Trade, environment and market access: policy reforms in a small open economy

Shinya Kawahara

Environment and Development Economics / Volume 19 / Issue 02 / April 2014, pp 173 - 181
DOI: 10.1017/S1355770X13000442, Published online: 22 October 2013

Link to this article: http://journals.cambridge.org/abstract_S1355770X13000442

How to cite this article:
Shinya Kawahara (2014). Trade, environment and market access: policy reforms in a small open economy . Environment and Development Economics, 19, pp 173-181 doi:10.1017/S1355770X13000442

Environment and Development Economics 19: 173–181 © Cambridge University Press 2013
doi:10.1017/S1355770X13000442

Trade, environment and market access: policy reforms in a small open economy

SHINYA KAWAHARA
Faculty of Economics, Rissho University, 4-2-16 Osaki, Shinagawa-ku, Tokyo 141-8602, Japan. Email: kawahara@ris.ac.jp

Submitted 15 September 2011; revised 20 August 2012; accepted 17 June 2013; first published online 22 October 2013

ABSTRACT. This paper investigates how market access and welfare are affected by piecemeal reforms of tariffs and pollution taxes in a small open economy. By constructing a general equilibrium model of international trade, which is extended to allow production-generated pollution, we characterize conditions under which a tariff reform and a pollution tax reform increase the value of the small country's imports. It is shown that uniform proportional cuts in tariffs that increase welfare do not necessarily improve market access, and the Ju–Krishna rule of tariff reforms that improves market access does not necessarily increase welfare. A reduction in all pollution distortions proportional to their degree of distortion can be shown to improve both welfare and market access.

1. Introduction

Over the past several decades, policy linkage in the context of piecemeal reforms has been extensively studied in the field of international trade and the environment. Copeland (1994), which is the first study to explicitly deal with this issue, examines the welfare impact of tariffs and pollution taxes in a small open economy to demonstrate that proportional tariff cuts and proportional removal of all pollution distortions improve the small country's welfare provided that all industries protected by tariffs tend to be heavy polluters. Subsequent literature following Copeland (1994), such as Beghin *et al.* (1997) and Turunen-Red and Woodland (2002, 2004), mainly focuses on the welfare implications of trade and environmental policies.[1]

[1] Beghin *et al.* (1997) examine the welfare effect of piecemeal policy reforms when both consumption and production externalities exist. Turunen-Red and

The author would like to thank Brian Copeland for his helpful comments and suggestions. An earlier version of this paper was presented at the 37th Annual Meeting of the Canadian Economics Association, held at Carleton University. The author is grateful to Jennifer Pedussel Wu for her useful comments. Useful suggestions from the editor and anonymous reviewers concerning improvements to the paper are also appreciated. This research was supported in part by JSPS Grant-in-Aid for Scientific Research (Grant Number 25380334). Any remaining errors are the author's own.

While welfare is obviously an important target for policy makers, another important aspect emerges when examining the issue of trade and the environment: market access. For instance, in the recent trade negotiations, there were some concerns about whether policy makers can remove trade restrictions and distortions to ensure that market access for developing countries is not worsened, and whether the introduction of tougher environmental regulations will impede the international trade of goods and services and thereby worsen market access for developing countries. While these issues are gaining greater importance and were in fact reflected in the WTO's latest trade negotiations in Doha,[2] no attempt has been made to investigate this issue within a formal framework.

The purpose of this paper is to examine how market access and welfare are affected by piecemeal reforms of tariffs and pollution taxes in a small open economy. In particular, we characterize sufficient conditions under which a tariff reform and a pollution tax reform increase the value of the small country's imports. It is shown that uniform proportional cuts in tariffs (known as the UPC rule) that increase welfare do not necessarily improve market access, and the rule of tariff reforms that improves market access (known as the Ju–Krishna rule) does not necessarily increase welfare. A reduction of all pollution distortions proportional to their degree of distortion can be shown to improve both welfare and market access.

