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The Paradox of Tax Competition: Effective Corporate Tax Rates as a Determinant of Foreign Direct Investment in a Neo-Kaleckian Model

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The Paradox of Tax Competition: Effective Corporate Tax Rates as a Determinant of Foreign Direct Investment in a Modified Neo-Kaleckian Model

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Abstract

After demonstrating the empirical relevance of tax competition effects across OECD countries, we incorporate such effects into a Kaleckian model. Corporate tax rates are seen as affecting investment by the effect on the location of multinational enterprise (MNE) investment, not on the total size of worldwide MNE investment. Hence, unlike the neoclassical approach, in our analysis investment is not driven by tax rates affecting the cost of capital, which is objectionable from a post-Keynesian perspective. With this locational qualification in place, we augment a traditional neo-Kaleckian model with the effects of MNE investment and determine under what conditions a country's policymakers can stimulate demand by raising corporate tax rates (via the usual Kaleckian redistribution channel) or lowering tax rates (via the tax competition FDI channel). The result of this exercise shows that our model predicts countries of small economic size will be more likely to engage in tax competition. Moreover, if the usual Keynesian stability condition holds, we can show that the effect of higher corporate tax rates on demand is much more likely to be negative than positive. To see how an interdependent world system of corporate tax rates may interact and develop over time, we use a procedural-based simulation approach using the conditions derived from our modified neo-Kaleckian model to inform the behavioural rules of our simulated policymakers. The simulations show a propensity of corporate tax rates around the world to convergence and to fall in systems with realistic parameter ranges, offering an explanation for the empirical phenomenon of the so-called "race to the bottom" in corporate tax rates. The "bottom" is shown within our model to be a bad equilibrium, from which tax coordination is proposed as a means of escape.

JEL Classification: E11, E12, E62, F55, H25

Keywords: Tax competition, Kalecki, multinational enterprises, race to the bottom, simulation, foreign direct investment, policy coordination.

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1. Introduction

Researchers, international organisations and civil society actors have been ringing the alarm on tax competition developments for decades now.[1] Concerns of a global race to the bottom in corporate tax rates have grown as has the consensus that tax competition drives at least a part of this downward trajectory. Yet despite the wealth of post-Keynesian literature examining the causes and consequences of growing income inequality, the seemingly inequality-exacerbating trend of corporate tax competition has received little, if any, attention in post-Keynesian models. This paper attempts a first step in this direction.

The tax competition literature is dominated by models built on the neoclassical theory of capital, which puts the cost of capital at the centre of investment decisions made using marginalist optimisation.[2] Given post-Keynesians' long-standing objections to neoclassical investment theory, many of the formal tax competition models are hard to swallow. Yet, if we consider post-Keynesian theories of investment, where the main determinants are often animal spirits, capacity utilisation, and the profit rate or share, then it is not clear how tax competition can arise at all. The resolution offered in this paper is that corporate tax rates do not determine total worldwide investment, but do determine *where* some of that investment takes place.

In particular, we consider the investment of multinational enterprises (MNEs). In total, the sum of their investment may be determined by traditional post-Keynesian variables, but the question of how the location of such investment is determined is an open one since MNEs are by their very nature not tied to any given state and may float from region to region. Some MNEs will look to minimise wage costs. Some will seek entry to markets, or to pursue other goals. But some too will look to lower or minimise their tax bill. It is in this sense, then, that we speak of corporate tax rates as determining investment in this paper—and expressly not the neoclassical distortion-reducing sense. With such logic in mind, we propose a modified neo-Kaleckian model with relative effective corporate tax rates to incorporate the channel through which tax sensitive foreign direct investment (FDI) may enter into a country.

The paper seeks to shed light on the conditions under which an economy may stimulate demand by competing for FDI using corporation tax and whether these conditions predispose a system of countries to a "race to the bottom". Contrary to the traditional neo-Kaleckian model, we find that there is now scope to stimulate demand through decreasing, not increasing, corporate tax rates. All the more so, if an economy is of small economic size relative to total worldwide greenfield FDI and if the Keynesian stability condition holds.

Furthermore, the possibility of stimulating demand by lowering corporate tax rates is found to be dependent on the average worldwide corporate tax rate. In order to see how the interdependent world system of corporate tax rates might interact and develop over time, we use a procedural-based simulation approach using the conditions derived from our modified neo-Kaleckian model to inform the rules of our simulated policymakers. We find that the

[1] See, for example, OECD (1998) or Berkhout (2016).
[2] See Wilson (1999) for an overview of the tax competition literature.

simulated system of corporate tax rates can tend upwards or downwards, depending on whether the Kaleckian redistribution effects dominate the tax competitive FDI effects, which in turn depends on the inputted system parameters. But overall, we find convergence of corporate tax rates in all simulated systems, and most interestingly, we find "race to the bottom" developments in systems with realistic parameters ranges.

As this is an unconventional neo-Kaleckian model, it is important to demonstrate the empirical relevance of adding corporate tax rates to the investment function. To this end we report on the empirical literature already in existence and detail our own investigations into the relationship between effective corporate tax rate differentials and greenfield FDI inflows. We find evidence for a panel of 33 OECD countries that tax differentials are indeed significant, suggesting MNEs are attracted by lower effective tax rates even in a diverse range of countries like the ones examined.

The paper culminates with the finding that tax competition leaves countries predisposed to race to the bottom, where the bottom, our model suggests, is a bad equilibrium. This leads us to think of tax competition as representing a kind of paradox, akin other seemingly paradoxical results in the post-Keynesian literature (*cf.* Lavoie 2014, p. 18) which we can state as follows: While using tax and fiscal policy to compete for FDI may be advantageous and rational for one country, it will be restrictive and irrational if a group of countries compete. Tax coordination is suggested as a preventative measure from racing to the bottom, and as a means of escaping the bad equilibrium that results.

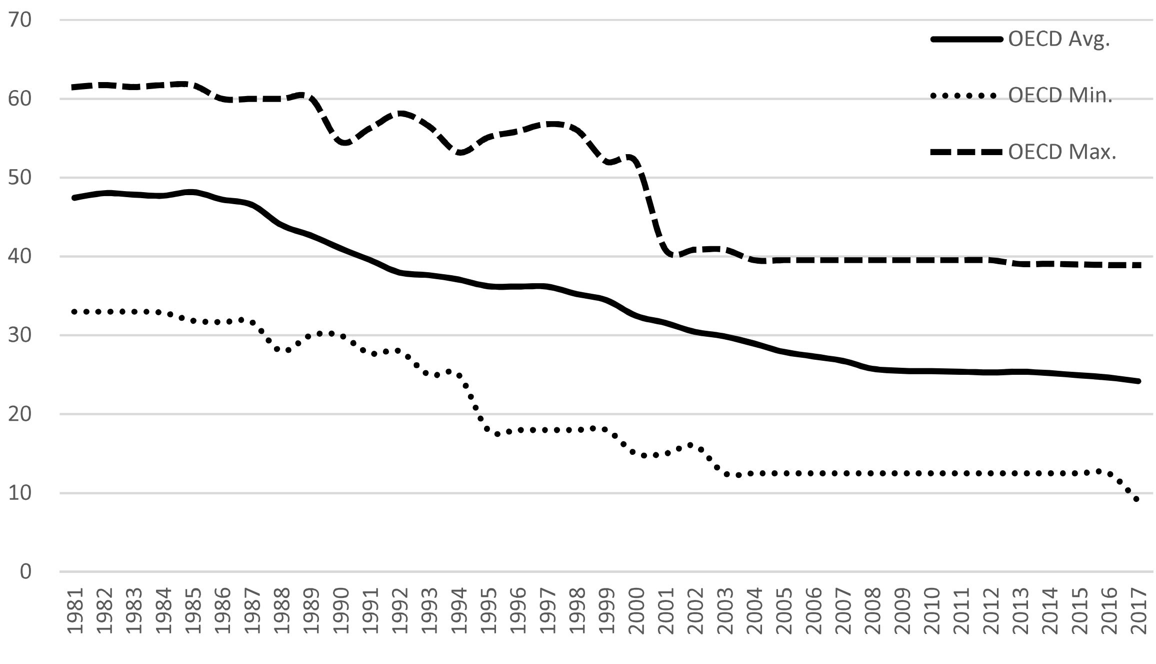
The paper is organised as follows. We begin in section two with the observation that statutory corporate tax rates have fallen steadily around the world since the 1980s and we discuss the possibility of tax competition driving this trend. In section three, we define the corporation tax rate variable we find to be of greatest relevance for tax competition purposes, the average effective corporate tax rate (AECTR), and report on our econometric approach to estimating the impact of relative AECTRs on greenfield FDI inflows. Our post-Keynesian theory of tax competition is offered in part four. From the benchmark neo-Kaleckian model, where increasing corporate tax rates can only increase capacity utilisation, we introduce our modified model where tax competition considerations imply demand may be negatively affected by higher AECTRs. Section five takes the conditions to stimulate demand using corporate tax rates from the modified neo-Kaleckian model and asks what would happen if policymakers around the world incorporate such conditions into their procedural rules for setting tax and fiscal policy. Our attempt at an answer comes in the form of a simulated approach, which finds reason to suspect a downward trend in the distribution of world tax rates is most likely. Section six discusses the implications of the neo-Kaleckian tax competition model and evaluates the desirability of tax competition. Section seven wraps up with some concluding thoughts.

2. The Global Race to the Bottom in Corporate Tax Rates

Figure 2.1 reflects what can be referred to as the "global race to the bottom in corporation tax" (see, for example, Berkhout 2016). Graphed are the minimum, average, and maximum values of total statutory corporate income tax rate for the 35 OECD countries between the years of 1981 and 2017 with data from the OECD tax database. There can be little argument that the whole distribution has seen a sustained downward shift, with the mean virtually halving from 47.5% in 1981 to 24% in 2017. What has been more contested are the drivers behind the downward trend.

