Price Salience and Social Comparisons as Policy Instruments: Evidence from a Field Experiment in Energy Usage

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- Social comparisons change energy consumption
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- Social comparisons change energy consumption
  - Schultz et al., 2007; Allcott, 2011; Costa & Kahn, 2013
- **In a common setting, we evaluate the relative strength of two types of information interventions.**

Motivation 2. Subsidized Energy in Developing Countries

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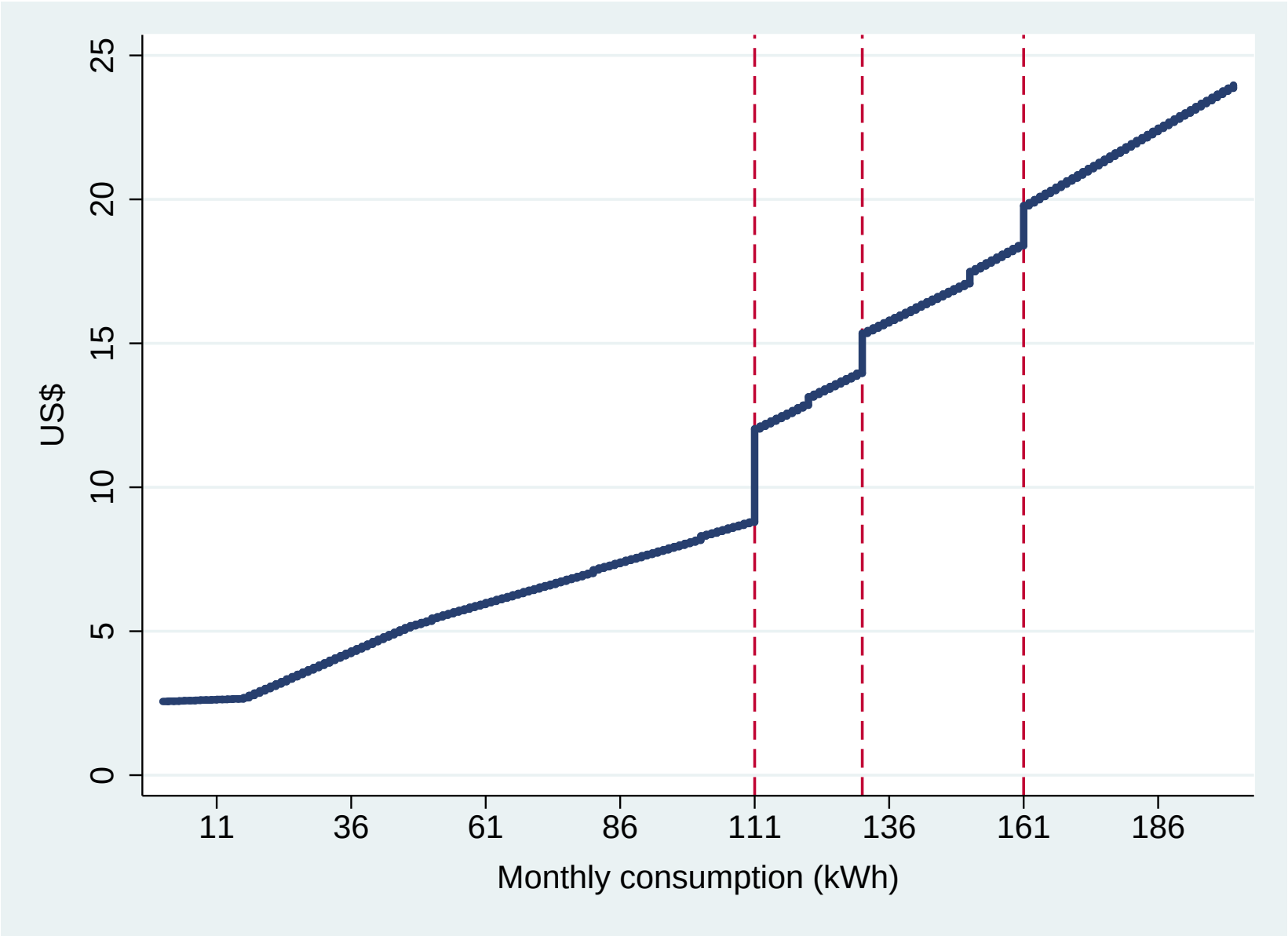
- Electricity (and other fuels) are highly subsidized
  - In Ecuador, cost of electricity subsidies is $438 million (2% of public sector expenditures)
- Politics makes increasing prices difficult
  - Cost to electricity consumers would increase 27% if subsidies removed
- Can consumption be reduced by non-price means?
  - Reduces emissions
  - Reduces funds allocated to subsidies

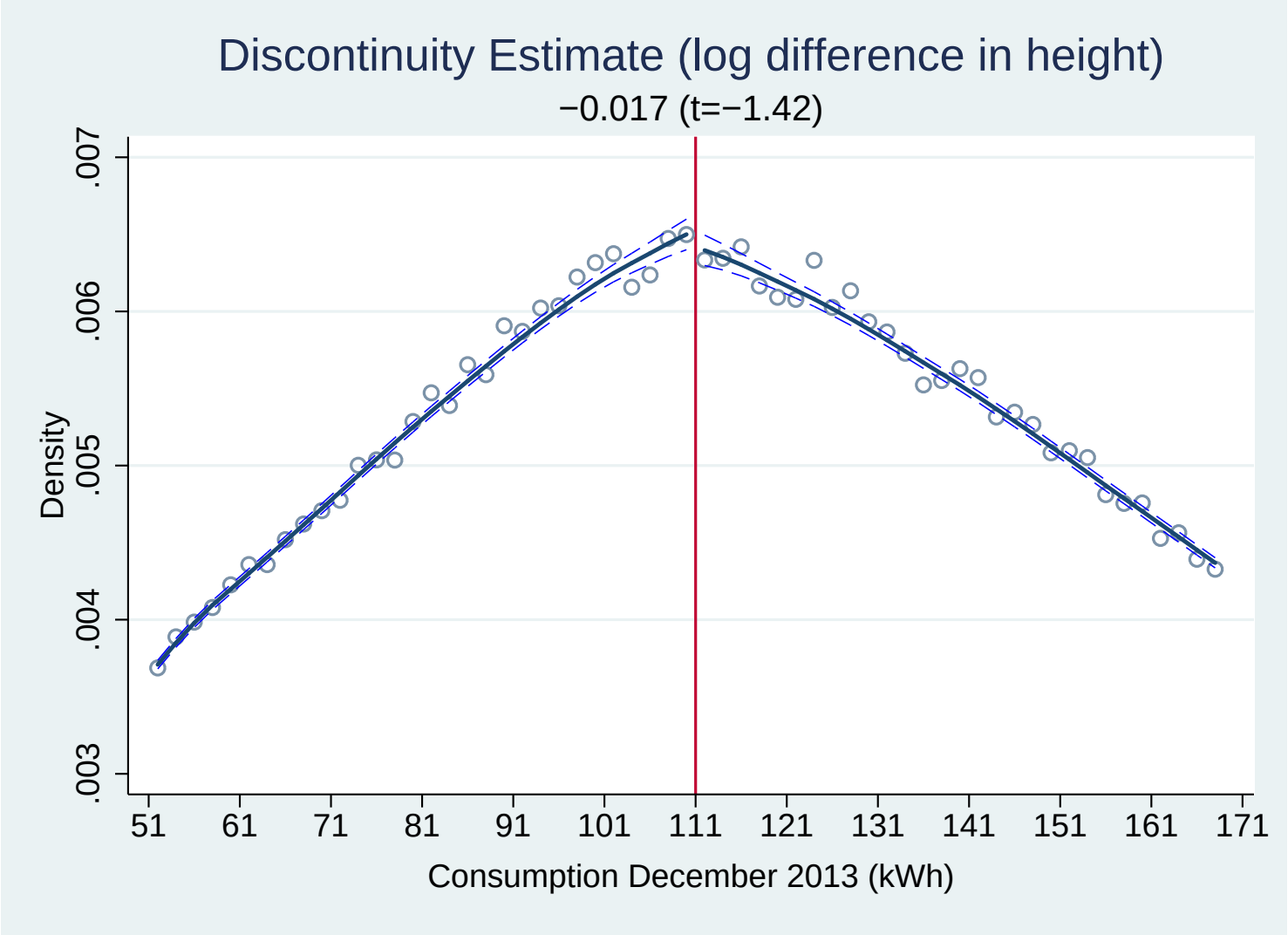
Residential Electricity in Quito

- We partner with the Electric Utility in Quito, Ecuador (EEQ)
- EEQ's tariff has Notches

Example of Total Tariff Function in Quito



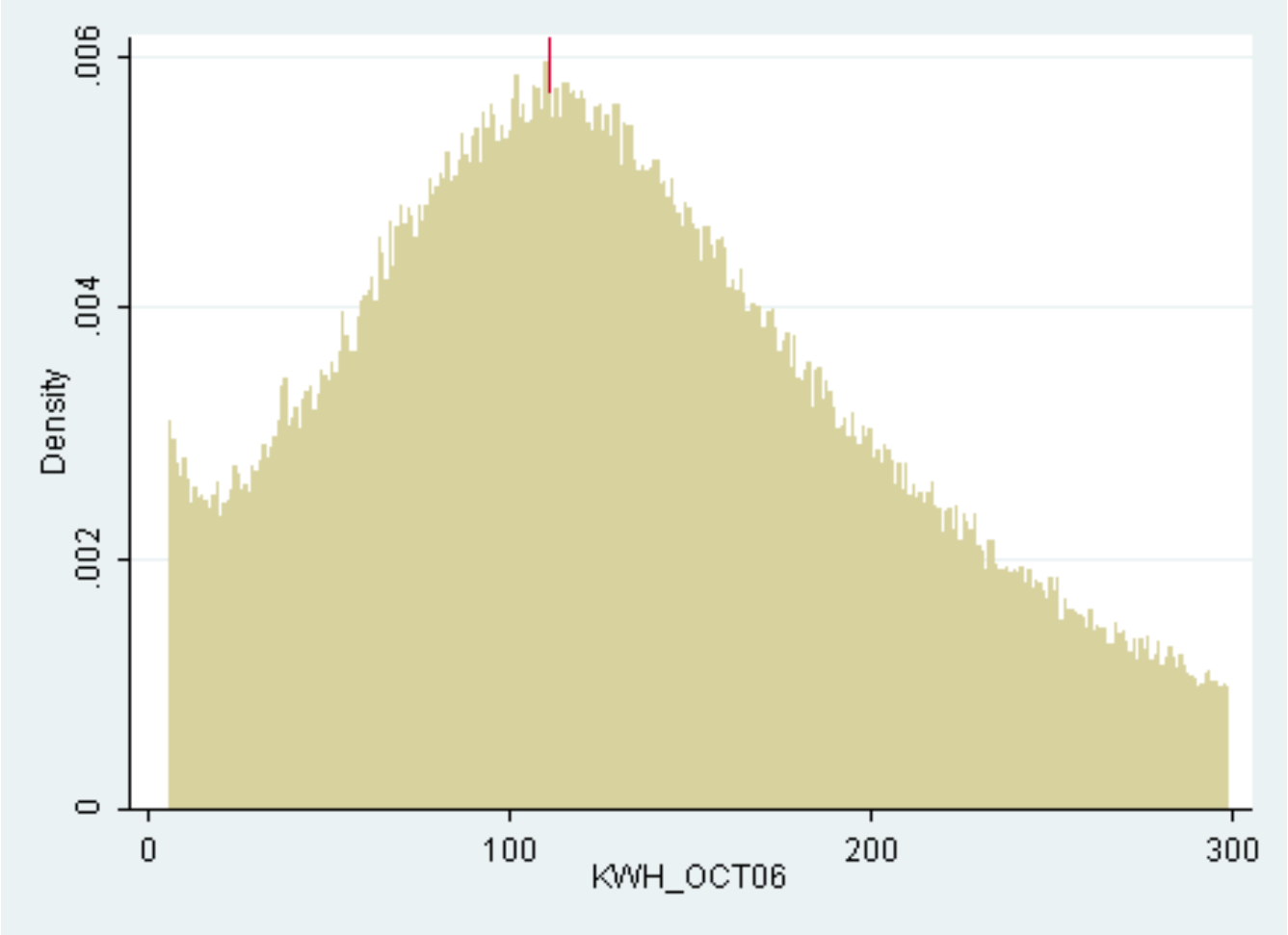
Pre-treatment Evidence of No Bunching



Approach: "McCrary Test"

Chetty Test

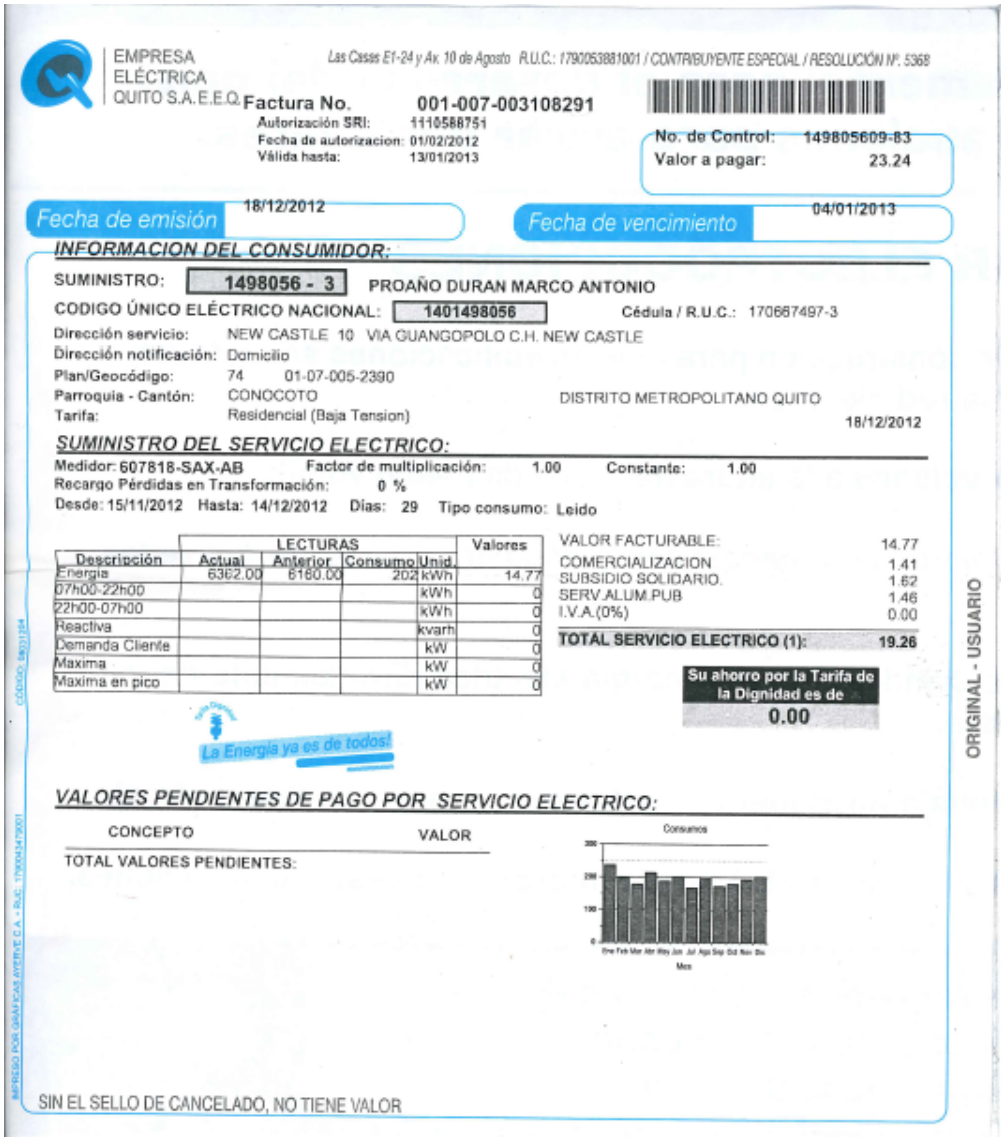
Mode in Consumption around 110 existed prior to notch's creation in 2007



Residential Electricity in Quito

- We partner with the Electric Utility in Quito, Ecuador (EEQ)
- EEQ's tariff has Notches
- Biggest notch (at 111 kwh) does not appear to induce consumption reduction around the notch
- Bill design suggests that salience is a cause

Electricity Bill



EMPRESA ELÉCTRICA QUITO S.A.E.E.Q.

Las Casas E1-24 y Av. 10 de Agosto R.U.C.: 1790053881001 / CONTRIBUYENTE ESPECIAL / RESOLUCIÓN Nº. 5368

Factura No. 001-007-003108291
Autorización SRI: 1110588751
Fecha de autorizacion: 01/02/2012
Válida hasta: 13/01/2013

No. de Control: 149805609-83
Valor a pagar: 23.24

Fecha de emisión 18/12/2012
Fecha de vencimiento 04/01/2013

INFORMACION DEL CONSUMIDOR:

SUMINISTRO: 1498056 - 3 PROAÑO DURAN MARCO ANTONIO
CODIGO ÚNICO ELÉCTRICO NACIONAL: 1401498056 Cédula / R.U.C.: 170667497-3
Dirección servicio: NEW CASTLE 10 VIA GUANGOPOLO C.H. NEW CASTLE
Dirección notificación: Domicilio
Plan/Geocódigo: 74 01-07-005-2390
Parroquia - Cantón: CONOCOTO DISTRITO METROPOLITANO QUITO
Tarifa: Residencial (Baja Tension) 18/12/2012

SUMINISTRO DEL SERVICIO ELECTRICO:

Medidor: 607818-SAX-AB Factor de multiplicación: 1.00 Constante: 1.00
Recargo Pérdidas en Transformación: 0 %
Desde: 15/11/2012 Hasta: 14/12/2012 Días: 29 Tipo consumo: Leido

Descripción	LECTURAS Actual	Anterior	Consumo	Unid.	Valores
Energia	6362.00	6160.00	202	kWh	14.77
07h00-22h00				kWh	0
22h00-07h00				kWh	0
Reactiva				kvarh	0
Demanda Cliente				kW	0
Maxima				kW	0
Maxima en pico				kW	0

VALOR FACTURABLE:	14.77
COMERCIALIZACION	1.41
SUBSIDIO SOLIDARIO	1.62
SERV.ALUM.PUB	1.46
I.V.A.(0%)	0.00
TOTAL SERVICIO ELECTRICO (1):	**19.26**

Su ahorro por la Tarifa de la Dignidad es de **0.00**

La Energía ya es de todos!

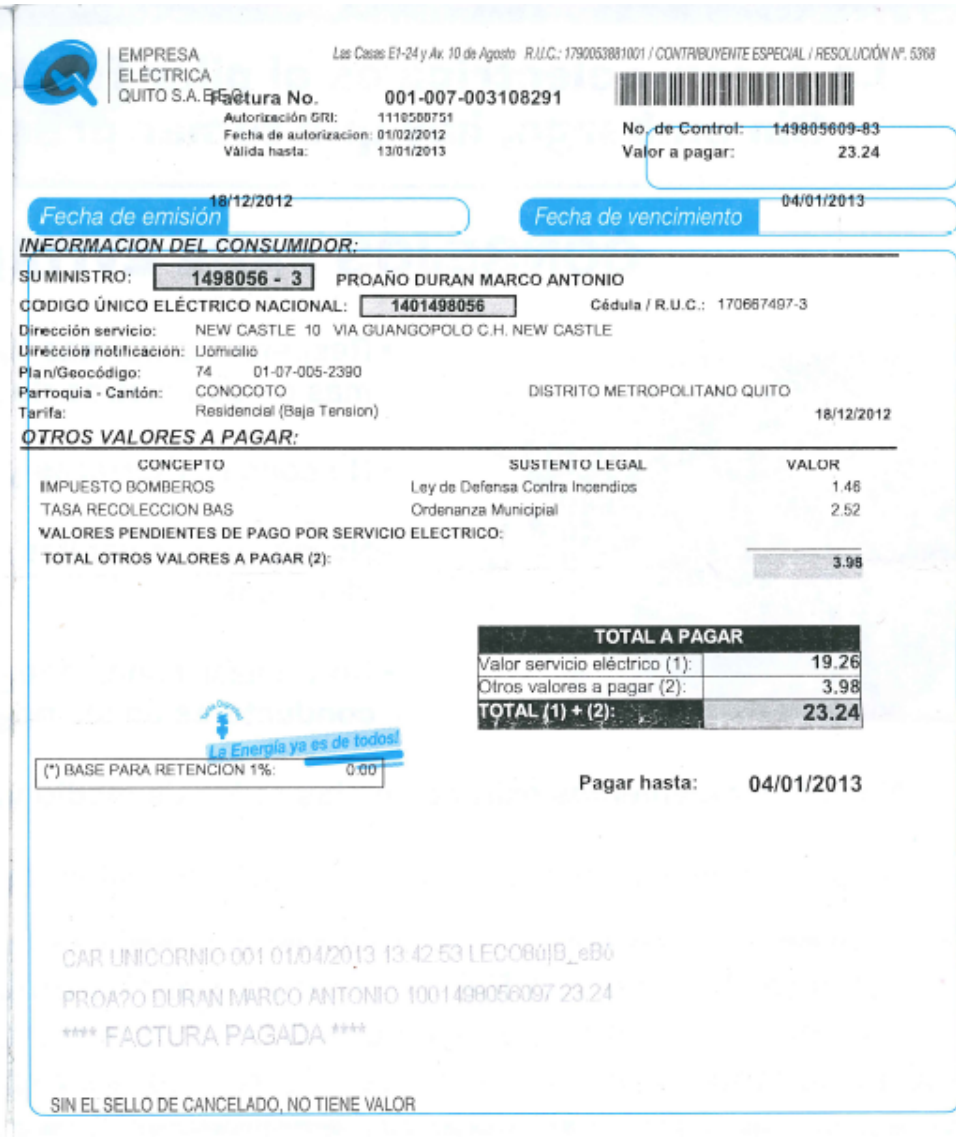
VALORES PENDIENTES DE PAGO POR SERVICIO ELECTRICO:

CONCEPTO	VALOR
TOTAL VALORES PENDIENTES:	

Consumos

SIN EL SELLO DE CANCELADO, NO TIENE VALOR

ORIGINAL - USUARIO



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OTROS VALORES A PAGAR:

CONCEPTO	SUSTENTO LEGAL	VALOR
IMPUESTO BOMBEROS	Ley de Defensa Contra Incendios	1.46
TASA RECOLECCION BAS	Ordenanza Municipal	2.52
VALORES PENDIENTES DE PAGO POR SERVICIO ELECTRICO:		
TOTAL OTROS VALORES A PAGAR (2):		3.98

TOTAL A PAGAR	
Valor servicio eléctrico (1):	19.26
Otros valores a pagar (2):	3.98
TOTAL (1) + (2):	**23.24**

La Energía ya es de todos!

