Regions are not countries:

A new approach to the border effect

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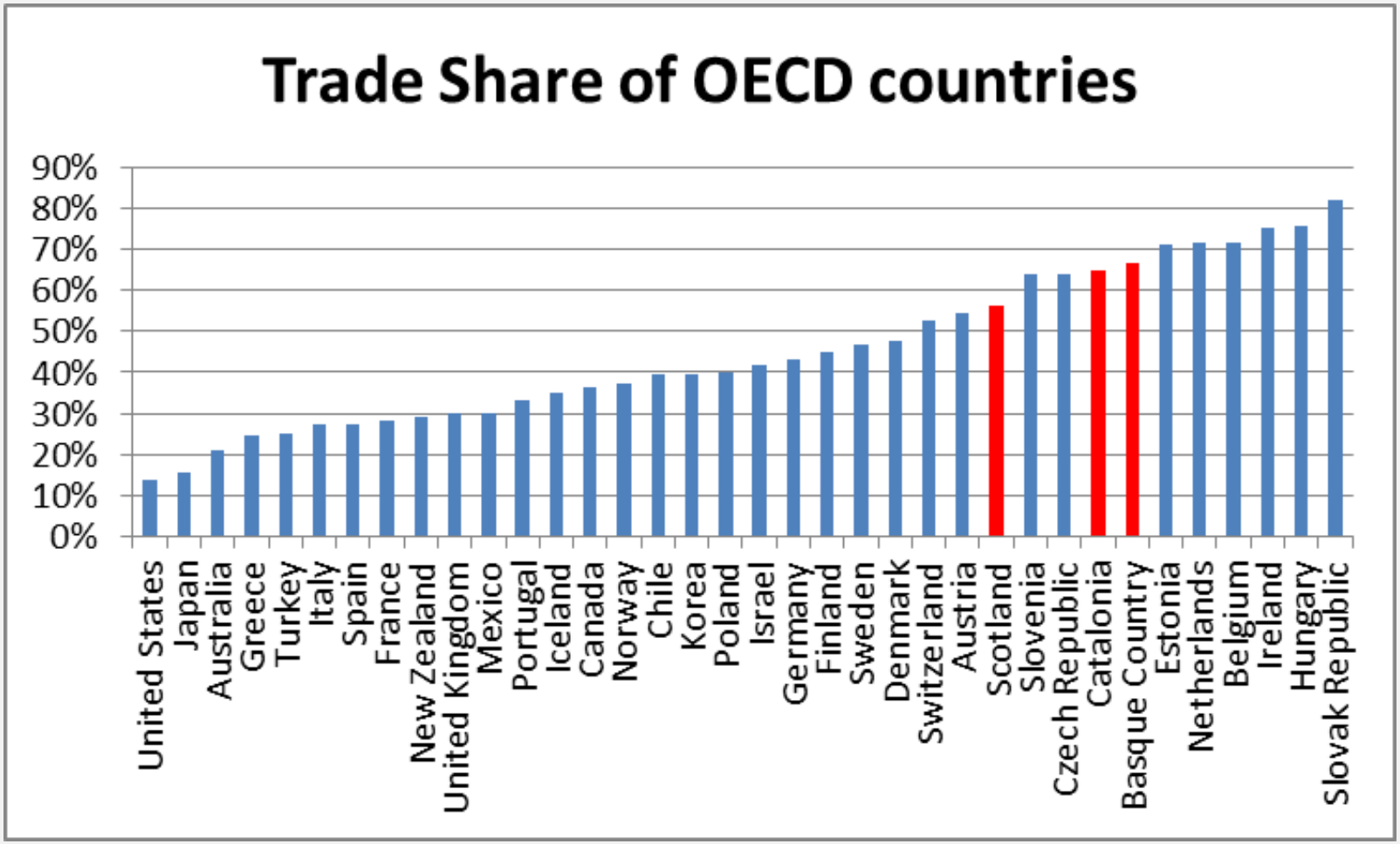
Summary

Introduction *(1/4)*

- What are implications for economic integration of national borders?
  - Background: moves towards independence in Scotland, Catalonia, Basque Country, Venice, Flanders, etc
- What are implications for economic integration of EU membership?
  - Background: proposal for "In/Out" referendum on EU in UK in 2017
- How does economic integration within EU compare with other continental scale federations like USA and Canada?

Introduction *(2/4)*

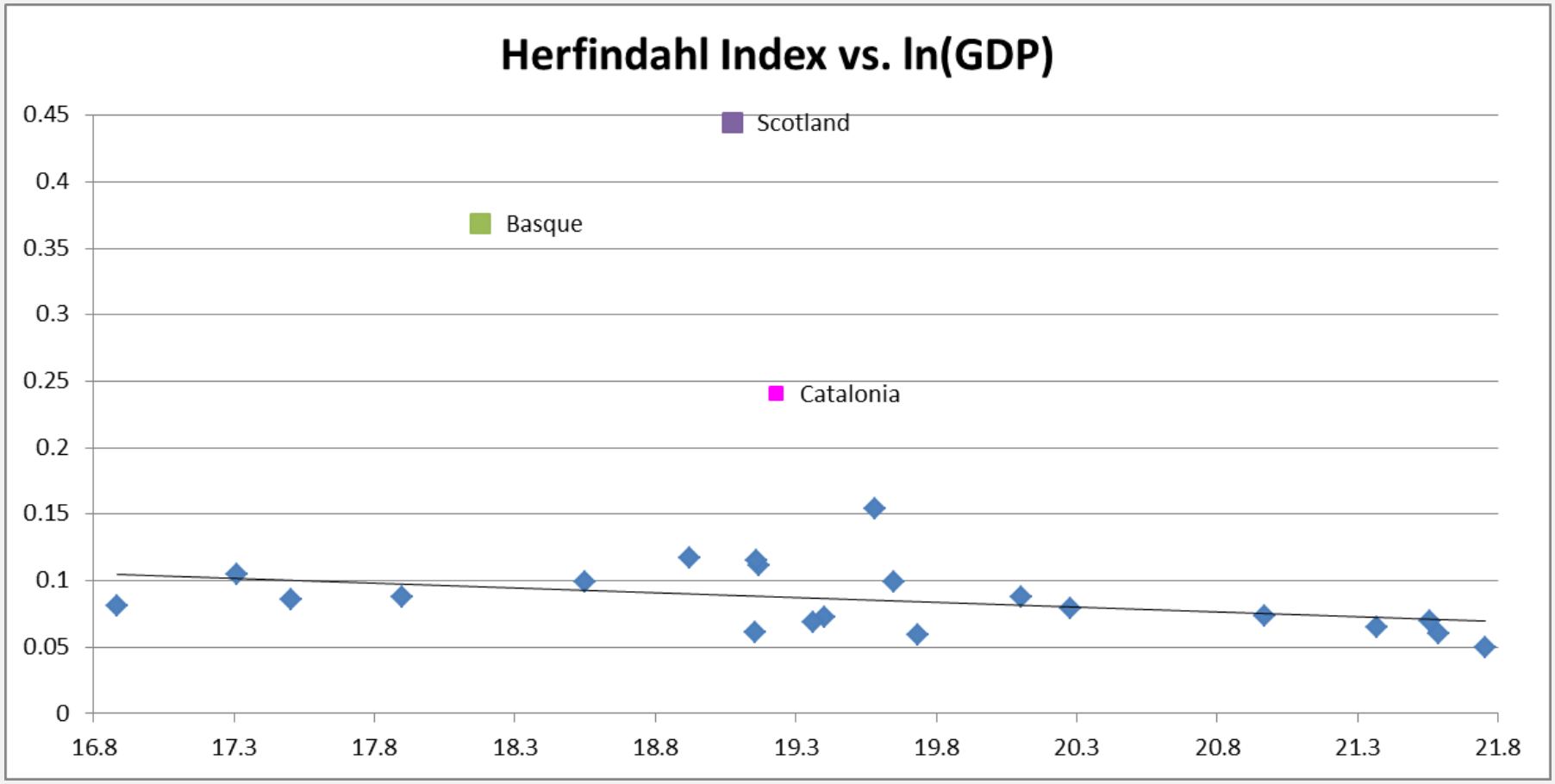
- Trade Patterns for Scotland, Catalonia, & Basque Country: typical small open economies?



Trade share of Catalonia, Basque Country, Scotland and members of OECD

Introduction *(3/4)*

- Trade Patterns for Scotland, Catalonia, & Basque Country: definitely a-typical small open economies!



Herfindahl Index: Catalonia, Basque, Scotland & European OECD members

Introduction *(4/4)*

- What explains these trade patterns for Scotland, Catalonia & Basque Country?

- Economic literature points to the "border effect":
  - observation that trade is higher within a state than across a national border
  - econometric exercise, McCallum (1995)
  - theory consistent, Anderson & van Wincoop (2003)

- Recent developments in new trade theory, described by Arkolakis, Costinot, & Rodriguez-Clare [ACRC] (2012), have unified many of the models
  - Within all these "gravity models" the welfare consequences of a change in economic integration will be identical
  - Given home shares, λ, and the trade elasticity, ϵ.

