An Evaluation of the Employment Effects of Barriers to Outsourcing

Subhayu Bandyopadhyay[a*], Sugata Marjit[b], Lei Yang[c]

[a]*Federal Reserve Bank of St. Louis and IZA, Bonn*
[b]*Center for Studies in Social Sciences, India*
[c]*The Hong Kong Polytechnic University, Hong Kong*

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Abstract

Barriers to outsourcing that are being currently implemented in the US effectively tax its companies who "export" jobs through outsourcing. The objective is to raise domestic employment. Given that many of the important international markets where the US has a comparative advantage feature non-atomistic firms, we evaluate the implications of such policies in an oligopolistic context. We find that while an outsourcing tax favors domestic workers by causing firms to switch to a greater use of domestic sources (the substitution effect), the loss in international competitiveness has a negative volume effect (the output effect), which pulls in the other direction. First, we identify the conditions that determine the relative strengths of these effects, which inform us about the conditions under which such a tax achieves its stated objective. Next, we consider the international policy interdependence that arises when a competing nation also engages in such a policy. An interesting finding is that even if a unilateral tax by the US raises its employment, this may turn around in a Nash policy equilibrium, where the competing nation abandons free trade and also engages in unilateral outsourcing policies. Finally, we extend the basic model to look at the effects of credit shortage and product differentiation. Interesting findings are that both a credit crisis (as in recent years) and increased product differentiation tend to worsen the employment effects of the outsourcing tax. The qualitative nature of our findings is similar between Cournot and Bertrand competition, suggesting that our results are robust to the mode of strategic behavior.

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*Corresponding author: Research Division, Federal Reserve Bank of St. Louis, PO Box 442, St. Louis, MO 63166-0442, USA. E-mail: bandyopadhyay@stls.frb.org; Tel: 314-444-7425; Fax: 314-444-8731. The views expressed are those of the authors and do not necessarily represent official positions of the Federal Reserve Bank of St. Louis or of the Federal Reserve System.

1   Introduction

Global outsourcing has emerged as a major economic strategy for firms in developed nations in the face of global competition and rising domestic labor costs. This process has been facilitated by a revolutionary transformation of information technology. In turn this has benefited developing nations like India, which has cheaper labor which is sufficiently skilled to take advantage of such technologies. Software and service exports have grown at a rapid pace. Tele and computer networking, and international time differences have made virtual business a round-the-clock affair.[1] While this has led to significant productivity gains in developed nations, it has also fueled debate on how this may impact their labor force. While the substitution effect of hiring cheaper foreign labor is negative for US employment, the total effect is ambiguous. This is because increased profitability for US firms (through the efficiencies achieved in production) allow them to expand operations, and this volume effect raises domestic employment. The total effect of outsourcing can therefore be positive.

The recent global recession has hit US labor markets, among others, quite hard. While national income has stabilized, unemployment is high, and perhaps is yet to peak. If the economy follows the "jobless recovery" path of some earlier recessions, it will take quite a few years for unemployment to come down to more acceptable levels. The political realities in these uncertain times call for employment generating policies until the fears of continuing high levels of unemployment are alleviated. Recently, the US Senate has passed a bill that would raise the visa fees for affected companies (ones with US staff, who have more than half of their US-based employees on H1-B or L-1 visas) by around $2000 per visa application (see Sharma and Johnson, 2010). This bill is most relevant to the technology outsourcing companies, and its objective is to incentivize these companies to hire more local workers.[2] In a recent speech in Parma, Ohio, President Obama suggested that he would like to reform tax codes in such a way that there is less incentive for US companies to outsource jobs (see White House press release dated 9/8/2010, available at www.whitehouse.gov). Another recent example of government opposition to outsourcing is Executive Order 2010-09S of Governor Ted Strickland of Ohio, which bans the use of public funds for the purchase of services provided offshore. This order (available at http://governor.ohio.gov/) explicitly

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[1] See Bhagwati et al. (2004) for a discussion of the evolution of different types of outsourcing.
[2] For a comparison of the labor market effects of outsourcing and immigration, see Jones (2005).

links the ban to the lack of employment opportunities due to the recent recession:

"Ohio's Economic Vitality Necessitates Constant Vigilance in State Job Creation Efforts. State officials and employees must at all times remain passionately focused on initiatives that will create and retain jobs in the United States in general and in Ohio, in particular, and must do so especially during Ohio's continuing efforts to recover from the recent global recession."

It is, however, not clear that these proposed policies will raise domestic employment. Indeed, if the contractionary effect of such a barrier dominates the incentive effect to hire local workers, domestic employment will fall. This is all the more plausible in the longer run, when the companies have had a chance to adjust their production and location plans. Such considerations call for a careful analytical discussion of the wisdom of these policies. Bearing in mind that many of the outsourcing firms are non-atomistic, strategic considerations are also important. To capture this, we depart from some of the recent influential papers like Grossman and Rossi-Hansberg (2008) and Acemoglu and Autor (2010), which operate in a competitive context. As will become evident, there is some similarity between our framework and theirs' in the modeling of production technology. Oligopolistic behavior in our model, however, leads to a non-trivial departure because of at least two reasons. First, by considering a non-atomistic framework, we capture the reality faced by many of the larger outsourcing firms like the technology giants Microsoft, Intel, Infosys etc. Second, in such an environment, cost asymmetries between firms are critically important in determining market shares. In turn, this determines domestic employment. Thus, outsourcing policies that are designed to generate domestic employment may end up being self-defeating if market share transfer effects are large.[3] We derive several other results which highlight the importance of using an oligopolistic framework.[4]

The academic literature on outsourcing has expanded at a fast pace. Grossman and Helpman (2005) and others discuss modus-operandi, contractual designs and consequences of outsourcing and contrast the mechanism with foreign direct investment and other types of foreign factor mobility. Kikuchi (2006) and Marjit (2007) discuss emergence of outsourc-

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[3] For an analysis of the effects of cost asymmetries on market shares see Neary (1994) and Lahiri and Ono (2004), among others.

[4] It is important to note that the empirical results pertaining to the effects of outsourcing on employment are far from conclusive. A nice example is the contribution by Harrison and McMillan (2006) who find that outsourcing raises (reduces) US employment if firms are to perform significantly different (similar) tasks in foreign affiliates and at home.

ing in separated time zones. Batra and Beladi (2010) provide a factor proportions model of outsourcing, while Mitra and Ranjan (2010) consider the effects of outsourcing on unemployment generated by search frictions. Chen et al. (2004) and Zhao (2001) provide analyses of outsourcing in oligopolistic contexts, but their focus is completely different from ours. The former paper analyzes strategic incentives to buy intermediate inputs provided by a foreign firm, where the domestic and the foreign firm compete oligopolistically in the final goods market. On the other hand, Zhao (2001) focuses on the possibility that a vertically integrated unionized firm may want to outsource and move its production process horizontally, so that it is able to hedge against disruptions caused by the domestic union.

