Does tax competition make mobile firms more footloose?

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Abstract

Existing analyses of fiscal competition for foreign direct investment (FDI) often assume a one-shot interaction between governments and the firm within a static geographical environment where the firm makes a permanent location choice. We examine a regional model where the economic geography evolves, giving the firm an incentive to relocate. We show that government competition for FDI leads the firm to make efficient location choices such that it is more likely to relocate than in the absence of such international rivalry. This is because the national tax/subsidy offers absorb some of the firm’s relocation costs.

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1. Introduction

National governments often give significant tax and other incentives to foreign-owned firms to induce them to establish local production facilities. Yet the lifespan of these plants is often short, with the firms subsequently moving to new locations which have become more profitable relative to the initially chosen sites. In other words, the “geographic advantage” of one location relative to another potential production site can change over time, prompting the firm to relocate. For example, in 2007, the German public was outraged when Nokia announced the relocation of its production to Romania, only two years after Germany had retained the investment by offering subsidies.¹

This paper investigates the effect on firm mobility of governments making competing offers to attract and retain foreign direct investment (FDI) as geographic advantage evolves over time. In particular, we wish to determine whether such fiscal inducements can make firms more “footloose” than they would have been in the absence of such offers. Beyond this, we wish to determine whether any changes in industrial mobility associated with international competition for FDI are beneficial to society.

At the outset of our research, we anticipated that financial inducements offered for FDI would reduce the likelihood of firm relocation in response to asymmetric growth in market size. Our intuition suggested that, as the governments could anticipate future geographical developments and build them into their initial fiscal offers, there would be a more muted reaction to the unfolding of geography than would arise in the absence of international bidding for FDI. We shall demonstrate that this intuition is incorrect and attempt to provide an intuitively appealing explanation of the correct outcome.

¹ On 15 January 2008, Nokia announced the closure of its plant in Bochum, with the loss of 2300 direct employees, and the relocation of production to Jucu in Cluj County, Romania. Ironically, Nokia announced in September 2011 that the Romanian factory was itself to be shut down and production shifted to the Far East. A further example is Siemens in the north-east of England relocating to Eastern Europe (quoted in Haaland, Wooton and Faggio, 2002).
We consider the FDI decisions of a multinational enterprise (MNE) in a two-period model of production, trade and consumption in a region with an evolving pattern of geographic advantage arising from, for example, different rates of growth in population and market size, changing production costs or improvements in local infrastructure. With the existence of sunk set-up costs for the firm’s operations, such as building the plant or researching for the optimal location within a country, relocating production is more costly than staying in the initial location. This might create inertia on the part of the firm, such that it chooses to remain in one place despite the existing host country having become the relatively less-profitable location. Alternatively, if a nation is anticipated to develop a strong geographic advantage in the future, there is the potential that it will attract the firm immediately, despite being the less-profitable location when the FDI takes place.

We examine how government policies may encourage or hinder relocation of FDI in a changing economic environment. Our model has two active governments, each making offers of lump-sum taxes/subsidies in an attempt to attract the FDI of a single firm, which is owned in the rest of the world. We consider two time periods, in each of which the two governments can make offers to the firm. The firm can stay in its original location or choose to relocate at the beginning of the second period.

Our addition of a period makes a distinct contribution to the literature in that, not only does the firm have the opportunity to move its production internationally but the two governments are active in both periods and can change their offers to the firm in the second period. In contrast, most (but not all) existing formal analyses of fiscal competition for FDI (e.g. Haufler and Wooton, 1999) are “static”, in the sense that they focus on cases where the

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2 We assume that the underlying (technological) ability of firms to move (e.g., to co-ordinate production and sales across national borders) is constant.
underlying geography is fixed and the firm/government interaction is one-shot. Thus, these established models explain plant locations, but not plant relocations.

Haaland, Wooton and Faggio (2002) have a time dimension, in that they consider the costs facing an MNE when its production facilities within a country come to the end of their usefulness. Their analysis therefore takes into account not only the inducements made to firms by countries to induce FDI but also the differences in exit costs from different locations to explain why one potential host country is chosen over another. However, their model, once again, addresses a single location decision (for investment of an unknown period) and does not consider the possibility of relocation in the light of changing economic geography.

As our benchmark, we derive the location decisions of the firm over time when the governments do not bid to attract the FDI and, consequently, geographic advantage is the sole determinant of location. We call this case “laissez-faire”. We show that, depending on the initial pattern of geographic advantage and the growth disparity between the two nations, the firm might choose one country or the other as its permanent location or it may decide to relocate after the first period.