- This paper:
  - Use gravity model to "measure" borders between countries and between regions within countries
  - Use results of this cross country exercise to inform counterfactual policy experiments within a gravity model

Model *(1/9)*

- Based on Melitz (2003) (within "gravity" class)
  - Consumers in all countries have CES utility
  - Monopolistically competitive firms maximise profits, taking demand functions as given. Choose price/quantity of sales, and hire local labour
  - Firms heterogeneous in productivities.
    - Draw productivity from a Pareto distribution
    - Fixed cost of firm creation, paying this cost allows you to draw once.

- Trade Frictions:
  - Iceberg cost for selling in external market
    - relative to cost of selling in local market.
  - Fixed cost for market access is also increasing in the iceberg cost.

- General Equilibrium:
  - No Arbitrage - expected value of creating a firm driven to zero
  - All inputs (labour) employed
  - All income is spent & balance of payments in all economies.

- 2 sources of gains from trade.
  - Larger market provides:
    - Increased product variety in CES utility/Dixit-Stiglitz aggregator (Krugman).
    - Reallocation towards more productive firms (Melitz)

Reasons why free trade increases productivity:

- 2 types of firms: good and mediocre
  - in closed economy: mediocre firms find it worth surviving

- Open economy: good firms wants to hire to serve both the local and foreign markets
  - Since they are more productive, an open economy provides opportunities to expand, and this puts upwards pressure on wages

- Higher wage rates mean that mediocre firms now do not find it profitable to survive (fixed costs)

- Improvement in the average firm quality $\Rightarrow$ increase productivity and income

Model *(3/9)*

- Consumers have Dixit-Stiglitz, CES preferences over a continuum of goods. Demand for good i in country j:

$$q_i = \left(\frac{p_i}{P_j}\right)^{-\theta} \left(\frac{Y_j}{P_j}\right)$$

- A monopolistically competitive firm in country h takes demand for its good from market j as given, and maximises profits:

$$\pi^{hj}(i) = p_i q_i - W_h L_{hj}(i) = p_i q_i - W_h \left(\frac{\delta_{hj} q_i}{\phi_i} + c\frac{\delta_{hj} Y_j}{P_j}\right)$$

- Firm i in country h will choose to operate in country j only if by doing so it makes positive profits i.e

$$\phi_i > \Phi_{hj} = \left(\frac{c}{\Theta}\right)^{\frac{1}{\theta-1}} \left(\delta_{hj}\frac{P_h}{P_j}\frac{W_h}{P_h}\right)^{\frac{\theta}{\theta-1}}$$

  where $\Theta = (\theta-1)^{\theta-1}/\theta^{\theta}$

- $\delta \equiv$ cost of selling ext mkt relative to selling in local mkt i.e. $\delta_{hh} = 1$, $\forall h$

- Firms have the lifecycle:
  - Firm i is created in country h by paying a fixed cost $\tilde{c}W_h$
  - Once this (sunk) cost is paid, the firm receives productivity draw, ϕ_i
  - Conditional on this productivity draw and on the economic distances, $\delta_{hj}, \forall j$, the firm will choose to operate in all those markets in which it makes positive profits, $\phi_i > \Phi_{hj}$
  - Firms discount next period's profits at rate β (interpret as zero time discounting and survival probability $1 - \beta$)

- Firm productivities are drawn from a Pareto distribution (identical across countries) with threshold parameter b and shape parameter k
  - Imposing that the average revenues, profits and labour demand of a firm be finite implies that $k > \theta - 1$

- For convenience, define $\mu = k\theta/(\theta - 1)$

General Equilibrium:

- No Arbitrage - expected value of creating a firm driven to zero: $(1 - F(\Phi_{hh})) \sum_{t=0}^{\infty} \beta^t \left(\sum_j \pi_{hj} \right) - \tilde{c} W_h = 0 \Rightarrow ...$

$$\left(\frac{W_h}{P_h} \right)^{-\mu} \frac{D_h}{P_h} = \frac{\tilde{c}(1-\beta)}{c b^k} \left(\frac{c}{\Theta} \right)^{\frac{\mu}{\theta}} \left(\frac{1}{\theta} - \frac{1}{\mu} \right)$$

  where $D_h = P_h \sum_j \left(\frac{P_j}{P_h} \right)^{\mu} \delta_{hj}^{1-\mu} \frac{Y_j}{P_j}$

- All inputs (labour) employed: $S_h = M_h \sum_j L_{hj} + L_{creation} \Rightarrow ...$

$$\left(\frac{1}{\theta} - \frac{1}{\mu} \right) S_h = c M_h \frac{D_h}{P_h}$$

  where $L_{creation}$ balances firm birth and death in steady state.

- All income is spent & balance of payments in all economies:

$$\sum_j X_{jh} = Y_h = S_h W_h + T_h = \sum_j X_{hj} + T_h$$

  where T_h is exogenous capital flow.

- The gravity equation associated with the model is derived by summing over the output of all exporting firms: $X_{hj} = M_h p_{hj} q_{hj}$

$$\ln X_{hj} = \ln (S_h W_h) + \ln Y_j - \ln D_h + (1-\mu) \ln \left(\frac{P_h}{P_j} \delta_{hj} \right)$$

- For n countries, this is either a system of:
  - $5n$ equations (*) in $5n$ unknowns $\{S_h, M_h, W_h, P_h, \delta_h\}$ (**) with parameters and data $\{\theta, \mu, (S_h W_h), T_h, Y_h, D_h, X_{hj}\}$, $\forall h, j \in \{1, ..n\}$. Used for calibration.
  - $5n$ equations in $5n$ unknowns $\{Y_h, P_h, D_h, W_h, M_h\}$ with parameters $\{\theta, \mu, S_h, \delta_{hj}, T_h\}$, $\forall h, j \in \{1, ..n\}$. Used for policy experiments i.e. changing δ's.

(*) $n-1$ balance of payments equations, plus one normalisation of price indices

(**) $\delta_h \equiv \delta_{1h}$ and $\delta_{hj} = \frac{\delta_j}{\delta_h} \left(\frac{X_{1h} X_{hj}}{X_{1j} X_{hh}} \right)^{\frac{1}{1-\mu}}$

Model *(7/9)*

- As emphasised by ACRC (2012), a crucial parameter is the elasticity of trade flows to variable trade costs, ϵ:
  - Low ϵ: Δ frictions $\Rightarrow$ little trade flow response
  - i.e. trade is important/valuable, you buy even if expensive.

    $\Rightarrow$ any given decrease in trade implies much larger loses than if ϵ was large.

- Melitz parameters:
  - CES elasticity of substitution, take standard value from economic literature, BEJK (2003)
  - Pareto distribution parameter is taken to match firm size distribution (stdev of log domestic sales in the US)
  - Resulting *trade elasticity*, $1-\mu = -3.48$ (agrees well with Simonovska & Waugh (2013) Melitz elasticity, -3.41)

- Given these parameters plus national incomes and bilateral trade flows, we can derive bilateral trade frictions

- Two versions:
  - 3 country version: For each pair of economies i, j we take as exogenous the rest of the world. We then measure the values of δ_{ij}, δ_{iR} and δ_{jR} that make the model fit the trade data X_{ij}, X_{iR} and X_{jR}
  - Multicountry version (does not allow for capital movements), more computationally intensive.

- Implicit gravity equation:

$$\ln X_j^i = \ln\left(S_i W_i\right) + \ln Y_j - \ln D_i + (1-\mu)\ln\left(\frac{P_i}{P_j}\delta_j^i\right)$$

- We do **not** estimate this equation, but calibrate the model to find the value of δ's be so that it matches the data on trade and GDP.

