The Effect of Energy Price Changes when Salience is High: Residential Natural Gas Demand in Ukraine

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Salience

- Consumer ability to perceive the full price of a product
- Low salience = Consumer perceives only a part of the price of a product and/or misses the changes
- Salience is compromised when
  - Posted prices omit taxes (Chetty et al., 2009)
  - Automatic billing (e.g., E-Z Pass, in Finkelstein, 2009; electricity bills, Sexton, 2015)
- Salience is low for energy prices (Deryugina et al., 2019)

Price elasticity of Residential Natural Gas Demand

- Key for
  - Carbon tax
  - Infrastructure planning
  - Securing supply
  - Assessing possible rebound effect (Sorrell and Dimitropoulos, 2009)
- Generally thought to be low (possibly because of low salience? Deryugina et al., 2017)
- Need variation in price to estimate

Price Elasticity of Residential Natural Gas Demand

- Ukraine 2013-2017:
  - Extreme price changes (+700%)
  - Caused by conflict with Russia, other economic pressures
  - Permanent
  - High salience

Extreme Energy Price Changes

- How often are they observed?
  - California: SD&E elec. service territory during the 2000-01 Enron crisis
  - Former Soviet Republics (McRae, 2016)
  - Krauss (2016) (gas, Armenia)
  - Argentina since 2015
- How well are they studied?
  - Critical peak pricing (Wolak, 2011; Jessoe and Rapson, 2014) (elec., few summer events, temporary)
  - Krauss (2016) (gas, Armenia)

Ukraine: High Salience

- Bills are very clear, monthly, based on actual meter reading (not on presumptive or estimated consumption)
- Bill is for natural gas only
- No automatic debiting (0.6%; people pay at post office or bank)
- Tariffs are inclusive of taxes
- “utility book”
- People are responsible for their own consumption (no district heating) and own their homes (94.7%)
- Tariff increases were huge!
- “Conspiracy theories”

Sample gas bill

Постачальник: ПАТ "Закарпатгаз" ВОРФО м. Ужгород, вул. Погорелова, 2
тел.(0312) 61-21-46, 66-39-98, **р/р 26037301083700 МФО 312356**
Код 05448610

Рахунок сплатити протягом 10 днів. Виправленню не підлягає.

РАХУНОК №821489/11
на оплату за спожитий природний газ за **Листопад** 2014р.

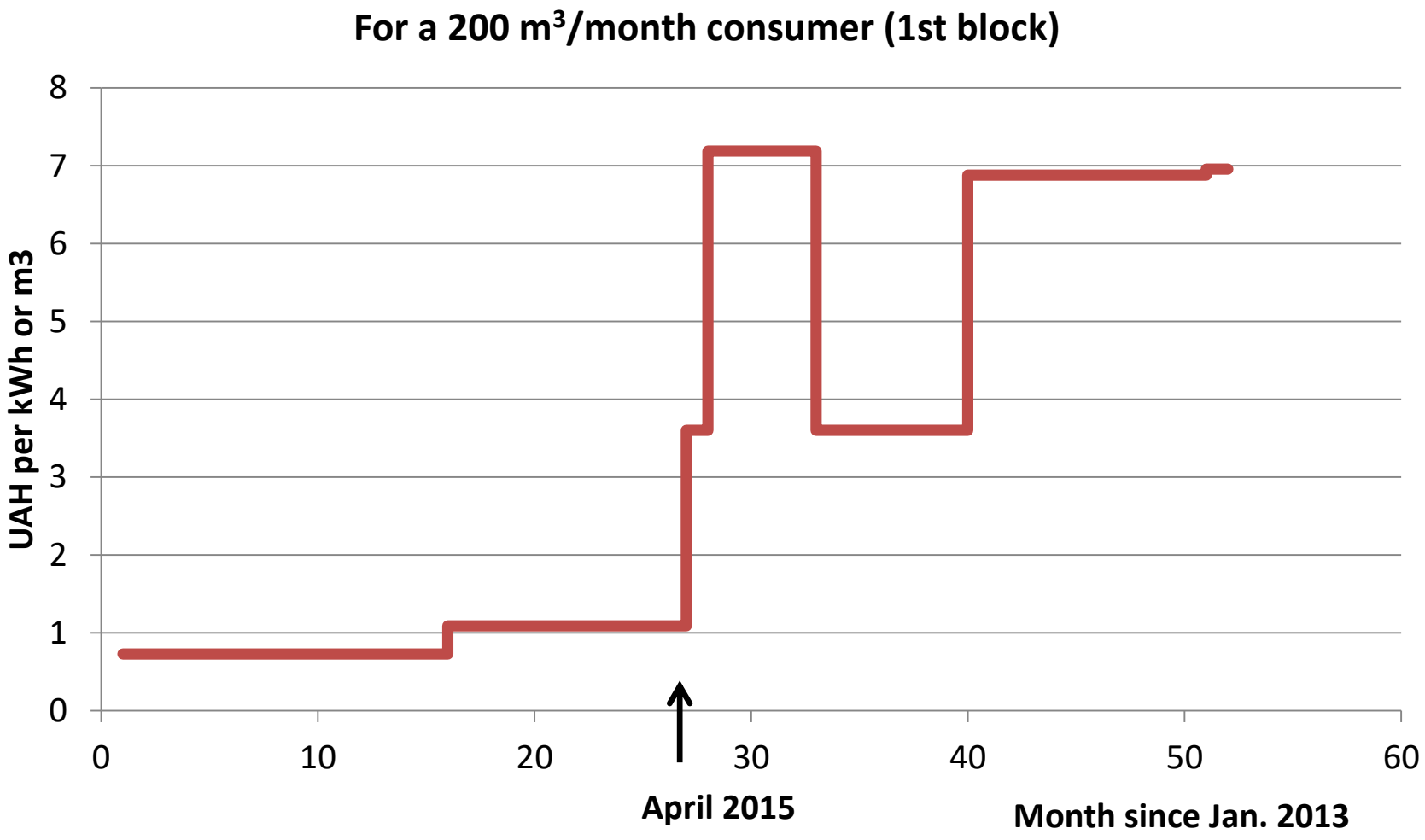
[redacted] **Споживач:** [redacted] **Адреса:** Ужгород, вул. Можайського, буд. 34, кв. 19.
Пільги- Осо 50%- 2 . **Лічильник** G4, №8046180.