Ju and Krishna (2000) is the first study to deal with the market access effects of piecemeal tariff reforms. While characterizing sufficient conditions under which a tariff reform improves market access and the link between welfare and market access in response to a tariff reform, their model does not consider pollution and environmental policy, which is the main focus of our study. Anderson and Neary (2007) study the same issue in a more general setting, and Kreickemeier and Raimondos-Møller (2008) examine the coordinated tariff-tax reforms that improve market access in a small open economy with no environmental externality. Kawahara (forthcoming) introduces a consumption-generated pollution into the model to examine how piecemeal reforms of tariffs on clean imports (defined as 'environmentally preferable products') affect a small country's welfare and its value of imports. The present paper examines how a pollution tax reform affects a country's value of imports, and how a tariff reform affects a country's value of imports in the presence of production-generated pollution. Furthermore, we seek to find positive results as to whether a tariff reform and a pollution tax reform can improve both welfare and market access.

The remainder of this paper is organized as follows. The next section describes the model that will be used throughout the analysis and examines the market access effect of tariffs and pollution taxes. The final section concludes the paper.

Woodland (2002) reinterpret Copeland's (1994) result by deriving different formulae for welfare-improving reforms. Turunen-Red and Woodland (2004) study multilateral reforms of tariffs and pollution taxes and characterize strict welfare-improving piecemeal reforms.

[2] WTO (2009) provides a comprehensive survey on this issue.

2. Welfare and market access

The model we use is the one developed by Copeland (1994). We consider a small open economy that produces $N+1$ goods. Let good 0 be the numeraire good on which neither tax nor subsidy is imposed. Let $t = (t^1, \ldots, t^N)$ represent the vector of import tariffs, where $t^i > 0$ if $m^i > 0$ and $t^i = 0$ otherwise for $i = 1, \ldots, N$. Thus, the domestic price of these non-numeraire goods is related to world price $p^w : p = p^w + t$. The production of goods generates K types of pollutants $z = (z^1, \ldots, z^K)$ that negatively affect the utility of the representative consumer u, the behavior of which is summarized by the expenditure function $e(p, z, u)$.[3] All pollutants are regulated by a set of pollution taxes at rate $\tau = (\tau^1, \ldots, \tau^K)$. Thus, the GDP function, which represents the competitive production sector, can be written as $g(p, \tau)$.[4] The application of the envelope theorem yields the compensated demand for goods as $c = e_p$, the supply of goods as $y = g_p$, and the supply of emissions as $z = -g_\tau$. We assume that the change in z does not directly affect the compensated demand for goods, that is, $e_{pz} = 0$.[5] All vectors are treated as column vectors and a prime ($\prime$) is used to denote a transpose.

The equilibrium of our small open economy can be represented by the following set of equations:

$$e(p, z, u) = g(p, \tau) + t'm + \tau' z, \tag{1}$$

$$m = e_p(p, z, u) - g_p(p, \tau), \tag{2}$$

$$z = -g_\tau(p, \tau), \tag{3}$$

where m is the net import demand vector. Assuming that the tax revenue is uniformly distributed to the consumer, equation (1) can be interpreted as the country's budget constraint. Equation (2) defines the net import demand as a difference between the country's demand and supply, and equation (3) recovers the level of pollution from the GDP function. Following Ju and Krishna (2000), we define the degree of market access as the value of imports that the country would accept at a particular world price[6]:

$$M = p^{w\prime}\tilde{m}, \tag{4}$$

where $\tilde{m}^i = m^i = e_{p^i}(p, z, u) - g_{p^i}(p, \tau)$ if $m^i > 0$ and $\tilde{m}^i = 0$ otherwise for $i = 1, \ldots, N$. Equations (1)–(4) can be used to derive equations used to

[3] For simplicity, we assume that the pollutants do not affect a firm's productivity. For studies dealing with this issue, see, for example, Baumol and Oates (1988) and Copeland and Taylor (1999).

