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Foreign direct investment under fiscal interdependence when policy is set unilaterally

Abstract

This paper develops a partial equilibrium model of foreign direct investment to analyze the potentially opposing interests between a host and foreign country. The two countries are fiscally interdependent and the fiscal variable is set unilaterally by the foreign country. The analysis indicates that fiscal independence is welfare-enhancing, particularly in the case where the outflow of FDI is large. The case where a lump-sum subsidy is set to address the exit of firms indicates that the need for subsidy payments subsides under fiscal independence.

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1 Introduction

There are country-specific cases which suggest that one of the benefits of attracting foreign multinational corporations is the jobs they create in the host country (e.g., Adams et al. 2014). Indeed, incentives to attract foreign corporations have been widely used to develop industry and create jobs (e.g., Lahiri and Ono 2004; Tolentino 2000). On the opposite side of the spectrum, there is evidence which suggests that job creation and the technology brought into the host country by foreign firms may be at the expense of welfare losses in the host country through, for example, environmental degradation (e.g., OECD 1999), the repatriation of profits and favoritism to firms from specific countries to establish operations in the host country (e.g., Svedberg 1981). This paper looks at, *inter alia*, the gains from foreign direct investment, on the one hand, but also the potential losses arising from favoritism to firms from a specific country to establish operations in the host country.

Historically, the role of multinational corporations can be illustrated through the case of the food industry in countries like Colombia and Mexico, but also in the case of the pharmaceutical industry in economies such as Ireland, India and Puerto Rico, and the car industry in the UK. Specifically, the Puerto Rican economy experienced unprecedented growth through tax incentives US firms enjoyed as foreign corporations operating in Puerto Rico (Dietz 2003; Baumol and Wolff 1996; Ramcharran 2011). Recently, however, the Puerto Rican economy has suffered large job losses arguably because a relatively large number of firms left to establish operations elsewhere (Federal Reserve Bank of New York 2012; Ramcharran 2011, p. 396). Figure 1 shows the downward trend in total employment in the manufacturing sector; real GDP in the economy also shows a decline along with labor productivity (Federal Reserve Bank of New York 2012; Collins et al. 2006, p. 35).

This decline in employment can be partly attributed to the reduction in the tax incentives offered by the US federal government (Federal Reserve Bank of New York 2012; GAO 2014). Indeed, there is evidence in the literature for the close linkage between tax in-

centives and job creation via foreign direct investment in OECD countries and the European Union (e.g., Adams et al 2014), and evidence that multinational corporations do react to tax incentives (e.g., Mutti 2003; Bénassy-Quéré et al 2005). In spite of the rapid job loss and the lack of strong tax incentives by the US government¹ little attention has been given by policymakers in Puerto Rico to the potential benefits of acquiring additional controls over economic policy-making tools.² The present work seeks to fill this void from a theoretical perspective.

With these in mind, this paper looks at the potential gains arising from job creation in the host country in industries which are oligopolistic in nature and, also, dominated by foreign firms which have established operations in the host country. I show that moving away from an equilibrium which entails a closer fiscal relationship between the host and foreign country is welfare-enhancing for both economies. The driver for this result is simply that a closer fiscal relationship implies the elimination of tax incentives to attract (and retain) foreign firms.³ It is also shown that as companies operating in the host country see greater profit opportunities abroad, they leave the host country and establish operations elsewhere, thereby having a detrimental impact on the host country. In this context it is shown that it is in the best interest of the host and foreign country to work together as two separate economies i.e., under fiscal independence. The case where the host economy offers a subsidy to offset the costs of a closer fiscal scenario and attract foreign firms is examined; I show that in this case the foreign country gains at the expense of the subsidy offered by the host country, and that this subsidy is unsustainable as profit opportunities abroad increase.

¹Tax incentive schemes have been characterized by a set US federal tax credits for US firms operating in Puerto Rico. These incentive promoted the development of the non-agricultural sector e.g., pharmaceutical, chemicals, drugs and electronics are some examples (Dietz 2003, p.140-160). The development of industry and job creation depends on US unilateral policy. Thus, if these policies are phased out (e.g., section 936 of the US Internal Revenue Services, the American Samoa Economic Development Credit), it is reasonable to expect US corporations to seek higher profits elsewhere.

²To be fair, more autonomy to implement policies to improve Puerto Rico's economy has been present in the public debate and discussed in the literature e.g., Catalá (2010). The Federal Reserve Bank of New York's Report on Competitiveness of Puerto Rico's economy also touches on this point.

³In the US-Puerto Rico case this result is consistent with the findings in a recent report by the General Accounting Office (GAO 2014) and consistent with the empirical literature (e.g., Bénassy-Quéré et al 2005).

The framework of analysis consists of two countries, a host and foreign country, where foreign, export-oriented firms operate in the host country. In the benchmark case welfare in the host country consists of employment creation exclusively, whereas the foreign country achieves welfare gains from the tax revenue arising from the production of foreign firms, which operate in the host country. What this set-up intends to capture is the case where the host country's welfare depends primarily on foreign firms. Additionally, the fiscal relationship is captured via a tax imposed on the production of foreign firms. The idea here is that under a closer fiscal relationship between the two economies firms operating in the host country would have to pay a relatively higher tax. A smaller tax, in contrast, represents the case where fiscal ties diminish. [Even though this setting may warrant the analysis of policymaking in a non-cooperative set-up, issues of non-cooperation of tax policy have been analyzed elsewhere \(e.g., Keen and Konrad 2013\) and thus the focus of the present analysis is on issues of unilateral policy and the derivation of new results. Issues of profit taxation have also been studied elsewhere \(e.g., Lahiri and Ono 2003\).](#)

In the context of the existing literature, there is a strand which looks at foreign direct investment and employment under imperfectly competitive markets (e.g., Brander and Spencer 1987; Lahiri and Ono 2003; Barros and Cabral 2000; Raff 2004; Adams et al. 2014; [Kayalica and Yilmaz 2004](#)); and a second related strand at competition of profit shifting (e.g., Janeba 1996,1998, 2000; Myles 1996; Denicolò and Matteuzzi 2000; Lahiri and Ono 2004; Fuest 2005). These strands look at issues of international tax/subsidy competition, strategic trade policy and foreign ownership; their analysis examines, among others, the conditions under which competing countries may enhance domestic welfare either via subsidies or a *laissez-faire* policy approach via a race to the bottom of local taxes.⁴

The contribution of this paper is at the intersection of these two strands. In particular,

⁴There is a third strand closely related to the present paper (e.g., Barro and Cabral 2000; Haufler and Wooton 1999, 2005; Bjorvatn and Eckel 2006), which looks at the conditions under which investment incentives (i.e., subsidies and/or lower taxation) are optimal when countries compete for FDI. The contribution to this strand is discussed in sections 3 and 4. [There is also an extensive literature which examines issues of FDI and strategic trade/environmental policies under Cournot conditions e.g., Kayalica and Lahiri \(2005\), Elliot and Zhou \(2013\), Sanna-Randaccio \(2012\) and Bayındır-Upmann \(2003\) just to name a few.](#)

the analysis examines the case where employment in the host country depends entirely on foreign firms operating in that country and, in addition, the incentives to attract foreign firms into the host country depend entirely on the foreign country's government. Issues of endogenous international tax competition (for a survey see e.g., Keen and Konrad 2013) or fiscal federalism (e.g., Wildasin 1988; Bucovetsky 1991) and strategic trade policy (e.g., Brander and Spencer 1987; Ishikawa and Spencer 1999) are put aside. Rather, the key issue at hand is employment considerations in one country and net tax revenue considerations in the second country, when policy is under the control of the latter. The goal of this paper is to specifically analyze the potentially opposing interests between the host and foreign country when there is a unique fiscal relationship between the two.

