Revisiting the Theory of Second-Best with Endogenous Policy Distortions

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Abstract: One of the most far reaching results from the literature of second-best is the difference between price and quantity distortions. Loosely stated the result is: unlike the case of exogenous price distortions, there is no second-best adjustment of policy for exogenous quantitative distortions. This difference has important implications for several issues in the economics of international trade, these include: theories of trade reform, preferential trade agreements, and immiserizing growth. In this paper, I ask whether price and quantity distortions are different even after they are endogenized. I present a simple political economy model to endogenize trade and pollution policy distortions. I find that endogenous quantitative distortions (quantitative restrictions in the model) have the same second-best effects as price distortions (tariffs). In other words, once we recognize the endogeneity of policy, tariffs and quotas can be equal once again.

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1 Introduction

The difference between exogenous price and quantity distortions is one of the most important results from the literature of the 'second-best'[1] (see Krishna and Panagariya, 2000 for an excellent survey). Generally stated, the result is: while a second-best policy response[2] is optimal in the presence of an exogenous price distortion, it has no merit in the presence of an exogenous quantitative distortion (Corden and Falvey, 1985).

The isolation of quantitative distortions has far-reaching implications. Several important results in the economics of international trade stem from this result. Consider for example the economics of trade reform for a small economy. It is well known that if trade is regulated by exogenous tariffs, piecemeal trade reform need not increase welfare. This is because piecemeal reform can overlook the second-best optimality of certain tariffs. However, the isolation of a quantitative distortion ensures that if trade is regulated by quotas any trade reform, piecemeal or coordinated, cannot reduce welfare (Falvey, 1988). Similar results highlighting the benefits of quotas are also found elsewhere in the literature of international trade. A brief list includes the economics of multilateral trade reform (Turunen-Red, and Woodland, 2000), the economics of preferential trade agreements (Meade, 1955), the theory of immiserizing growth (Alam, 1981), and issues of trade and the environment (Copeland, 1994, Beghin et. al., 1997).

All these papers share the assumption of exogenous distortions. However, it is not always realistic to assume that distortions are beyond the policy makers control. Often distortions are created in the government's self-interest, due to uncertainty, or imperfect information regarding the effects of policy. Would price and quantity distortions be different even after they are endogenized?

In this paper, I investigate second-best policy responses to endogenous distortions. To endogenize distortions I use a simple political economy model. In this model the government uses trade and pollution policy to maximize a weighted welfare function where domestic producers get a higher weight than consumers. International trade is regulated by either a tariff, or a quota, and pollution is regulated using a pollution tax.

I find two results relevant to the theory of the second-best. Firstly, a second-best policy re-

[1] From the Penguin dictionary of economics: "A theory formulated by Lipsey and Lancaster (1956), which says that, in the absence of being able to attain all the conditions necessary for the existence of the most desirable possible economic situation, the second-best position is not necessarily one in which the remaining conditions will hold".

[2] A *second-best* policy response is an attempt to mitigate the impact of the distortion through indirect policy.

sponse can exist even when policy and distortions are endogenous. As most earlier analyses of second-best policy relied on exogenous restrictions on policy, it was not clear whether second-best policy was relevant in a world where distortions were endogenous. Through this paper, I provide an example of that relevance. Secondly, and perhaps more importantly, I find that endogenous quantitative distortions (quantitative restrictions in the model) have the same second-best effects as price distortions (tariffs).

The intuition behind these results is simple. When price and quantity distortions are exogenous the second-best policy response is designed to alter distorted quantities to mitigate aggregate welfare damage. While indirect policy can alter distorted quantities in the presence of a price distortion, it is ineffective when the quantity which needs to be altered is itself specified as the distortion. Thus in the presence of exogenous quantity distortions there is no second-best response. In contrast when distortions are endogenous, the government optimally trades off aggregate welfare while creating the distortion. The second-best response is not designed to alter quantities to mitigate aggregate welfare damage. In the political economy context considered in this paper the second-best adjustment is designed to optimally transfer welfare from consumers to politically favored domestic producers. As the indirect domestic policy (a pollution tax in our case) is equally efficient at transferring welfare in the presence of tariffs or quotas there is no difference in the second-best adjustment.