[4] A convex technology set and fixed input vector are assumed throughout the analysis and hence are omitted in the GDP function. See Dixit and Norman (1980), Woodland (1982) and Feenstra (2004) for detailed properties of the GDP function.

[5] This assumption is made for analytical simplicity. None of our results should be affected by relaxing this assumption.

[6] As in Kreickemeier and Raimondos-Møller (2008), the numeraire good is excluded from the reform and the definition of market access.

evaluate the welfare and the market access effects of policy reforms. First, totally differentiating (1)–(3) and rearranging give the equation representing the welfare effect of policy reforms derived by Copeland (1994)[7]:

$$(e_u - t' e_{pu})du = [t' m_p + (e_z - \tau)' g_{\tau p}]dt + [(e_z - \tau)' g_{\tau\tau} - t' g_{p\tau}]d\tau, \quad (5)$$

where $m_p = e_{pp} - g_{pp}$ is a negative semi-definite matrix. Assuming that all goods are normal, the sign of the coefficient of du on the left-hand side of (5) becomes positive.[8] Next, totally differentiating (4) and using (5) give the equation representing the market access effect of policy reforms:

$$dM = [(p^w + \lambda t)' m_p + \lambda (e_z - \tau)' g_{\tau p}]dt + [\lambda (e_z - \tau)' g_{\tau\tau} - (p^w + \lambda t)' g_{p\tau}]d\tau, \quad (6)$$

where $\lambda = p^{w'} e_{pu}/(e_u - t' e_{pu})$ is a scalar that satisfies $\lambda \in (0, 1)$.[9]

2.1. Tariff reform

Consider a simple tariff reform rule: a reduction of all tariffs by the same proportion $dt = -t\alpha$, where $\alpha > 0$. This is known as the UPC rule, and the welfare effect under this sort of tariff reform in the presence of pollution was examined by Copeland (1994). That is, substituting $dt = -t\alpha$ and $d\tau = 0$ into (5), Copeland (1994) obtains the welfare effect of the tariff reform:

$$(e_u - t' e_{pu})du = -t' m_p t\alpha - (e_z - \tau)' g_{\tau p} t\alpha. \quad (7)$$

Copeland (1994) interpreted the ith element of the term $-(e_z - \tau)' g_{\tau p}$ as the *pollution damage intensity* of industry i, and concluded that if all industries protected by import tariffs were pollution damage intensive, the welfare effect of the tariff reform would become positive.

On the other hand, substituting $dt = -t\alpha$ and $d\tau = 0$ into (6), we obtain the market access effect of the tariff reform:

$$dM = -(p^w + \lambda t)' m_p t\alpha - \lambda (e_z - \tau)' g_{\tau p} t\alpha. \quad (8)$$

The first term on the right-hand side of (8) represents the effect of tariff reform on the value of imports through the change in import demand. For interpretation, we decompose this term into two effects. The tariff reform changes the domestic price of goods, which affects the demand for imports. On the one hand, this will simply change the value of imports while, on the other, the change in import demand will have an impact on the remaining tariff distortions. This will affect welfare and hence generate an income effect that changes the value of imports. Unlike the welfare

[7] Equation (5) in this paper corresponds to equation (7) in Copeland (1994).

[8] See Dixit and Norman (1980) and Neary (1995) for detailed discussions and interpretations on this condition.

[9] The homogeneity of the expenditure function implies that $e_u = (p^w + t)' e_{pu} + e_{0u}$; that is, $e_u - t' e_{pu} = p^{w\prime} e_{pu} + e_{0u}$. Thus, $\lambda \in (0, 1)$ under our assumption that all goods are normal (i.e., $e_{pu} > 0$ and $e_{0u} > 0$).

effect, the sign of this term is ambiguous and, hence, the UPC rule of tariff reform may not improve market access. In this case, a tariff reform of the type $dt = -(p^w + \lambda t)\alpha$, suggested by Ju and Krishna (2000), determines the sign of the first term as being non-negative. The second term represents the effect of tariff reform on the value of imports through the change in pollution. The sign of this term becomes positive if all industries that are protected by import tariffs are pollution damage intensive. The tariff reform in this case corrects the existing pollution distortions, which works in the direction of increasing welfare. This will generate a positive income effect that increases the demand for imports. Thus, we derive the following proposition concerning the market access effect of tariff reform.

