Measuring Costs and Benefits of Independence.

David Comerford
University of Edinburgh

Nicholas Myers
University of Edinburgh

José V. Rodríguez Mora
University of Edinburgh

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Abstract

Preliminary.

We assess, using a calibrated, 3 country, Melitz trade model, the costs to Catalonia of independence, against the benefits it would see from not paying the large fiscal transfer that this relatively wealthy autonomous community pays to the rest of Spain. The model is calibrated to Catalonia, the rest of Spain, and the rest of the world; and also to Portugal, Spain and the rest of the world. In so doing, the effective distance between Catalonia & the rest of Spain, and between Portugal & Spain, are estimated. The intellectual experiment that is undertaken here is to compare the benefits to Catalonia of not paying the fiscal transfer, against the costs that arise from its effective distance from the rest of Spain becoming that of Portugal's with Spain. We find that the costs outweigh the benefits. We further extend this methodology to other countries in the EU and observe that even those country pairs that are relatively close in a gravity-style estimation, look to be distant compared to that observed between sub-national regions. This suggests that the economic benefits, through closer trade links, of further integration at the EU level are large; and that the costs, given the current institutional framework, of break-up of member states into smaller states within the EU, are relatively high.

1 Introduction

1.1 Independence

- Serious possibility in the short run
- Economic arguments given:.
  - Against staying in the Union:
    * Government farther away from the people than independence: political failure.
    * Redistribution with poorer regions. Bad if you are relatively rich.
  - In favour of the Union:
    * Independence increases policy and fiscal competition: political failure.
    * Regulator closer to groups of interest that they regulate: more corruption.
    * An integrated economy provides with larger market. Better allocation
      · Love of variety, Krugman style: More firms serving markets. Aggregate Increasing returns to scale.
      · Better firm selection: Melitz. Larger market puts upward preassure on wages as very efficient firms increase their labor demand to serve larger market. Low productivity firms exit the market as wages are too high.
- Non economic arguments:
  - In favor: I like it
  - Against: I do not like it.
- This paper: measure SOME of the likely economic effects. The ones that we know how to measure.
  - Against the Union: No redistribution to the rest of Spain
  - For the Union: Access to Larger integrated Market.
- Relatively easy to measure redistributive costs, but difficult to measure advantages of integration.
  - It is difficult to forecast changes in integration following national separation.
- We do not have a theory of distance. If we had, we would use it.
- What we can use is an exercise of comparison. What would happen if the distance between, say, Catalonia and the Rest of Spain became that of Spain's closest trading partner: Portugal.

- It is not outlandish to think that in the long run Spain's closest trading partner would be a good model for the interaction between Catalonia and the rest of Spain.
- We do not try to capture transition dynamics because in the short and medium term it is difficult to guess the degree of interaction, as two forces operate in different directions.
  - The process of separation should be expected to create tensions which would reduce the interactions between the former partners.
  - On the other hand, history must have build strong links that may persist for some time.
- We do not know how long it would take to get into this long term.

1.2 Spain is the closest nation to Portugal (and vice versa)

- We choose Portugal not because is geographically close to Spain, but because it trades a lot with Spain.
- We do not make nor make any claim on why is Portugal so economically close to Spain. It can be because of geography, or history, or culture, or chance. We do not care. The fact is that it is.
- Put gravity equations.

1.3 Border Effect within EU

- Economic agents that share a national state seem to be closer to each other than identical agents in different national states.
- This is true even within the EU.
  - Comparing Portugal and Catalonia vis a vis to Spain.

in%	Portugal/Spain	Catalonia/RoS
$\frac{X_{hj}+X_{jh}}{Y_j+Y_h}$	2.51	11.35
$\frac{X_{hj}+X_{jh}}{Y_j}$	17.31	60.69
$\frac{X_{hj}+X_{jh}}{X_{Rj}+X_{jR}}$	36.27	91.31

  -
    * First row is their bilateral trade as a percentage of their combined GDP
    * Second row is their bilateral trade as a percentage of Portugal and Catalonia's GDP respectively
    * Third row is bilateral trade as a percentage of the trade of Portugal and Catalonia respectively with the rest of the world.

- Catalonia trades much much more with the rest of Spain than Portugal does with its closest trading partner, Spain.
  - The fact that they are part of the same political structure must have to do with it.

- Catalans and inhabitants of the rest of Spain share many more things than Portuguese and Spanish.
  - They have the same regulations.
  - They interact much more: same education, trade-fairs, contacts and networks.
  - They share one language
- All this things are likely to change in the mid term. We find thus natural to make our exercise.

2 Model

- Standard Hopenhayn-Melitz model of firm heterogeneity and international trade.
  - Firms are monopolistic competitors in a Dixit-Stiglitz (love of variety) framework.
  - They have a fix cost of creation of the firm
  - and a fix cost of operating in each market where they choose to operate.
  - The operating profit of being active in a foreign country depends positively on that country's demand, and depends negatively on the economic distance between the countries.
  - Less distance has positive effects because
    - It increases the numbner of firms serving a market
    - It improves the quality of the firms that serve in the country, as the more productive firms increase labor demand in order to export. This increases wages, and drives unproductive firms out of the market.
- A firm's life consits of the following stages.
  - It chooses whether to pay the fix cost to draw a productivity.
  - If it pays that cost, it receives a productivity.
  - If this productivity is large enough it goes ahead with production. Otherwise, it disappears.
  - Firms die exogenously with a fixed probability every period.
- There are three economies h, j and rest of the world R.

2.1 Individual firm

- Consider an individual firm in economy h

- In each economy (h, j and R) there are Dixit-Stiglitz consumers. Thus, the demand for any good i in country j, is given by the demand function:

$$q_i = \left(\frac{p_i}{P_j}\right)^{-\theta} \left(\frac{Y_j}{P_j}\right)$$
$$p_i = P_j \; q_i^{-\frac{1}{\theta}} \; \left(\frac{Y_j}{P_j}\right)^{\frac{1}{\theta}}$$

