BREXIT'S EFFECTS ON TAX COMPETITION BETWEEN THE UK AND E.U.

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ABSTRACT

Harry Jones: Brexit's effects on tax competition between the UK and E.U.
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This paper analyses the effects that the imminent exit of Britain leaving the E.U. will have on tax competition, and the implications this may have regarding policy in a game theoretic context. The paper uses game theory to provide an explanation of how tax competition leads to a race-to-the-bottom, resulting in inefficient tax rates which threatens the provision of public goods and services. When applied to circumstances of Brexit, findings reveal that tax competition will intensify between the UK and E.U. upon Brexit with the UK likely becoming the more aggressive jurisdiction in cutting taxes, most notably due to it becoming less attractive to Foreign Direct Investment. The paper concludes the most notable policy implication that Brexit imposes is that the UK jeopardises tax coordination with the E.U. - which causes a sub-optimal Nash equilibrium - and should try to be restored post-Brexit.

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CONTENTS

CHAPTER 1: INTRODUCTION

Economists have been increasingly observing tax competition since the 1980s, due to the concern that it erodes government revenues. There are a few reasons as to why the discourse surrounding the issue of tax competition has increased since the 1980s, but the main reason is globalisation. With a more economically integrated world, in particular the existence of supranational Unions such as the E.U., the financial cost of crossing borders continues to diminish. Mobile capital (i.e. human and financial capital) can be viewed as a global common (Konrad, 2008), and is therefore resources for which countries will inevitably compete over as an economic stimulant. This competition is seen to have grown as a direct result of the decreased cost experienced by mobile capital relocating, and the growth of footloose industries.

Most economists argue that the result of such competition inevitably lowers government revenues, as a 'race to the bottom' regarding tax rates can occur. This is concerns residents' welfare given some assumptions, such as public goods being necessary and governments acting benevolently. It is thus important to understand the process of this, and then the effects that Brexit will have upon the nature of tax competition between the UK and E.U.

The concern of the UK departing the E.U. is mostly two-fold. Firstly, the UK's economic environment will become uncertain and arguably unstable, possibly causing UK tax rate setting to become more aggressive. Secondly, it undermines attempts to coordinate taxation, which is of concern as many economists argue that tax coordination collectively raises all competing jurisdictions' revenue

In this paper I will be investigating these concerns by using a game theoretic model in order understand the intuition behind the argument that tax competition causes a race-to-the-bottom thus causing inefficient tax rates. I will then apply this model to circumstances of Brexit to understand the consequences that Brexit will have on tax competition, and the policy recommendations resulting from this prediction.

CHAPTER 2: LITERATURE REVIEW

In 1997, Sinn argues why there is cause to be apprehensive regarding competition among governments. In his paper he suggests that whilst there are many government activities that are best left to the free market, the places in which the market fails, it is the government's job to pay direct attention to and intervene accordingly, in a term he coined the "selection principle". The emphasis of his and many others' concern is that market failure occurs where a good or service cannot be provided efficiently by the free market's competing firms, and so argues the same problems would arise if governments were also competing, due to the non-cooperative element, as explained in detail later in this paper. Whilst it assumes that the government is benevolent and helps overcome collective irrationalities derived from individualism, the concern is shared among many and remains to be the backbone of why tax competition inherently leads to inefficient tax rates.

This poses the concern that many economists share, as originally cautioned by Oates (1972): if public goods and services are necessary, and these are funded by government tax revenues, then we should be apprehensive towards any competition that leads to lower taxes, rendering them inefficient.

2.1 Game theoretic foundations of tax competition

The basic notion of tax competition is where jurisdictions reduce taxes so they are low relative to other jurisdictions, in order to reduce potential future tax burdens for economic agents in an attempt to attract capital or labour (Genschel and Schwarz, 2011). The behaviours in which two or more decision-makers interact, and how they take into account others' strategies when deciding their own policy, is in essence game theory. Thus, anticipating the other jurisdiction's policy when deciding their own (Wagener, 2013). This only works when assuming the players act rationally (maximise utility), which is imbedded in rational choice theory (Levin and Milgrom, 2004). This allows us to use Best Response analysis, where there is a best response for each given strategy the other player plays, and after doing this for both players, we may be left with a Nash equilibrium(s) (Varian, 2014). Given the assumption that jurisdictions act rationally, and with perfect information, game theory is a suitable approach in modelling tax competition. It was Zodrow and Mieszkowski (1986) who built the basic model for tax competition, and continues to be relevant as a base

model in explaining the interdependency of countries' tax rates. It stipulates that in the scenario of two countries sharing a mobile tax base, if one country cuts tax rates, the other country's revenue is directly negatively impacted as capital relocates to the other jurisdiction, and vice versa. Thus each country will inevitably take their competitors potential action into account when deciding their own policy, and cut taxes in anticipation of their rivals lowering their tax. Thus each player will act rationally towards their objective, presumably tax revenue maximisation. This is a static game with the assumption that both countries are homogenous, and also assumes perfect information.