Показники лічильника			Ціна, 1м3: 1,089 грн.		
Попередній	Фактичний на дату 30.11.2014	Плановий, на кінець місяця рекомендов.	під час відсутності лічильника, м3.	в т.ч. по пільзі, м3.	Всього нараховано, м3.
444	647	0			
203 м3	0 м3		0,00	191,09	203,00

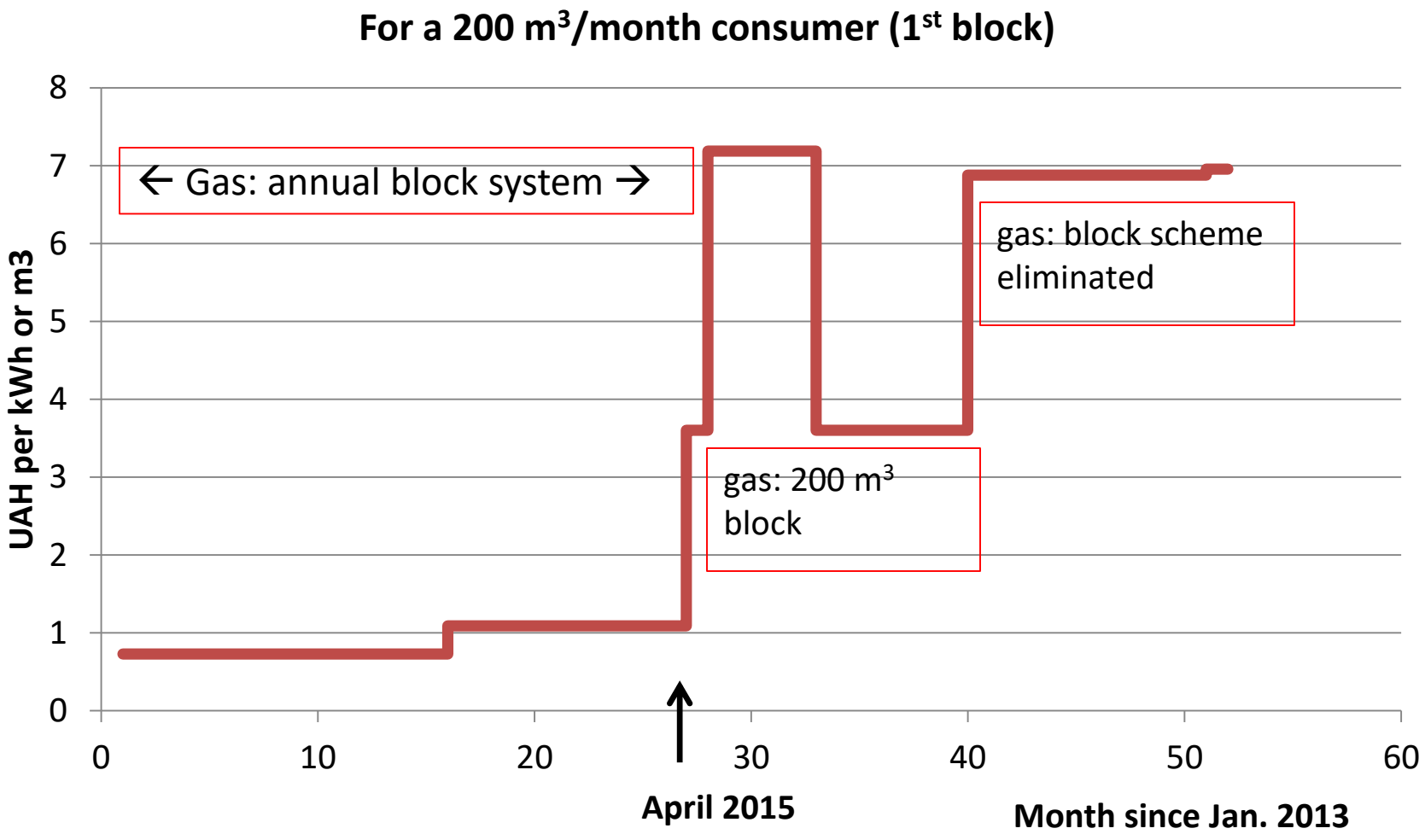
Увага! Сплачувати за газ можливо через платіжну систему на сайті http://ipay.ua Детальна інформація на сайті http://zk.104.ua