There tend to be two competing explanations that are most often given to explain the global race to the bottom (Devereux *et al.* 2003). First is the claim that we have seen the emergence and spread of a common intellectual trend driving rates down. Within the realm of economic thinking, we can broadly understand this as the neoclassical counterrevolution. Contrary to the preceding Keynesian and structuralist approaches, the 1980s saw a widespread resurgence of the belief that taxation can have significant distortionary effects that diminish total economic activity and, as such, should be minimised. The opposing view is that the race to the bottom is driven by tax competition, where taxation is not independently decreased out of concerns for frictions or inefficiency but rather with the intention of diverting flows from one region to another. Since this form of beggar-thy-neighbour, regulatory competition is not solely conducted in terms of statutory rates but also corporate subsidies, deductions, tax breaks, and so on, our preferred definition of tax competition in this paper is as follows: *Tax competition refers* to *the uncooperative setting of the relevant tax and fiscal policy variables in order to*

Figure 2.1 *OECD Statutory Corporate Tax Rates (%): 1981 - 2017*



Source: OECD (2018)

attract, or avoid losing, foreign direct investment inflows. While tax competition may be conceived at the city or state level, we will restrict our attention in this paper to the country level of analysis.

Econometric issues relating to the disentanglement of a common trend from strategic interaction (i.e. tax competition) as well as the ambiguity and mismeasurement of effective tax rates have made empirical investigation into the causes of the global race to the bottom difficult. However, more recent empirical methods do suggest that tax competition is at least one significant determinant of the race to the bottom in corporate taxes.

In their survey on *What Do We Know About Tax Competition?*, Devereux and Loretz (2013, p.765) argue that "despite significant variation in the approaches there emerges a relatively clear pattern of evidence for tax competition", which is especially strong within the EU. Winner (2005) uses panel data on 23 OECD countries to show that increasing capital mobility has decreased the tax burden on capital and increased the tax burden on labour, especially since the mid-1980s, consistent with the existence of tax competition. Lastly, Overesch and Rincke (2010) also find strong evidence for tax competition. They go even further and estimate that the average statutory corporate tax rate for their sample of 32 European countries would have been 40% in the counterfactual scenario with no tax competition in 2006, compared to the actual value of 27.5%.

Hence, it would seem that tax competition is at least partly behind the global race to the bottom in corporate tax rates. However, we may still ask if policymakers are right to think that lower tax rates are truly effective in attracting FDI.

3. Empirical Analysis: Do Relatively Low Effective Corporate Tax Rates Attract Greenfield Foreign Direct Investment?

Given evidence of policymakers strategically engaging in tax competition, it is now essential to determine whether relative effective corporate tax rates really can be thought of as another determinant of the investment function. In this part, the empirical analysis investigating this relationship is reported. Rather than estimate the effective corporate tax rates on gross fixed capital formation, we opt to estimate the effect on greenfield FDI, which enters directly into gross fixed capital formation in a given country in a given period. This will give us an insight as to whether tax competition affects investment, while excluding the extra noise that comes with estimating investment functions.

3.1 The Effective Average Corporate Tax Rate

As already discussed, tax competition goes beyond competition solely on statutory corporate tax rates. Hence, an effective rate of corporation tax is more appropriate, but how should we define such a rate?

In the tax competition literature, the estimates of the effective corporate tax rates most frequently used are based on the methodology developed by Devereux and Griffith (2003).

However, since this methodology also builds on neoclassical capital theory, it is subject to the same theoretical criticisms mentioned in the introduction. Besides the theoretical objections, estimates based on this approach are also practically unwieldy. This is because the approach of Devereux and Griffith (2003), as it is a forward-looking measure of effective rates, requires a given discount rate (to calculate net present values of investments), a given rate of economic rent, a given discount rate and rate of inflation, as well as assumptions as to whether investment is financed out of retained earnings and equity or debt. For example, depending on how one sets these parameters, the average effective tax rate of the G7 countries is somewhere between 43% and 7% in 1980 and between 33% and 6% in 2005 according to this approach.[3] For these reasons, we reject this neoclassically inspired approach to estimating effective corporate tax rates.

Therefore in this paper we opt for the simpler and arguably more relevant AECTR, which we will denote by τ and define as follows:

$$\tau = \frac{Total\ Corporate\ Tax\ Revenues}{Adjusted\ Net\ Operating\ Surplus} * 100 \tag{3.1}$$

The numerator of 3.1 refers to all taxes collected on the income, profits, and capital gains of corporates (with data from the OECD). The denominator of 3.1 represents operating surpluses of the total economy, netted by depreciation and adjusted for the compensation of the self-employed (data from AMECO). This definition does better to capture the effects of non-statutory tax competition. It is a backward-looking measure of the effective tax rate, as Devereux and Griffith (2003, p. 108) point out, which works well in a post-Keynesian analysis since one can argue MNEs indeed look at the general and average tax conditions in a country in that period or the period before, rather than try to maximise in a fundamentally uncertain world. Unless explicitly stated otherwise, in this paper we will take our corporate tax rate to mean the AECTR as defined by 3.1.

3.2 Review of the Empirical Literature

There does not appear to be any strong consensus in the literature regarding the effect of corporate taxes on FDI. Previous reviews of the literature range from concluding that the evidence is "mixed", e.g. Lee (2001, p. 15), to summarising that "most studies have to date found … a negative relationship between tax rates and FDI flows" (Dellis *et al.* 2017, p.11). Differences in results are due to differences in samples, dependent variables, definitions of the relevant tax variables, control variables, and econometric techniques. For example, for the seven papers reviewed in Table 3.1, the dependent variables have been defined as total FDI inflows, bilateral FDI flows, greenfield FDI inflows, and the probability of an MNE investing in a given country. A number of tax variables have been investigated, such as the statutory corporate tax rate, implicit capital tax rate, total tax revenue to GDP ratios, length of tax holiday, tax treaty dummy

[3] Estimates found in Klemm (2005), based on Devereux and Griffith (2003)

Table 3.1. *Literature review summary on the empirical effect of corporation tax variables on FDI*

Study	Countries	Years	Method	Dependent Variable	Tax Variable(s)	Effect
Conclude that tax variables do not matter:						
Wheeler and Mody (1992)	42 countries with US MNEs	1982 – 1988	Panel methods with time fixed effects	MNE investment in country *i*, relative to country *j*	Corpoate tax revenues	No significant effect
Alam and Shah (2010)	10 advanced economies	1985 – 2009	Panel methods with country fixed effects	Total FDI inflows	Statutory corporate tax rate	No significant effect
Conclude that higher tax rates have negative effects and higher favourable tax conditions have positive effects:						
Woodward and Rolfe (1993)	16 Caribbean countries	1984-1987	Conditional logit model	Probability of an MNE investment in country *i*	Number of years of tax holiday	Positive effect
Di Giovanni (2005)	194 countries	1990 – 2001	Gravity model with country fixed effects	Total FDI inflows	Average statutory rate	Negative effect
					Presence of tax treaty	Positive effect
Razin and Sadka (2006)	24 OECD Countries	1981 – 1998	OLS & Heckman Selection Model	Bilateral FDI flows	Source statutory rate	Negative effect
					Host statutory rate	Positive effect
Lahreche-Revil (2006)	Compares EU15 to new member states	1990 – 2002	Gravity model with country fixed effects	Bilateral FDI flows	Implicit capital tax rate	Negative effect
					Host statutory rate	Negative effect
					AECTR	No effect
Dellis *et al.* (2017)	21 OECD countries	2005 – 2014	OLS, Random effects, IV, and GMM	Total FDI inflows	Ratio of total tax revenues to GDP	Negative effect
Most frequently used control variables	Host market size (GDP), trade openness, unit labour costs, outward FDI, political/legal stability variables, infrastructure variables, quality of institutions, distance (for bilateral FDI), MNE home GDP (for bilateral FDI)					

variables, and—the variable preferred in this paper, defined in equation 3.1—the AECTR. Further details of the empirical literature reviewed and the general results are summarised in Table 3.1. The literature reviewed is presumably not exhaustive, though chosen at random from what was available.

The literature reviewed here thus also finds that most studies support the claim that higher tax rates have a negative effect on FDI. To square this result with the earlier cited literature review that found mixed results (Lee 2001), we might hypothesise that more recent work has tipped the balance decidedly more in the one direction. Yet this does not take into account the size of the effects and where they are most relevant. Lahreche-Revil (2006), for example, finds that negative effects of most tax rates on FDI flows within the old EU member states, but stressed that despite the best efforts of new member states to undercut their neighbours, they have been doing so to little effect (in the 1990s, at least). In general, then, without a more unanimous consensus, more empirical work is still required, towards which the remainder of this part aims to contribute.

3.3 Data, Empirical Approach, and Results

The analysis is conducted on a strongly balanced panel of 33 OECD member countries over the years 2005 – 2016.[4] There are two main reasons for this setting. Firstly, a large number of countries is desired in order to test the generality of the hypothesised relationship and, second, the best available data with smallest measurement error is naturally preferred. The measurements of FDI can suffer from many distortions. For example, the existence of special purpose entities as well as lending from domestic enterprises to MNEs within the borders of a country have both been found to bias FDI data (Dellis *et al.,*2017 pp. 6-7). The OECD's latest vintage of FDI data using the "OECD Benchmark Definition of FDI, 4th edition" addresses these issues, but, at the present time, only has data on the years 2005 – 2016 and hence our time frame.

The OECD FDI data is used in addition to data from UNCTAD (2017) on greenfield FDI. It is greenfield FDI that is more relevant for our purposes, as it enters directly into gross fixed capital formation in a given country. FDI is a broader concept more closely related to financing, which may or may not be used to purchased fixed capital goods. Hence, we will use the FDI empirical analysis as a kind of robustness check against the greenfield FDI analysis.

The preferred empirical specification is given in equation 3.2, where the control variables are based on the most frequently cited in the literature (see Table 3.1).

$$\log(GF\_FDI_{it}) = \beta_0 + \beta_1(\tau_{f,t} - \tau_{i,t}) + \beta_2\log(GDP_{it}) + \beta_3 ulc_{it} + \beta_4 openness_{it} \tag{3.2}$$

GF_FDI_{it} is greenfield FDI, taken from the UNCTAD World Investment Report (2017). Our control variables are nominal GDP in purchasing power parity, trade openness (defined as

[4] The countries are the 35 OECD countries minus Chile and Israel, for data availability reasons. The panel is balanced except for 9 missing observations for the tax rate differential.

exports plus imports of goods and services divided by GDP), and nominal unit labour costs. Data on the first two are taken from the OECD database whereas data on unit labour costs is lifted from the AMECO database. The variable of interest is the effective corporate tax differential, where $\tau_{f,t}$ is the average AECTR in the 33 countries in year t and $\tau_{i,t}$ is the tax rate in country i in year t. Again, the AECTR is as defined in equation 3.2. We take the logarithms of greenfield FDI and GDP to allow for a more convenient interpretation.[5] The hypothesised signs of β_1, β_2, and β_4 are positive while we would expect β_3 to be negative. Descriptive statistics are offered in the appendix.

