Competitiveness, Environmental Policy and the Location of Industry

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Abstract

The literature that deals with environmental policy and competitiveness has largely approached these issues in a partial way. Authors who analyze the impact of environmental policy on competitiveness and location decisions of firms tend to focus on the impact of an exogenous change in environmental policy. Literature on the impact of the "openness of an economy" on environmental policy stringency and policy competition typically assumes that 2 governments act strategically in their choice of environmental policy stringency levels in a world with 1 firm who decides where to locate. In this paper we review the literature on competitiveness and environmental policy. We also introduce the New Economic Geography literature which enables to determine both the stringency of environmental policy as well as the location choice of firms.

Keywords: Environmental policy, policy competition, location behavior

JEL: F18; Q28; D21

1. Introduction

The impact of environmental compliance costs on foreign direct investment and the location decision of firms has been analysed in both theoretical and empirical economic literature. The issue has also been the subject of some debate among environmentalists, industry representatives, free trade advocates and other governmental and non-governmental organisations (Ulph, A. (1994); Jenkins, R. (1998); Keller and Levinson (2002)). This paper explores the literature on the impact of environmental policy on location decisions. In the second section, we review some of the traditional literature that analyses the impact of environmental policy on the location of firms. The third section explores the literature on the impact of location decisions on environmental policy competition. Note that environmental policy competition is only relevant if location decisions are determined (in part) by differences in environmental policy stringency. If that were not the case, there would be no reason why governments should engage in environmental policy competition to attract firms. In the fourth section, we introduce the New Economic Geography (NEG). Although the literature on environmental policy, location decisions and policy competition within that framework is still in the early stages, it seems to offer a promising avenue for further research.

2. Location decisions and environmental policy

Theoretical literature that deals with localisation decisions includes, among others, Motta and Thisse (1994), Markusen et al. (1995) and Ulph and Valentini (1997). Motta and Thisse (1994) assume a two-country economy with two firms, each of them located in one of the two countries and producing a homogeneous good. They analyse the way in which the environmental policy in a country impacts the location decision of local firms. They assume location independent variable production costs and constant and fixed relocation costs. They also assume that one country does not change its environmental policy stance. They show that relocation depends on the size of the market. If markets are small, relocation is never profitable and a more stringent environmental policy in one country will stop the local producer from exporting to the other country. As market size increases however, relocation becomes a possibility. If markets are sufficiently large, partial relocation might even be considered in the absence of environmental policy.

Markusen (1997) models the location decisions by imperfectly competitive firms in the presence of trade barriers when confronted with environmental regulation. He shows that in an environment with multinational firms, the impact of a change in costs on production and trade is smaller compared to the situation with no multilateral firms. He also shows that the form of cost increases is very important. Regulations, which have an impact on fixed costs, can be absorbed through the exit of some firms, whereas a change in the marginal cost is absorbed through changes in production.

Ulph and Valentini (1997) use a two-country framework with one upstream and one downstream industry and two firms in each industry. In this way, they introduce an element of economic geography so that both industries might find it advantageous to be located close to one another. Firms face constant marginal costs but have to incur a fixed cost if they wish to relocate to another country. They show that there might be some 'hysteresis effects'. In the absence of environmental policy, all production, both in the up- and downstream industries, is located in the low cost country. If this country increases environmental taxes, firms will not change their location at first. At some level of environmental taxes, two equilibriums emerge but firms do not relocate. If environmental taxes increase further, firms relocate. However, if the low cost country decides to lower taxes, it will have to do so in a significant way as the model moves from one equilibrium in the high cost country to two equilibriums without any relocation. The model only reaches the original equilibrium with all production in the original country if environmental costs are further reduced.