Our production structure is somewhat similar to Grossman and Rossi-Hansberg (2008). It also draws from an earlier literature with contributions from Dornbusch, Fischer, and Samuelson (1977), Sanyal (1983) and Marjit (1987), in that we model outsourcing in terms of a continuum of stages of production. An important novelty of this paper is that we embed this production technology in a tractable oligopolistic framework. Our analysis of competing employment generating policies by two rival nations, is, to our knowledge, also novel to the literature.

We highlight some of our findings below. We show that the relative efficiency of the US firm with respect to its foreign competitor as well as the degree of product differentiation between US and foreign products dictate the strength of the substitution effect relative to the contractionary employment effect of an outsourcing tax. We also consider the possibility that foreign nations may be pursuing outsourcing policies to augment their domestic employment. In an oligopolistic international market, this leads to outsourcing policies of the US to be interdependent with those of foreign exporting nations (say EU). This interdependence is characterized by the Nash equilibrium in employment maximizing outsourcing policies (taxes or subsidies). Several interesting results emerge, including the possibility that although a unilateral outsourcing tax of the US may raise employment if EU were to commit to free trade, this may turn around if EU also intervenes.

Finally, the outsourcing policies need to be carefully analyzed in the light of the continuing problems of the global economy. In particular, the fall in consumer demand and global financial tightening are affecting firms' decisions. In this context, our paper is one of the first to establish a link between credit shortage and the employment effects of outsourcing taxes.

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We find that global financial tightening strengthens the output effect of the outsourcing tax, thereby making it more likely to reduce domestic employment. Similar results are obtained for a fall in consumer demand. Therefore, the current recessionary environment seems to be a particularly bad time to impose barriers to outsourcing.

The rest of the paper is organized into five sections. Section 2 presents the basic homogeneous good Cournot model. Section 3 considers outsourcing by both exporting nations (say US and EU) and the properties of Nash equilibrium in employment maximizing outsourcing taxes. Section 4 considers cooperative outsourcing taxes. Section 5 extends the basic model to consider capital costs, and product differentiation in the context of both Bertrand and Cournot competition. Section 6 concludes.

2 The Basic Homogeneous Good Model

There are n symmetric US firms engaged in Cournot competition with n^E foreign firms from the EU, selling a homogeneous good in the global market. Labor is the only factor of production. The EU firms remain passive as far as outsourcing goes (we relax this assumption in the next section), and needs α workers per unit of output paying them a wage w^E. The US firms are engaged in active outsourcing and require one unit of labor to produce one unit of output. The production process is fragmented in stages indexed by $z \in [0, 1]$. While $a(z)$ is per unit labor requirement in the US to produce the z-th. stage, it is $a^*(z)$ in India.

Relative efficiency of Indian and US workers are such that we can rank them as follows

$$r(z) = \frac{a^*(z)}{a(z)}, r' > 0. \tag{1}$$

In effect, we assume that the Indian workers have comparative advantage in earlier stages of production. Wages in the US and India are w and w^*, respectively. Barriers to outsourcing are captured through a tax t on outsourcing, so that the effective Indian wage facing US companies is $w^*(1 + t)$. Define

$$A(\tilde{z}) = \int\limits_{0}^{\bar{z}} a(z)dz, \tag{2}$$

and,

$$A^*(\tilde{z}) = \int_0^{\bar{z}} a^*(z)dz. \tag{3}$$

and assume

$$A(1) = A^*(1) = 1. \tag{4}$$

An implication of (4) above is that neither nations dominates the other in terms of overall labor productivity. However, the relative productivity of the different stages differ such that it is possible for a firm to get higher productivity by carrying out some stages of production in one of the nations, while carrying out the rest in the other. The cost minimizing allocation of this production decision is similar to Grossman and Rossi-Hansberg (2008) and described below.[5]

The staging of the game is as follows. In stage 1, US firms optimally choose outsourcing, i.e. what fraction of the production process will be outsourced to India. In stage 2, they engage in Cournot competition with the EU firms. Let $\tilde{z}$ be such that

$$r(\tilde{z}) = \frac{w}{w^*(1+t)} \Rightarrow \tilde{z} = \tilde{z}(w, w^*, t). \tag{5}$$

This equation represents the cost minimization decision of a firm. Given $r'(z) > 0$, it must be that $\forall z > \tilde{z}$, $\frac{w}{w^*(1+t)} < r(z)$, implying that a US firm can reduce its cost of production by switching the process z from India to the US. The opposite is true when $\frac{w}{w^*(1+t)} > r(z)$. This is demonstrated in Figure 1. Therefore, $z \in [0, \tilde{z}]$ is outsourced to India and $z \in [\tilde{z}, 1]$ is sourced locally. Hence, the constant marginal cost of a US firm is given by

$$\tilde{c} = w[1 - A(\tilde{z})] + w^*(1+t)A^*(\tilde{z}). \tag{6}$$

The constant marginal cost of a EU firm is

$$c^E = \alpha w^E. \tag{7}$$

Let q_i be the output of the i-th US firm, and q_j^E of the j-th EU firm. We assume a simple linear inverse demand function for the final good,

$$p = \gamma - \left(\sum_{i=1}^n q_i + \sum_{i=1}^{n^E} q_j^E\right) = \gamma - Q - Q^E, \tag{8}$$

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[5]This decision is also similar to equation (2), page 585, of Dixit and Grossman (1982).

where Q and Q^E are the aggregate US and EU output, respectively. The Nash-Cournot first order conditions for profit maximization are:

$$p - \tilde{c} - q_i = 0, \Rightarrow q_i = q = p - \tilde{c}, \tag{9a}$$

$$p - c^E - q_j^E = 0, \Rightarrow q_j^E = q^E = p - c^E, \text{ and,} \tag{9b}$$

$$q - q^E = c^E - \tilde{c}. \tag{9c}$$

Standard calculations yield:

$$Q = nq = (\frac{n}{n + n^E + 1})[\gamma - (n^E + 1)\tilde{c} + n^E c^E], \tag{10a}$$

$$Q^E = n^E q^E = (\frac{n^E}{n + n^E + 1})[\gamma - (n + 1)c^E + n\tilde{c}]. \tag{10b}$$

Proposition 1 *An outsourcing tax will reduce US employment if and only if the substitution effect of the tax is dominated by the negative output effect of the tax. The output effect is more likely to dominate when: (i) the market size is smaller; (ii) there is a greater number of EU firms; and, (iii) the US and Indian technology are more different.*

Proof. Aggregate employment in the outsourced industry in the US is given by

$$L = [1 - A(\tilde{z})]Q \Rightarrow \frac{\partial L}{\partial t} < 0 \text{ iff } [1 - A(\tilde{z})]\frac{\partial Q}{\partial t} < QA'(\tilde{z})\frac{\partial \tilde{z}}{\partial t}. \tag{11}$$

The left hand side of the second inequality of (11) is the output effect on domestic employment arising out of the impact of the tax on aggregate domestic output. If output falls, domestic employment must also fall at a given $\tilde{z}$. The right hand side captures the substitution effect, where a higher tax will cause the home firms to switch to a greater use of domestic sources. The relative strength of these effects determines whether outsourcing can achieve its desired objective of domestic employment creation. Using (5),

$$\frac{\partial \tilde{z}}{\partial t} = -\frac{r(\tilde{z})}{(1 + t)r'(\tilde{z})} < 0. \tag{12}$$