(*) BASE PARA RETENCION 1%: 0.00

Pagar hasta: 04/01/2013

CAR UNICORNIO 001 01/04/2013 13:42:53 LEC080B_eB6
PROAÑO DURAN MARCO ANTONIO 1001498056097 23.24
**** FACTURA PAGADA ****

SIN EL SELLO DE CANCELADO, NO TIENE VALOR

Residential Electricity in Quito

- We partner with the Electric Utility in Quito, Ecuador (EEQ)
- EEQ's tariff has Notches
- Biggest notch (at 111 kwh) does not appear to induce consumption reduction around the notch
- Bill design suggests that salience is a cause
- **One of our information interventions seeks to make notch salient & measure effect**

Social Comparisons

Social Comparisons

- Non-price incentives are used to influence behavior
  - Energy consumption, alcohol and drug use, retirement savings, eating disorders, gambling, voting, tax compliance, recycling...
- Social comparisons are used to encourage conservation
  - Information on private optimum level of consumption
    - Becker (1965)
  - Moral payoff loss of consuming above the social norm
    - Levitt & List (2007)

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    - Levitt & List (2007)
- **We make salient the typical consumption level for our target population**

Experimental Design

Experimental Design

- Information intervention to HHs with historical average consumption between 100 and 125 kWh
- Letters attached to the monthly electric bills in March 2014

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- Information intervention to HHs with historical average consumption between 100 and 125 kWh
- Letters attached to the monthly electric bills in March 2014
- **Random assignment of 3 treatments (16k each)**
    1. Make the 111 kWh price notch salient
    2. Make a social comparison (same level as in the notch)
    3. Do both
- Control (16k)

Action Shot

SUMINISTRO: XXXXXXX - X

Plan/Geocódigo:

EMPRESA ELÉCTRICA QUITO

INFORMACIÓN IMPORTANTE

Ahorre Electricidad y Ahorre Dinero

Estimado Cliente:

La siguiente información con respecto a su consumo mensual de electricidad durante el año pasado puede ser de su interés.

Su consumo promedio mensual fue aproximadamente:	**115 kWh**
Un hogar similar al suyo consume en promedio:	**110 kWh**

Esto significa que durante el año pasado usted consumió aproximadamente **4.5 % más** que otros hogares similares. Le exhortamos que haga un uso eficiente de la energía para ahorrar dinero.

Por favor lea con atención los consejos para ahorrar energía que le damos a continuación para que empiece a ahorrar dinero ya! Comparta esta información con los demás miembros del hogar.

- No deje la puerta del refrigerador abierta por mucho tiempo y asegúrese que la puerta cierre herméticamente.
- No deje el televisor encendido si nadie lo mira.
- No olvide apagar las luces al salir de una habitación.

¡AHORRE ELECTRICIDAD, AHORRE DINERO!

Price Notch Salience Letter

IMPORTANT INFORMATION

Save Electricity and Save Money

Dear Customer:

Electricity in Quito is billed using a progressive pricing system. What this means for you is that there is a large increase in your monthly bill should you consume more than 110 kWh.

We thought that you might be interested in the following information regarding your monthly electricity use over the past year.

Price Notch Salience Letter

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We thought that you might be interested in the following information regarding your monthly electricity use over the past year.

Your average consumption was: **115 kWh**

Price Notch Salience Letter Cont...

This means that you have paid around **$12** a month for the electricity you use (**$144** per year). If you were to reduce your electricity use by **5 kWh** per month (around **4%** of your average consumption), your bill would be reduced by nearly **47%** and would save approximately **$64** per year. We encourage you to use energy wisely to save money.

Price Notch Salience Letter Cont...

This means that you have paid around **$12** a month for the electricity you use (**$144** per year). If you were to reduce your electricity use by **5 kWh** per month (around **4%** of your average consumption), your bill would be reduced by nearly **47%** and would save approximately **$64** per year. We encourage you to use energy wisely to save money.

Please read carefully the following savings tips so you can start saving electricity now. Share this information with all the other members of the household.

- Don't leave the refrigerator door open for too long and make sure it closes tightly
- Turn off the television if nobody is watching it
- Don't forget to turn off the lights when leaving a room

Social Comparison Letter

Same Intro...

Social Comparison Letter

Same Intro...

We thought that you might be interested in the following information regarding your monthly electricity use over the past year.

Your average consumption was: **115 kWh**

The average household like you consumes: **110 kWh**

This means that you have consumed approximately 5% more electricity per month than others like you. We encourage you to use energy wisely to save money.

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Same Ending...

Conceptual Framework

For Households Historically Above 110

- Information intervention changes (perceived) budget set

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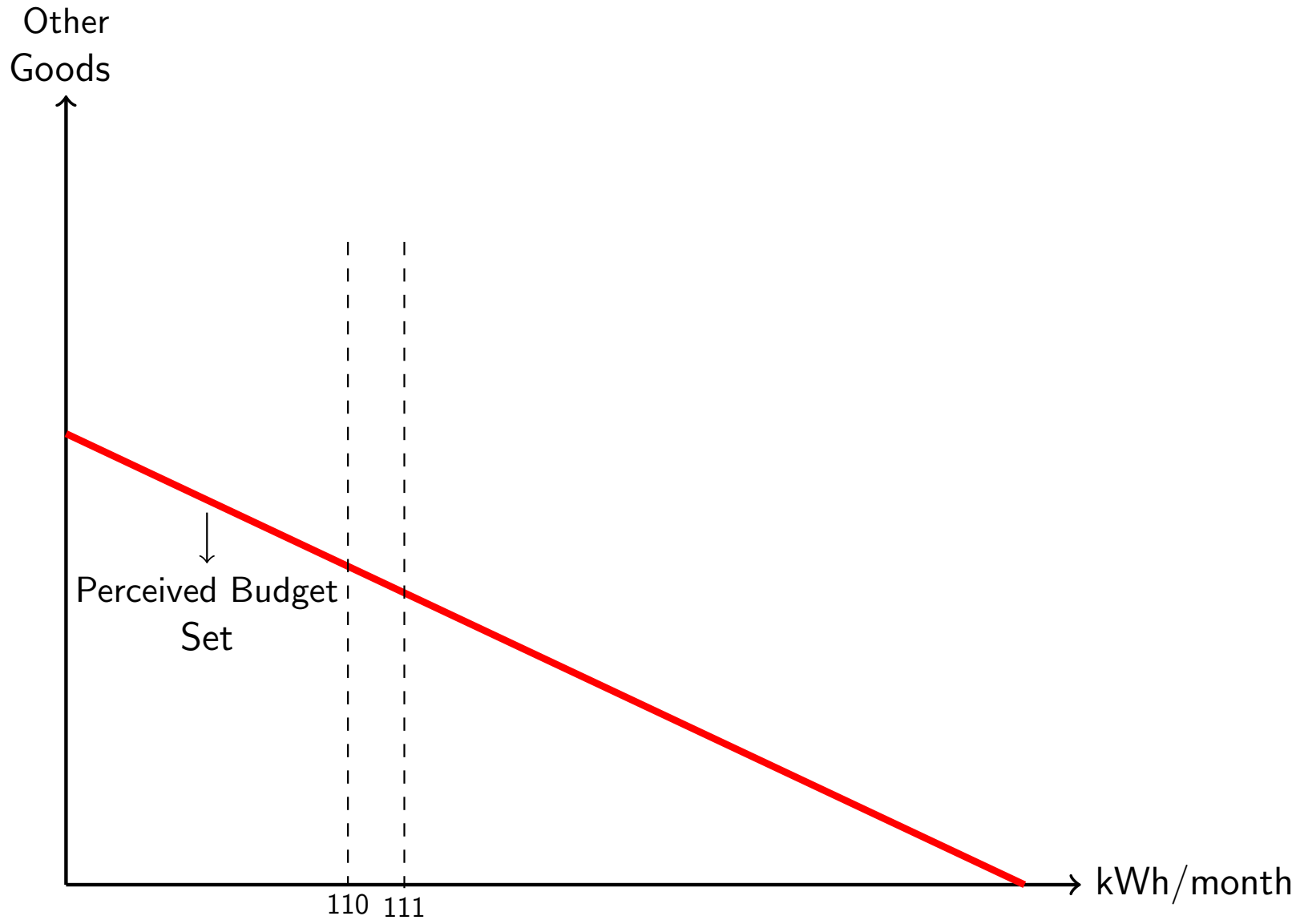
  - **Price Salience** $\rightarrow$ information that tariff is notched rather than linear
  - **Social Comparison** $\rightarrow$ adds a linear moral cost of consuming above the norm (Levitt & List, 2007)
- But households face optimization frictions, so "noise" is added to predictions

Above 110: Price Salience



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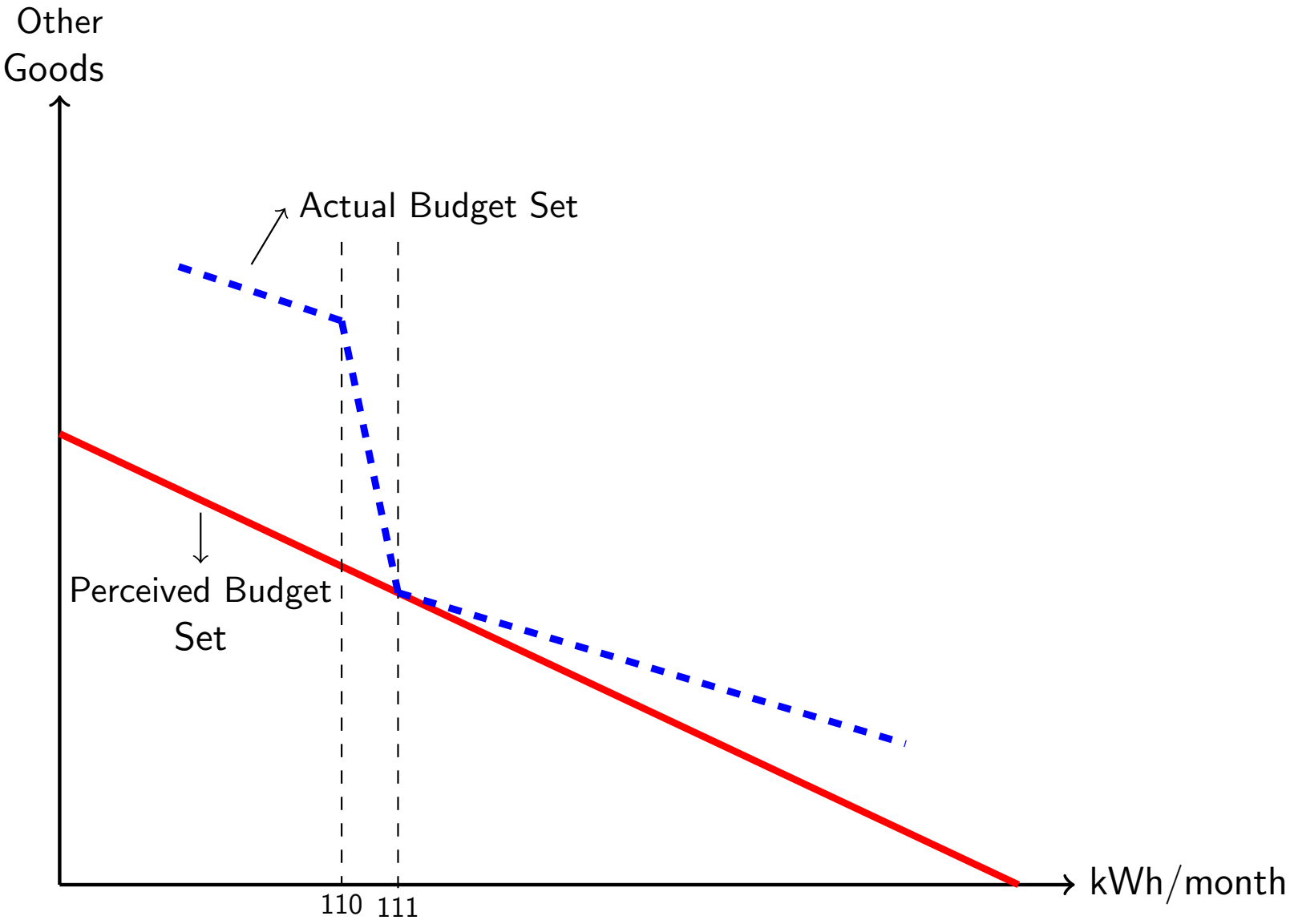

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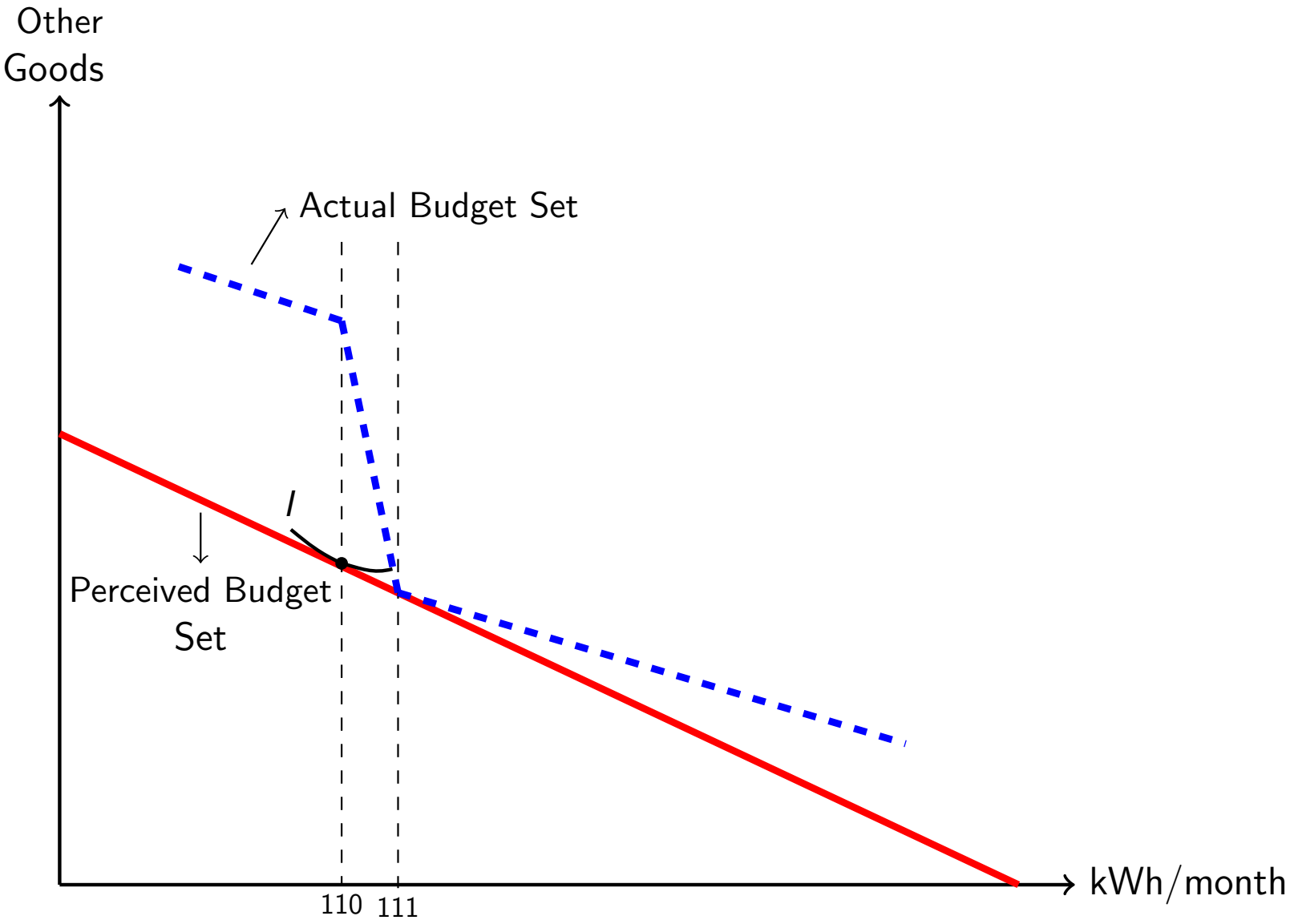

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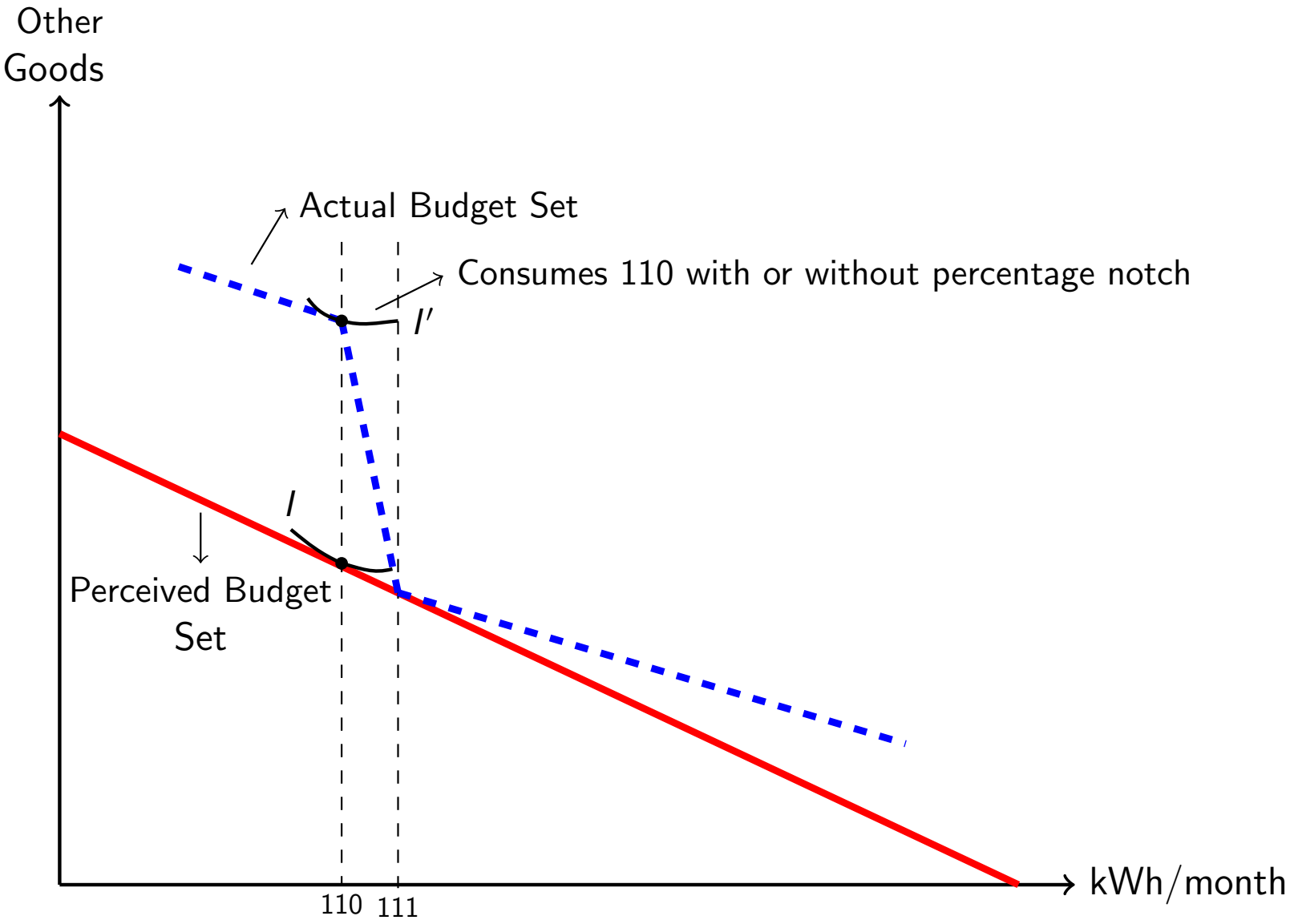

