Regional Prices Differences and Economic Development Gaps

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- In the recent years, though, there has been a growing interest in regional development patterns.
- This is largely driven by new data and econometric techniques.
- As a result within-country comparisons have emerged as an important testing ground for economic development theories.

(Gennaioli et al., 2013; Acemoglu et al. 2014)

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- Regional GDP comparisons do not fully adjust for relative price differences across regions.
- Most available regional GDP statistics are adjusted for prices differences only at the country level.
- Yet, prices differ systematically also within countries across regions, as they do across countries.

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There is a vast literature on relative price differences and how they vary with economic development. *(Rogoff, 1996; Taylor, 2002; Bergin et al., 2006; Deaton, 2010; Johnson et al. 2013, Feenstra et al., 2015; Inklaar & Prasada-Rao, 2017)*

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Beyond the US case we don't know much about regional price differences.

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- Provides some direct evidence for within-country price differences.
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- Constructs price-adjusted real GDP series at the regional level.
- Assesses how these price corrections affect key conclusions about regional economic development.

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Eventually it will be extended to a global level.

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- Compare income difference across EU regions with and without price adjustment.
- Show how interregional price adjustment alter results about income convergence.

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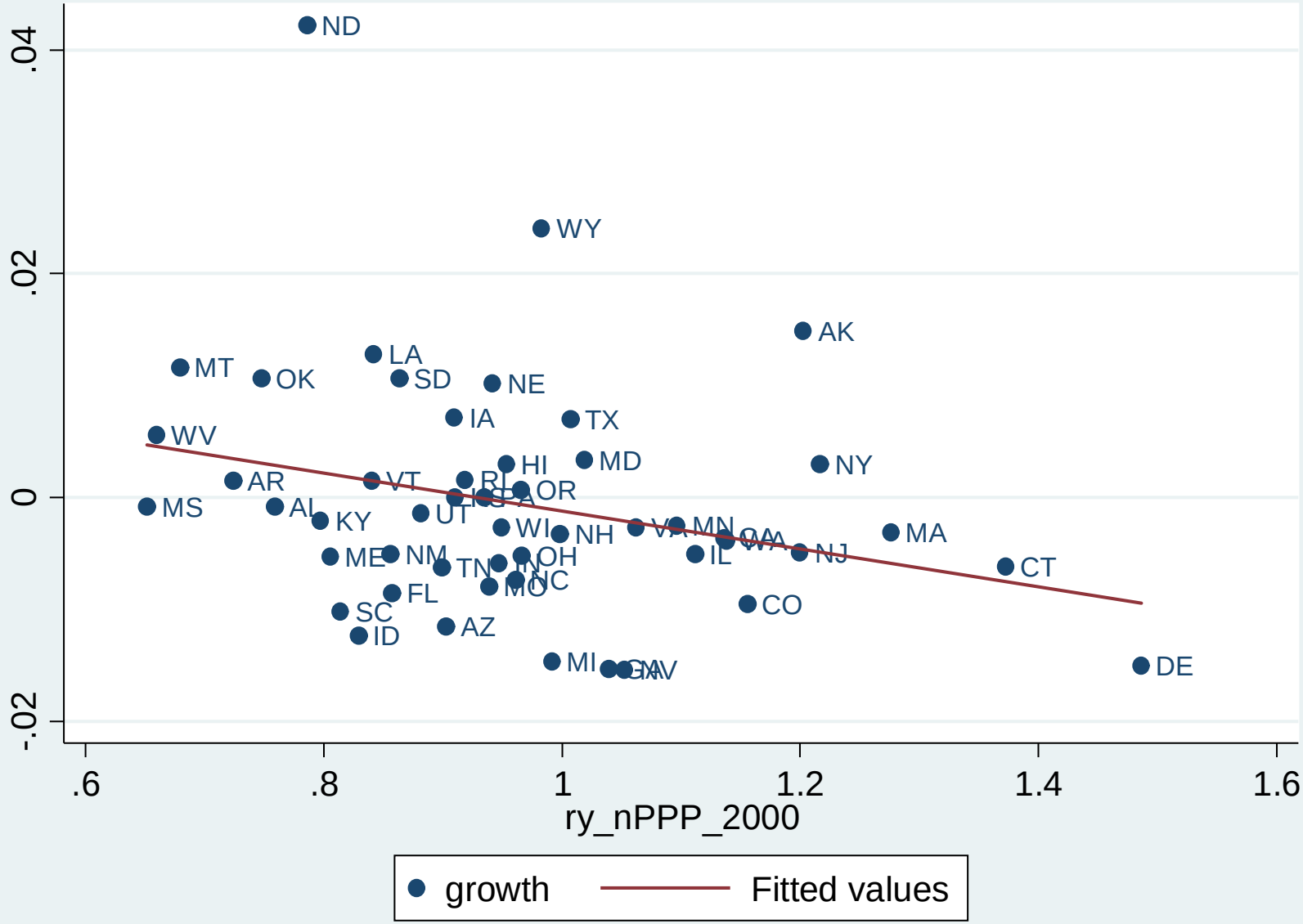
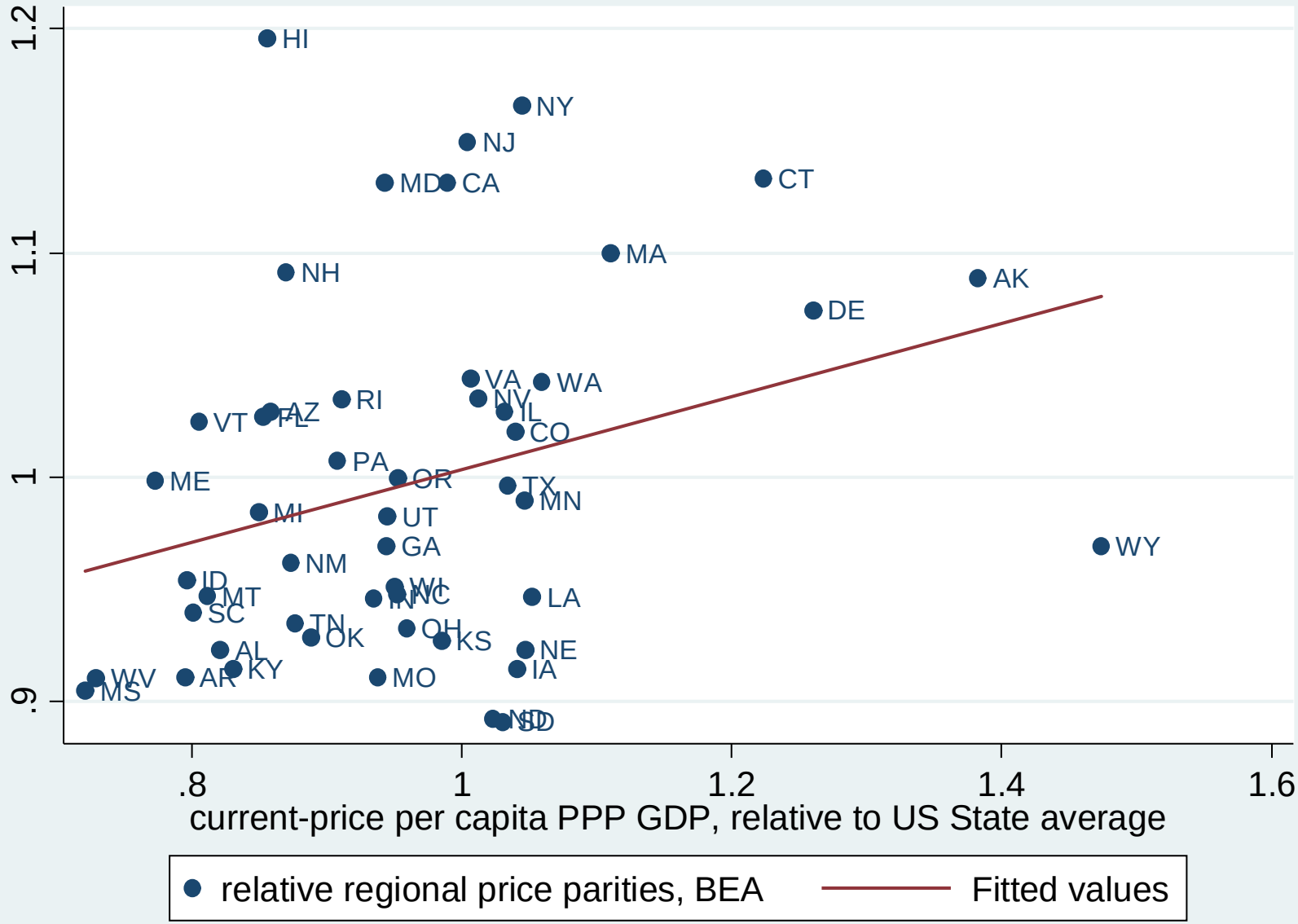
- The US is a highly integrated and competitive economy.