- where:
  - $\theta > 1$ is the elasticity of substitution across goods, which we assume to be identical in all countries.
  - p_i is the nominal price of good i
  - P_j is the price aggregator for country j
  - q_i are the units of good i sold in country j
  - and Y_j is the nominal GDP in country j
- The only input is labor.
- Production takes place with a constant returns to scale technology subject to fix costs (to be discussed below)
- Taking (arbitrarily) a firm from h selling in j.Its productivity is $\frac{\phi}{\delta_{hj}}$,
  - where ϕ is idiosyncratic to the firm
  - and δ_{hj} is the distance between h and j
- δ_{hj} is the most important parameter of the model. We call it "distance"
  - It reflects how much easier it is to sell into a domestic market than to a foreign one, and how much more difficult it it is sell to a country which is further away. The advantages than a local producer has versus a foreign producer if both have the same intrinsic quality ϕ.
  - It is not geographic distance, albeit it necessarily has something to do with it, but a much more general "economic distance".
    * It has to do with language, reulatory differences, differences in taste of the consumers, and whatnot.
  - We do not try to explain where does it come from. We just measure it.
  - We write this paper because we have no theory of distance. If we had, we would use it. Our point is to measure distance in the context of the model, and to make thought experiments and comparisons.
  - We assume that when selling in a domestic country distance equals one, that this is the lower bound of distance and that the distance from h to j equals the distance from j to h :

$$\delta_{hh} = \delta_{jj} = 1$$
$$\delta_{hj} = \delta_{jh} \geq 1$$

- Nominal operating profits for the firm from h in market j are:

$$\tilde{\pi}_{hj} = \max_q P_j \; q^{1-\frac{1}{\theta}} \; \left(\frac{Y_j}{P_j}\right)^{\frac{1}{\theta}} - W_h \; \frac{\delta_{hj}}{\phi} q$$

  all production occurs in the local labor market of the firm (h).Thus W_h are nominal wages at h per unit of effective labor.

- Consequently profit maximization yields revenues, labour demand (for production porpouses) and operating profit respectively:

$$r_j^h = \theta\Theta \left(\frac{\phi}{\delta_{hj}}\right)^{\theta-1} \left(\frac{W_h}{P_j}\right)^{-(\theta-1)} Y_j$$
$$\hat{L}_j^h = (\theta-1)\,\Theta \left(\frac{\phi}{\delta_{hj}}\right)^{\theta-1} \left(\frac{W_h}{P_j}\right)^{-\theta} \frac{Y_j}{P_j}$$
$$\tilde{\pi}_j = \Theta \left(\frac{\phi}{\delta_{hj}}\right)^{\theta-1} \left(\frac{W_h}{P_j}\right)^{-(\theta-1)} Y_j$$

  - where for simplicity we call:

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

- To run a firm has fix cost per unit of time.
  - This cost amounts to hire a fix number of people.
  - This cost depends on both the size of the market that it is going to be served $\left(\frac{Y_j}{P_j}\right)$, and the distance of the market to the production center (δ_{hj}).
  - The larger the market, the more complex it is to sell there (and the larger the reward).
  - The further away it is. The more complicated it is to sell there. The more difficult.
  - The number of workers necessary (the fixed costs) is assumed to be:

$$f_{hj} = c \times \delta_{hj} \times \frac{Y_j}{P_j}$$

  - where c is a cost parameter equal in all countries.

- Thus, the per period profit of operating in market j if you are in h is then:

$$\pi_j^h = \tilde{\pi}_j^h - W_h f_{hj}$$

$$\pi_j^h = \left[\Theta \left(\frac{\phi}{\delta_{hj}}\right)^{\theta-1} \left(\frac{W_h}{P_j}\right)^{-\theta} - c\delta_{hj}\right] W_h \frac{Y_j}{P_j}$$

- Conditional on existence (we will determine existence of the firm below) a firm from h will choose to operate in j only if its operating profit exceeeds its fix cost for that market. Thus is, only if its productivity is high enough or distance low enough.

$$\pi_j^h \geq 0 \quad \Longleftrightarrow \quad \phi > \Phi_j^h = \left(\frac{c}{\Theta}\right)^{\frac{1}{\theta-1}} \left(\delta_{hj} \frac{P_h}{P_j} \frac{W_h}{P_h}\right)^{\frac{\theta}{\theta-1}}$$

  - Where Φ_j^h is the threshold of quality of a firm. This is only firms *that exist in* h and have intrinsic productivity larger than Φ_j^h will choose to export to j.
  - Notice that $\frac{P_h}{P_j}$ is the real exchange rate of the goods sold in j in terms of goods sold in h.
    In other words, given that the marginal utility of money in h and j are respectively $\frac{1}{P_h}$ and $\frac{1}{P_j}$, then $\frac{P_h}{P_j}$ is the relative value of money in j with respect to h.
  - Thus, Φ_j^h is larger (and the larger quality of exporting firms) if
    * the distance between h and j is larger, as this increases the complexity of selling into j
    * labor in h is the more expensive. As this makes production more costly
    * The real exchange rate $\frac{P_h}{P_j}$ is larger, as it is less atractive to sell to j instead of h.
      If P_j is low (relative to P_h, high $\frac{P_h}{P_j}$), then the price of your good in country j will necesarily be low (otherwise you do not sell much in j).
  - Notice that the threshold Φ_j^h is independent of the size of both markets. It is in particular independent of the size of j. This because of our assumption that the fix costs are linear in market size.
    We believe that this is not completely unreasonable, and simplifies the analisys enormeously.
    Furthermore. Doing it like this insures that the relative size of two economies is irrelevant if δ equals one. Which for the purpouses of our analysis is the correct assumption.
  - If fix costs were not linear in size, this would have huge implications of size on economic activity.
    For instance. If they were independent of size (as it is normally assumed) then larger economies would be much better off. In particular nobody would want to trade with small economies, and it would be impossible to replicate the fact that small economies are typically more open than large ones. We do not want to impose advantages to large unions. Thus, our hypothesis.

- Total labor demand of the firm for the purposes of market j (including fix costs) is:

$$L_j^h = (\theta - 1)\,\Theta \left(\frac{\phi}{\delta_{hj}}\right)^{\theta-1} \left(\frac{W_h}{P_j}\right)^{-\theta} \frac{Y_j}{P_j} + c\delta_{hj}\frac{Y_j}{P_j}$$

  which is increasing in ϕ and market size

2.2 The average firm.

- At the time of creation the quality of the firm ϕ is randomly determined by a distribution function $F(.)$ wich is equal in all economies. F is assumed to be a *Pareto distribution* with parameter k and lowest value b.

  For simplicity we define

$$\mu = k\frac{\theta}{\theta - 1}$$

  Furthermore, we assume

$$k > \theta - 1, \tag{1}$$

  otherwise mean profits would not be defined. This has to do with the properties of the Pareto distribution.

- We assume (and we will later confirm) that

$$\Phi_h^h < \Phi_j^h < \Phi_R^h$$

  - This is, the lowest threshold of activity is to operate in the domestic market.
  - Thus, all exporters also sell domestically, but not vice versa.