Using the envelope property of the cost minimization problem:

$$\frac{\partial \tilde{c}}{\partial t} = w^* A^*. \tag{13}$$

Differentiating (10a) and using (13),

$$\frac{\partial Q}{\partial t} = -(\frac{n}{1+n+n^E})(1+n^E)w^*A^*. \tag{14}$$

Noting that: $A'(\tilde{z}) = a(\tilde{z})$, and using (5), (10a), (12) and (14) in (11), we have:

$$\frac{\partial L}{\partial t} < 0 \text{ iff}$$

$$w^*(1+t) > \frac{a(\tilde{z}(.))r(\tilde{z}(.))[\gamma - \tilde{c}(w, w^*, t)(1+n^E) + n^E c^E]}{(1+n^E)[1 - A(\tilde{z}(.))]A^*(\tilde{z}(.))r'(\tilde{z}(.))}. \tag{15}$$

The subsections below discuss each of the cases and establish the numbered claims made in the proposition above. ∎

2.1   Market Size:

A fall in γ, which captures the size of the market, does not affect $\tilde{z}$. It reduces the right hand side of (15) without affecting the left hand side, making it more likely to be satisfied. One can expect that a global recession will decrease demand because of lower incomes (i.e., reduce γ). On the other hand, the pressure on the government to raise employment is the greatest in such times. If the government responds by raising the outsourcing tax, it is more likely to be counterproductive.

2.2   Foreign Competition, Cost Asymmetry and Market Share Effects:

It is easy to show that when n^E rises, the right hand side of (15) falls, making it more likely to be satisfied. To see why this happens, consider the following ratio:

$$-\frac{(\frac{\partial Q}{\partial t})}{Q} = \frac{(1+n^E)w^*A^*}{[\gamma - \tilde{c} + n^E(c^E - \tilde{c})]} = \frac{(1+n^E)(\frac{\partial \tilde{c}}{\partial t})}{[\gamma - \tilde{c} + n^E(q - q^E)]}. \tag{16a}$$

The numerator of (16a) captures the scale effect of the outsourcing tax from a change in the output, while the denominator the substitution effect (from foreign to domestic labor) at a given output level. Under initial symmetry of costs (i.e., $c^E = \tilde{c}$), a rise in n^E cannot change the denominator of (16a). The numerator, however, rises making the scale effect stronger, and thus raising the likelihood of an employment reduction (from an outsourcing tax). The intuition is the following. First, notice that the tax pushes up $\tilde{c}$ (above c^E) and transfers market share to each foreign firm to the tune of:

$$\frac{\partial(q^E - q)}{\partial t} = \frac{\partial(\tilde{c} - c^E)}{\partial t} = \frac{\partial \tilde{c}}{\partial t}. \tag{16b}$$

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Therefore, the total market share transfer due to this effect is: $[n^E(\frac{\partial \tilde{c}}{\partial t})]$. The larger the number of foreign firms, the greater is this transfer effect, resulting in a more substantial domestic output reduction because of the tax. Under initial cost asymmetry, if foreign cost is higher (i.e., if $c^E > \tilde{c}$), home firms have proportionally larger market share at the initial equilibrium. In turn, this implies the denominator of (16a) must rise with n^E. But even in this case, it is easy to show that the ratio in (16a) must rise as the numerator rises faster. In summary, the cost raising effect of t and thus the transfer of market share gets magnified in the presence of a larger number of foreign firms. This market share transfer effect favors employment reduction (from an outsourcing tax) regardless of the pattern of initial cost asymmetry.

2.3   Technology Difference Between the US and India:

Consider the possibility that the US and India have identical technology. In this case $a(z) = a^*(z)$ for all z, and $r(z) \equiv 1$. This situation is described in Figure 2. Clearly, no interior solution can exist in this situation as long as US and Indian wage costs differ. If $w/w^*(1 + t) > 1$, all of the production is outsourced to India. Consider now two different technology profiles, 1 and 2, respectively: $[a^1(z), a^{*1}(z)]$, and $[a^2(z), a^{*2}(z)]$. Therefore:

$$r^1(z) = \frac{a^{*1}(z)}{a^1(z)}, \text{ and } r^2(z) = \frac{a^{*2}(z)}{a^2(z)}. \tag{17}$$

Also, assume that:

$$r^1(z) = r^2(z) = 1, \text{ at } z = \bar{z}. \tag{18}$$

US technology is closer to Indian technology in profile 1 (compared to profile 2) if:

$$|1 - r^1(z)| \leq |1 - r^2(z)|, \text{ for all } z. \tag{19}$$

Figure 2 graphs $r^i(z)$ and shows that when $w/w^*(1 + t) > 1$, the equilibrium level of outsourcing for profile 1 ($\tilde{z}^1$) must exceed that of profile 2 ($\tilde{z}^2$). Also, in the linear case, a rise in the outsourcing tax must lead to a much sharper level of decline in outsourcing for profile 1 compared to profile 2, because of the former's greater elasticity.

Overall, the message here is that when US and Indian technologies differ a lot, the $r(z)$ schedule in Figure 2 is likely to be relatively inelastic and therefore an outsourcing tax will

more likely reduce employment. We should note that we have to temper this conclusion because the elasticity of the $r(z)$ scehdule is endogenous. The different technology profiles here are asscoiated in equilibrium with different levels of z. Therefore, elasticity alone does not allow us to make a definitive statement about the direction of the employment effect of an outsourcing tax.

3   Outsourcing By Both the US and EU and Nash Employment Maximizing Taxes

It is typical in the strategic trade policy literature for a government to focus on trade policies that maximize the net rent earned by the nation. However, as we have discussed earlier, the current political compulsions of reducing unemployment are pivotal. In this context, it is reasonable to consider employment maximization as an objective of the government. To simplify the analysis and to avoid a boring taxonomy of cases, we focus on the employment objective, rather than on a mix of different objectives. It is, however, not difficult to extend this analysis to consider an objective function that is constituted of both employment and of rents earned by the nation.[6] We also extend the basic model to allow for outsourcing done by the EU firms and to consider outsourcing policy by the EU as well. As will become evident below, the outsourcing policy choices of the US and EU are interdependent. Consequently, we analyze the Nash outsourcing policy equilibrium that arises in this context. Several interesting results are derived, which inform us about the qualitative nature of outcomes that are associated with such a strategic equilibrium. As in the US case, the production process is fragmented in stages indexed by $z^E \in [0,1]$. Let $a^E(z^E)$ be the per unit labor requirement in the EU to produce the stage z^E, while it is $a^{*E}(z^E)$ in India. As in (1):

$$r^E(z^E) = \frac{a^{*E}(z^E)}{a^E(z^E)}, \, r^{E\prime} > 0. \tag{20}$$

That is, we assume that the Indian workers have comparative advantage in earlier stages