- As a result there are strong forces leading to both price and income convergence.

Income Convergence across US States



Penn Effect across US States



Income and Price Differences across US States

Year 2007				
US States				
	Mean	St. Dev.	Min	Max
Relative GDP per capita (Unadjusted)	1	0.1965	0.6784	1.5658
Relative GDP per capita (Adjusted)	1	0.1555	0.7505	1.5339
Relative Price Index (BEA)	1	0.0794	0.8935	1.1991

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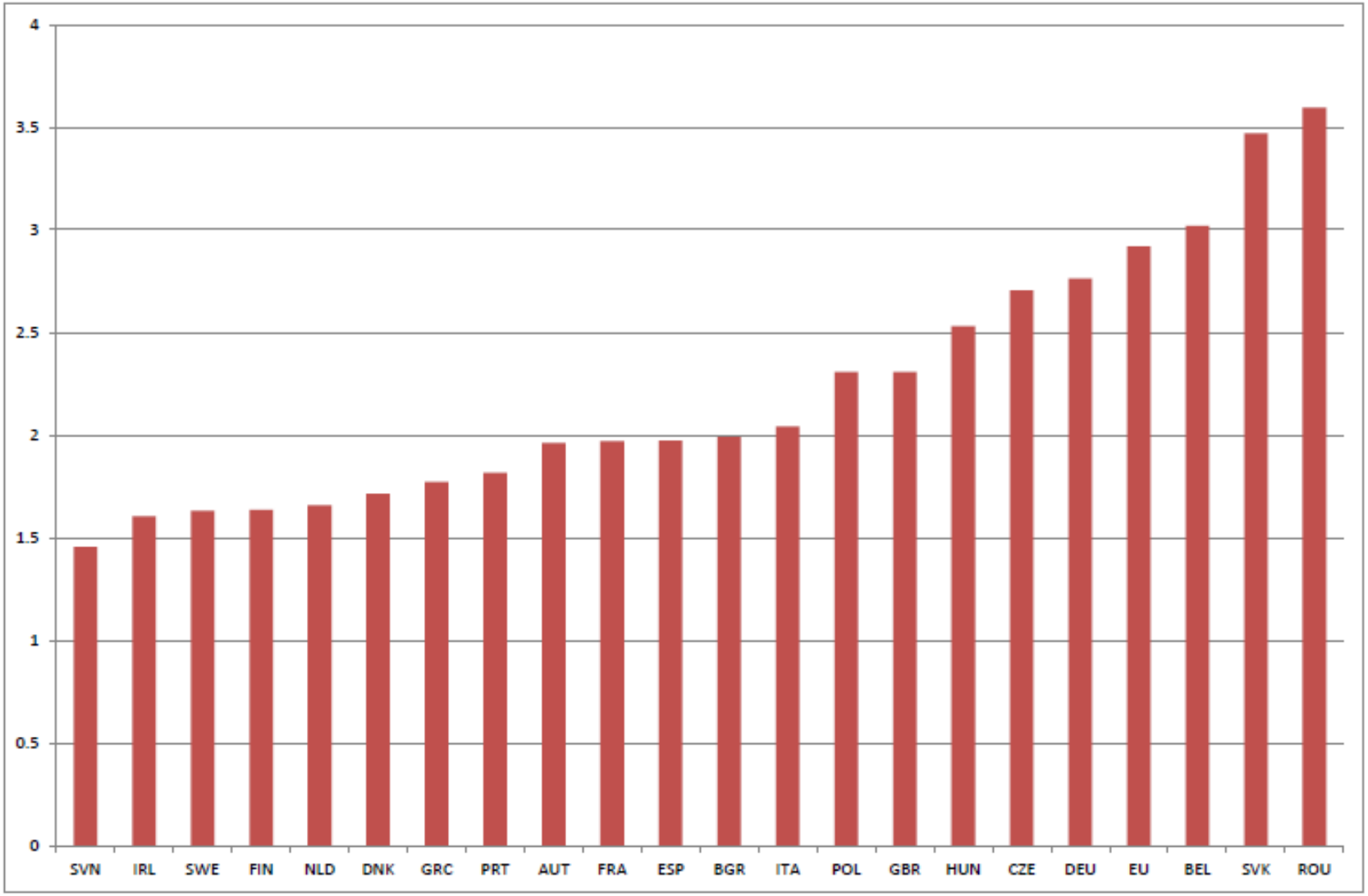
EU Regions (NUTS-2)				
Relative GDP per capita (252 Regions)	1	0.2997	0.0761	1.6939
Relative GDP per capita (201 West Regions)	1.1634	0.2162	0.3580	1.6939

Within-Country Income Differences in the EU



Direct Evidence

on Regional Price Differences

Numbeo Online Price Database

NUMBEO

Select City (Cost of Living) | What are you looking for?

Cost Of Living | Property Prices | Crime | Health Care | Pollution | Traffic | Quality Of Life | Travel

Taxi Fare Calculator

Gas Prices Calculator

Cost of Living

Cost of Living

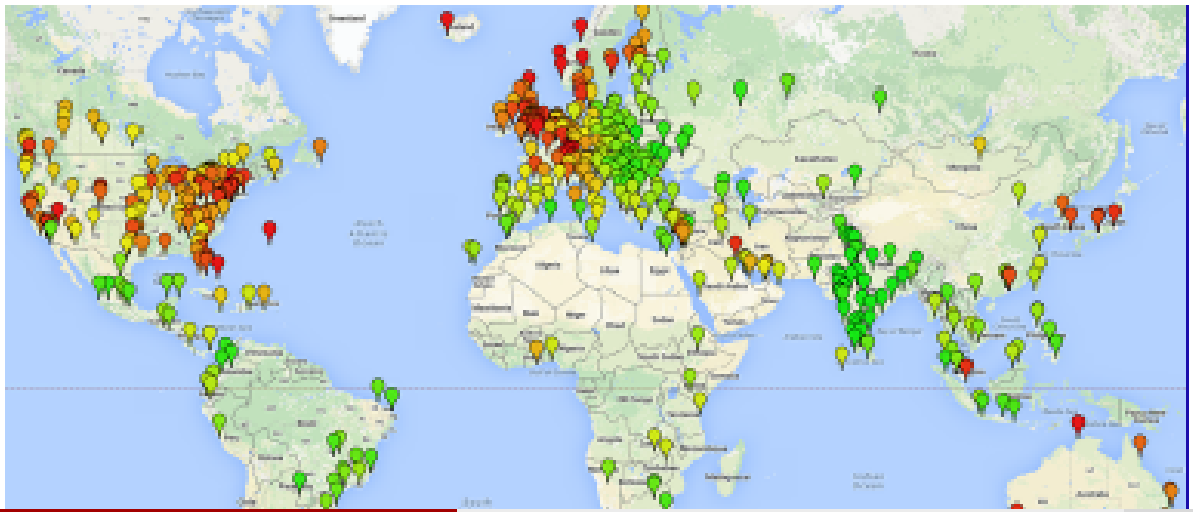
Like | Tweet | G+1

Numbeo is the world's largest database of user contributed data about cities and countries worldwide. Numbeo provides current and timely information on world living conditions including cost of living, housing indicators, health care, traffic, crime and pollution.

3,718,100 prices in 6,624 cities entered by 408,552 contributors

Select Location: Type and Pick City Or ---Select country---

Your city is not here? Tell us about cost of living in your city!