Panel unit root tests are conducted for all variables, using the test developed by Levin, Lin and Chu (2002). Since the test requires a balanced panel, we are forced to exclude the year 2016 and the panel of variables for Turkey from the test. The short time dimension reduces the statistical power of the test. However, no more suitable test was available at the time of writing.[6] We acknowledge this limitation and report the results of the panel unit root tests in the statistical appendix. After demeaning the data to remove any potential cross dependency—as advised by Levin, Lin and Chu (2002)—and adjusting for a small T dimension, we find evidence to reject the null hypothesis of a unit root in one of the panels for all variables. Hence, we proceed on the basis that the stationarity assumption is satisfied.

Regarding the appropriate panel model to use, we begin with a pooled OLS model and use the Breusch-Pagan Lagrange multiplier to test the null hypothesis of no random effects. The test strongly rejects the null hypothesis in all regressions, thus the pooled OLS model is seen as dominated by the random effects model. Likewise, the Hausman test was implemented to compare random effects with fixed effects specifications. The Hausman test indicated that the random effects model produced inconsistent estimators, hence the fixed effects specification is our preferred specification. All tests were conducted controlling for time effects, which were found to be jointly significant in an F test.

Another econometric hurdle is one that is frequently found in the literature. That is the problem of endogeneity. With reference to our equation 3.2, it can be argued that greenfield FDI causes GDP, as well as vice versa, and hence we have reason to suspect the presence of simultaneity bias. Hence, we proceed, as do others (e.g. Dellis *et al.* 2017), by using lags of GDP as instrumental variables, being sure to satisfy the relevance and exogeneity criteria for valid instrument selection. Again, a Hausman test is employed to ensure the latter. Lastly, Busch-Godfrey tests revealed the presence of serially correlated errors, but the Peseran test failed to detect cross-sectional dependency. As a result, the estimated standard errors were made robust to the presence of autocorrelation as well as heteroskedasticity.

[5] β_2 can be interpreted as an elasticity with this transformation. For the other three variables, the appropriate interpretation of the coefficient is $\%\Delta(GF\_FDI_{it}) = 100 * \beta_k$, for $k = 1, 3,$ or 4, given an increase of one unit.

[6] For example, the test developed by Harris and Tavaris (1999) would be more appropriate. Unfortunately, it is not one of the available options in the available software (R)

Our results are displayed in Table 3.2, where the three columns contain the three specifications with order of preference decreasing right to left: Fixed effects with instrumental variables, fixed effects, and pooled OLS. An increase in our variable of interest, the effective tax rate differential, by one percent is found to lead to an increase in greenfield FDI of around 2.6%. Hence, we find evidence that undercutting the world average in corporate tax rates does lead to greater greenfield FDI inflows. Our control variables enter with the expected signs, except the unit labour costs variable which is not found to be significant in our preferred specifications. Note that trade openness is measured as a ratio, not a percentage, hence the seemingly large size of its effect.

Table 3.2. *Regressions results – Relatives effective corporate tax rate as a determinant of greenfield FDI?*

	Dependent variable:		
	log(Greenfield FDI)		
	Pooled OLS	FE	FE with IV
	(1)	(2)	(3)
Effective Tax Rate Differential	0.029***	0.025***	0.026***
	(0.009)	(0.004)	(0.004)
log(GDP)	0.843***	0.879***	0.890***
	(0.065)	(0.044)	(0.048)
Unit Labour Costs	−0.011*	−0.002	0.006
	(0.006)	(0.008)	(0.005)
Trade Openness	0.179	0.253***	0.254***
	(0.230)	(0.083)	(0.087)
Constant	−1.817		
	(1.234)		
Observations	387	387	355
R^2	0.728	0.757	0.774
Adjusted R^2	0.725	0.747	0.765
F Statistic	247.836*** (df = 4; 370)	288.953*** (df = 4; 371)	291.684*** (df = 4; 340)
Note:			*p<0.1; **p<0.05; ***p<0.01

3.4 Robustness Checks

To check the robustness of these results, we take a similar empirical approach and apply it to the same specification but change the dependent variable and variable of interest (the tax variable). Our specifications may be with random effects or fixed effects, depending on the results of the Hausman test. The results found in Table 3.2 are found to be robust to the tests conducted.

To begin, we keep greenfield FDI as our dependent variable and estimate the effect of, first, the AECTR and, second, total tax revenues as a percentage of GDP.[7] In both cases, our tax variable is found to be negative and highly significant, giving further evidence in favour of the hypothesis that lower corporate taxes encourage greenfield FDI inflows. In our preferred specification (instrumental variables), an increase in the AECTR is found to decrease greenfield FDI by 2.6% and an increase in total tax revenues as a percentage of GDP is found to decrease our dependent variable by 3.2%. Our control variables are also of a similar size and sign to as is displayed in Table 3.2, but we opt to relegate the full results to the appendix.

Our second robustness check uses total FDI inflows data as our dependent variable:

$$\log(FDI_{it}) = \beta_0 + \beta_1(\tau_{f,t} - \tau_{i,t}) + \beta_2 \log(GDP_{it}) + \beta_3 ulc_{it} + \beta_4 openness_{it} \tag{3.3}$$

Again, full results can be found in the appendix. The effective tax rate differential is found to have a similar effect to that found in Table 3.2, positive and significant with a size of 0.023. Our alternative tax variables also produce much the same result. The effective corporate tax rate is negative and significant, as is the total tax activity variable, both with similar sizes.

With regards to the possibility of low corporate tax rates attracting FDI, our results all point in the same direction. Hence, it would seem warranted to include relative corporate tax considerations in an investment function, as we shall now do in part four. The main limitation of our empirical approach has already been mentioned, namely the inability to run a panel unit root test that accounts for the small time dimension. Indeed, our high R^2 may imply the presence of spurious effects. That being said, the tax differential variable seems unlikely to be nonstationary given how it is constructed. Yet this remains a point which could be addressed in further research.

4. A Neo-Kaleckian Model with Tax Competition Effects

The empirical relevance of tax competition urges us to incorporate its effects into post-Keynesian theory. To the best of my knowledge, no such post-Keynesian theory already exists. Capital taxes, of which corporation taxes can be considered a part, have been dealt with by a variety of post-Keynesian authors (see, for example, You and Dutt (1996), Laramie and Mair (2003), Dutt (2013), Obst *et al.* (2017)). However, these authors are focused on the effects of capital taxes on distribution and public debt. These effects are the more usual concerns of post-Keynesian analysis that ought to be included in any post-Keynesian theory of tax competition. Yet, in this first step, we will for simplicity assume balanced public budgets at all times and leave debt effects for the subject of further research. In order to include the distributional effects in

[7] This total tax activity variable covers all tax revenues in a country, not just corporate tax revenue. It is thus not preferred. However, it is frequently found in the literature and can be seen as a proxy for relationship we are interested in.

our model, we will add our tax competition effects to a neo-Kaleckian model, as popularised by Rowthorn (1981), Dutt (1984), Taylor (1985) and Amadeo (1986).

In building our post-Keynesian approach, we are not alleging, in contrast to the neoclassical capital theory of, for example, Jorgensen (1963), that lower capital taxes will increase the amount of MNE investment in the world economy by removing market distortions. The argument is rather that total MNE investment is determined by the usual post-Keynesian determinants and then that investment is *allocated* among countries according to differences in AECTRs, other things being equal.[8] Indeed, such is the very nature of MNEs that they locate their activities in the country that offers the conditions most conducive to its goal. Whether the objective of the MNE is growth, profit, or power maximisation,[9] we can say quite generally that, other things being equal, it will try to minimise its tax bill.[10] With this qualification, we can begin to build a post-Keynesian theory of tax competition that does not rely on all the objectionable assumptions at the heart of the neoclassical approach.

4.1 The Effect of Higher Corporation Taxes in a Traditional Neo-Kaleckian Model

Before we introduce tax competition effects, let us briefly consider the effects of higher capital taxes in a neo-Kaleckian model with no FDI inflows. We will simplify our approach by assuming that the tax on corporate profits is the only tax in the economy and, as already mentioned, that the government runs a balanced budget at all times:

$$G = \tau\Pi \tag{4.1}$$

where G is government expenditure and Π represents the total profit level. We assume workers earn wages and capitalists earn profits such that the classes and their income types are mutually exclusive. Furthermore, we will proceed using the classical saving hypothesis that workers do not save, whereas capitalists save a fraction s of their income. Hence, using the usual Weisskopf decomposition for the rate of profit, we arrive at our savings rate (σ) function:[11]

$$\sigma = \frac{S}{K} = \frac{s_\pi(1-\tau)\Pi}{K} = s_\pi(1-\tau)\left[\frac{\Pi}{Y}\frac{Y}{Y^P}\frac{Y^P}{K}\right] = s_\pi(1-\tau)h\frac{u}{v} \tag{4.2}$$

where S is total savings, K is the capital stock, Y is output, Y^P is potential output, s_π is the propensity to save out of profits, h is the profit share, u is the capacity utilisation rate, and v is

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[8] Examples of factors that may also affect FDI and that may not be equal include access to markets, labour costs, quality of infrastructure, etc.

[9] See Lavoie (2014, ch.3.3) for more on post-Keynesian views of the goal of the firm.

[10] This approach relates to what Palley (2015, p.53) terms "barge economics" because "it is as if factories are placed on barges that float between countries to take advantage of lowest costs – which can be due to under-valued exchange rates, *low taxes, subsidies,* absence of regulation, or abundant cheap exploitable labour" [emphasis added].