With these in mind, Janeba (1996) shows, in a two-country model with imperfect competition in the output market, that the foreign government has an incentive to provide full tax credit if profits are completely repatriated. Barros and Cabral (2000) look at competition between countries to attract foreign direct investment via a subsidy and show, among others, that competition via subsidies may result in efficiency gains.⁵ In contrast, the present paper assumes that only one country has control over policy and so I do not model subsidy/tax competition as it is often times done in the literature. I also assume away issues of profit shifting since these have been analyzed extensively elsewhere. The reason for this departure is twofold. First, there is a small, though important, number of cases of economies which have practically no say on the implementation of policy even when this is key for the creation of local jobs.⁶ Second, the goal here is to characterize the policy offered by the host country in the case where the foreign country sets *a priori* the conditions of the fiscal relation between

⁵Ishikawa and Spencer (1999) also show the potential efficiency gains from subsidies in vertical oligopolies in a two-country model.

⁶The analysis applies to the case of the Marshall Islands, American Samoa, Bermuda and other small Caribbean economies. Examples of policy includes the American Samoa Economic Development Credit for the tuna and processing industry (see 2014 Press release Congressman Faleomavaega, <http://faleomavaega.house.gov/media-center/press-releases/senate-finance-committee-passes-two-year-extension-of-american-samoa>. The Caribbean Basin Initiative (CBI) also exemplifies US unilateral policy in the Caribbean and Central America. The CBI provides a platform for US investment to flourish in the region while allowing for unilateral policy changes by the US government (ITA 2000; USTR 2013). Country examples include Costa Rica, Guyana, El Salvador, Honduras and Jamaica (Dypski 2002).

the two countries.⁷

The present paper is closely related to the model of FDI in Kayalica and Yilmaz (2004) where the host country sets policy (tariff and output tax), profits are repatriated and the government cares about employment, tax revenue and consumer surplus. Welfare analysis is restricted to the host country. The authors show that when policy is set simultaneously a zero-tariff and output subsidy is optimal; this is consistent with results here. However, I extend the welfare analysis to a two-country model and focus on the opposing interests across countries. Furthermore, Lahiri and Ono (2003) examine the properties of the local content and FDI on welfare in the presence of unemployment. They show that the host country's welfare, which depends entirely on employment from foreign firms, may benefit from stricter requirements on the one hand, but on the other foreign firms may exit the market since they are required to employ less efficient inputs. Even though their model focuses on local content, it points out to two opposing effects a host government needs to weigh when employment is key.⁸

In the context of US states, issues of trade restrictions and subsidy competition for FDI among states have been explored in the literature e.g., Adams et al (2014). In their analysis the authors show, *inter alia*, that a (costly) positive subsidy for FDI is possible when states compete with each other for FDI. A key driver for this result is the presence of trade policy: the presence of a tariff may induce states to compete with each other for jobs in a costly fashion by offering higher subsidies to attract foreign firms. Although the subsidy as a policy to attract FDI is part of the present paper, it differs crucially from Adams et al. in that (i) trade policy is assumed away in order to focus on the fiscal relation between two

⁷As examples of policies set *a priori*, some US corporations are tax exempt because of tax rules set unilaterally by the US government (see Permanent Subcommittee on Investigations, "Offshore Profit Shifting and the U.S. Tax Code", <http://www.hsgac.senate.gov/subcommittees/investigations/hearings/offshore-profit-shifting-and-the-us-tax-code>).

⁸Other papers in the literature under oligopoly examine the effects of local content requirements on cross-hauling e.g., Lahiri and Ono (2004), chapter 10. In a different strand of the theoretical literature Grossman and Iyigun (1995) show, in a general equilibrium setting, that if the return on the investment in the colonial sector is small, then the colonial power abandons the colony. In this sense I found consistent results in the present paper, but in an oligopoly setting since the focus here is on a very specific type of imperfectly competitive market.

countries, (ii) welfare analysis incorporates the foreign country (i.e., the country of origin of FDI) and not just the host country as they do, and (iii) the goal of the present paper is not to analyze exports versus location decisions by firms. What I want to analyze rather is the potentially opposing interests between the host and foreign country in the presence of a unique fiscal relationship where employment considerations are key to the host country.

The fourth strand this paper contributes to is the rich literature on Puerto Rico's economy, where little attention has been given to the development of theoretical models to study its economy. Bosworth and Collins (2006), Baumol and Wolff (1996) as well as Dietz (2003) study the determinants of economic growth, and Sotomayor (2004) the effects of federal transfer policy on income inequality. Dunn (2011) studies empirically the relation between political dependence and development in a group of islands including Puerto Rico. Catalá (2013) and Dietz (1986) provide a historical perspective on the economy of Puerto Rico, including its institutional development. The issue of industrial policy and trade is touched by Lawrence and Lara (2006), where they argue that trade liberalization is not likely to hurt industries in Puerto Rico which do not operate under preferential trade treatment. This suggests that by opening the economy to a more liberal trade model, current industries are not likely to be negatively impacted. Dietz (2003) and GAO (1998, 2014) discuss the implications of federal tax incentives on the local economic and federal tax revenue (income and corporate taxes). None of these works delve into the analysis of the manufacturing sector and federal incentives from a theoretical perspective.

The rest of the article is structured as follows. Section 2 presents the model followed by the cases where firms are taxed and the host country offers a subsidy to attract foreign firms. Section 5 concludes.

2 The Model

Consider n identical export-oriented foreign firms operating in the host country, which compete à la Cournot. Inverse market demand arises from preferences such that

$$p = \alpha - \beta \sum_i x_i \quad (1)$$

where x_i denotes output by foreign firm i ($i = 1, 2, \dots, n$). Each firm i exhibits constant marginal costs, c_i , and is subject to a per-unit tax, t , for each unit of output, which is set unilaterally by the foreign country. Each firm maximizes profit by simultaneously choosing its level of output taking all other firms' output as given. In particular, each firm i solves

$$\max_{x_i} \pi^i = (p - c_i - \theta t)x_i \quad (2)$$

Even though this type of per-unit tax is not new in the literature, it intends to capture the tax foreign firms operating in the host country pay to the foreign government. As pointed out in Brander and Spencer (1987, p. 265), an output tax affects “the employment issue most directly”, a key aspect in this paper. The positive constant θ captures exogenous non-economic factors (e.g., political or regulatory factors) and so the effective tax is given by θt ; the role of θ is discussed in section 4. For example, even in the case where the tax makes sense from an economic standpoint, politicians may want to abolish the tax i.e., $\theta \simeq 0$ for political reasons.