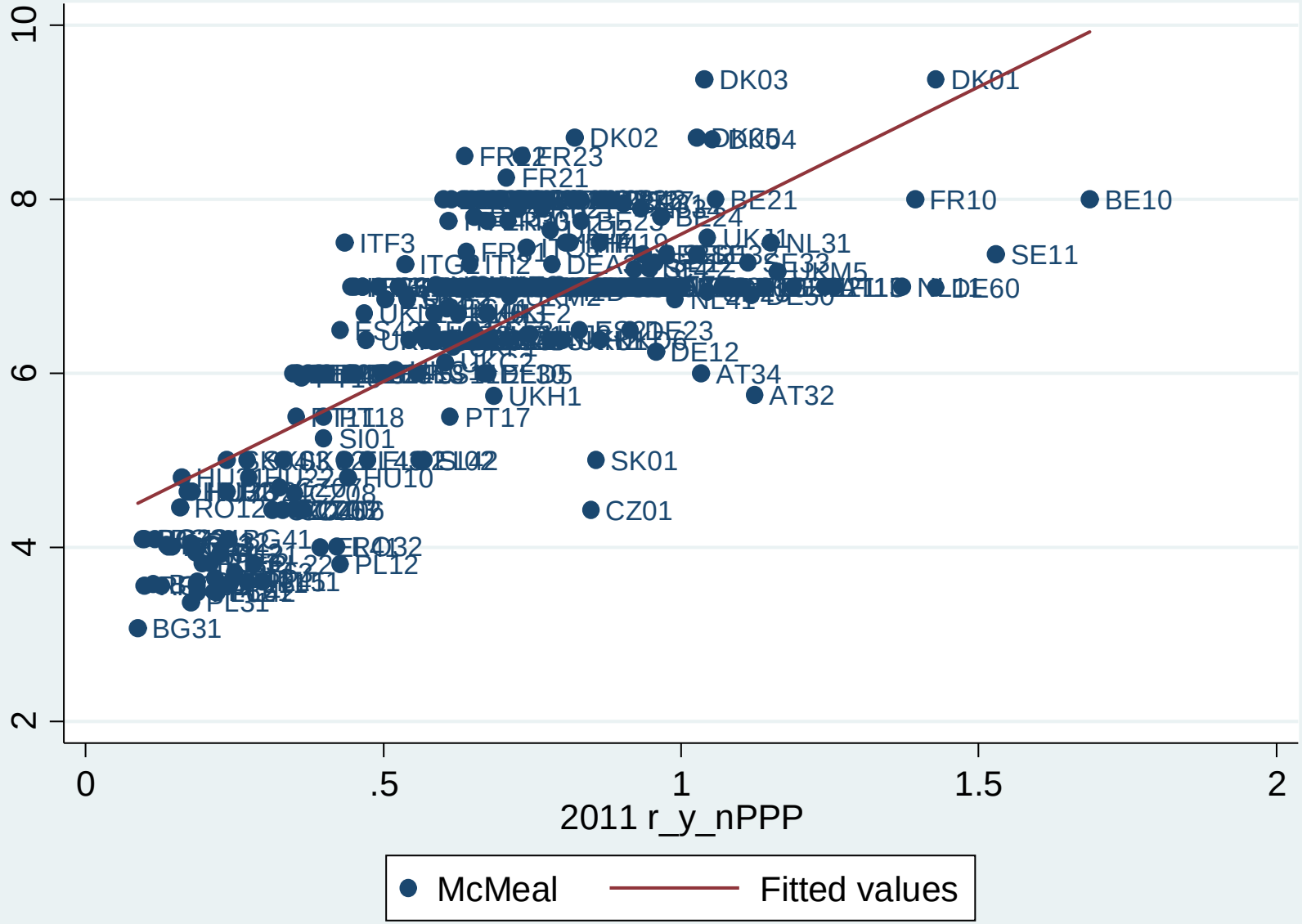
Numbeo Online Price Database

- Crowd-sourced global database of reported consumer prices and other statistics.
- Founded by ex-Google software engineer.
- Collaborative online platform enabling user-shared information.
- Provide 3.7 million price data on a variety of goods.
- Data come primarily from cities.

Numbeo Online Price Database

Examples of Reported Goods		
Meal, Inexpensive Restaurant	One-way Ticket (Local Transport)	1 Pair of Jeans (Levis 501 Or Similar)
McMeal at McDonalds	Monthly Pass (Regular Price)	1 Summer Dress in a Chain Store
Domestic Beer (0.5 liter draught)	Taxi Start (Normal Tariff)	1 Pair of Nike Running Shoes
Cappuccino (regular)	Taxi 1km (Normal Tariff)	1 Pair of Men Leather Business Shoes
Coke/Pepsi (0.33 liter bottle)	Volkswagen Golf 1.4 90 KW Trendline	Apartment (1 bedroom) in City Centre
Water (0.33 liter bottle)	Utilities (Electricity, Heating, Water, Garbage)	Apartment (3 bedrooms) in City Centre
Milk (regular), (1 liter)	1 min. of Prepaid Mobile Tariff Local	Price per Square Meter to Buy Apartment in City Centre
Loaf of Fresh White Bread (500g)	Internet (10 Mbps, Unlimited Data, Cable/ADSL)	Tennis Court Rent (1 Hour on Weekend)
Rice (white), (1kg)	Fitness Club, Monthly Fee	Cinema, International Release, 1 Seat