- The firm exists only if

$$\Phi_h^h \leq \phi$$

- Expected profit of a firm, conditional on existence:

$$\begin{aligned} \bar{\pi}^h = & \int_{\Phi_h^h}^{\Phi_j^h} \pi_h^h(\phi) \frac{dF(\phi)}{1 - F\left(\Phi_h^h\right)} \\ & + \int_{\Phi_j^h}^{\Phi_R^h} \left[\pi_h^h(\phi) + \pi_j^h(\phi)\right] \frac{dF(\phi)}{1 - F\left(\Phi_h^h\right)} \\ & + \int_{\Phi_R^h}^{\infty} \left[\pi_h^h(\phi) + \pi_j^h(\phi) + \pi_R^h(\phi)\right] \frac{dF(\phi)}{1 - F\left(\Phi_h^h\right)} \end{aligned}$$

$$\mu = k\frac{\theta}{\theta - 1}$$

$$\bar{\pi}^h = cW_h \left[\frac{1}{\theta} - \frac{1}{\mu}\right]^{-1} \frac{1}{\mu} \left\{\frac{Y_h}{P_h} + \left(\frac{P_j}{P_h}\right)^{\mu} (\delta_{hj})^{1-\mu} \frac{Y_j}{P_j} + \left(\frac{P_R}{P_h}\right)^{\mu} (\delta_{hR})^{1-\mu} \frac{Y_R}{P_R}\right\}$$

- It is useful to define effective (nominal) demand in economy h as:

$$D_h = P_h \left\{\frac{Y_h}{P_h} + \left(\frac{P_j}{P_h}\right)^{\mu} (\delta_{hj})^{1-\mu} \frac{Y_j}{P_j} + \left(\frac{P_R}{P_h}\right)^{\mu} (\delta_{hR})^{1-\mu} \frac{Y_R}{P_R}\right\}$$

- The expected labor demand[1] is the sum of the labor demand used for selling into each of the 3 markets:

$$\bar{L}^h = c\left[\frac{1}{\theta} - \frac{1}{\mu}\right]^{-1}\left(1 - \frac{1}{\mu}\right)\frac{D_h}{P_h}$$

- The expected sales:

$$\bar{r}^h = cW_h\left[\frac{1}{\theta} - \frac{1}{\mu}\right]^{-1}\frac{D_h}{P_h}$$

2.3 Firm Creation & Destruction. No-Arbitrage Condition.

- Firms die exogenously with a fixed probability of $1 - \beta$ every period
- In order to draw a productivity firms need to pay a fixed cost wich consists in paying during a number of workers $\tilde{c}$.

  We assume $\tilde{c}$ to be equal in all economies.
- The expected value of drawing a productivity for a firm in economy h is:

$$V^h = \left(1 - F\left(\Phi_h^h\right)\right)\frac{1}{1-\beta}\bar{\pi}^h$$

- Free entry the number of firms that are created needs to satisfy the following relationship:

$$\left(1 - F\left(\Phi_h^h\right)\right)\frac{1}{1-\beta}\bar{\pi}^h = W_h \times \tilde{c}^h$$

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

2.4 Number of Firms. Labor Market clearing.

- The number of firms: M_h
- Each period $(1-\beta)\,M_h$ die, thus in steady state the number of firms who try out has to be such that the ones who succeed (have $\phi > \Phi_h^h$) equal $(1-\beta)\,M_h$. Thus the number of firms who pay the fix cost has to be

$$\frac{(1-\beta)}{1 - F\left(\Phi_h^h\right)}M_h$$

- So the labor employed in paying the fix creation cost is:

$$L_{creation} = \frac{(1-\beta)}{1 - F\left(\Phi_h^h\right)}\tilde{c}M_h$$

[1] Notice that average labor demand does not depend on the wage... Nevertheless labor demand it is going to depend on wages because the **number** of firms will depend on it.

- Labor demand is the summation of $L_{creation}$ and the labor employed by the firms that have decided to go ahead $\left(M_h\bar{L}^h\right)$:

$$L_h^D = cM_h \left(\frac{c}{\Theta}\right)^\mu \left(\frac{W_h}{P_h}\right)^\mu \frac{(1-\beta)}{b^{\mu\frac{\theta-1}{\theta}}} \frac{\tilde{c}^h}{c} + \theta \left(\frac{\mu-1}{\mu-\theta}\right) \frac{D_h}{P_h}$$

- Which has to be equal to the efective labor supply, which is just the population of the economy times their productivity.
  - We allow the effective labor per capita to be different in the different economies.
-
  - Total effective labor supply is exogenously set at $S_h = N_h A_h$.
    - The productivity of workers at h is A_h
    - The population at h is N_h
  - We will callibrate the value S_h
  - Assuming Labor Supply equals labor demand and using theno arbitrage condition:

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

2.5 Total Demand.

- An important part of our exercise is the existence of a fiscal transfer from j to h of FS_jW_j. This is, F is the percentage of GDP transferred from j to h. Which in principle could be negative.

$$Y_j = (1-F)\, S_j W_j$$
$$Y_h = S_h W_h + F S_j W_j$$

2.6 Closing the model via Balanced Trade

- To close the model we equalize Income to aggregate demand. This is, we determine the proper aggregate prices P_j, P_h, P_R.
- A consequence of this is that trade is balanced, albeit not necessarily bilaterally balanced.
- It is easier, and equivalent, to impose trade balance, and derive from there the relevant aggregate prices,
- Thus, in each country total exports equal total imports. There can be vis-a-vis surpluses/deficits, but overall trade balance.
- Total exports from h to j:

$$X_j^h = M_h \frac{\left(1 - F\left(\Phi_j^h\right)\right)}{\left(1 - F\left(\Phi_h^h\right)\right)} \int_{\Phi_j^h} r_j^h(\phi) \frac{dF(\phi)}{1 - F\left(\Phi_j^h\right)}$$
$$= M_h c \left(\frac{P_h}{P_j}\right)^{1-\mu} \frac{W_h}{P_h} \delta_{hj}^{1-\mu} Y_j \left(\frac{1}{\theta} - \frac{1}{\mu}\right)^{-1}$$