I shall follow Lahiri and Ono (2004) in that foreign firms will operate in the host country as long as they make at least a level of profits, $\tilde{\pi}_i$ i.e., reservation level of profits. Since the host country is assumed to be small $\tilde{\pi}_i$ is assumed to be constant. If profits opportunities abroad for firm i , $\tilde{\pi}_i$, increase then firm i will exit the host country and establish operations elsewhere. This is consistent with evidence which suggests that large US corporations show a trend of moving operations overseas (Bailys and Bosworth 2014). The free entry and exit of firms is thus captured by the following condition

$$\pi_i = \tilde{\pi}_i \quad (3)$$

Maximization of (2) yields under symmetry the following first-order condition

$$p - c - \theta t = \beta x \quad (4)$$

This equation, along with equation (3), determine the equilibrium level of output, x , and number of firms, n . I shall assume an interior solution throughout. In particular,

$$x = \sqrt{\tilde{\pi}_i / \beta} \quad (5)$$

$$n + 1 = \frac{(\alpha - c - \theta t)}{\beta \sqrt{\tilde{\pi}_i / \beta}} \quad (6)$$

Clearly, the effect of the tax works exclusively via the number of firms, meaning that a higher tax induces firms to exit the market due to higher tax payments and thus lower profits. As potential profits abroad, $\tilde{\pi}_i$, rise firms exit the market and so each foreign firm in the host country produces more i.e., $\partial n / \partial \tilde{\pi}_i < 0$ and $\partial x / \partial \tilde{\pi}_i > 0$.⁹

3 Welfare

Consider two countries, namely, a home (host) and foreign country. Foreign firms operate in the host country, face no competition from host firms, and export the production of a homogeneous good to a third market. Welfare in the host country depends on the income derived by the output generated by foreign firms. These are simplifying assumptions which intend to capture the important role of US firms in terms of employment creation abroad.

⁹Comparative static results hold with general demand and cost functions. To see this profits are given by (2), but now costs are a function $c(x)$ satisfying $c' > 0$, $c'' > 0$, and inverse market demand curve, $p = p(nx)$, satisfying $p' < 0$, $p'' > 0$ and $xn = X$. Profit maximization under symmetry gives $p + xp' - c' - \theta t = 0$, and the free entry and exit of firms is determined by $\tilde{\pi} = px - c(x) - x\theta t$. These implicitly determined the equilibrium $x = x(t, \tilde{\pi})$, $n = n(t, \tilde{\pi})$ and $X = nx$. Profits are assumed to be concave, $p'(n+1) + nxp'' - c'' < 0$, marginal revenue is decreasing in output, $2p' + nxp'' < 0$, and marginal profits fall with total output, $p' + xp'' < 0$. Total differentiation yields

$$\begin{aligned} \delta dx &= -x^2 p'' \theta dt - x[p' + xp''] d\tilde{\pi} \\ \delta dn &= x[2p' + nxp'' - c''] \theta dt + [p'(n+1) + nxp'' - c''] d\tilde{\pi} \end{aligned}$$

where $\delta > 0$ is the determinant of the coefficient matrix. Here output by each firm falls with the tax, whereas in the linear case (i.e., $p'' = 0$) such an effect is nil. In particular, $X_t < 0$, $x_t < 0$, $n_t < 0$, $x_{\tilde{\pi}} > 0$, $n_{\tilde{\pi}} < 0$, $X_{\tilde{\pi}} < 0$.

I shall follow Lahiri and Ono (1998) and assume that the cost of production translates as income in the host country:

$$W^h = cnx \tag{7}$$

Welfare in the foreign country depends entirely on the revenue which arises from the tax foreign firms pay to the government of the foreign country. This set-up intends to capture the benefits to the US government arising from the tax revenue generated by US (foreign) firms operating abroad. That is,

$$W^f = \theta tnx \tag{8}$$

A smaller tax, *ceteris paribus*, can be thought of as a case where the two countries relate to a lesser extent from a fiscal standpoint; that is, a small tax indicates that the fiscal interaction between economies in the type of industry modeled here is less. A relatively large tax denotes the case where the two economies relate relatively more from a fiscal standpoint.

The notion of a “fiscal relation” or “fiscal interaction” is specifically modeled based on the idea that tax revenue raised by the foreign country depends exclusively on the home country. For example, a positive tax denotes the tax revenue from US firms operating abroad (host country) to the US federal government. A relatively small (large) positive tax, *ceteris paribus*, denotes less (more) benefits in the form of revenue to the foreign country arising specifically from operations of foreign firms in the host country, and therefore a smaller (higher) degree of fiscal interaction.

The order of events is as follows. The foreign country chooses the tax so as to maximize W^f . Firms then take policy as given and maximize profits by choosing the level of output. Notice that by assumption the home country does not have a say on the choice of the tax. The choice of a tax to be paid to the US government is solely determined by the US government; [this is a plausible assumption based on the discussion presented in the introductory section](#). In what follows it is important to keep in mind that the comparative static analysis starts from an equilibrium which denotes a degree of fiscal interaction between

the two countries. That is, the initial equilibrium is neither complete fiscal independence nor complete fiscal dependence. This initial set-up illustrates the extent to which the equilibrium moves to an equilibrium characterized by either more or less fiscal independence.

3.1 Non-cooperative equilibrium

The characterization of the optimal tax, t^* , which is set by the foreign country, is given by the maximization of (8):

$$\frac{1}{\theta} \frac{\partial W^f}{\partial t} = nx + t \left(n \frac{\partial x}{\partial t} + x \frac{\partial n}{\partial t} \right) = 0 \Rightarrow t^* = \frac{\alpha - c - \beta x}{2\theta} > 0 \quad (9)$$

where $\partial x / \partial t = 0$ and $\partial n / \partial t = -\theta / \beta x$, and W^f is a strictly concave function where at $t = 0$, $\partial W^f / \partial t > 0$ thus indicating a positive optimal tax, t^* .¹⁰ To see the difference in incentives across countries arising from the tax, differentiation of (7) and (8) gives

$$\frac{1}{c} \frac{\partial W^h}{\partial t} = n \frac{\partial x}{\partial t} + x \frac{\partial n}{\partial t} \quad (10)$$

$$\frac{1}{\theta} \frac{\partial W^f}{\partial t} = nx + t \left(n \frac{\partial x}{\partial t} + x \frac{\partial n}{\partial t} \right) \quad (11)$$

where $\partial W^h / \partial t < 0$ and $W^h = cnx$ is a linear function of the tax. Figure 2 summarizes some of the results from the analysis. First, it is noteworthy that the welfare maximizing tax for the host country is a zero-tax policy since this would result in more foreign firms operating in that country. Second, for the foreign country, however, there is an incentive to set a positive tax since it raises welfare in that country via tax revenue.¹¹

¹⁰It can be shown that in the presence of consumer surplus and linear demand the foreign country's welfare, $W^f = CS(nx) + \theta n x t$, yields $\partial W^f / \partial t = 0 \Rightarrow t^* = 0$, where CS denotes consumer surplus. Although this result depends on the linearity assumption, it does indicate the possibility of a zero-tax regime. In a more general setting and analogous to Brander and Spencer (1987, p. 267), the optimal tax is small *if and only if* $-1 + P_X X_t = 0$ (subscripts denote partial derivatives) where demand is given by $P = P(X)$ and $X = nx$. That is, the optimal tax is small as long as the price increase due to the tax is close to unity. Even in this more general setting, the analysis points to the incentive the foreign country has to set a lower tax in the presence of consumer surplus i.e., a tax more in line with the home country's welfare maximizing conditions.