Нараховано всього, грн.	Пільги, грн.	Рекомендована сума до сплати, грн.
221,07	104,05	117,02
Залишок на рахунку		75,67
Коригування		0,00
Субсидія		0,00
Оплачено:		75,67
Всього до сплати, грн.:		**117,02**

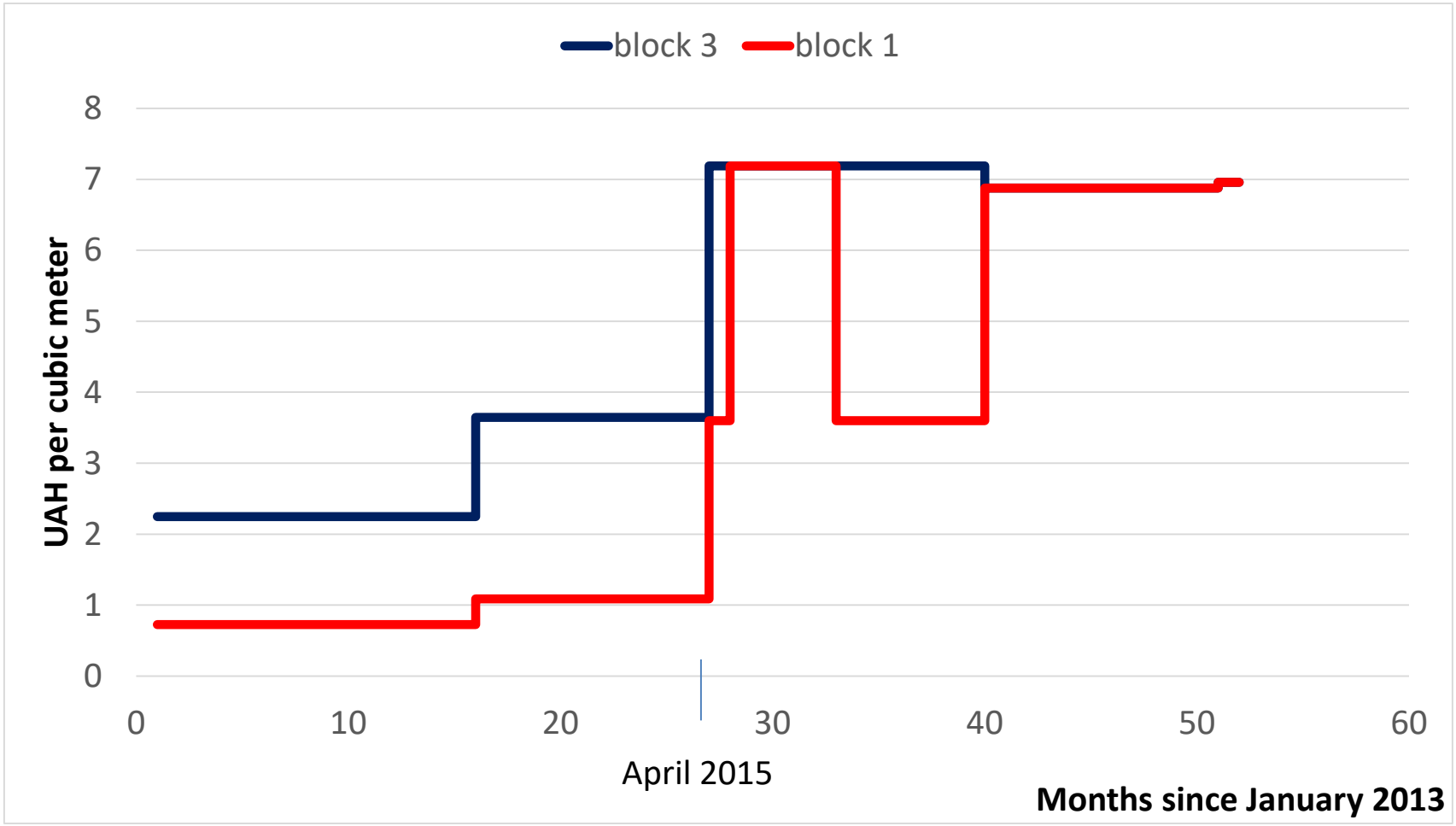
Gas Tariffs 2013-2017



Gas Tariffs 2013-2017



Tariffs for Light and Heavy Users



Government Policies

- Tariff hikes were a major shock to the population.
- Very good payment compliance, despite difficulties.
- Subsidies
  - Means-tested assistance to help pay energy bills
  - Lump-sum transfers, do not change marginal prices
  - Since 2010, but jacked up Sept. 2016

Research Questions

- What is the short-run price elasticity of demand…
  - In generally high salience, big price shocks conditions?
- Is there heterogeneity depending on income and housing type?
- Is there heterogeneity due to awareness and higher/lower salience?

Methods & Data

- Panel dataset with monthly electricity and gas meter readings
- Collected from households in Uzhhorod, Ukr.
- Survey enumerators asked respondents to show bills from Jan. 2013 and took down info
- 2 waves
  - May-June 2016
  - May-June 2017


National Capital (2,650,000 in 2004)
over 1,000,000
over 500,000
over 100,000
over 25,000
other main city
Capital of province (Oblast)
Ukranian provinces (Oblasti) have the name of their capitals. Crimea (Respublika Krym) is an autonomous republic of Ukraine