We then introduce “fiscal competition”, where each country makes bids to attract the FDI in order to maximise its domestic welfare on the assumption that local production of the firm’s output is preferred to the market being served by imports. We show that the firm’s location choices under repeated fiscal competition are efficient and that, compared to laissez-faire, the firm is more likely to relocate production. This greater propensity to relocate under fiscal competition is due to the fact that, with endogenously determined fiscal inducements, the host governments absorb some of the firm’s relocation costs in their tax/subsidy offers.

In our model, geographical change is necessary to explain plant relocations over time. In contrast, adopting fixed geography, King et al. (1992, 1993) explain relocation on the basis of ex ante uncertainty and ex post disappointment. In their approach, the firm does not know a
given location’s characteristics with certainty prior choosing its location and might move away after investing if conditions turn out to be worse than it expected.\(^3\) Our model can explain plant relocations in the absence of uncertainty or surprises and we view this as a positive contribution.

Konrad and Kovenock (2009) have an infinite horizon model but there is no change in the geography of the region. There is international competition for firms that arrive in a flow, each living for two periods. No relocation takes place. If there is no means of discriminating between firms in tax setting, a country faces a trade-off between imposing a high tax on an existing (immobile) firm and setting a low tax in order to attract a new firm.

The remainder of the paper is organised as follows. The next section describes our model. Sections 3 and 4 solve the model under laissez-faire and fiscal competition, respectively. Section 5 compares those two cases and discusses our main result and, finally, section 6 concludes.

2. The Model

Our model comprises a region composed of two countries, a single firm, and two periods. The countries, denoted \(A\) and \(B\), constitute a regional market for the firm’s product and compete against each other to attract inward FDI from the firm. The region is surrounded by prohibitive trade barriers, such that the firm must produce in either \(A\) or \(B\) in order to serve consumers in both countries. The fixed costs of production ensure that the firm will operate only plant at any point in time, with exports within the region being subject to a (non-prohibitive) trade cost. The national governments seek to maximise the welfare of their residents. We assume that the firm’s owners reside outside the region and, therefore, their welfare is not taken into account by either country.

\(^3\) Given the amount of effort that firms and their agents typically put into their research into alternative locations, such pre-investment ignorance may seem somewhat implausible.
2.1 Parameterisation of the model

There are two periods in our model, labelled 1 and 2. The countries make competing bids to attract the firm’s investment in both periods and the firm may relocate its production between the periods. Our key modelling innovation is that the geography of the region alters over time, from one period to the next. Specifically, we assume that the population of country $B$ changes from one period to the next while that of country $A$ remains the same. We normalise the population of $A$ to one and let $m_t$ denote the size of country $B$ in period $t$. We define $\mu_t = m_t - 1$ to be $B$’s “market-size advantage” in period $t$, acknowledging that $\mu_t$ may be positive or negative. The size of $B$ might change for a variety of demographic, economic or border-related reasons such as population growth, emigration, immigration, real income growth, territorial expansion, etc.\(^4\)

We assume that inward FDI creates a welfare gain for the host country relative to the benefits of importing the good from the other country in the region. Let $S_L$ and $S_F$ denote the per-capita levels of welfare in a country under “local” production (that is, hosting the FDI) and “foreign” production (that is, importing the product), respectively. Thus, the per-capita welfare gain from local production is $V \equiv S_L - S_F$, where we assume that $V > 0$. This can arise because the intra-regional trade cost means that the market price is lower (and consumer surplus higher) under local production, or it may be that inward FDI offers a wage premium for local workers. The fact that local production offers an aggregate welfare gain to the host country (equal to $V$ for $A$ in each period and $m_tV$ for $B$ in period $t$) is the central motivation for the countries’ willingness to bid for inward FDI.

The firm earns per-capita variable profits of $\pi_L$ on local sales and $\pi_F$ on foreign (export) sales, where $\omega \equiv \pi_L - \pi_F > 0$ due to the intra-regional trade cost. Thus, $\omega$ measures the profit

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\(^4\) There are several real-world examples of discrete changes in market size, such as the unification of Germany and the eastern enlargement of the EU.
premium from local sales. Therefore, the firm’s total variable profits in period $t$ are $\pi_L + m_t \pi_F$ if production is located in $A$, and $\pi_F + m_t \pi_L$ if production is located in $B$. We define $\mu_t \omega$ to be $B$’s “geographic advantage” in period $t$, that is, the variable-profit premium that $B$ offers to the firm relative to $A$.