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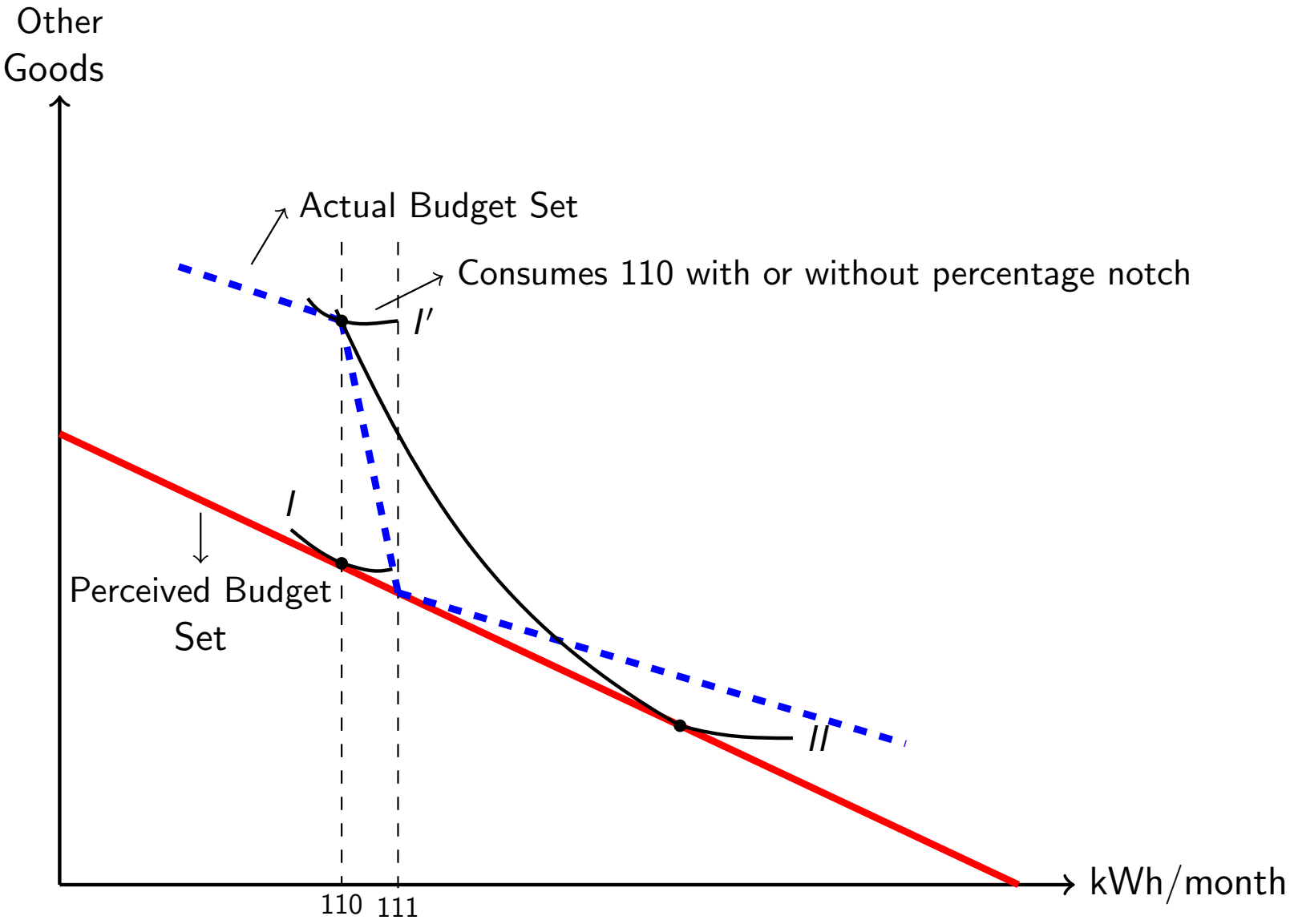

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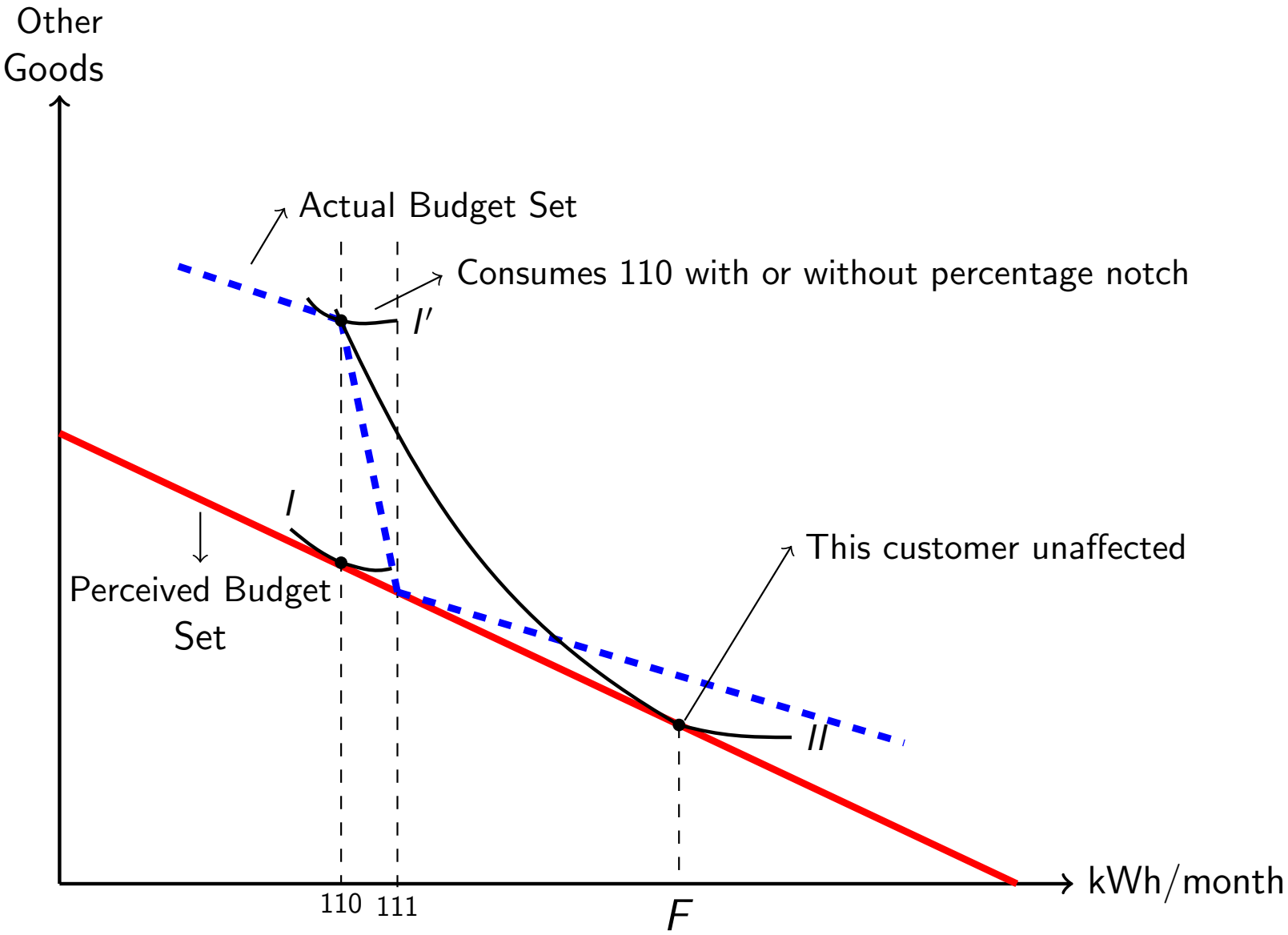

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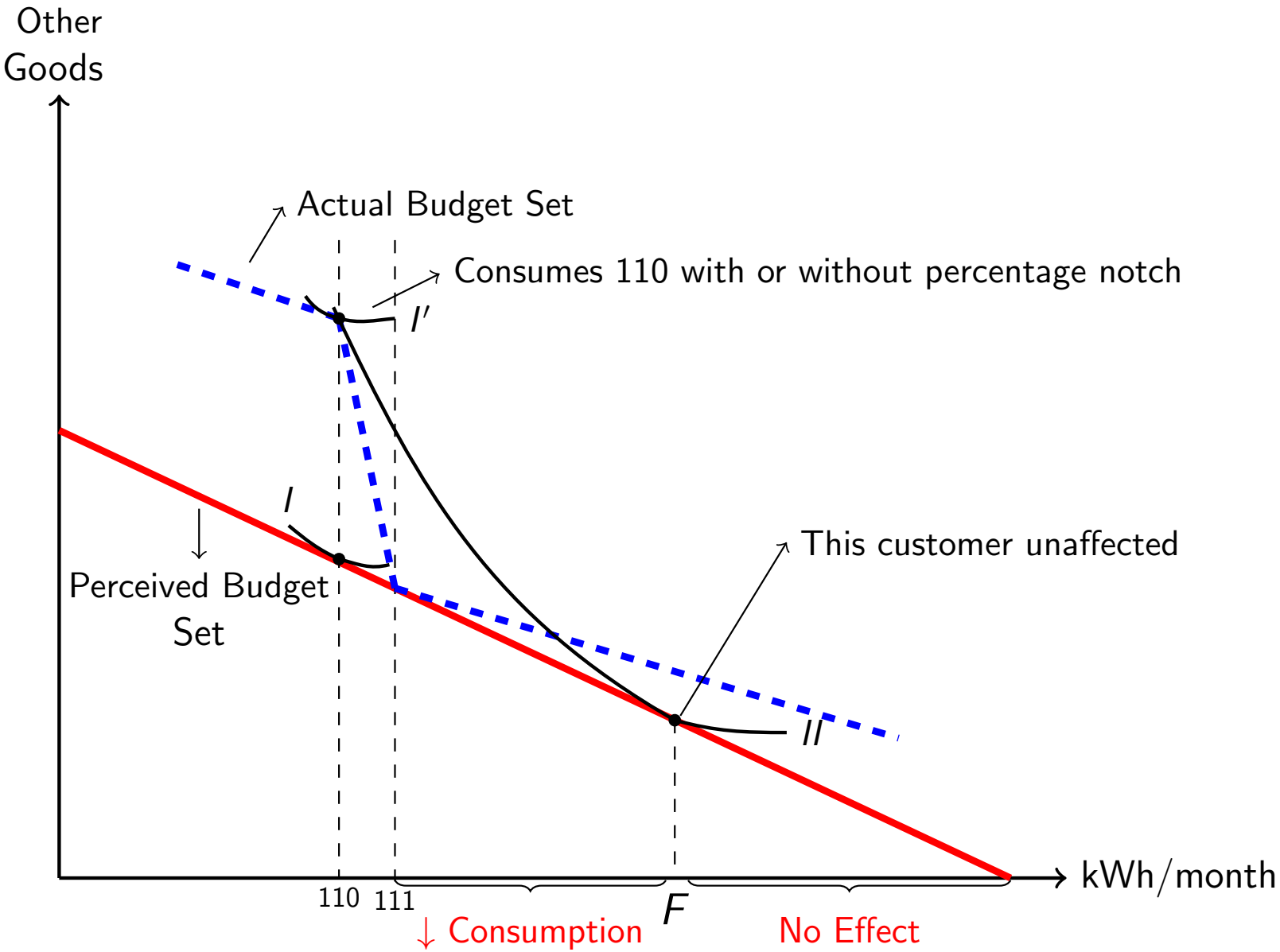
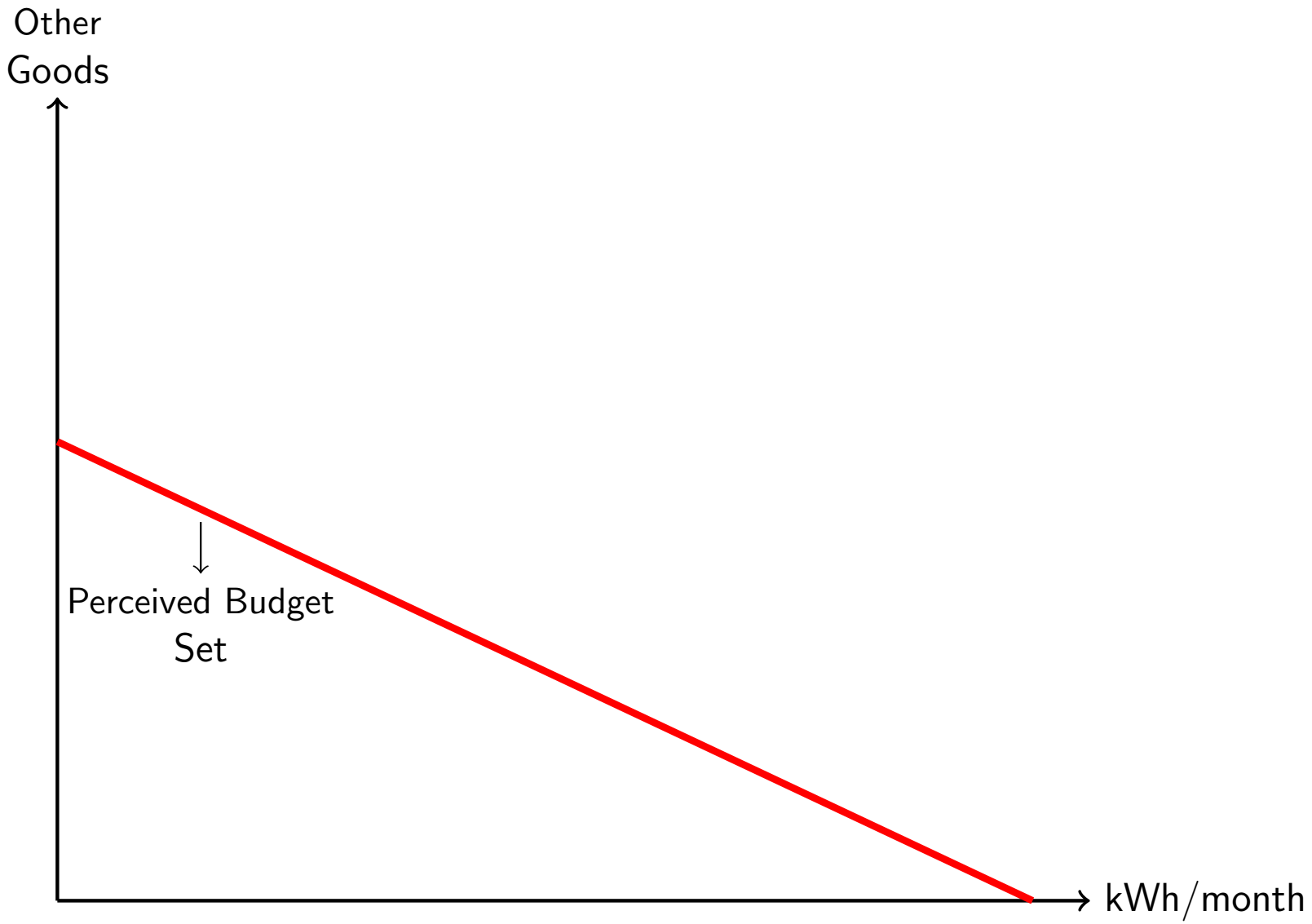


Above 110: Social Norm



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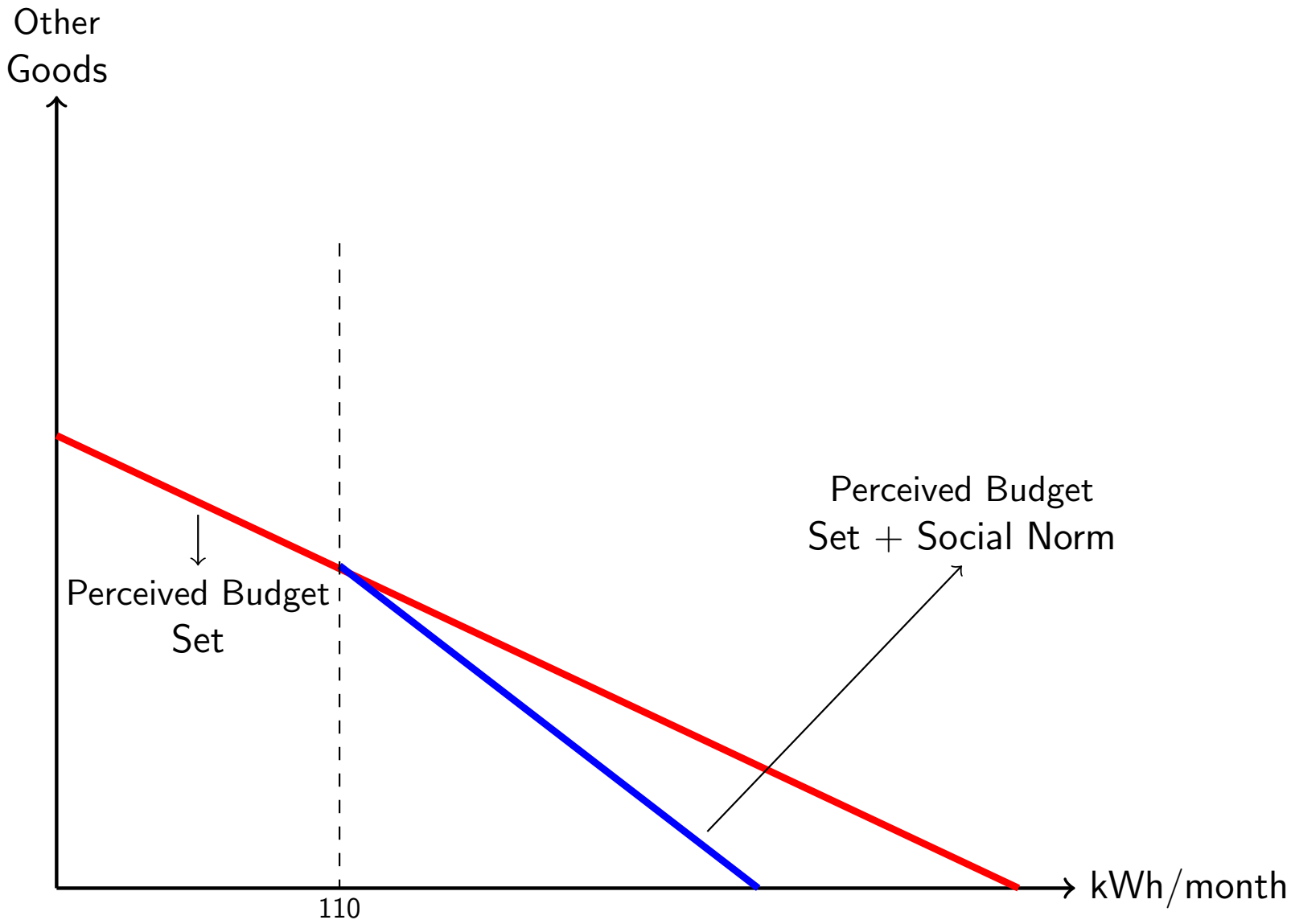

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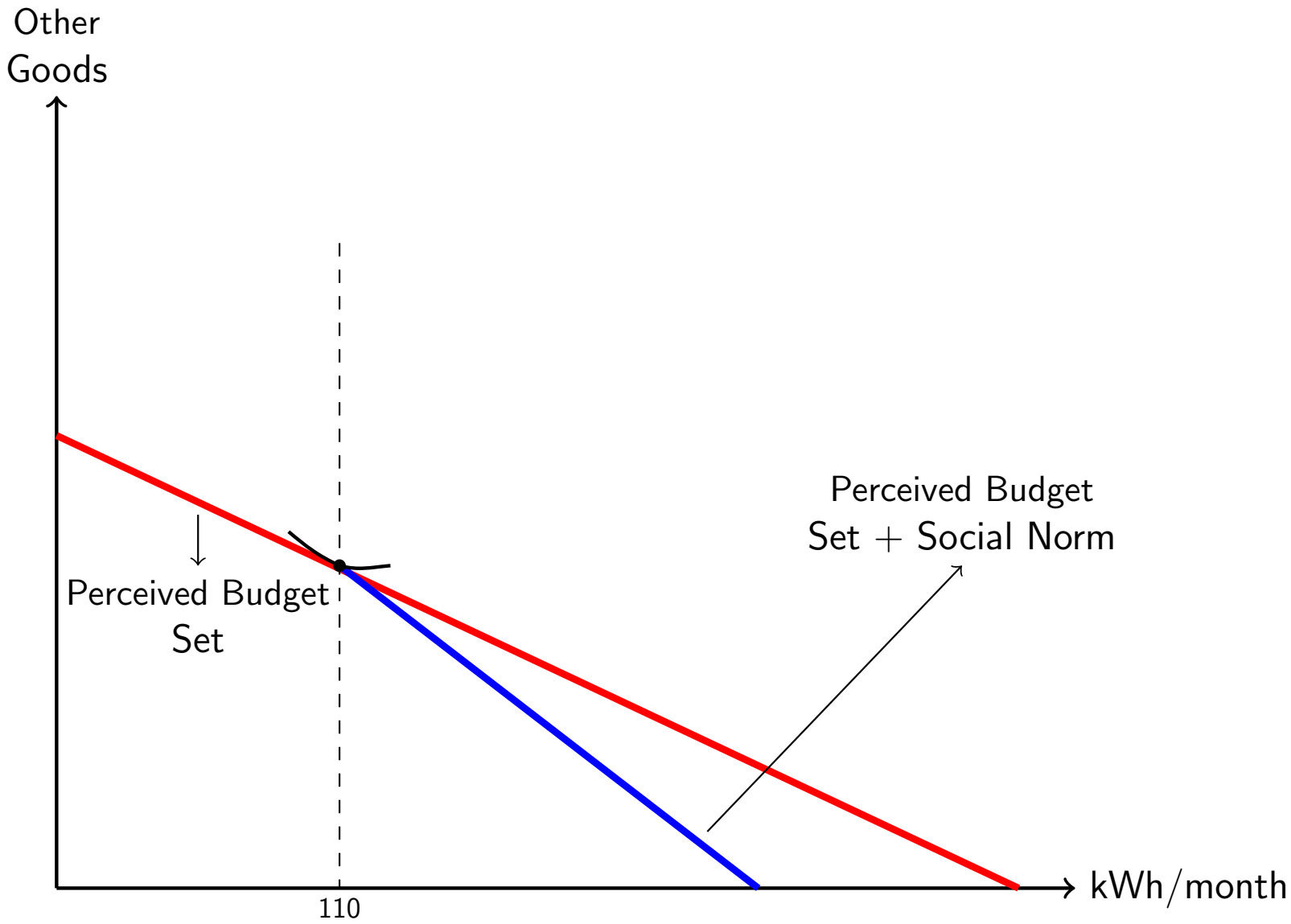