From a theoretical point of view, the evidence seems to suggest that environmental policy stringency matters in determining the location of firms. However, the empirical literature is somewhat less clear cut in terms of this conclusion. As noted in Levinson (2003) and Brunnermeier and Levinson (2004) until recently, most of the empirical literature found little or no impact of environmental policy stringency on the location behaviour of firms. However, as new data becomes available and empirical estimates become much more sophisticated, some evidence of an impact emerges. The evidence however is to a large extend limited to the U.S. and the impact of environmental policy stringency on location decisions, output and employment is in most cases only significant for polluting firms or industries. Becker and Henderson (2000) for instance use the US Clean Air Act which imposes uniform national ambient air quality standards. Counties that do not meet these standards are 'out-of-attainment' (OA) while those who do are 'in-attainment" (IA). Firms moving into an OA area are subject to an environmental standard that requires them to use equipment that achieves the 'Lowest Achievable Emissions Rate' irrespective of the costs. Firms moving into IA counties on the other hand are subject to less stringent environmental standards. Becker and Henderson (2000) find that counties with an OA status saw a substantial drop in new plant births in heavily polluting industries. List et al. (2003) find similar evidence with respect to plant relocation behaviour in New York State's counties for 1980-1990. Greenstone (2002) finds that OA countries lost on average 590.000 jobs and $75 billion worth of output from heavily polluting industries between 1972 and 1987. In terms of foreign direct investment, Keller and Levinson (2002) suggest that U.S. states with relatively higher compliance costs witnessed a decline in both the value and the count of new polluting foreign investment projects. However, although there evidence suggests a significant impact in statistical terms, they conclude with respect to economic significance that *"their implied magnitudes are small"* (Keller and Levinson (2002), p. 698). As an alternative, another measure of the impact of environmental policy stringency on the location of industry is to look at surveys that question companies on their motives. Sleuwaegen et al. (2000) questioned companies on their motive to relocate. Their results suggest that environmental compliance costs are not an issue as none of their respondents mentioned them as an important reason for relocation. Brunnermeier and Levinson (2004) provide similar evidence.

Concluding, in the empirical literature, there is some support for the hypothesis that environmental factors have an effect on the location decisions. However, it is questionable if the economic magnitude of differences in environmental policy stringency is important especially if one considers relatively clean industries.

3. Environmental policy competition

The contributions discussed in the previous section focus on the location decision of a single firm in the presence of an exogenous change in environmental policy. Hence, it is as if governments do not take the location decisions into account when they set environmental policy levels. The literature on environmental policy competition explicitly models a government's decision with respect to environmental policy stringency levels as a function of a firm's location decision. Environmental policy may increase costs for firms. Governments who are competing for foreign capital may be tempted to reduce their environmental standards so as to stay attractive to foreign firms. If one government reacts to the lowering of standards by another government, this may lead to a process of ecological dumping. If they do not engage in environmental policy competition, governments may be reluctant to implement tough standards in a process called regulatory chill (Bagwell and Staiger (2001)).

Markusen et al. (1995) present a "2 country – 2 sector" model. There are 2 countries (A and B) and there is 1 'dirty' imperfectly competitive firm who produces X and 1 'clean' competitive industry that produces Y. The production of 1 unit of X causes 1 unit of emissions. Environmental pollution is local and it is taxed. As 1 unit of output causes 1 unit of emissions, taxing emissions is equivalent to taxing products. This allows the authors to offer countries the ability to tax exports differently than production that is sold locally. If X-goods are shipped internationally, they incur transport costs. Furthermore, there is a firm specific cost and a plant specific cost. As there are both transport costs and plant specific costs, the 'dirty' firm has to choose between 4 different modes of production. In the first one, the firm opens a plant in each country to serve to local market. In doing so, the firm avoids transport costs but has to incur a plant specific cost in each country as well as the firm specific cost. As an alternative, the firm can open a plant in 1 country (A or B) to serve both markets from that plant. If the firm opens a plant in A (B), it saves the plant specific cost associated with production in 2 countries but incurs transport costs on its production in A (B) that it exports to B (A). The transport costs are born by the firm. A last possibility for the firm is to shut down completely and to stop production completely.

Consumers in A and B derive utility from the consumption of both X and Y but disutility from the pollution caused by the production of X. Individuals have 2 sources of income. First of all they have a labour income. Secondly, as the government redistributes the revenue from the pollution tax equally among individuals, they receive a transfer. In their model Markusen et al. (1995) assume that the ownership

of the firm is widely distributed throughout the world so that the firm's profits are not included as a source of income for individuals.

Governments set pollution taxes non-cooperatively so as to maximize welfare of the country, i.e. the utility from the consumption of X and Y minus the disutility from pollution subject to the budget constraint. As the budget does not include the firm's profit, welfare maximization implies that the government will not take into account the firm's profits in setting environmental taxes.