- Trade balance:
  - In country h :

$$X_j^h + X_R^h = X_h^j + X_h^R \tag{2}$$

  - In country j:

$$X_h^j + X_R^j = X_j^h + X_j^R \tag{3}$$

  - If h and j are in balance, R must be too as 2 and 3 they imply:

$$X_R^h + X_R^j = X_h^R + X_j^R$$

- Balanced trade in h:

$$M_h \frac{W_h}{P_h} \left\{ \left(\frac{P_h}{P_j} \right)^{1-\mu} \delta_{hj}^{1-\mu} Y_j + \left(\frac{P_h}{P_R} \right)^{1-\mu} \delta_{hR}^{1-\mu} Y_R \right\}$$
$$= Y_h \left\{ M_j \left(\frac{P_j}{P_h} \right)^{1-\mu} \frac{W_j}{P_j} \delta_{hj}^{1-\mu} + M_R \left(\frac{P_R}{P_h} \right)^{1-\mu} \frac{W_R}{P_R} \delta_{hR}^{1-\mu} \right\}$$

- For country j :

$$M_j \frac{W_j}{P_j} \left\{ \left(\frac{P_j}{P_h} \right)^{1-\mu} \delta_{hj}^{1-\mu} Y_h + \left(\frac{P_j}{P_R} \right)^{1-\mu} \delta_{jR}^{1-\mu} Y_R \right\}$$
$$= Y_j \left\{ M_h \left(\frac{P_h}{P_j} \right)^{1-\mu} \frac{W_h}{P_h} \delta_{hj}^{1-\mu} + M_R \left(\frac{P_R}{P_j} \right)^{1-\mu} \frac{W_R}{P_R} \delta_{jR}^{1-\mu} \right\}$$

3 Model Solution

3.1 Equilibrium Definition

- Our concept of equilibrium is that all 14 of the following conditions are satisfied simultaneously.
- At this stage, this is a system of 14 equations (below), in 14 endogenous variables $(\{D_h, D_j, D_R, P_h, P_j, P_R, Y_h, Y_j, Y_R, W_h, W_j, W_R, M_h, M_j, M_R\})$ [2], with 12 parameters $\{\theta, \mu, \delta_h j, \delta_h R, \delta_j R, c, \tilde{c}, b, \beta, S_h, S_j, S_R\}$

[2] There are 15 endogenous variables here but it's relative prices, not absolute prices, that matter. Therefore one of the prices must be normalised to 1, leaving 14 endogenous variables.

$$D_h = P_h \left\{ \frac{Y_h}{P_h} + \left(\frac{P_j}{P_h} \right)^{\mu} (\delta_{hj})^{1-\mu} \frac{Y_j}{P_j} + \left(\frac{P_R}{P_h} \right)^{\mu} (\delta_{hR})^{1-\mu} \frac{Y_R}{P_R} \right\} \tag{1}$$

$$D_j = P_j \left\{ \frac{Y_j}{P_j} + \left(\frac{P_h}{P_j} \right)^{\mu} (\delta_{hj})^{1-\mu} \frac{Y_h}{P_h} + \left(\frac{P_h}{P_j} \frac{P_R}{P_h} \right)^{\mu} (\delta_{jR})^{1-\mu} \frac{Y_R}{P_R} \right\} \tag{2}$$

$$D_R = P_R \left\{ \frac{Y_R}{P_R} + \left(\frac{P_j}{P_R} \right)^{\mu} (\delta_{jR})^{1-\mu} \frac{Y_j}{P_j} + \left(\frac{P_h}{P_R} \right)^{\mu} (\delta_{hR})^{1-\mu} \frac{Y_h}{P_h} \right\} \tag{3}$$

$$\left(\frac{W_h}{P_h} \right)^{-\mu} \frac{D_h}{P_h} = \frac{\widetilde{c}(1-\beta)}{cb^{\mu \frac{\theta-1}{\theta}}} \left(\frac{c}{\Theta} \right)^{\frac{\mu}{\theta}} \left(\frac{1}{\theta} - \frac{1}{\mu} \right) \mu \tag{4}$$

$$\left(\frac{W_j}{P_j} \right)^{-\mu} \frac{D_j}{P_j} = \frac{\widetilde{c}(1-\beta)}{cb^{\mu \frac{\theta-1}{\theta}}} \left(\frac{c}{\Theta} \right)^{\frac{\mu}{\theta}} \left(\frac{1}{\theta} - \frac{1}{\mu} \right) \mu \tag{5}$$

$$\left(\frac{W_R}{P_R} \right)^{-\mu} \frac{D_R}{P_R} = \frac{\widetilde{c}(1-\beta)}{cb^{\mu \frac{\theta-1}{\theta}}} \left(\frac{c}{\Theta} \right)^{\frac{\mu}{\theta}} \left(\frac{1}{\theta} - \frac{1}{\mu} \right) \mu \tag{6}$$

$$\left(\frac{1}{\theta} - \frac{1}{\mu} \right) S_h = cM_h \frac{D_h}{P_h} \tag{7}$$

$$\left(\frac{1}{\theta} - \frac{1}{\mu} \right) S_j = cM_j \frac{D_j}{P_j} \tag{8}$$

$$\left(\frac{1}{\theta} - \frac{1}{\mu} \right) S_R = cM_R \frac{D_R}{P_R} \tag{9}$$

$$Y_h = S_h W_h + F S_j W_j \tag{10}$$

$$Y_j = (1-F) S_j W_j \tag{11}$$

$$Y_R = S_R W_R \tag{12}$$

$$M_h \frac{W_h}{P_h} = Y_h \frac{M_j \left(\frac{P_j}{P_h} \right)^{1-\mu} \frac{W_j}{P_j} \delta_{hj}^{1-\mu} + M_R \left(\frac{P_R}{P_h} \right)^{1-\mu} \frac{W_R}{P_R} \delta_{hR}^{1-\mu}}{\left(\frac{P_h}{P_j} \right)^{1-\mu} \delta_{hj}^{1-\mu} Y_j + \left(\frac{P_h}{P_R} \right)^{1-\mu} \delta_{hR}^{1-\mu} Y_R} \tag{13}$$

$$M_j \frac{W_j}{P_j} = Y_j \frac{M_h \left(\frac{P_h}{P_j} \right)^{1-\mu} \frac{W_h}{P_h} \delta_{hj}^{1-\mu} + M_R \left(\frac{P_R}{P_j} \right)^{1-\mu} \frac{W_R}{P_R} \delta_{jR}^{1-\mu}}{\left(\frac{P_j}{P_h} \right)^{1-\mu} \delta_{hj}^{1-\mu} Y_h + \left(\frac{P_j}{P_R} \right)^{1-\mu} \delta_{jR}^{1-\mu} Y_R} \tag{14}$$