Hindriks and Myles (2004) explain tax competition to occur due to the provision of public goods being financed by a tax on locally employed capital, and assume capital to be mobile enough to relocate in response to the differences in tax rates among jurisdictions, whilst assuming residents to be less mobile. They use a one-shot game to explain how a race to the bottom occurs and why this causes a reduction in welfare, but lies heavily on the assumption that policy is decided simultaneously.

2.2 Tax coordination in the E.U.

Many economists and organisations have tried to combat this in order to restore the inefficiencies that result in non-cooperative behaviour. The OECD (1998) reports on the issues that arise from tax competition, often resulting in policy suggestions. Suggestions often state multiple or all jurisdictions could prevent such inefficient tax rate setting that occurs in a non-cooperative game through tax coordination. It is when tax-paying mobile capital are forced to pay similar rates irrespective of location, it is defined as tax coordination (Mitchell, 2004), such as harmonising corporation tax. As explained by Tresch (2011), since 1990 countries like Germany who have high corporation rates have often lobbied for E.U. tax harmonization. This is because they don't want their tax revenue to be outcompeted by smaller countries such as Ireland, who have had relatively low corporate tax for financial services and manufacturing (Genschel et al., 2011).

The Ireland example is described as a preferential tax regime, as the manufacturing sector was subject to a 10% corporation tax, which was lower than other sectors, and was ordered to phase out this regime by the E.U. (European Commission, 2017). Tax havens are another damaging regime, as they offer preferential rates to non-residents in order to attract mobile

capital, which cannot be competed with by bigger nations that need to fulfil higher public good demand (Avi-Yonah, 2007). These are part of the E.U.'s Code of Conduct (European Commission, 1997) and deemed to be harmful.

An explicit example of the E.U. fighting harmful tax competition in general was the 15% minimum VAT enforced on member states in 1992 (European Parliament fact sheets, 2003). This was a pre-emptive effort to prevent competition leading to inefficient rates, and also to combat tax arbitrage, which is where the process of legally profiting from the spread caused by differing tax treatments from long (buying) and short (selling) positions of an asset (Erickson et al, 2002).

The literature in advocating tax coordination often refers to a Pareto improvement, where a cooperative equilibrium makes at least one country better off without harming another countries in comparison to the Nash Equilibrium under competition (Keen, 1989). Keen and Konrad (2014) argue that given full commitment and complete information, and international transfer of capital being feasible, centrally planned taxation will be at least as good as any decentralised equilibrium outcome. They concede there may be some asymmetric information and potential commitment issues, but argue a minimum tax is still viable. They conclude that a minimum tax is Pareto superior because it will make at least one country better off without harming the other, as long as the minimum tax is close to the unconstrained Nash equilibrium.

2.3 Brexit and Foreign Direct Investment

FDI is important to tax competition because it is a barometer of how attractive a country; a change in a jurisdiction's ability to attract FDI may affect the nature of the tax competition. Thus Brexit is important, because Britain would suffer from a fall in FDI for three reasons according to Dhingra et al (2016). Firstly, it would cause management difficulties for firms in regards to co-ordination costs and complex supply chains. Secondly, leaving a single market makes the UK less attractive, given it is a free trading, tariff-free trading zone to its 28 members plus Iceland, Norway Liechtenstein and Switzerland. Thirdly, there is economic uncertainty over what trade deals the UK will agree. Another factor which positively affects FDI is output growth, which is forecasted to grow at 1.6% between 2017 to 2030, which is

comparable to the decade proceeding the 2008 global financial crisis. Many companies have been vocal in their threat to leave Britain regarding a hard Brexit, as a report by Ukie (2017) finds, 40% of UK gaming companies threaten they will leave upon Brexit, as well as Microsoft threatening to pull business from the UK, and HSBC and UBS planning to relocate 1,000 employees from London to an E.U. country.

CHAPTER 3: METHODOLOGY AND METHODS

The method of this project operates within the neoclassical paradigm of orthodox methodology, meaning quantitative research is the preferred method of research. Quantitative different to qualitative research, and are the research methods of the competing paradigms Positivism and Interpretivism respectively. Both paradigms differ in their views on epistemology and ontology, thus having different relationships between research and theory i.e. deductive and inductive reasoning (Bryman and Bell, 2011).

This paper uses deductive reasoning, which alludes to the notion that an objective reality exists, irrespective of subjective interpretation. A top-down approach is thus used in this project, thereby using a current theory – a game theoretic model - in order to understand real-world implications. This is a positivist approach that uses the epistemology of a natural science, as well as an ontology that believes social facts to exist in reality external to human observation. This contrasts with qualitative (interpretivist) research where a theory is derived from patterns found in human observation.