Proposition 1. *Suppose that all industries that are protected by import tariffs are pollution damage intensive. Then, we have the following.*

(a) *The tariff reform* $dt = -t\alpha$, $\alpha > 0$, *which improves welfare (Copeland, 1994), may or may not increase the value of imports. The value of imports increases in the case of a tariff reform of type* $dt = -t\alpha$, $\alpha > 0$, *if all initial tariffs are set at the same ad valorem rates.*

(b) *The tariff reform* $dt = -(p^w + \lambda t)\alpha$, $\alpha > 0$, *which increases the value of imports in the model without pollution (Ju and Krishna, 2000), also increases the value of imports in the Copeland model. A tariff reform of type* $dt = -(p^w + \lambda t)\alpha$, $\alpha > 0$, *improves welfare, if all initial tariffs are set at the same ad valorem rates.*

Proof : See appendix. □

Part (a) in Proposition 1 describes how the UPC rule affects the value of imports. In the Copeland model, the UPC rule increases the value of imports, if (i) all industries that are protected by import tariffs are pollution damage intensive, and (ii) all tariffs are set at the same *ad valorem* rates. Since (i) is only relevant in the Copeland model, the UPC rule also increases the value of imports under (ii) in the model without pollution. The only difference between the models with and without pollution is the presence of the second term on the right-hand side of (8). As discussed above, this term represents the income effect on the value of imports arising from pollution, and its sign depends on whether the tariff-protected industries are pollution damage intensive. In particular, if tariff-protected industries are *not* pollution damage intensive, then the sign of this term becomes negative, which decreases the value of imports. That is, the UPC rule that satisfies (ii) and hence increases the value of imports in the model without pollution might rather decrease the value of imports in the Copeland model. A sufficient condition for not decreasing the value of imports is condition (i).

Part (b) describes how the Ju–Krishna rule affects the value of imports and welfare. As demonstrated by Ju and Krishna (2000), the Ju–Krishna rule always increases the value of imports in the model without pollution. However, in the Copeland model, a tariff reform generates an income effect arising from pollution. If tariff-protected industries are not pollution damage intensive, then the sign of the income effect becomes negative, which

decreases the value of imports. That is, the Ju–Krishna rule that increases the value of imports in the model without pollution might rather decrease the value of imports in the Copeland model. A sufficient condition for the reform not to decrease the value of imports is condition (i). Whether the Ju–Krishna rule increases welfare, irrespective of the existence of pollution, depends on whether the rule coincides with the UPC rule. Since the Ju–Krishna rule is essentially equivalent to the UPC rule under condition (ii), the Ju–Krishna rule increases welfare in the model without pollution. In the Copeland model, we need to have both conditions (i) and (ii) for welfare improvement. In this case, the Ju–Krishna rule increases both welfare and the value of imports.

2.2. Pollution tax reform

Next, consider a simple pollution tax reform rule: a reduction of all pollution distortions proportional to the pollution distortion vector $d\tau = (e_z - \tau)\alpha$, where $\alpha > 0$. The welfare effect of this sort of pollution tax reform was also examined by Copeland (1994). That is, substituting $d\tau = (e_z - \tau)\alpha$ and $dt = 0$ into (5), Copeland (1994) obtains the welfare effect of the pollution tax reform:

$$(e_u - t' e_{pu})du = (e_z - \tau)' g_{\tau\tau}(e_z - \tau)\alpha - t' g_{p\tau}(e_z - \tau)\alpha. \tag{9}$$

Using expressions analogous to (9), Copeland (1994) concluded that, as in the tariff reform, if all tariff-protected industries were pollution damage intensive, the welfare effect of the pollution tax reform would become positive.