3.2 Substitutions

- We perform 3 classes of substitution to simplify our system and reduce the dimensionality of the problem:
  - We assume that the rest of the world is exogenous with respect to h and j. Therefore, equations (6), (9), and (12), which relate the variables in the rest of the world to themselves can be eliminated and replaced with the exogenous parameters Y_R, M_R, W_R which appear in the other equations, and we lose the parameter S_R. Equation (3) can then be regarded as a definitions for D_R, which since it appears nowhere else in the system, can be ignored. We therefore have reduced the system to 10 equations in 10 endogenous variables with 14 parameters.
  - We write the system in real terms, so that

    $$x_i = \frac{X_i}{P_i} \text{ , for all } X \in \{Y, W, D\}, i \in \{h, j, R\}$$

    The price indices are replaced with the relative price indices

    $$Q_{hj} = \frac{P_h}{P_j}$$

    $$Q_{hR} = \frac{P_h}{P_R}$$

  - It is found that we can redefine the endogenous variables by mutiplying through by a combination of parameters of the model without changing any of the interesting ratios given by the model. Many of the parameters can then be cancelled. This vastly reduces the dimensionality of the problem. The substitutions made are:

$$B = \frac{\widetilde{c}\,(1-\beta)}{b^{\mu\frac{\theta-1}{\theta}}}$$

$d_h = \tilde{d}_h c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{\mu}{1-\mu}}$	$d_j = \tilde{d}_j c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{\mu}{1-\mu}}$	$Q_{hR} = \tilde{Q}_{hR} \left(\frac{\tilde{M}_R \tilde{w}_R}{\tilde{y}_R}\right)^{-\frac{1}{2\mu-1}}$
$y_h = \tilde{y}_h c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{\mu}{1-\mu}}$	$y_j = \tilde{y}_j c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{\mu}{1-\mu}}$	$y_R = \tilde{y}_R c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{\mu}{1-\mu}}$
$w_h = \tilde{w}_h c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{1}{1-\mu}}$	$w_j = \tilde{w}_j c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{1}{1-\mu}}$	$w_R = \tilde{w}_R c^{\frac{\mu-\theta}{\theta(1-\mu)}} B^{\frac{1}{1-\mu}} S_h^{-\frac{1}{1-\mu}}$
$M_h = \tilde{M}_h c^{-\frac{\mu-\theta}{\theta(1-\mu)}-1} B^{-\frac{1}{1-\mu}} S_h^{\frac{1}{1-\mu}}$	$M_j = \tilde{M}_j c^{-\frac{\mu-\theta}{\theta(1-\mu)}-1} B^{-\frac{1}{1-\mu}} S_h^{\frac{1}{1-\mu}}$	$M_R = \tilde{M}_R c^{-\frac{\mu-\theta}{\theta(1-\mu)}-1} B^{-\frac{1}{1-\mu}} S_h^{\frac{1}{1-\mu}}$

- Notice that we do not transform Q_{hj}
- The variables that we will use in the model are the ones with tilde, which are implicitly defined above.
  - This means that absolute values for the model's endogenous variables cannot be seen from our calibration. What we can see are changes between two calibrations. Moreover all our targets are relative variables and so we are not losing any information by making these change of variables.
- Furthermore, we define the following variables:

$$s_j = \frac{S_j}{S_h}$$

$$\Delta_h = \delta_{hR}^{1-\mu} \tilde{y}_R \left(\frac{\tilde{M}_R \tilde{w}_R}{\tilde{y}_R}\right)^{\frac{\mu}{2\mu-1}}$$

$$\Delta_j = \delta_{jR}^{1-\mu} \tilde{y}_R \left(\frac{\tilde{M}_R \tilde{w}_R}{\tilde{y}_R}\right)^{\frac{\mu}{2\mu-1}}$$

  - s_j is the relative effective size of j with respect to h. This is:

$$s_j = \frac{N_j A_j}{N_h A_h}$$

    Given that we take N_j and N_h directly from the data, it gives us the implied ratio of worker's productivity. Notice that this does not map directly into productivity because it is filtered by the distribution of firm's qualities.
  - Δ_h and Δ_j are measures of effective size of the rest of the world from the viewpoint of h and j respectively. This is, they are filtered by their economic distances to the rest of the world. The larger it is, the more economic interaction there is with R.

    Notice that its ratio it is a measure of the relative distance to the rest of the world of h with respect to j.

- The system is then 10 equations (below) in 10 endogenous variables $\left\{\tilde{d}_h, \tilde{d}_j, Q_{hj}, \tilde{Q}_{hR}, \tilde{y}_h, \tilde{y}_j, \tilde{w}_h, \tilde{w}_j, \tilde{M}_h, \tilde{M}_j\right\}$ with 6 parameters $\{\theta, \mu, \delta_{hj}, \Delta_h, \Delta_j, s_j\}$:

$\tilde{d}_h = \tilde{y}_h + \delta^{1-\mu} Q_{hj}^{-\mu} \tilde{y}_j + \Delta_h \tilde{Q}_{hR}^{-\mu}$	$\tilde{d}_j = \tilde{y}_j + \delta^{1-\mu} Q_{hj}^{\mu} \tilde{y}_h + \Delta_j \tilde{Q}_{hR}^{-\mu} Q_{hj}^{\mu}$
$\tilde{d}_h = \left(\frac{1}{\theta} - \frac{1}{\mu}\right) \mu \Theta^{-\frac{\mu}{\theta}} \tilde{w}_h^{\mu}$	$\tilde{d}_j = \left(\frac{1}{\theta} - \frac{1}{\mu}\right) \mu \Theta^{-\frac{\mu}{\theta}} \tilde{w}_j^{\mu}$
$\tilde{d}_h = \frac{1}{\tilde{M}_h} \left(\frac{1}{\theta} - \frac{1}{\mu}\right)$	$\tilde{d}_j = \frac{s_j}{\tilde{M}_j} \left(\frac{1}{\theta} - \frac{1}{\mu}\right)$
$\tilde{y}_h Q_{hj} = \tilde{w}_h Q_{hj} + F s_j \tilde{w}_j$	$\tilde{y}_j = (1 - F) s_j \tilde{w}_j$
$\tilde{M}_h \tilde{w}_h \left(Q_{hj}^{-\mu} \delta^{1-\mu} \tilde{y}_j + \tilde{Q}_{hR}^{-\mu} \Delta_h\right) = \tilde{y}_h \left(\tilde{M}_j \tilde{w}_j Q_{hj}^{\mu-1} \delta^{1-\mu} + \tilde{Q}_{hR}^{\mu-1} \Delta_h\right)$	
$\tilde{M}_j \tilde{w}_j \left(Q_{hj}^{\mu} \delta^{1-\mu} \tilde{y}_h + \left(\frac{\tilde{Q}_{hR}}{Q_{hj}}\right)^{-\mu} \Delta_j\right) = \tilde{y}_j \left(\tilde{M}_h \tilde{w}_h Q_{hj}^{1-\mu} \delta^{1-\mu} + \left(\frac{Q_{hj}}{\tilde{Q}_{hR}}\right)^{1-\mu} \Delta_j\right)$	

