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The taxation of intellectual property and government tax setting

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Motivation

- Governments around the world are grappling with the question of how to tax the income from intellectual property
  - important component of firms activity and economic growth
  - income is highly mobile - firms can and do locate income offshore to reduce tax liability
  - tax can also distort the location and organisation of real activities

- Policy moves
  - modifications to CFC rules in US and UK
  - number of European countries recently introduced 'Patent Boxes'

Patent Box

- Substantially reduced rate of corporation tax for the income derived from patents
- Recently introduced by a number of European countries
  - Belgium 6.8% (full rate, 34%); Netherlands 10% (full rate, 25%); Luxembourg 5.9% (full rate, 39%) UK to introduce in 2013, 10% (full rate, 24%)
- Preferential rate on an important form of more mobile activities

Preferential tax treatment

- Historically, income from IP subject to the main statutory rate

- Mirrlees review: *"In principle, it would be efficient to tax rents from relatively immobile activities at a higher rate than rents from more mobile activities"*

- In practice
  - mobile income subject to lower effective rates
  - but explicit differentiation difficult to implement and discouraged by international agreements

Preferential tax treatment

- Theoretical results predicated on underlying assumptions
  - Keen (2001) - a preferential regime improves revenues by isolating tax competition in one part of the tax system
  - Janeba and Peters (1999) - in equilibrium tax competition leads to no tax on mobile income and lowers all revenues for all governments

- Work to reconcile opposing results (e.g. Janeba and Smart (2003))
  - predictions depend on assumptions about elasticities of tax bases and form of strategic interactions

The location of IP and government tax setting

- Aim: provide empirical evidence on how responsive the location of IP is to corporate tax and model a process of government tax setting

- *Firm behavior – Griffith, Miller and O'Connell (2011)*

- *Government tax setting – work going forward*

The location of IP and government tax setting

- Aim: provide empirical evidence on how responsive the location of IP is to corporate tax and model a process of government tax setting

- *Firm behavior – Griffith, Miller and O'Connell (2011)*
  - structural model of firm location choice (drawing on discrete choice demand models used in the Industrial Organisation literature)
  - estimate the impact of corporate taxes on innovative European multinationals' choices over where to hold patents
  - explicitly allow for heterogeneity in where patents are located and how responsiveness such choices are to tax (random coefficients)