[11] Note that we simply by assuming that the incidence of corporate tax falls solely on capitalists.

the potential output to capital ratio, assumed to be constant. The rate of investment (*g*) is determined by animal spirits (γ_1) and the rate of capacity utilisation:

$$g = \frac{I}{K} = \gamma_1 + \gamma_2 u \tag{4.3}$$

Lastly, and following Hein (2014, p. 290), we shall consider the determinants of the rate of net exports (*b*) to be the real exchange rate (e^R), domestic capacity utlisation and foreign capacity utilisation (u_f): [12]

$$b = \frac{NX}{K} = \beta_1 e^R - \beta_2 u + \beta_3 u_f \tag{4.4}$$

In the goods market equilibrium, leakages must equal injections, implying that the savings rate must be equal to the rates of investment and net exports:

$$\sigma = g + b \tag{4.5}$$

Before we solve our system, we must highlight the assumption of Keynesian stability.

$$\frac{\delta\sigma}{\delta u} > \frac{\delta g}{\delta u} + \frac{\delta b}{\delta u} \tag{4.6}$$

And so, for our particular open-economy model, stability in the goods market thus requires the following:

$$s_\pi(1-\tau)\frac{h}{v} + \beta_2 > \gamma_2 \tag{4.7}$$

Now we are in position to solve our model by inserting equations 4.1 until 4.4 into 4.5 and solving for the equilibrium capacity utilisation rate (u^*):

$$u^* = \frac{\gamma_1 + \beta_1 e^R + \beta_3 u_f}{s_\pi(1-\tau)\frac{h}{v} - \gamma_2 + \beta_2} \tag{4.8}$$

A few remarks are in order. Unsurprisingly, the paradox of savings (Keynes, 1936) holds in our model. The paradox of costs (Kalecki, 1966; Rowthorn, 1981) may or may not hold depending on the effect of the profit share on the real exchange rate (*cf.* Hein and Vogel 2007, pp.483-484). However, this is not our focus here. What is of greater interest for our purposes is the effect of an increase in the capital tax rate on equilibrium capacity utilisation, which is positive:

$$\frac{\delta u^*}{\delta\tau} > 0 \tag{4.9}$$

[12] We also follow the assumption that the Marshall-Lerner condition holds and, as such, the effect of the real exchange rate on the rate of net exports (β_1) is positive.

This effect is due to the injection of capitalist income through government spending, which would have otherwise been a leakage in the form of capitalist savings. Hence, this effect is dependent upon our assumptions about the fiscal budget. We would expect that if the government runs a deficit or a balanced budget, then the effect will hold whereas if the governments runs a surplus, it may not hold. The same effect found in 4.9 is derived by Dutt (2013), though not in a strictly neo-Kaleckian model.

From the standpoint of such a wage-led model, the current worldwide downward trend in corporate tax rates can only be viewed as ill-informed and self-defeating since 4.9 indicates demand, proxied by u, is positively affected by higher corporation tax. Now we look to compare these results to a neo-Kaleckian model with tax competition effects.

4.2 The Effect of Higher Corporation Taxes in a Modified Neo-Kaleckian Model with Tax Competition

We begin by stating our assumptions about MNE investment.[13] We will treat the total size of worldwide MNE investment as an exogenous and autonomous variable, that we will denote by I_m. That is to say that we limit the determinants of worldwide MNE investment to the animal spirits of the MNEs.[14] Furthermore, let us suppose MNEs choose to locate a fraction of total worldwide greenfield FDI in country i based on whether that country has a high or low AECTR (τ_i) relative to the world average of AECTRs (τ_f):

$$I_{m,i} = \frac{\tau_f - \tau_i}{\tau_f} I_m \tag{4.10}$$

If the AECTR in country i is lower than the rest of the world average, we expect positive greenfield FDI effects in country i, whereas if the AECTR is higher we expect disinvestment and MNEs relocating their activities to a foreign country.

One may make the altogether reasonable objection that the relationship in 4.10 is too simplistic as various other factors will determine MNE location decisions. In which case, we may think of I_m as the part of total worldwide MNE investment that is sensitive to taxation. For instance, MNEs whose production is not labour intensive may pay more attention to ensuring a minimum tax bill rather than a minimum wage bill, since the latter may be a small part of overall costs relative to the former.

Let us now add greenfield FDI from equation 4.10 to our gross investment rate function (4.3). Since we are speaking in terms of *greenfield* FDI, the term enters directly into the gross investment rate function. But first, we must standardise gross investment due to MNEs in country i ($I_{m,i}$) by the capital stock in country i, as we did before.

[13] In this paper, we will take MNE investment and greenfield FDI to be synonymous.

[14] Further research could look at the effect of introducing other typical post-Keynesian determinants of total worldwide MNE investment such as world demand and MNE retained earnings. For now, however, the simpler assumption will do.

$$g_i' = g_i + \frac{I_{m,i}}{K_i} = \gamma_{1,i} + \gamma_{2,i}u + \frac{\tau_f - \tau_i}{\tau_f} g_{m,i} \qquad (4.11)$$

where $g_{m,i} = I_m / K_i$. An important point here is that $g_{m,i}$ will be much larger for some economies than others. This follows from the fact that total worldwide greenfield FDI (I_m) is truly huge, as the estimates from UNCTAD (2017) provided in Table 4.1 indicate. To put this in context, if MNEs were a country, their combined total investment in 2017 would rank 4th highest in the world after China, the US, and Japan (World Bank, 2018). The denominator of $g_{m,i}$, the capital stock in country i (K_i) may be quite small, relatively speaking, as it will vary depending on how big and how rich a country is. Hence, for small and/or developing countries we might expect $g_{m,i}$ to have quite a dominant influence.

Table 4.1 *Estimated Worldwide Greenfield Foreign Direct Investment (I_m), Billions US$*

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
I_m	818	805	1294	958	819	867	645	827	721	773	828

Source: UNCTAD (2017)

Proceeding now to solve our system for the equilibrium rate of capacity utilisation, and reiterating that our stability condition in 4.6 must apply again for our model to be determinate, we arrive at:

$$u_i^* = \frac{\gamma_{1,i} + \beta_{1,i}e^R + \beta_{3,i}u_f + \frac{\tau_f - \tau_i}{\tau_f} g_{m,i}}{s_{\pi,i}(1-\tau_i)\frac{h_i}{v_i} - \gamma_{2,i} + \beta_{2,i}} \qquad (4.12)$$

Again, as we did with the benchmark model, let us now take the derivative of capacity utilisation with respect to the domestic AECTR. To examine its sign, we then set it equal to zero:

$$\frac{\delta u^*}{\delta \tau} = 0 \quad \text{when}$$

$$\frac{\tau_f\ (s_{\pi,i}\, h_i/v_i)\ \ (\gamma_{1,i} + \beta_{1,i}e^R + \beta_{3,i}u_f)}{g_{m,i}} + \gamma_{2,i} - s_{\pi,i}(1-\tau_f)\frac{h_i}{v_i} - \beta_{2,i} = 0 \qquad (4.13)$$

The effect is not immediately obvious, but we can simplify equation 4.13 a great deal as we interpret its meaning. Take the first term in 4.13:

$$\frac{\tau_f\ (s_{\pi,i}\, h_i/v_i)\ \ (\gamma_{1,i} + \beta_{1,i}e^R + \beta_{3,i}u_f)}{g_{m,i}} \qquad (4.13a)$$

For certain economies in particular, this term may be vanishingly small. Total worldwide MNE investment over the capital stock in country i—the denominator—may dwarf the size of the numerator. In smaller or poorer countries in particular, $g_{m,i}$ will be large whereas the fraction, $\tau_f\ (s_{\pi,i}\, h_i/v_i)$, of domestic investment due to animal spirits and net exports due to the real exchange rate and foreign demand may be relatively small. Developing countries may exhibit especially weak animal spirits or international competitiveness. The term 4.13a implies that, all other things being equal, economic size matters for FDI inflows. Our model predicts that smaller and/or developing countries will be more likely to engage in tax competition, which certainly rings true of countries like Ireland, Switzerland, Estonia, and Hungary. Further empirical evidence for a negative relationship between the size of the economy and probability to engage in tax competition is found in Winner (2005).

We do not wish to pretend that the term in 4.13a is zero for all countries. However, it is worth mentioning that if a large number of small economies are competing over AECTRs in a way that attenuates the average world AECTR, τ_f, then eventually even relatively large economies may see this term shrink towards zero. But for now, we will simply consider countries of small economic size and assume 4.13a to be roughly zero.

Let us now turn our attention to the remainder of 4.13:

$$\frac{\delta u_i^*}{\delta \tau_i} = 0 \quad \text{when}$$

$$\gamma_{2,i} - s_{\pi,i}\left(1-\tau_f\right)\frac{h_i}{v_i} - \beta_{2,i} = 0 \tag{4.13)'}$$

It is clear $\frac{\delta u_i^*}{\delta \tau_i}$ is dependent on the average foreign tax rate, τ_f. Treating h_i and all parameters as constant, we can determine the effect of τ_i on u_i^* by finding the foreign tax rate for which the effect is zero. Let us denote this special rate $\tau_{f,i}^*$:

$$\frac{\delta u_i^*}{\delta \tau_i} = 0 \ \text{ when}$$

$$\tau_{f,i}^* = \frac{(s_{\pi,i}\, h_i/v_i) - \gamma_{2,i} + \beta_{2,i}}{(s_{\pi,i}\, h_i/v_i)} \tag{4.14}$$

The economic meaning of behind $\tau_{f,i}^*$ is as follows: There is, for each country, a hypothetical foreign AECTR that exactly balances the Kaleckian distributional effects with the open-economy FDI effects of an increase in the domestic AECTR on domestic capacity utilisation for all values of τ_i. Every country has a different equilibrium foreign tax rate, as determined by the specific parameter values in equation 4.14. Hence the responsiveness of demand to changes in the corporation tax rate in country *i* depends on how the actual foreign AECTR compares to that country's hypothetical equilibrium rate. Exceeding or falling below this rate gives the results in Table 4.2:

Table 4.2 *The effect of an increase in the AECTR of country i on domestic demand is dependent upon average foreign AECTR*

Condition	$\tau_f > \tau^*_{f,i}$	$\tau_f < \tau^*_{f,i}$
Effect	$\frac{\delta u^*}{\delta \tau_i} > 0$	$\frac{\delta u^*}{\delta \tau_i} < 0$
Dominant economic force	Kaleckian redistribution	FDI tax competition
Assuming $\tau_f\ (s_\Pi h/v)\,(\gamma_1 + \beta_1 e^R + \beta_3 u_f)/g_{m,i} \approx 0$		

We refer to this special equilibrium rate, $\tau^*_{f,i}$, as hypothetical because it may be greater than 100%, unlike the actual average foreign AECTR. Note, however, it cannot be negative due to our assumption of Keynesian stability, expressed in 4.7. In fact, let us reprint the stability condition here, and compare it to our derivation of $\frac{\delta u^*}{\delta \tau}$ (equation 4.13'), as it will prove additionally instrumental in providing another condition:

Keynesian stability if $$s_{\pi,i}(1-\tau_i)\frac{h_i}{v_i} + \beta_{2,i} > \gamma_{2,i} \qquad (4.7)$$