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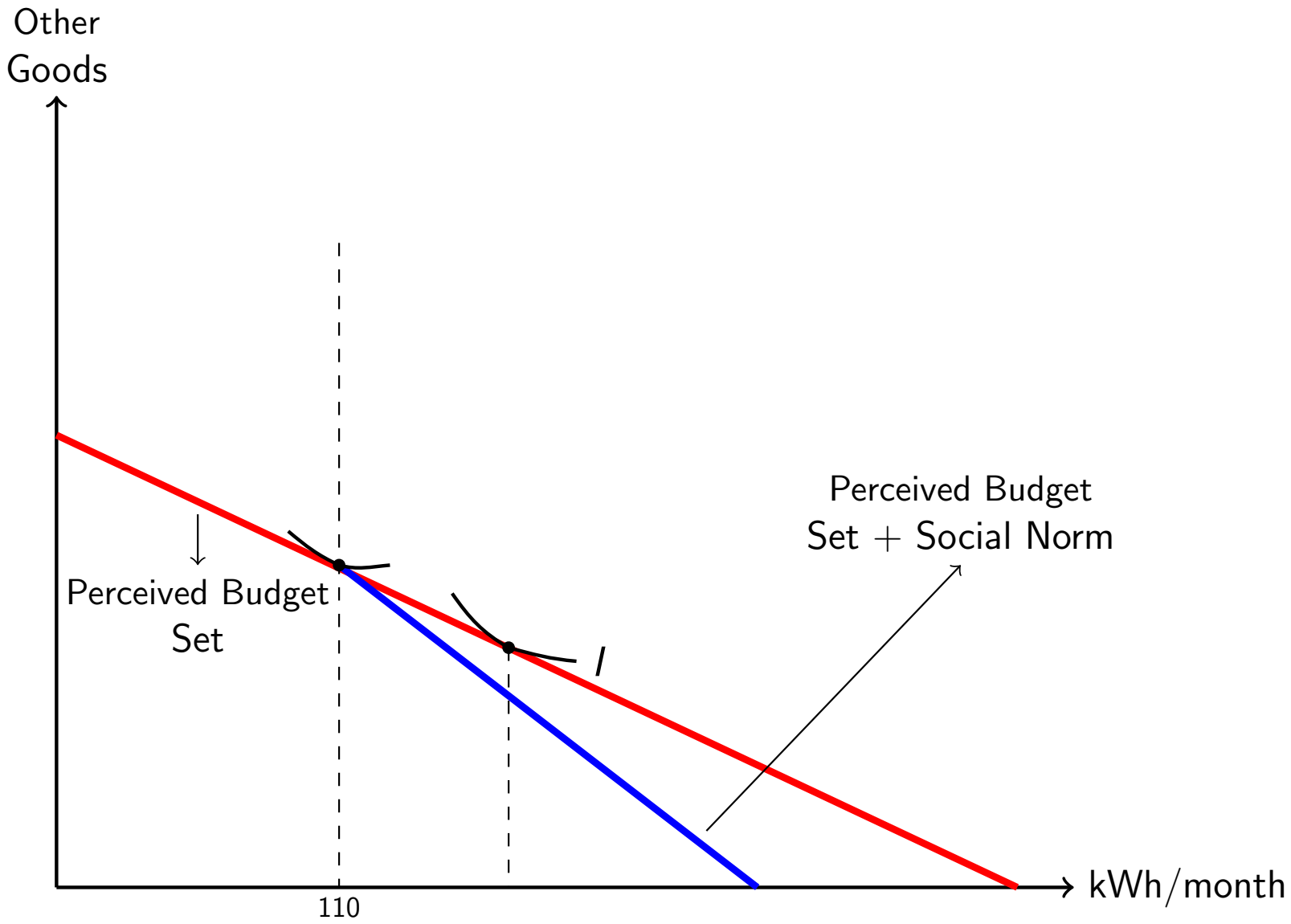

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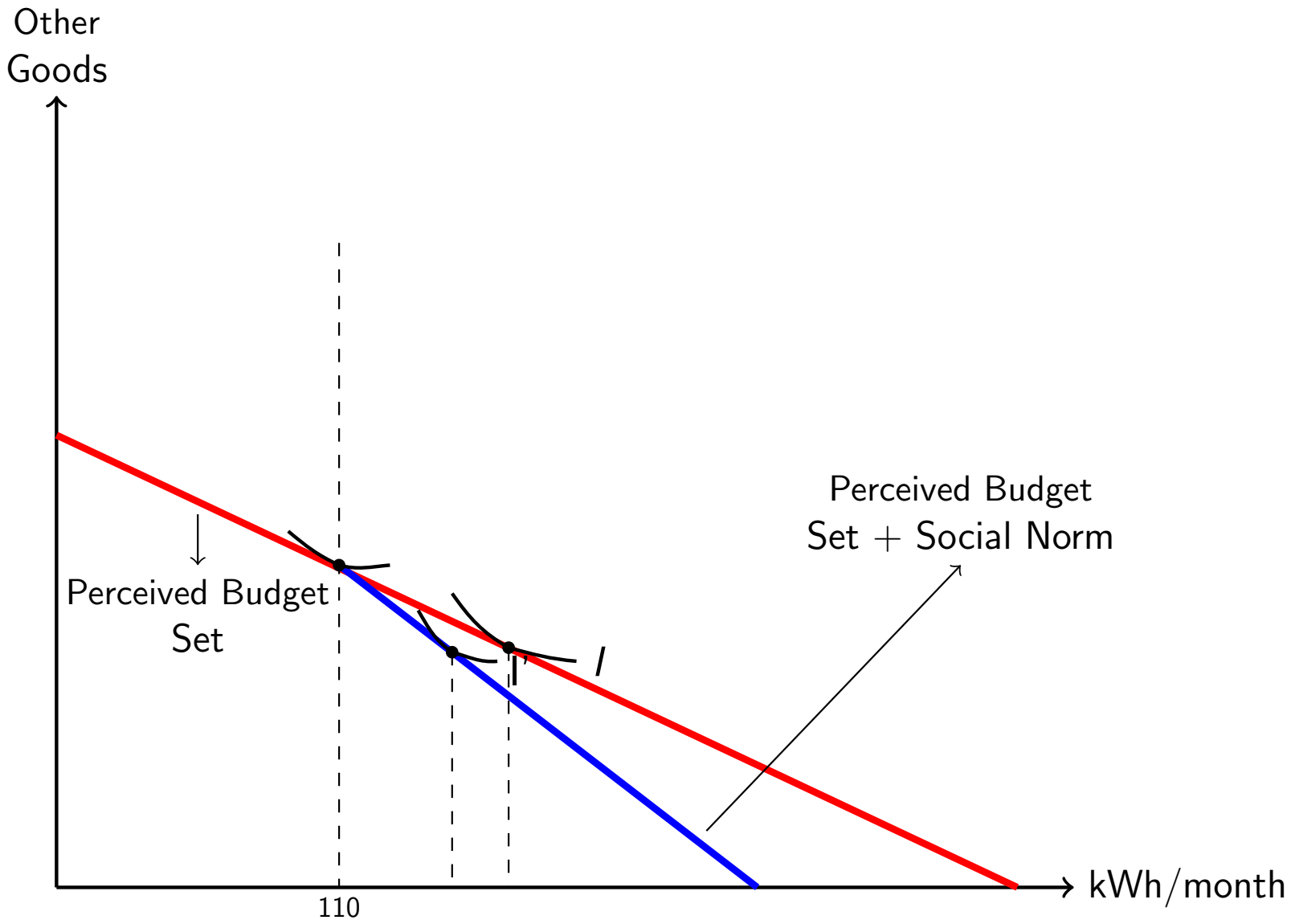

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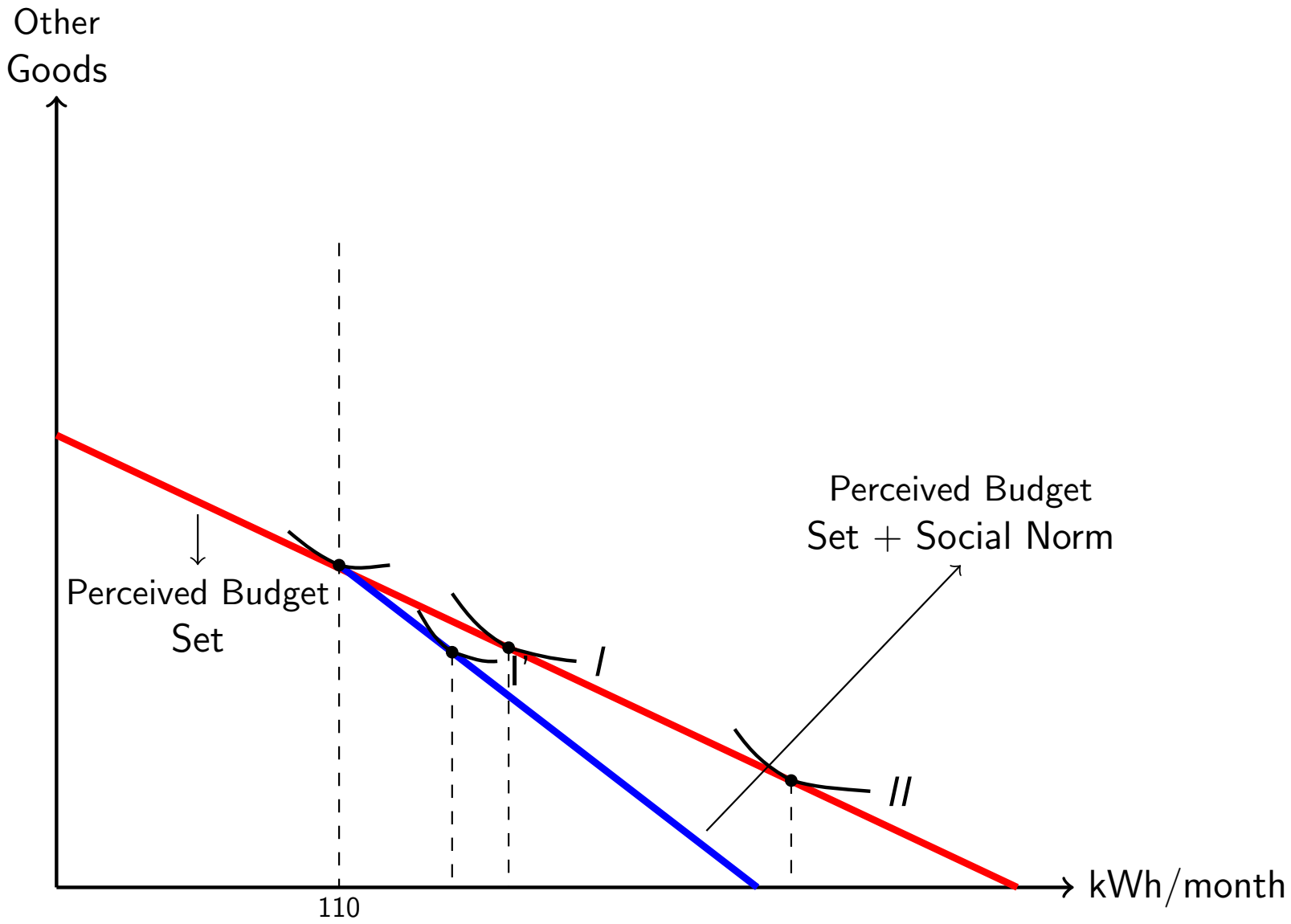

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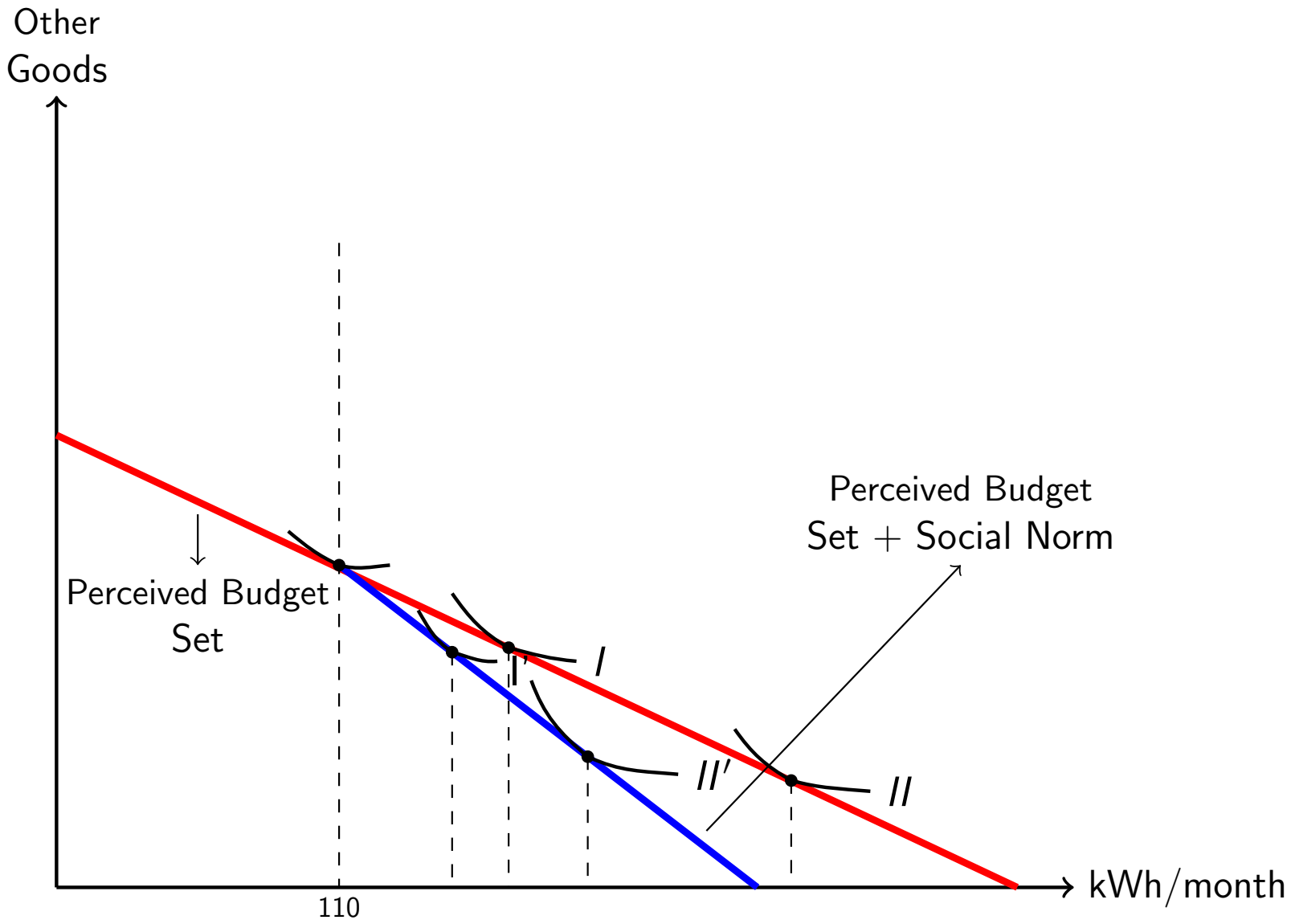


Results

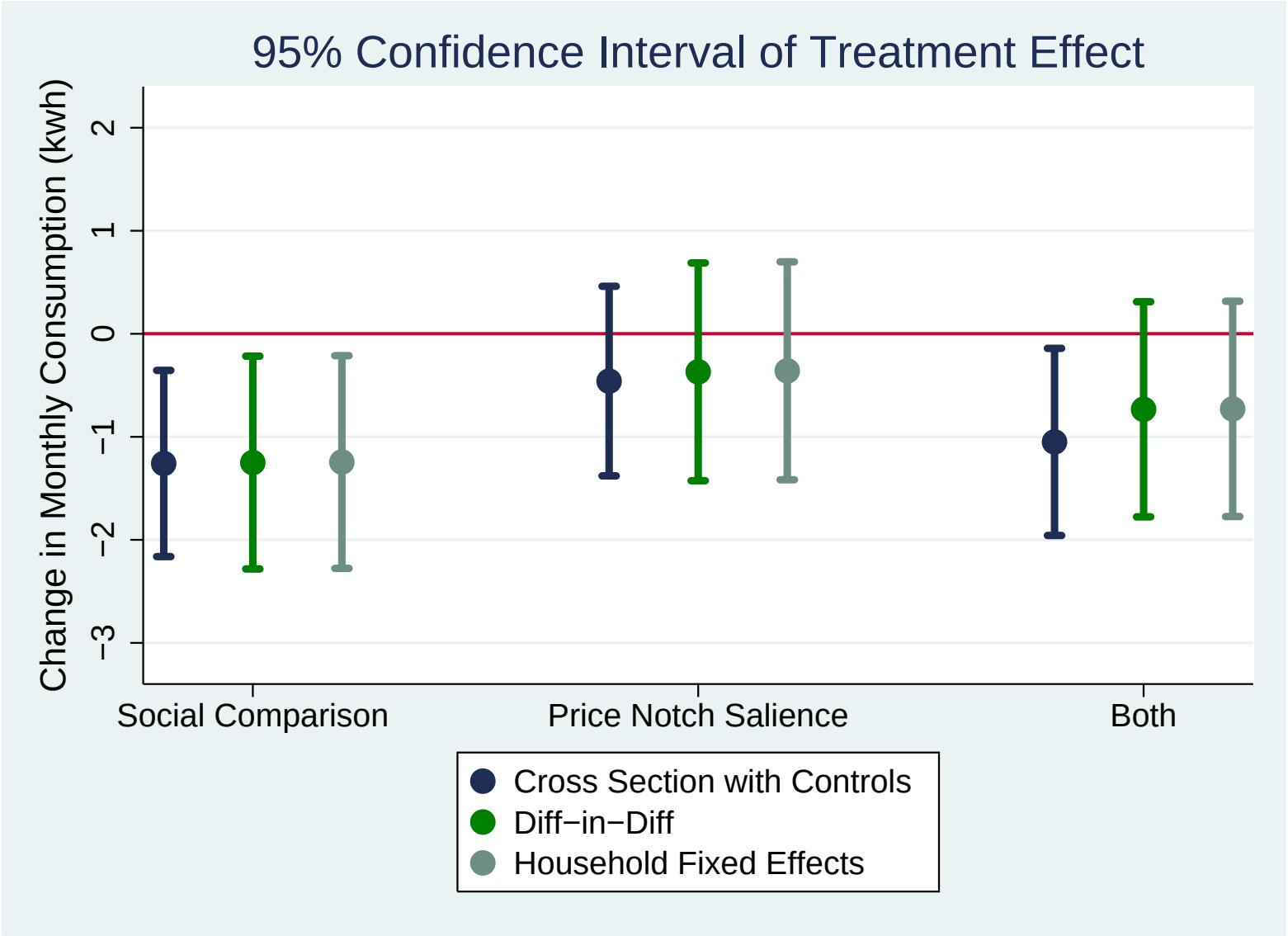
Results

- We study 3 post-treatment months (April-June 2014)
  - Data: household-level monthly consumption
  - Split results by whether historically "Above" or "Below" 110
- One time treatment so decay likely
- We interpret as the effect of a one-time (low-cost) information intervention