Depending on the parameters of their model, Markusen et al. (1995) distinguish between 3 possible cases. In the first 2 cases, environmental pollution does not cause too much disutility. The authors then show that this assumption implies that countries A and B will start a process of under-cutting each other's environmental tax on both production for the local and production for the export market below their globally optimal non-strategic Pigouvian level. If plant fixed costs are large compared to transport costs, the authors show that this will result in more plants than in the non-strategic Pigouvian case. If plant level fixed costs are not too large, the number of plants equals the number for the Pigouvian case. However, if the disutility from pollution is high, both countries can engage in a 'race to the top' scenario in which they continue to increase environmental taxes so as to avoid the situation where the firm settles in their jurisdiction. The not in my back yard (NIMBY) scenario produces an outcome in which X is not produced at all even if the joint welfare of both regions could be increased if it was produced.

A crucial assumption in the Markusen et al. (1995) paper is the fact that the population of A and B do not own the firm producing the X-good. Hoel (1997) drops this assumption and allows residents of both countries to have a stake in the firm. However, they do not have a majority in the sense that they can decide where the firm locates. He does not take into account transport costs. Hence, in his model, it is never optimal for a firm to locate in 2 countries as his model continues to assume that there are firm level fixed costs and constant marginal costs. The latter are increasing in the emission tax.

The fact that individuals from countries A and B own a share in the firm producing the dirty X-good implies that they derive utility from the firm's profits. As these are negatively affected by the emission tax, governments are concerned about the negative impact of their environmental policy on the firm's profits. He shows that firm ownership matters. For instance, assume that a firm is located in country B. If ownership is evenly distributed and environmental pollution is harmful so that the welfare of B is worse off than the welfare of A, he shows that it is optimal for A to set its environmental tax at a level which guarantees that the firm will not locate there. The other country B can not do better than to choose the tax rate which maximizes its welfare given that the firm is located within its jurisdiction. However, this changes if there is a big difference in ownership. If country A's ownership is large compared to country B's, then country A should lower its tax rate to attract the firm while B will increase taxes.

The empirical literature on environmental policy competition is less developed and it focuses on the U.S. experience (Levinson (2003)). In order to provide evidence which supports the hypothesis that jurisdictions compete in terms of environmental policy, one has to establish that stringency levels in jurisdiction A depend on those in other jurisdictions. Furthermore, the association has to be positive. Fredriksson and Millimet (2002) find a positive association between environmental policy stringency in U.S. states and the level in neighboring states. Their evidence suggests that the elasticity of the one states' stringency level for changes in neighboring levels are greater than unity. Furthermore, their results support the hypothesis that the effect of an increase in neighboring states stringency levels is larger if their own level is initially more lax. Hence, from these results one can conclude that both ecological dumping as well as a NIMBY scenario seem to be supported by these results. As the authors conclude: *"increases in neighboring states may cause the own state to leapfrog ahead of its neighbors. NIMBY behavior of yeardstick competition may lie behind this result"* (Fredriksson and Millimet (2002), p. 117). Levinson (2003) finds similar evidence although the elasticity is lower and suggests that states keep up with other states stringency levels. His evidence further suggests elasticity exceeds unity in the case of hazardous waste taxes if states are unable to tax out of state waste at higher rates than local waste. Hence, for hazardous waste, his evidence supports a race to the top or NIMBY-type of behavior. One of the problems with this type of exercise is the fact that policy competition has many dimensions. Jurisdictions might react to other jurisdictions lowering of corporate tax levels by lowering theirs, but also by increasing the supply of some public good or reducing the level of environmental taxes. Fredriksson et al. (2004) find some evidence that this behavior affects environmental policy stringency. For U.S. states, they find that there are cross-policy interactions between environmental stringency, taxes and government expenditures. They find, for instance, some evidence which suggests that U.S. states appeal to firms by lowering environmental stringency levels as a response to neighboring states improving their provision of public goods and reducing their taxes.