$\boldsymbol{\frac{\delta u_i^*}{\delta \tau_i} < 0}$ **if** $$s_{\pi,i}(1-\tau_f)\frac{h_i}{v_i} + \beta_{2,i} > \gamma_{2,i} \qquad (4.13)'$$

If we are to avoid indeterminacy in our model, it must follow that if the AECTR in country *i* is greater than the average in the rest of the world (i.e. if $\tau_i > \tau_f$) then a rise in that country's AECTR *must* negatively affect its demand. We can demonstrate this in the following way:

$$If\ \tau_i > \tau_f \quad \Rightarrow\ s_{\pi i}\left(1-\tau_f\right)\frac{h_i}{v_i} + \beta_{2i} > \ s_{\pi i}(1-\tau_i)\frac{h_i}{v_i} + \beta_{2i} \ > \gamma_{2i}$$

$$\Rightarrow\ s_{\pi i}\left(1-\tau_f\right)\frac{h_i}{v_i} + \beta_{2i} > \gamma_{2i}$$

$$\Rightarrow\ \tau_f < \frac{(s_{\pi,i}\, h_i/v_i) - \gamma_{2,i} + \beta_{2,i}}{(s_{\pi,i}\, h_i/v_i)}$$

$$\Rightarrow\ \tau_f < \tau^*_{f,i}$$

$$\Rightarrow\ \frac{\delta u_i^*}{\delta \tau_i} < 0$$

Our special condition for all sufficiently small countries is thus:

$$If\ \tau_i > \tau_f, \qquad then\ \frac{\delta u_i^*}{\delta \tau_i} < 0 \tag{4.15}$$

Assuming $\tau_f\ (s_\Pi h/v)\,(\gamma_1 + \beta_1 e^R + \beta_3 u_f)/g_{m,i} \approx 0$

The intuition behind the special condition in 4.15 may not be immediately obvious. It stems from the assumption of 4.13a being zero, which in turn is dependent on the influence of total worldwide greenfield FDI dominating domestic economic activity. Since $g_{m,i}$ is so large, relatively speaking, a given small economy simply cannot afford to lose even a fraction of it and so will ensure it remains tax competitive, i.e. it will set $\tau_i < \tau_f$. Such an FDI-dominated country may redistribute profits to stimulate demand, but only if it is receiving positive FDI inflows to begin with. Clearly, the assumption of Keynesian stability and the assumption of small economic size relative to MNE investment is crucial in our analysis.

5. Dynamics of the Neo-Kaleckian Tax Competition Model

Suppose that the government in each country *i* observes the effect of $\boldsymbol{\tau_i}$ on $\boldsymbol{u_i^*}$ and reacts accordingly, raising or lowering $\boldsymbol{\tau_i}$ to stimulate demand. Such behaviour will give rise to complex dynamics in the world system, as each country partly determines the average world AECTR, to which countries then react when setting domestic rates, giving rise to further feedback effects. Will the system of world corporate tax rates converge in any way or will tax rates exhibit more erratic or explosive behaviour?

In attempt to shed light on this question, let us first entertain some simplifying assumptions and visualisations. Then we can relax some of the assumptions and turn to simulations to better analyse the real dynamics. Two key assumptions that will be maintained throughout this section is that the stability condition must be respected at all times and that the term in 4.13a is zero. Hence, again we can think of our analysis here as applying to a system of small and/or less developed economies.

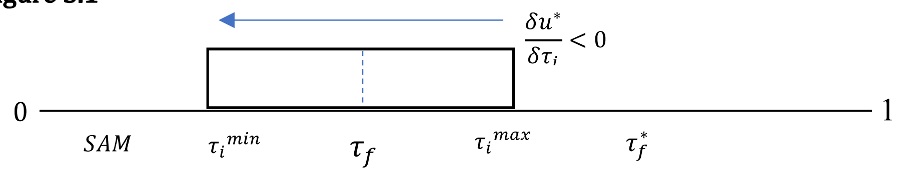
5.1. Dynamics of a Simplified World Corporate Tax System

To begin, assume that countries are completely homogeneous, such that $\tau_{f,i}^* = \tau_f^*$ for all countries. Further suppose that, in our initial position, the tax rate on corporate profits in country i (τ_i) is uniformly distributed around the average worldwide tax rate (τ_f). Lastly, assume that the size of the rate of adjustment of τ_i over time is uniform in all countries. Let us assume that the rate of adjustment is limited for political and bureaucratic reasons to c % per year (that is $\left|\frac{\delta \tau_i}{\delta t}\right| = \bar{c}\ ,\ \forall\ i$). Then we must have two scenarios, either we have $\tau_f^* > \tau_f$ or $\tau_f^* < \tau_f$. We take each case in turn.

5.2.1. Simplified Scenario 2: $\boldsymbol{\tau_f^* > \tau_f}$

Figure 5.1 illustrates the scenario where our entire distribution from ${\tau_i}^{min}$ to ${\tau_i}^{max}$, represented by the rectangle in the possible tax space of [0,1], is below τ_f^*. Now the conditions derived in section four indicate all countries in the distribution will see tax competitive FDI effects dominate redistributional effects. Policymakers will thus reduce AECTRs and hence the entire distribution will see a downward shift.

Figure 5.1

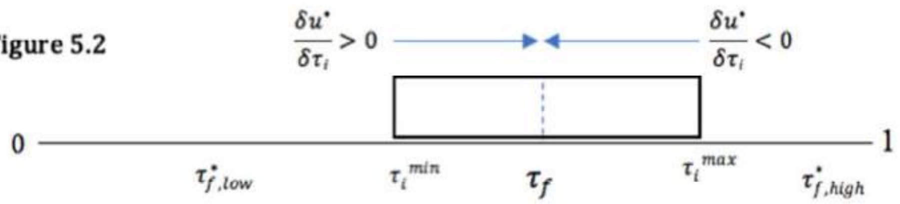


This process will continue until some lower bound, which we may think of as zero or, perhaps more realistically, some other socially acceptable minimum (henceforth SAM). We might suppose that AECTRs will be bounded at the lower end by political and ethical considerations, which in reality may vary from country to country. This scenario represents a race to the bottom: A downward trend in the entire distribution of AECTRs that converges only at the "bottom", whether defined as zero or some other SAM.

5.1.2. Simplified Scenario 2: $\tau_f^* < \tau_f$

As is proved in the demonstration of the special condition in (4.15), there can be no scenario where $\boldsymbol{\tau_f^*} < \boldsymbol{\tau_f}$ for all countries in the distribution due to the operation of Keynesian stability which implies that countries with AECTRs above $\boldsymbol{\tau_f}$ must, in fact, also have equilibrium foreign AECTRs above $\boldsymbol{\tau_f}$. Hence in this setup, the homogeneity assumption must be relaxed to maintain the Keynesian stability assumption: Those countries with AECTRs above $\boldsymbol{\tau_f}$ must, by construction, have an equilibrium foreign AECTR which is higher than $\boldsymbol{\tau_f}$ (denoted $\boldsymbol{\tau_{f,high}^*}$ in Figure 5.2) and thus face the condition of $\boldsymbol{\delta u^*/\delta\tau < 0}$, whereas countries with AECTRs in the lower half of the distribution have an equilibrium foreign AECTR below $\boldsymbol{\tau_f}$ (denoted $\boldsymbol{\tau_{f,low}^*}$) and face the condition where $\boldsymbol{\delta u^*/\delta\tau > 0}$. Rather than all countries being subjected to the same force, as in simplified scenario one, our setup now entails that countries in the lower half of the distribution will increase their AECTR, whereas countries in higher half of the distribution will decrease their AECTR. This is depicted in Figure 5.2.

Figure 5.2



Given our assumptions about the distribution and rate of adjustment being uniform, after one period the average world AECTR would not change and the same process would be repeated in every period thereafter until all countries share the same AECTR, τ_f. In this scenario, then, we would not expect an upward nor a downward trend in the average world AECTR, but we would expect a narrowing of the spread of domestic AECTRs. That is, we would expect convergence across countries.

Our two simplified scenarios present us with two working hypotheses. First, there is reason to believe tax rates will tend to converge around some point. Second, we might suppose that if the corporate tax rate distribution does move, it will be in a downward direction. However, we have thus far relied on very unrealistic simplifications: It is extremely unlikely that equilibrium foreign tax rates are equal between countries. Countries are clearly not so homogeneous. Furthermore, the distribution of corporate tax rates around the world is probably not uniform and the rate of adjustment will surely vary between countries, and perhaps even between years. The SAM may also vary from one country to another. It is argued here that we can take this true heterogeneity into account through the use of simulations and still reach broad, nontrivial conclusions.

Table 5.1. *Procedural rules for how a given country sets its AECTR in a given period*

Rule #	If…	Then…		Reason
1.	$\tau_{i,t} < SAM_i$	$\tau_{i,t+1} = \tau_{i,t} + x_{i,t}$	…otherwise…	Sociopol. minimum
2.	$\tau_{i,t} > \tau_{f,t}$	$\tau_{i,t+1} = \tau_{i,t} - x_{i,t}$	…otherwise…	Keynesian stability
3.	$\tau_{f,t} = \tau^*_{f,i}$	$\tau_{i,t+1} = \tau_{i,t}$	…otherwise…	Table 4.2
4.	$\tau_{f,t} > \tau^*_{f,i}$	$\tau_{i,t+1} = \tau_{i,t} + x_{i,t}$	…otherwise…	Table 4.2
5.	$\tau_{f,t} < \tau^*_{f,i}$	$\tau_{i,t+1} = \tau_{i,t} - x_{i,t}$	[end]	Table 4.2

where x_i is the rate of change of the effective corporate tax rate in country *i*

5.2. Dynamics of a Complex World Corporate Tax System

Let us formalise the intuition of the preceding discussion by giving the policymakers procedural rules they follow when deciding upon how to set their AECTR. Suppose the government in country *i* sets its domestic AECTR in time period *t* by following the rules of Table 5.1 in the stated order.

Rule one says policymakers in country *i* will increase the corporate tax rate in the next period by $x_{i,t}$ percentage points if the rate falls below the socially acceptable minimum. Rule two puts into operation the condition given by 4.15, derived from the stability condition. If the AECTR in a given country at any time exceeds the world average, then that country will reduce its AECTR in the next period. The last three rules are based on the condition found in equation 4.13'. This order of procedural operation ensures that the corporate tax rate does not fall below zero (or otherwise unrealistically low) and that the stability condition is respected before all else.