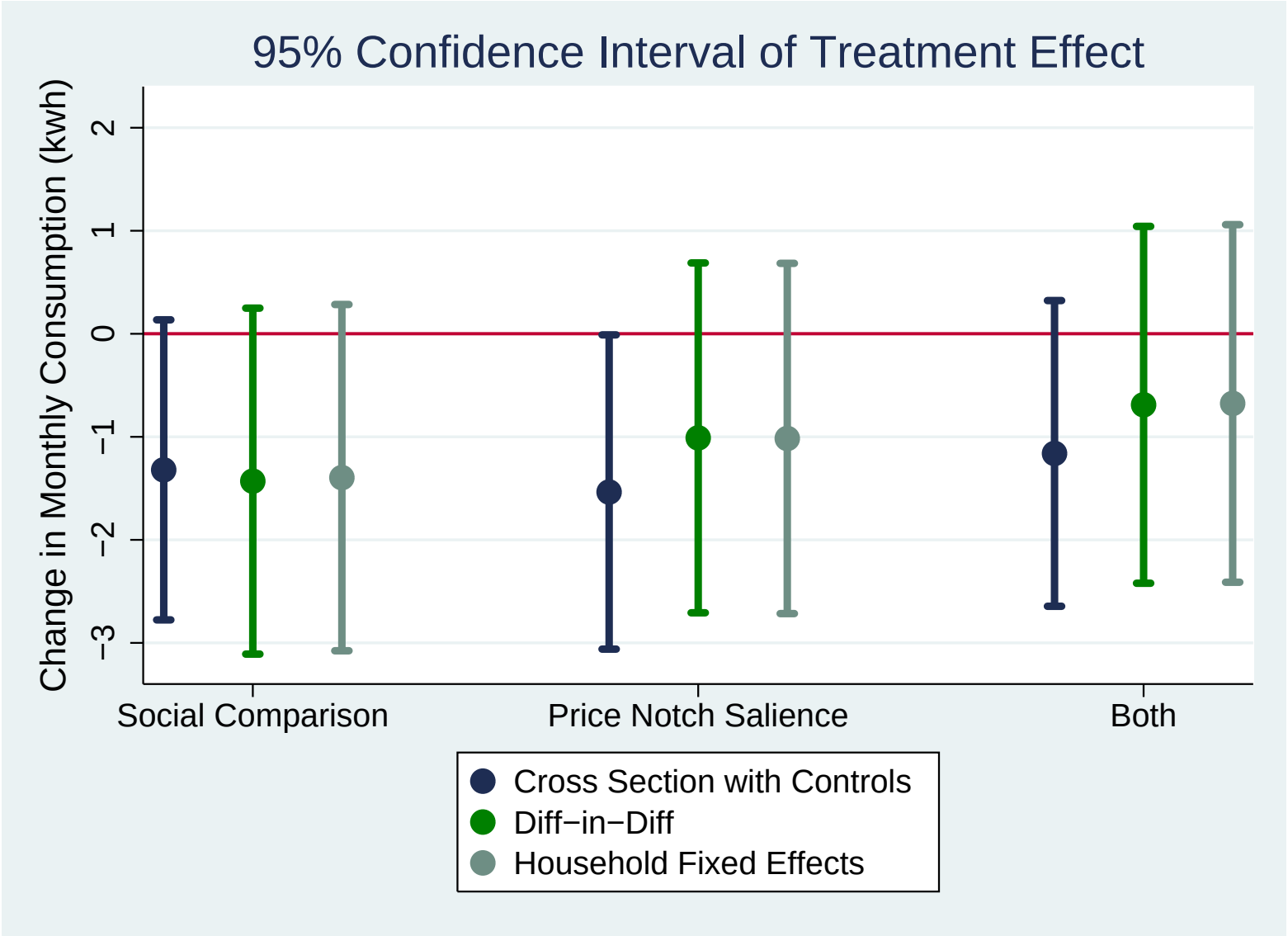
Sample is Balanced

Tabular

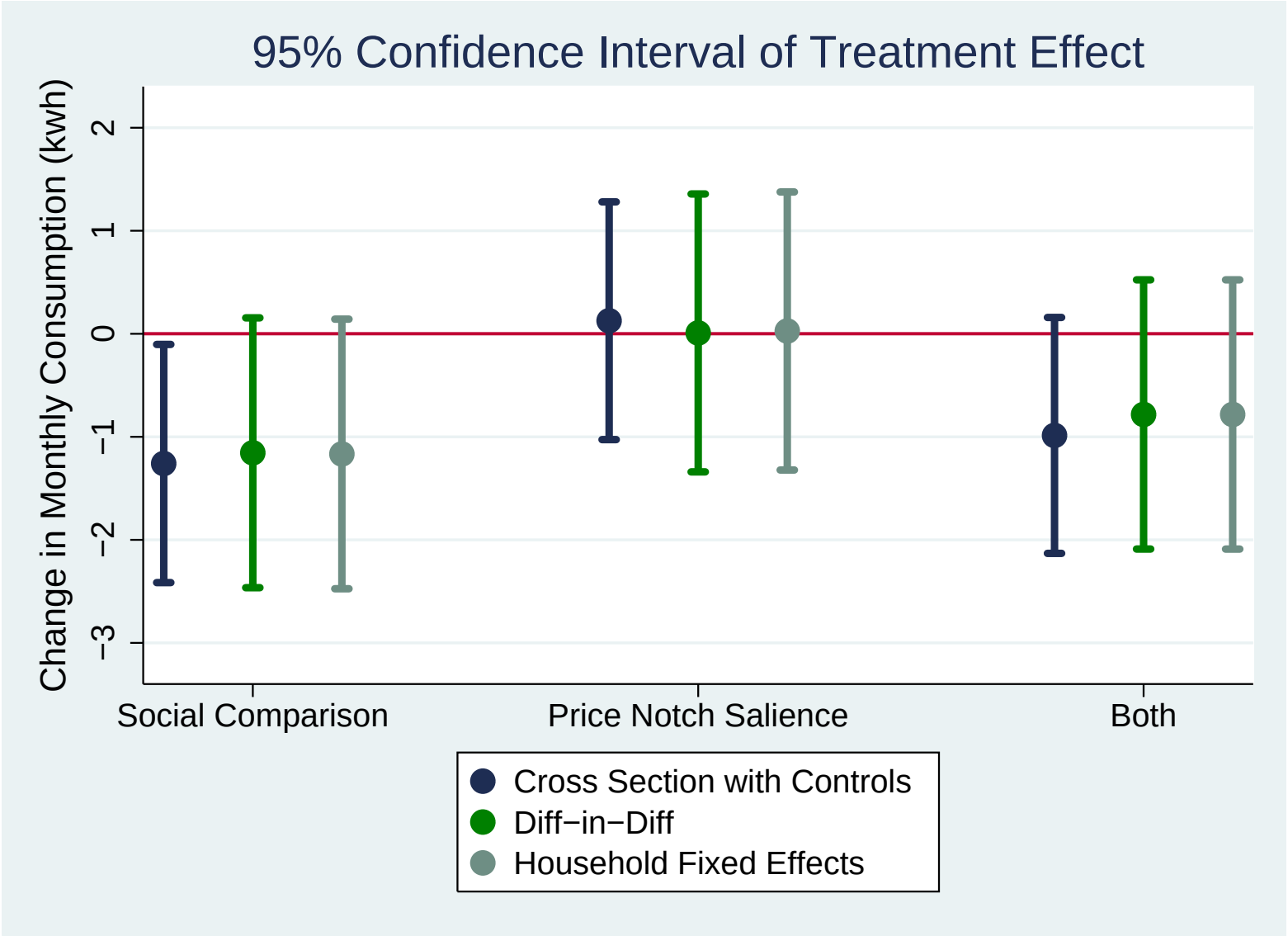
ATE Estimates - Above 110



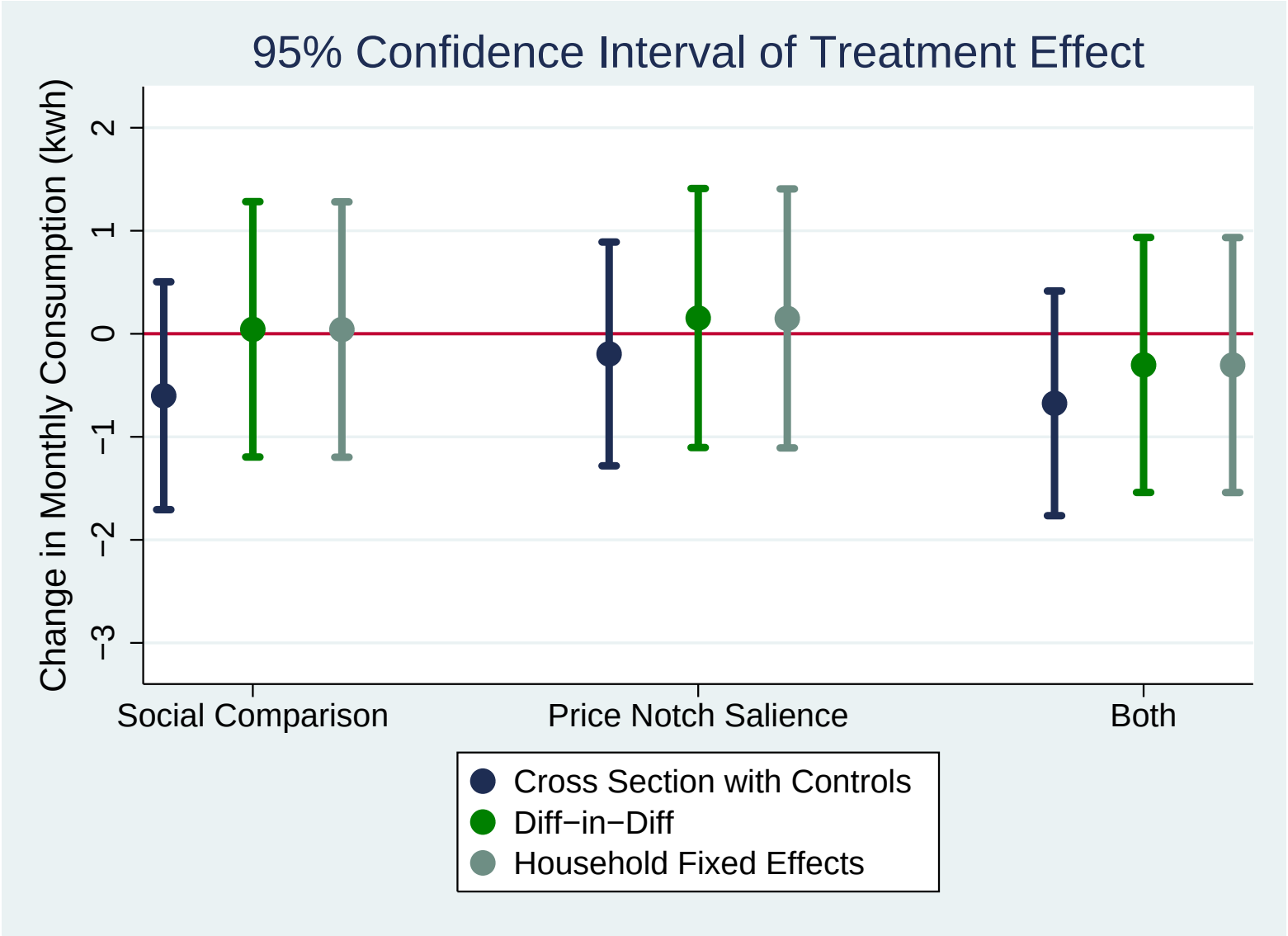
ATE Estimates - 111-115



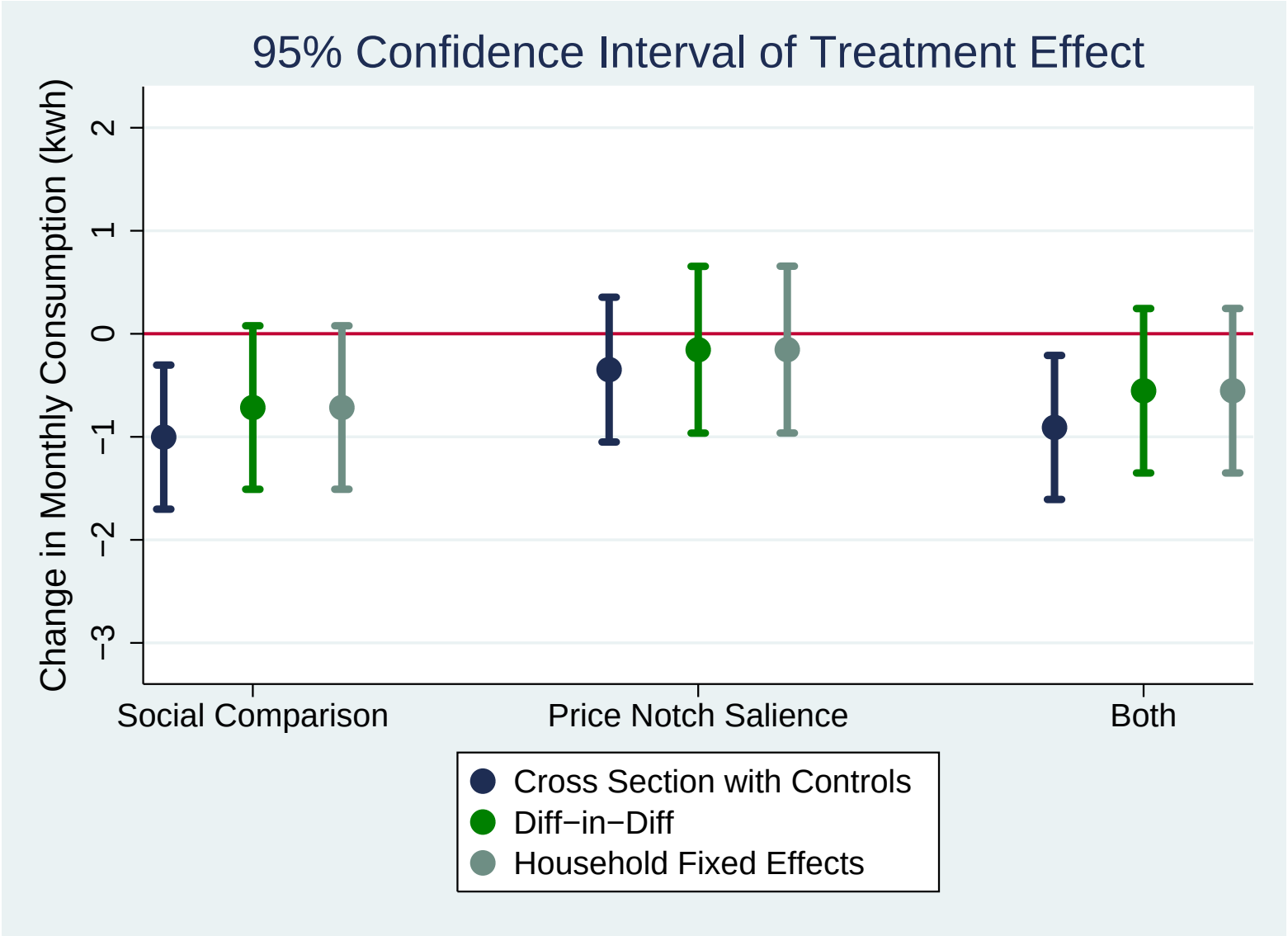
ATE Estimates - 116-125



ATE Estimates - Below 110



ATE Estimates - Above & Below



Summary

- **Social comparison** treatment reduces consumption:
  - 1.0% reduction in 3 months after treatment
  - Compare to 2% effects of (longer-term) OPOWER Home Energy Reports
  - Equivalent to turning off 60 Watt bulb for $\approx$ half hour per day
  - Effect similar for those "just above" and "far above" the benchmark comparison (with precision caveats)
  - Social comparisons may have "wider range"
- **Price notch saliency** may have effect for those "just above" but overall effect for those above 100 is zero/small
- Suggests that incentive to conserve is "linear in distance to comparison" for **Social Comparison**, but "non-linear" for **Price Notch**
- No boomerang for households below 110

Thanks

Electricity Distribution in Ecuador

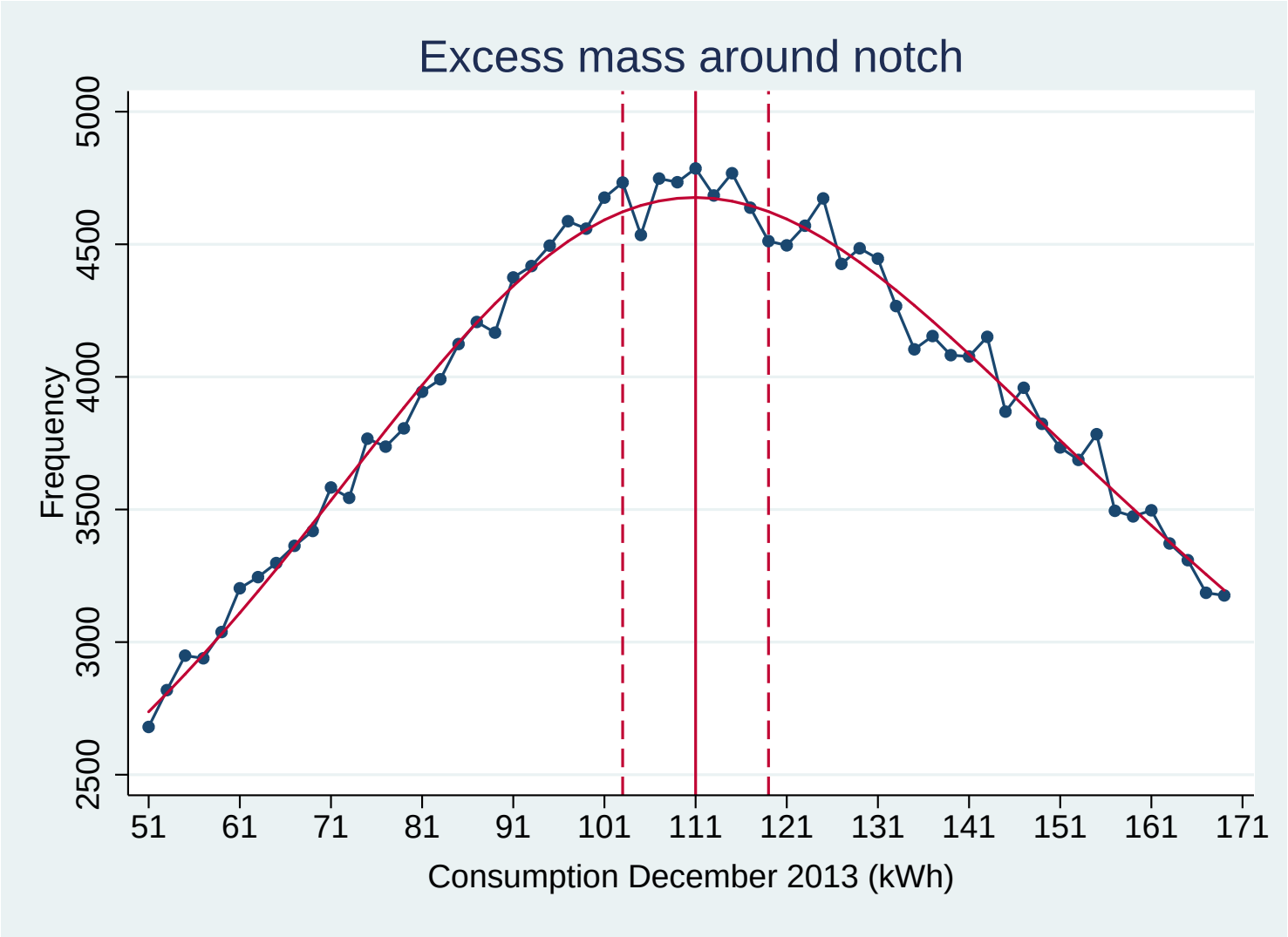
Electricity Use by Households around Notch

End Use	Average Usage
Refrigerator	39.8
Appliances	12.8
Television	12.7
Lighting	9.4
Washing Machine	8.0
Water Heater	8.0
Iron	6.6
Cooking	4.0
Music Electronics	2.8
Heating	0.7

Source: ENERINTER Asesoría Energética Internacional, 2012.

Data for EEQ Households with Monthly Avg Usage between 99 and 110kWh

Pre-treatment evidence #2: effect of notch



Approach: "Excess bunching?"