3.3 Calibration Procedure

- For a given set of parameters, we find the equilibrium by applying the Newton-Raphson method to find the roots of the above system of equations.
- Given a vector of data targets, T_D, from the model equilibrium we can calculate their modelled equivalents, T_M. We adjust the parameters of the model until $T_M = T_D$, using a version of the Simulated Method of Moments.
- Let $Y \equiv T_D - T_M$. Now perturb the modelled equivalents of the data targets with respect to each of the parameters to create a matrix, X. If the system is perfectly identified (i.e. same number of parameters as data targets $\Longrightarrow X$ square) then vector, N, of number of times these parameter perturbations have to be applied in order to move the modelled targets to the data, satisfies

$$Y - XN = 0$$
$$\text{i.e. } N = X^{-1} Y$$

- Clearly this assumes that the equilibria are linear in parameter space. Given non-linearity, changing the parameters by the amount implied by the calculated value of N will not actually take us to the point where $T_M = T_D$. However, this process is applied repeatedly until we converge upon the solution.
- The process can also be generalised to deal with more targets than parameters. Define a vector m of moment conditions:

$$Y - XN = m$$

- We try to minimse some norm of m, given some weighting matrix W

$$\text{Norm} = m' W m$$

- The form of the minimisation problem is identical to that faced in GMM, so by analogy, the solution is

$$N = (X' W X)^{-1} X' W Y$$

4 Data

Aggregate Data

- All data is for the year 2005
- Bilateral trade between Spain and Portugal in goods is acquired from the OECD "STAN Bilateral Trade Database"
- Bilateral trade between Spain and Portugal in services is aquired from OECD "Trade in Services by Partner Country"
  - Spain does not report exports in services to Portugal in 2005. Exports from Spain to Portugal in services are aquired from Portugal's reported imports from Spain.
- Data for trade in goods and services is the sum of these two values. Everything is reported in dollars.
- Bilataral trade flows in goods and services between Catalonia and the rest of Spain/rest of world is aquired from the Statistical Institute of Catalonia (IDESCAT) 2005 input-output table.
  - Value of Catalan exports to rest of Spain is 35.52% of Catalan GDP
  - Value of Catalan exports to rest of the world is 30.4% of Catalan GDP
  - Value of Catalan imports from rest of Spain is 25.16% of Catalan GDP
  - Value of Catalan imports from rest of world is 36.06% of Catalan GDP
- GDP of Spain and Portugal is from the world bank (world development indicators).
- Eurostat reports that Catalonia's GDP is 18.7% of Spain's GDP

Data Summary ($)

	Rest of Spain (h) **and Catalonia** (j)	**Spain** (h) **and Portugal** (j)
Y_h	$919,275,613,609$	$1,130,798,885,738$
Y_j	$211,523,272,129$	$191,847,858,529$
X_j^h	$53,223,709,552$	$20,973,098,000$
X_h^j	$75,144,306,877$	$12,245,288,721$
X_R^h	$223,308,603,857$	$266,645,329,000$
X_R^j	$64,309,823,143$	$41,046,170,331$
X_h^R	$280,503,308,146$	$344,529,506,279$
X_j^R	$76,271,486,854$	$50,534,969,000$

Micro Data

- We use 2005 data from the Encuesta Sobre Estrategias Empresariales (ESSE) which surveys a representative sample of manufacturing firms in Spain with more than 10 employees. 1911 firms provide information about their sales.

- We define a firm to be Catalan if more than 50% of a firm's employment is based in Catalan plants. A firm is Rest of Spain if less than 50% of its employment is based in Catalonia plants. According to this criterion, 414 firms in our sample are Catalan and 1497 are Rest of Spain.
- The key statistics we are interested in are the percentage of Catalan and Rest of Spain firms who sell in the Rest of Spain and Catalonia respectively and the percentage of Catalan and Rest of Spain firms who export to the rest of the world.
  - To find this, we use the variable "geographic range of the market." This variable tells us the 1st, 2nd, 3rd, 4th and 5th most important markets to the responding firm.
  - The six potential responses are 1. Local 2. Provincial 3. Regional 4. National 5. Abroad 6. Domestic and Abroad.
- We assume that a Catalan firm only sells in Catalonia ($\Phi_j^j < \phi < \Phi_h^j$) if the firm does not list "National," "Domestic and Abroad" and "Abroad" as one of the most important markets and if they say they do not export. We assume a Rest of Spain firm does not sell in Catalonia if the same conditions are met.
- A firm sells in the ROW if it responds yes to the question of whether or not they export.
- For verification of the calibration, we look at the ratio of sales of firms who at least sell in the rest of Spain $\phi > \Phi_h^j$ to sales of firms who export $\phi > \Phi_R^j$

Average Sales of Firms

	Sales Revenue (€)	**n**
Firms with $\phi > \Phi_h^j$	95,404,810	355
Firms with $\phi > \Phi_R^j$	108,394,800	307
Ratio = 0.88		

- Domestic sales = total sales - export revenue. The standard deviation of log domestic sales is 1.9

Selection of k and θ

- Bernard, Eaton Jensen and Kortum (2003) (BEJK) select a θ of 3.79 and to match the size and productivity advantage of US firms that export.
- Markups (not productivity) are drawn from a pareto distribution so the shape parameter used in their paper is not applicable
- Many papers use $\theta = 3.8$ following BEJK.
  - See: Ghironi and Melitz (2005) , Davis and Harrigan (2011), Bernard, Redding and Schott (2007) etc...
- Some papers calibrate k to match the standard deviation of log domestic sales in the US (as found by BEJK)

- See: Davis and Harrigan (2011) ($k = 3.4$), Ghironi and Melitz (2005) ($k = 3.4$) , Demidova (2008, working paper version) ($k = 3.3$), Felbermayer and Jung (2012 ($k = 3.3$)

- Standard deviation of firm sales in our model is

$$\frac{\theta - 1}{k}$$

	Standard deviation of log sales	Implied k
Observed US data (BEJK 2003)	1.67	1.7
Simulated US data (BEJK 2003)	0.84	3.3
Spain data (ESSE survey)	1.90	1.5

- For means to be defined, a parameter restriction of $\theta - 1 < k$ is imposed.