The method used to predict the implications that Brexit will have on E.U. tax competition will be through game theory in a model presented by Hindriks and Myles (2013). The model is relatively simple but provides an intuitive understanding of the non-cooperative behaviours of intergovernmental tax rate setting. In using game theory I will be using the concept of Nash equilibria, which is to find a stable solution from multiple possible strategies where no player gains from changing strategy. The multiple strategies available may be to raise or lower taxes for example, but importantly the strategy chosen will take into account the other player's potential strategies and the payoffs yielded. Thus, perfect information is to be assumed, whereby both jurisdictions are informed about the history of the game, as well as complete information where utility functions, all strategies and all payoffs are common knowledge. Given the nature off this study being in a neoclassical paradigm, governments are assumed to be rational agents as they seek to maximise utility (Vriend, 1996), in this case tax revenue, as well as benevolence regarding the positive relationship between an increase in revenue leading to a proportional increase in public spending.

This project will use the Hindrik's and Myles model and adapt it with the aid of more broad international trade theory. This will then be applied to the imminent Brexit situation in

conjunction with theory on tax coordination for more context, in order to deduce the implications of Brexit and derive appropriate policy recommendations as a result.

For the purpose of this paper, the E.U. will be treated as one consolidated jurisdiction in regards to tax competition with the UK post-Brexit. It will also be implicitly assumed that 'Brexit' means the UK leaves the Single Market in its entirety, meaning it will not be in a multilateral trade agreement with Europe such as being a EEA member.

CHAPTER 4: MODEL FRAMEWORK

This section outlines the principle model that was put forward by Hindriks and Myles (2013) and will be the foundation for my theoretical analysis on how Brexit will affect tax competition. The model presents some assumptions and a clear structure in determining the behaviour and strategies used in tax competition, and how it leads to inefficient tax rates. The model framework section will be in the context of the UK and E.U. before applying it to more realistic and contemporary axioms representative of the reality of Brexit.

4.1 Assumptions

The model assumes jurisdictions to simultaneously decide on a strategy (tax rate), whilst taking into account the other's potential strategies and payoffs, hence the perfect information assumption. Non-cooperation is also assumed until later analysis. Secondly, the model assumes the game to be one-shot, meaning only one stage of the game, meaning there is no room for tit-for-tat strategies, credible threats or learning off past games. Thirdly, the model notions that the capital market adjusts to political decisions, including changes in tax rate. Within this assumption, it is assumed there is perfect mobility; relocating mobile capital is zero-cost. Lastly, it is assumed that both jurisdictions are symmetrical, meaning factor endowments and country size are homogenous.

This is because certain goods and services are not allocated through a market price since "the buyer cannot confine enjoyment of them to himself", for example street lighting, which is non-excludable (Cope, 1987, p8). Tax revenue being transferred to workers through cash or public goods is also an underlying assumption, and implies tax revenue maximisation is an

government objective, and is interchangeable with the aim of increasing residents' welfare. This is why in inefficient tax rates will be defined as "inefficient", because taxes fund *necessary* public goods and services.

4.2 Capital allocation

If we assume output to be a composition of mobile capital and fixed labour, this gives us a production function of $F(Ki, L)$, where aggregate capital is K_i and aggregate Labour employed is L_i in country i. *This will be a two 'country' example, where subscript 'uk' is the UK and subscript 'eu' represents the E.U.* Technology and the quantity of labour are assumed to be homogeneous between countries in this example, as well as the tax base sharing fixed stock of capital.

We can express the capital-labour ratio as k_i, under constant returns to scale $F(Ki, Li) = Lif(ki)$. The production function $f(k_i)$ however has diminishing returns and is thus concave. k_1 and k_2 make up the fixed stock capital of the tax base, $\overline{k}$. Revenue from the per-unit tax on capital (t_i) is used to supply public good and services, and is expressed as $Gi = tiki$. This suggests a cut in UK corporation tax for example, would directly decrease the UK Government's supply of goods and services. This is what predicates the concern of 'inefficient tax rates'; rates which cannot provide enough revenue to cover the aforementioned necessary public goods and services.

Below, we can see how through frictionless arbitrage (capital mobility being zero-cost), the allocation of capital regarding which jurisdiction they decide to locate in is zero-sum, due to capital stock being fixed ($\overline{k}$), and depends on the capital tax rate.

$$f'(k_{uk}) - t_{uk} = f'(k_{eu}) - t_{eu} = f'(\overline{k} - k_{uk}) - t_{eu} \quad \text{(Expression 1)}$$

4.3 Capital reacting to policy change

Figure 1 demonstrates how a difference in tax rates causes capital to be re-allocated and why net returns to capital will always be equalised. It's important to understand that the marginal product of capital (Y-axis) differs between countries when $t_{uk} \neq t_{eu}$, given that the capital allocation (X-Axis) differs in response to tax rates, thus $MPk_{uk} \neq MPk_{eu}$. For example, a decrease in UK per-unit capital tax would cause a re-allocation of capital; an inflow to the

UK from the E.U., as seen from moving from point A to B due to the reduction in tax from t_{uk}' to t_{uk}''. Net productivity thus increases from f'(k_{uk})-t_{uk}' to f'(k_{uk})-t_{uk}'' from the tax cut, thus shifting upwards thereby increasing the UK's share of mobile capital (x-axis) in the UK-E.U. tax-base (k_{uk}> $\overline{k}$).