¹¹This result is in line with the literature on FDI which argues that countries will compete to attract foreign firms (FDI) via lower taxation. In figure 2 t^{**} is simply the value of the tax so that $W^h = 0$. It can be shown that $t^* < t^{**}$.

Proposition 1. *Starting at the [non-cooperative](#) tax, t^* , welfare in the host country rises, but welfare in the foreign country falls with a decrease in the tax.*

Next, I examine differences in incentives across countries in setting the optimal tax arising from changes in profit opportunities abroad. The key result here is that as profit opportunities elsewhere improve, the number of foreign firms operating in the host country falls and, as a result, tax revenue in the foreign country diminishes; the foreign country thus responds by setting a lower tax in order to control the exit of firms from the home country. The analysis indicates that the incentives for the foreign country to set a tax diminish as foreign firms move abroad seeking higher profit opportunities. In other words, as profits opportunities abroad become sufficiently large the benefits to the foreign country, arising from the revenue in the home country, become negligible. [Figure 3](#) summarizes these results.¹² [Figure 3](#) shows, among others, the level of profits such that the optimal tax is very small; after this threshold the incentive to set a tax by the foreign country is nil and therefore the benefits to the foreign country associated with the host country become negligible.

It is noteworthy that as a result of foreign firms exiting the home country, and the resulting decrease in the optimal tax by the foreign country, the end result is an equilibrium where there is relatively less fiscal interaction. This reduction in the tax, although not sufficiently strong to avert a reduction in welfare in the host and foreign country, does minimize welfare losses. In particular, the change in welfare in the host and foreign country with respect to the reservation level of profits is given by

$$\begin{aligned} \frac{1}{c} \frac{\partial W^h}{\partial \tilde{\pi}} &= n \frac{\partial x}{\partial \tilde{\pi}} + x \frac{\partial n}{\partial \tilde{\pi}} + x \frac{\partial n}{\partial t} \frac{\partial t}{\partial \tilde{\pi}} \\ &= -\frac{\partial x}{\partial \tilde{\pi}} + x \frac{\partial n}{\partial t} \frac{\partial t}{\partial \tilde{\pi}} \end{aligned} \quad (12)$$

¹²Setting [\(11\)](#) equal to zero yields $t^* = (\alpha - c - \beta x)/(2\theta)$. Hence, $\partial t^*/\partial \tilde{\pi} < 0$; $t^* \rightarrow (\alpha - c)/2\theta$ as $\tilde{\pi} \rightarrow 0$; $t^* = 0 \Rightarrow \tilde{\pi} = (\alpha - c)^2/\beta$. Even though the foreign country could set a subsidy to keep firms exiting the host country, this case is ruled out; this is because as foreign firms move elsewhere the foreign country still gets tax revenue from the new location firms are operating at, where higher profits are generated.

where $n(\partial x/\partial \tilde{\pi}) + x(\partial n/\partial \tilde{\pi}) = -\partial x/\partial \tilde{\pi} < 0$, and the last term denotes the effect on home's welfare via the adjustment of the tax as a result of a change in $\tilde{\pi}$. The effect of $\tilde{\pi}$ on foreign's welfare is given by

$$\begin{aligned} \frac{1}{\theta} \frac{\partial W^f}{\partial \tilde{\pi}} &= t \left(x \frac{\partial n}{\partial \tilde{\pi}} + n \frac{\partial x}{\partial \tilde{\pi}} \right) + \frac{\partial t}{\partial \tilde{\pi}} \left(nx + t \left(x \frac{\partial n}{\partial t} + n \frac{\partial x}{\partial t} \right) \right) \\ &= -t \frac{\partial x}{\partial \tilde{\pi}} + tx \frac{\partial n}{\partial t} \frac{\partial t}{\partial \tilde{\pi}} + nx \frac{\partial t}{\partial \tilde{\pi}} \end{aligned} \quad (13)$$

where the first term captures the effect on foreign's welfare via reductions in the tax revenue. The last two terms capture the effect via the tax adjustment as a result of a change in $\tilde{\pi}$, where the government needs to balance the effects on tax revenue via the exit of firms, on one side, and reductions in the revenue for a given tax base on the other.

Starting at t^* , the home country experiences a reduction in welfare via the exit of firms, $-\partial x/\partial \tilde{\pi}$ in (12), but at the same time an increase in welfare as a result of the tax adjustment by the foreign country, $x(\partial n/\partial t)(\partial t/\partial \tilde{\pi})$. The former effect offsets the latter and thus home's welfare falls as firms exit the market seeking higher profits. As a result, the foreign country experiences a decrease in welfare. In particular, at t^* (12) and (13) become

$$\left. \frac{\partial W^h}{\partial \tilde{\pi}} \right|_{t=t^*} = -\frac{1}{2} \frac{\partial x}{\partial \tilde{\pi}} < 0 \quad (14)$$

$$\left. \frac{\partial W^f}{\partial \tilde{\pi}} \right|_{t=t^*} = -\theta t \frac{\partial x}{\partial \tilde{\pi}} < 0 \quad (15)$$

where from (9) $\partial t/\partial \tilde{\pi} < 0$, and the last two terms in (13) cancel out.¹³

¹³In the general case (14) holds and (15) holds under mild conditions; a necessary and sufficient condition is derived to ensure $\partial t/\partial \tilde{\pi} < 0$. Consider welfare in the foreign country in (8). Differentiation with respect to t gives (subscripts denote partial derivatives) $W_t^f = \theta(X + tX_t)$. Strict concavity of $W^f(\cdot)$ yields positive optimal tax. This is analogous to the linear case. The welfare function of the home country in (7) yields $W_t^h = cX_t + Xc'x_t < 0$ i.e., corner solution. The second term is not present in the linear; it simply compensates the first term via higher income. Then, total differentiation of $W_t^f(t(\tilde{\pi}), \tilde{\pi}) = 0$ yields

$$t_{\tilde{\pi}} = -W_{t\tilde{\pi}}^f/W_{tt}^f \quad \text{where} \quad W_{t\tilde{\pi}}^f = \theta \left(X_{\tilde{\pi}} - \frac{X}{X_t} X_{t\tilde{\pi}} \right)$$