- *Government tax setting – work going forward*

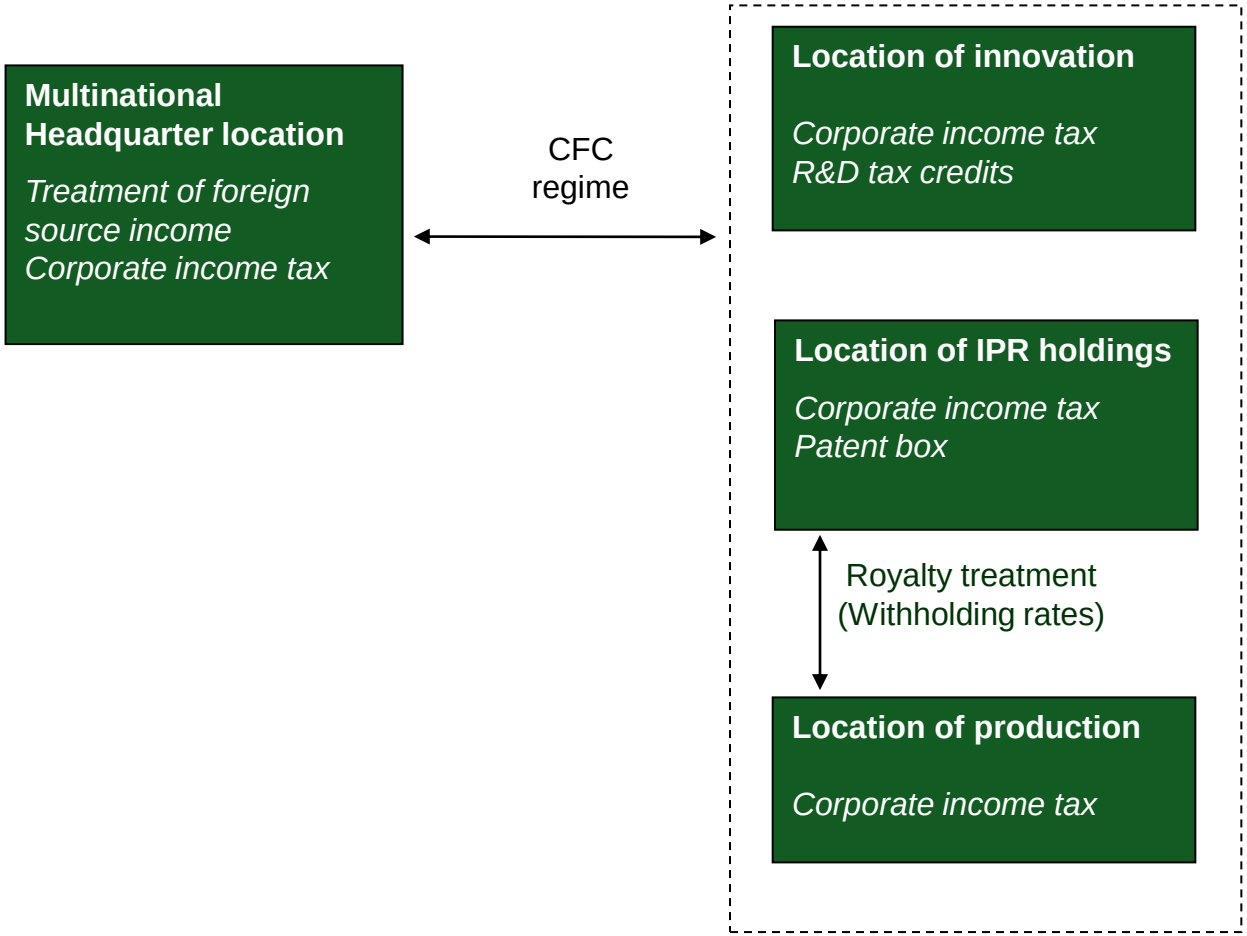
The location of IP and government tax setting

- Aim: provide empirical evidence on how responsive the location of IP is to corporate tax and model a process of government tax setting

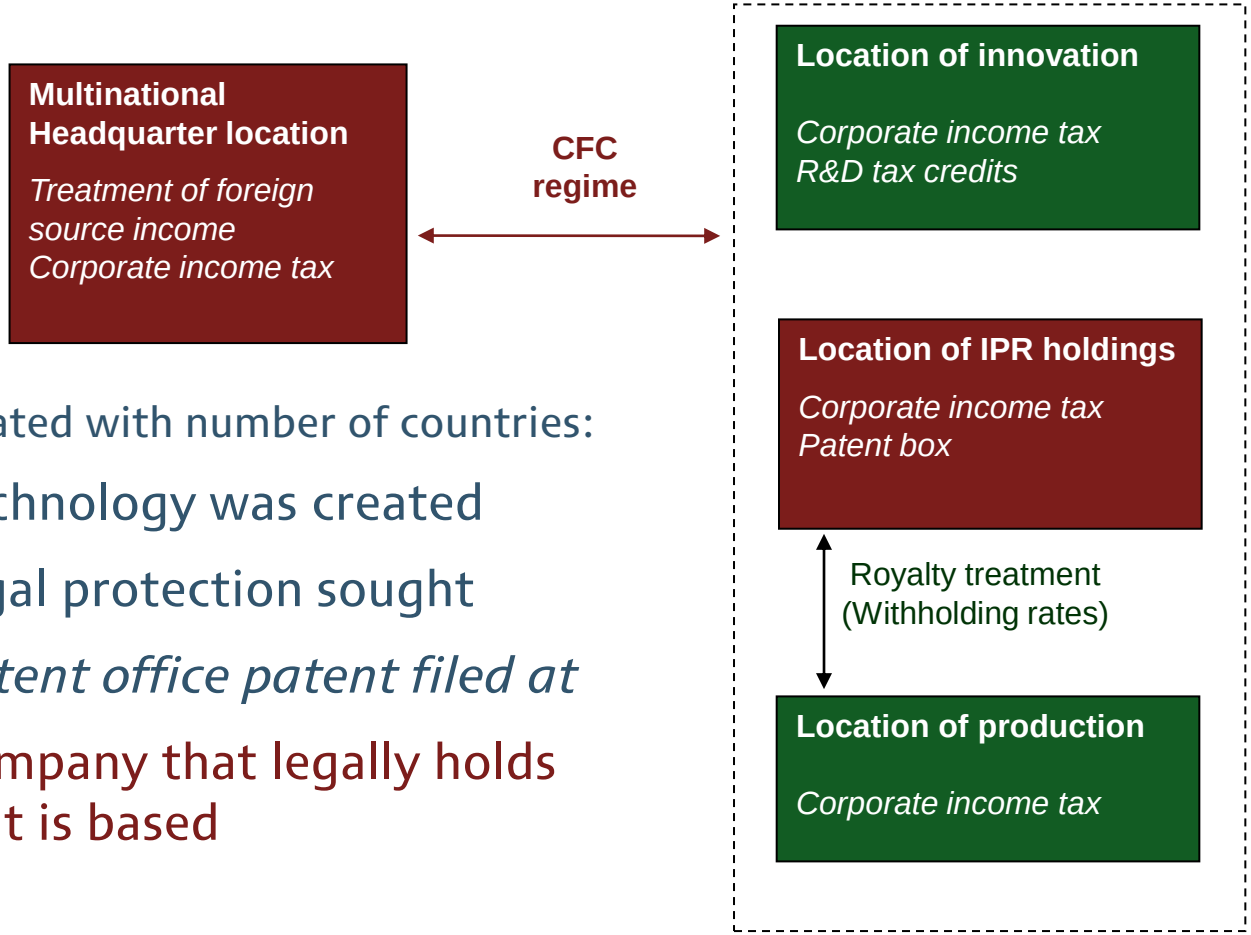
- *Firm behaviour – Griffith, Miller and O'Connell (2011)*