BELARUS
RUSSIAN FEDERATION
POLAND
SLOVAKIA
HUNGARY
MOLDOVA
ROMANIA
SEA OF AZOV
BLACK SEA
KYYIV (Kiev)
Here!
UKRAINE
0 km 4.5 90 13.5 km
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Sampling frame

2016 Survey

- N=500 households
  - Sample was representative of the stock of housing

- Energy bills from Jan 2013 to Apr 2016
- Max T=40

2017 Survey

- N=500 households
  - N=250 representative of the stock of housing
  - N=250 Choice-based sampling – wall insulation visible from the outside (see photo)

- Energy bills from Jan 2013 to Apr 2017
- Max T=52

Wall insulation, Uzhhorod

Wall insulation, Uzhhorod

Descriptive Statistics

	Wave 1	Wave 2
Type of home: SF home unit in MF building semi-detached	 39.8% 56.8% 3.4%	 35.2% 61.4% 3.2%
Size of the home (square meters)	79.95	78.34
Main heating fuel: natural gas electricity solid fuels	 73.0% 15.8% 8.8%	 72.0% 21.4% 6.0%
Natural gas usage/month (cubic meters)	139.6	142.8
Receives “benefits”	7.5%	5.0%
Has done EE renos since Jan 2013	31.0%	54.6%

Sample used for this paper

- Wave 1 and wave 2
- Did **not** do any EE upgrades Jan 2013-time of the survey
  - we are interested in **short-run elasticity**
  - we are interested in gas usage changes solely due to behaviors
- N=514
  - Wave 1: N=305
  - Wave 2: N=209