There are two effects: (i) an increase in $\tilde{\pi}$ induces a reduction in the tax to control for the exit of firms (the first term is negative); (ii) the sign of the second term in $W_{t\tilde{\pi}}^f$ is ambiguous and new: it denotes the change in the tax base via the nonlinearities in the number of firms and output per firm. If second term is small

Proposition 2. *Starting at the [non-cooperative](#) tax, t^* , the gains from the host country that flow into the foreign country vanish as foreign firms exit the home country seeking higher profits elsewhere.*

Proposition 3. *There exists a reservation level of profits such that the non-cooperative tax is zero i.e., fiscal independence.*

3.2 Cooperative equilibrium

Next, I look at the tax in a cooperative context. The key result here is that there are potential welfare gains for sufficiently large reservation level of profits under fiscal independence. Results from the analysis are in line with the literature.¹⁴ The tax is derived from the maximization of total welfare, $W = W^h + W^f = (c + \theta t)nx$, which yields the following first-order condition

$$\frac{\partial W}{\partial t} = (c + \theta t)x \frac{\partial n}{\partial t} + \theta nx = 0 \quad \Rightarrow \quad t_o = \frac{\alpha - c - \beta x}{2\theta} - \frac{c}{2\theta} \quad (16)$$

where the $W(\cdot)$ function is strictly concave and the coordinated tax, t_o , is less than the tax set by the foreign country unilaterally, t^* ; moreover, $t_o > 0$ if and only if $c < (\alpha - \beta x)/2$ i.e., marginal costs are sufficiently small. The reason the coordinated tax is positive under this condition is that the need to attract foreign firms to the home country via lower taxation is less if foreign firms are sufficiently efficient.

To show the potential welfare gains under fiscal independence for a sufficiently large reservation level of profits I shall use $0 < t_o < t^*$ and derive the reservation level of profits

(i.e., demand is not too convex), then $t_{\bar{\pi}} < 0$ i.e., $|X_{\bar{\pi}}| > |\frac{X}{X_t} X_{t\bar{\pi}}|$. Next, differentiation of (7) and (8) yields

$$\left. \frac{dW^f}{d\bar{\pi}} \right|_{t=t^*} = \theta t X_{\bar{\pi}} + \theta t_{\bar{\pi}} (X + t X_t) < 0 \quad ; \quad \left. \frac{dW^h}{d\bar{\pi}} \right|_{t=t^*} = c(t_{\bar{\pi}} X_t + X_{\bar{\pi}}) + X c' (t_{\bar{\pi}} x_t + x_{\bar{\pi}})$$

An exogenous increase in the reservation level of profits lowers welfare in the foreign country. In the home country, welfare falls if changes in income arising from more output are small (i.e., c' is small) and $t_{\bar{\pi}}$ is small.

¹⁴e.g., Bjorvatn and Eckel (2006) and Barro and Cabral (2000) show that under intense competition (i.e., large reservation level of profits) incentives to attract firms raise welfare in the coordinated equilibrium. The key contribution here is that I derive the reservation level of profit under no taxation i.e., fiscal independence.

associated with welfare gains. This is illustrated in figure 3; specifically, for $\tilde{\pi} \in [\tilde{\pi}_1 = (\alpha - 2c)^2/2\theta, \tilde{\pi}_2 = (\alpha - c)^2/2\theta]$ the tax, when set unilaterally by the foreign country, exceeds the coordinated tax associated with fiscal independence i.e., for sufficiently large reservation level of profits fiscal independence, $t_o = 0$, raises global welfare.

Proposition 4. *There are welfare gains under fiscal independence for a sufficiently large reservation level of profits.*

4 When a Subsidy is Offered by the Local Government

One of the policy responses against the flight of firms is for the local government to offer a subsidy. I extend the analysis presented in section 3 by including a lump-sum subsidy payment by the local government to foreign firms operating in that country.¹⁵ The analysis indicates that if such a subsidy is offered, then more foreign firms operate in the host country, thereby raising revenue in the foreign country. In terms of the optimal subsidy, there is a clear distinction between the interest of the foreign and host country. Figure 4 summarizes this result. It is important to note that the subsidy is paid by the host government and thus it raises questions about how best to afford it. It is noteworthy that the optimal subsidy is positively related to the reservation level of profits, thereby putting extra pressure on the local government to keep foreign firms operating in the host country. The policy implication here is that the subsidy might be a viable option up to a point, since the cost of the subsidy may be too high as profit opportunities abroad improve.¹⁶

In the presence of a subsidy the order of events is as follows. The foreign country chooses the tax optimally so as to maximize W^f , and the home country takes that tax as

¹⁵A lump-sum subsidy is used because it is a policy which influences entry/exit decisions while keeping the notion of fiscal interdependence, as defined in the present paper, intact and thus facilitates comparison with results in previous sections.

¹⁶Bjorvatn and Eckel (2006) show that the non-cooperative equilibrium may be characterized by investment incentives (i.e., subsidy) in the case where there is intense competition. In contrast, in the present model the subsidy is offered up to a threshold and actually becomes unsustainable if competition is too intense. Barro and Cabral (2000) show that in some cases welfare in one country rises, but falls in the other country, via subsidies; in the present model, however, both countries gain because welfare gains in one country translate to the other country.

given and chooses the subsidy that maximizes W^h . Firms then take policy as given and maximize profits by choosing the level of output in a Cournot-Nash fashion. The analysis focuses on the case where the optimal subsidy is positive since the focus is on the case where the host country tries to slowdown the exit of foreign firms. The assumption about the order of events seeks to capture the host country's government choice of the subsidy based on the tax or degree of fiscal dependence determined unilaterally by the foreign country. The model is solved using backward induction.

The key difference in the solution of the profit-maximization problem, when compared to the no-subsidy case, is the equilibrium level of output by each firm obtained in the maximization problem. In particular, the profit-maximization problem is given by $\max_{x_i} \pi^i = (p - c_i - \theta t)x_i + S$, where S denotes the lump-sum subsidy, and therefore the first-order condition is analogous to (4). The free-entry condition given in (3) along with the first-order condition of firms yield, under symmetry, the equilibrium output, $x = \sqrt{(\tilde{\pi} - S)/\beta}$, and number of firms, which is analogous to (6). It can be shown that the number firms rises with the subsidy due to higher profits, and as a result each firm's output falls i.e., $x_S = -1/2\beta x < 0$, $n_S = (\alpha - c - \theta t)/2\beta^2 x^3 > 0$, where subscript denote partial derivatives.