- *Government tax setting – work going forward*
  - simple model of revenue maximising governments
  - many, asymmetric countries
  - alternative assumptions on the form of governments' strategic behaviour

Firm behaviour - location and taxes



Firm behaviour - location and taxes



Patents associated with number of countries:

- where technology was created
- where legal protection sought
- *which patent office patent filed at*
- where company that legally holds the patent is based

Heterogeneity

- Expect considerable heterogeneity in where patents are located and how responsive such choices are to tax
  - benefits and costs of choosing a lower tax location may differ with expected value of patent
  - firms face different costs of locating patent income - organisational structure; strategies; headquarter countries; markets.
  - non-tax characteristics of countries

- Allow for unobservable patent heterogeneity
  - through random coefficients
  - allows realistic substitution patterns and rich elasticities (escape Independence of Irrelevant Alternatives (IIA) property)

Model of firm behaviour

- In year *t*, firm *i* chooses to hold patent *p* in the location *j* such that:

$$j_p^* = argmax_{j\in\{1,\ldots,J\}}\left\{\left(1-\tau_{ijt}\right)\tilde{V}_p - C\left(\tilde{V}_p, X_i\right) - F_{ipj}\right\}$$

$\tilde{V}_p$	expected net present pre-tax value
τ_{ijt}	tax rate on patent income, including CFC regimes
$C\left(\tilde{V}_p, X_i\right)$	cost that firm *i* incurs when locating the patent
X_i	vector of firm characteristics
F_{ipj}	net fixed costs to firm *i* of locating patent *p* in location *j*,

Empirical specification

- Define patents according to 3 industry classifications, *r*, and 2 broad firm size categories, *s*

$$j_p^* = argmax_{j \in \{1,\ldots,J\}} \{\varphi_{ip} - \delta_p \tau_{ijt} - (\gamma_{rsj} + e_{ipj})\}$$

patent specific response to the tax rate: $\delta_p = \mu_{rs} + \sigma_{rs}\eta_p$

where $\eta_p \sim N(0,1)$ $e_{ipj} \sim i.i.d\ extreme\ value$

The random coefficient, η_p, allows for variation in responsiveness of location choice to tax along unobservable dimensions

Data: Firms, patents and taxes

- Location of Intellectual Property – data on EPO patent applications
  - address of subsidiary that made application
- Multinational firm ownership structure from accounts data
  - result: European parent firms and their patent applications held in European and US subsidiaries
- Taxes
  - statutory corporate rate in source country
  - CFC regime operated in home country
    - Define source countries deemed to be 'low tax' country
  - observed Patent Boxes rates used in simulations