This result has potentially important implications. The perceived isolation of exogenous quotas implied that a piecemeal reform of quotas always improves welfare (Falvey 1988), it implied that growth in the presence of a distortionary quota never reduces welfare (Alam, 1981), and that countries that restrict foreign trade using quotas alone can form preferential trading agreements without any cost to the rest of the world (Meade, 1955). Once we recognize that both tariffs and quotas are endogenous these results need not be true. Our results indicate that policy prescriptions from models with exogenous distortions can be incorrect. Our results also indicate that we should accord a quota the same care as accorded to a tariff.

This paper is a natural unification of two literatures. It combines insights from the political economy literature explaining distortions in policy (see Drazen, 2002, for a comprehensive survey) with the second-best literature analyzing policy responses to exogenous distortions (see Krishna and Panagariya, 2000).[3] The main contribution of this analysis is to underscore the importance of

[3]Krishna and Pangariya (2000) present a simple theory unifying the various results in the theory of the second-best. They argue that the difference between price and quantity distortions arise from a difference in how pre-imposed

understanding why a policy distortion exists. Once we understand why a distortion is created we are better equipped to understand and predict policy responses following the distortion. If we do not account for the distortion creating process, our incomplete analysis might lead us to recommend incorrect responses to the distortions in question.[4]

The rest of the paper is organized as follows. In Section 2 I present the model used in the paper. In Section 3 I present optimal policy for a welfare maximizing government, rederiving results presented previously in the literature. I present endogenous distortions using a political economy model is Section 4 and demonstrate how the differences between price and quantity distortions disappear once we recognize the endogeneity of policy. I conclude in Section 5.

2 The Model

Consider a small economy with two goods: a non-polluting numeraire good and a polluting non-numeraire good, and two groups: producers and consumers. Production of the numeraire good (denoted y_0) is by a linear technology using a single input: labor (l_0). The world and domestic price of the numeraire good is normalized to 1. There is always free trade in the numeraire and it is always produced in this economy. Note that when the numeraire good is produced, wage $w = 1$.

Production of the non numeraire good y produces pollution (z) as a by-product. The two outputs y and z are jointly produced by a convex technology using two inputs: sector-specific polluting capital (k), and labor (l). Returns to the owners of polluting capital (k) are represented by a restricted profit function,

$$\pi^k(t,p) = \widetilde{\pi}^k(t,p,w;k),$$

where t is the tax on pollution, and p is the domestic price for the polluting good. The world price for the polluting good is denoted p^* (which need not equal the domestic price as trade restrictions on the polluting good are possible). Restricted profit functions are positively linearly homogenous and satisfy Hotelling's lemma, that is, $\pi_t^k(t,p) = -z$,and $\pi_p^k(t,p) = y$ (subscripts on functions

restrictions enter the underlying economic optimization problem. While the analysis in Krishna and Panagariya (2000) is general and powerful enough to unify most second-best problems, it does not recognize important implications that arise from endogenizing distortions.

[4] Rodrik (1987) shows that while the simple rule of 'policy targeting' is optimal in the presence of exogenous distortions, it can be sub-optimal when distortions are endogenously created. Thus, although the author employs a different context, the policy recommendation is similar: it is important to understand the process by which the distortion is created before recommending broad policy prescriptions.