This explains how the fixed capital stock is allocated between two jurisdictions. Both jurisdictions are aware that a higher tax drives out capital, meaning $\frac{dk_{uk}}{dt_{uk}} < 0$, and is thus used as a key input when deciding an optimum policy, which is how the Nash equilibrium will be formed as explained on section 4.4.

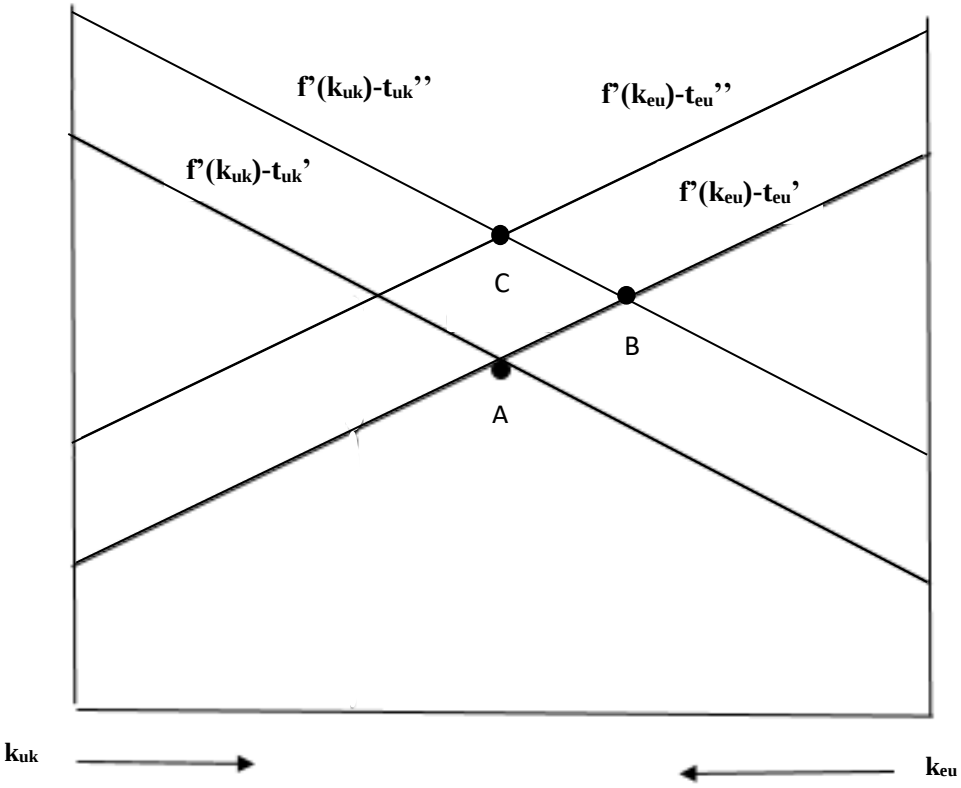

Figure 1: capital stock allocation (Hindriks and Myles, 2013)

It is also important to understand the *amount* capital allocation changes in response to a tax change, as sometime this can be elastic or inelastic. This relationship can be expressed as

$$\frac{dk_{uk}}{dt_{uk}} = 1/[f''(k_{uk}) + f''(k_{uk})] \qquad \text{(Expression 2)}$$

4.4 Understanding Best Response

The following expression denotes the assumption mentioned earlier that Government is benevolent and thus tax revenue is transferred to workers (cash or public goods and services). Capital owners are exogenous to this Government net income calculation, which is total output minus immobile (i.e. labour) income, plus tax revenues.

$$y_{uk} = f(k_{uk}) - f'(k_{uk})k_{uk} + t_{uk}k_{uk} \qquad \text{(Expression 3)}$$

Given the presumption that the UK and E.U.'s governmental objective function is to maximise residents' net income, they must take into account how, and the degree to which, capital responds to a change in tax (Expression 2) when deciding on tax rates, as this is an input into the net income (residents' welfare). Best Response is referred to as the players' optimal strategy, which is defined as the strategy that yields the highest outcome (payoff) for a player, taking into account the strategies and payoffs of the other player (Fudenberg and Tirole, 1991). Given this, both the jurisdictions' taxation will become a function of one another's, and it can thus be concluded that the UK's Best Response function is:

$$t_{uk} = -k_{uk}f''_{eu} = r_{uk}(t_{eu})$$

and the EU's:

$$t_{eu} = -k_{eu}f''_{uk} = r_{eu}(t_{uk})$$

Bearing in mind that the UK's tax rate is in response to the EU's tax choice, the expression for this response function can be expressed as $t_{uk}^* = r_{uk}(t_{eu}^*)$, given that (t_{uk}^*, t_{eu}^*) is the Nash equilibrium pairing, which is diagrammatically explained on section 4.5. The Nash equilibrium can be seen in figure 2, in tangent with the two symmetrical upward sloping best response curves; denoted as

$$\frac{dr_{uk}}{dt_{eu}} = [(f''_{eu} - k_{uk}f'''_{eu})dk_{uk}/dt_{uk}]/[1 + (f''_{eu} - k_{uk}f'''_{eu})dk_{uk}/dt_{uk}]$$

Where $f'' < 0$ and $dk_{uk}/dt_{uk} < 0$.