Results; coefficients on corporate tax

	Multinomial logit	*Multinomial logit*	*Random coeff. logit*
	(1)	*(2)*	*(3)*
		Electrical Industry	
Large firms			
Tax rate, Mean	0.59	-3.17	**-5.01**
	(0.04)**	(0.09)**	**(0.12)****
Tax rate, Std Dev	-	-	**6.80**
	-	-	**(0.16)****
Medium firms			
Tax rate, Mean	-1.11	-4.48	**-5.17**
	(.08)**	(0.19)**	**(0.27)****
Tax rate, Std Dev	-	-	**3.52**
	-	-	**(0.51)****
Industry-firm size specific country fixed effects	no	yes	**yes**

Results; coefficients on corporate tax

	Multinomial logit	*Multinomial logit*	*Random coeff. logit*
	(1)	*(2)*	*(3)*
		Chemical Industry	
Large firms			
Tax rate, Mean	-0.04	-1.42	**-4.00**
	(0.04)	(0.09)**	**(0.14)****
Tax rate, Std Dev	-	-	**8.85**
	-	-	**(0.20)****
Medium firms			
Tax rate, Mean	-0.55	-2.67	**-3.30**
	(0.08)**	(0.18)**	**(0.22)****
Tax rate, Std Dev	-	-	**4.06**
	-	-	**(0.39)****
Industry-firm size specific country fixed effects	no	yes	**yes**

Results; coefficients on corporate tax

	Multinomial logit	*Multinomial logit*	*Random coeff. logit*
	(1)	*(2)*	*(3)*
	Engineering industry		
Large firms			
Tax rate, Mean	0.44	-1.80	**-2.60**
	(0.05)**	(0.11)**	**(0.13)****
Tax rate, Std Dev	-	-	**4.66**
	-	-	**(0.23)****
Medium firms			
Tax rate, Mean	-0.15	-2.98	**-3.76**
	(0.07)*	(0.16)**	**(0.21)****
Tax rate, Std Dev	-	-	**4.20**
	-	-	**(0.39)****
Industry-firm size specific country fixed effects	no	yes	**yes**

Own and cross tax elasticities market elasticities

	Country changing tax rate														
Location country	Belgium	Denmark	Finland	France	Germany	Ireland	Italy	Luxembourg	Netherlands	Norway	Spain	Sweden	Switzerland	UK	US
Belgium	**-1.006**	0.031	0.051	0.171	0.026	0.001	0.042	0.006	0.168	0.006	0.004	0.080	0.111	0.143	-0.012
Denmark	0.064	**-1.375**	0.056	0.261	0.076	0.001	0.089	0.011	0.228	0.011	0.007	0.109	0.193	0.257	0.038
Finland	0.055	0.030	**-1.568**	0.471	0.112	0.001	0.062	0.005	0.486	0.006	0.004	0.193	0.147	0.202	0.054
France	0.030	0.023	0.077	**-0.917**	0.035	0.000	0.031	0.003	0.232	0.004	0.002	0.097	0.095	0.124	0.000
Germany	0.011	0.016	0.046	0.087	**-0.642**	0.000	0.016	0.003	0.109	0.004	0.002	0.060	0.069	0.080	-0.053
Ireland	0.082	0.081	0.083	0.311	0.094	**-0.768**	0.129	0.017	0.252	0.016	0.014	0.136	0.461	0.318	0.053
Italy	0.028	0.029	0.038	0.117	0.025	0.001	**-0.842**	0.008	0.089	0.008	0.005	0.064	0.091	0.132	-0.014
Luxembourg	0.058	0.056	0.045	0.194	0.074	0.001	0.124	**-1.299**	0.129	0.013	0.010	0.089	0.160	0.242	0.028
Netherlands	0.038	0.025	0.103	0.301	0.056	0.000	0.030	0.003	**-1.067**	0.004	0.002	0.124	0.116	0.148	0.018
Norway	0.061	0.055	0.056	0.249	0.085	0.001	0.115	0.013	0.183	**-1.340**	0.008	0.105	0.168	0.242	0.039
Spain	0.043	0.041	0.040	0.148	0.052	0.001	0.097	0.012	0.090	0.010	**-1.081**	0.068	0.099	0.171	0.018
Sweden	0.052	0.035	0.119	0.365	0.090	0.001	0.063	0.006	0.359	0.007	0.004	**-1.405**	0.146	0.196	0.043
Switzerland	0.069	0.061	0.085	0.336	0.094	0.002	0.087	0.010	0.316	0.011	0.005	0.140	**-0.857**	0.276	0.052
UK	0.052	0.046	0.069	0.258	0.067	0.001	0.073	0.008	0.239	0.009	0.005	0.109	0.160	**-1.181**	0.026
US	-0.007	0.012	0.031	-0.001	-0.075	0.000	-0.013	0.002	0.048	0.002	0.001	0.040	0.058	0.044	**-0.266**