- The value of k must be greater than $k_{\text{min}} = 2.8$

5 Results

- Here we calibrate the model to two configurations. Catalonia-Rest of Spain, and Portugal-Spain.

- Parameters not calibrated:

	Configuration 1	Configuration 2
θ	3.8	3.8
k	3.3	2.80001
μ	4.5	3.8

- We use two diffrerent configurations.
  - Configuration 1 uses the parameters of BEJK 2003 for a simulated distribution of firms in the US.
  - Configuration 2 is an attempt to use Spanish firm data. The standard deviation of firm size in Spain appears to be substantially larger than in the US.

    In order to match this moment we would need to have a vey low value of k, which would be incompatible with our model given the established value of θ (remember that we face the restriction 1). Because of this we choose the minimum value for k compatible with our restrictions, 2.8.

    Notice that by doing we do not completely match the firm distribtion in Spain. Nevertheless given the effects of k on the calibrations, we are quite confident that we are underestimating the cost of larger distance.

- We take the transfer of Catalonia to rest of Spain to be 6.5% of the GDP of Catalonia.

- This is the official number for the trasfer with the methodology of "flujo beneficio" for the year 2005. That seems the most natural for doing this exercise.

  In 2009 this number would be 5.8% of the GDP of Catalonia.

- Parameters that we calibrate using SMM:
  - Distance δ_{hj}
  - Effective size of rest of the world market for h and j: Δ_h, Δ_j
  - Relative size of each economy's efficteve labor force: s_j
    - Given population size, it is detemined by labor productivity in each economy:

- Targets:
  - Interaction between h and j : $\frac{X_{hj}+X_{jh}}{Y_h+Y_j}$
  - Total trade in h : $\frac{X_{hj}+X_{jh}+X_{hR}+X_{Rh}}{Y_h}$
  - Total trade in j : $\frac{X_{hj}+X_{jh}+X_{jR}+X_{Rj}}{Y_j}$
  - Relative GDP: $\frac{Y_h}{Y_j}$

- Model Validation:
  - Average Sales of Catalan Firms who sell to rest of Spain, but not internationally divided by average sales of Catalan firms that export to RoW.

5.1 Distance of Catalonia with Rest of Spain.

Catalonia/Rest of Spain	Calibrated Parameters	
	$\theta = 3.8,\ k = 3.3$	$\theta = 3.8,\ k = 2.8$
δ	1.4475262	1.5832302
Δ_h	0.051932638	0.001540549
Δ_j	0.036699025	0.001088654
s_j	0.27694317	0.28203118

Catalonia/Rest of Spain	MODEL		DATA
Targets	$\theta = 3.8,\ k = 3.3$	$\theta = 3.8,\ k = 2.8$	
$\frac{X_{hj}+X_{jh}}{Y_h+Y_j}$	0.11351976	0.11351976	0.11351976
$\frac{X_{hj}+X_{jh}+X_{hR}+X_{Rh}}{Y_h}$	0.68769357	0.68769357	0.68769357
$\frac{X_{hj}+X_{jh}+X_{jR}+X_{Rj}}{Y_j}$	1.2714881	1.2714881	1.2714881
$\frac{Y_h}{Y_j}$	4.3459786	4.3459786	4.3459786

- The percapita incomes are matched to the data, but not so the effective labor per capita, wich is derived from the data given the model.

  The ratio of efficiency labor per capita in Catalonia to the rest of Spain is:

Catalonia	$s_j \times \frac{N_h}{N_j}$
$\theta = 3.8,\ k = 3.3$	1.47
$\theta = 3.8,\ k = 2.8$	1.49

- For model validation we look at how the distribution of firm sizes implied by the model matches the distribution in the data. It does so remarkably well:

Model Validation	MODEL	DATA
Cat firm size ratio	0.91312292	0.88

5.2 Distance of Portugal with Spain.

Portugal/Spain	Calibrated Parameters	
	$\theta = 3.8,\ k = 3.3$	$\theta = 3.8,\ k = 2.8$
δ	2.3481041	2.8876014
Δ_h	0.047784234	0.00141576
Δ_j	0.017895542	0.000530212
s_j	0.20548007	0.21262926

- The per-capita incomes are matched to the data, but not so the effective labor per capita, wich is derived from the data given the model.

  The ratio of efficiency labor per capita in Portugal to Spain is:

Portugal	$s_j \times \frac{N_h}{N_j}$
$\theta = 3.8,\ k = 3.3$	0.91
$\theta = 3.8,\ k = 2.8$	0.93

- Notice that the distance implied between Portugal and Spain is substantially larger than the distance implied between Catalonia and the Rest of Spain.

Portugal/Spain	MODEL		DATA
Targets	$\theta = 3.8,\ k = 3.3$	$\theta = 3.8,\ k = 2.8$	
$\frac{X_{hj}+X_{jh}}{Y_h+Y_j}$	0.025115086	0.025115086	0.025115086
$\frac{X_{hj}+X_{jh}+X_{hR}+X_{Rh}}{Y_h}$	0.56985661	0.56985661	0.56985661
$\frac{X_{hj}+X_{jh}+X_{jR}+X_{Rj}}{Y_j}$	0.650513	0.650513	0.650513
$\frac{Y_h}{Y_j}$	5.8942482	5.8942482	5.8942482

5.3 Experiment 1: Changing Distance.

$\theta = 3.8,\ k = 3.3$	$\delta = 1.4475262$	$\delta = 2.3481041$	*% change*
Y_j	$B\$211.3$	$B\$192.6$	-8.9%
Y_h	$B\$919.3$	$B\$901.3$	-2.0%
$\frac{X_{hj}+X_{jh}}{Y_j}$	60.7%	14.0%	-46.7%
$\frac{X_{jR}+X_{Rj}}{Y_j}$	66.5%	79.8%	$+13.4\%$
Φ_j^j	n/a	n/a	-11.9%
Φ_h^j	n/a	n/a	$+79.7\%$
Φ_R^j	n/a	n/a	-5.4%

$\theta = 3.8,\ k = 2.8$	$\delta = 1.5832302$	$\delta = 2.8876014$	% *change*
Y_j	$B\$211.3$	$B\$188.5$	-10.9%
Y_h	$B\$919.3$	$B\$897.1$	-2.4%
$\frac{X_{hj}+X_{jh}}{Y_j}$	60.7%	14.0%	-46.7%
$\frac{X_{jR}+X_{Rj}}{Y_j}$	66.5%	80.1%	$+13.6\%$
Φ_j^j	n/a	n/a	-14.5%
Φ_h^j	n/a	n/a	$+107.6\%$
Φ_R^j	n/a	n/a	-6.4%

- We equalize nominal GDP to its data value, which implies a value for the non-calibrated parameters. This is irrelevant, as we only make comparisons on changes or ratios of GDP from where the non-calibrated parameters disappear.