denote partial derivatives). Producer welfare equals restricted profits, and thus the welfare for the owners of polluting capital k is

$$w^k(t,p) = \pi^k(t,p). \tag{1}$$

All consumers have quasi-linear utility functions. The sub-utility function for the non-numeraire good is denoted $u(x)$ and is strictly increasing and concave. Damage from pollution is linearly separable and is represented by a strictly increasing and convex function $v(z)$. Given the quasi-linear structure, demand for the non-numeraire good is purely a function of its price. Demand is denoted $x(p)$ and

$$\gamma(p) = [u(x(p)) - px(p)] \tag{2}$$

represents consumer surplus. Assume that each consumer is endowed with a single unit of labor and total consumer population is normalized to 1. Consumer income is a combination of wages and government transfers. Government transfers comprise of pollution tax revenues tz, and tariff revenues or quota rents (T) (whenever imposed). The indirect utility function for a consumer is

$$w^l(t,p) = [1 + \gamma(p) - v(z) + tz + T]. \tag{3}$$

3 The Social Planner's First and Second-Best Policy

In this section I present the social planner's optimal first and second-best policy. The social planner sets a pollution tax and either an optimal tariff or quota on the non-numeraire good to maximize aggregate welfare. This section follows earlier literature on second-best policy where optimal welfare maximizing policy in the presence of exogenous distortions is explored.

3.1 Optimal Policy with a Tariff

Consider first the case where the social planner sets a tariff ($\tau \gtreqless 0$) in addition to the pollution tax (t) to maximize aggregate welfare. Domestic price for the non numeraire good equals the world price plus the tariff ($p = p^* + \tau$). Total tariff revenue collected (or disbursed as a subsidy) is $T = \tau m(t,p)$, where $m(t,p) = x(p) - \pi_p^k(t,p)$ is the net import or export of the non-numeraire polluting good. Aggregate welfare $W(t,\tau;p^*)$ is the sum of all individual group welfare in society, this includes consumer welfare, rents accruing to the specific factor, tax and tariff revenues. The social planner's problem is

$$\max_{t,\tau} W(t,\tau;p^*) = \sum_{i\in\{k,l\}} w^i = 1+\gamma(p) - v(z) + tz + \tau m + \pi^k(t,p). \tag{4}$$

The first order conditions for the welfare maximizing tariff $(\hat{\tau})$ and pollution tax $(\hat{t})$ are

$$W_\tau = [t - v_z][z_p] + \hat{\tau}[m_p] = 0, \tag{5}$$

and

$$W_t = [\hat{t} - v_z][z_t] + \hat{\tau}[m_t] = 0, \tag{6}$$

where $z_t = -\pi^k_{tt}$, $z_p = -[\pi^k_{tp}]$,[5] $m_t = [-\pi^k_{pt}]$ and $m_p = [x_p - \pi^k_{pp}]$. The solution to these two first order conditions gives us the optimal tariff for our small open economy,

$$\hat{\tau} = 0. \tag{7}$$

The optimal tariff for a small open economy equals zero. From the same conditions the welfare maximizing pollution tax is

$$\hat{t} = v_z. \tag{8}$$

The welfare maximizing pollution tax equals marginal social damage from pollution. This is the standard Pigouvian prescription for treating externalities.

3.1.1 Second-Best Policy

We now consider a scenario similar to that often evaluated in the literature of second-best policy. We assume that a distortion is exogenously given and then identify welfare maximizing interventions in the presence of this distortion. The exogenously given distortion is a tariff on the non-numeraire good $(\bar{\tau} \neq 0)$. The government can only control the pollution tax and uses this instrument to correct for the pollution externality and the exogenous distortion.

The optimal pollution tax in the presence of an exogenously given tariff $(\bar{t})$ is

$$\bar{t} = v_z - \bar{\tau}\frac{m_t}{z_t},$$

which can be rewritten as

$$\bar{t} = v_z + \bar{\tau}\frac{[-\pi^k_{pt}]}{[\pi^k_{tt}]}. \tag{9}$$

[5] Assume that $z_p = -[\pi^k_{tp}] > 0$. In other words, pollution rises as the price of the polluting good increases.