Let it be stressed that we need not introduce undue notions of unbounded rationality. We merely impose that governments always wish to stimulate demand with corporate tax rates and know when the Kaleckian effects outweigh the FDI effects and vice versa. They do not, however, understand the dynamics of the system itself nor know by how much they should change tax rates in a given period to achieve some optimum. Indeed, they may overshoot or undershoot the average world AECTR and have to move their AECTR in the opposite direction in the following period. They operate according to simple rules of thumb, as summarised in Table 5.1, with what we might call a procedural or an "environment-consistent" level of rationality (*cf.* Lavoie 2014, p. 87).

Let us begin our simulations with two controlled scenarios where all countries are different, but have shared characteristics, and then add full heterogeneity in our last scenario. Specifically, we will start with two simpler scenarios where all countries have unique equilibrium foreign AECTRs which are all lower or higher than the actual foreign AECTR in the initial period. In other words, in scenario one we have $\tau^*_{fi} < \tau_{f,1}\ \forall\ i$ and in scenario two we have $\tau^*_{fi} > \tau_{f,1}\ \forall\ i$. In our third scenario we input broadly realistic parameters for τ^*_{fi} such that, in the initial position, countries share no such characteristics by construction.

We arbitrarily decide to simulate a system of 20 countries over 100 periods with a fixed rate of adjustment in all scenarios. Additional robustness checks are conducted to ensure results are not overly dependent on these dimensions of the simulations. One such robustness check is reported here, which is that we allow the rate of adjustment to vary over countries *and* over time, for 1000 periods instead of 100. Finally, for each scenario, 100 simulations are run to ensure a large sample size for the sake of generality.

5.2.1. Complex Scenario 1: $\tau^*_{fi} < \tau_{f,1}\ \forall\ i$

Given our analysis in simplified scenario one, we would expect counteracting forces to buffet the average world AECTR up and down but not to stray far from its initial value. We test this hypothesis by using the initial parameters for our 20 countries as generated by Table 5.2. Clearly, by construction, τ^*_{fi} will be lower than the initial average world AECTR, $\tau_{f,1}$.

Table 5.2. *Parameter generation for complex scenario 1*

Parameter		Random number betweeen
Equilibrium foreign AECTR in country *i*	τ^*_{fi}	0.00 – 0.20
Initial AECTR in country *i*	$\tau_{i,1}$	0.20 – 0.50
Rate of adjustment of AECTR in country *i* in period *t* (when allowed to vary over time)	$x_{i,t}$	0.01 – 0.10
Socially acceptable mimimum AECTR in country *i*	SAM_i	0.00 – 0.10

Since we are most interested in the trend and the dispersion of AECTRs around the world we report three metrics from the results of our simulations. The first two relate to the trend of average world AECTRs, τ_f. The first is the percentage of simulations that show a decrease in τ_f by the end of the simulation period (100 or 1000 periods). This is reported in column two of Table 5.3. Column three captures the average size of this change in τ_f across 100 simulations ($\tau_{f,end} - \tau_{f,initial}$). The last metric relates to the spread of AECTRs so as to test if there is some convergence. In column four, we report the change in the standard deviation of the AECTRs between the end and initial period ($\sigma_{end}^{\tau_i} - \sigma_{initial}^{\tau_i}$), averaged across 100 simulations.

Table 5.3. *Simulation results for complex scenario 1*

1. Rate of Adjustment	2. Downward trend?	3. $\tau_{f,end} - \tau_{f,initial}$ (in %, averaged across 100 simulations)	4. $\sigma_{end}^{\tau_i} - \sigma_{initial}^{\tau_i}$ (in %, averaged across 100 simulations)
Fixed 100 periods	40% of simulations	0.44 (0.23)	-5.30** (0.10)
Variable 1000 periods	56% of simulations	-5.40* (2.50)	-3.50** (0.13)

Note: * significant at 5% level **significant at the 1% level

The simulation results for complex scenario one are displayed in Table 5.3. The numbers in parentheses are standard errors. If we can assume the distribution of sample averages is normal, the usual inference methods apply. We find that a minority of simulations (40%) trend downward when the rate of adjustment is fixed whereas 56% of simulations trend downward when the rate of adjustment is variable over time. In the former case, this gives rise to a final world AECTR that is not statistically different from its initial level. This supports our hypothesis that τ_f will be attracted to its initial level. In the case with a variable rate of adjustment, a significant downward trend is found, with the end τ_f at 5.4 percentage points lower than the initial τ_f. In both cases, strong evidence of a narrowing spread is found.

Visualisations of complex scenario one are given in Figures 5.3a, 5.3b and 5.3c. These three examples were taken from the two hundred simulations to illustrate the three different patterns of development for τ_f. Figure 5.3a shows an upward trend whereas Figure 5.3b shows a downward trend, both simulated with fixed rates of adjustment. Notice the size of the change after 100 periods is small. Figure 5.3c is more interesting and surprising. Over the 1000-period test period, τ_f fluctuates substantially (between 25% and 60%) and seemingly erratically. This is under condition of variable rate of adjustment, which can also give rise to more straightforward upward and downward trends. Though not displayed in the figures, the spread of the distribution of τ_i around τ_f narrows in all simulations.

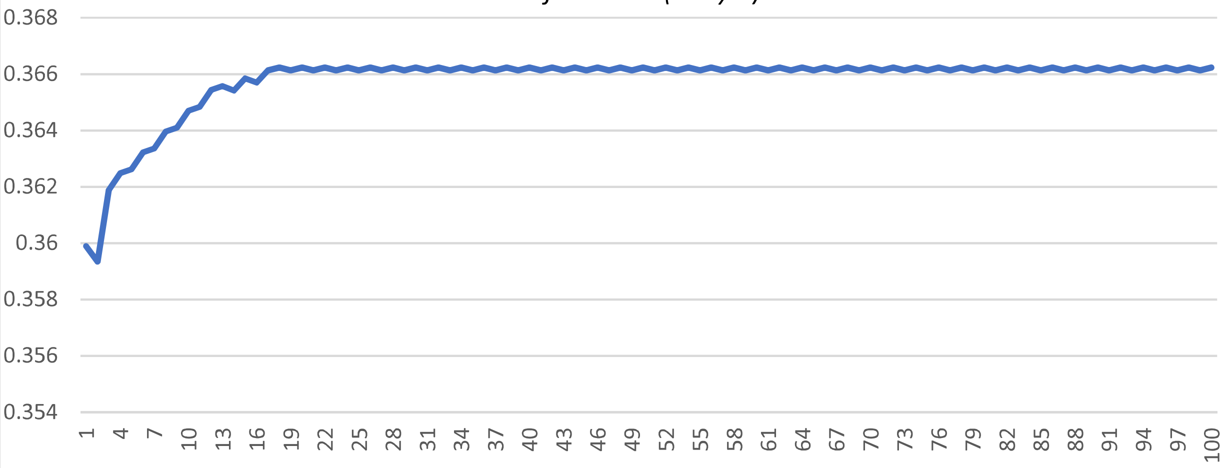


Figure 5.3a. *An upward trending world AECTR, τ_f, arising from complex scenario 1 with fixed RoA (100yrs)*

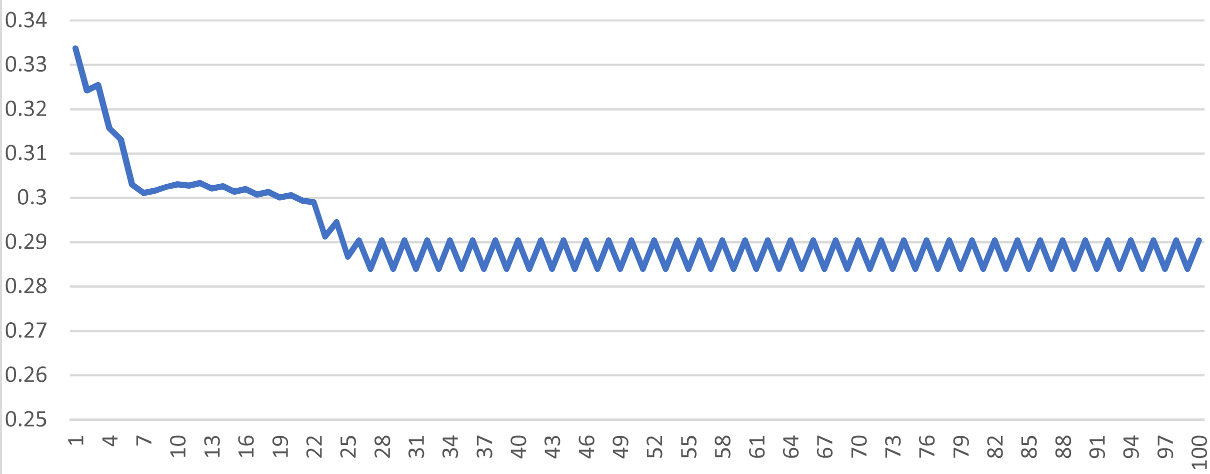


Figure 5.3b. *A downward trending world AECTR, τ_f, arising from complex scenario 1 with fixed RoA (100yrs)*

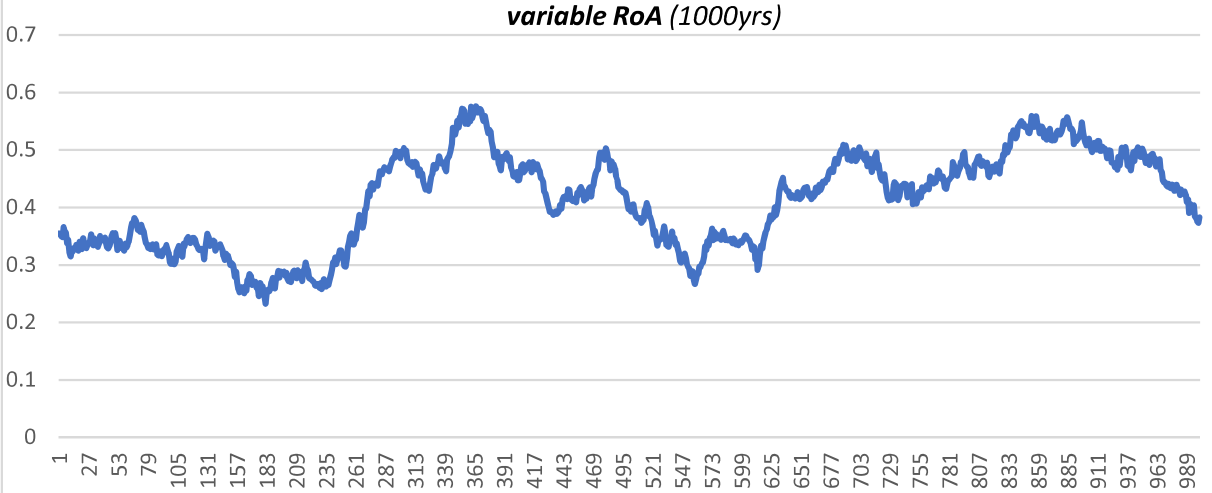


Figure 5.3c. *An erratic world AECTR, τ_f, arising from complex scenario 1 with* ***variable RoA*** *(1000yrs)*

5.2.2. Complex Scenario 2: $\tau_{fi}^{*} > \tau_{f,1}\ \forall\ i$

For complex scenario two, we take the exact same approach only we shift the distribution of τ_{fi}^{*} above that of the initial distribution of τ_i, which we broaden slightly. These changes are reflected in Table 5.4. Our simplified scenario suggests we will see a race to the bottom.