The Model

$$lnG_{it} = \alpha_i + \tau_t + \mathbf{W}_{it}\boldsymbol{\beta} + \gamma_1 \cdot \ln P_{it} + \gamma_2 \cdot \ln S_{it} + \gamma_3 \cdot D_{it} + \varepsilon_{it}$$

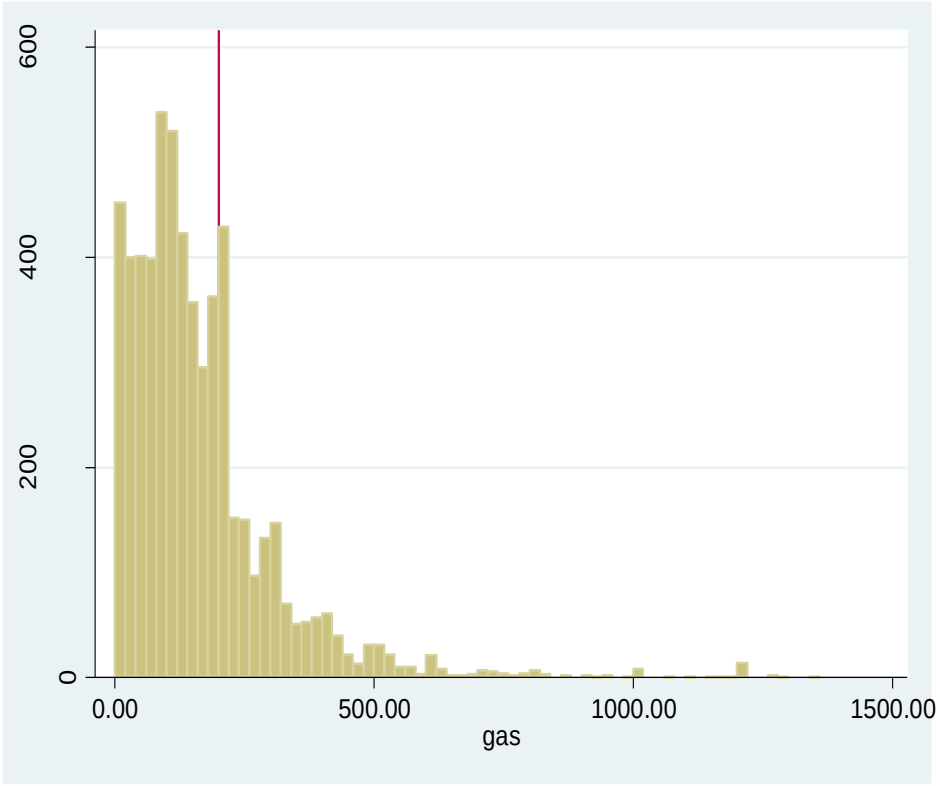
weather price subsidy Subsidy but amt. unknown

where i=respondent, t=month and year.

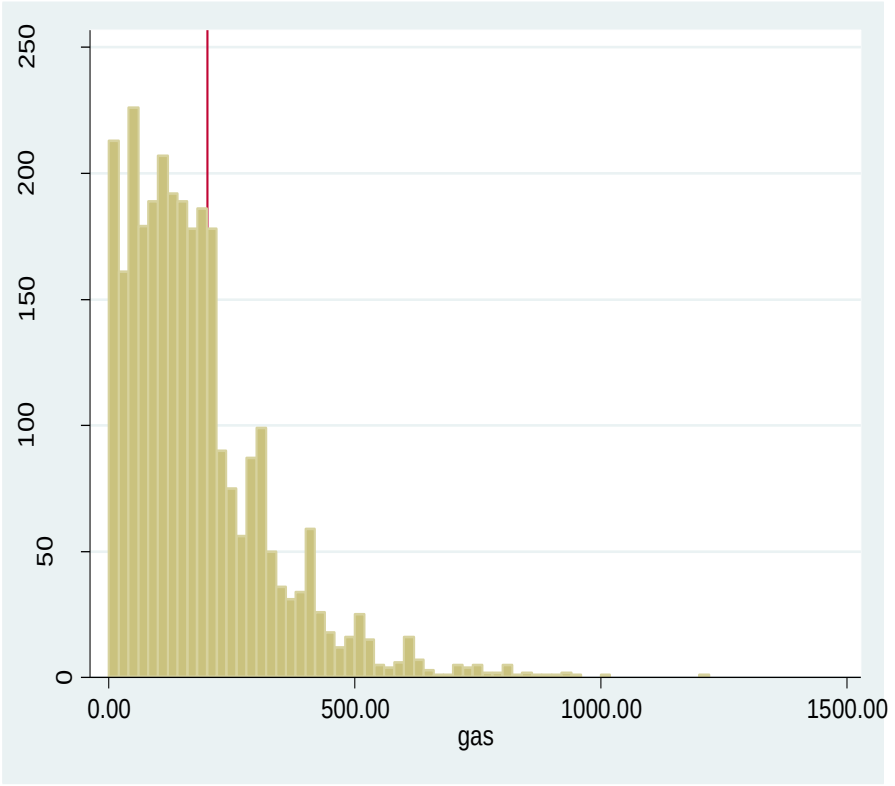
- Estimate in the first differences to get rid of α_i
- Marginal or average price? Borenstein (2009), Ito (2014)
- IBR for much of the study period: marginal price positively correlated with consumption → must instrument
- Excluded instruments: rates in each block (Nieswiadomy and Molina, 1989; Olmstead and Mansur, 2013); log benefits allowance and log benefits discount off the regular rates.