For the firm, building a plant in either country entails a sunk, capital cost of $F$. For simplicity, we assume that, once a plant has been established, its capital does not depreciate over time. We further assume that there is a per-period, fixed cost $C$ of operating a plant that it is sufficiently large that the firm will only ever operate one plant, even if it has built two.

Finally, $\delta \in [0,1]$ is the discount factor, common to both host countries and the firm. If $\delta = 1$ then equal weights are placed on the payoffs in the two periods, whereas $\delta = 0$ means complete myopia.

### 2.2 Solution strategy

The two periods are separated by the change in $B$’s geographic advantage. In each period the firm chooses the location of its plant and its production level. In the case of *laissez faire* (denoted LF), where the governments make no direct attempts to influence the firm’s choice of location, the prime influence on the firm will be the geographic advantage enjoyed by $B$ and how this evolves from one period to the next. Under fiscal competition (denoted FC), the countries compete for the FDI in two auctions that are conducted sequentially. Table 1 summarises the sequence of moves in the two cases.

### Table 1 about here

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5 Our assumptions that $V$ and $\omega$ are both positive require that variable production costs are sufficiently similar in $A$ and $B$.

6 We briefly consider the effects of allowing for depreciation, which are intuitive, below.

7 This cost $C$ plays a background role in our model, in that it exists only to generate sufficiently large increasing returns to scale in production, and it plays no role otherwise.
We assume that both countries and the firm aim to maximise the present discounted value of their payoffs (social welfare and post-tax profits, respectively). For the potential hosts, social welfare is captured by $V$ at the per-capita level less any net transfers to the firm. We assume that the host countries announce their offers simultaneously in each period and that these offers are irreversible within a period but can, of course, be changed between periods.\(^8\)

Our game is one of complete information, and we assume that the change in the economic geography between periods 1 and 2 is anticipated, though we do consider the consequences of relaxing this assumption when discussing our results. Our solution concept is the subgame-perfect Nash equilibrium in pure strategies and we compare the firm’s equilibrium location choices under FC and LF.

3. *Laissez-faire (LF)*

Under LF, the governments refrain from setting taxes or subsidies in either period, and the firm decides its location solely on the basis of profits. The location pattern in this case is the benchmark for our later analysis of fiscal competition.

The firm’s equilibrium locations under LF depend upon $B$’s market-size advantage in each period. These locations are depicted in Figure 1 which plots the equilibrium outcomes in $(\mu_1, \mu_2)$ space. The area labelled “$AB$” corresponds to the firm adopting the “location profile” $AB$, defined as choosing to produce in $A$ in period 1 and in $B$ in period 2. The other zones in the diagram can be interpreted similarly.

\(\text{FIGURE 1 ABOUT HERE}\)

\(^8\) In section 4.2, we consider what happens if the host countries and the firm can make binding commitments at the start of period 1.
3.1 Derivation of the firm’s equilibrium locations

To interpret Figure 1, we begin by thinking about the firm’s location choice in period 2, which depends on its geographic advantage in that period, \( \mu_2 \omega \), and consequently on its relative size \( \mu_2 \). If the firm produced in \( A \) in period 1, it will prefer \( B \) to \( A \) in period 2 if and only if \( B \)’s period-2 geographic advantage, \( \mu_2 \omega > F \), is sufficiently large to be able to compensate the firm for its relocation costs of building a new plant. However, if the firm was already in \( B \) in period 1, relocation would only be profitable if \( B \)’s geographic advantage declined such that \( \mu_2 \omega < -F \). These two inequalities determine the positions of the two horizontal inter-regional boundaries in Figure 1. The latter inequality is clearly the less demanding. This makes intuitive sense as the firm is “more likely” to choose \( B \) in period 2 if it previously chose \( B \) in period 1 because continuing to produce in \( B \) requires no further sunk-cost outlay (whereas moving to \( B \) from \( A \) does). Indeed, the firm might optimally remain in \( B \) in period 2 even if \( B \) loses its geographic advantage (that is, \( \omega \mu_2 < 0 \)). Moreover, it is clear that \( B \) will always, regardless of the firm’s location in period 1, be chosen in period 2 if its geographic advantage is sufficiently large (specifically, if \( \mu_2 > F/\omega \)).