Price Differences across EU Regions



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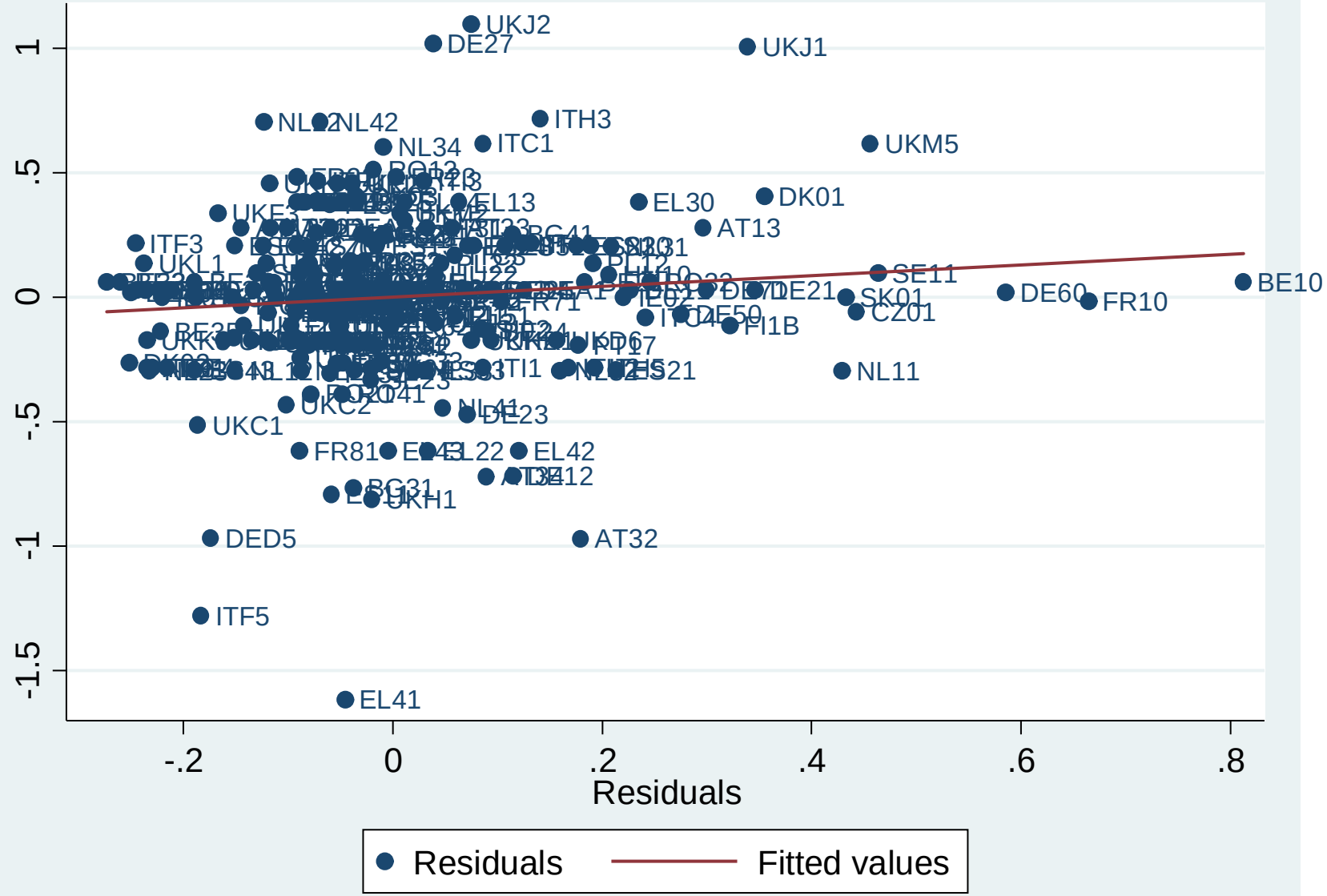

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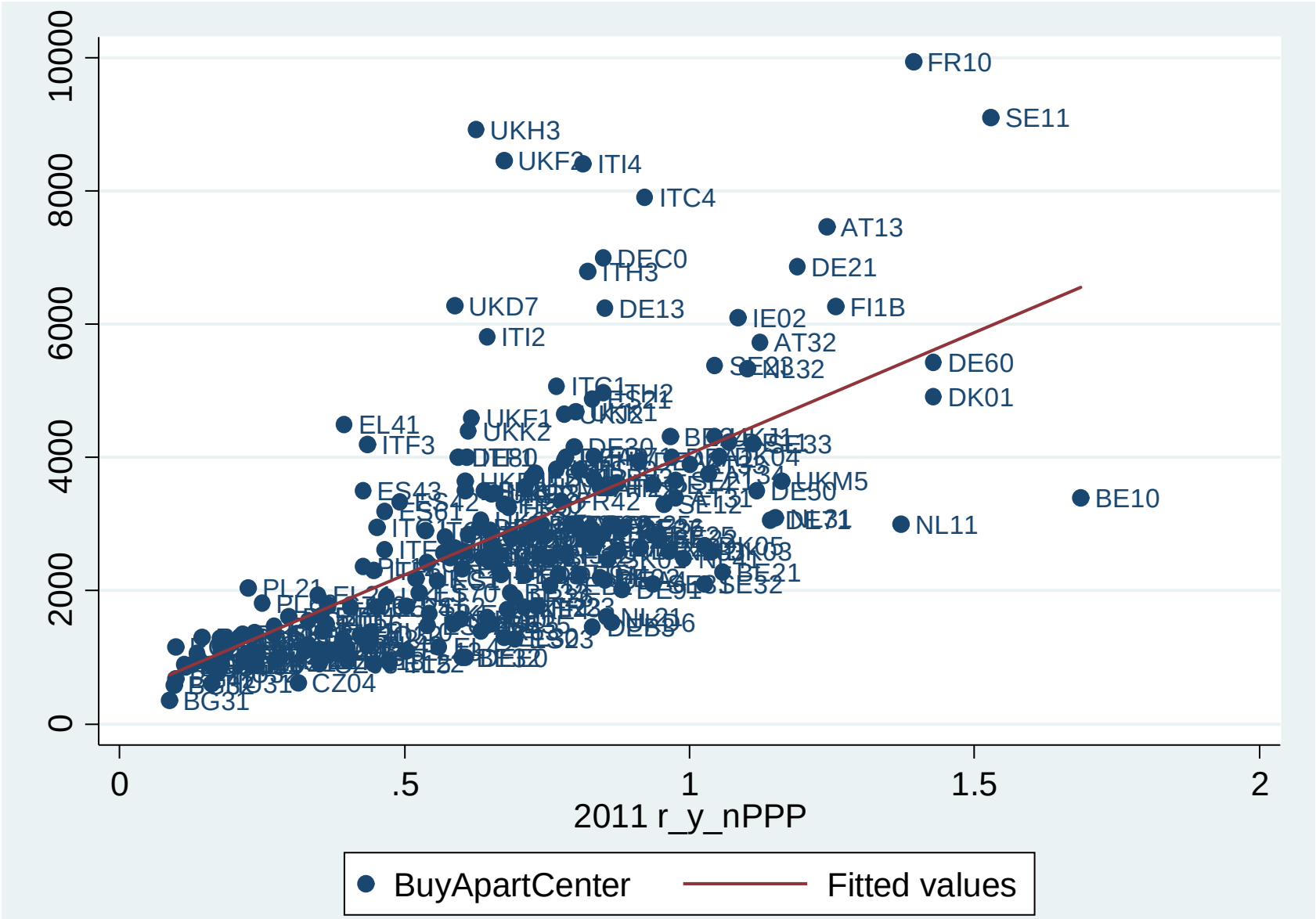