Marginal or Average Prices? Bunching at the Block Cutoff

April 2015-April 2016 (heating season, block is 200 m^3)



April 2015-April 2016 (no blocks)



Sources of variation in tariffs

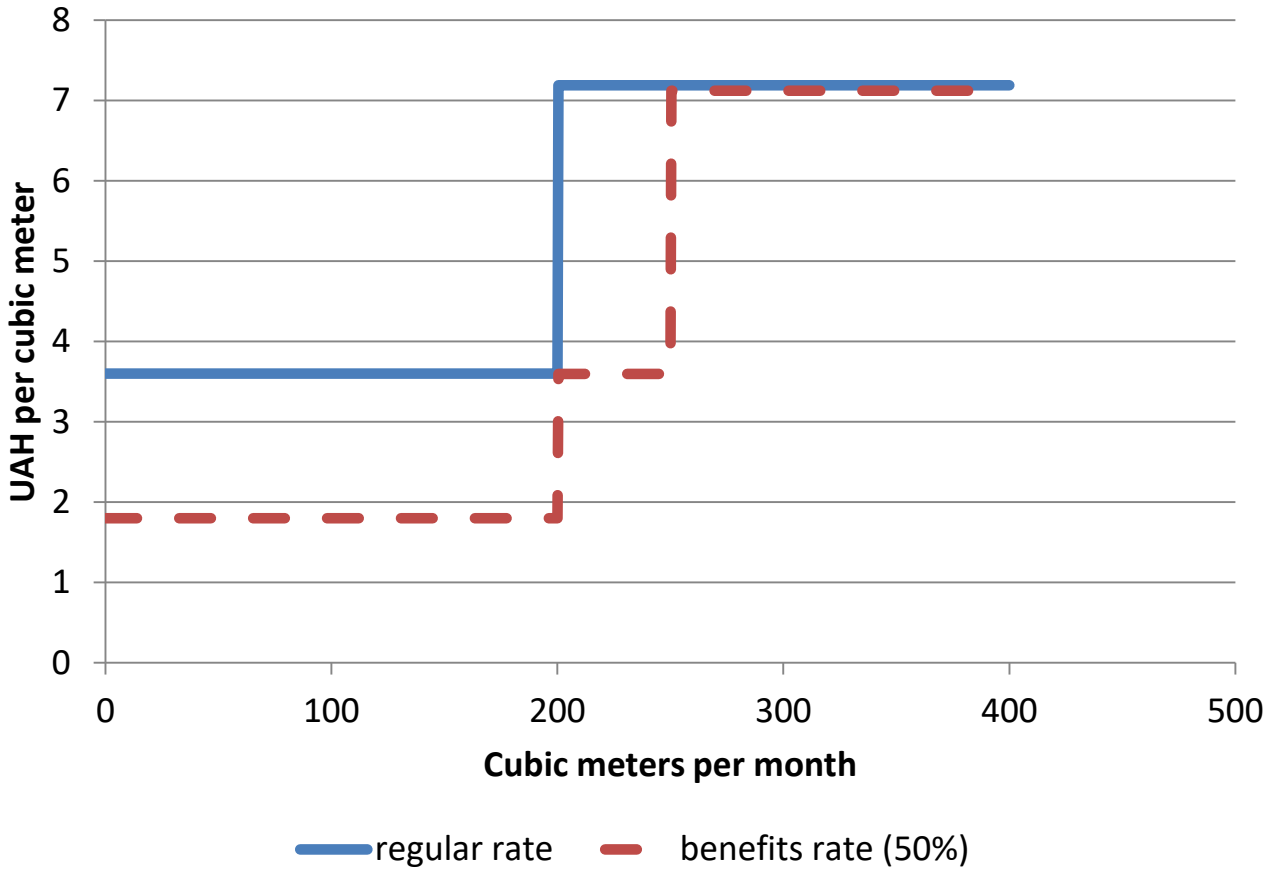
- Tariffs were changed over time
  - At different rates in the different blocks
- Blocks were changed
- Benefits
  - Children of the War
  - Participants of Battle Actions
  - Military
  - Chernobyl decontamination workers
  - …