Data

- The data used is:
  - 2006 GDP, and bilateral trade flow (goods & services), OECD data
  - US State GDP from Bureau of Economic Analysis
  - US bilateral state trade (goods only), from the Freight Analysis Framework Regional Database
  - Canadian provincial GDP, and bilateral provincial trade (goods and services), from Statistics Canada
  - Spanish autonomous community GDP from Eurostat
  - Spanish bilateral Autonomous Community trade (goods only), from *C-intereg: analisis del comercio interregional espanol*
  - Scottish, Catalan & Basque income and trade (goods & services) data from local government input-output tables

- **Conservative basis** or **SKIP**

Goods Only vs Goods and Services *(1/2)*

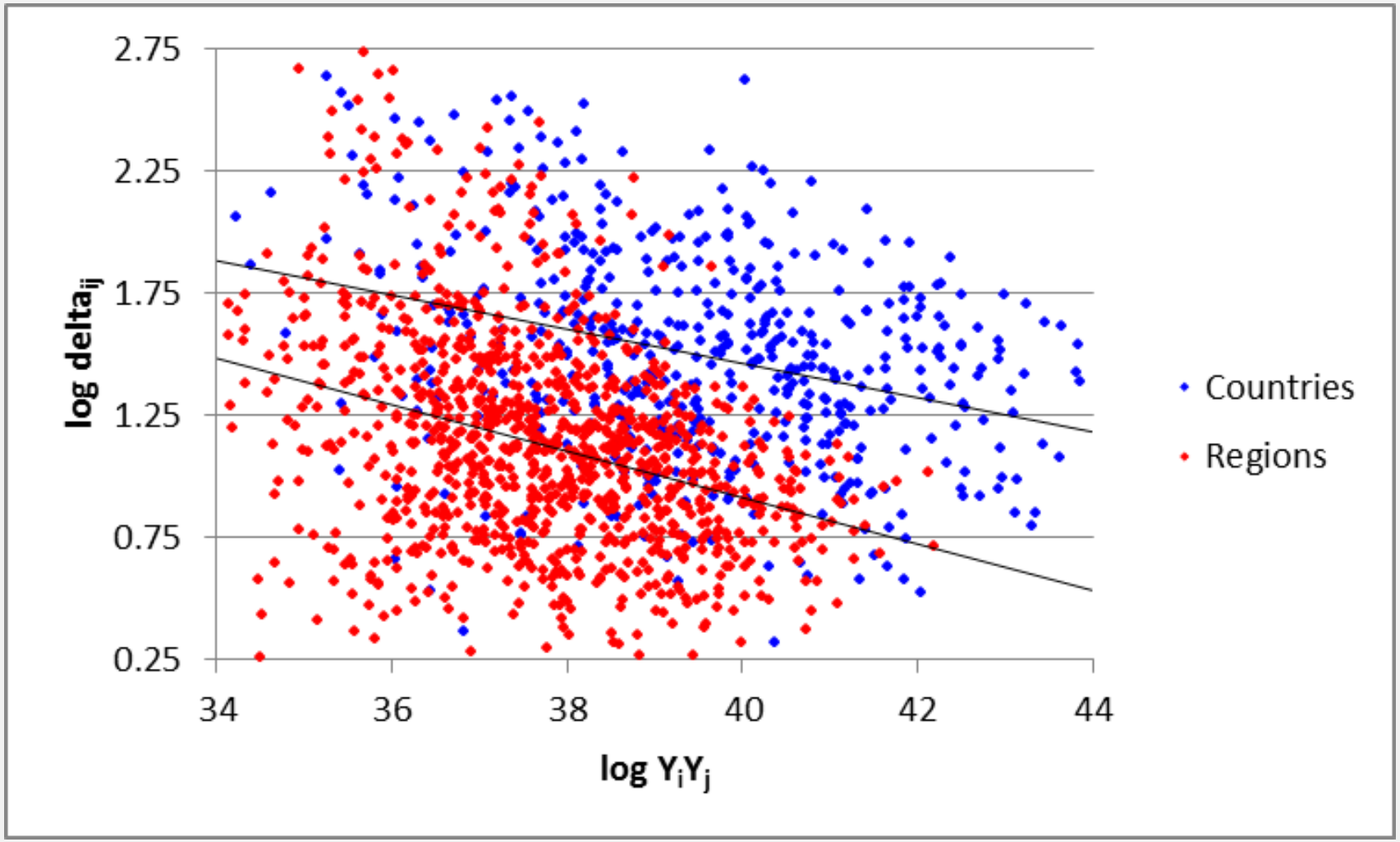
- External trade, from OECD, is goods and services
- Estimating internal goods and services trade by applying ratio of internal to external goods only trade to the external goods and services trade
- This will be conservative if trade in services is more home biased than trade in goods
- We have the data for Canadian Provinces, plus (exports only) for Scotland, Catalonia & Basque Country
- It shows that this is indeed the case:

Goods Only vs Goods and Services *(2/2)*

Region	Goods Only	Goods & Services
Newfoundland	63%	89%
Prince Edward Island	104%	167%
Nova Scotia	71%	107%
New Brunswick	55%	80%
Quebec	44%	64%
Ontario	26%	41%
Manitoba	78%	118%
Saskatchewan	78%	106%
Alberta	49%	68%
British Columbia	48%	72%
Yukon	122%	192%
Northwest Territories	57%	108%
Nunavut	147%	296%
Scotland	136%	179%
Catalonia	126%	135%
Basque Country	74%	94%

Ratio of internal to external trade, goods only, and goods & services

Results: Regions vs Countries (A)



Scatter of measured bilateral frictions against GDPs of trading partners

SKIP

Size *(1/2)*

- Negative relationship between measured trade frictions and GDPs of trading partners

- This is expected:
  - Create simple world: many identical entities; gravity equation perfectly describes trade between each entity; trade friction $\bar{\delta}$
  - Observed "countries" are then different sized units which just aggregate these identical entities
  - In this simplified world the relationship between measured trade friction and size can be shown to have the slope

$$\frac{1-\bar{\delta}^{1-\mu}}{2(1-\mu)} \to \frac{1}{2(1-\mu)} \text{ , as } \bar{\delta} \to \infty$$

  - This limit has value of -0.14 given the parameters we're using.

- So purely due to the impact that country size has in this model, we should expect to see a negative slope in the range $(-0.14, 0)$

Size *(2/2)*

- The measured slope for both the countries and the regions is within this range

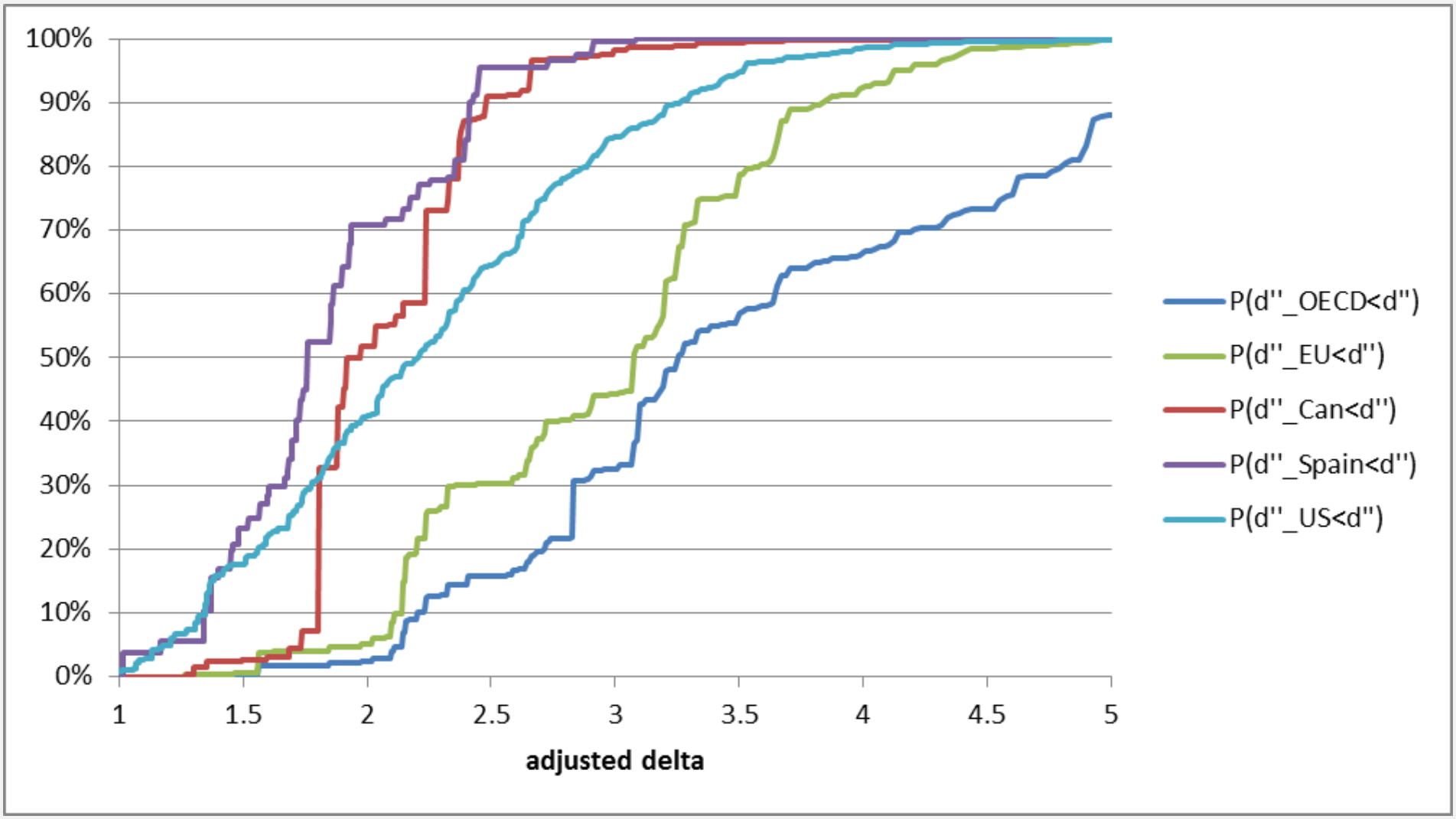
- Construct a size adjusted friction, δ'_{ij}, using some postulated relationship between sizes and frictions, k:

$$\ln \delta'_{ij} = \ln \delta_{ij} - k(\ln Y_i Y_j - \ln \bar{Y}\bar{Y})$$

- Given that regions tend to be smaller than countries, the more negative is k the smaller the adjusted frictions for regions relative to countries