If there is a positive tariff (import tax or export subsidy) on the polluting good the pollution tax is raised above marginal social damage. This reduces the impact of the positive tariff. A positive tariff transfers consumer surplus to domestic producers by restricting trade and consequently raising consumer and producer prices. A higher pollution tax implies lower domestic production and higher imports. This in turn implies higher tariff revenues. A higher pollution tax also implies greater pollution tax revenues. By raising the pollution tax the government is able to reduce the trade restricting effects of the tariff and also refund some of the lost consumer surplus through increased tariff and tax revenues. Following the same logic, if there is a negative tariff (an import subsidy or an export tax) the pollution tax is lowered below marginal social damage. Note that the use of the pollution tax to reduce the impact of an exogenous tariff is possible as the pollution tax can influence quantities traded.

3.2 Optimal Policy with a Quantitative Restriction

Next consider the case of a quantitative restriction instead of a tariff. The social planner sets an export quota ($m \leq 0$) or an import quota ($m \geq 0$) in addition to the pollution tax (t) to maximize aggregate welfare.[6] Total quota rents are given by: $T = (p - p^*)\, m$.

Domestic equilibrium for the polluting good is given by

$$x(p) \leq \pi_p^k(t, p) + m,$$

in other words domestic demand is less than or equal to domestic supply. Assume that the quota is binding. In that case the domestic price for the polluting good is determined by

$$x(p) = \pi_p^k(t, p) + m. \tag{10}$$

The market equilibrium condition (10) can be used to derive the change in the price of the polluting good from a change in the binding quota:

$$\frac{dp}{dm} = -\frac{1}{\left[\pi_{pp}^k - x_p\right]} < 0. \tag{11}$$

The derivative shows that a marginal increase in a binding import quota, or a reduction in a binding export quota causes a reduction in the price of the polluting good. Similarly, equation (10) can

[6] Note the quota can only restrict imports or exports. Unlike the tariff (as defined in this paper) it cannot be used to promote imports or exports.

also be used to derive the change in domestic price due to a change in the pollution tax:

$$\frac{dp}{dt} = \frac{\left[-\pi^k_{pt}\right]}{\left[\pi^k_{pp} - x_p\right]} > 0. \tag{12}$$

When the pollution tax is raised the domestic supply of the polluting good falls. To restore parity between net domestic demand and supply, the equilibrium price rises.

The social planner's problem is

$$\max_{t,m} W\left(t, m; p^*\right) = \sum_{i \in \{k,h,l\}} w^i = 1 + \gamma\left(p\right) - v\left(z\right) + tz + \left(p - p^*\right) m + \pi^k\left(t, p\right). \tag{13}$$

The first order condition for the optimal quota ($\hat{m}$) is

$$W_m = \left(p - p^*\right) = 0. \tag{14}$$

The first order conditions for the welfare maximizing pollution tax ($\hat{t}$) is

$$W_t = \left[\hat{t} - v_z\right]\left[z_t + z_p \frac{dp}{dt}\right] = 0. \tag{15}$$

The solution to these two first order conditions gives us the optimal quota for our small open economy. The optimal quota is a non-binding quota such that the domestic price equals the world price.

$$p = p^*. \tag{16}$$

Note that this is exactly the same outcome as when the tariff is set equal to zero. The welfare maximizing pollution tax ($\hat{t}$) is,

$$\hat{t} = v_z. \tag{17}$$

The welfare maximizing pollution tax equals marginal social damage from pollution.

3.2.1 Second-Best Policy

Now compare the second-best effects of a price versus a quantity distortion. Instead of having an exogenously given tariff, consider an exogenously given quantitative restriction ($\bar{m}$) on the non-numeraire good. The optimal pollution tax in the presence of an exogenously given quota ($\bar{t}$) is

$$\bar{t} = v_z. \tag{18}$$

The pollution tax equals marginal social damage from pollution. Note that the optimal pollution tax is not adjusted for the presence of a quantitative restriction. As imports are set by a binding quota, the pollution tax cannot affect quantities traded. Further, any increase in the pollution tax also raises consumer prices and reduces consumer surplus (see equation 12). Thus the government cannot use pollution policy to mitigate the welfare damage of the exogenously given quota. This is in contrast to the case of an exogenous tariff where an increase in the pollution tax can return some of the lost consumer surplus back to consumers (see discussion after equation 9).