4.5 Current UK-E.U. tax competition

The inefficiencies that arise from the UK and E.U. competing can be analysed with Best Response and isoquant curves as it shows us their optimal (rational) policy given the other player's policy. The iso curves used (I_i) are analogous to indifference curves, they represent different combinations of taxation that leads to the same revenue. The slope of a country's iso-revenue curve will be zero when intersecting its best response line because this is when the country's tax will be at its optimum given the other country's tax (Keen and Konrad, 2012). With the assumption the UK and E.U. are in a non-cooperative game, t*,t* is the NE because there is no reason for either country to deviate from this strategy. A move to point A on figure 2, per unit tax becomes t_{uk}>t* and t_{eu}=t*, which would be irrational for the UK. This move would lead to capital relocating to the E.U., and a loss in welfare (as explained in section 4.3 and 4.4), hence why it lies outside of the iso-revenue curve. Thus, point B doesn't lie on the $r_{uk}(t_{eu})$ line either, because Best Response analysis suggests the strategy of increasing taxes, thus deviating from NE, to be a strictly dominated strategy. $I_{uk}(t*, t*)$.

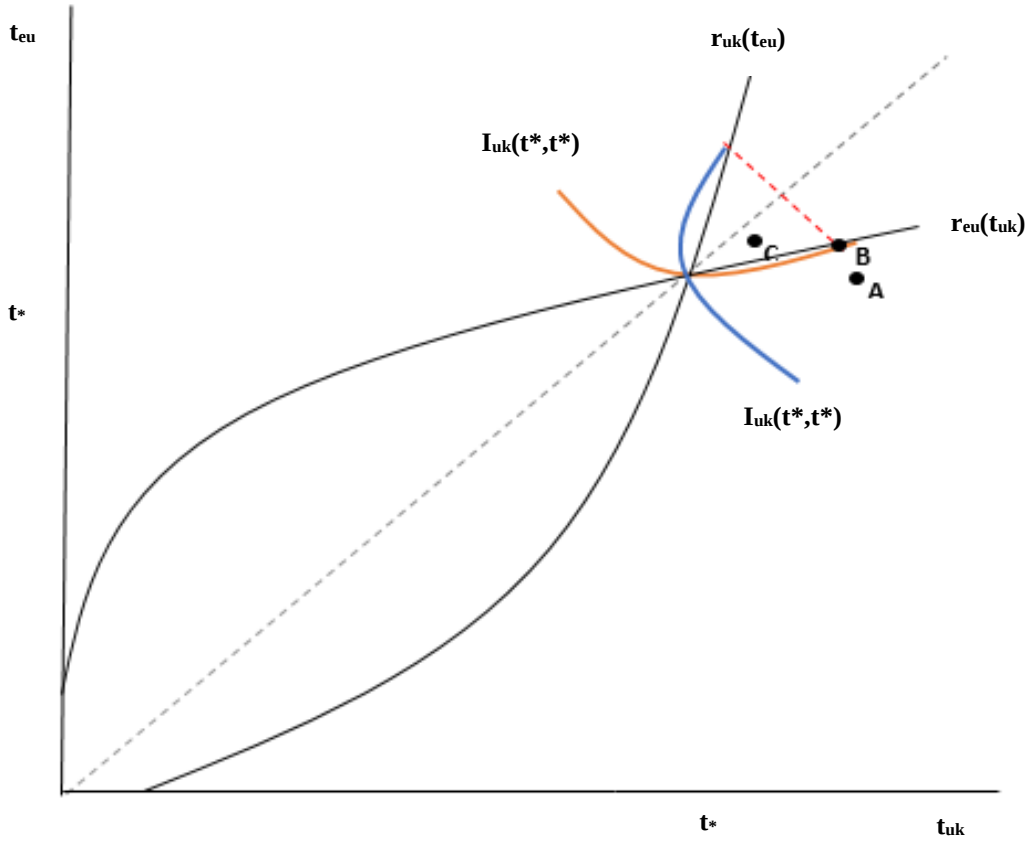

Figure 2: Iso-revenue and Best Response curves in a one-shot simultaneous game (Keen and Konrad, 2012).

This doesn't suggest taxation is optimum in the broader sense, as optimum here refers to best response analysis. A tax combination anywhere along a country's iso curve yields the same revenue, and utility. Anything above the iso-curve, whilst unfeasible in the present, represents greater revenue, which indicates that any amalgamation of taxes that is inside the concaved line means revenue must be greater.

This is because positive fiscal externalities exist; if one country was to raise taxes, it would benefit the other, as it would now be optimal for them also to raise taxes, thus both jurisdictions would yield more utility than under the original NE. It is possible for both jurisdictions to yield greater revenue under cooperation, which is represented by the area surrounding point C: inside the cone shape of both concave iso curves, and the red dotted line. This area suggests it is possible to increase utility through mutually increased taxes, however, given best response analysis this can only be achieved through tax coordination, thus needing a change in either the rules or payoffs of the game. The only logical and realistic way to achieve this is through law and regulation, where for example a minimum tax is introduced, thus ruling out the rationalizable action of reducing taxes (below this price floor).