4.1 Non-cooperative equilibrium

Consider the welfare functions in the presence of a lump-sum subsidy:

$$\max_S W^h = cnx - nS \quad (17)$$

$$\max_t W^f = \theta tnx \quad (18)$$

where S denotes the lump-sum subsidy to foreign firms operating in the host country. The home country chooses the subsidy so as to maximize (17), taking the tax as given; the first-order condition is characterized by $\partial W^h / \partial S = 0$. It can be shown (I delve into this point below) that the optimal subsidy is positive as long as it lies within a certain range of $\tilde{\pi}$. In particular, taking the tax of the foreign country as given, the first order condition of the

home country is given by $\partial W^h/\partial S = c(xn_s + nx_S) - n - Sn_S = -cx_s - n + Sx_s(n+1)/x = 0$, where $S > 0$ if and only if $\tilde{\pi}_0 > (2\alpha - c - \theta t)^2/4\beta$. I shall restrict the analysis to this range of positive subsidy in order to address the policy issue that motivates this section. As long as the subsidy is positive, it can be shown that the function $W^h(\cdot)$ is strictly concave. In this second stage, the maximization problem yields a subsidy as a function of the tax.

The foreign country maximizes (18), using the subsidy obtained from the second stage. The first-order condition for the foreign country yields $\partial W^f/\partial t = \theta t(x\partial n/\partial t + n\partial x/\partial t) + \theta t S_t(x\partial n/\partial s + n\partial x/\partial s) + \theta nx = 0$, where subscripts denote partial derivatives; thus assuming strict concavity in the $W^f(\cdot)$ function the optimal tax is positive since at $t = 0$, $W_t^f > 0$. Substituting the optimal tax, t^{**} , back into $\partial W^h/\partial S = 0$ yields the optimal subsidy, $S^h = S^h(t^{**})$.

Having characterized optimal policy, figure 4 shows the incentives of the foreign country vis-à-vis the host country, viz., foreign has an incentive to set a relatively high subsidy at the expense of home. That is, given the optimal tax, the subsidy level the foreign country would set exceeds that of the home country, thereby resulting in a welfare reduction in the home country. The analysis also indicates that welfare in the foreign country falls as the subsidy approaches zero. The intuition is that a larger subsidy in home raises revenue in foreign at no cost to the foreign country.¹⁷ Analogously, using $W_t^f = 0$, S^h denotes the subsidy satisfying $W_S^h = 0$, which in figure 4 is positive as long as $\tilde{\pi} > (2\alpha - c)^2/4\beta$.

Using the above analysis, I investigate how an exogenous change in the reservation level of profits affects the optimal subsidy for the home country, assuming that the tax remains fixed. In particular, the pressure on the host government to raise the optimal subsidy, resulting from an increase in profit opportunities abroad, builds up without any tax adjustment from the foreign country; the range of $\tilde{\pi}$ for which this happens is illustrated in

¹⁷The value of $S^f < 0$ in figure 4 is obtained by using the optimal tax and differentiating W^f with respect to the subsidy. $W_t^f = 0$ gives t^{**} . Then, at t^{**} $W_S^f = \theta t/2\beta x > 0$, where $nx_S + xn_S = 1/2\beta x$; hence, $W_{SS}^f > 0$. For the host country the optimal subsidy will be positive as long as the subsidy payments do not exceed the gains in revenue. Formally, the optimal subsidy for the host country is positive if and only if $c - 2\beta nx > 0$.

figure 5 i.e., S^h is positive between $\tilde{\pi}_0$ and $\tilde{\pi}_{00}$ as shown in the dashed area in the figure.¹⁸ The figure also shows $\tilde{\pi}_{00}$ as the value on the 45 degree line where $\tilde{\pi} = S^h$; recall that the non-negativity of x requires $\tilde{\pi} > S^h$ and so the value of S is bounded by $\tilde{\pi}_{00}$. If the reservation level of profits becomes large (i.e., exceeds $\tilde{\pi}_{00}$) subsidy payments become unsustainable for the host country.

Using this range the analysis indicates that, for a given tax, the host country raises the optimal subsidy as profits elsewhere rise. In particular, starting at $\tilde{\pi} \in (\tilde{\pi}_0, \tilde{\pi}_{00})$ differentiation of $W_{S^h}^h(S^h(\tilde{\pi}), \tilde{\pi}) = 0$, yields

$$-W_{S^h S^h}^h \frac{\partial S^h}{\partial \tilde{\pi}} = W_{S^h \tilde{\pi}}^h = \frac{2}{x} \left(\frac{\partial x}{\partial S^h} \right)^2 (c - \beta n x) - \frac{\partial n}{\partial \tilde{\pi}} > 0 \quad (19)$$

where $W_{S^h S^h}^h < 0$ from the concavity of $W^h(\cdot)$, $\partial n / \partial \tilde{\pi} < 0$ and $c - \beta n x > 0$ since $S^h > 0$. This case (i.e., for a given tax) is particularly relevant in a situation where the foreign government does not react to exogenous changes in the reservation level of profits.

The pressure of subsidy payments on the host government may also arise from changes in the effective tax via θ . The idea here is that the effective tax may rise for political or regulatory reasons e.g., the foreign country unilaterally raises the tax seeking a close fiscal relation or cost-increasing regulations in the foreign country are applied to the home country. Intuitively, an increase in the effective tax (increase in θ) reduces the number of foreign firms operating in the host country. As a result, the host government responds with subsidy payments to avoid the exit of firms. In the standard case where the tax and subsidy are positive the change in the subsidy, S^h , is given by

$$-W_{S^h S^h}^h \frac{\partial S^h}{\partial \theta} = W_{S^h \theta}^h = \frac{t(2\pi - 3S^h)}{2\beta^2 x^3} > 0 \quad (20)$$

where $W_{S^h S^h}^h = 0$ implies $n(2\pi - 3S^h)/x = (c + S^h/x) > 0$. The relation between θ and S captures the interplay between political factors and subsidy payments in the home country.

¹⁸Formally, $S^h > 0$ if and only if $\tilde{\pi}_0 > (2\alpha - c)^2/4\beta$. This condition is derived evaluating $\partial W^h / \partial S$ at $S = 0$ and solving for $\tilde{\pi}$ in $c - 2\beta x n > 0$, while keeping constant the optimal tax chosen by the foreign country.

Next, I look at the extent to which the host country changes its subsidy payments due to a change in the reservation level of profits via the tax. If the effective tax falls via t because, say, $\tilde{\pi}$ rises, then the subsidy falls as a result. This suggests that as profit opportunities abroad become large, the incentives to set a higher tax by the foreign country diminish thereby reducing the pressure by the host country to set a positive subsidy to attract firms. In particular, differentiation of $S^h = S^h(t(\tilde{\pi}), \tilde{\pi})$ gives (subscripts denote partial derivatives)

$$dS^h/d\tilde{\pi} = S_t^h t_{\tilde{\pi}} + S_{\tilde{\pi}}^h \quad (21)$$

where the sign of (21) is in general ambiguous. The term $S_{\tilde{\pi}}^h > 0$ is given by (19); and the term $t_{\tilde{\pi}} < 0$ is obtained by differentiating $W_t^f(t(\tilde{\pi}), \tilde{\pi}) = 0 \Rightarrow -W_{tt}^f t_{\tilde{\pi}} = -\theta x_{\tilde{\pi}} < 0$, since $x_{\tilde{\pi}} > 0$. The term S_t^h is obtained by differentiating $W_{S^h}^h(S^h(t), t) = 0 \Rightarrow W_{S^h S^h}^h S_t^h = -n_t + S^h x_{S^h} n_t > 0$, since a positive optimal subsidy is assumed. The first term in (21) captures the interplay between the tax adjustment as $\tilde{\pi}$ rises and the subsequent adjustment in the subsidy; this term is negative because a decrease in the tax, resulting from a higher reservation level of profits, requires lower subsidy payments by the home government, which suggests that subsidy payments subside in an equilibrium characterized by relatively more fiscal independence. If this effect is large (small) then the home country lowers (raises) subsidy payments.