The pollution tax in equations (9) and (18) re-states the previously demonstrated difference between price and quantity distortions. While there is a second-best adjustment in domestic policy for a trade distortion created by a tariff (see equation 9) there is no such adjustment for a trade distortion created by an exogenous quantitative restriction (similar results are presented in Copeland, 1994, Corden and Falvey, 1985, and Krishna and Panagariya, 2000). The reason is that in the presence of an exogenous and binding quantitative restriction the government cannot use domestic policy to influence quantities imported, or exported. Correspondingly there is no second-best adjustment. In the next section we will investigate whether such a difference across price and quantity distortions exists even when the distortion is endogenized.

4 Endogenizing Policy Distortions

In this section I present a political economy model that endogenizes policy distortions. The government's objective in the political economy model is to maximize a weighted welfare function where domestic producers get a higher weight than consumers. There are several reasons why the government might assign a higher weight on the welfare of domestic producers. The reason most often proposed is lobbying activity. It is often argued that the relatively smaller and more wealthy group of domestic producers is more likely to lobby the government than consumers.

By analyzing politically determined policy I wish to study policy responses to endogenous policy distortions. Earlier papers have shown that policy responses differ across exogenous price and quantity distortions. In this section I investigate whether there is such a difference across endogenous price and quantity distortions.

4.1 Optimal Policy with a Tariff

In this section we assume that the government chooses a tariff and a pollution tax to maximize its weighted welfare. Formally the maximization problem for the government is

$$\max_{t,\tau} G(t, \tau; p^*) = \beta \pi^k (t, p) + W(t, \tau; p^*), \tag{19}$$

where $\beta > 0$.[7] Note that the welfare of the domestic producers gets a higher weight than that of consumers.

The first order condition that determines the politically optimal tariff ($\tilde{\tau}$) is

$$G_\tau = \beta \pi_p^k + \left[\tilde{t} - v_z\right][z_p] + \tilde{\tau}[m_p] = 0. \tag{20}$$

The first order condition that determines the politically optimal pollution tax rate ($\tilde{t}$) is

$$G_t = \beta \pi_t^k + \left[\tilde{t} - v_z\right][z_t] + \tilde{\tau}[m_t] = 0. \tag{21}$$

Using these equations we can derive the optimal tariff. Let $\theta(p) = \frac{\pi_p^k}{m}$ denote the ratio of domestic production to imports. Note that imports can be either fixed using a tariff ($m = x(p) - \pi_p^k$) or constrained using a quota (m). Let $e(p) = \frac{-\left[x_p(p) - \pi_{pp}^k\right]p}{x(p) - \pi_p^k}$ denote the elasticity of import demand for the polluting good. Similarly, define $\varepsilon_z = \frac{\pi_{tt}^k t}{-\pi_t^k}$ as the elasticity of pollution with respect to the pollution tax. Using this notation and recalling that $z_t = -\pi_{tt}^k$, $z_p = -\left[\pi_{tp}^k\right]$, $m_t = \left[-\pi_{pt}^k\right]$ and $m_p = \left[x_p - \pi_{pp}^k\right]$ we can express the *nominal rate of protection*: a proportional change in domestic price directly brought about by the trade policy instrument (either tariff or quota) for the polluting good as

$$\frac{(p - p^*)}{p} = \beta \frac{\pi_{tt}^k}{\left(\pi_{tt}^k - \frac{\left[\pi_{tp}^k\right]^2}{\left[\pi_{pp}^k - x_p\right]}\right)} \left[\frac{\theta(p)}{e(p)} - \frac{1}{\varepsilon_z} \frac{\tilde{t}\left[-\pi_{tp}^k\right]}{\left[\pi_{pp}^k - x_p\right]p}\right]. \tag{22}$$