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[6] See Mukherjee and Suetrong (2009) for an interesting analysis of oligopolistic markets where a nationalized firm's objective is to maximize a combination of profit and national welfare. Although we do not pursue such modeling here, an analogous formulation could consider the government's objective as a convex combination of national rents and the employment level. The weight on employment could derive from political economy considerations in an era of high unemployment and unequal distribution of assets among the voting population. This will be the case if most voters are laborers without corresponding access to the rents earned in the form of oligopolistic profits.

of production compared to EU. As in (2):

$$A^E(\tilde{z}^E) = \int_0^{\tilde{z}^E} a^E(z^E)dz^E, \tag{21}$$

and,

$$A^{*E}(\tilde{z}^E) = \int_0^{\tilde{z}^E} a^{*E}(z^E)dz^E. \tag{22}$$

and assume

$$A^E(1) = A^{*E}(1) = 1. \tag{23}$$

Let w^E and t^E be the wage rate and the outsourcing tax rate of the EU, respectively. Using the same staging of the game as before, cost minimization by EU firms must imply that $z^E \in [0, \tilde{z}^E]$ will be outsourced to India and $z^E \in [\tilde{z}^E, 1]$ will be sourced locally, where

$$\frac{w^E}{w^*(1 + t^E)} = r^E(\tilde{z}^E) \Rightarrow \tilde{z}^E = \tilde{z}^E(w^E, w^*, t^E) \tag{24}$$

The constant marginal cost of a EU firm is

$$c^E = w^E[1 - A^E(\tilde{z}^E)] + w^*(1 + t^E)A^{*E}(\tilde{z}^E). \tag{25}$$

The employment level in the EU is

$$L^E = [1 - A^E(\tilde{z}^E)]Q^E. \tag{26}$$

Notice from equations (5) through (11), that while $\tilde{z}$ is independent of t^E, the home output Q is not, because c^E is affected by changes in t^E. Therefore, home employment L is also affected by t^E. Thus, the outsourcing taxes that seek to increase employment in the EU and US are interdependent. We analyze this interdependence through the Nash assumption. That is, the US assumes t^E to be given when choosing its employment maximizing outsourcing tax rate, and the EU behaves analogously. Formally, the first order conditions of the choice of outsourcing tax for the two nations define their respective Nash reaction functions as:

$$L_t(t, t^E) = 0 \Rightarrow t = t(t^E); \text{ and,} \tag{27a}$$

$$L^E_{t^E}(t, t^E) = 0 \Rightarrow t^E = t^E(t). \tag{27b}$$

Lemma 1 *The outsourcing taxes in the US and EU are strategic complements for each other.*

Proof. From (27a):

$$\frac{\partial t}{\partial t^E} = \frac{L_{tt^E}}{(-L_{tt})}. \tag{28}$$

Since the second order condition of the US outsourcing tax requires that $L_{tt} < 0^7$, the sign of the US reaction function depends on L_{tt^E}, where

$$L_{tt^E} = -a(\tilde{z})(\frac{\partial \tilde{z}}{\partial t})(\frac{\partial Q}{\partial t^E}), \text{ where } \frac{\partial Q}{\partial t^E} = \frac{nn^E w^* A^{*E}(\tilde{z}^E)}{n + n^E + 1} > 0. \tag{29}$$

Using (29) and recalling from (12) that $\frac{\partial \tilde{z}}{\partial t} < 0$, L_{tt^E} must be positive. Therefore, the US reaction function must be positively sloped. Similarly, the EU reaction function is also positively sloped. ∎

Proposition 2 *At a symmetric Nash equilibrium with positive outsourcing taxes, the Nash employment level exceeds the free trade level. In a symmetric subsidy equilibrium, the employment level may or may not exceed the free trade level.*

Proof. Notice that the equation of an iso-employment curve for the US is:

$$L(t, t^E) = \bar{L} \Rightarrow (\frac{dt^E}{dt})_{|\bar{L}} = -\frac{L_t}{L_{t^E}}. \tag{30}$$

Using (27a) in (30) it is clear that the slope of the iso-employment curve for the US is zero on its reaction function. Further, using (29)

$$L_{t^E} = (1 - A)Q_{t^E} > 0. \tag{31}$$

Using (30) and (31) we can show that evaluated on the US Nash reaction function:

$$(\frac{d^2 t^E}{dt^2})_{|\bar{L}, L_t = 0} = -\frac{L_{tt}}{L_{t^E}} > 0. \tag{32}$$

(32) implies that in the neighborhood of the US reaction function the US iso-employment curves are convex. Also, (31) implies that L is monotonically increasing with t^E for a given t. Consider Figure 3. Let L^0 be the US employment level at free trade, L^1 the employment level at its employment maximizing tax for $t^E = 0$, and L^N the employment level at the Nash equilibrium. Then it is evident that:

$$L^N > L^1 > L^0. \tag{33}$$

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[7]It can be shown that $L_{tt} = Q_t a(\tilde{z})\tilde{z}_t[(\frac{1-A}{A^*})r - 2] - Qa'(\tilde{z})(\tilde{z}_t)^2 - Qa(\tilde{z})\tilde{z}_{tt}$, where $\tilde{z}_{tt} = -(\frac{\tilde{z}_t}{1+t})[2 - \frac{rr''}{(r')^2}]$. A sufficient but not necessary set of conditions for $L_{tt} < 0$ is that $r < \frac{2A^*}{1-A}$, $a'(\tilde{z}) \geq 0$, and $r'' \leq 0$.

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Because of symmetry, the same ranking applies to the EU also. Now consider a symmetric subsidy equilibrium in Figure 4. It is clear that in this case:

$$L^N < L^1, \text{ and, } L^0(\text{not drawn}) < L^1. \tag{34}$$

It is, however, not possible to compare L^N and L^0. While both must be lower than L^1, their ranking vis-à-vis each other is ambiguous, in general. ∎

Proposition 3 *At an asymmetric Nash equilibrium, the US employment level may be lower than that under free trade, but EU's employment must exceed the free trade level.*

Proof. Consider Figure 5, where the employment maximizing Nash equilibrium involves a tax by the US and a subsidy by the EU. Let L^{E0}, L^{E1} and L^{EN} be the EU employment levels at free trade, at the EU employment maximixing tax for $t = 0$, and at the Nash equilibrium, respectively. Then it is clear that:

$$L^{EN} > L^{E1} > L^{E0}. \tag{35}$$

As it is drawn, the iso-employment curve L^0 intersects the US reaction function northeast of N, therefore

$$L^N < L^0. \tag{36a}$$

Thus, it is possible that even with a positive unilateral employment maximizing outsourcing tax by the US, its employment may fall in a Nash equilibrium compared to the free trade level. Of course, if the intersection is southwest of N, employment rises in the Nash equilibrium. ∎

Corollary 1 *For a sufficiently large number of US firms and for a given number of EU firms, we get a tax-subsidy Nash equilibrium where US employment is lower than free trade, while EU employment must rise.*

Proof. It is easy to show that the US Nash reaction function is independent of the number of US firms n, because it raises the substitution and the output effects of t equiproportionately. However, a larger n reduces the unilateral tax of the EU, thus shifting its reaction function down. The result is that for sufficiently large values of n we get a Nash equilibrium to the south-west of B in Figure 5, where the US employment falls below the free trade level. Of course, EU employment must exceed its respective free trade level. ∎

Both proposition 3 and the corollary have very interesting policy implications. Proposition 3 shows that even if a unilateral outsourcing tax may raise employment, its imposition in an interdependent world may be counterproductive. This is because the tax may lead to a reaction by the EU which may abandon free trade and engage in its unilateral employment maximizing policy. The result may be an unintended outcome (from the US perspective) where although the EU gains employment, US loses relative to free trade. Furthermore, the corollary shows that the more dominant the US is in terms of the number of firms it has in the market, the more likely it is that the outsourcing tax is counterproductive in a Nash equilibrium.