Proposition 5. *If the reservation level of profits is sufficiently large, then subsidy payments become unsustainable for the host country. Subsidy payments subside under fiscal independence.*

It is noteworthy that the opposing interests across the two countries about the optimal tax do not change in the presence of the subsidy, meaning that a zero-tax is in the best interest of the home country. This result is analogous to the one derived in the previous section.¹⁹

¹⁹At the optimal subsidy (i.e., using $W_s^h = 0$, the fact that $W^h = n(cx - S) > 0$ and $n_t < 0$), $W_t^h = (cx - S)n_t < 0$ and $W_{tt}^h = -n_t S_t > 0$, where differentiation of the first order condition $W_S^h(S(t), t) = 0$ yields $-W_{SS}^h S_t = W_{St}^h > 0$, where $W_{St} = n_t X_S(-1 + cx_S)/xn_S > 0$ and $W_{SS}^h < 0$ from the concavity of the $W^h(\cdot)$ function.

4.2 Cooperative equilibrium

Next, I examine the tax-subsidy policy vis-à-vis the non-cooperative equilibrium. The key result here is that there are welfare gains from fiscal independence, particularly as the reservation level of profits becomes large.²⁰ To characterize the coordinated policy, global welfare, $W^h + W^f$, is maximized first with respect to the subsidy; this characterization is then used to maximize global welfare with respect to the tax. In particular,

$$\frac{\partial(W^h + W^f)}{\partial S} = (c + \theta t) \left(x \frac{\partial n}{\partial S} + n \frac{\partial x}{\partial S} \right) - n - S \frac{\partial n}{\partial S} = 0 \Rightarrow \tilde{S} = \tilde{S}(t) \quad (22)$$

The coordinated tax is chosen so as to maximize global welfare imposing the condition in (22):

$$\begin{aligned} \left. \frac{\partial(W^h + W^f)}{\partial t} \right|_{\tilde{S}} &= (c + \theta t)x \frac{\partial n}{\partial t} + nx\theta - S \frac{\partial n}{\partial t} + \left((c + \theta t) \left(x \frac{\partial n}{\partial S} + n \frac{\partial x}{\partial S} \right) - n - S \frac{\partial n}{\partial S} \right) S_t \\ &= ((c + \theta t)x - S) \frac{\partial n}{\partial t} + nx\theta = 0 \end{aligned} \quad (23)$$

whence, using (22):

$$2\theta t = \alpha - 2c - 2\beta x \quad (24)$$

Using (24) in (22) yields the coordinated subsidy $S^{fb} = \tilde{\pi}/2$; hence, substituting S^{fb} into (24) gives the coordinated tax $2\theta t^{fb} = (\alpha - c - \beta\sqrt{\tilde{\pi}/2\beta}) - c - \beta\sqrt{\tilde{\pi}/2\beta}$, where $x = \sqrt{\tilde{\pi}/2\beta}$. As in the case with no subsidy, the coordinated tax is positive if firms are sufficiently efficient i.e., $t^{fb} > 0 \Leftrightarrow c < (\alpha - \beta x)/2$.

Next, I compare policies with the non-cooperative equilibrium. First, evaluating (22) at the non-cooperative subsidy, S^h , indicates that the coordinated subsidy exceeds the subsidy from the non-cooperative equilibrium (i.e., $S^{fb} > S^h$) as long as the tax is positive;

²⁰Barro and Cabral (2000), Bjovattn and Eckel (2006) and Haufler and Wooton (2005) show that under certain conditions about market size and degree of competition incentives (subsidies/lower taxation) raise welfare in the coordinated equilibrium. The contribution here is that, in the presence of fiscal interdependence, incentives via lower taxation and subsidies raise global welfare at any level of competition (i.e., reservation level of profits) to attract FDI.

that is,

$$\frac{\partial(W^h + W^f)}{\partial S} \Big|_{S^h} = \theta t \left(n \frac{\partial x}{\partial S} + x \frac{\partial n}{\partial S} \right) > 0 \quad (25)$$

where S^h satisfies $\partial W^h / \partial S = 0$ from the non-cooperative equilibrium. Second, evaluating $\partial(W^h + W^f) / \partial t$ at the non-cooperative tax, t^{**} , indicates that the coordinated tax is smaller i.e., $t^{fb} < t^{**}$.

These results indicate that there are welfare gains in an equilibrium closer to fiscal independence. Using the closed-form solutions for the tax and subsidy it is easy to see that taxation falls and the subsidy rises as profit opportunities for foreign firms elsewhere improve; this is consistent with the result in the case where there is no subsidy, particularly as the reservation level of profits becomes large. [Results also indicate that it is in the interest of the two countries to encourage foreign firms to invest](#) in the home (host) country both via lower taxation (set by the foreign country) and subsidies (set by the home country) for any positive level $\tilde{\pi}$; this is because incentives raise employment in the home country and tax revenue in the foreign country. It is noteworthy that because of the opposing interests across countries subsidization for all values of $\tilde{\pi}$ contrasts with the non-cooperative subsidy where the subsidy is positive for a specific range of $\tilde{\pi}$; this suggests the need for subsidies to raise global welfare.

Proposition 6. *There are welfare gains under fiscal independence, particularly for sufficiently large reservation level of profits. There are also welfare gains under subsidy payments for any reservation level of profits.*

5 Conclusion

This paper develops a partial equilibrium model to analyze the effects of export-oriented foreign firms operating in the host country. At the center of the analysis is that the host country's main (only) source of employment arises from foreign firms; the key component in

the foreign country's welfare is the revenue it derives from foreign firms in the host country. A key difference with the literature is that part of the incentive scheme to promote employment in the host country is set unilaterally by the foreign government. In this setting it is shown that a zero-tax equilibrium is in the interest of the host country. This result follows through in the case where the foreign country is also the consuming country [and subsidy payments are made available to the host country as a policy tool](#). In the present paper a small-tax equilibrium represents the case where the foreign and host country relate to a lesser extent in the sense that the tax revenue that flows from the host country to the foreign country vanishes. This is what I refer to as an equilibrium of fiscal independence. The analysis is particularly relevant to the case of US possessions where the level of employment provided by foreign (American) corporations in oligopolistic industries has been at the center of policy making. In some cases the level of employment in these sectors shows a sharp decline along with the demise of the relatively aggressive incentives for US corporations (Federal Reserve Bank of New York 2012); the analysis suggests that a more independent policymaking setting would benefit all parties.