Change in Tariffs by Block

	Proportional increase		
Date of the tariff change	**1st block**	**2nd block**	**3rd block**
from April to May 2014	+3.36%	+62.84%	+62.13%
from March to April 2015	+230.58%	+302.01%	-1.23%
from April to May 2015	+99.66%	0.00%	0.00%
from September to October 2015	-49.92%	0.00%	0.00%
from March to April 2016	+91.08%	-4.30%	-4.30%
from April to May 2017	+1.11%	+1.11%	+1.11%

Tariff remained stable during the months after the dates indicated above, until the next tariff increase.

Additional variation from “benefits”



Allowance =250 m^3/mo. Discount on tariff=50%.

For usage within the allowance, price is 50% the regular tariff.

This results in 3 blocks instead of 2.

Estimation results-Natural Gas Demand

	(A) OLS	(B) IV (2SLS)
Δln marg price [SR price elasticity]	0.0460 (1.77)	-0.1643*** (-5.46)
Δln Subsidy	0.0200 (1.28)	0.0208 (1.31)
Received subsidy but amount unknown	0.1184 (0.52)	0.1363 (0.62)
Excluded instruments for marginal price	None	Log tariffs, log benefits
Number of observations	12,763	12,726
Number of households	512	512

All regressions include household FE, time FE, weather and other time varying controls.

Heterogeneity in SR Elasticity

Sample:	**SR elasticity (IV 2SLS)**	**T stat**
Above median income	-0.0788	-1.76
Below median income	-0.2044***	-4.32
MF building	-0.1294***	-3.46
SF or semi-detached home	-0.2247***	-4.67
No EE renos since Jan 2013, but some 1-7 years prior	-0.1458***	-4.30
No EE renos since Jan 2013, and none in the 1-7 years prior	-0.2330***	-3.94

All regressions include household FE, time FE, weather and other time varying controls.

Salience, Attentiveness and SR Elasticity

Sample:	**SR elasticity (IV 2SLS)**	**T stat**
People who correctly estimate their winter usage	-0.1297***	-3.55
People who overstate their winter usage	-0.2315***	-5.05
Heavy users (224 or more m^3/month)	-0.1995***	-3.21
Light users (less than 224 m^3/month)	-0.1473***	-4.86
Gas meter inside the home	-0.1566***	-5.17
SF home and meter inside the home	-0.1739***	-3.43

All regressions include household FE, time FE, weather and other time varying controls.

Conclusions

- Consumers did respond to the tariff hikes in the short term…
  - Price elasticity is small (compared to the huge price changes)
  - A moderate user (200 m^3/mo.) would have reduced consumption by 18-25% for a 230% price increase (e.g. Mar-April 2015)
- Government subsidies helped pay bills but did not hinder efforts to reduce usage
- We speculate that people that do not do EE renos may be the ones who, by necessity or skills, are the most productive at reducing energy use
- Results suggest that a carbon tax on natural gas would have little effect, unless…

Thank you.
Comments? Questions?
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Ukraine and Natural Gas

- Ukraine produces natural gas, but not enough
- Forced to import some two-thirds of its needs
  - Mostly for heat generation and manufacturing
  - Not much for electricity generation
- “Was” also important transit for Russian pipeline natural gas exports to Europe
- Russia suspended deliveries in 2014 (and 2006)
- EU to the rescue!