Market elasticities (subset of countries)

Location country	***Country changing tax rate*** Belgium	France	Ireland	Luxembourg	Netherlands	Sweden	UK
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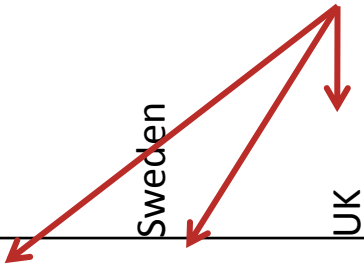
Table 9 market elasticities; standard logit model

Less elastic demand; unrealistic substitution patterns



	Country changing tax rate						
Location country	Belgium	France	Ireland	Luxembourg	Netherlands	Sweden	UK
Belgium	**-0.816**	0.173	0.001	0.003	0.130	0.049	0.090
France	0.031	**-0.671**	0.001	0.003	0.130	0.049	0.090
Ireland	0.031	0.173	**-0.311**	0.003	0.130	0.049	0.090
Luxembourg	0.031	0.173	0.001	**-0.755**	0.130	0.049	0.090
Netherlands	0.031	0.173	0.001	0.003	**-0.656**	0.049	0.090
Sweden	0.031	0.173	0.001	0.003	0.130	**-0.649**	0.090
UK	0.031	0.173	0.001	0.003	0.130	0.049	**-0.658**

Model of firm behaviour; summary

- Tax does affect location of patent holding
  - important to account for interactions between tax jurisdictions
  - significant heterogeneity the responsiveness of patents' location to tax (including important variation along unobserved characteristics)
  - More realistic substitution patterns that previous models
  - *Going forward - extend to make estimates more flexible*

Model of government tax setting

- Governments, j, set tax rate, τ_j , to maximise revenue, R_j
- There are two tax bases, $b \in (1,2)$, which differ in mobility, are completely separate , and are unaffected by tax
- Many asymmetric countries

Constrained (one tax rate for all income)

$$max_{\tau_j} R_j = \tau_j s_j^1(\tau_j, \tau_{-j})M^1 + \tau_j s_j^2(\tau_j, \tau_{-j})M^2$$

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Unconstrained (rate differentiation)

$$max_{\tau_j^b} R_j^b = \tau_j^b s_j^b(\tau_j^b, \tau_{-j}^b)M^b$$

- Keen (2001) – compare revenue in two cases when two symmetric countries and M^b fixed – revenue no lower in unconstrained case

Model of government tax setting

- Patent Box ~ governments set tax rate for the income from intellectual property

$$max_{\tau_j^1} R_j = \tau_j^1 s_j^1(\tau_j^1, \tau_{-j}^1) M^1$$

- First order condition:

$$\frac{dR_j}{d\tau_j^1} = \tau_j^{1*} \frac{ds_j^1(\tau_j^1, \tau_{-j}^1)}{d\tau_j^1} + s_j^1(\tau_j^1, \tau_{-j}^1) = 0$$

- At Nash Equilibrium, own tax elasticity = -1

$$\varepsilon_{j|\tau_j^1=\tau_j^{1*}} = \frac{\tau_j^{1*}}{s_j^1(\tau_j^1, \tau_{-j}^1)} \frac{ds_j^1(\tau_j^1, \tau_{-j}^1)}{d\tau_j^1} = -1$$

Strategic interactions

- *Betrand* – governments set taxes taking the actions of all other governments as given

- *Sequential moves* - EU countries have introduced Patent Boxes in succession and others may be expected to follow (Stackelberg model)
  - why were these countries the first to tax discriminate and how we can expect other governments to respond?