4 Cooperative Employment Maximizing Taxes

It is useful to analyze the cooperative employment maximizing taxes as a benchmark to compare the Nash taxes. Joint employment is:

$$L^C(t, t^E) = L(t, t^E) + L^E(t, t^E). \tag{37}$$

The cooperative first order conditions are:

$$L_t^C(t, t^E) = L_t(t, t^E) + L_t^E(t, t^E) = 0, \text{ and,} \tag{38a}$$

$$L_{t^E}^C(t, t^E) = L_{t^E}(t, t^E) + L_{t^E}^E(t, t^E) = 0. \tag{38b}$$

Evaluating the marginal benefit of the US outsourcing tax at the Nash equilibrium (where $L_t = 0$), we find:

$$L_t^C(t, t^E)_{|N} = L_t^E(t, t^E) = (1 - A^E)Q_t^E > 0, \text{ because } Q_t^E = \frac{nn^E w^* A^*(\tilde{z})}{n + n^E + 1} > 0. \tag{39}$$

Similar analysis suggests that $L_{t^E}^C$ is also strictly positive at the Nash equilibrium. Under symmetry, this must imply that the cooperative taxes exceed the Nash taxes. This is because cooperative taxes internalize the positive spillover caused by one nation's outsourcing tax on the other nation.

Proposition 4 *At a symmetric cooperative equilibrium, the tax levels must exceed the Nash taxes. The employment levels of the two nations must be at least as large as the free trade level and strictly larger than the Nash level.*

Proof. The proof of the first part of the proposition lies in the discussion above. Given that free trade is always an option for the two nations when they come to a joint agreement, by revealed preference the cooperative employment levels cannot be any less than the free trade level. Finally, given that there is a strictly positive local gain (as shown in equation 39 above) from raising taxes above Nash taxes, the symmetric cooperative taxes must yield higher employment compared to the Nash taxes. ∎

In the symmetric case, the cooperative equilibrium lies northeast of the Nash equilibrium on the 45 degree line in tax space. Thus, a small movement northeast along the 45 degree line from the Nash equilibrium must raise employment. If the parameters are such that the Nash equilibrium involves subsidies, while the cooperative equilibrium involves taxes, the free trade outcome lies between the two, and therefore must be associated with higher employment levels compared to Nash. This possibility was also discussed in the context of proposition 2, and suggests that unilateral intervention may be counterproductive in an interdependent world.

5   Some Extensions of the Basic Model

In previous sections we assumed that there are no capital costs so that production only involves labor costs. We also assumed that products exported by the two nations are not differentiatied and that firms engage in Cournot competition. We relax these two assumptions below and analyze how our findings need to be qualified. The reasons for looking at these cases are the following. First, numerous surveys suggest that access to external capital is important for production because firms often have to incur substantial costs including payments to workers that cannot be funded out of their cash flow or accumulated reserves (Chor and Manova (2009)). Hence, in the face of a global liquidity crunch, it is particularly important to establish a link between credit shortage and the employment effects of outsourcing barriers. Secondly, it is clear that many major players in export markets produce differentiated goods. For example, while both Boeing and Airbus produce airplanes and compete in the commercial aircraft market, their products are not identical. Therefore, it is useful to analyze how our results may extend to the case of product heterogeneity and alternate modes of competition. Finally, for simplicity, we use the basic model of section 2, where only the US firms engage in outsourcing.

5.1 Capital Costs:

Assume that the firm obtains the capital for payments to workers from an outside credit market. Let R, R^*, and R^E denote the interest rate in the US, India and Europe respectively. A global credit crunch will tend to raise the cost of capital for all firms. The following proposition addresses the effect of such a phenomenon on the employments effects of an outsourcing tax.

Proposition 5 *An equiproportionate rise in capital cost in all nations due to a global credit shortage makes employment reduction due to an outsourcing tax by the US more likely.*

Proof. We assume that initially $R = R^* = R^E$, which is followed by an equiproportionate rise in these rates. Let $\tilde{z}'$ denote the threshold stage of production, such that $z \in [0, \tilde{z}']$ is outsourced to India and $z \in [\tilde{z}', 1]$ is sourced locally. If $\tilde{z}$ is the corresponding threshold level where there is no capital cost (as in previous sections), then

$$r(\tilde{z}') = \frac{w(1+R)}{w^*(1+R^*)(1+t)} = \frac{w}{w^*(1+t)} \Rightarrow \tilde{z}' = \tilde{z}. \tag{40}$$

(40) implies that the stages to be outsourced to India do not change when the interest rates rise equiproportionately. The marginal costs of production in the US and EU are, respectively,

$$\tilde{c}' = [w\{1 - A(\tilde{z})\} + w^*(1+t)A^*(\tilde{z})](1+R) = \tilde{c}(1+R), \text{ where,}$$
$$\tilde{c} = w\{1 - A(\tilde{z})\} + w^*(1+t)A^*(\tilde{z}), \text{ and,} \tag{41a}$$

$$c^{E'} = \alpha w^E(1+R) = c^E(1+R). \tag{41b}$$

The aggregate US and EU output levels are, respectively,

$$Q' = (\frac{n}{n + n^E + 1})[\gamma - (n^E + 1)\tilde{c}' + n^E c^{E'}], \tag{42a}$$

$$Q^{E'} = (\frac{n^E}{n + n^E + 1})[\gamma - (n + 1)c^{E'} + n\tilde{c}']. \tag{42b}$$

The aggregate employment in the US is $L' = [1 - A(\tilde{z})]Q'$. Therefore,

$$\frac{\partial L'}{\partial t} < 0 \text{ iff}$$

$$w^*(1+t) > \frac{a(\tilde{z})r(\tilde{z})[\frac{\gamma}{1+R} - (1 + n^E)\{w(1 - A(\tilde{z})) + w^*(1+t)A^*(\tilde{z})\} + n^E \alpha w^E]}{(1 + n^E)[1 - A(\tilde{z})]A^*(\tilde{z})r'(\tilde{z})}. \tag{43}$$