On the basis of the above discussion, in order to determine the firm’s location profile over time, there are three cases to consider.

Case 1. \( \mu_2 \omega > F \). Here, the firm always chooses \( B \) in period 2, and thus its overall location profile is either \( AB \) or \( BB \). \( BB \) is chosen if and only if \( \mu_1 \omega > -\delta F \), that is, \( B \) does not have first-period geographic disadvantage so large that it would justify initial production in \( A \) with anticipated relocation.

Case 2. \( \mu_2 \omega < -F \). This is the converse of case 1 above, where \( B \)’s geographic advantage declines so much ends up so small that \( A \) always hosts the production in period 2. Overall, \( BA \) is chosen over \( AA \) if and only if \( \mu_1 \omega > \delta F \), that is, \( B \)’s first-period geographic advantage is sufficient to offset the relocation cost.
Case 3. $F > \mu_2 \omega > -F$. This is the intermediate case where, in period 2, $B$’s geographic advantage is such that the firm optimally chooses to remain wherever it produced in period 1. Here, $BB$ dominates $AA$ if and only if $\mu_1 > -\delta \mu_2$, $B$’s initial size advantage is sufficient to offset its future, discounted size disadvantage. This inequality then defines the negatively sloped boundary between $AA$ and $BB$ in Figure 1.

### 3.2 Discussion

The pattern in Figure 1 makes intuitive sense. If $B$ is at a size disadvantage in both periods (the SW quadrant), then the firm chooses $AA$. Conversely, if country $B$ is larger than $A$ in both periods (the NE quadrant), then the firm chooses $BB$. A rise in $B$’s size advantage over $A$ in period $t$ makes $B$ more likely to be chosen as the location of production in that same period. If $B$’s size is constant over time (so that $\mu_2 = \mu_1$), then the firm remains in its initial location for both periods, choosing whichever country is larger. Thus, relocation, which occurs in the location profiles $AB$ and $BA$, requires some change in the relative market-size of country $B$ over time.\(^9\)

Finally, we note two extensions of our analysis, which are both straightforward within the context of Figure 1.\(^{10}\) First, if the demographic change between periods 1 and 2 is unanticipated, then the two relocation regions, $AB$ and $BA$, both expand sideways. In this case, the firm assumes that $\mu_2 = \mu_1$ when deciding its period-1 location, choosing $B$ initially if and only if $\mu_1 > 0$. Thus, the $AB/BB$, $AA/BB$ and $AA/BA$ inter-regional boundaries all become the vertical line $\mu_1 = 0$.\(^{11}\) Therefore, relocation by the firm between periods 1 and 2 is more likely if the geographical change is unanticipated. This makes intuitive sense because some

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\(^9\) If the intra-regional trade cost falls, which reduces $\omega$, then relocation over time becomes less likely: both $AB$ and $BA$ shrink.

\(^{10}\) The following observations hold good in the FC case, which we consider in the next section.

\(^{11}\) However, the vertical positions of the flat $AB/AA$ and $BA/BB$ inter-regional boundaries do not change because when period 2 arrives, the new geography is revealed and the firm’s period-2 decision problem is then identical to that under anticipated geographical change.
adjustment can occur before an anticipated geographical shock (that is, in the firm’s period-1 location decision), whereas all the adjustment must occur after an unanticipated shock, making relocation after the shock more likely. We can also observe that the effect on Figure 1 of assuming unanticipated geographical change is identical to that of assuming complete myopia (that is, $\delta = 0$).

Second, if the plant cost $F$ is fixed rather than sunk (such that it must be paid in both periods even if production remains in the same location), then the firm optimally chooses $B$ in period $t$ if and only if $\mu_t > 0$. The absence of a sunk cost implies a separability between the periods such that the firm’s location in a given period depends only on $B$’s contemporaneous size advantage. In this case, each of the four regions in Figure 1 would coincide exactly with one of the quadrants. One can see this by setting $F = 0$. Of course, one can think of this fixed-cost case as representing complete capital depreciation between periods.

4. Fiscal Competition (FC)

Under FC, the potential hosts compete by making offers in both periods to win or retain the firm’s production. The firm’s equilibrium locations under FC are depicted in Figure 2, where the LF boundaries are shown as dashed lines. We consider FC in each period starting with period 2.