- *Cooperation* – better outcomes is countries collaborate?
  - has there been a break down in (implicit) EU cooperation (and if so why did the Benelux countries deviate?)
  - would EU cooperation to prevent preferential rates be revenue improving?

Dependencies in tax setting

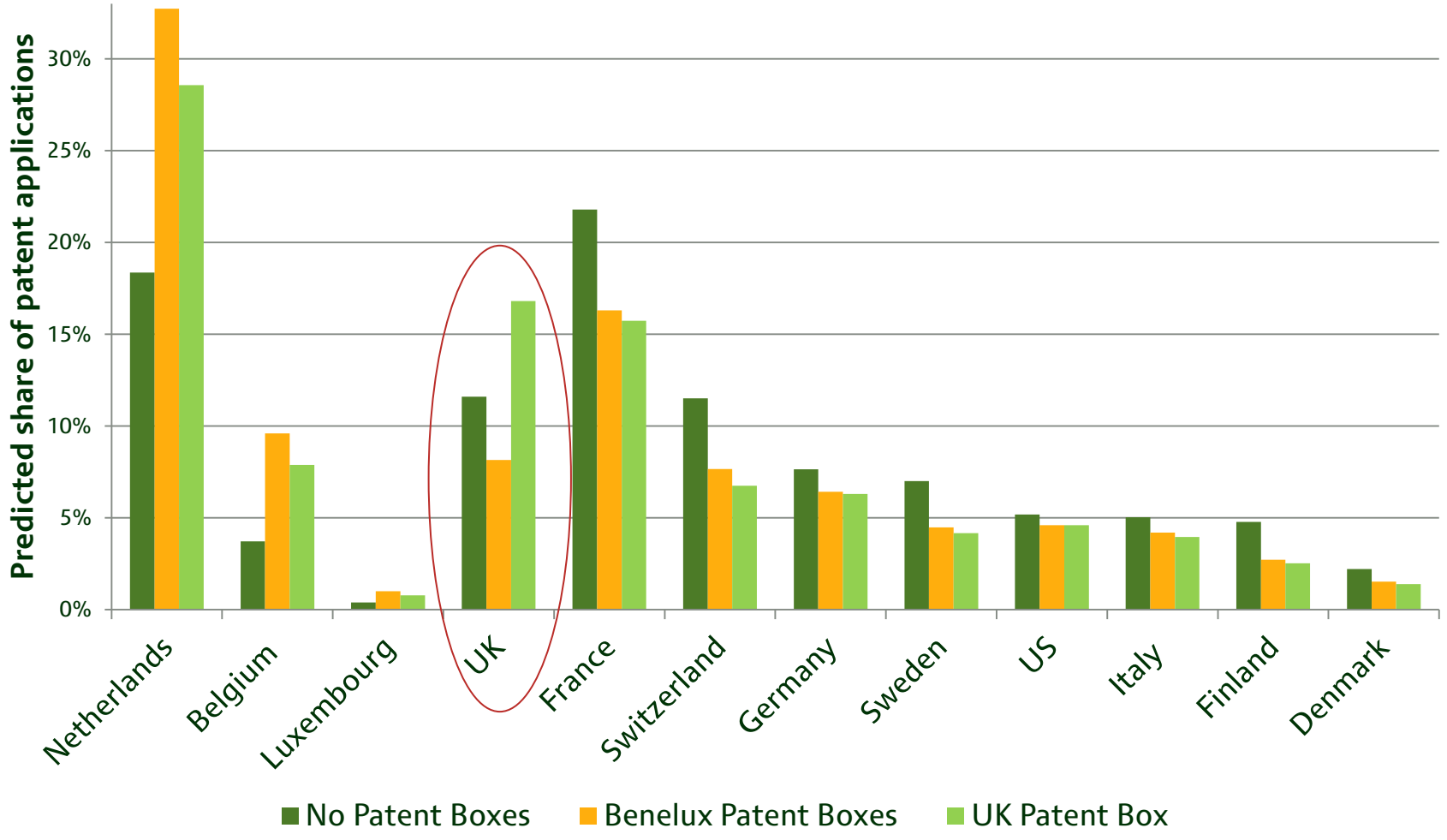
- Counterfactual policy analysis holding other governments actions fixed

- How do Benelux Patent Boxes affect where patents held?
  - increase share of patents held in Benelux countries
  - fall in UK share (12% -8%) , and elsewhere

- A UK Patent Box
  - fall in Benelux countries' share (still higher than before)
  - increase in UK share (to 17%)

- Government revenue from patent income falls in all countries
  - function of the share of patent income held in a country and the relevant tax rate.