An increase in R for all the nations has no effect on any of the terms in the above expression other than the term $\frac{\gamma}{1+R}$, which is reduced. This means that a rise in R makes it more likely that a US outsourcing tax will reduce employment. The reason is that capital costs have different impacts on the substitution effect and the output effect of the outsourcing tax. A global rise in the capital cost does not affect the stages outsourced, but the firms' marginal production costs rise, thereby decreasing their output. As aggregate output is reduced, the substitution effect of the outsourcing tax is smaller, while the negative output effect gets magnified. Hence, it is much more likely that an outsourcing tax will reduce employment in such an environment. ■

5.2 Product Differentiation:

This subsection considers the case where the goods produced by the US and EU are not homogeneous, but ordinary substitutes for each other. Also, for simplicity we assume that one US firm competes with one EU firm in a third country market. This is represented by the following direct demand functions for the two firms, where superscripts denote nations H (US) and E (Europe), respectively,

$$q^H = \alpha^H - p^H + \theta p^E, \ \alpha^H > 0, \ 0 \leq \theta < 1. \tag{44a}$$

$$q^E = \alpha^E - p^E + \theta p^H, \ \alpha^E > 0. \tag{44b}$$

The parameter θ is a measure of the degree of product differentiation (or substitutability). When $\theta = 0$, the goods are unrelated. As $\theta \to 1$, the goods are close substitutes. Also, by restricting θ to be less than unity we assume that the own-price effect on demand is stronger than the cross-price effect. Notice that we also assume that the degree of substitutability between the products enters the demand functions in a symmetric way: $\frac{\partial q^H}{\partial p^E} = \frac{\partial q^E}{\partial p^H} = \theta$. Production technology is assumed to be the same as in section 2, hence the US firm and the EU firm still face constant marginal costs $\tilde{c}$ and c^E, given by equations (6) and (7), respectively.

Proposition 6 *For differentiated products, an outsourcing tax is more likely to reduce employment for a higher degree of product differentiation, for both Cournot and Bertrand competition. The qualitative effect of the demand and cost parameters on the employment effect of the tax is similar between the two modes of competition.*

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Proof. Under Nash-Bertrand competition, the first order conditions of the US firm and the EU firm, and the respective Bertrand reaction functions are,

$$q^H - (p^H - \tilde{c}) = 0 \Rightarrow p^H = \frac{\alpha^H + \tilde{c}}{2} + \frac{\theta}{2}p^E. \tag{45a}$$

$$q^E - (p^E - c^E) = 0 \Rightarrow p^E = \frac{\alpha^E + c^E}{2} + \frac{\theta}{2}p^H. \tag{45b}$$

Using (45a) and (45b), and noting that $L = [1 - A(\tilde{z})]q^H$, we get

$$\frac{\partial L}{\partial t} < 0 \text{ iff } w^*(1+t) > \frac{a(\tilde{z})r(\tilde{z})[2\alpha^H - (2-\theta^2)\tilde{c} + \theta(\alpha^E + c^E)]}{(2-\theta^2)[1 - A(\tilde{z}(.))]A^*(\tilde{z})r'(\tilde{z})}. \tag{46}$$

Noting that $\tilde{z}$ is independent of θ, it is easy to show that the right-hand-side of (46) is increasing in θ, making the inequality more likely to be satisfied for lower values of θ (i.e., for more differentiated products). This completes the proof for Bertrand competition.

To analyze Nash-Cournot competition for differentiated products we invert the demand functions given in (44a) and (44b).[8] The inverse demand functions are,

$$p^H = \mu^H - \frac{q^H}{1-\theta^2} - \frac{\theta q^E}{1-\theta^2}, \mu^H = \frac{\alpha^H + \theta\alpha^E}{1-\theta^2}. \tag{47a}$$

$$p^E = \mu^E - \frac{q^E}{1-\theta^2} - \frac{\theta q^H}{1-\theta^2}, \mu^E = \frac{\alpha^E + \theta\alpha^H}{1-\theta^2}. \tag{47b}$$

The Nash-Cournot reaction functions are implicitly defined by the following first-order-conditions:

$$p^H - \tilde{c} - \frac{q^H}{1-\theta^2} = 0. \tag{48a}$$

$$p^E - c^E - \frac{q^E}{1-\theta^2} = 0. \tag{48b}$$

Using $L = [1 - A(\tilde{z})]q^H$, we get,

$$\frac{\partial L}{\partial t} < 0 \text{ iff}$$

$$w^*(1+t) > \frac{a(\tilde{z})r(\tilde{z})[(2-\theta^2)\alpha^H - 2(1-\theta^2)\tilde{c} + \theta(\alpha^E + (1-\theta^2)c^E)]}{2(1-\theta^2)[1 - A(\tilde{z}(.))]A^*(\tilde{z})r'(\tilde{z})}. \tag{49}$$

It can be readily shown that like (46), the right-hand-side of (49) is increasing in θ. Therefore, the employment effect of an outsourcing tax is more likely to be negative for lower values of θ. Also, comparing the two equations it is easy to see that the effects of the demand and cost parameters α^j and c^j ($j = H, E$) on the employment effect are similar between price and quantity competition. This completes the proof for proposition 6. ∎

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[8] See Dastidar (1997) for a comparison of Cournot and Bertrand equlibria for the homogeneous good case. Also, see a recent paper by Roy Chowdhury (2009).

When θ is low, the US firm is a near-monopoly. The own-effect of a cost increase on domestic output is strong, meaning that the outsourcing tax will have a larger effect on output and employment when products are more differentiated. This makes intuitive sense. A near-monopoly has greater price setting power. Therefore, faced with a tax increase it raises price to a greater degree (thereby reducing quantity more) compared to a firm which faces more international competition. This suggests that one should be more careful in imposing barriers to outsourcing when international markets exhibit high degrees of product differentiation between US and foreign firms.

6 Conclusion

We have found several interesting results regarding the effects of outsourcing barriers in oligopolistic international markets. First, we point out that in an international oligopoly, while the substitution effect of a tax favors domestic employment, the output effect leads to employment reduction. Thus, *a priori*, the net employment effect is ambiguous. Our analysis identifies the conditions and the parameters which determine whether the employment effect is positive or negative. Second, we build on this insight to consider unilateral employment maximizing outsourcing taxes by both the US and the EU. Given the interdependence in their policies, we analyze the Nash equilibrium in unilateral employment maximizing taxes. While the US must gain employment relative to free trade in a symmetric Nash taxation equilibrium, this result need not hold in a Nash subsidy equilibrium or under asymmetry. We also find that the cooperative taxes must exceed the Nash taxes because they internalize the positive employment spillovers caused by one nation on the other. We extend the basic model considered in section 2 to consider credit shortage and product differentiation. We find that global financial tightening strengthens the output effect of the outsourcing tax, thereby making it more likely to reduce domestic employment. Finally, we find that regardless of the mode of competition (Bertrand or Cournot), greater product differentiation worsens the employment effects of an outsourcing tax.