As an alternative way to look at the impact of policy competition, a number of authors analyze the impact of the decision by the U.S. Reagan administration to delegate responsibility for a number of air pollution standards from the federal to the U.S. state-level. List and Gerking (2000) and Millimet (2003) use this phase to assess if emissions for a number of air pollutants have increased or decreased after regional states became responsible for standards. The assumption of these authors is that if the delegation of responsibility results in regulatory competition and if this results in a race to the bottom, emissions of these air pollutants should have increased or abatement expenditure should have decreased. None of these 2 contributions find any evidence that would suggest a race to the bottom as they do not find evidence that emissions have increased after the decentralization. This seems to suggest that U.S. states did not engage in a race to the bottom to attract firms.

What is striking if we look at the literature mentioned in sections 2 and 3 is that there seems to be a gap between the predictions based on theoretical models and the empirical evidence. While the theoretical evidence clearly indicates that en-

vironmental policy matters for location, the empirical evidence is not so convincing. Theoretical literature in section 3 suggested that there is a clear danger for a race to the bottom. However, at least for U.S. states, there is little evidence to suggest that a race to the bottom has occurred. One of the reasons why the empirical literature and theoretical literature seem to offer different conclusions could be the fact that the latter does not take into account the geography of polluting industries (Yoshino (2004)). A framework within which agglomeration and transport costs are analyzed is the New Economic Geography (NEG).

In the next section we will review (NEG) literature and its implications for policy competition. As will be argued in that section, the NEG seems to offer a framework which is able to reconcile the empirical findings with predictions from theory.

4. New Economic Geography

4.1. NEG: an introduction

The math of a typical NEG model is quite demanding so we will not present the mathematical part and introduce their intuition which will (hopefully) be sufficiently clear.

New Economic Geography analyses a world within which consumers have an appetite for variety, where there are economies of scale internal to the firm and it is costly to ship goods internationally. The typical NEG model reduces this world to a "2 country – 2 factors of production – 2 sectors" world. The production sectors are typically an agricultural sector (A) and a manufacturing sector (M). The A-sector produces a homogeneous good under a constant return to scale production function in a perfectly competitive market. International trade in A-goods is free, i.e. there are no transport costs. The M-sector produces a differentiated good in a monopolistically competitive market. International trade in M-goods is costly. Typically, NEG models assume "iceberg" trade costs that capture all costs associated with selling internationally. With iceberg trade costs a firm has to ship more goods than required as some of them melt away in transit. The idea comes from the earliest geography models and was used to capture the notion that if wheat was transported by horse-drawn wagon, some of the wheat that was shipped was eaten by the horse. Hence, merchants had to ship more than required in the foreign market as some of the shipped wheat was used to feed the horse in transit (Baldwin et al. (2003).

The 2 factors of production are labor and capital. The production factor capital may be physical or human capital (i.e. skilled labor). Labor is internationally immobile while capital can move from one country to another. The A-sector only uses labor. Labor is paid a fixed wage. The M-sector requires the input of both labor and capital. More specifically, it requires 1 unit of capital to develop a variety of the differentiated good. Production implies a marginal input requirement of capital (see Fujita et al. (1999)) or labor and each variety is produced under a constant return to scale production function. The use of capital represents the fixed cost part of the M-production process. Capital's income equals the total revenue from selling the variety minus the wages paid to labor. Hence, the reward to capital is equal to the operating profit of the firm.

The mobile factor of production will migrate to the country where its real welfare is highest. If this factor is human capital, then the owner of the factor of production migrates with this factor (see Fujita, Krugman en Venables (1999) and Forslid en Ottaviano (2003)). If the mobile factor is physical capital, migration of the factor of production does not necessarily imply migration of his owner (see Martin en Rogers (1995)). In most models, real welfare is equal to real income for the mobile factor.

The 2 countries are identical: they share the same technology and consumers have the same preferences for A- and M-sector goods and varieties. With the exception of a model with physical capital as the mobile factor of production, one can assume that labor is evenly spread across countries (see Baldwin et al. (2003) for a discussion of what they call the FC model with exogenous asymmetry). Furthermore, a consumer prefers more varieties over less of the M-good. A typical consumer spends a fixed share of his or her income on the A-good and uses the other part to purchase a basket of individual varieties of the M-good. Demand for an individual variety depends among others, on the aggregate cost of the basket of M-goods (i.e. how many baskets can he or she buy with the part of the income devoted to buying M-goods), total income and the cost of an individual variety.