On the other hand, substituting $d\tau = (e_z - \tau)\alpha$ and $dt = 0$ into (6), we obtain the market access effect of the pollution tax reform:

$$dM = \lambda(e_z - \tau)' g_{\tau\tau}(e_z - \tau)\alpha - (p^w + \lambda t)' g_{p\tau}(e_z - \tau)\alpha. \tag{10}$$

The first term on the right-hand side of (10) represents the effect of pollution tax reform on the value of imports through the change in pollution. The sign of this term is non-negative because of the positive semi-definiteness of $g_{\tau\tau}$. The pollution tax reform corrects the existing pollution distortions, which works in the direction of increasing welfare. This will generate a positive income effect that increases the demand for imports. The second term represents the effect of pollution tax reform on the value of imports through the change in production. The sign of this term becomes positive if all tariff-protected industries are pollution damage intensive. For interpretation, we decompose this term into two effects. The pollution tax reform typically reduces the output of the polluting industry. On the one hand, this will simply increase excess demand by shrinking production (supply). On the other hand, if these polluting industries are protected by import tariffs, the contraction of the polluting industry also corrects the remaining tariff distortions. This will work in the direction of increasing welfare and hence generate a positive income effect that increases the value of imports. We derive the following proposition concerning the market access effect of pollution tax reform.

Proposition 2. *If all industries protected by import tariffs are pollution damage intensive, the pollution tax reform* $d\tau = (e_z - \tau)\alpha, \alpha > 0$, *which improves welfare (Copeland, 1994), increases the value of imports.*

Proposition 2 shows that, under the relevant correlation condition, a reduction of all pollution distortions proportional to their degree of distortion increases the value of imports. As discussed above, this rule of pollution tax reform also increases welfare. Therefore, as long as the correlation condition is satisfied, a policy maker who properly knows the marginal damage from pollution e_z can achieve both welfare improvement and market access enhancement by implementing the pollution tax reform.

3. Concluding remarks

This paper investigated how market access and welfare would be affected by piecemeal reforms of tariffs and pollution taxes in a small open economy. First, we showed that the famous UPC rule that led to welfare improvement also increased the value of imports if all tariffs were set at the same *ad valorem* rates. Second, we showed that if all industries protected by import tariffs were pollution damage intensive, applying the Ju–Krishna rule of tariff reform would increase the value of imports. If all tariffs were set at the same *ad valorem* rates, then the Ju–Krishna rule also improved welfare. Finally, we showed that if all industries protected by import tariffs were pollution damage intensive, a reduction of all pollution distortions proportional to their degree of distortion increased both welfare and the value of imports.

When deriving our results, we repeatedly used the condition that all industries protected by import tariffs were pollution damage intensive. Obviously, this condition is a sufficient condition and has been extensively used in the previous literature (Copeland, 1994 and others).[10] If this condition is not satisfied, the welfare and market access effects depend on the relative magnitude of the positive and negative impacts on remaining distortions from tariffs and pollution taxes. In particular, if all pollution taxes τ are set close to the marginal damage e_z, then the negative side effect on pollution distortions arising from the tariff reform becomes smaller and hence the welfare and market access effects of the reform are the same as those in the model without pollution. If, on the contrary, the gap between pollution taxes and marginal damage is very large, the negative side effect arising from the reform would be greater. This paper characterizes the conditions under which these reforms have a positive side effect on the remaining distortions.

References

Anderson, J.E. and J.P. Neary (2007), 'Welfare versus market access: the implications of tariff structure for tariff reform', *Journal of International Economics* **71**(1): 187–205.

[10] As pointed out by Turunen-Red and Woodland (2000), the condition is satisfied for pollutants that are relatively lightly taxed (i.e., $e_z > \tau$) and that are, by and large, associated with products that are highly protected.