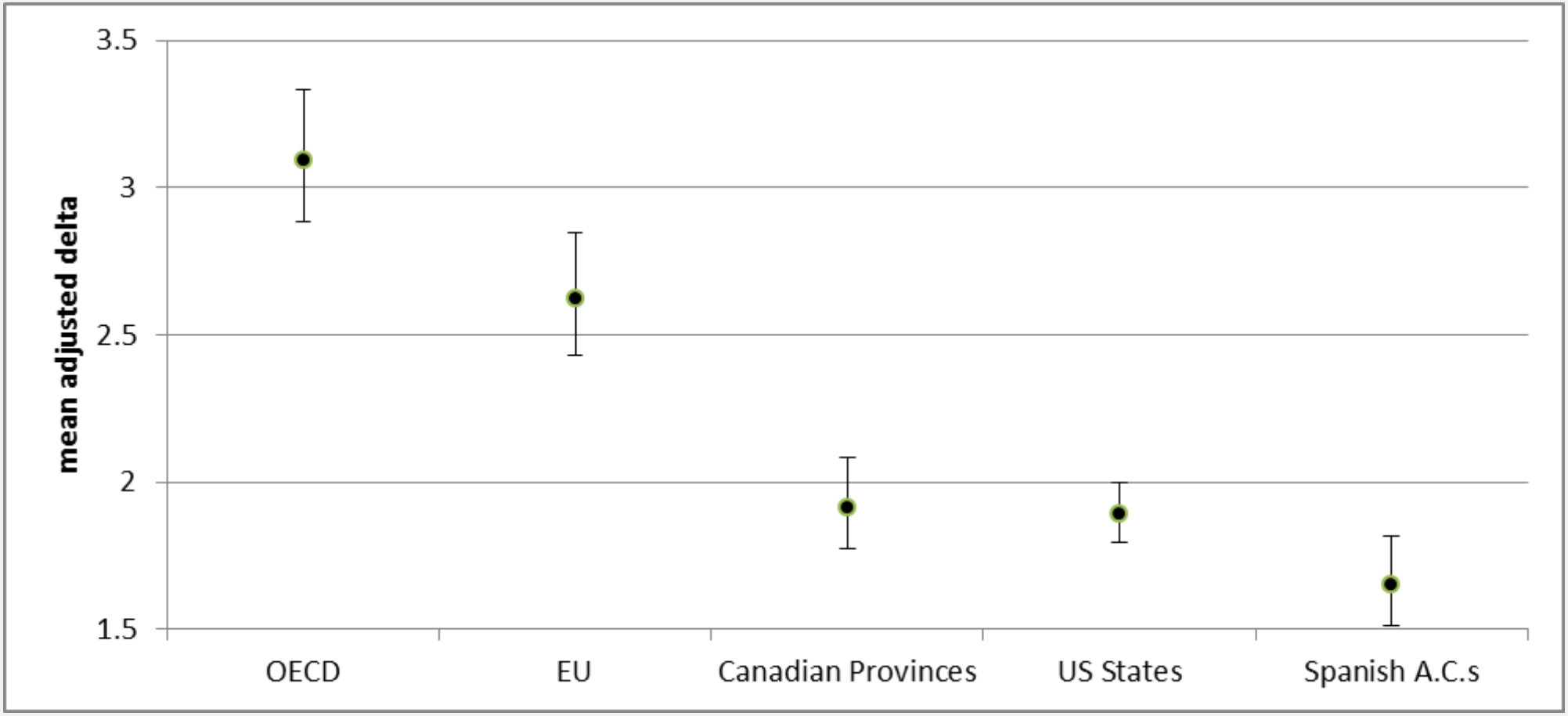
- We want to err on the side of prudence so choose k as the measured slope for OECD countries (-0.07) as it is shallower than the measured slope for regions (-0.09) and much shallower than our theoretical limit (-0.14)

Results: Regions vs Countries (B) *(1/2)*



Empirical CDF of size adjusted frictions by grouping

Results: Regions vs Countries (B) *(2/2)*



Mean size adjusted friction by grouping

SKIP

Weighting

- Frictions appear high between Nunavut & Newfoundland, and trade is economically insignificant. In calculating the average Canadian provincial friction should this count as much as the Quebec Ontario frictions?

- Iceberg costs, $\tau_{hj} = 1 - 1/\delta_{hj}$, represent general equilibrium cost of trade frictions i.e. the costs that are actually paid in GE

- Weight frictions by their total impact:

$$\begin{aligned} \text{Economic loss in trade from } h \text{ to } j, &= \tau_{hj} X_{hj} \\ \text{Suggests weighted average iceberg cost, } \bar{\tau} &= \frac{\sum_j \sum_{h \neq j} \tau_{hj} X_{hj}}{\sum_j \sum_{h \neq j} X_{hj}} \\ \text{Therefore weight given to each data point is} &: \frac{X_{hj}}{\sum_j \sum_{h \neq j} X_{hj}} \end{aligned}$$

- CDF and means shown on previous slides used this weighting scheme

Results: Regions vs Countries

- **RESULT: frictions systematically smaller between regions than between countries**

- This is true even when both regions and countries are spread across a continental scale distances like US States or Canadian Provinces & EU countries

- This motivates our exercises:
  [1] On independence, we must expect that eventually the region-region borders between the independence seeking region and the rest of its current country, will come to resemble a normal country-country border
  - Identify a plausible counterfactual friction for an independence seeking region by looking for the independent country with which trade is least frictional
  - Model independence by giving independence seeking region this friction with its union partner instead of the friction seen in the data

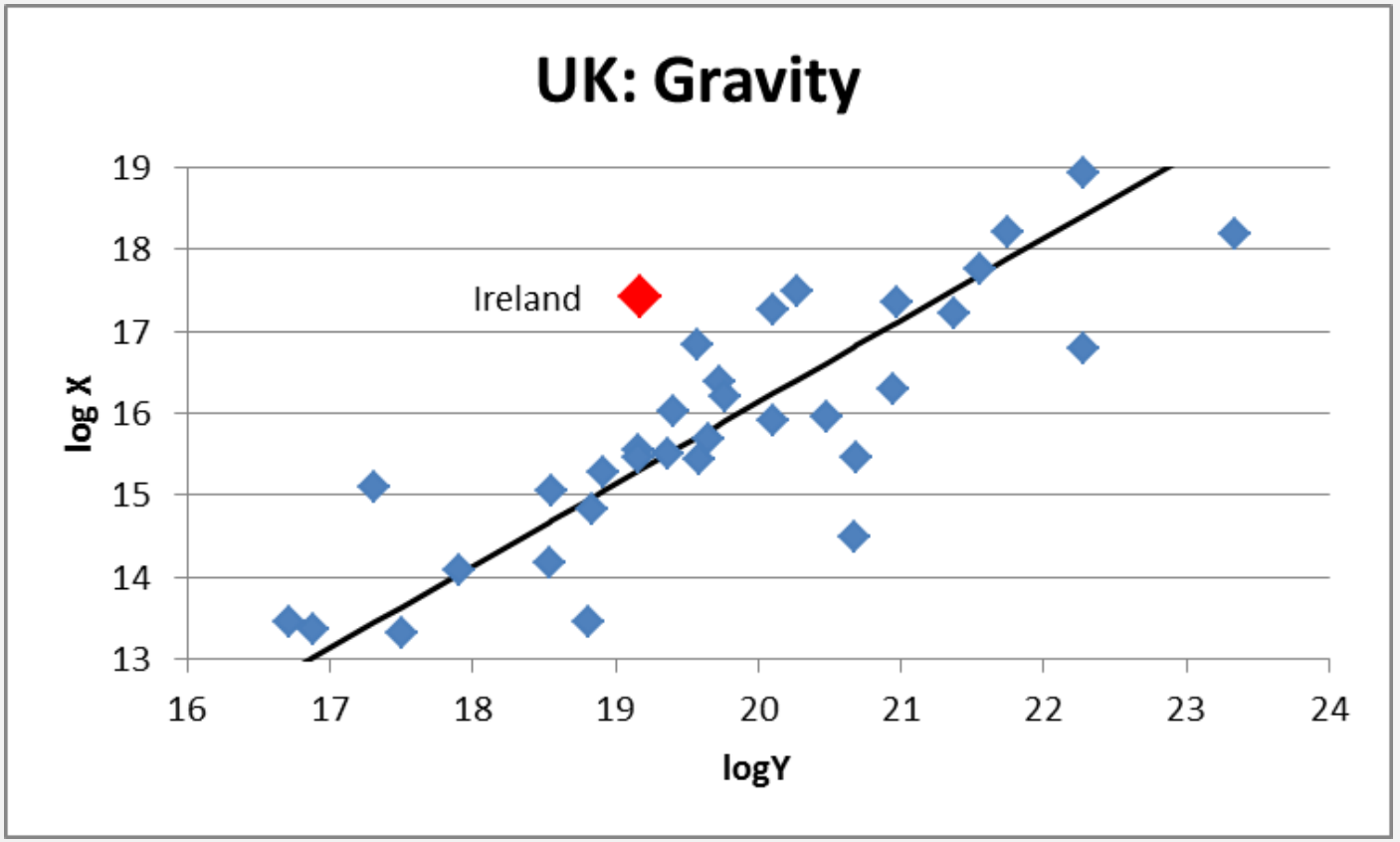
  [2] Look more closely at EU vs non-EU borders: what is the evidence for EU membership promoting economic integration?
  - EU is, unsurprisingly, more closely integrated than OECD (but less integrated than US or Canadian federations)
  - Is there a strong effect from EU membership? There is a correlation
  - Model a British exit from EU by increasing trade frictions using this correlation