With these assumptions, a typical NEG model's firm engages in mill pricing: it charges the same producer price for sales in all markets and transport costs are born by the consumer. Notice that this is different from the model in Markusen et al. (1995) where the firm did not pass the transport costs on to consumers. The producer price is a fixed mark-up over marginal costs. As Baldwin et al. (2003) note, this implies that the operating profit on a unit sold is constant and does not depend on the market where that unit was sold. Hence, operating profits, and thus the reward for the fixed factor, are also constant and they equal a fixed share of revenues.

With these assumptions a NEG model has two stable equilibriums: a symmetric one where the mobile factor is located in each country and a core-periphery outcome with full agglomeration of the mobile factor in 1 country. There are 3 forces that determine the stability: market-access effect, the cost-of-living effect and the

market-crowding effect (see Baldwin et al. (2003) for a detailed analysis). In order to illustrate these effects, assume that the mobile factor of production is evenly spread across countries (i.e. we start from the symmetric equilibrium). Assume that 1 unit of the mobile factor migrates from one country (say the north) to the other (say the south) and that ownership can not be separate from the production factor. This means that the market of the north increases in size as the person who migrates spends the income he or she earns where he or she lives. This raises the revenues of a typical firm located in the north as it has one extra person to sell to and hence, its operating profits as they are a fixed share of revenues and thus the reward for the mobile factor. The south on the other hand, looses a person to the north and it looses someone who used to buy M-goods in the south but does so now in the north. A typical southern firm witnesses a drop in revenues (as there is one person less to sell to) and hence, its operating profits and its reward for the mobile factor. As the reward for the mobile factor increases in the north and decreases in the south, and all other things being equal, more mobile factors will move from the south to the north. Hence, this demand linked market access force is sell-reinforcing.

Secondly, the same migration leads to an increase in the number of varieties produced in the north. As transport costs are passed on to the consumer, a typical northern consumer used to import that variety from the south and used to pay transport costs. However, as this variety is now produced in the north, there is no longer the necessity to import it and hence to pay transport costs. This means that the basket of M-goods becomes cheaper in the north. A typical southern consumer sees an increase in the cost of purchasing a basket of M-goods. The variety that used to be produced locally now needs to be imported and hence, the consumer pays for the transport costs. This cost-of-living effect is also self-reinforcing: as the cost of living drops in the north but increases in the south, the mobile factor's real reward increases in the north and decreases in the south. This will create additional pressure on southern mobile factors to migrate to the north as the real reward is higher than the real reward in the south.

The market-access effect and cost-of-living effects are self-reinforcing would and result in a perfect agglomeration of the M-sector with 1 country having all of the M-firms while the other country has none. This implies that there is a core with all M-firms and a periphery that produces only the A-good.

The last effect, the market-crowding effect, tempers the agglomeration forces. If a firm moves from the south to the north, the degree of competition increases in the north while it reduces in the south. Overall, this means that revenue in the north decreases but increases in the south. This means that producing in the south becomes relatively more attractive compared to production in the north. This effect lessens the impact of the previous two effects and favors symmetrical outcomes where firms are evenly spread across countries.

The impact of these 3 forces changes with trade costs. As long as trade costs are important, the market-crowding effect prevails. Starting from a symmetrical equilibrium, the market-crowding effect is able to undo the impact of the market-access and cost-of-living effect and the economy ends up back in the symmetrical equilibrium. However, as trade becomes sufficiently free and trade costs pass some threshold called the break point, the market-crowding effect is no longer able to undo the impact of the other two forces: the economy moves from a symmetrical equilibrium towards a fully agglomerated one with all M-firms in 1 country. Hence, if trade costs are sufficiently high, the symmetrical equilibrium is stable. For intermediate or high trade openness on the other hand, the symmetrical equilibrium is unstable: a small deviation implies that the economy moves from symmetry to a fully agglomerated world where all firms are located in a single country.