Back

Envelope Stuffing

Back

Sample balanced across treatments

Pre-treatment: Average monthly consumption in 2013 (kWh)

Group	Count	Average	Median	Standard Deviation
Control	15,875	112.39	112	7.23
Social Comparison	15,854	112.34	112	7.22
Price Notch Salience	15,860	112.39	112	7.23
Both	15,853	112.36	112	7.19

Back

Sample balanced across treatments

Pre-treatment: Average monthly consumption in 2013 (kWh)

	Difference	Standard Error	t-statistic	p-value	95% CI	
Social Comparison vs. Control	-0.054	0.081	-0.66	0.508	-0.212	0.105
Price Notch Salience vs. Control	-0.002	0.081	-0.02	0.982	-0.161	0.157
Both vs. Control	-0.034	0.081	-0.43	0.671	-0.193	0.124
Price Notch Salience vs. Social Comparison	0.052	0.081	0.64	0.523	-0.107	0.211
Both vs. Social Comparison	0.019	0.081	0.24	0.813	-0.140	0.178
Both vs. Price Notch Salience	-0.033	0.081	-0.40	0.687	-0.192	0.126

Back

ATE Estimates - Above 110 Pre-Treatment

Dependent Variable: Monthly Consumption (kWh)

	Cross Section (April-June 2014)				Panel (January 2013-June 2014)		
					Diff-in-Diff	Fixed Effects	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Social Comparison	-1.362**	-1.317**	-1.247***	-1.259***	-1.250**	-1.245**	-1.245**
	(0.599)	(0.597)	(0.461)	(0.461)	(0.527)	(0.527)	(0.527)
Price Notch Salience	-0.378	-0.375	-0.426	-0.459	-0.369	-0.359	-0.359
	(0.612)	(0.609)	(0.469)	(0.469)	(0.539)	(0.540)	(0.540)
Both	-0.760	-0.695	-1.064**	-1.049**	-0.733	-0.729	-0.729
	(0.607)	(0.604)	(0.464)	(0.463)	(0.532)	(0.533)	(0.533)
Month-by-year FE	Yes	Yes	Yes	Yes	No	No	Yes
Avg Q 2013	No	Yes	No	No	No	No	No
Q 1-2/2014 4-6/2013	No	No	Yes	Yes	No	No	No
Route FE	No	No	No	Yes	No	No	No
Houshold FE	No	No	No	No	No	Yes	Yes
Observations	110,242	110,242	110,242	110,242	661,599	661,599	661,599

Robust standard errors clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1

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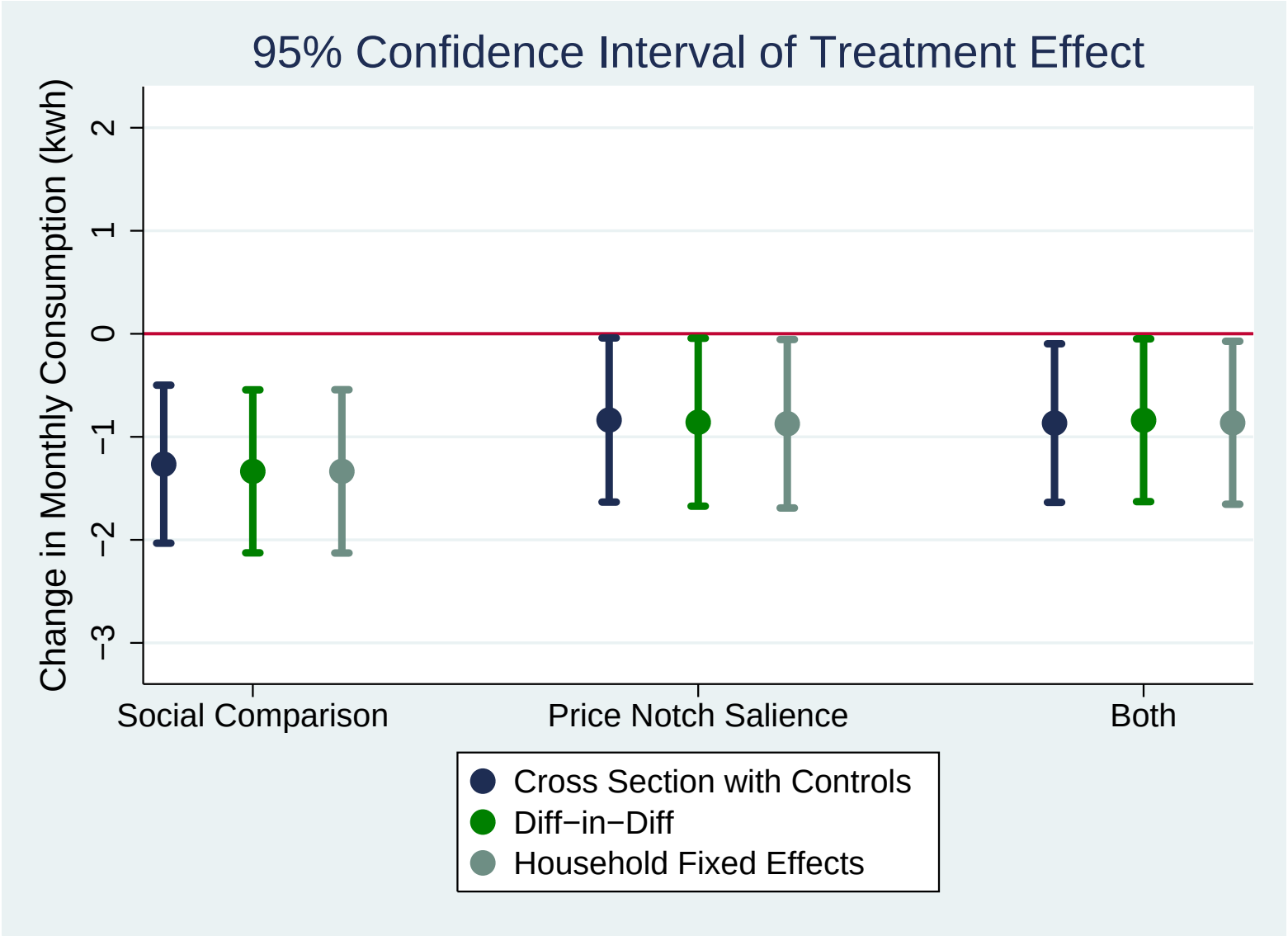
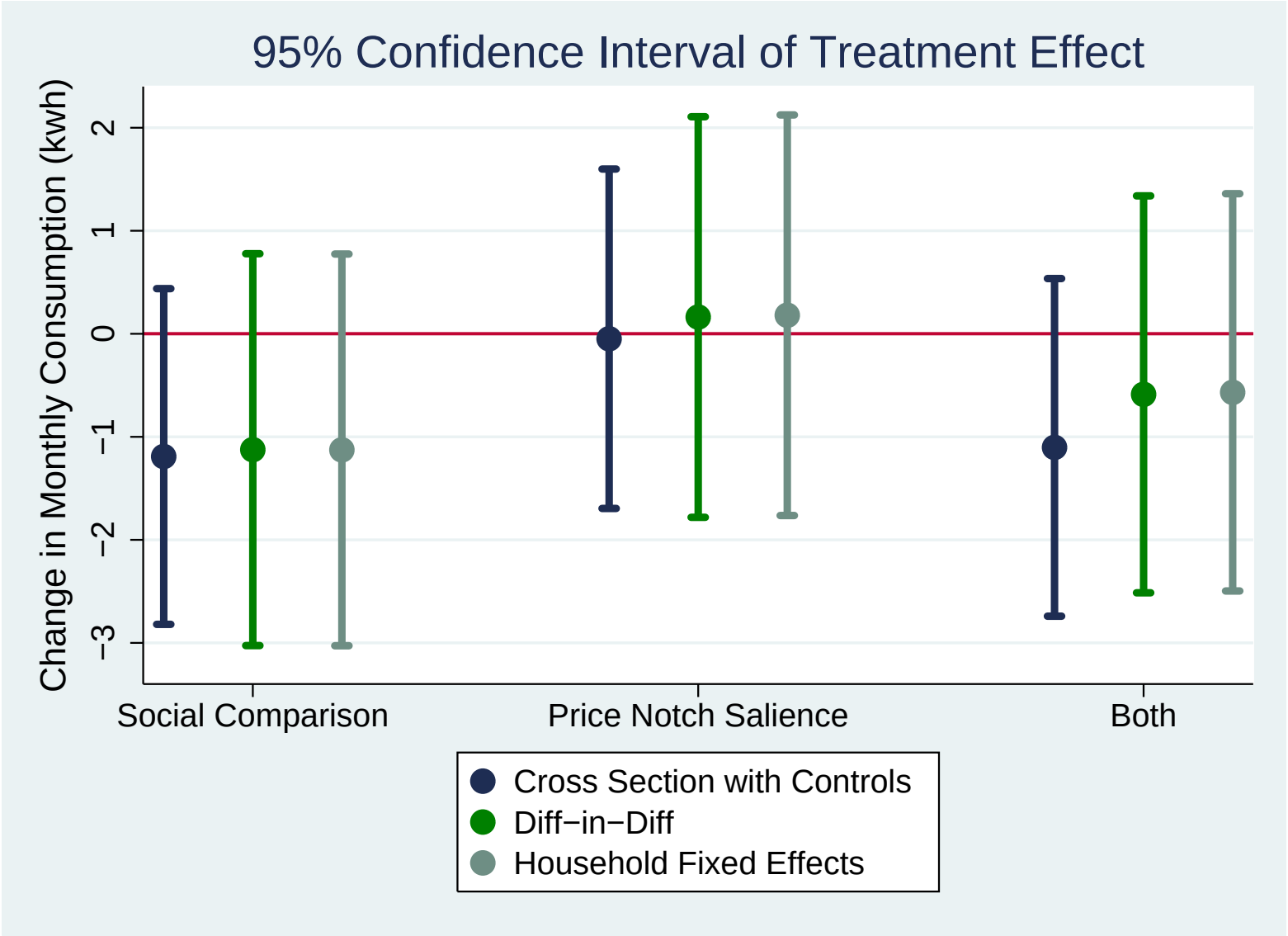
ATE Estimates - Above 110, Low Var HHs



ATE Estimates - Above 110, High Var HHs



ATE Estimates - Cross 110

	Above 110 – treatment moves below	**Below 110 – treatment moves above**
Social Comparison	0.020***	-0.006
	(0.006)	(0.007)
Price Notch Salience	0.010*	-0.012*
	(0.006)	(0.007)
Both	0.012**	-0.005
	(0.006)	(0.007)
Constant	0.407***	0.367***
	(0.006)	(0.007)
Number of observations	110,586	75,912

Robust standard errors clustered at the household level.
*** p<0.01, ** p<0.05, * p<0.1

Conceptual Framework: HHs Historically Above 110

- Information intervention changes (perceived) budget set

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  - Initially consider utility maximization with *no optimization frictions*

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- Information intervention changes (perceived) budget set
  - Initially consider utility maximization with *no optimization frictions*
  - Prior to treatment: HHs assume tariff is linear with marginal price = average price at 111kwh
  - **Price Salience** $\rightarrow$ information that tariff is notched rather than linear

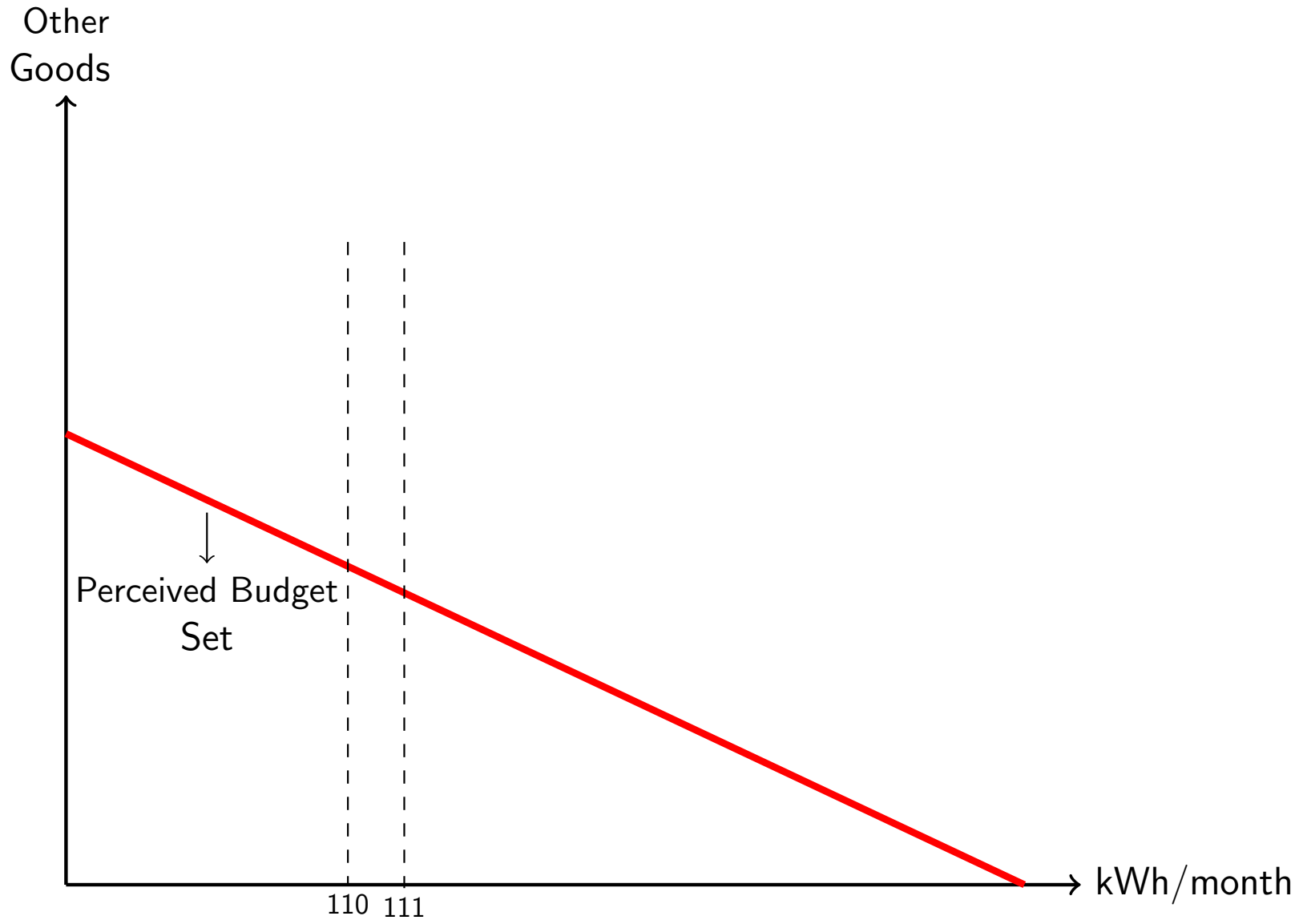
Conceptual Framework: HHs Historically Above 110

- Information intervention changes (perceived) budget set
  - Initially consider utility maximization with *no optimization frictions*
  - Prior to treatment: HHs assume tariff is linear with marginal price = average price at 111kwh
  - **Price Salience** $\rightarrow$ information that tariff is notched rather than linear
  - **Social Comparison** $\rightarrow$ adds a linear moral cost of consuming above the norm (Levitt & List, 2007)

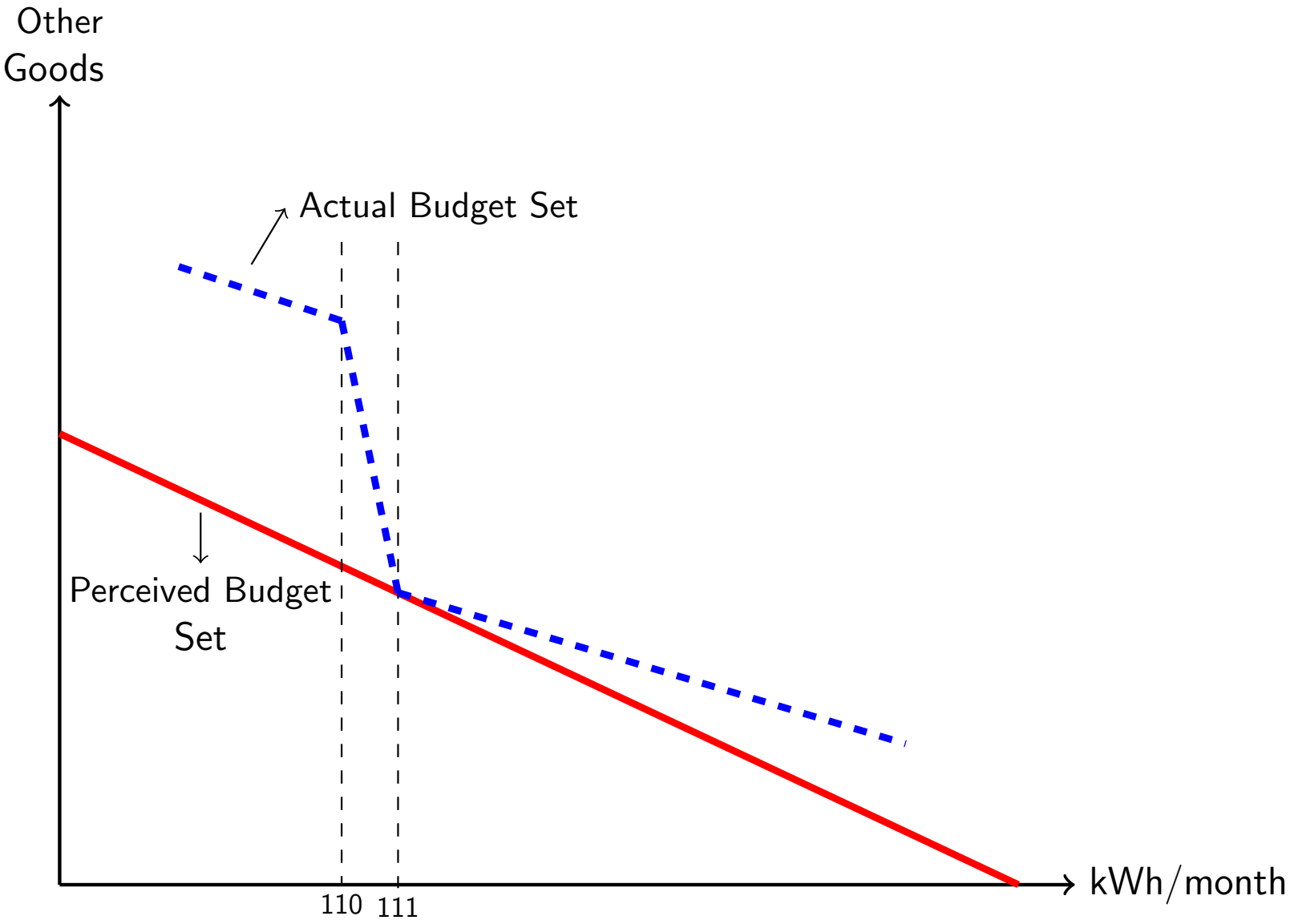
Conceptual Framework: HHs Historically Above 110

- Information intervention changes (perceived) budget set
  - Initially consider utility maximization with *no optimization frictions*
  - Prior to treatment: HHs assume tariff is linear with marginal price = average price at 111kwh
  - **Price Salience** $\rightarrow$ information that tariff is notched rather than linear
  - **Social Comparison** $\rightarrow$ adds a linear moral cost of consuming above the norm (Levitt & List, 2007)
- Add ex post optimization frictions

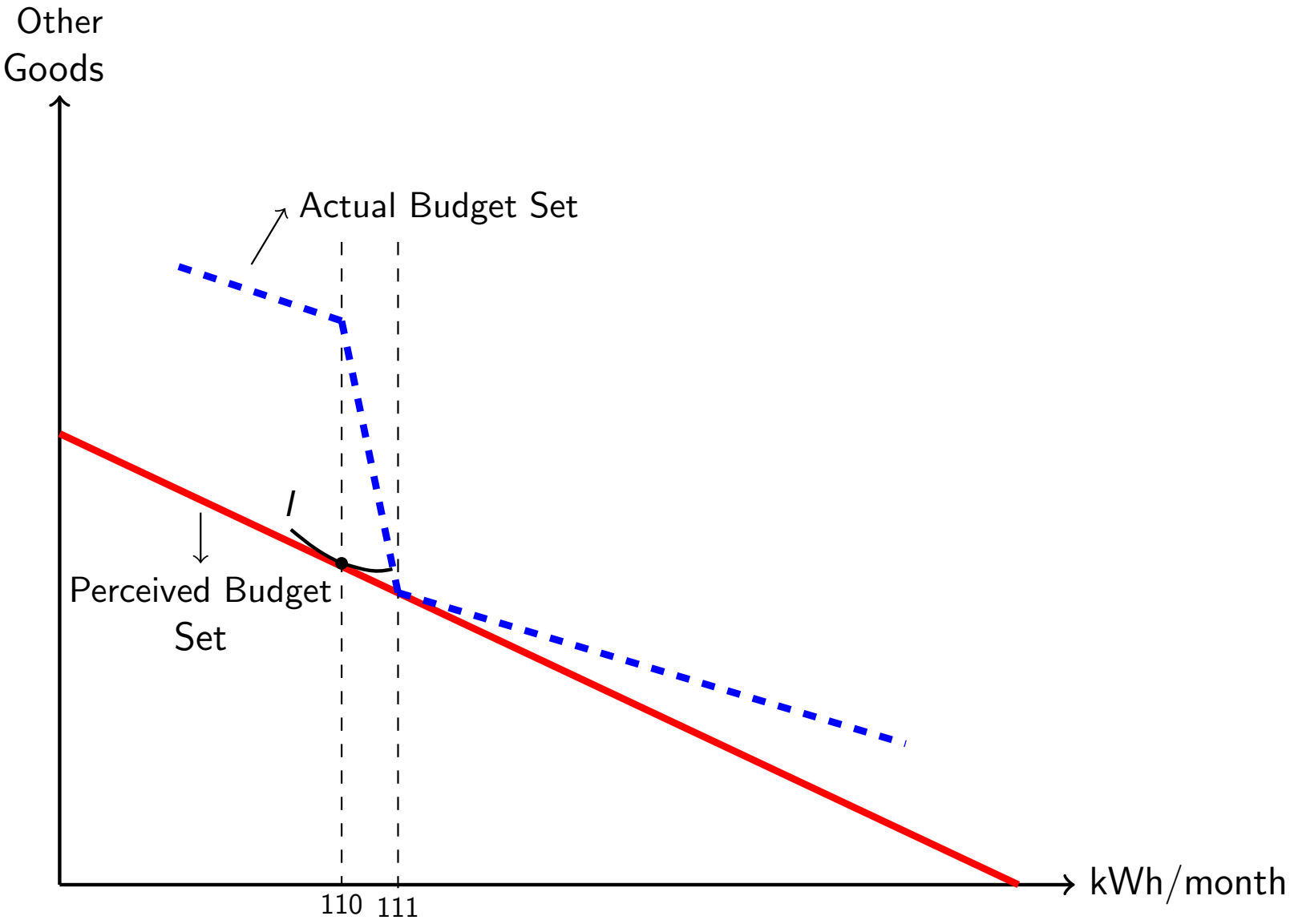
Above 110: Price Salience (No Frictions)