The first term in the square bracket above ($\frac{\theta(p)}{e(p)}$) is the protection to the polluting good due to the extra weight granted by the government to producers. All things being equal, the polluting good has higher nominal protection if: it has a lower elasticity of imports, and a higher proportion

[7] Please see Grossman and Helpman (1994) for the micro-foundations for this weighted welfare function. The authors show that government policy obtained from maximizing the above weighted welfare function is equivalent to government policy chosen under the following conditions: a) The government collects political contributions. b) The producers of the non-numeraire good are organized as a political lobby, and c) the contribution function offered by the producers is differentiable.

of domestic production to imports. An equivalent expression for tariff protection of organized industries is derived by Grossman and Helpman (1994).

The second term in the bracket is the second-best adjustment of protection for pollution policy, $-\frac{1}{\varepsilon_z}$ captures the reduction in pollution tax of the polluting good due to the extra preference given to producers (please see discussion following equation (23) below), and $\frac{t[-\pi_{tp}^k]}{[\pi_{pp}^k - x_p]p}$ captures the relationship between tariffs and the pollution tax relevant for the second-best adjustment.

Using the above notation the pollution tax ($\tilde{t}$) can be expressed as,

$$\frac{\tilde{t} - v_z}{\tilde{t}} = \beta \frac{\pi_{tt}^k}{\left(\pi_{tt}^k - \frac{[\pi_{tp}^k]^2}{[\pi_{pp}^k - x_p]}\right)} \left[-\frac{1}{\varepsilon_z} + \frac{\theta(p)}{e(p)} \frac{p\left[-\pi_{pt}^k\right]}{\tilde{t}\pi_{tt}^k} \right]. \tag{23}$$

Note that the pollution tax is no longer equal to marginal social damage. It differs from marginal social damage due to two terms. The first term in the square brackets ($-\frac{1}{\varepsilon_z}$) reflects the government's preference for domestic producers. The government is willing to reduce the pollution tax below marginal social damage as long as the elasticity of pollution to pollution tax is not too high (a similar expression for a politically optimal pollution tax is derived in Gulati, 2007). The second term captures the second-best adjustment for the politically determined tariff. As expected this second-best adjustment depends on the nominal rate of protection granted ($\frac{\theta(p)}{e(p)}$) and the relationship between tariffs and pollution tax ($\frac{p[-\pi_{pt}^k]}{\tilde{t}\pi_{tt}^k}$) relevant to this second-best adjustment.

Equations (22 and 23) demonstrate that there is a second-best adjustment of pollution policy and the nominal rate of protection even when policy distortions are endogenous. Most analyses of second-best policy demonstrated second-best adjustments only in the presence of exogenous distortions. For that reason, it was not clear whether the theory of the second-best was relevant for a framework that allowed complete endogeneity of policy. This result verifies that relevance. We will discuss the reason for this second-best policy adjustment in the next sub-section.

4.2 Optimal Policy with a Quantitative Restriction

The government now maximizes its weighted welfare function by choosing a pollution tax and a quota. Formally the maximization problem is

$$\max_{t,m} G(t, m; p^*) = \beta \pi^k(t, p) + W(t, \tau; p^*), \tag{24}$$

where $\beta > 0$.