As Baldwin et al. (2003) show, there are agglomeration rents. Assume that all M-firms are in the north. The existence of agglomeration rents implies that the difference in the real reward for the mobile factor between the north and the south is positive. The existence of these agglomeration rents implies that mobile factors can become quasi fixed. Furthermore, as trade costs decrease, the strength of the agglomerative forces rises. The agglomeration rents are also present in the model with physical capital but one has to assume an exogenous difference in the size of the countries (see Baldwin et al. (2003)).

As shown in Ludema and Wooton (2000) this has important implications for tax policies. If there are agglomeration rents and governments play a tax game, these authors show that if a reduction in trade costs increases agglomerative forces, then the tax in the core will unambiguously rise. In a core-periphery situation, a rise in the core's tax may have no effect on location. This is due to the fact that agglomeration forces create location-specific rents that can be taxed up to some point without affecting the location of capital (Baldwin and Krugman (2004)). As Andersson and Forslid (2003) have shown, a developed country could gain tax setting independence if taxes are used to supply a public good (such as a better environment) if trade costs are lowered between it and a developing country. However, integration with another developed country reduces its tax setting independence. Baldwin et al. (2003) also show that if the preference for this public good rises with per capita income, international tax competition might lead to a race to the top.

4.2. Environmental policy and capital mobility

The papers discussed in the previous section deal with tax policy in general. In terms of the applications of the NEG framework to environmental policy, Pflüger (2001) analyses a NEG model with physical capital where migration of capital does not necessarily imply migration of its owner. Elbers and Withagen (2004) and Yoshino (2004) assume a model where migration of the factor of production implies migration of its owner. These contributions have in common that, by adding environmental policy and

quality to a NEG model, they add forces favoring the symmetrical or core-periphery equilibrium. A worsening of environmental quality for instance, induces mobile factors of production to relocate to a country or region with the cleaner environment. On the other hand, if governments distribute tax revenue among their residents, this creates an incentive not to migrate.

Pflüger (2001) analyses a 2 country model where the environment is used in the production process but causes disutility for the people living in the country where production takes place. In addition to emissions, the firm requires labor as an input in the production process. Labor and emissions are (to some extend) substitutes. To start production, the firm needs one fixed unit of capital. Capital is mobile internationally, labor and emission are not. The government taxes emissions. The revenue from the tax is distributed equally among the residents of that country.

The emission tax affects the marginal cost of production. As is standard in most NEG models, the price is a fixed mark-up over marginal costs. It follows that an increase in environmental costs will be passed on to consumers. As labor and emissions are substitutes however, an increase in the emission tax rate does not imply an increase in environmental costs of the same magnitude. Indeed, if emission taxes increase, the firm will lower input of emissions and increase input of labor.

The responsiveness of firms to changes in the emission tax will always be negative: an increase in the emission tax will always lead to some relocation out of the country. In absolute value, the responsiveness is higher for pollution intensive firms. An increase in environmental costs puts them in a negative competitive position compared to foreign firms. However, the absolute value is smaller for high trade costs. Hence, firms whose products are expensive to ship internationally will not always respond immediately to a change in emission taxes by relocating to another country. As Ederington et al. (2005) note, these firms are not footloose.

A rise in emission taxes in the domestic country has multiple impacts on the economy. First of all, as emission taxes increase, firms use fewer emissions in their production process. Secondly, environmental quality improves as a number of firms move to the foreign country. However, raising taxes comes with some losses in terms of utility as well. First of all, as prices are a fixed mark-up over marginal cost and an increase in taxes raises the latter, the prices charged by domestic firms increase as well. This implies that the overall price of a basket of manufactured goods produced domestically increases compared to the foreign country. Secondly, due to the substitution of emissions with labor and relocation, emission tax revenues decrease with higher taxes. This implies that the government has less revenue to redistribute which makes its market less attractive to firms as it implies that there will be less expenditure on manufactured goods. Thirdly, as firms relocate, local consumers incur transport costs on the goods they used to buy from home producers but have to import now.

In setting their emission taxes, governments take into account these effects. Note that this implies that this model changes from the ones discussed in previous sections as the government here takes into account both the impact of its policies on the environment as well as on the level of income and the cost-of-living effect. Pflüger (2001) shows that a government sets environmental taxes below their cooperative level if production is relatively clean relative to transport costs. If that is the case, emissions cause little disutility and it is worthwhile to keep firms at home so as to avoid the transport costs on imports. If, on the other hand, production is relatively dirty compared to transport costs, the optimal strategy is to increase emission taxes. In this case, the disutility from emissions is not compensated by the fact that consumers avoid having to pay transport costs. In the former case, ecological dumping is a possibility while in the latter, a NIMBY scenario emerges.