All of the above results have interesting policy implications. For example, responding to a global downturn (which reduces demand or raises the cost of credit) by raising the outsourcing tax is likely to be counterproductive. Analogously, given that nations are interdependent, policy paradoxes may arise. For example, even though an unilateral tax may

raise employment, it may be counterproductive to use it because it may engender a strategic response by other nations which engage in outsourcing, thereby leading to an undesirable employment loss in the resulting strategic equilibrium. Finally, we should note an important strength of this paper. The strategic trade theory literature often finds that policy prescriptions are not robust to the mode of competition. In contrast, our analysis demonstrates that the qualitative nature of our findings do not change if firms compete in prices (Bertrand) rather than in quantities (Cournot).

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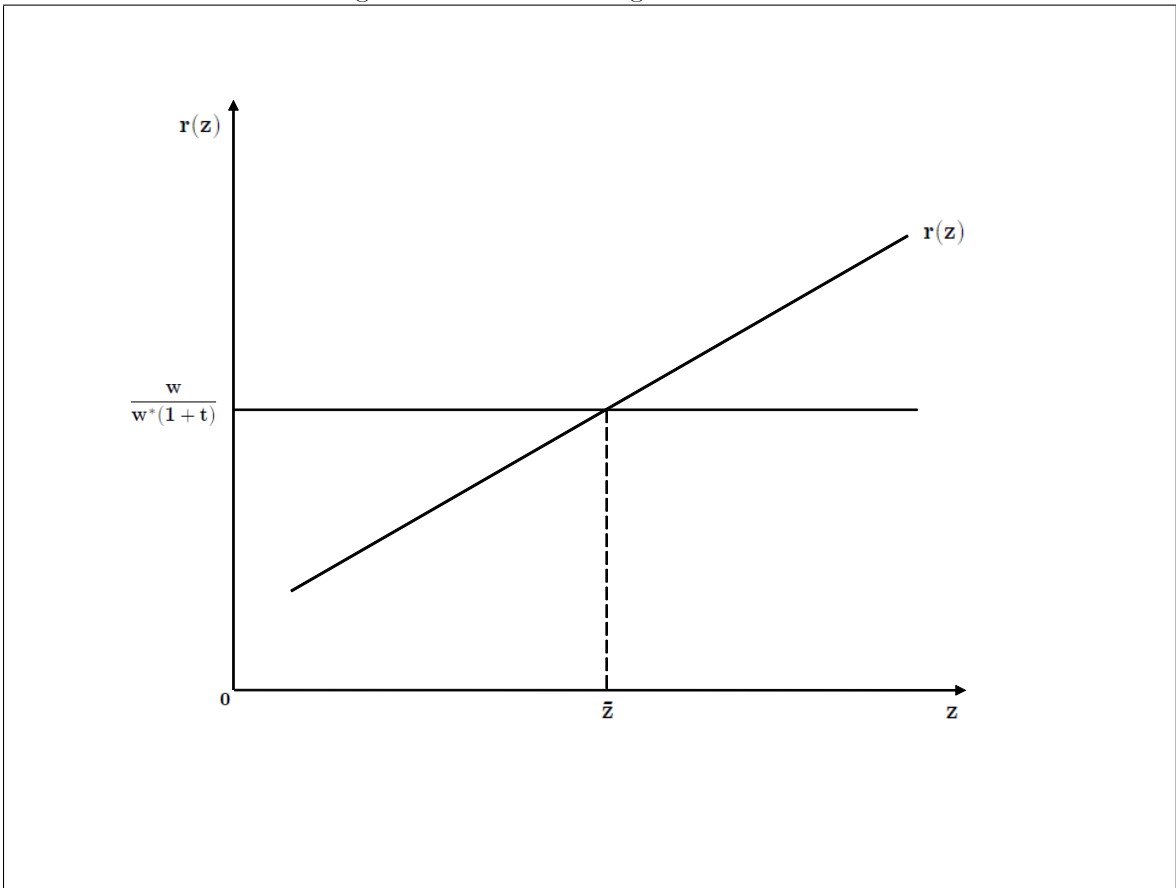Figure 1: The Outsourcing Choice
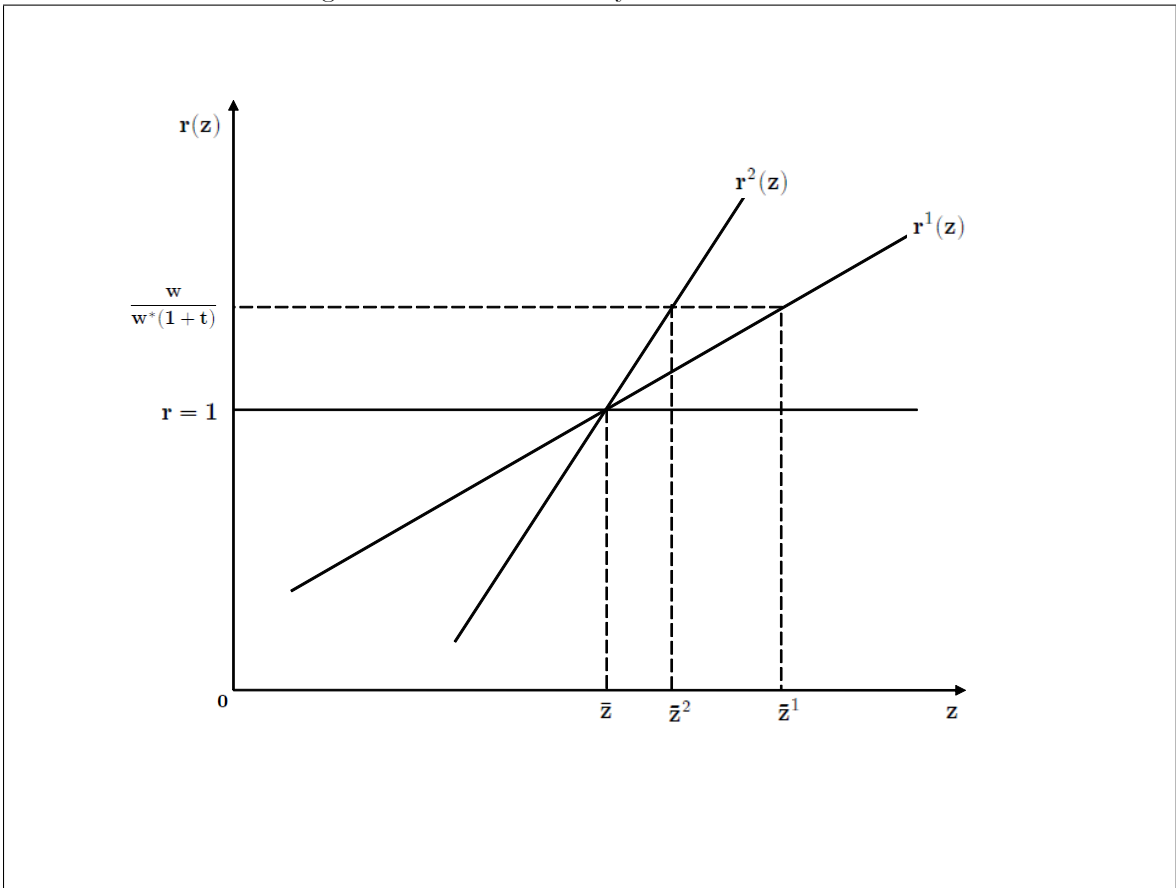
Figure 2: Effect of Elasticity Differences
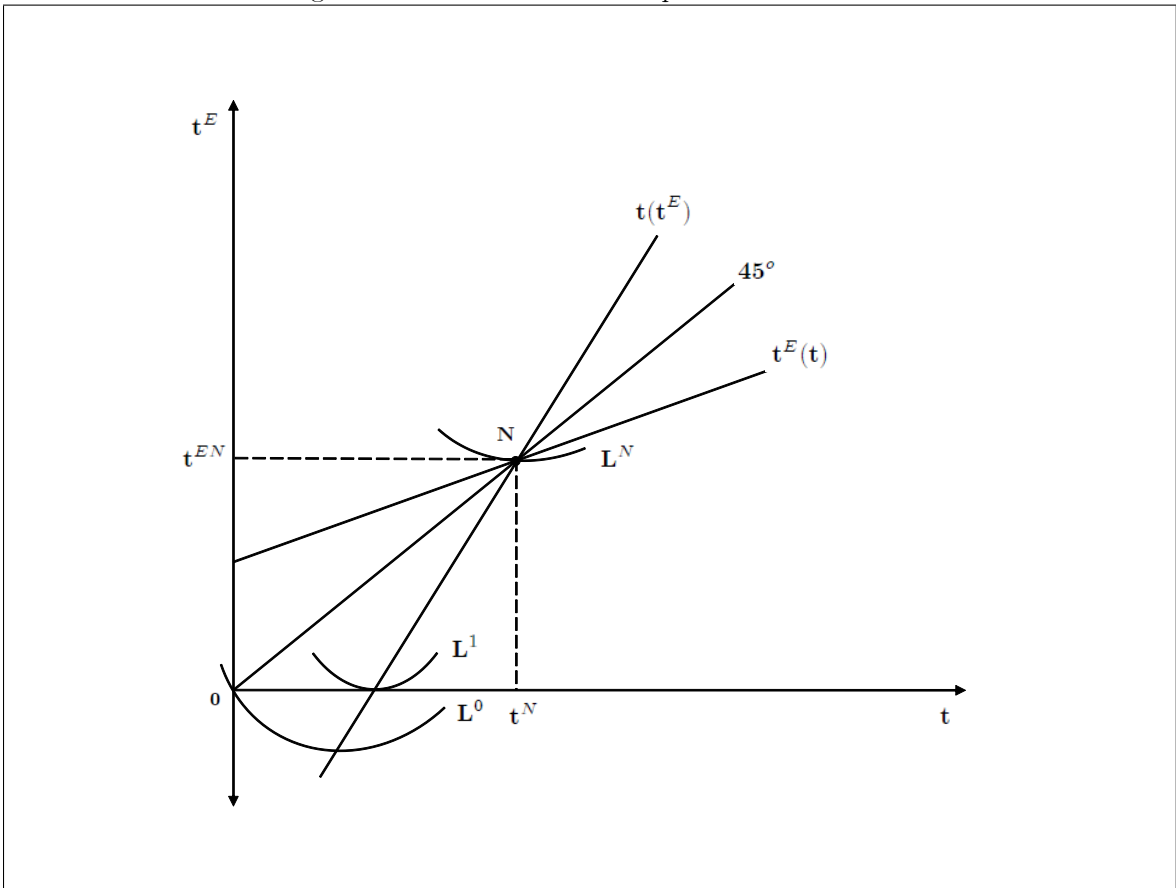
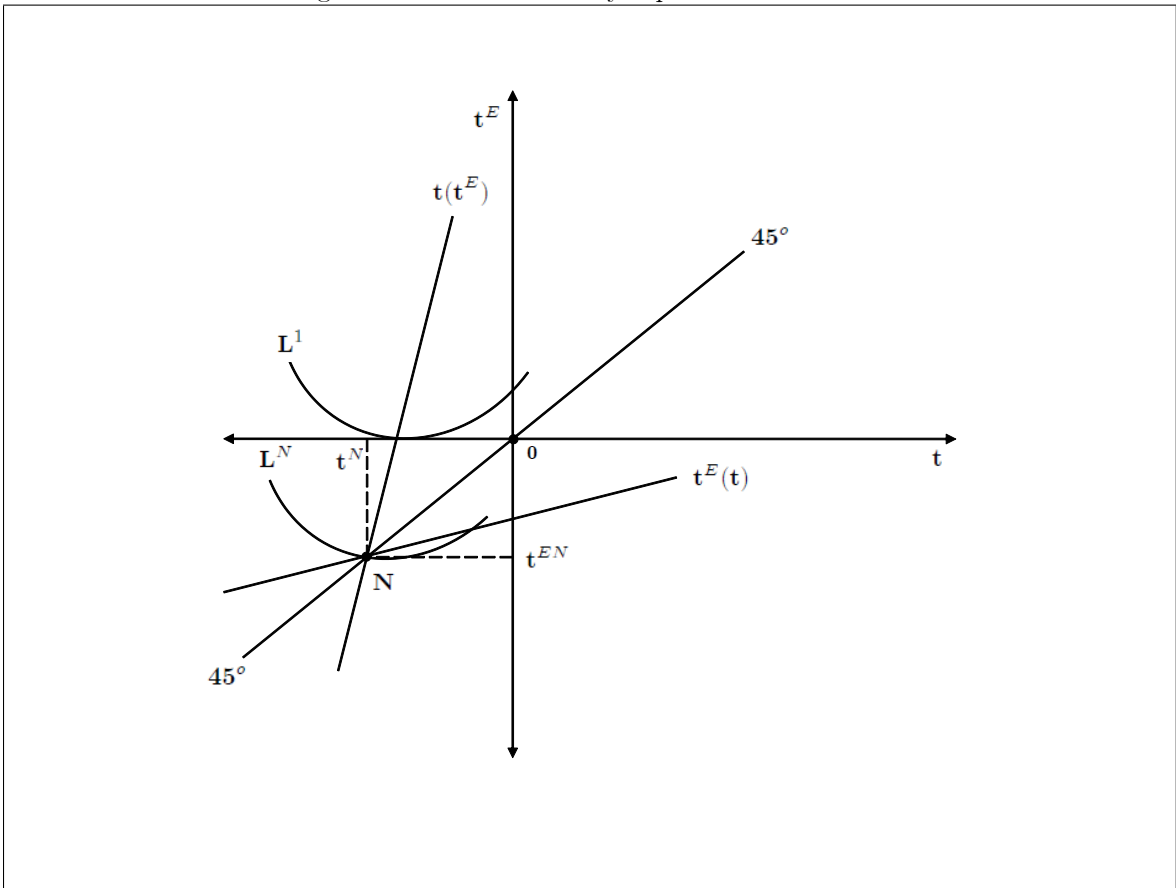Figure 3: The Nash Taxation Equilibrium

Figure 4: The Nash Subsidy Equilibrium

Figure 5: The Tax-Subsidy Equilibrium

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