  [3] What would benefits be to EU of replacing current country-country borders with typical region-region borders?
  - A *United States of Europe*

Regions to countries: Who is the closest? *(1/2)*

Select largest +ve deviation from that predicted by gravity regression

$$\ln X_j = \alpha + \ln Y_j + \epsilon_j$$

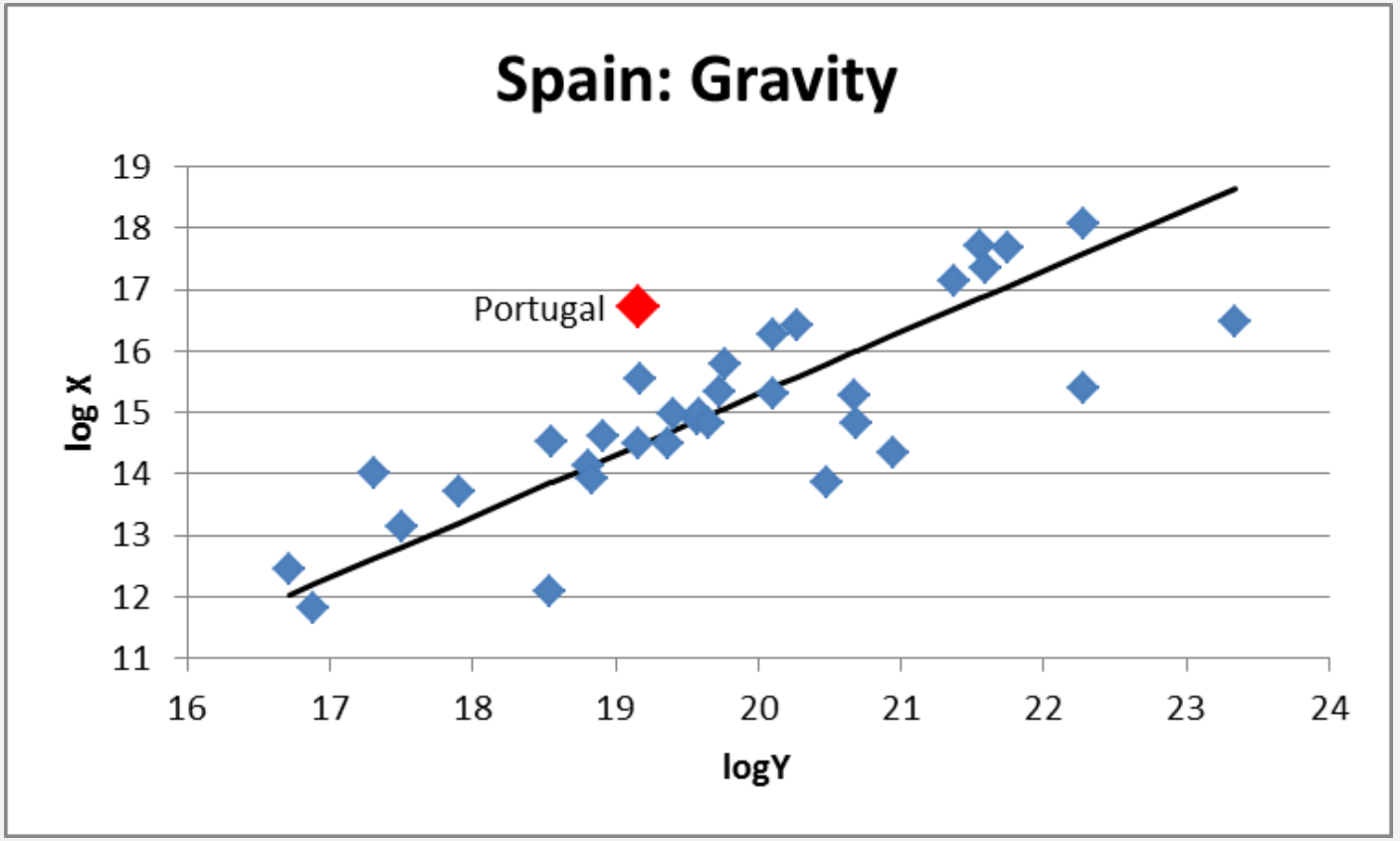


i.e. Scotland counterfactual is **Ireland**

Regions to countries: Who is the closest? *(2/2)*

Select largest +ve deviation from that predicted by gravity regression

$$\ln X_j = \alpha + \ln Y_j + \epsilon_j$$



i.e. Catalonia & Basque Country counterfactual is **Portugal**

Regions to countries: Results *(1/6)*

	Portugal / Spain	Catalonia / rSpain	Basque / rSpain	Ireland / UK	Scotland / rUK
$\frac{X_j^i + X_i^j}{GDP_i}$	18.5%	60.7%	82.5%	32.3%	78.8%
$\frac{X_j^i + X_i^j}{X_R^i + X_i^R}$	35.8%	91.3%	149.5%	30.0%	193.4%
λ_i	66.7%	34.9%	33.1%	24.8%	43.8%
δ_{ij}	2.32	1.41	1.55	1.81	1.57

Calibrating the model to the data

Regions to countries: Results *(2/6)*

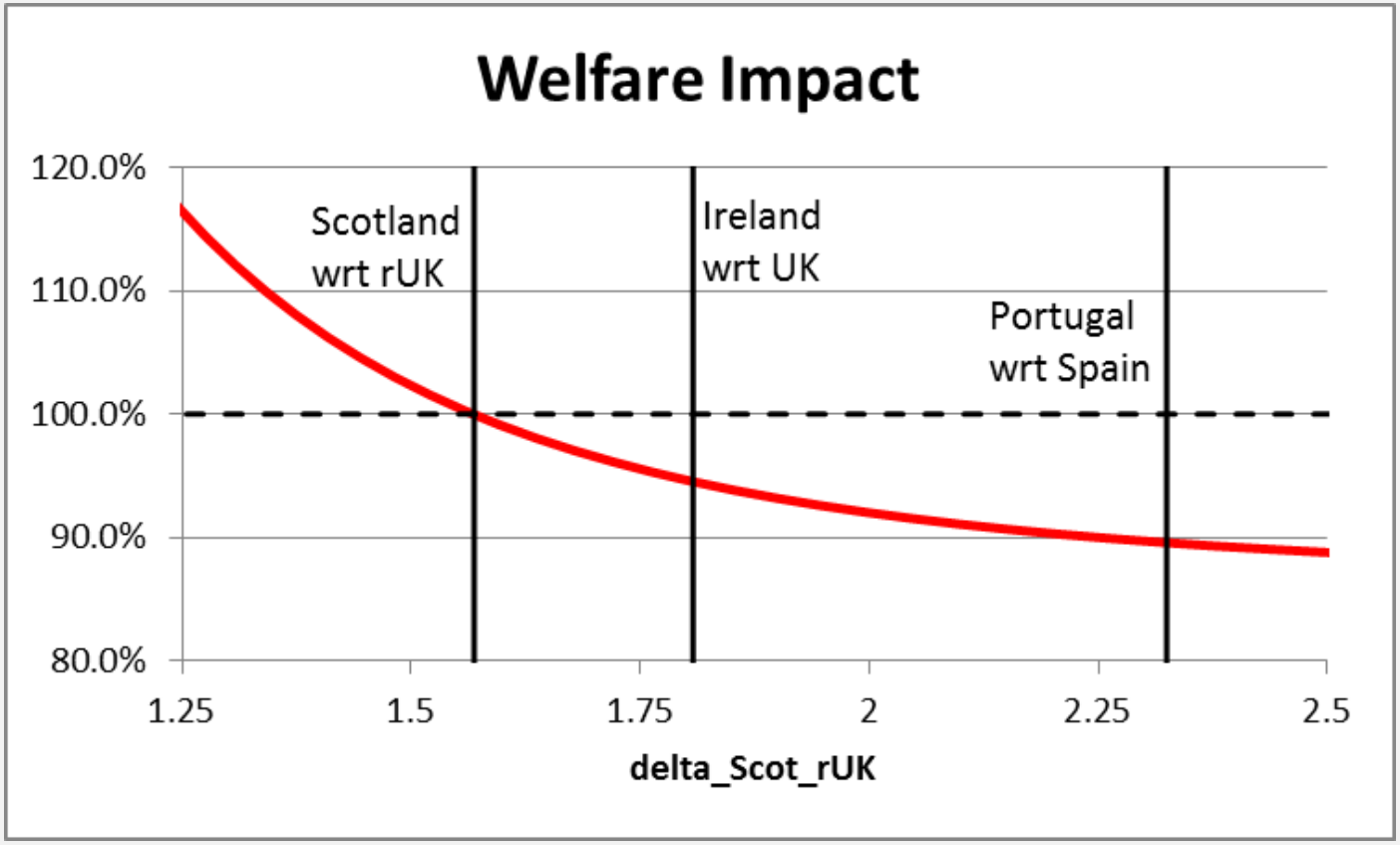
Δreal GDP:	Catalonia	Basque	Scotland	Portugal	Ireland
Autarky	-25.8%	-26.9%	-20.9%	-10.9%	-32.7%
Independence	-10.4%	-12.5%	-5.5%		
Autarky after independence	-17.2%	-16.5%	-16.3%	-10.9%	-32.7%
Independence / Autarky	40.2%	46.3%	26.2%		

