)	0.121*** (0.0260)
Obs.	36,856	28,604	20,481
Eff. obs. left of cutoff	5,312	4,238	2,207
Eff. obs. right of cutoff	5,572	4,386	2,295
BW estimate	57.92	58.91	42.43
BW bias	91.65	94.75	74.35

Table: Controlling for sample selection in the parametric RDD

	Second-stage results		
	(1) Income t+1	(2) Income t+3	(3) Income t+5
Granted	0.0533*** (0.0179)	0.0761*** (0.0185)	0.0795*** (0.0188)
Credit score	-0.0021 (0.0311)	-0.0011 (0.0350)	-0.0051 (0.0205)
Granted x Credit score	0.0184 (0.0367)	0.0038 (0.0401)	0.0087 (0.0233)
Mills ratio	0.9150 (1.3962)	0.9683 (1.3121)	0.6129 (0.8163)
Obs.	53,585	45,333	37,210
Controls as in Table 4	Yes	Yes	Yes
Clustering	Individual	Individual	Individual
	First-stage results		
	Pr. application t	Pr. application t	Pr. application t
Income	0.0739*** (0.0083)	0.0767*** (0.0083)	0.0781*** (0.0108)
Wealth	0.0580** (0.0270)	0.0625** (0.0305)	0.0642** (0.0316)
Education	0.0245*** (0.0072)	0.0220*** (0.0079)	0.0237** (0.0094)
Firm size	0.0014 (0.0024)	0.0026* (0.0015)	0.0034** (0.0014)
Firm leverage	0.2870*** (0.0331)	0.3022** (0.0610)	0.3147** (0.1103)
Gender	0.0081*** (0.0023)	0.0081*** (0.0028)	0.0074*** (0.0031)
Obs.	228,507	228,507	228,507
Clustering	Individual	Individual	Individual

Table: Controlling for sample selection in the non-parametric RDD

	Second-stage results		
	(1)	(2)	(3)
	Income t+1	Income t+3	Income t+5
Robust	0.0601*** (0.014)	0.0613*** (0.0163)	0.106*** (0.0182)
Obs.	53,585	45,333	37,210
Eff. obs. left of cutoff	8,203	6,049	4,080
Eff. obs. right of cutoff	8,480	6,261	4,197
BW estimate	62.4	56.13	45.09
BW bias	96.25	87.24	79.11

Table: Income inequality

	Income _t	Income t+5
Panel A. Inequality measures around the cutoff		
Gini coefficient	0.207	0.226
Theil index	0.067	0.074
Panel B. Inequality measures for accepted vs. denied applicants		
<u>Credit is granted</u>		
Gini coefficient	0.224	0.200
Theil index	0.080	0.065
<u>Credit is denied</u>		
Gini coefficient	0.193	0.214
Theil index	0.058	0.073

Notes: Panel A reports the Gini coefficient and the Theil index for individuals' income at time t and time $t + 5$ around the cutoff (credit score $< |0.1|$). Panel B compares the equivalent Gini coefficients and Theil indices for the samples of accepted and rejected applicants.

Table: Hard Information and Soft Information

	Residuals > 0			Residuals ≤ 0		
	(1) Income t+1	(2) Income t+3	(3) Income t+5	(4) Income t+1	(5) Income t+3	(6) Income t+5
Robust	0.0764*** (0.0244)	0.0595** (0.0234)	0.135*** (0.0293)	0.0856*** (0.0319)	0.0391 (0.0318)	0.0695* (0.0378)
Obs.	30,998	27,016	23,136	26,768	22,498	18,255
Eff. obs. left of cutoff	4,649	3,927	2,549	3,748	3,375	2,373
Eff. obs. right of cutoff	4,937	4,118	2,720	4,549	3,373	2,556
BW estimate	56.13	54.27	47.11	54.2	52.29	41.28
BW bias	94.29	93.18	79.26	92.16	90.25	76.64

Table: Including industry, loan type, and year fixed effects in the parametric RDD

	(1)	(2)	(3)	(4)	(5)	(6)
	Income t+1	Income t+3	Income t+5	Income t+1	Income t+3	Income t+5
Granted	0.0534*** (0.0063)	0.0751*** (0.0066)	0.0713*** (0.0072)	0.0536*** (0.0063)	0.0754*** (0.0066)	0.0718*** (0.0072)
Credit score	-0.0051 (0.0038)	0.0029 (0.0040)	0.0089** (0.0044)	-0.0056 (0.0039)	0.0027 (0.0041)	0.0084* (0.0044)
Granted x Credit score	0.0021 (0.0052)	-0.0089 (0.0055)	-0.0172*** (0.0059)	0.0025 (0.0053)	-0.0087 (0.0056)	-0.0168*** (0.0060)
Income t-1				0.0975*** (0.0053)	0.0657*** (0.0056)	0.0447*** (0.0058)
Education				0.0023 (0.0016)	-0.0017 (0.0017)	0.0004 (0.0019)
Firm size				-0.0004 (0.0021)	0.003 (0.0022)	-0.0015 (0.0024)
Firm leverage				0.1872*** (0.0672)	0.2877*** (0.0745)	0.2435*** (0.0778)
Loan amount				-0.0008 (0.0020)	-0.0023 (0.0021)	-0.0014 (0.0023)
Maturity				0.0004** (0.0002)	0.0001 (0.0002)	0.0002 (0.0002)
Constant	0.0429*** (0.0029)	0.0297*** (0.0030)	0.0209*** (0.0032)	-0.002 (0.0038)	-0.0004 (0.0039)	0.0005 (0.0041)
Observations	53,585	45,333	37,210	53,585	45,333	37,210
Clustering	Individual	Individual	Individual	Individual	Individual	Individual

Table: Alternative bandwidth selection methods

	(1)	(2)	(3)	(4)	(5)	(6)
	Income t+1	Income t+1	Income t+3	Income t+3	Income t+5	Income t+5
	0.0611*** (0.0127)	0.0716*** (0.0167)	0.0610*** (0.0131)	0.0645*** (0.0178)	0.103*** (0.0159)	0.0956*** (0.0215)
Obs.	57,766	57,766	49,514	49,514	41,391	41,391
Eff. obs. left of cutoff	7,743	5,053	8,260	4,373	5,180	2,599
Eff. obs. right of cutoff	10,530	5,284	7,802	4,536	4,831	2,738