Baumol, W.J. and W.E. Oates (1988), *The Theory of Environmental Policy*, Cambridge: Cambridge University Press.
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.
Copeland, B.R. (1994), 'International trade and the environment: policy reform in a polluted small open economy', *Journal of Environmental Economics and Management* **26**(1): 44–65.
Copeland B.R. and M.S. Taylor (1999), 'Trade, spatial separation, and the environment', *Journal of International Economics* **47**(1): 137–168.
Dixit, A.K. and V. Norman (1980), *Theory of International Trade*, Cambridge: Cambridge University Press.
Feenstra, R.C. (2004), *Advanced International Trade*, Princeton, NJ: Princeton University Press.
Ju, J. and K. Krishna (2000), 'Welfare and market access effects of piecemeal tariff reform', *Journal of International Economics* **51**(2): 305–316.
Kawahara, S. (forthcoming), 'Welfare and market-access effects of piecemeal tariff reforms on environmentally preferable products', *Journal of International Trade and Economic Development*.
Kreickemeier, U. and P. Raimondos-Møller (2008), 'Tariff-tax reforms and market access', *Journal of Development Economics* **87**(1): 85–91.
Neary, J.P. (1995), 'Trade liberalisation and shadow prices in the presence of tariffs and quotas', *International Economic Review* **36**(3): 531–554.
Turunen-Red, A.H. and A.D. Woodland (2002), 'Unilateral reforms of trade and environmental policy', in A.D. Woodland (ed.), *Economic Theory and International Trade: Essays in Honour of Murray C. Kemp*, Northampton: Edward Elgar, pp. 124–140.
Turunen-Red, A.H. and A.D. Woodland (2004), 'Multilateral reforms of trade and environmental policy', *Review of International Economics* **12**(3): 321–336.
Woodland, A.D. (1982), *International Trade and Resource Allocation*, Amsterdam: North-Holland.
WTO (2009), *Trade and Climate Change: A Report by the World Trade Organization and the United Nations Environmental Programme*, Geneva: World Trade Organization.

Appendix

This appendix describes the proof of Proposition 1. First, consider part (a). To examine the sign of the terms on the right-hand side of (8), we re-express the specific tariff vector t by using the equivalent *ad valorem* tariff vector s as

$$t = \begin{bmatrix} s^1 & 0 & \dots & 0 \\ 0 & s^2 & \dots & 0 \\ \vdots & \vdots & \ddots & 0 \\ 0 & \dots & \dots & s^N \end{bmatrix} \begin{bmatrix} p^{w1} \\ p^{w2} \\ \vdots \\ p^{wN} \end{bmatrix} = sp^w,$$

and use this relationship to rewrite the first term on the right-hand side of (8) as

$$-(p^w + \lambda t)' m_p t\alpha = -(p^w + \lambda s p^w)' m_p s p^w \alpha.$$

If all *ad valorem* tariffs are set at an identical level ($s^i = s^*$ for all i), this can be written as

$$-(1 + \lambda s^*)s^* p^{w\prime} m_p p^w \alpha \geq 0.$$

Thus, in this case, the market access effect of a tariff reform of type $dt = -t\alpha$, $\alpha > 0$, will be positive if all industries that are protected by import tariffs are pollution damage intensive.

Next, consider part (b). Considering (5), a tariff reform of type $dt = -(p^w + \lambda t)\alpha$, $\alpha > 0$, improves welfare if

$$-t' m_p (p^w + \lambda t)\alpha + (e_z - \tau)' g_{\tau p}(p^w + \lambda t)\alpha > 0.$$

If all *ad valorem* tariffs are set at an identical level ($s^i = s^*$ for all i), then the first term on the left-hand side of the above inequality can be written as

$$-s^*(1 + \lambda s^*) p^{w\prime} m_p p^w \alpha \geq 0.$$

Thus, in this case, the welfare effect of a tariff reform of type $dt = -(p^w + \lambda t)\alpha$, $\alpha > 0$, will be positive, if all industries that are protected by import tariffs are pollution damage intensive.