The first order condition determining the politically optimal quota (m_o) is

$$G_m = \beta \pi_p^k \frac{dp}{dm} + (p - p^*) + \left[\tilde{t} - v_z\right] [z_p \frac{dp}{dm}] = 0. \tag{25}$$

The first order condition determining the politically optimal pollution tax rate ($\tilde{t}$) is

$$G_t = \beta \left[\pi_t^k + \pi_p^k \frac{dp}{dt}\right] + \left[\tilde{t} - v_z\right] [z_t + z_p \frac{dp}{dt}] = 0. \tag{26}$$

Using these equations, and the definition of $\frac{dp}{dm}$ (equation 11) and $\frac{dp}{dt}$ (equation 12) we can derive the optimal nominal rate of protection from the quota as

$$\frac{(p - p^*)}{p} = \beta \frac{\pi_{tt}^k}{\left(\pi_{tt}^k - \frac{\left[\pi_{tp}^k\right]^2}{\left[\pi_{pp}^k - x_p\right]}\right)} \left[\frac{\theta\,(p)}{e\,(p)} - \frac{1}{\varepsilon_z} \frac{\tilde{t}\left[-\pi_{tp}^k\right]}{\left[\pi_{pp}^k - x_p\right] p}\right]. \tag{27}$$

Note that the optimal rate of protection granted is the same as using a politically optimal tariff (see equation 22). As discussed following equation (22), the first term in the square brackets ($\frac{\theta(p)}{e(p)}$) is protection due to the extra weight granted by the government to producers. All things being equal, the polluting good has higher nominal protection if: it has a lower elasticity of imports, and a higher proportion of domestic production to imports. The second term in the bracket is the second-best adjustment of protection for pollution policy.

The pollution tax ($\tilde{t}$) is expressed as,

$$\frac{\tilde{t} - v_z}{\tilde{t}} = \beta \frac{\pi_{tt}^k}{\left(\pi_{tt}^k - \frac{\left[\pi_{tp}^k\right]^2}{\left[\pi_{pp}^k - x_p\right]}\right)} \left[-\frac{1}{\varepsilon_z} + \frac{\theta\,(p)}{e\,(p)} \frac{p\left[-\pi_{pt}^k\right]}{\tilde{t}\pi_{tt}^k}\right]. \tag{28}$$

This too is equivalent to the pollution tax derived in equation 23. The first term in the square brackets ($-\frac{1}{\varepsilon_z}$) reflects the government's preference for domestic producers. The second term captures the second-best adjustment for the politically determined tariff.

Equations (23, and 28) demonstrate the following. Firstly, there is an adjustment of pollution policy and the nominal rate of protection even when policy distortions are endogenous. The reason for this second-best adjustment can be understood once we consider the first-best for our politically motivated government. In its first-best, the government's objective to transfer welfare from consumers to producers does not conflict with maximizing aggregate welfare. This can be done when the government has non-distortionary instruments at its disposal (see Dixit et al., 1997, and

Grossman and Helpman, 1994, for a discussion). With non-distortionary instruments the government can set policy to maximize aggregate welfare and then use the non-distortionary instrument to transfer as much welfare as possible to domestic producers.

In our model this is not possible. Due to the absence of non-distortionary instruments the government has to create distortions to transfer welfare to domestic producers. Given standard production and consumption functions there are diminishing returns to the government from using each distortionary instrument. The government chooses the level of each instrument such that the net marginal benefit to the government from creating the distortion in each instrument equals each other. This causes the chosen level for each instrument to depend on the level of the other instrument (the second-best adjustment).

Secondly, these equations also imply that a second-best adjustment of domestic policy (in our case the pollution tax) for trade policy is the same irrespective of the instrument used to provide trade protection. When price and quantity distortions are exogenous the second-best policy response is designed to alter distorted quantities to mitigate aggregate welfare damage. While a second-best policy response can alter distorted quantities in the presence of a price distortion, it is ineffective when the quantity which needs to be altered is itself specified as the distortion. Thus in the presence of exogenous quantity distortions there is no second-best response. In contrast when distortions are endogenous, the government optimally trades off aggregate welfare while creating the distortion. Thus the second-best response is not designed to alter quantities to mitigate aggregate welfare damage. In the context presented in this paper the second-best adjustment is designed to optimally transfer welfare to domestic producers from consumers. As the domestic policy (a pollution tax in our case) is equally efficient at transferring welfare in the presence of tariffs or quotas there is no difference in the second-best adjustment.