Yoshino (2004) analyses a model which is close to Pflüger's but introduces the environment in a model within which the ownership and the factor of production are not separable. Comparable to Pflüger's model, the government redistributes emission tax revenues to all its residents irrespective of their nationality, i.e. entrepreneurs who have migrated from the foreign country receive an equal part of the emission tax revenue. The author shows that besides the market-access effect, cost-of-living effect and market-crowding effect, there are 2 additional effects: the pollution effect and the tax-revenue effect. As more entrepreneurs locate in one country, the local environment detoriates due to increased pollution from the manufacturing industry. As entrepreneurs care for the local environmental quality, this effect works in favor of a symmetric equilibrium. The tax-revenue effect on the other hand is a force which works towards a core-periphery outcome. Starting from a symmetric equilibrium and assuming that 1 entrepreneur relocates from the south to the north, the emissions in the north increase. However, so do emission tax revenues. As these are distributed among residents, their income increases and hence the attractiveness of the northern market. This induces more southern entrepreneurs to relocate. The author shows that the pollution intensity matters. From an initial symmetric equilibrium, low pollution industries are more footloose compared to high pollution intensive industries. Yoshino (2004) further highlights the importance of the nature of environmental pollution. If pollution is purely local, the model behaves quite differently from a model within which pollution is global.

There is little empirical evidence which directly includes measures of agglomeration economies. Although some literature includes measures of market size or transport costs when it analyzes the impact of environmental costs on firm location behavior, this is done as a control but not as a direct test of agglomeration forces (see Keller and Levinson (2002)). Ederington et al. (2005) are the first to our knowledge to test empirically whether transport costs matter. They try to predict the net imports of the U.S. by industry and year using environmental costs, trade barriers and 3 different variables to capture 'footlooseness' of an industry: transport costs, plant level fixed costs and agglomeration economies. If U.S. manufacturing firms have relocated abroad due to stringent environmental policy in the U.S., net imports in these industries would be higher compared to the case where such relocation did not

occur. Their evidence suggests that higher environmental costs are indeed associated with more imports which would suggest that firms produce outside of the U.S. due to environmental stringency. However, they also show that 'footlooseness' matters. For industries with transport costs for instance, environmental costs have a much smaller effect on imports. The same conclusion holds for industries with important plant level fixed costs. This suggests that these industries have had less incentive to relocate due to environmental costs. In terms of environmental policy, this is especially relevant as the evidence presented in Cole et al. (2005) suggests that the most pollution intensive firm is also energy intensive, physical capital intensive and human capital intensive which indicates that these firms may incur large plant fixed costs. Hence, combining the evidence in Ederington (2005) and Cole (2005) seems to suggest that pollution intensive firms are not footloose as they are characterized by important plant level fixed costs. Furthermore, if their products are also expensive to ship internationally, it might be very difficult for these industries to relocate.

5. Conclusion

This paper reviews some of the literature on the impact of environmental policy on competitiveness. The early literature reviewed in section 2 highlighted the fact that firm location decisions respond to differences in environmental policy costs. In section 3, the environmental policy competition literature showed the possibility of both an ecological dumping type of competition between governments and an NIMBY type of competition. The empirical literature however is somewhat at odds with the predictions from theory. The data seems to suggest that environmental policy stringency has little impact on locations decisions. Although one can find statistically significant estimates, in general, their economic significance is rather small. In the fourth section, we introduced the NEG as a framework for evaluating the impact of environmental policy on location behavior. It was shown that this richer framework seems to offer a theoretical basis for the conclusion that relocation due to environmental policy considerations is limited as firms do not simply compare environmental policy costs but also take into account agglomeration economies and income effects.

All in all, the evidence presented here is indicative of the fact that environmental policy does not have an important impact on location decisions of firms. Although there might be instances where firms find it advantageous to relocate, both theory and data argue that environmental policy costs are only a (small) part of the relocation story.

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