**Figure 2 about here**

4.1 FC in period 2

If $A$ has attracted the FDI in period 1, then $B$ wins the period-2 competition if and only if $\mu_2(V + \omega) > F$. This inequality can be decomposed into three terms. $B$’s valuation premium over $A$ in period 2 is $\mu_2V$, $\mu_2\omega$ is $B$’s geographic advantage in period 2, and $F$ reflects the fact that production in $B$ in period 2 requires new investment whereas continuing to produce in $A$
does not. In this situation, B’s winning tax offer in period 2 is given by \( \tau_{BC} = \mu_2\omega - (F + V) \), where the superscript \( C \) stands for “capture”. In other words \( \tau_{BC} \) is B’s equilibrium tax that induces relocation from A in period 2. Essentially, B can extract its geographic advantage from the firm through the tax, but must offset this against \( F \) and \( V \), the cost of relocating the FDI to B and A’s subsidy offer, respectively.

If, however, B won the firm’s plant in period 1, then it will retain the FDI by winning the period-2 competition if and only if \( \mu_2(V + \omega) > -F \). In this inequality, the \( F \) term reflects the fact that continuing to produce in B in period 2 requires no new investment whereas relocation does. Consequently, B’s winning tax offer in period 2 is given by \( \tau_{BR} = \mu_2\omega + F - V \), where the superscript \( R \) stands for “retain”. Thus \( \tau_{BR} \) is B’s equilibrium tax that retains the firm in period 2. It is increasing in \( F \) such that B gains leverage in the period-2 competition from having a pre-existing plant (while A does not).

Note that \( \tau_{BR} - \tau_{BC} = 2F > 0 \). In equilibrium, country B imposes a higher tax in period 2 to retain the firm than to capture it. This is due to the existence of a sunk investment in a plant from period 1. Indeed, if \( F = 0 \), such that there were no sunk cost associated with starting production in a given location, then \( \tau_{BR} = \tau_{BC} \) and the outcome of the competition in period 2 would be independent of the location of production in period 1.

### 4.2 FC in period 1

As in the LF case, there are three cases to consider.

**Case 1.** \( \mu_2(V + \omega) > F \). B always wins the period-2 competition, regardless of the winner in period 1, and thus the firm’s overall location profile is either AB or BB. We can show that B will win the period-1 competition if and only if \( \mu_1(V + \omega) > -\delta F \). If this

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12 Another way of interpreting the inequality is that it ensures higher post-tax profits in B if both countries offer their maximum bids (i.e., subsidies equal to their valuations).
inequality holds then it is the case that having the firm locate in $B$ in both periods generates greater world welfare than if the firm was initially in $A$ then relocated.

Case 2. $\mu_2(V + \omega) < -F$. This is analogous to Case 1 (above), except that $A$ always wins the production in period 2. Reworking the previous analysis, we can show that $B$ wins the period-1 competition if and only if $\mu_1(V + \omega) > \delta F$.

Case 3. $F > \mu_2(V + \omega) > -F$. This is the intermediate case where, in period 2, $B$’s size is such that the period-1 winner (whether $A$ or $B$) retains the firm. Thus, the firm’s overall location profile is either $AA$ or $BB$. $B$ wins the period-1 competition if and only if $\mu_1 > -\delta \mu_2$, as in Case 3 of LF.

4.3 Discussion

The most striking feature of Figure 2 is that it is qualitatively identical to Figure 1, the LF case. Indeed, the dashed lines in Figure 2 are the inter-regional boundaries from Figure 1. Therefore, our observations regarding the outcomes in LF (in sub-section 3.2) carry over to the FC case.13

If the plant cost $F$ were a per-period fixed cost rather than a sunk cost, then our model would follow Haufler and Wooton (1999) in finding that, in any period, the larger country within a region always hosts the FDI, under both LF and FC. In contrast, with repeated periods and a sunk plant investment that persists over time, we have shown that the smaller country might host production for a period, under both LF and FC. It is clear in Figure 2 that $AB$ and $BA$, the areas where relocation occurs between periods 1 and 2 are bigger under FC than in LF. Thus, relocation by the firm between the two periods is “more likely” under FC. This is our central result, which we discuss further in the next section.

13 Note that if the geographical change is unanticipated, then relocation remains “more likely” under FC than under LF but, in that case, this arises because the conditions on $\mu_2$ for relocation to occur are weaker under FC. In contrast, with unanticipated geographical change, the vertical $\mu_1$ inter-regional boundaries in Figures 1 and 2 coincide.
Furthermore, the equilibrium location profile over time under FC is efficient, in the sense that it coincides with the choices that would be made by a social planner who decides the firm’s period-1 and period-2 locations to maximise the present discounted value of world welfare. This extends the well-known efficiency result from the one-shot FC game to the two-period case.