5 Conclusion

In this paper I revisit second-best policy when distortions are endogenized. In earlier literature, a second-best policy response helped mitigate the social welfare damage of an exogenous distortion. However, when distortions are endogenous, the second-best policy response need not mitigate social welfare damage anymore. When distortions are endogenous, the second-best policy response exists for the same reason as the government's objective for creating the distortion. If the government's objective is to support preferred groups (like in this paper) the second-best policy response is designed to optimally support the preferred groups using the policy instruments at hand. More generally, the reason for a second-best policy response depends on the government's objective function, and the constraints it faces. This implies that before one analyzes the second-best effects of a distortion, it is crucial to understand the reason why the distortion exists. Only once we understand this reason, can we recognize potential differences, or similarities across price and quantity distortions.

A potentially interesting future extension of this research would be to revisit some of the results in international trade built around differences across exogenous price and quantity distortions. For example, one interesting application would be to build a model of endogenous trade policy and reform, and then investigate whether the welfare effects of trade reform differ across the type of instrument being reformed?

References

[1] Alam, M.S., (1981), "Welfare Implications of Growth under a Quota," *Economics Letters*, 8, 177-180.

[2] Beghin J., D. Roland-Holst, and D Van Der Mensbrugghe (1997), "Trade and Pollution Linkages: Piecemeal Reform and Optimal Intervention", *Canadian Journal of Economics*, 30(2), 442-455.

[3] Bhagwati J. (1971), "The Generalized Theory of Distortions and Welfare", in Bhagwati, J. R. W. Jones, R. Mundell, J. Vanek, (Eds.), *Trade Balance and Payments and Growth. Papers in International Economics in Honor of Charles P. Kindleberger,* North Holland, Amsterdam.

[4] Copeland Brian, R. (January 1994), "International Trade and the Environment: Policy Reform in a Polluted Small Open Economy", *Journal of Environmental Economics and Management*, 26(1), 44-65.

[5] Corden, W. M., and R. E. Falvey (1985), "Quotas, and the Second Best", *Economic Letters,* 18, 67-80

[6] Dixit, A., G. M. Grossman and E. Helpman. (1997) "Common Agency and Coordination: General Theory and Application to Government Policy Making." *Journal of Political Economy,* 105(4), 752-769.

[7] Drazen, A. (2002), *"Political Economy in Macroeconomics,"* Princeton University Press, Princeton, New Jersey.

[8] Ederington J. (December 2001), "International Coordination of Trade and Domestic Policies", *American Economic Review*, 91(5), 1580-1593.

[9] Falvey, Rodney E. (August 1988), "Tariffs, Quotas and Piecemeal Policy Reform," *Journal of International Economics*, 25(1-2), 177-183.

[10] Grossman G.M. and E. Helpman.(1994) "Protection for Sale." *The American Economic Review,* 84(4), 833-850.

[11] Gulati, Sumeet, (2007), 'Free Trade and the Burden of Domestic Policy,' *Mimeo*, Food and Resource Economics, University of British Columbia.

[12] Krishna, P. and A. Panagariya (2000), "A Unification of Second Best Results in International Trade", *Journal of International Economics,* 52, 235-257

[13] Lipsey R. G. and K. Lancaster (1956), "The General Theory of Second Best," *Review of Economic Studies*, vol. XXIV, pp 11-32.

[14] Meade, J.E., (1955), *"The Theory of Customs Unions,"* North-Holland, Amsterdam.

[15] Rodrik D. (November 1987), "Policy Targeting with Endogenous Distortions: Theory of Optimum Subsidy Revisited," *The Quarterly Journal of Economics*, 102(4), 903-911.

[16] Turunen-Red, A. H., and A. D. Woodland (2000), "Multilateral Policy Reforms and Quantity Restrictions on Trade," *Journal of International Economics,* 52,153-168