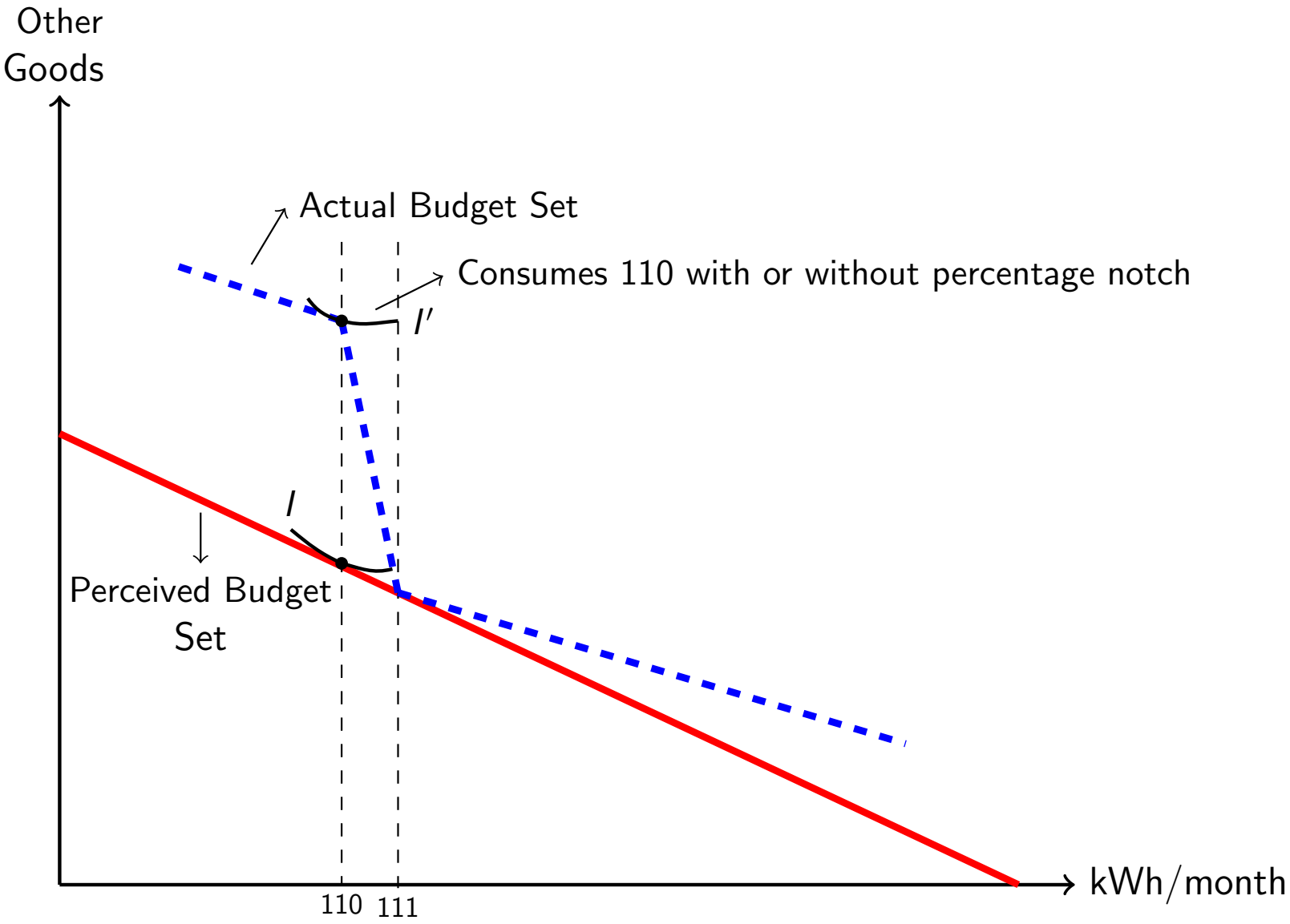
Above 110: Price Salience (No Frictions)



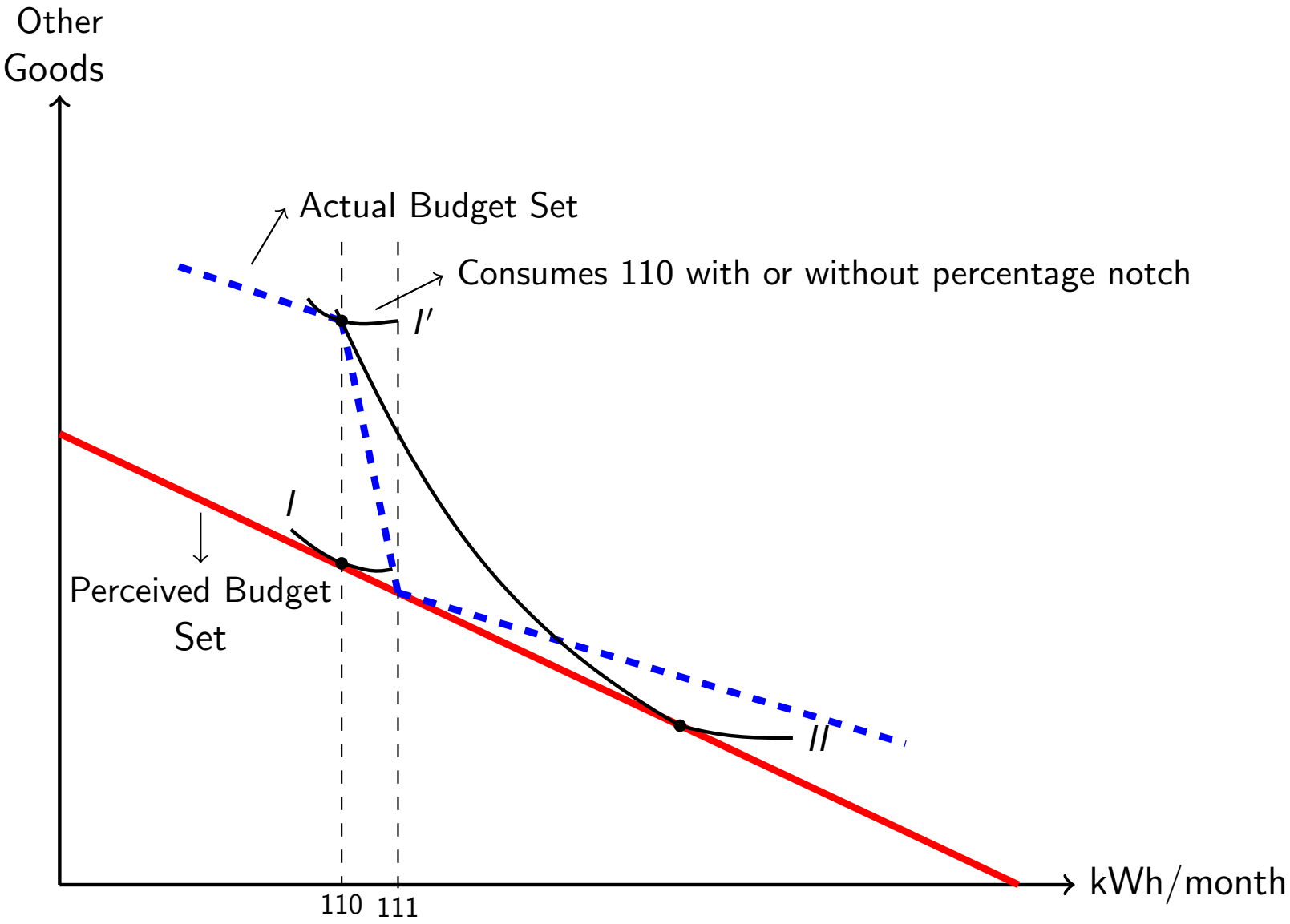
Above 110: Price Salience (No Frictions)



Above 110: Price Salience (No Frictions)



Above 110: Price Salience (No Frictions)



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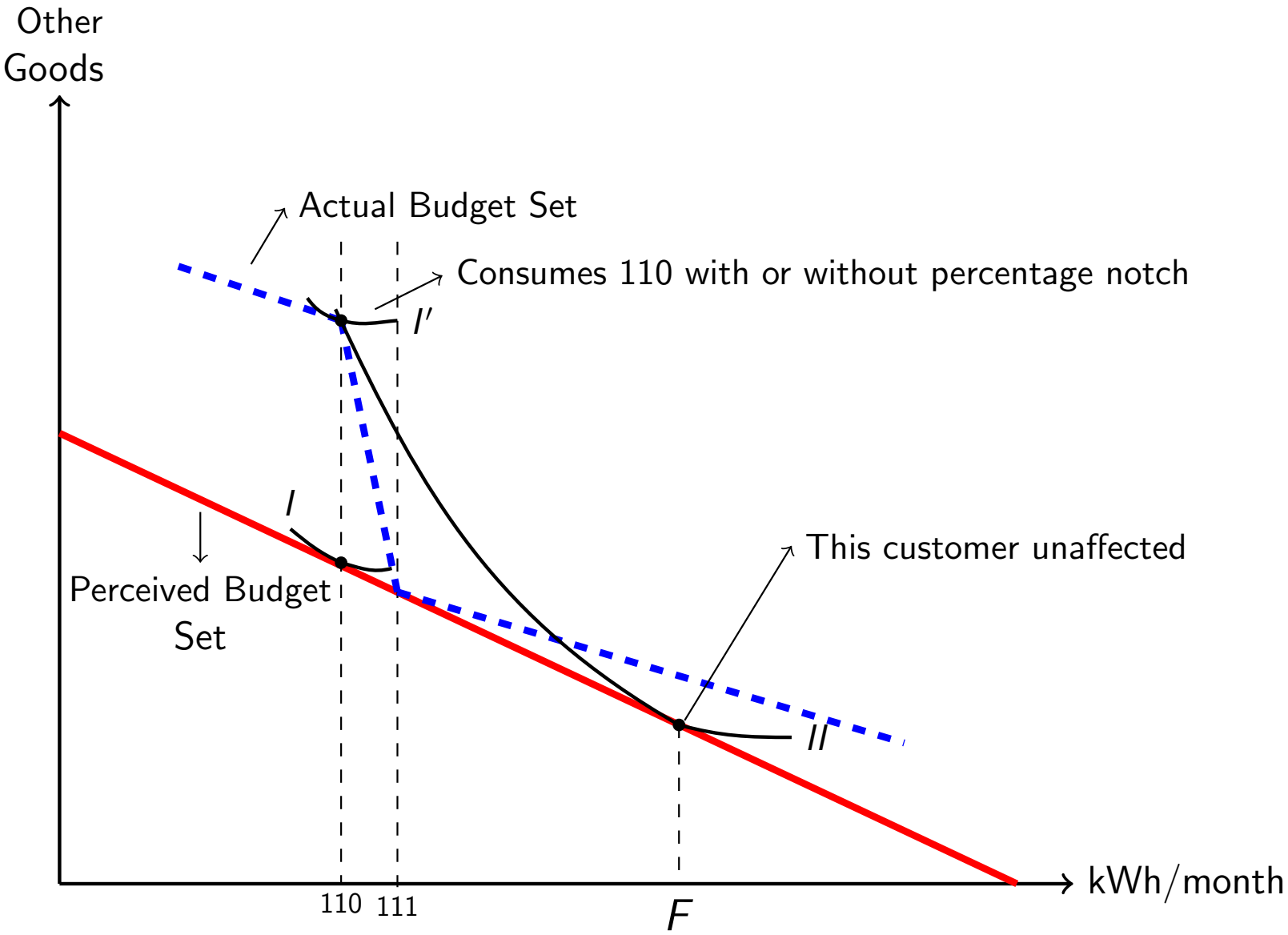
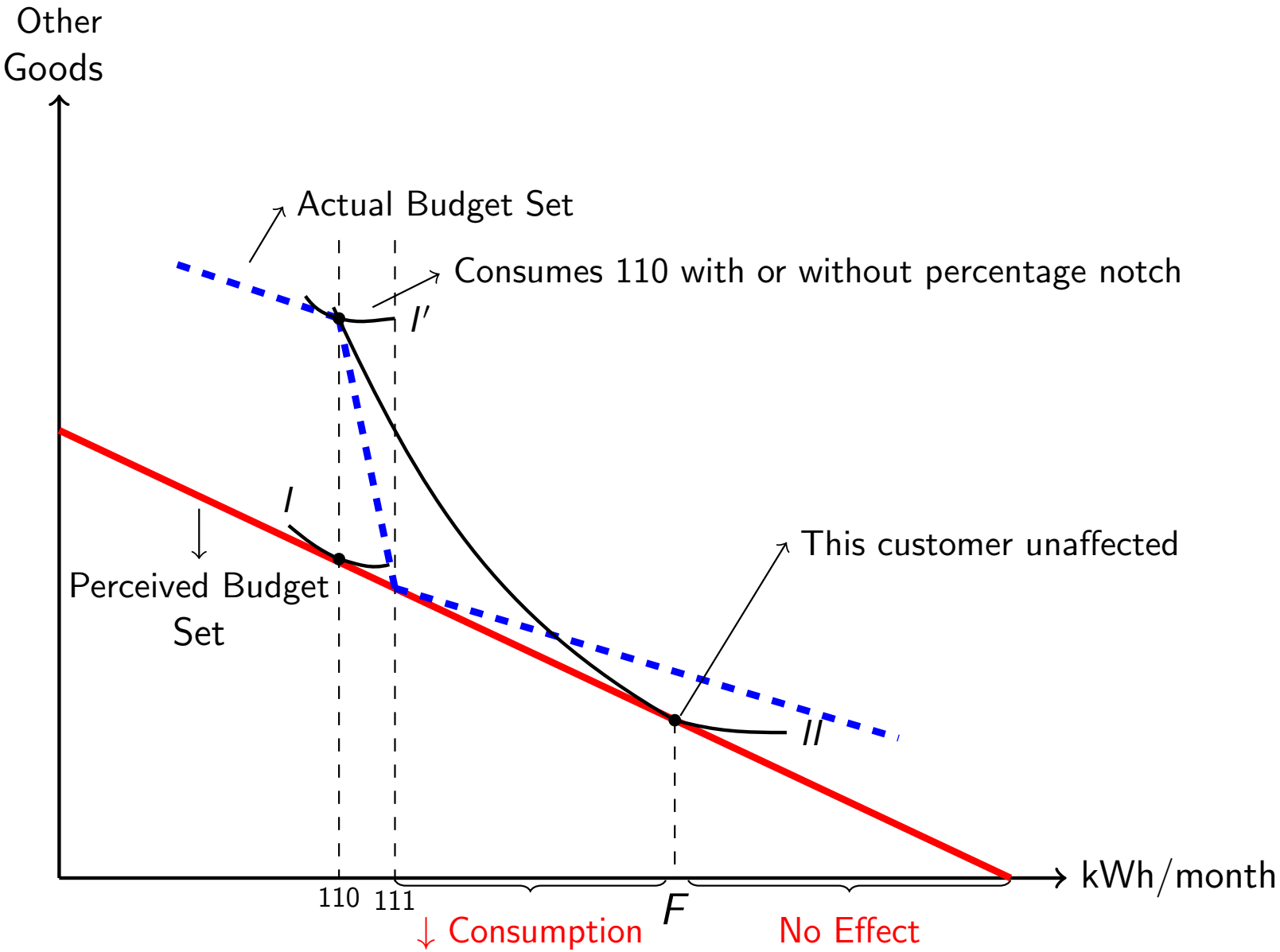


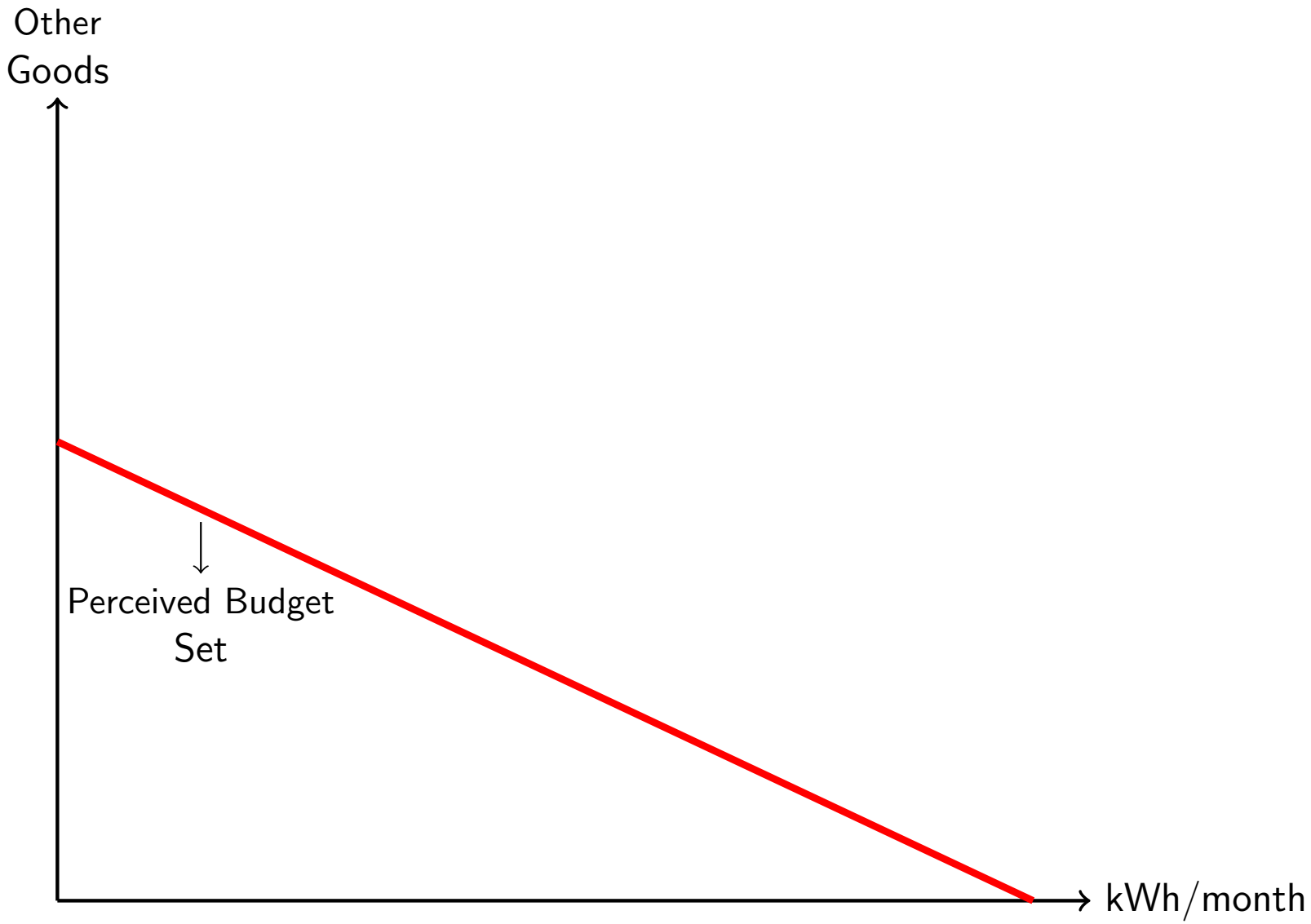
Above 110: Price Salience (No Frictions)



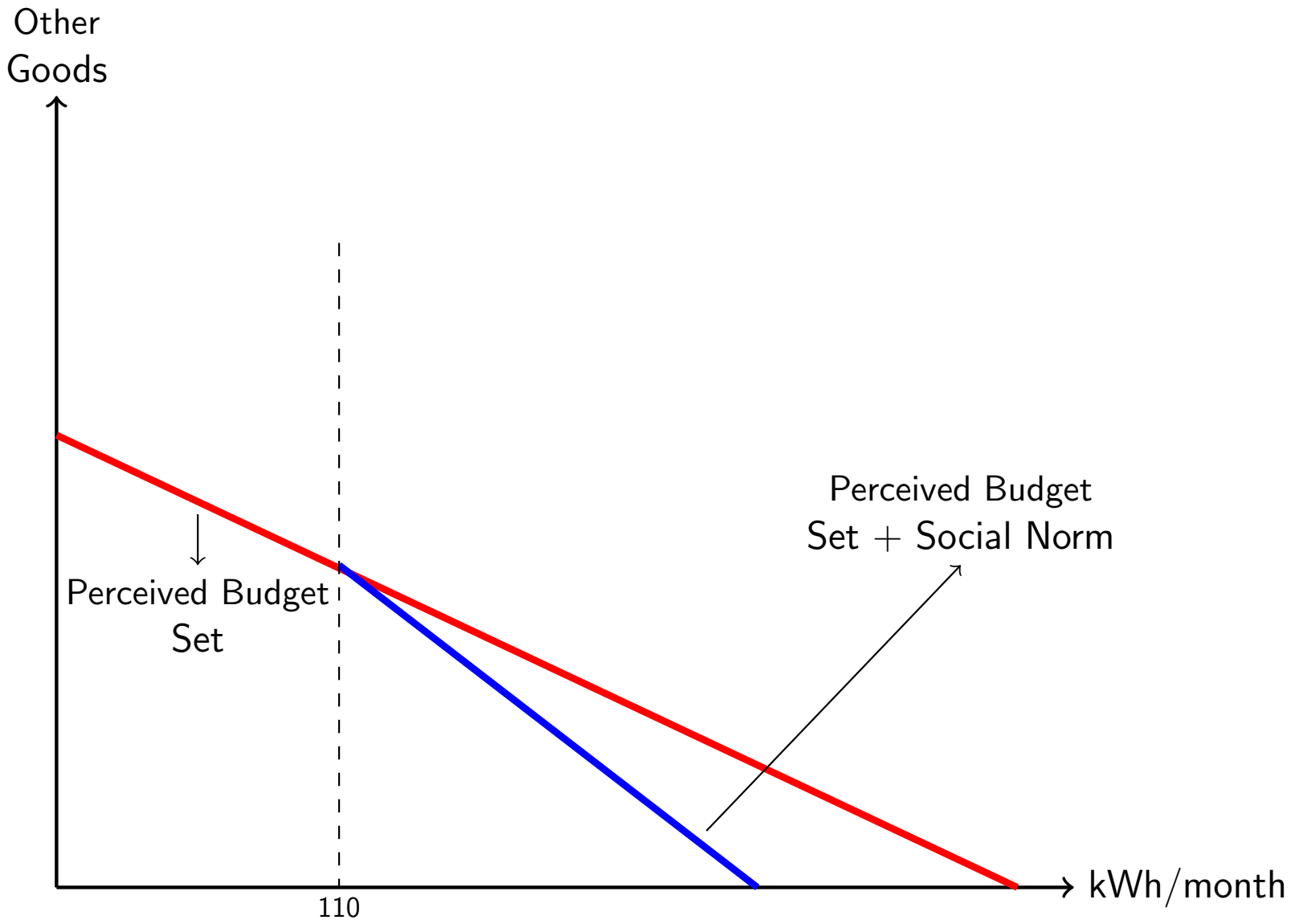
Above 110: Price Salience (With Frictions)