We can use our analysis to investigate the time profile of equilibrium taxes/subsidies paid. For simplicity, let us assume that $B$ possesses a market-size advantage throughout, such that $\mu_1, \mu_2 > 0$. As a consequence, the equilibrium under FC is $BB$ in Figure 2. $B$’s equilibrium tax in period 2 is given by $\tau_{BR} = \mu_2 \omega + F - V$, as shown above. $B$’s equilibrium tax in period 1 is found to be $\tau_{B1} = \mu_1 \omega - \delta F - V$. Subtracting the earlier tax from the later, we find the time profile of $B$’s equilibrium tax, $\Delta \tau_B = (\mu_2 - \mu_1) \omega + (1 - \delta)F$. The change in tax between reflects both any change in $B$’s geographic advantage as well as the opportunity of $B$ to exploit the fact that the firm has already sunk investment in a local plant.

5. Comparison between LF and FC

Our central result is that, compared to LF, there is greater observed plant mobility between periods 1 and 2 under FC. This is may, perhaps, appear counter-intuitive. To explore this result and provide the missing intuition, we focus on the case where $\mu_2$ is sufficiently large that the firm’s period-2 location is always $B$.

We start with the observation that the firm in period 1 can anticipate perfectly the FC taxes that it will face in period 2. In particular, the firm can determine how its location choice in period 1 affects its tax burden in period 2. We have assumed that firm is aware that its optimal location in period 2 is $B$. Therefore, for given offers in period 1, the difference in its discounted profit of choosing $A$ over $B$ in that period is $\delta(\tau_{BR} - \tau_{BC}) - \omega \mu_1 - \delta F$, where
\[ \tau_B^R - \tau_B^C = 2F > 0. \] The firm will be aware that, by choosing \( A \) in period 1, it can reduce the tax that it will pay \( B \) in period 2 compared to what it would have to pay had it chosen \( B \) as its initial location. The firm effectively manipulates its tax burden in period 2 through its choice of location in period 1. In essence, with endogenously determined fiscal inducements, the government of \( B \) absorbs some of the firm’s relocation cost in its tax/subsidy offers. In LF, the firm cannot avail itself of this opportunity (as no taxes or subsidies are offered) and, consequently, the firm is more willing to relocate under FC than it would with LF.

An alternative interpretation of our result compares the private and social incentives to choosing a location in period 1 that avoids subsequent relocation. Assume again that the firm will end up in \( B \) in period 2. Under LF, choosing \( B \) over \( A \) in period 1 is \emph{privately} profitable if and only if \( \omega \mu_1 + \delta F > 0 \). By choosing \( B \) over \( A \) in period 1, the firm gains \( B \)'s period-1 geographic advantage of \( \omega \mu_1 \) (which may or may not be positive) and avoids the future cost \( \delta F \) of having to build a second plant in \( B \) in period 2. On the other hand, choosing \( B \) over \( A \) in period 1 is \emph{socially} beneficial if and only if \( (V + \omega)\mu_1 + \delta F > 0 \). In contrast to the previous inequality, this includes \( V\mu_1 \), taking account of international differences in the “social benefits” from inward FDI. Thus, choosing \( B \) over \( A \) in period 1 is privately profitable if and only if \( \mu_1 > -\delta F/\omega \) and socially beneficial if and only if \( \mu_1 > -\delta F(V + \omega) \).

Clearly the latter, social condition is more demanding than the private condition. Thus, whenever it is socially beneficial to avoid relocation through the choice of \( B \) in period 1, then this will also be the privately more-profitable choice under LF. However, it might be privately more profitable to avoid relocation when doing so is detrimental socially. This means that there can be “too little” relocation from a social-welfare/efficiency point of view under LF. In

\[14\text{ By moving from } B \text{ to } A \text{ in period 1, the firm foregoes } B \text{'s period-1 geographic advantage (hence } -\omega \mu_1 \text{), and it will also have to build a second plant (in } B \text{) in period 2 (hence } -\delta F \text{).}\]

\[15\text{ These conditions define vertical inter-regional boundaries in Figures 1 and 2.}\]

\[16\text{ Note, however, that the private and social preferences between } AA \text{ and } BB \text{, neither of which involve relocation over time, coincide: The } AA/BB \text{ boundary is the same in Figures 1 and 2.}\]
contrast, the location pattern that occurs over time under FC maximises social welfare. This yields our result that there is a greater likelihood of relocation under FC than LF (in that relocation will take place over a wider range of parameter values with FC than would take place in LF).