Losses on independence relative to losses on autarky

- Not "The Cost of Independence"
- Ceteris paribus cost of creating border between region and current partner with same magnitude as border that exists between whole union & suitable counterfactual. Parameter dependent
- Comparison between these costs of independence and complete autarky is relatively invariant to parameters

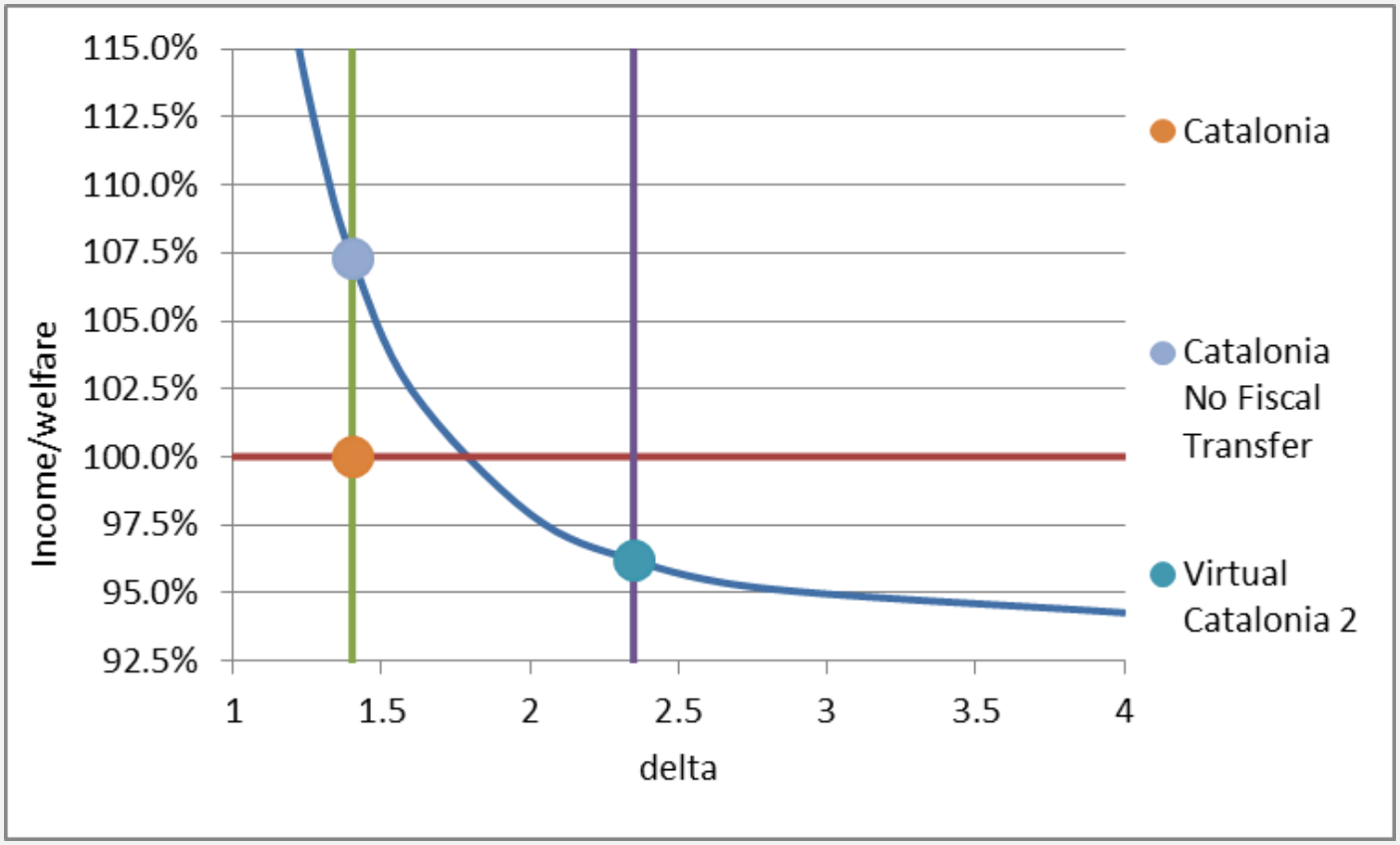
Regions to countries: Results *(3/6)*

- Our exercise is about "what if" scenarios: other scenarios can also be proposed
- Graph shows Scots welfare impact as function of friction with rUK, conditional on calibrated friction with rest of the world