CHAPTER 5: APPLICATION TO BREXIT

It can now be understood through the Hindrik's and Myles (2013) model how capital responds to policy change, and why non-cooperative tax competition leads to mutually lower tax rates, which equates to decreased welfare. However, a "noncooperative game among homogenous countries" isn't necessarily representative of the current and future game between the UK and EU. In this chapter, some assumptions will be altered. Firstly, that the UK and E.U. are equal in attracting foreign direct investment, and so accounting for any predicted changes in future UK FDI is important as this will affect their optimal tax policy. Then this chapter will account for current E.U. tax coordination attempts, and how Brexit undermines this. And lastly this chapter will account for the UK and E.U. being heterogeneous in size and factor endowments.

5.1 FDI's effects on UK-E.U. tax competition

One factor that will affect UK - E.U. tax competition is whether Britain is a more or less attractive place for investment as a result of Brexit, as this will affect capital allocation and thus the both jurisdictions optimal policy (best response).

5.1.1 Britain's attractiveness

Brexit has many unknowns regarding future trade deals that the UK could agree on, however one immediate certainty is that Britain will exit the Single Market, where 44% (£240 billion) of their exporting trade exists; and 53% (£309 billion) of imports were traded in 2016 (Office for National Statistics, 2017). These figures are disproportionately high in regards to the number of countries in the world, and in conjunction with geographical proximity, this is due to the Single Market being a tariff and quota-free trading BLOC, where countries can trade without Government intervention, thus leaving the pricing being naturally competed down by the free market. Given the earlier Brexit assumption that the UK will lose their right to free trade with the European Economic Area, it implies there will be tariffs imposed on UK-based firms exporting to the E.U. Given that almost half of UK exports are to the E.U., it is evident this could have damaging effects on UK exports, as UK products will have an artificially higher price than before, which will reduce demand making it difficult to compete with the members of the EEA.

This reduction in demand for UK exports could lead to fewer companies investing in the UK. Dhingra et al (2016) estimated a 22% decrease in inward FDI to the UK would ensue as a result of Brexit. The disadvantage in competitiveness for the UK could be argued in terms of having a decrease in marginal product of capital. Figure 1 could also denote the attractiveness argument, only there would be a shift in $f'(k_{uk})$ with Britain's marginal product of capital decreasing, thus shifting the fixed stock capital allocation towards the EU.

The UK could perhaps find other trade deals after Brexit in its attempt to attract FDI. However, Britain will have less bargaining power when negotiating future trade deals than the E.U. as the UK is a fifth of the Single Market's size (Dhingra et al, 2016). It will also take a long time for negotiations to be progress to agreements, with the possibility that "Britain will be at the back the queue", as stated by Obama in 2016 (Asthana and Mason, 2017). It is

also not just a worry for attracting future FDI, but many current UK-based firms have warned their departure upon Brexit, examples of which can be found in the literature review.

There are also agglomeration effects to consider, as London is one of the largest cities in the world for financial services, and services in general. There are many benefits for companies to group and network together in one city such as the major investment banks in order to benefit from economies of agglomeration, such as accumulating innovative ideas and decreases in production costs through (e.g. specialisation). This could mean that many London-based service companies do not relocate as a result of Brexit, as the agglomeration benefits outweigh the benefits of being in the Single Market. Whilst this may not be representative of all capital and future FDI, the service sector accounts for 79% of UK GDP (ONS, 2017), and accounts for 91% of London's economy (Cullen, 2017). In this case, some London and serviced based capital relocation would be inelastic to changes in capital taxation.

5.1.2 Implications on policy

We can see the effects on figure 3 that a loss in attractiveness has on the UK's best response line - a leftward shift, moving from point A to B. This can be explained by the logic of best response tax setting; from point A to B there was a greater drop in t_{uk} than t_{eu}. This is because the UK now has to offer a lower per-unit capital tax than the EU for MPk_{uk} to equal MPk_{eu} and thus attract capital, which can be seen in reference to the deviation from the dotted line where $t_{uk}=t_{eu}$. This effect also happens with the EU as they're now less attractive without the UK, but their loss of FDI is relatively less than the UK's and thus yield the same marginal productivity with a larger tax rate. Point C becomes the new Nash equilibrium, and capital allocation is still evenly split ($2/\overline{k}$). Harmful tax competition is thus worsened, with both jurisdictions' tax rates lower than the tax under the pre-Brexit NE, thus $t\,\overline{k}\,/2 < t*\,\overline{k}\,/2$, with t* being pre-Brexit NE.