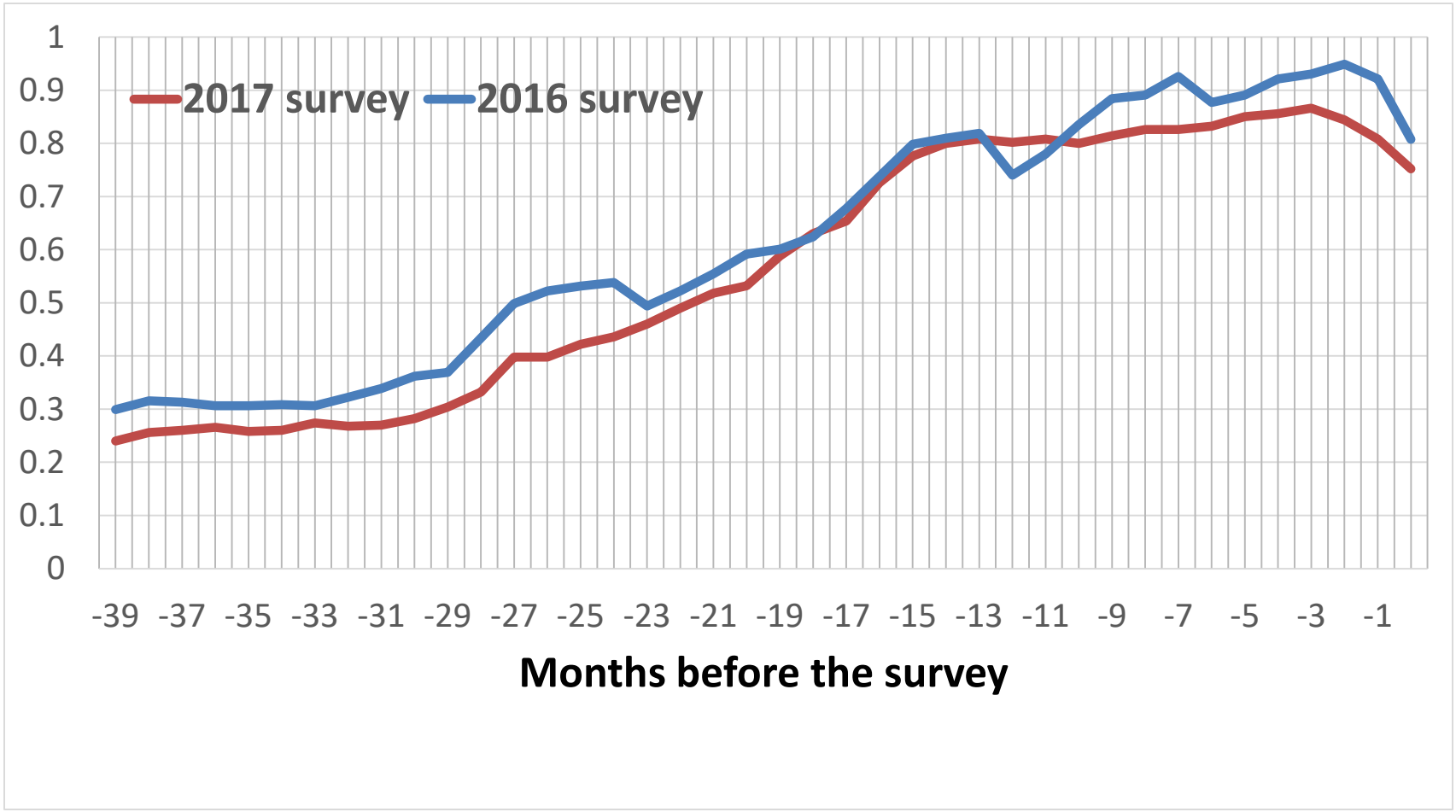
Suppliers and Regulators in Ukraine

- Naftogaz
- Regional subsidiaries, e.g. Zakarpattiagaz
- Prices set by NERC, an independent government agencies

Preliminary Data Checks

- Unbalanced panel:
  - Is there attrition bias?
  - No. People appear more likely to report recent bills, as is normal.
  - Formal checks suggest no attrition bias (Wooldridge, 2010, p. 823-4)

Share of gas bills available



Survey response rates

		wave 1	wave 2
total contact attempts		959	802
	address not found	16	20
	unable to access building	77	11
	no response @ door	182	94
	ineligible (renters)	53	42
	total invalid or failed contacts	328	167
valid contacts made		631	635
	declined to partipate	108	117
	completed questionnaires	500	500
	bad questionnaires	23	18
response rate out of valid contacts		79.24%	78.74%