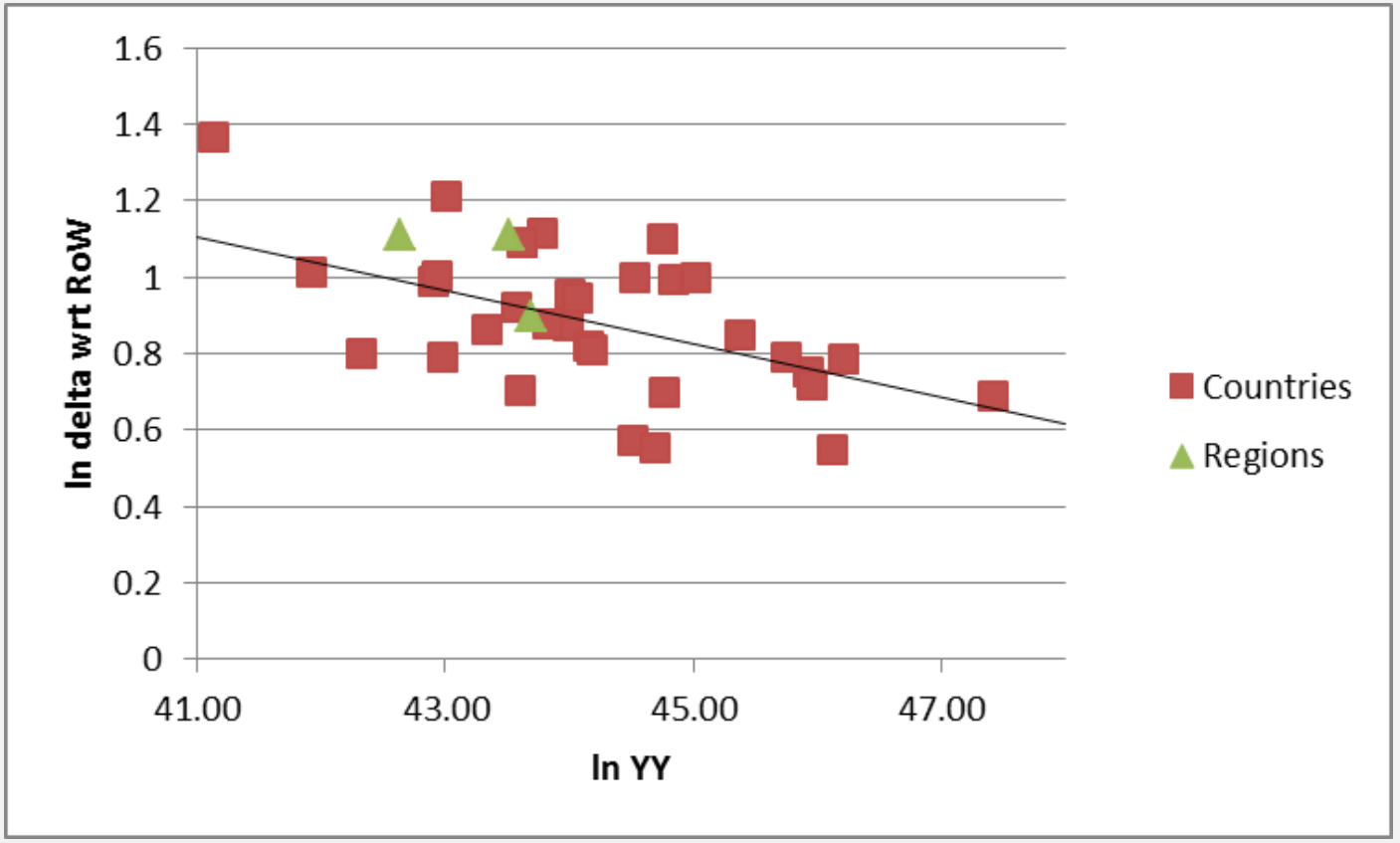


- Increase in trade with rest of the world would be a vertical shift in curve

Regions to countries: Results *(4/6)*

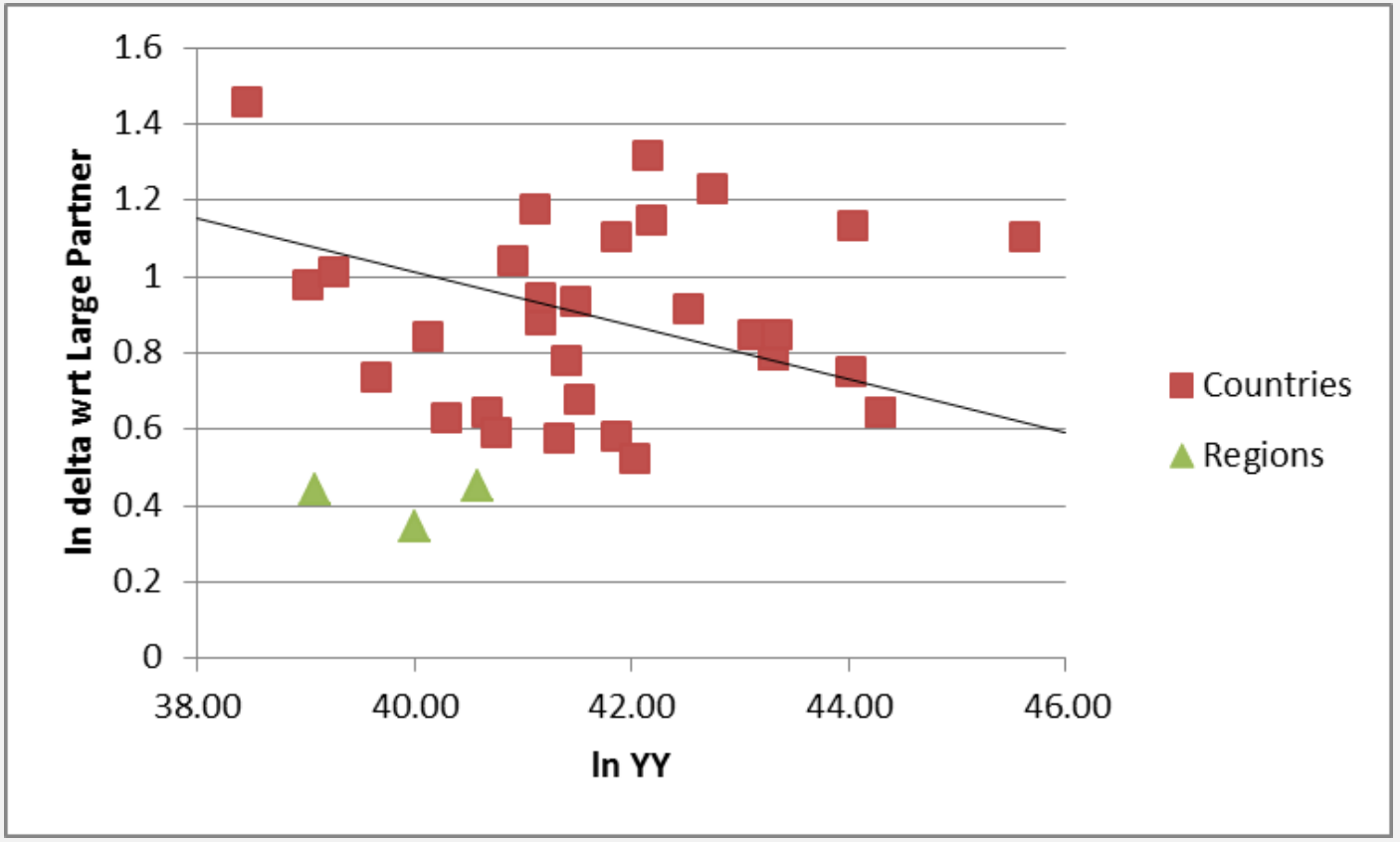


Regions to countries: Results *(5/6)*



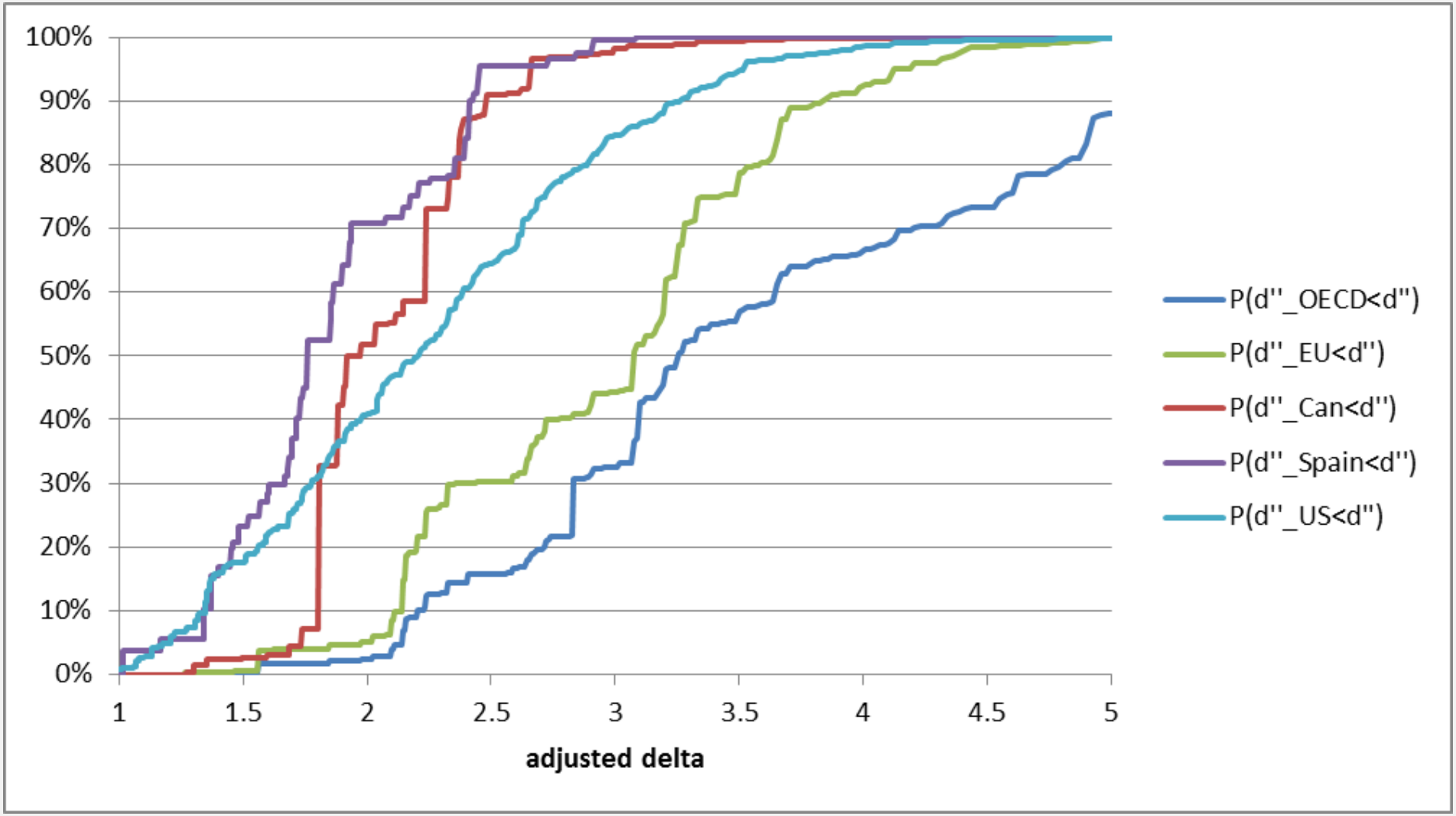
We don't find evidence that supports an expectation of increased trade with the rest of the world