6. Extensions to our analysis

We now briefly discuss the implications of two of our modelling assumptions: commitment (or the lack of it); and having only two periods.

6.1 Commitment

Consider what would happen if we assumed binding commitments in both tax/subsidy-setting and location choice. Suppose that, at the beginning of period 1, the firm commits to remain in whichever country it initially chooses, and each country commits, in present-value terms, to a lifetime tax/subsidy total, even though it would be in the winning country’s interests to change this after the firm has incurred its sunk investment cost. We are assuming that all commitments are credible.

Essentially, the assumption of “binding commitments” returns our two-period analysis of competition to a simpler, one-shot case. The valuations of countries A and B are \((1 + \delta)V\) and \((m_1 + \delta m_2)V\), respectively. The present discounted value of the firm’s pre-tax profits is \((1 + \delta)\pi_L + (m_1 + \delta m_2)\pi_F\) in A and \((1 + \delta)\pi_F + (m_1 + \delta m_2)\pi_L\) in B. Maintaining our assumption that \(V + \omega > 0\), it follows that B wins the firm for both periods if and only if \(\delta \mu_2 > -\mu_1\). Therefore, with binding commitments, the boundary between A’s winning region and that of B is given by the downward-sloping inter-regional boundary between AA and BB in Figures 1 and 2.\(^{18}\)

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\(^{17}\) Our definition of “commitment” follows King and Welling (1992, p. 65).

\(^{18}\) Note that because the no-commitment equilibrium under FC is efficient, there will be scope for welfare-enhancing renegotiations whenever the binding-commitment and no-commitment equilibria diverge (i.e. whenever the latter involves relocation between periods).
6.2 More periods

How limiting is our assumption of having two periods? With only two periods, relocation either coincides with changes in economic geography or the firm does not move. If we had more periods, then a richer sequencing of moves would be possible.

We conjecture that our analysis could be extended to a multi-period, infinite horizon model in which B’s geographic advantage builds over time. In such a setting under LF, the firm has to decide upon the point at which it should relocate production to B, presuming that it is initially operating in A. This should be straightforward to work out as the firm has an incentive to delay its new FDI as late as possible, in order to put off the outlay of F for as long as possible.

The outcome under FC will be more complex. The equilibrium offers once the firm has relocated to B are straightforward to calculate but the national offers prior to the move are harder to work out, as they will depend upon expectations as to when the firm will move. The solution to this will provide the additional insight from extending the model beyond two periods. If the firm starts in A and evolving geographic advantage guarantees that it will eventually relocate to B, does FC accelerate this move or delay it?

7. Conclusions

Our initial intuition regarding industrial relocation over time has been contradicted. The central result of our analysis is that plant relocation over time is more likely to occur when governments compete to attract FDI than in the absence of tax/subsidy incentives (perhaps contrary to intuition). This outcome should not be taken to imply that there is excessive plant mobility under fiscal competition but that, from an efficiency point of view, there is too little plant mobility under laissez-faire.
8. References


<table>
<thead>
<tr>
<th>Period</th>
<th>Investment Environment</th>
<th>LF</th>
<th>FC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Period 1</strong></td>
<td>Firm chooses its location, invests, produces and sells.</td>
<td>A and B announce offers to attract the FDI.</td>
<td>Firm chooses its location, invests, produces and sells.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Firm chooses its location, invests, produces and sells.</td>
<td>Tax/subsidy paid to/by the winning country.</td>
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<td></td>
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<td>Tax/subsidy paid to/by the winning country.</td>
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<tr>
<td></td>
<td>Geographic advantage may change.</td>
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</tr>
<tr>
<td><strong>Period 2</strong></td>
<td>Firm chooses whether to relocate, produces and sells.</td>
<td>A and B announce revised offers to attract/retain the FDI.</td>
<td>Firm chooses whether to relocate, produces and sells.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tax/subsidy paid to/by the winning country.</td>
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</tbody>
</table>

**Table 1. Sequence of moves**

**Figure 1. Equilibrium locations under LF**
Figure 2. Equilibrium locations under FC