- The increase in distance with the largest trading partner of Catalonia has dramatic effects on trade and GDP.

- The deadweight loss goes from 3.3% of GDP in configuration 1, to 4% in configuration 2. In any case a large GDP fall.

- The degree of interaction with the rest of Spain becomes similar to the Portuguese one. It is actually somewhat lower due to the fact that Catalonia is closer to the rest of the World than Portugal is.

- The degree of interaction with the rest of the world increases, as catalan firms find harder to sell in the rest of Spain, and thus reallocate towards the rest of the world. Likewise Catalan consumers become less prone to consume Spanish products.

  Notice that this increase is not of the same magnitude than the decrease in trade with the rest of Spain due to the fact that there is no decrease in the intrinsic distance with the rest of the world.

  In any case, notice that the distance of Catalonia with the rest of the World is smaller than the Portuguese one.

- The most remarkable thing of the table is the implications that it has on firm composition, and via this mechanism, on TFP.

  Wages in Catalonia fall, and this makes less productive firms viable. Notice the fall in the threshold of quality of domestic firms.

  Morover, the threshold of quality for exporting to the rest of Spain rises dramatically, as it is much harder to overcome the larger distance, while the threshold to export to the rest of the world actually falls due to lower wages.

  There is an aditional composition effect, as wages lower less productive firms account for a larger share of employment, pushing TFP down.

5.4 Experiment 2: Changing Transfers.

$\theta = 3.8,\ k = 3.3$	$\delta = 1.4475262,\ F = 0.065$	$\delta = 2.3481041,\ F = 0$	% *change*
Y_j	$B\$211.3$	$B\$210.0$	-0.7%
Y_h	$B\$919.3$	$B\$883.4$	-3.9%
$\frac{X_{hj}+X_{jh}}{Y_j}$	60.7%	13.0%	-47.7%
$\frac{X_{jR}+X_{Rj}}{Y_j}$	66.5%	74.6%	$+8.2\%$
Φ_j^j	n/a	n/a	-9.6%
Φ_h^j	n/a	n/a	$+78.6\%$
Φ_R^j	n/a	n/a	-5.4%
$\theta = 3.8,\ k = 2.8$	$\delta = 1.5832302,\ F = 0.065$	$\delta = 2.8876014,\ F = 0$	% *change*
Y_j	$B\$211.3$	$B\$206.5$	-2.4%
Y_h	$B\$919.3$	$B\$878.4$	$-4,4\%$
$\frac{X_{hj}+X_{jh}}{Y_j}$	60.69%	13.1%	-47.6%
$\frac{X_{jR}+X_{Rj}}{Y_j}$	66.46%	74.9%	$+8.4\%$
Φ_j^j	n/a	n/a	-11.7%
Φ_h^j	n/a	n/a	$+106.0\%$
Φ_R^j	n/a	n/a	-6.4%

- Obviously the money that is not transfered to the rest of Spain increases GDP of Catalonia.
- It has a multiplier effect due to IRS implied in the Dixit-Stiglitz framework. Notice thogh that the deadweight losses are the same as before (3.3% and 4% in each configuration). What changes here is the distribution of the losses, which now fall more heavily on the Rest of Spain.
- It does not affect much to the firm quality distribution with respect to what would happen if transfers do not decrease.
- The loss in Catalonia is mitigated, but still substantial.
- The loss in the rest of Spain is substantially larger.

5.5 Border Effects Within The EU

- We see that Catalonia is much closer to the rest of Spain than Portugal is to Spain. Can we interpret this as an effect of belonging to a single country? Are sub national borders "thinner" than the "thick" borders between nations?
- The single market in the EU is an attempt to create the trade benefits of a single country across Europe. Are national borders within the EU "thinner" than borders across the EU/non-EU divide?
- The following table shows the distances calibrated for Norway, Sweden, Switzerland and Austria

$\theta = 3.8,\ k = 3.3$	δ
Norway vs the EU	2.4947471
Sweden vs rest of the EU	2.3502257
Switzerland vs the EU	2.1442397
Austria vs the rest of the EU	2.2063201

Portugal vs Spain for Comparison 2.3481041

- The borders between these countries and the (rest of the) EU look similar to each other and similar to the border between Portugal and Spain.
- Obviously many potential engogeneity issues here e.g. perhaps Switzerland did not join the EU as there were some costs and it already had all the distance and trade benefits that it could get from the EU countries.
- A general conclusion that can be drawn from this is that the EU/non EU border looks like any other country border, i.e. it is much "thicker" than the "thin" within country borders such as that between Catalonia and the rest of Spain.

6 Conclusions

- We do an exercise to measure the gains for Catalonia's TFP and GDP of deep integration with the rest of Spain
- We show that the losses associated to increasing the distance with the rest of Spain are large.
  - The combined GDP loss of increasing the distance is of between 3.3 and 4 percent.
  - From the point of view of Catalonia the loss if unacompained by a fiscal gain are huge. Of between 9 and 11 percent.
  - If accompained by a stop in redistribution the loses for Catalonia would, obviously, be smaller, but still substantial. Of between 0.7 and 2.5 percent. In this case the loss for the rest of Spain would be much larger, of more than the 4%.
- A larger share of this would be a consequence of a worsening in the distribution of firm's quality in Catalonia:
  - Very mediocre firms that today would find impossible to survive when facing direct competition from the rest of Spain, would find it worth to survive in the independence scenario.
  - This is because they are sheltered from a large degree of competition by the larger distance.
- There are two dimensions that characterize a firm. Its quality and its location.
  - When distance increases the second dimension becomes more salient. Firms that are not that good but are local find themselves in a better competitive position, as they access what is more of a captive market.
  - This would be the bulk of the loss of independence: the rise of mediocricity.
- This sort of models also have predictions on the effects on the distribution of incomes.

- See Pica and Rodríguez Mora (2011) and Helpman, Itskhoki and Redding (2008, 2010)
- One should expect an increase of the income in the middle of the distribution, plus decreases both to the poor and the rich.
- In the case of Catalonia the decrease of the poor should be expected to be larger, given the ethnic composition of society.
- It is interesting that the support of independence seems to be associated to the expected gains of social groups.