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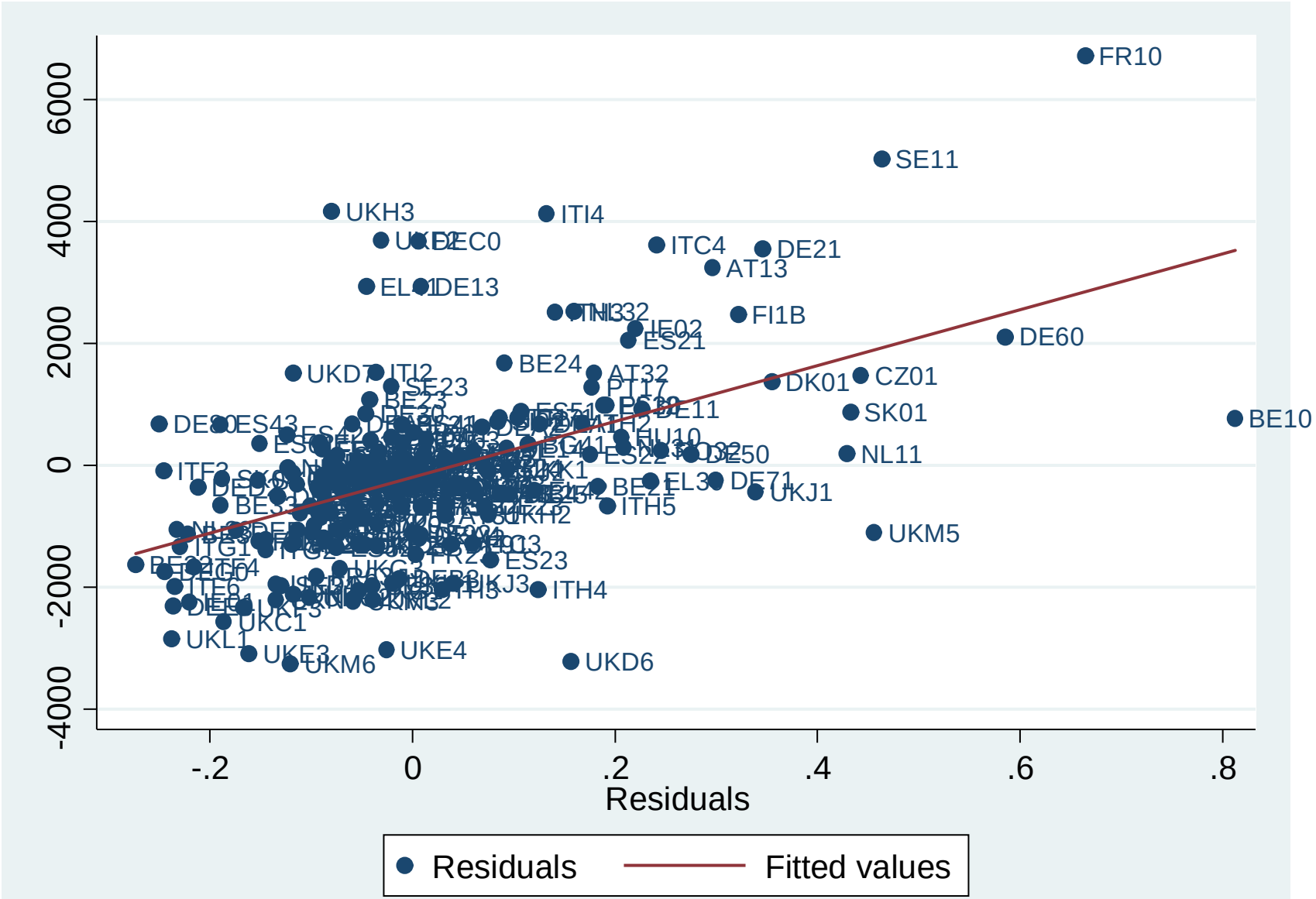

Indirect Evidence on Regional Price Differences

The Short-Cut Method

- This technique -referred to as the "short-cut" method- has a long history in the international comparison literature *(Kravis, Heston & Summers, 1978, 1982; Prados, 2000, Klasing & Milionis, 2014).*

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- The link between relative price differences and relative income levels (Penn Effect) implies that the relationship:

$$\frac{y_{i,t}^{PPP}}{y_{j,t}^{PPP}} = f\left(\frac{y_{i,t}^{nPPP}}{y_{j,t}^{nPPP}}, priceIsolation_{i,t}\right)$$

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- So if $f(\cdot,\cdot)$ was known, it could be employed to predict $\frac{y_{i,t}^{PPP}}{y_{j,t}^{PPP}}$ from $\frac{y_{i,t}^{nPPP}}{y_{j,t}^{nPPP}}$ and $priceIsolation_{i,t}$.