Inevitably, the analysis rests on a set of assumptions which limits the generality of some results and which could be relaxed to expand the analysis. [First, although some of the results follow through under a non-linear demand setting where demand is not too convex, relaxing the linearity assumption is a natural extension of the analysis. Therefore, results should be understood in that context.](#) Second, the analysis does not take into account general equilibrium effects and other aspects such as the large transfer payments from the US government to low-income households in its possessions and its effects on employment in other sectors of the economy. The implications of labor mobility are not considered either; this is a potentially relevant extension of the model given the degree of labor mobility from US possessions to the US mainland. The analysis, however, focuses on an industry which is quite isolated in terms of forward and backward linkages (for the case of Puerto Rico see Dietz 2003), but that it has had an important role in the development process of the

economy e.g., financial and construction sectors. [An extension along the lines of Ishikawa and Spencer \(1999\)](#) is likely to add a new, richer dimension to the analysis. Third, the analysis does not model potential sources of unemployment such as labor productivity. In the case of Puerto Rico, for example, evidence suggests that in the manufacturing sector labor productivity has shown a reduction since 1975 (Collins et al 2006, p. 35). Labor productivity is important in that it may further exacerbate the employment effects arising from foreign corporations. Fourth, policy questions about the feasibility of a more diversified industry and product differentiation are not addressed here, even though they have been mentioned in the literature as important aspects for the manufacturing sector to recover (Ramcharan 2011). Another potential extension of the model is to endogenize the political process by modeling the choice of θ . This would help study potential offsetting effects between the economic and political objectives between the host and foreign country.

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Figure 1: Total employment manufacturing sector in Puerto Rico (1990-2013), seasonally adjusted. Source:BLS

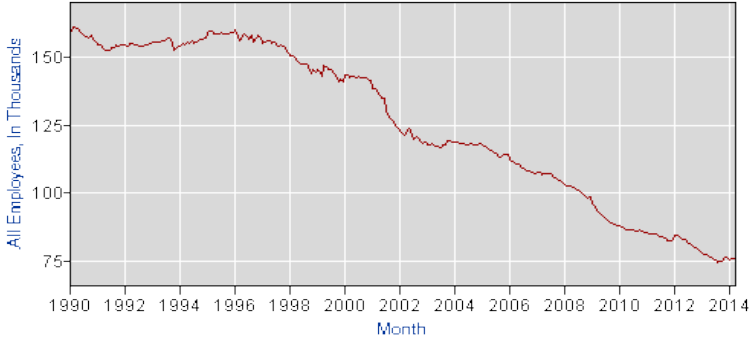


Figure 2: Welfare and the Tax

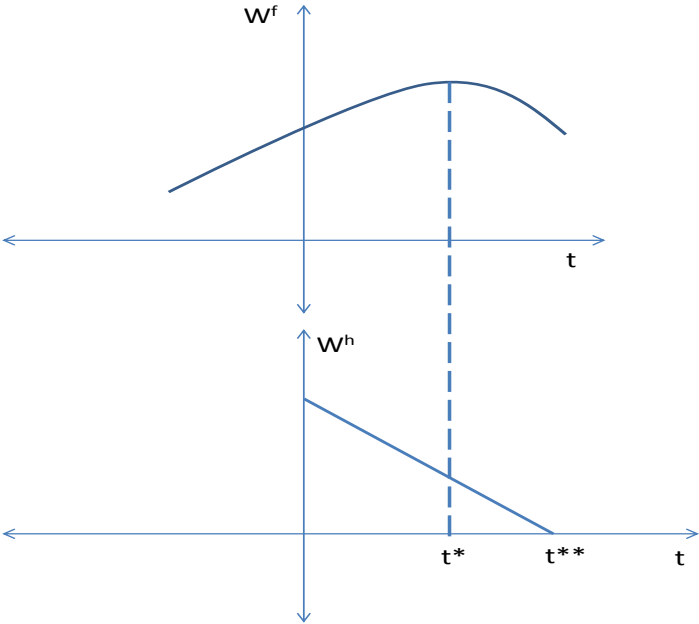


Figure 3: Welfare Gains from Large Profits

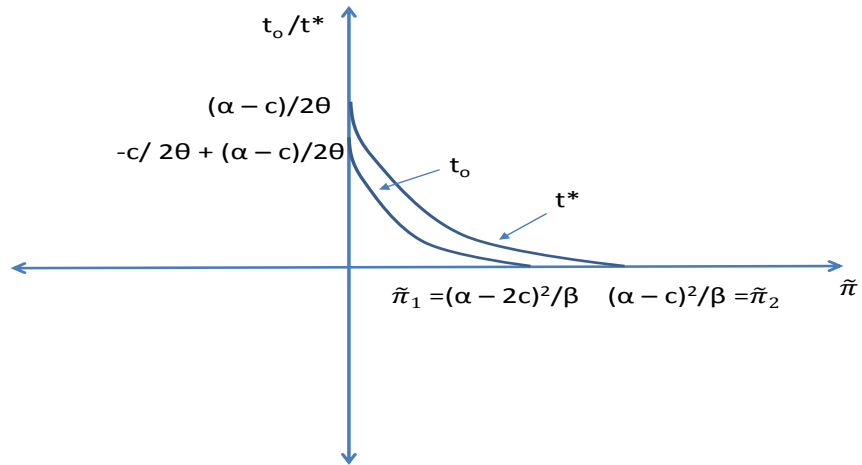


Figure 4: Welfare and the Subsidy

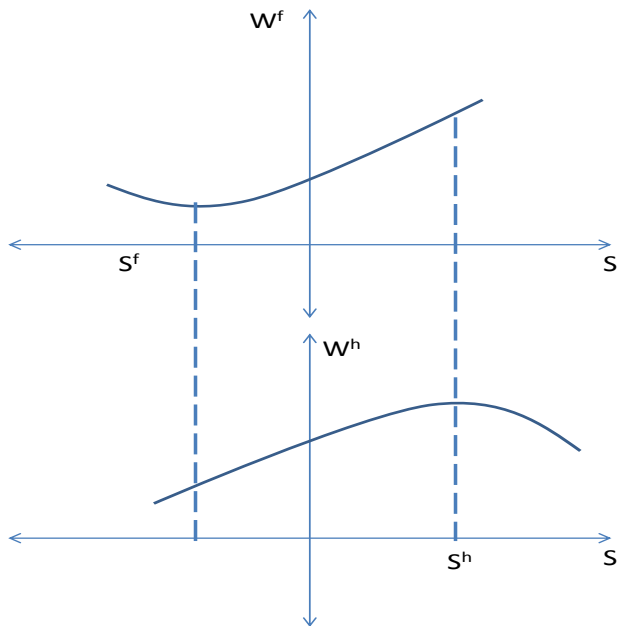


Figure 5: Profits and the Subsidy