- Predictions:
  - "Just Above" will reduce consumption to the notch
  - "Far Above" unaffected
- .... but consumers cannot fully optimize
  - Cannot perfectly monitor consumption daily
  - Meter read cycle can be +/- a day
- Adds "noise" to these predictions

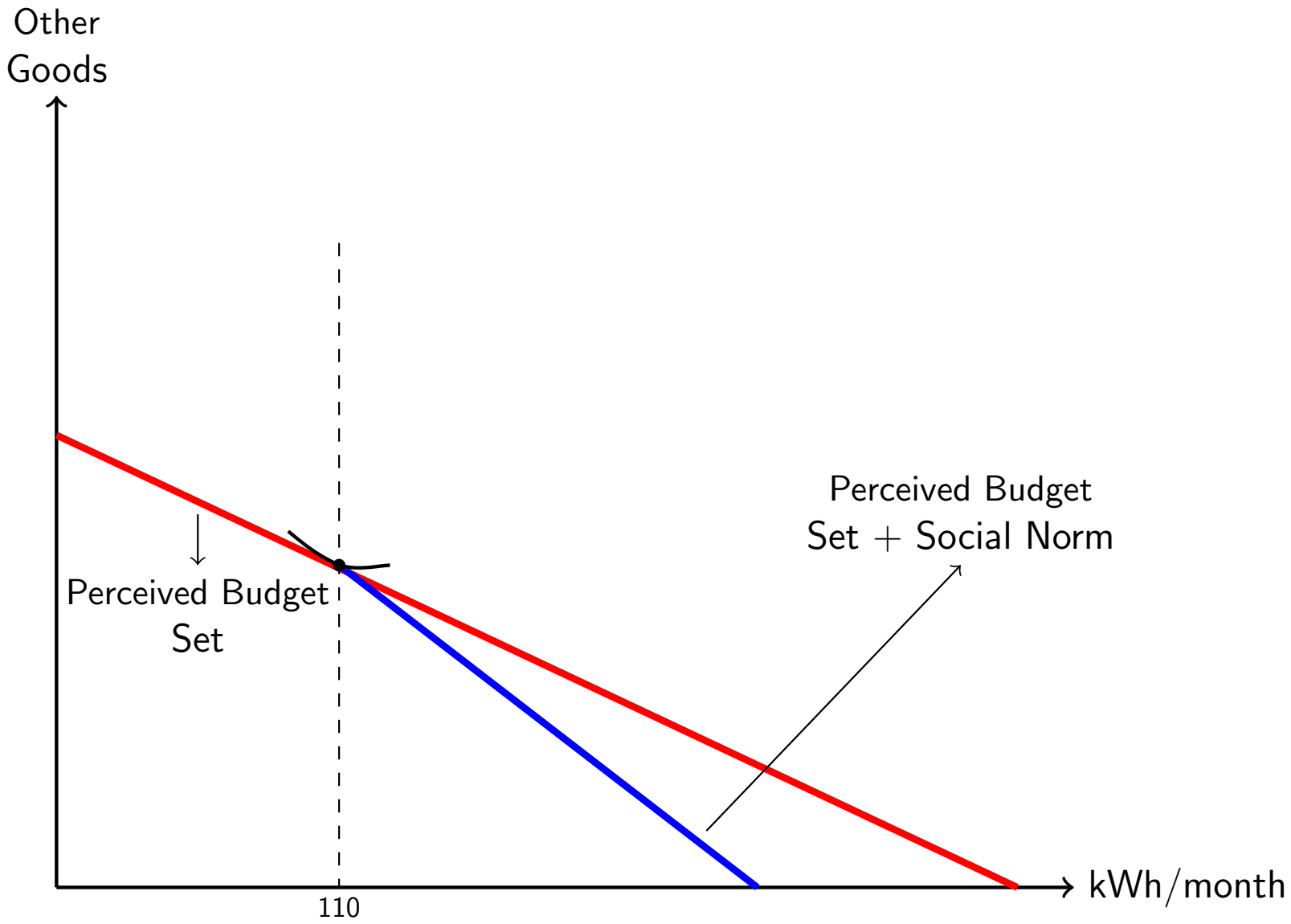
Above 110: Social Norm (No Frictions)



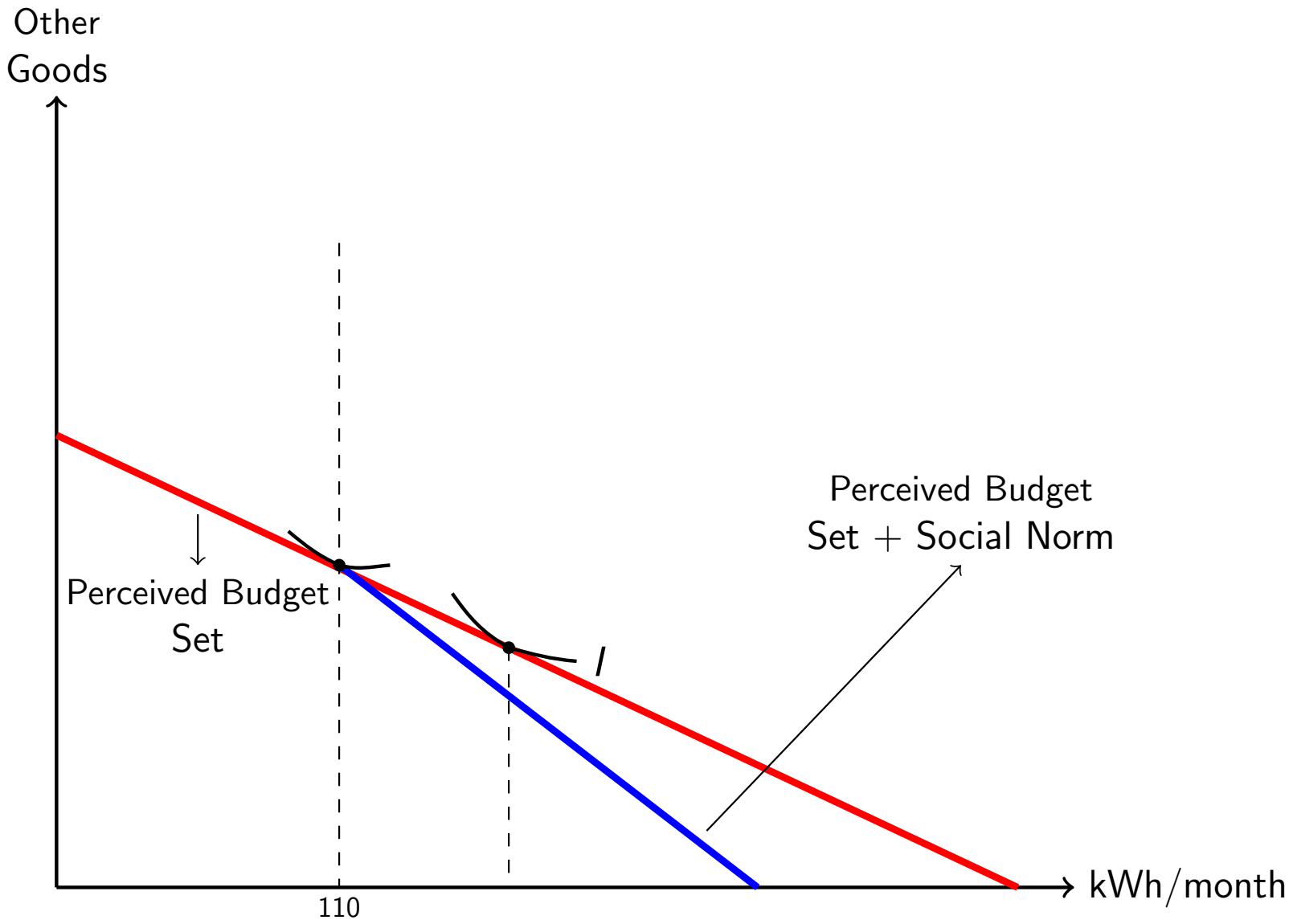
Above 110: Social Norm (No Frictions)



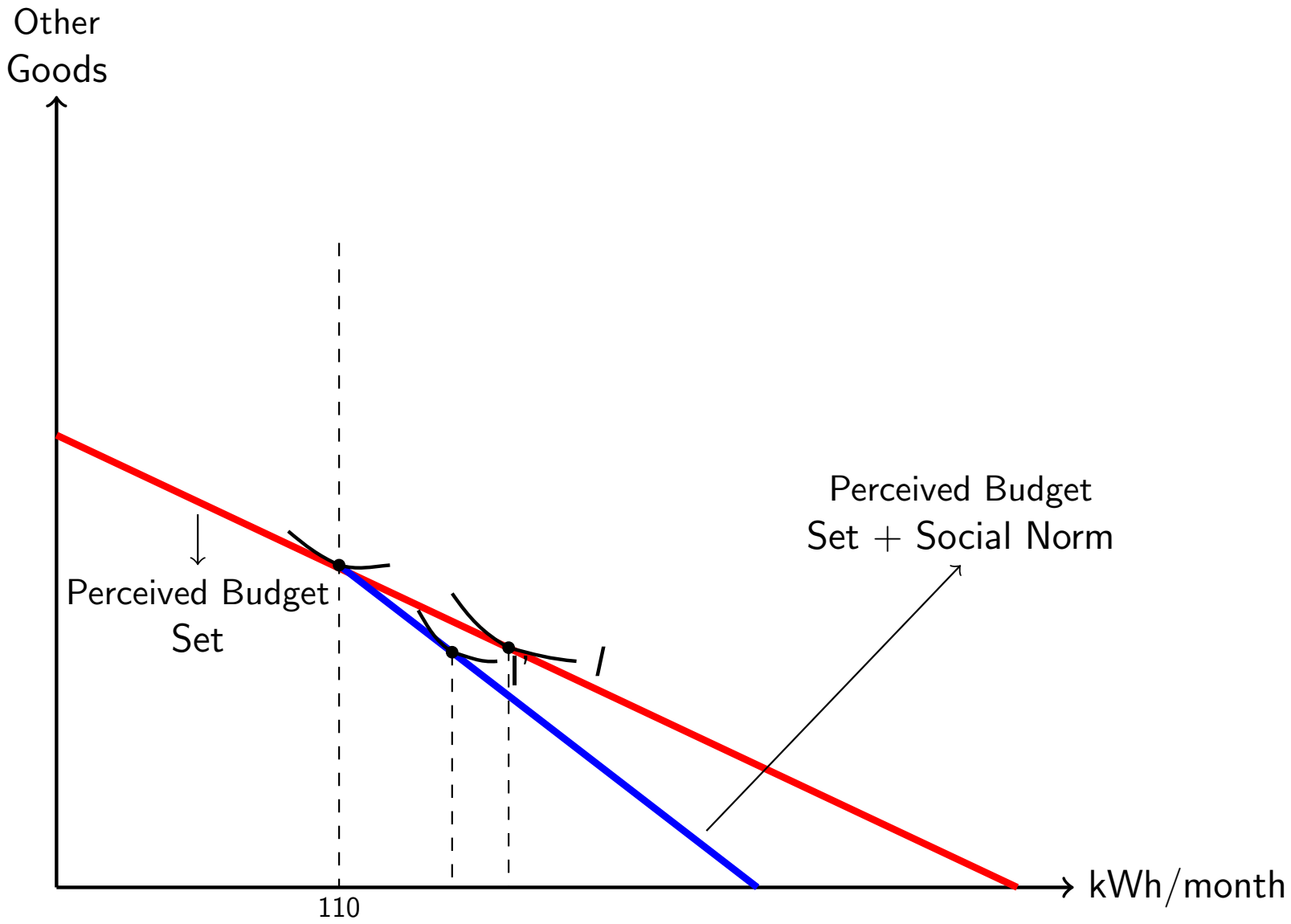
Above 110: Social Norm (No Frictions)



Above 110: Social Norm (No Frictions)



Above 110: Social Norm (No Frictions)



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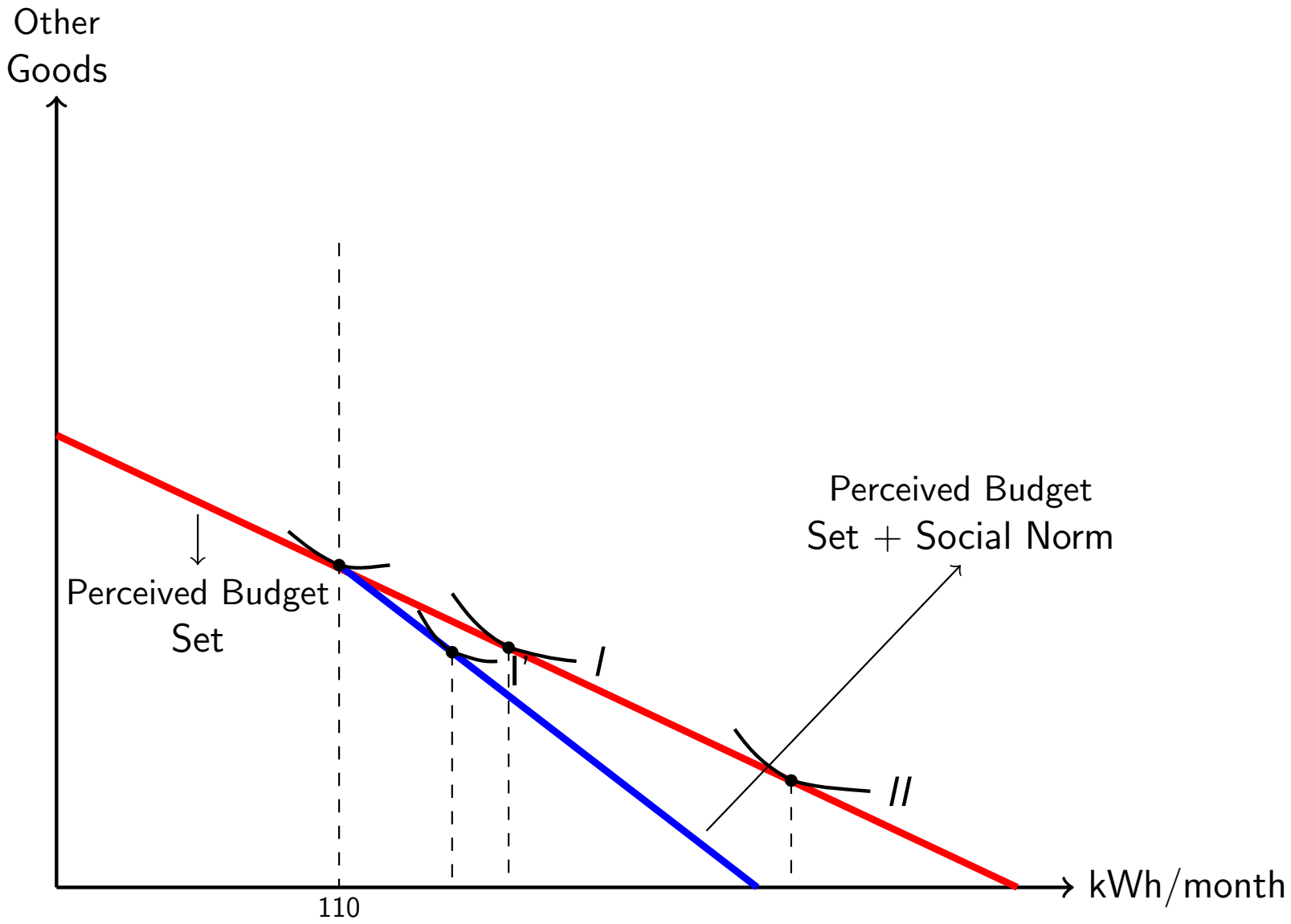

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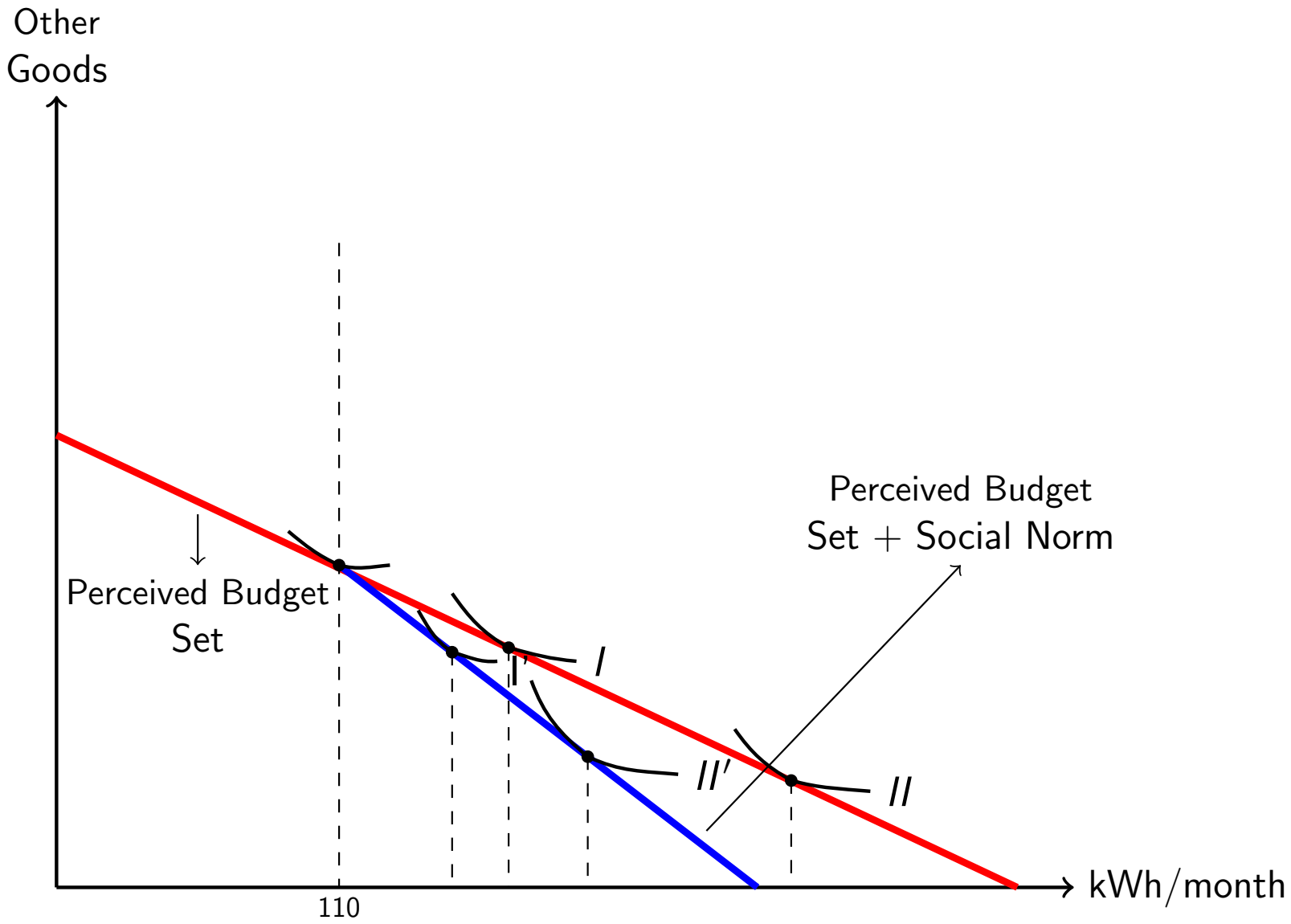

Above 110: Social Norm (With Frictions)

- Predictions:
  - "Just Above" and "Far Above" will reduce consumption
  - Shift density of consumption to the left
  - Optimization frictions add "noise" to prediction (as with Price Salience)

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