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The Short-Cut Method

- Specify a long-linear $f(\cdot,\cdot)$:

$$\ln \frac{y_{i,t}^{PPP}}{y_{US,t}^{PPP}} = \alpha + \beta_1 \ln \frac{y_{i,t}^{nPPP}}{y_{US,t}^{nPPP}} + \beta_2 (\ln \frac{y_{i,t}^{nPPP}}{y_{US,t}^{nPPP}})^2 + \beta_2 (\ln \frac{y_{i,t}^{nPPP}}{y_{US,t}^{nPPP}})^3 + \\ + \beta_3 \ln \frac{Pop_{i,t}}{Pop_{US,t}} + \beta_4 \ln \frac{Area_{i,t}}{Area_{US,t}} + \beta_5 \ln LandLock_i + \varepsilon_{i,t}.$$

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- Allow β_1 and β_2 to also vary with the level of development and the exchange rate regime.
- Estimate this equation based on the Penn World Table data and alternative based on the US state data from BEA.
- Use the estimated relationship to make out-of-sample predictions of $y_{i,t}^{PPP}$ for EU regions using the $y_{i,t}^{nPPP}$ of Eurostat.

Short-Cut Estimation Results

Dependent Variable	PPP-Adjusted Per Capita GDP Relative to US				
Data	Penn World Tables 8				BEA
Estimation Method	GLS	GLS	GLS	GLS	GLS
ln(y_nPPP)	0.288***	0.304***	0.244***	0.328***	0.821***
	(0.0281)	(0.0309)	(0.0285)	(0.0752)	(0.0138)
ln(y_nPPP)^2	-0.163***	-0.0475	0.0331	0.113	0.0986***
	(0.0430)	(0.0524)	(0.0409)	(0.0883)	(0.0151)
ln(yPPP)^3	0.0200***	0.00982*	0.0775***	0.0540***	-0.0162***
	(0.00590)	(0.00580)	(0.00961)	(0.0135)	(0.00274)
ln(Population)	-0.0663***	-0.0225***	-0.0661***	-0.0613***	0.0185***
	(0.00445)	(0.00439)	(0.0101)	(0.0159)	(0.00196)
ln(Area)	-0.464***	-0.0192	0.170***	0.144***	0.0444***
	(0.0255)	(0.0265)	(0.0202)	(0.0272)	(0.00422)
Currency Regime	0.0914***	0.107***	0.0152	0.0541	
	(0.0144)	(0.0243)	(0.0121)	(0.0511)	
ln(y_nPPP) x Currency Regime	0.0402***	0.101***	-0.0437**	-0.00964	
	(0.0125)	(0.0206)	(0.0221)	(0.0660)	
ln(y_nPPP)^2 x Currency Regime	0.000969	0.0162***	-0.0244***	-0.0162	
	(0.00247)	(0.00384)	(0.00849)	(0.0234)	
Periphery	0.276***	0.283***	0.366***	0.119*	0.0387
	(0.0208)	(0.0326)	(0.0226)	(0.0657)	(0.0533)
ln(y_nPPP) x Periphery	0.561***	0.512***	0.594***	0.314***	0.285
	(0.0329)	(0.0411)	(0.0371)	(0.0928)	(0.342)
ln(y_nPPP)^2 x Periphery	0.227***	0.0605	0.0795*	-0.0691	0.448
	(0.0430)	(0.0522)	(0.0407)	(0.0862)	(0.530)
Adj. R-squared	0.865	0.914	0.974	0.948	0.953
Observations	8,625	1,873	1,246	270	255
Countries/Regions	188	188	27	27	51

GLS estimation corrects for heteroskedasticity and serial correlation within panels.
Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

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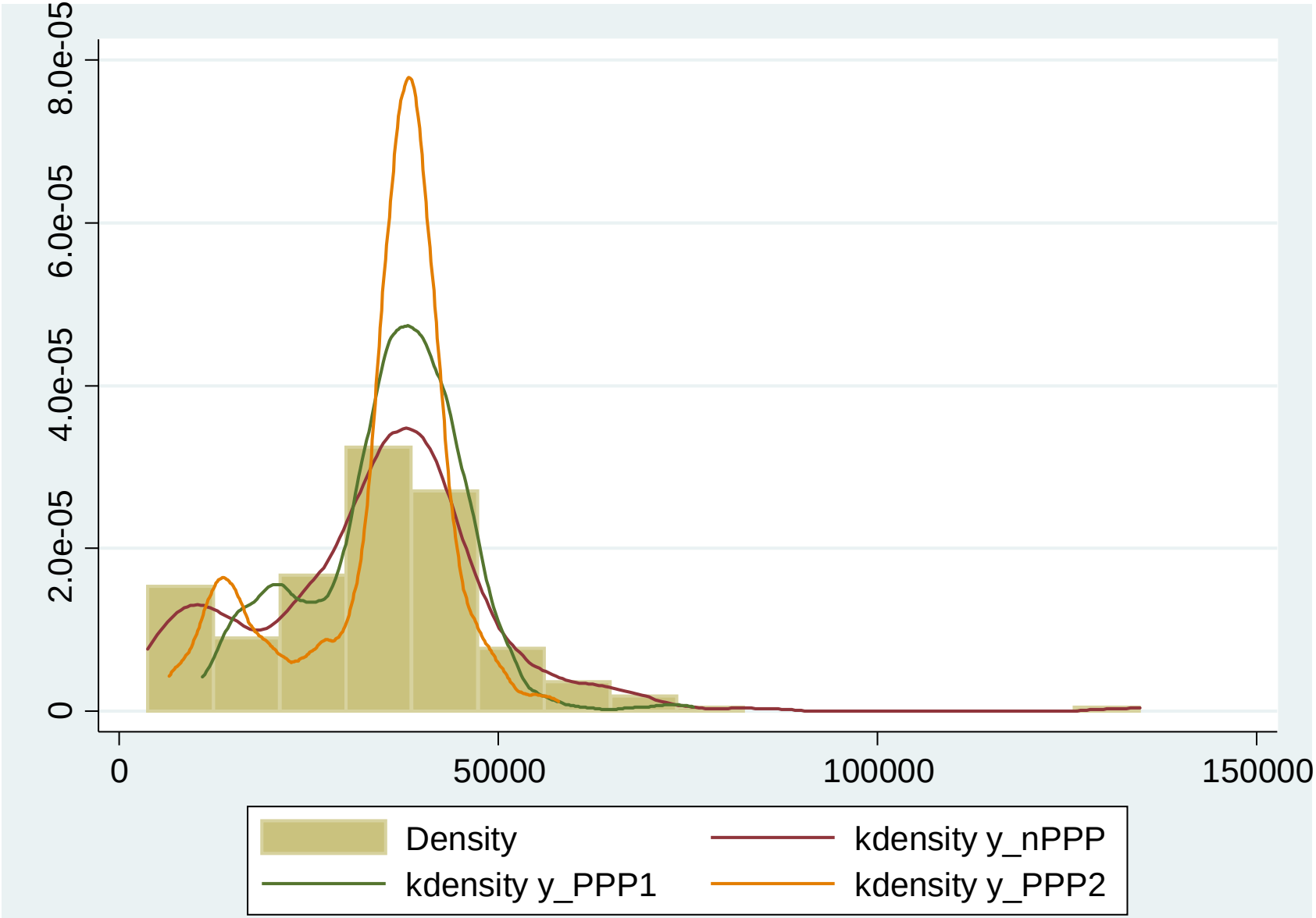
GLS estimation corrects for heteroskedasticity and serial correlation within panels.
Standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1