Patent box simulations (shares in each country)



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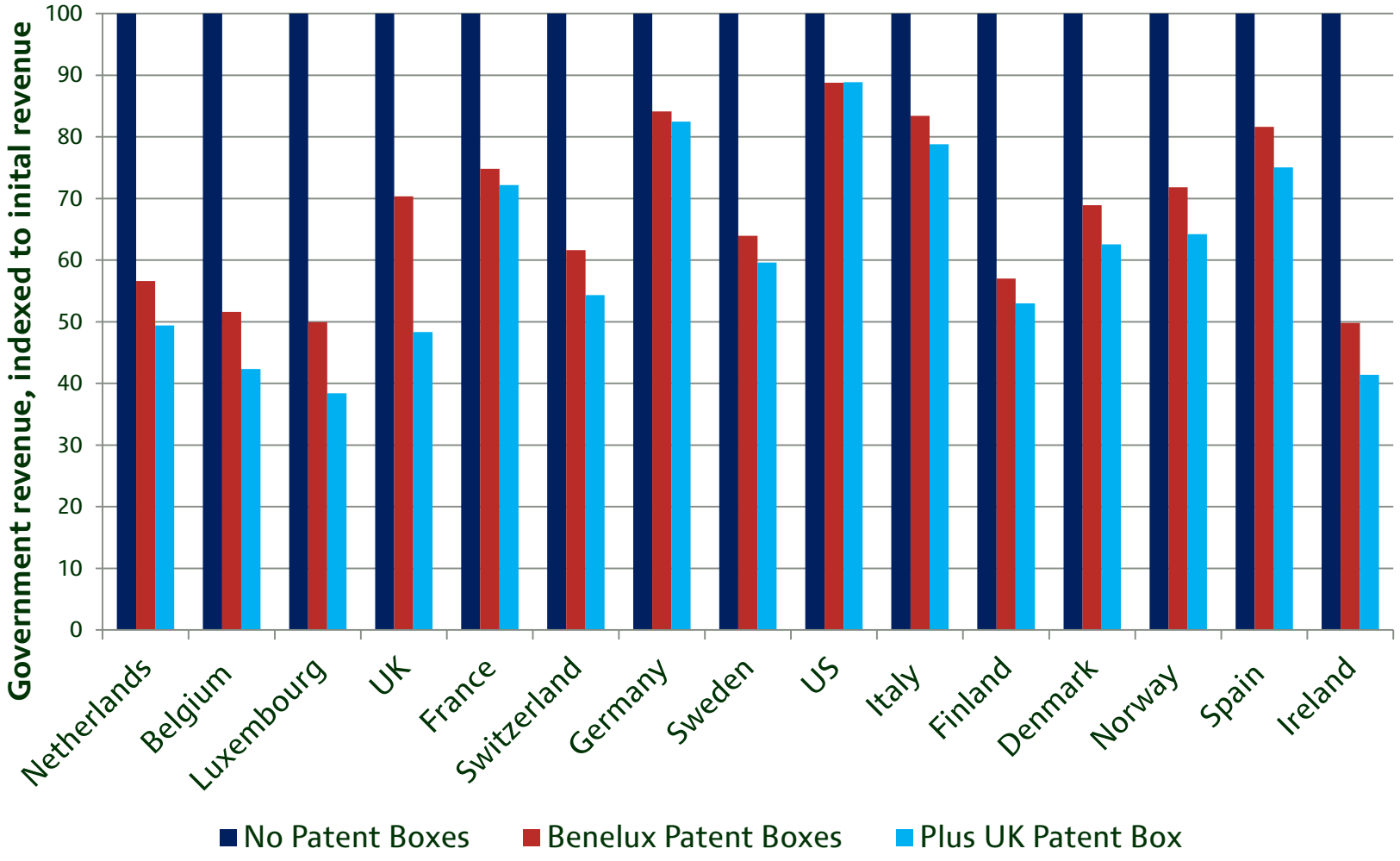
Tax revenue (indexed to 100 before Patent Boxes)



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