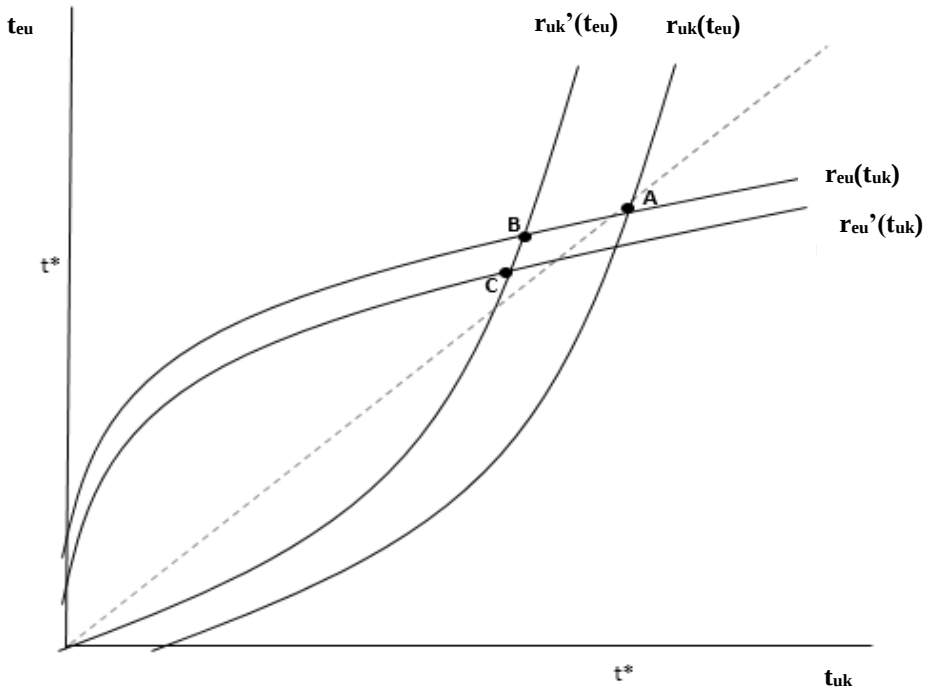

Figure 3: Best response curves shift in regards to both the UK and E.U. becoming less attractive

5.2 Semi-cooperation

This paper has so far assumed that the UK and E.U. are playing a noncooperative game, which isn't entirely realistic as there are clear attempts, and some success, in achieving tax coordination through both harmonisation and minimum taxes within the E.U. It is reasonable to assume that upon Brexit however, the UK will no longer have to comply with E.U. legislation such as the VAT Directive, and thus post-Brexit UK-E.U. tax competition will be assumed as unequivocally noncooperative.

The endeavour of E.U. tax harmonisation is evident with the E.U. looking to relaunch a Common Consolidated Tax Base (European Commission, 2016) and France and Germany backing the idea of a common corporation tax (Holehouse, 2017). Effective harmonisation already exists, such as the E.U. stopping Ireland's preferential tax regime of 10% corporation tax for manufacturing (European Commission, 2017), as well as demanding Ireland to recoup €13 billion back from Apple regarding tax loopholes (Stearns, 2016). The E.U. Commission are also looking to re-launch the Common Consolidated Corporate Tax Base (COMM, 2016). Minimum tax is another type of coordination, such as the minimum 15% VAT floor

(European Parliament fact sheets, 2003) to prevent tax arbitrage which is mandatory for member states. It is clear then that, to some degree, tax coordination exists within the E.U., and given its failures to *strictly* harmonise corporation tax, it will now be assumed there is semi-cooperation.

Given that the UK will most likely not have to comply to these legislations upon Brexit (BBC News, 2017), there will be a transition from a noncooperative to a semi-cooperative game, in which the benefits of coordination could be lost. Instead, tax competition may intensify, leading to less tax revenue and a loss in residents' welfare as explained in section 4.3.

The E.U. understands that the payoff when countries don't or can't cut taxes yield a greater payoff than under the noncooperative NE. It is because of the inefficiently low tax rates that non-cooperation yields under the Nash equilibrium, that any coordination through pre-game communication or legal regulation to raise taxes of both countries will results in increased tax revenues for both countries as seen in Expression 4.

$$t\,\overline{\mathrm{k}}\ /2 > t*\ \overline{\mathrm{k}}\ /2. \qquad \text{(Expression 4)}$$

It can be seen on figure 2 the effect of Brexit will have on the UK; point B is the cooperative equilibrium, and t*,t* is the non-cooperative equilibrium. It is evident that point B is above the iso curve meaning greater utility, with greater tax revenue; both t_{uk} and t_{eu} now higher. This is made possible by removing the rationalizable strategy of cutting taxes, such as minimum VAT or the E.U.'s prevention of preferential regimes. Legislation is the most effective way to achieve this in a one-shot simultaneous game, as there is no opportunity for credible threats or learning from past games.

Tax competition in the E.U. can thus best be described as a semi-cooperative game, and upon Brexit, the few current tax coordination policies will no longer be applicable to the UK. This implies a sub-optimal shift from point B back to t*,t* on figure 2, and thus an intensification of tax competition.