Adjusted Regional Income Differences



Adjusted Regional Income Differences

Year 2007			
EU Regions (NUTS-2)			
Shares of Variance Explained			
GDP per capita Measure	Overall	Within	Between
Country-Price Adjusted	45.51%	100.00%	34.52%
Region-Price Adjusted	30.74%	39.51%	29.24%

Adjusted Regional Income Differences

Year 2007			
EU Regions (NUTS-2)			
Shares of Variance Explained			
GDP per capita Measure	Overall	Within	Between
Country-Price Adjusted	45.51%	100.00%	34.52%
Region-Price Adjusted	30.74%	39.51%	29.24%
Variance Decomposition			
GDP per capita Measure	Overall	Within	Between
Nominal	100.00%	37.00%	63.00%
Country-Price Adjusted	100.00%	56.00%	43.00%
Region-Price Adjusted	100.00%	29.00%	71.00%

Implications for Income Convergence

Growth Regression Setup

We test for within-country income convergence using the panel growth regression setup:

$$g^{y}_{i,c,t} = \alpha_0 + \beta \ln y_{i,c,t-1} + \gamma' X_{i,c,t} + \delta_c + \delta_t + \varepsilon_{i,c,t},$$

- $y_{i,c,t}$: GDP per capita adjusted for regional price differences.
- $X_{i,c,t}$: various regional controls
- Frequency: overlapping 3-year periods
- Sample Period: 2000-2013

Growth Regressions Results

Dependent Variable	3-year-average growth rate of GDP per capita			
Price Adjustment	Across Countries			
GDP per capita (t-1)	-0.00296	-0.00936***	-0.0133**	
	(0.00269)	(0.00354)	(0.00582)	
Pop. Growth		-0.0908***	-0.0948***	
		(0.0199)	(0.0198)	
Investment Share		0.0144***	0.0181***	
		(0.00524)	(0.00532)	
Tert. Schooling			0.00671***	
			(0.00155)	
Agricultural Share			-0.0706***	
			(0.0226)	
Adj. R-squared	0.56	0.59	0.62	
Observations	1,601	1,601	1,601	
Number of regions	245	245	245	

Regression include country and time fixed effects. Driscoll-Kraay standard errors in parentheses.

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

Growth Regressions Results

Dependent Variable	3-year-average growth rate of GDP per capita					
Price Adjustment	Across Countries			Across and Within Countries		
GDP per capita (t-1)	-0.00296	-0.00936***	-0.0133**	-0.00491	-0.00357	-0.00192
	(0.00269)	(0.00354)	(0.00582)	(0.00814)	(0.00459)	(0.00672)
Pop. Growth		-0.0908***	-0.0948***		-0.0972***	-0.0784**
		(0.0199)	(0.0198)		(0.0373)	(0.0368)
Investment Share		0.0144***	0.0181***		0.00505	-0.00794
		(0.00524)	(0.00532)		(0.0101)	(0.0102)
Tert. Schooling			0.00671***			-0.00147
			(0.00155)			(0.00246)
Agricultural Share			-0.0706***			0.00373
			(0.0226)			(0.0426)
Adj. R-squared	0.54	0.59	0.63	0.73	0.76	0.78
Observations	1,601	1,601	1,601	1,601	1,601	1,601
Number of regions	245	245	245	245	245	245

Regression include country and time fixed effects. Driscoll-Kraay standard errors in parentheses.

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

Summary of Findings

This paper investigates the role of regional price difference for economic development and finds that:

1. Direct and indirect measures suggest that price differences at the regional level are sizeable.
2. Richer regions tend to have higher prices in line with the Penn effect.
3. Not adjusting for regional prices differences leads to:
   (a) an overstatement of within-country income differences.
   (b) a bias towards higher convergence rates across regions.

These findings imply that proper quantification of regional income differences requires good information on regional price differences.

Next Steps

1. Extend analysis beyond EU regions to a global sample.
2. Conduct analysis at different levels of aggregation.
3. Compare with luminosity data.
4. Assess implications for income-level regression analysis.
5. Assess implications for growth and development accounting exercises.