Table 5.4. *Parameter generation for complex scenario 2: Changes to Table 5.3*

Parameter		Random number betweeen
Equilibrium foreign AECTR in country *i*	τ_{fi}^{*}	0.50 – 0.70
Initial AECTR in country *i*	$\tau_{i,1}$	0.10 – 0.50

The results of complex scenario two are displayed in Table 5.5. We see a downward trend in all 100 of 100 simulations, regardless of whether it is with a fixed rate of adjustment or a variable rate of adjustment. The results in columns 3 and 4 are very similar as well for both types of adjustment. We see a massive and very significant reduction in τ_f of around 25 percentage points over the simulated period. We also see a significant reduction in the standard deviation of τ_i.

Given that $E(\tau_{i1}) = 30\%$ and that $E(SAM_i) = 5\%$, a decrease in 25 percentage points across simulations truly does represent a race to the bottom, even with heterogeneous initial positions, rates of adjustment and socially acceptable minima.

Table 5.5. *Simulation results for complex scenario 2*

1. Rate of Adjustment	2. Downward trend?	3. $\tau_{f,end} - \tau_{f,initial}$	4. $\sigma_{end}^{\tau_i} - \sigma_{initial}^{\tau_i}$
		(in %, averaged across 100 simulations)	
Fixed 100 periods	100% of simulations	-25.20** (0.27)	-6.80** (0.15)
Variable 1000 periods	100% of simulations	-24.70** (0.27)	-6.30** (0.15)

Note: * significant at 5% level **significant at the 1% level

5.2.3. Complex Scenario 3: Realistic Parameters

For our third and final complex scenario, we let $\tau_{fi}^{*} > \tau_{f,1}$ for some country *i* and $\tau_{fj}^{*} < \tau_{f,1}$ for some country *j*. That is to say, we do not impose that the initial distribution of τ_i must be entirely above or below the distribution of τ_{fi}^{*} for all countries. In order to increase the relevance of this scenario further, we let τ_{fi}^{*} be determined by realistic ranges for the parameters which define it (see 4.14 for the definition of τ_{fi}^{*}). These parameters take a random value from the ranges given in Table 5.6.

Table 5.6. *Parameter generation for complex scenario 3*		
Parameter		Random number betweeen
Propensity to save out of profits	$s_{\pi\, i}$	0.40 – 0.90
Profit share	h_i	0.25 – 0.45
Potential output to capital stock ratio	v_i	0.20 – 0.50
Responsiveness of investment to changes in capacity utilisation	$\gamma_{2\, i}$	1.80 – 2.90
Responsiveness of net exports to changes in capacity utilisation	$\beta_{2\, i}$	1.20 – 2.80
Initial AECTR in country *i*	τ_i	0.10 – 0.50
Rate of adjustment of AECTR in country *i* in period *t* (when allowed to vary over time)	$x_{i,t}$	0.01 – 0.10
Socially acceptable mimimum AECTR in country *i*	SAM_i	0.00 – 0.10

A number of these possible ranges deserve comment. Both $\gamma_{2,i}$ and $\beta_{2,i}$ are not *a priori* self-evident, so the range of values for both parameters found for the EU15 in Onaran and Obst (2016) is used. Potential output is a notoriously ill-defined variable, but nonetheless we need at least a reasonable approximation. We therefore let the value of the capital stock fall between two and five times the value of potential output, a range that is found by comparing the measured capital stock to actual GDP in the Penn World Tables (see Feenstra *et al* 2015) and attenuating the ratio mildly to reflect the fact that potential GDP will be bigger than actual GDP. Taken together, the hypothetical equilibrium foreign tax rate, defined in equation 4.14, may take on a value between -7.5 and 6 for our "realistic" countries. However, recalling that the stability condition must prevent τ_{fi}^* from turning negative, we define τ_{fi}^* as zero whenever our randomly generated variables give rise to a negative τ_{fi}^* and leave it positive otherwise.[15]

The last three of these parameters are not (easily) empirically verifiable. However, experience suggests there are naturally reasonable ranges. The SAM and rate of adjustment are determined by socio-political, ethical and bureaucratic factors. In reality, it seems quite unlikely that a country would increase or decrease its effective corporate tax rate by more than ten

[15] Admittedly, this is not an elegant solution, but it seems to be best available one. Taking the absolute value of τ_{fi}^* will bias it upwards, making it much more likely to be greater than $\tau_{f,1}$, thus giving us complex scenario 2 most often. Thus, we simply redefine any negative value as zero. In any case, our results in Table 5.7 are virtually the same even when negative values are permitted.

percentage points in one period, for example. The initial positions also appear reasonable given data on AECTRs around the world.

The results of this simulation scenario are displayed in Table 5.7. The outcome is virtually the same as that of complex scenario two. We see a race to the bottom, reflected in the fact that $\tau_{f,initial} - \tau_{f,end} = E(\tau_1) - E(SAM)$. We also see a tightening of the distribution as in all the results before.

Table 5.7. *Simulation results for complex scenario 3*

1. Rate of Adjustment	2. Downward trend?	3. $\tau_{f,end} - \tau_{f,initial}$ (in %, averaged across 100 simulations)	4. $\sigma_{end}^{\tau_i} - \sigma_{initial}^{\tau_i}$ (in %, averaged across 100 simulations)
Fixed 100 periods	100% of simulations	-24.16** (0.27)	-6.95** (0.14)
Variable 1000 periods	100% of simulations	-25.11** (0.25)	-6.40** (0.13)

Note: * significant at 5% level **significant at the 1% level

Our results suggest that even for broadly realistic and heterogeneous economies, we can expect to see tax competition as the dominant force in our model, driving AECTRs towards the bottom around the world. Given this plausible explanation of the propensity to compete to the bottom, let us now evaluate this downward race.

6. Implications of the Neo-Kaleckian Tax Competition Model

For all that we have said so far, we have yet to comment on the desirability of the effects of tax competition or the broader ramifications. We look now at the implications of our model, in terms of informing our view of the historical development of AECTRs around the world and guiding policy in the future.

6.1 The Chronology of Tax Competition

Our model has implications for the timing of events in the development of tax competition between countries. We briefly detail this chronology in this subsection.

A prerequisite for any tax competition at all—and an implicit assumption in our model—is free capital mobility. In terms of modern economic history, we can think of this in terms of the end of the original Bretton Woods system and the moves of the advanced economies to remove capital restrictions throughout the 1970s. Then, as suggested by our model, economies of smaller economic size, such as Ireland, Switzerland, and Hong Kong, were most induced to engage in tax competition. The fall of the iron curtain eventually increased tax competition with the likes of Estonia, Hungary and the Czech Republic following a similar approach.[16] Due to the

[16] See Eichler and Emmenegger (2017) for a ranking of countries around the world according to their AECTR and note the similarity of their size.

dynamics seen in section five, this has put downward pressure on $\boldsymbol{\tau_f}$, which, coupled with increasing worldwide MNE investment ($\boldsymbol{I_m}$) due to trends in globalisation such as offshoring, may put even relatively large economies under pressure to lower AECTRs since $\boldsymbol{\tau_f}\ (\boldsymbol{s_\Pi h/v})\,(\boldsymbol{\gamma_1} + \boldsymbol{\beta_1 e^R} + \boldsymbol{\beta_3 u_f})]/\boldsymbol{g_{m,i}}$ tends to zero as $\boldsymbol{\tau_f}$ tends to zero. In a sense, then, we may think of tax competition being a process marked by feedback effects where countries are more induced to compete on taxes the more other countries compete on taxes. This process may only intensify if $\boldsymbol{\tau_f}$ continues to fall and $\boldsymbol{I_m}$ continues to rise.

6.2 The Paradox of Tax Competition

This brings us to an assessment of the desirability of tax competition. The essence of the problem with tax competition is that a country simply cannot undercut its rivals indefinitely. By undercutting, more countries are more induced to undercut, giving rise to the "race to the bottom" dynamics we found in section five. Yet at the bottom, further undercutting is impossible. A country may only suffer disinvestment or MNE relocation if it chooses to increase its AECTR at the bottom. Our conditions derived in section four indicate that if $\boldsymbol{\tau_f}$ reaches zero or some other socially acceptable minimum, one country's attempt to exceed it will only dampen demand.

The tax competition term in the modified gross investment function, reprinted here, can only be zero or negative at the bottom. The bottom, then, represents a bad equilibrium: Stable, but not optimal. It is the proverbial ball and chain.

$$g_i' = \gamma_{1,i} + \gamma_{2,i}u + \frac{\tau_f - \tau_i}{\tau_f} g_{m,i} \tag{4.11}$$

Why would policymakers risk racing to the bottom? Perhaps they accept the possibility of a resulting bad equilibrium and pursue tax competition regardless. That is to say, they are captive to short-termism. Perhaps policymakers are unaware of the possibility of a bad equilibrium or suffer from wishful thinking, assuming other countries will not follow their lead and compete. Then the problem is one of bounded rationality.

Whatever the reasoning, such a process of tax competition reminds us of other seemingly paradoxical macroeconomic outcomes, common to post-Keynesian thinking (*cf.* Lavoie 2014, p.18). We might state the *paradox of tax competition*, then, as follows: While using tax and fiscal policy to compete for FDI may be advantageous and rational for one country, it will be restrictive and irrational to all countries in the long run.