Regions to countries: Results *(6/6)*



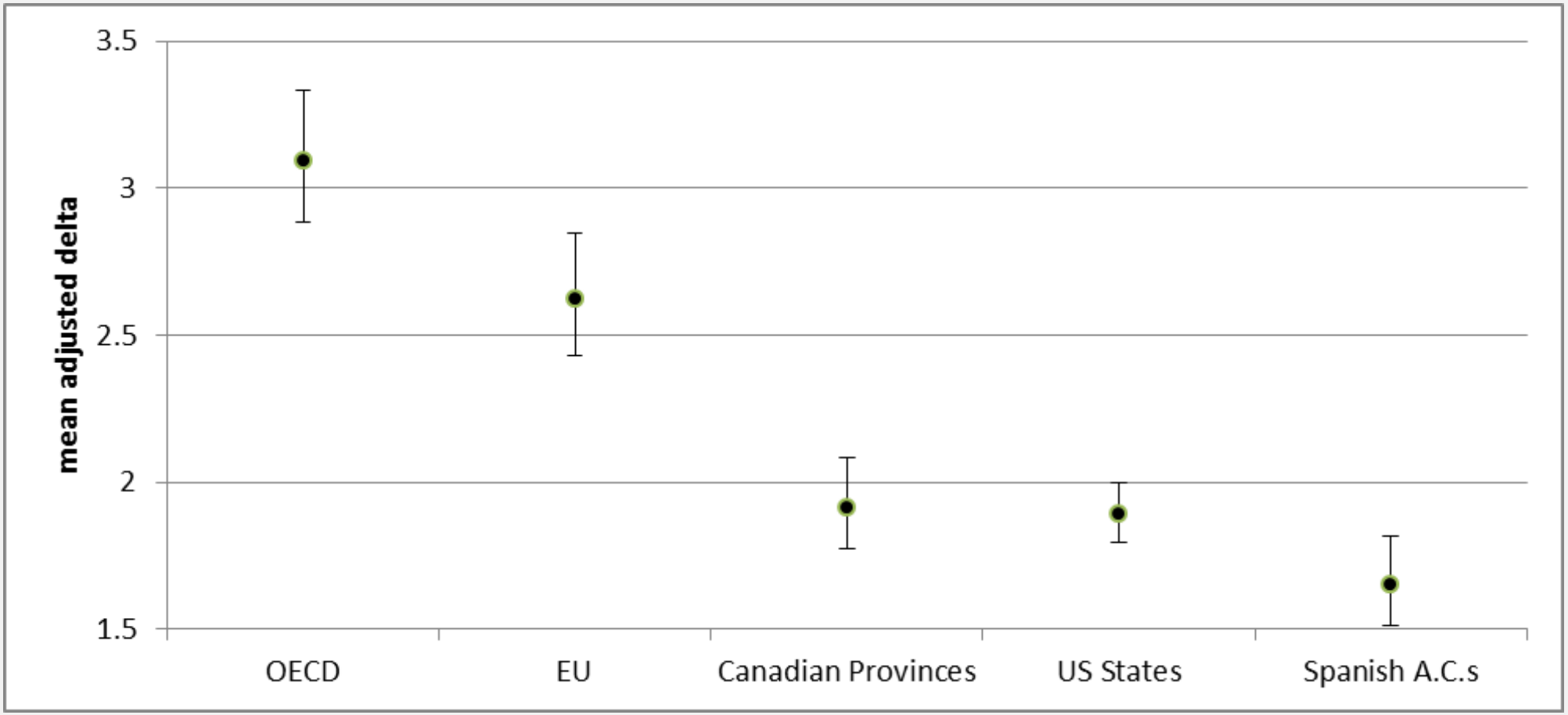
Contrasts with exceptionally low frictions these regions have with their current largest trading partners

Impact of EU membership *(1/3)*



Empirical CDF shows first order stochastic dominance for EU countries over the wider OECD country group

Impact of EU membership *(2/3)*



Mean size adjusted friction is significantly lower for EU countries than for the wider OECD country group

Impact of EU membership *(3/3)*

Non-EU	$Size\ Adj$ δ_{EU}	Matched EU	$Size\ Adj$ δ_{rEU}
Norway	2.90	Sweden	2.74
Iceland	3.81	Finland	2.99
		Denmark	2.80
Switzerland	2.53	Austria	2.51
Turkey	3.69	Greece	3.64

Frictions across and within EU borders

- Average effect:
  - Membership of EU is associated with 3% lower frictions with rEU
- Nothing like the differences seen between country-country and region-region borders

Brexit: Result

	UK in EU	UK out EU
δ_{rEU}	1.97	2.03
λ_{UK}	70%	71%
EU Trade Share	52%	50%
Δreal GDP		-0.5%

Trade cost of Brexit

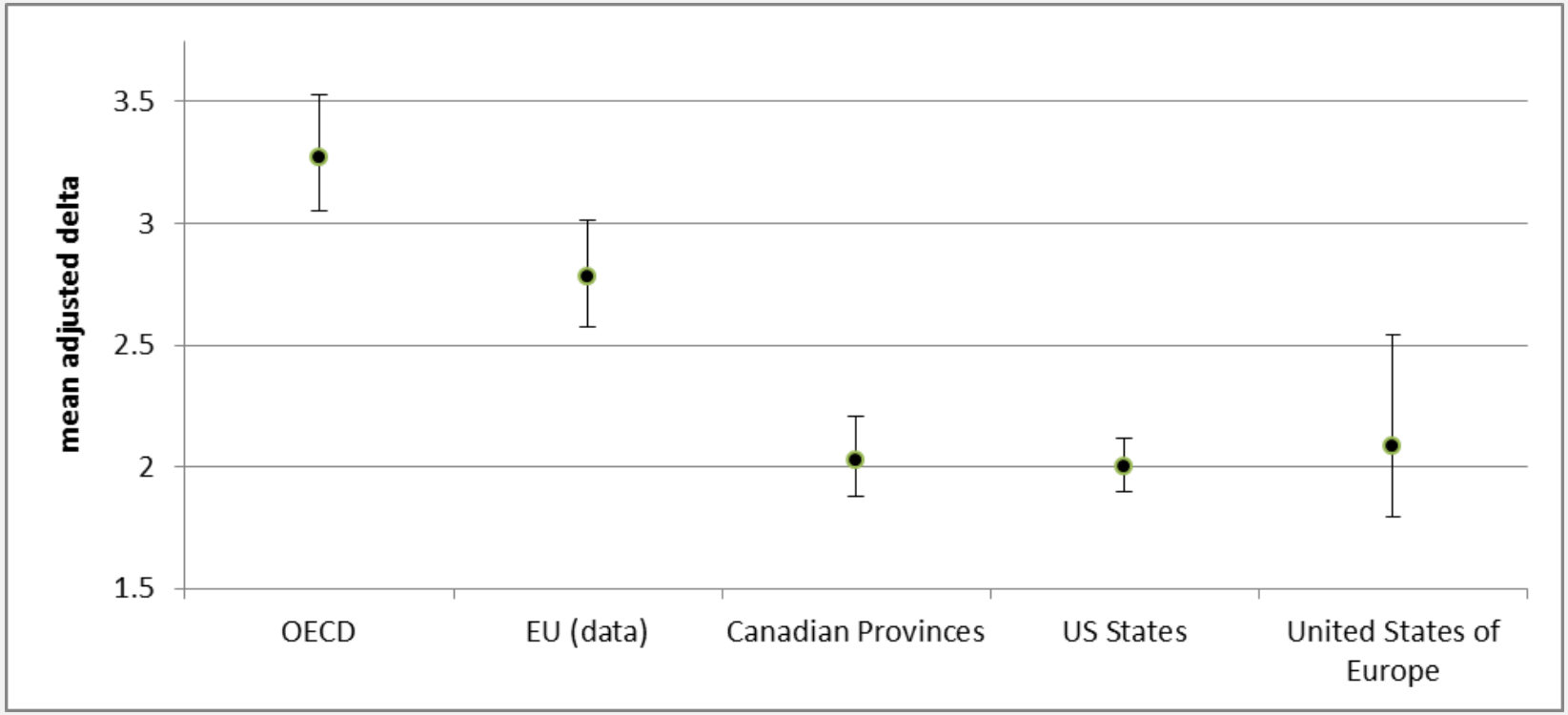
- Assume that UK vs rEU friction rises by 3% on Brexit
- Trade cost outweighs UK's net contribution: $\approx 0.2\%$ GDP

United States of Europe

- Let regional frictions, δ^r_{ij}, be related to country frictions, δ^c_{ij}, by the relation:

$$\delta^r_{ij} = (\delta^c_{ij})^{\exp(-x\%)}$$

- Then Scottish-Irish comparison $\Rightarrow x = 27\%$, & Catalan-Portuguese $\Rightarrow x = 89\%$
- Choose average, $x = 58\%$, and apply across EU. GDP rises by 17%



Reasonable estimate for United States of Europe?

Conclusions

- Gravity model: calibrate trade frictions for countries and regions, & calculate general equilibrium impact of changes in trade frictions

- Show that:
  - consistent with previous work on the border effect, country-country borders are systematically more frictional than region-region borders
  - country borders may be marginally less frictional within the EU, but definitely still in the class of country borders

- Propose series of counterfactual policy experiments and calculate welfare consequences of a ceteris paribus change in border frictions
  - region:region to country:country - economic integration benefits are a significant proportion of total gains from trade
  - EU member:rEU to EU non-member:rEU - impact of small increase in frictions outweighs small costs like UK's net contribution
  - country:country to region:region - potentially large gains if EU manages to replicate USA

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