5.3 Accounting for heterogeneity

The base model used so far assumes the two jurisdictions in the game, in this case the UK and E.U., to have homogeneous technology, factor endowments and more broadly country size, which is undeniably unrealistic. It is thus important to adjust for size differences between the UK and E.U., and how the relative smallness of the UK could be a huge benefit in its competition for capital accumulation. Hindriks and Myles (2013) did account for heterogeneity, as well as being theoretically coherent with Wilson's paper (1991) and empirically backed up by Genschel et al (2011), where smaller countries where found to have on average lower corporation tax than larger countries.

This coincides with the hypothesis that tax competition will become more intense upon Brexit. Although its described as a benefit, it has a similar effect on the Best Response curve as the proposed decrease in UK attractiveness: an inward shift from $r_1(t_2)$ to $r_1'(t_2)$ on figure 3, thus changing the optimal policy.

The reasoning here is simple: the opportunity cost of lowering taxes - the loss of tax revenue from domestic tax base- is smaller for a small country, as they have less share of the capital. The benefit of such a tax cut is thus relatively larger for the small country, as it gains a disproportionately large share of the capital from the larger country's tax base. It should also be noted that smaller countries tend to have less public good demand. The axiom that the E.U. is a single jurisdiction is most tested in this argument however, as it implies that upon Brexit, Britain will *become* a relatively small jurisdiction, whereas currently it is part of a large jurisdiction. This suggests that as a result of Brexit, Britain will have the benefit of smallness, meaning they will be incentivised to have relatively lower tax rates than the E.U., as they will gain a disproportionately large capital influx from the E.U. tax base relative to the small size of the UK.

5.4 Policy implications and suggestions

In summation of this paper's analysis, tax harmonisation appears to be the most useful strategy for the UK in limiting the negative impacts that Brexit will incur. With strong evidence that the E.U. currently has *some* level of cooperation, and how this is preferable to non-cooperation, it appears that retaining this relationship is important to offset the negative impact of the UK becoming less attractive. However, due to the tax cut threat of Philip Hammond, albeit a non-credible threat, it appears the UK will most likely capitalise on its new benefit of being relatively small in order to offset it being now less attractive for FDI. It is thus logical to conclude that tax competition will intensify post-Brexit.

The largest limitation in applying the base model has been the axiom that the E.U. acts as one jurisdiction has. This assumption, whilst useful in giving a clear and simple relationship between the UK and E.U for other analysis, proves to be too unrealistic given it is the foundation of the argument that UK benefits from becoming relatively small. All analysis in this paper excluding this argument points towards the UK suffering from an inward shift in the best response, meaning tax harmonisation would work as a useful damage limitation to this reduction in tax revenue. The 'smallness' argument however is contrary to this as it implies competing with the E.U. using its benefit of smallness is preferable, which contradicts the benefits of tax harmonisation policy, although it still implies tax competition intensifying.

Thus, in limiting the importance of the 'smallness' argument due to its heavy reliance on the singular jurisdiction assumption, it appears the consensus and aggregate of all analysis from this paper reasons that it would be preferable to the E.U., but particularly the UK, to continue their (semi) cooperation, and perhaps further build on their tax harmonisation policies such as the proposed relaunch of the Common Consolidated Tax Base.

However, these are more importantly limitations of the policy suggestion rather than limitations of the results testing the hypothesis. It appears quite conclusive in each segment of analysis that tax competition will intensify upon Brexit, most notably represented by the inward shifts of the best response curves in previous figures.

CHAPTER 6: CONCLUSION

The game theory model presented by Hindriks and Myles (2013) demonstrates a reasonable and intuitive explanation for the strategies and behaviours among jurisdictions when deciding on tax rates. It explains the capital allocation among a tax base, the best response for players, as well as accounting for heterogeneous factor endowments. When applied to the UK and E.U. among Brexit, it explains the reasoning behind tax competition intensifying, despite some tax coordination efforts from the E.U.

It is reasonable to conclude that upon Brexit, Britain will be moving from a semi-cooperative game - the degree to which is contestable - to a non-cooperative game, which would cause an intensification of tax competition and a shift to a more suboptimal NE. The aggressiveness of tax cutting however may come from the UK more so than the E.U., with the UK likely becoming less attractive for foreign direct investment. Although there are limitations to this assumption, given the effects of agglomeration and the potential for free trade deals to be agreed outside of the E.U., it is stipulated by Philip Hammond that there will be future corporation tax cuts, arguably indicating the UK government believe the UK will become less attractive. This in isolation could cause tax competition to intensify, as he has made a threat to the E.U., which will be taken into account regarding their next action. Given the perfect information assumption, the E.U. will be aware that it is in the UK's best interest to cut taxes, due to the 'benefit of smallness', making this a more credible threat.

In conclusion, it is reasonable to expect tax competition to intensify, particularly on the side of the UK, and the post-Brexit NE will further harm residents' welfare. There are limitations in both the model used and my application to the UK and E.U., including assumptions such as fixed stock capital among the tax base, frictionless arbitrage, and perhaps most importantly for the purpose of this paper, assuming the E.U. to act as one jurisdiction. Because of this, there are limitations to the suggested policy implications, despite it being reasonable to conclude that tax competition among the UK and E.U. will become more aggressive.

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