However, we need not be fatalistic nor defeatist about this reality. If, as mentioned above, the bad equilibrium is stable and suboptimal, what is the optimum? With reference to 4.11, the optimum at the bottom is to coordinate tax policy across nations to allow $\boldsymbol{\tau_f}$ to rise at a uniform rate with $\boldsymbol{\tau_i}$, such that countries can avail of the positive Kaleckian redistribution effects without suffering the negative tax competition effects. At the bottom, the only way for nations to rescue their fiscal autonomy is by entrusting it to one another, rather than leaving it in the implicit control of MNEs. Clearly, there is a role for regional blocs and global governmental organisations in this regard. Lastly, we need not wait to hit the bottom before acting to coordinate and harmonise. The question, as it often is, is one of political will.

7. Concluding Remarks

In this paper, we strived for a post-Keynesian theory on tax competition. We have found reason to think of it as a beggar-thy-neighbour policy, which ultimately leads to a suboptimal outcome for all countries that are small enough to be seduced to engage in it. It does not appear to be a problem that will resolve itself. In fact, if more firms continue to become multinational or the size of multinationals increase, the problem shall only worsen. Policy coordination will become increasingly relevant if the phenomenon of "barge economics" continues to be as influential as it currently is.

A few words on the main limitations of this theoretical approach and ideas for further research are in order. Firstly, one may object to the functional form of how MNEs are assumed to allocate tax sensitive FDI to a country, which is a simple linear function of how much a country undercuts the world average AECTR. One might reasonably expect the functional form to be more intricate and possibly non-linear, such that those countries that highly undercut the average, like Ireland, see disproportionately high rewards for doing so compared to those who only slightly undercut the average. Yet the linear form we employed seems like a natural and informative first step. Second, the assumption of Keynesian stability is essential in this analysis and without its operation, many of our conclusions would not follow. That being said, this applies to all neo-Kaleckian and post-Kaleckian models generally. Third, a deeper analysis of the term $\boldsymbol{\tau_f}\ (\ \boldsymbol{s_\Pi h/v})\ (\boldsymbol{\gamma_1} + \boldsymbol{\beta_1 e^R} + \boldsymbol{\beta_3 u_f})]/\boldsymbol{g_{mi}}$ is warranted, as are investigations regarding it size for different countries. Future research would have to look at how the presence of MNEs in a country may in fact increase the size of the numerator, which seems both reasonable and likely. Finally, further research could also relax the balanced budget assumption and incorporate these tax competition effects into a post-Kaleckian model, where the possibility of profit-led regimes will certainly complicate the analysis.

Despite its limitations, our theory does seem to capture aspects of reality quite well, such as the relationship between economic size and the likelihood of tax competition as well as the tendency of a race to the bottom. Contrary to some viewpoints, our theory indicates that tax competition is a real, and far from benign, modern phenomenon.

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Appendix

A. Data: Descriptive Statistics and Sources

	Greenfield FDI Inflows	*Trade Openness*	*Nominal Unit Labour Costs*	*FDI Inflows*	*Real GDP*	*Total Tax Revenue/ GDP*	*AECTR*	*World AECTR – Domestic AECTR*
Unit	*Mil US$*	*(Ratio)*	*(Ratio)*	*Mil US$*	*Mil US$*	*%*	*%*	*%*
Mean	9280	0.979	100	26054	1361302	33.83	18.37	0.10
Standard Error	665	0.028	0.66	2680	139011	0.36	0.52	0.50
Median	4586	0.823	100	10037	390983	33.54	17.46	1.34
Standard Deviation	13223	0.562	13.2	53330	2766291	7.19	10.24	9.83
Kurtosis	8.87	4.436	5.60	29.44	21.02	0.21	9.34	1.75
Skewness	2.81	1.761	1.34	4.75	4.43	-0.40	1.97	-1.08
Range	77153	3.331	102	508354	18616557	36.52	92.96	59.11
Minimum	1.8	0.246	69	-31670	7918	12.06	3.20	-39.66
Maximum	77155	3.577	171	476684	18624475	48.58	96.16	19.45
Observations	396	396	396	396	396	394	387	387
Data Source	UNCTAD (2017)	OECD	AMECO	OECD	OECD	OECD	OECD and AMECO	OECD and AMECO
Constructed by		*(X+M)/GDP*					(See Eq 3.1)	(See Eq 4.10)

B. Unit Root Tests

Tests for panel unit roots conducted using Levin, Lin, and Chu (2002) test, with demeaned data and adjusted t, to reflect smaller T dimension than N.

Null hypothesis (H_0): Panels contain unit roots.
Alternative hypothesis (H_a): Panels are stationary

	LLC test (time trend)	LLC test
Log($Greenfield\ FDI$)	-12.0573***	-9.6127***
Log(GDP)	-10.7638***	-5.9793***
Trade Openness	-8.8782***	-4.1704***
Unit Labour Costs	-9.2349***	-5.7963***
Log($Inward\ FDI$)	-10.9808***	-10.4296***
Log($Outward\ FDI$)	-16.8826***	-10.5312***
Tax Revenue/ GDP	-7.4826***	-5.9633***
AECTR	-11.2498***	-9.5730***
AECTR Differential	-11.3335***	-9.6926***
		*** Reject H_0 at the 1% level

C. Full Results of Robustness Checks

See section 3.3 for a description of how the following results were obtained.

Robustness Check 1: *Greenfield FDI and AECTR*

	Dependent variable:		
	log(Greenfield FDI)		
	Pooled OLS	FE	FE with IV
	(1)	(2)	(3)
Effective Tax Rate	−0.021**	−0.026***	−0.026***
	(0.010)	(0.004)	(0.004)
log(GDP)	0.847***	0.879***	0.890***
	(0.065)	(0.044)	(0.048)
Unit Labour Costs	−0.011**	−0.002	0.007
	(0.004)	(0.008)	(0.006)
Trade Openness	0.175	0.253***	0.257***
	(0.231)	(0.083)	(0.089)
Constant	−1.515		
	(1.173)		
Observations	387	387	354
R^2	0.736	0.757	0.774
Adjusted R^2	0.733	0.747	0.765
F Statistic	266.230*** (df = 4; 382)	288.965*** (df = 4; 371)	290.591*** (df = 4; 339)
Note:			*p<0.1; **p<0.05; ***p<0.01

Robustness Check 2: *Greenfield FDI and Tax Activity*

	Dependent variable:		
	log(Greenfield FDI)		
	Pooled OLS	RE	IV
	(1)	(2)	(3)
Total Tax Revenues/GDP	−0.030***	−0.030***	−0.032***
	(0.008)	(0.004)	(0.004)
log(GDP)	0.838***	0.843***	0.835***
	(0.068)	(0.049)	(0.050)
Unit Labour Costs	−0.014***	−0.012**	−0.009**
	(0.004)	(0.005)	(0.004)
Trade Openness	0.241	0.253**	0.215*
	(0.243)	(0.117)	(0.115)
Constant	−0.512	−0.724	−0.848
	(1.185)	(0.976)	(1.083)
Observations	394	394	361
R^2	0.740	0.743	0.753
Adjusted R^2	0.737	0.740	0.750
F Statistic	276.168*** (df = 4; 389)	280.933*** (df = 4; 389)	271.112*** (df = 4; 356)
Note:			*p<0.1; **p<0.05; ***p<0.01

Robustness Check 3: *FDI Inflows and AECTR Differential*

	Dependent variable:		
	log(FDI Inflows)		
	Pooled OLS	RE	IV
	(1)	(2)	(3)
log(GDP)	0.394***	0.394***	0.371***
	(0.132)	(0.095)	(0.095)
Relative Effective Tax Rate	0.024**	0.024***	0.023***
	(0.011)	(0.006)	(0.006)
Unit Labour Costs	−0.010	−0.010	−0.012*
	(0.006)	(0.007)	(0.007)
Trade Openness	0.002	0.002**	0.001*
	(0.002)	(0.001)	(0.001)
log(FDI Outflows)	0.425***	0.425***	0.427***
	(0.080)	(0.054)	(0.054)
Constant	0.790	0.790	1.384
	(1.646)	(1.078)	(1.078)
Observations	311	311	284
R^2	0.601	0.601	0.593
Adjusted R^2	0.595	0.595	0.586
F Statistic	91.990*** (df = 5; 305)	91.990*** (df = 5; 305)	80.963*** (df = 5; 278)
Note:			*p<0.1; **p<0.05; ***p<0.01

Robustness Check 4: *FDI Inflows and AECTR*

	Dependent variable:		
	log(FDI Inflows)		
	Pooled OLS	RE	IV
	(1)	(2)	(3)
log(GDP)	0.394***	0.394***	0.370***
	(0.133)	(0.096)	(0.096)
Effective Tax Rate	−0.023**	−0.023***	−0.021***
	(0.011)	(0.006)	(0.006)
Unit Labour Costs	−0.013*	−0.013*	−0.015**
	(0.007)	(0.007)	(0.007)
Trade Openness	0.002	0.002**	0.001*
	(0.002)	(0.001)	(0.001)
log(FDI Outflows)	0.423***	0.423***	0.426***
	(0.081)	(0.055)	(0.055)
Constant	1.502	1.502	2.075*
	(1.702)	(1.141)	(1.141)
Observations	311	311	284
R^2	0.598	0.598	0.590
Adjusted R^2	0.592	0.592	0.583
F Statistic	90.810*** (df = 5; 305)	90.810*** (df = 5; 305)	80.012*** (df = 5; 278)
Note:			*p<0.1; **p<0.05; ***p<0.01

Robustness Check 5: *FDI Inflows and Tax Activity*

	Dependent variable:		
	log(FDI Inflows)		
	Pooled OLS	RE	IV
	(1)	(2)	(3)
log(GDP)	0.368***	0.369***	0.340***
	(0.142)	(0.097)	(0.097)
Total Tax Revenues/GDP	−0.031**	−0.031***	−0.032***
	(0.013)	(0.009)	(0.009)
Unit Labour Costs	−0.013*	−0.012	−0.015*
	(0.008)	(0.008)	(0.008)
Trade Openness	0.002	0.002**	0.001*
	(0.001)	(0.001)	(0.001)
log(FDI Outflows)	0.425***	0.425***	0.430***
	(0.083)	(0.054)	(0.054)
Constant	2.493	2.394*	3.095**
	(1.920)	(1.239)	(1.239)
Observations	314	314	287
R^2	0.598	0.598	0.595
Adjusted R^2	0.592	0.591	0.588
F Statistic	91.772*** (df = 5; 308)	91.562*** (df = 5; 308)	82.503*** (df = 5; 281)
Note:			*p<0.1; **p<0.05; ***p<0.01

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