The international platform of Ludwig-Maximilians University's Center for Economic Studies and the Ifo Institute

CESifo Working Papers
www.cesifo.org/wp

Market Access and Welfare: Is there a Conflict?

Pascalis Raimondos-Møller
Alan D. Woodland

CESIFO WORKING PAPER NO. 5136
CATEGORY 8: TRADE POLICY
DECEMBER 2014

CESifo
Center for Economic Studies & Ifo Institute

CESifo *Working Paper No. 5136*

Market Access and Welfare: Is there a Conflict?

Abstract

According to the literature, well known tariff reform rules that are guaranteed to increase welfare will not necessarily increase market access, while rules that are guaranteed to increase market access will not necessarily increase welfare. Such conflict between welfare and market access objectives of trade policy is problematic and calls for finding alternative tariff reform rules that can achieve both objectives at the same time. The present paper contributes to this aim by using a new set of tariff reforms that are based on local optimality. Using such reforms it is shown that market access and consumer welfare will always be weakly compatible, in the sense that reforms based on each objective have the same signed effect on the other objective. For strong compatibility, whereby both objectives increase as a result of a locally optimal tariff reform, we derive both a necessary and sufficient condition and a simple sufficient condition.

JEL-Code: F150.

Keywords: piecemeal tariff policy, locally optimal reforms, market access.

*Pascalis Raimondos-Møller**
Department of Economics
Copenhagen Business School
Porcelanshaven 16A
Denmark – Frederiksberg 2000C
prm.eco@cbs.dk

Alan D. Woodland
University of New South Wales
Business School
Australia - Sydney NSW 2052
a.woodland@unsw.edu.au

*corresponding author

September 12, 2014
The research was supported by the Australian Research Council under its Discovery Grants program and by the Danish Social Science Research Council. We gratefully acknowledge the helpful comments by Jim Anderson and Peter Neary on an early version of our duality results.

1. Introduction

Increasingly, market access has been prominent as key goal of tariff reforms.[1] Until the publication of Ju and Krishna (2000), market access issues were ignored by the theoretical literature on tariff reforms.[2] They showed, somewhat surprisingly, that tariff reform rules that increase welfare may not (and in some interesting cases, will not) increase market access. They also showed that the opposite was true: finding reforms that increase market access may not increase welfare. Clearly, such a conflict between welfare and market-access objectives undermines the applicability of existing reform rules and calls for finding new ones that are consistent with both objectives. Anderson and Neary (2007) took the issue further by examining the moments of a tariff distribution and showing how they affect welfare and market access. They showed that, in general, the two objectives are indeed in conflict and that only under special conditions, e.g., when tariff reductions leave domestic relative prices unchanged, will both objectives be satisfied.[3]

The present paper addresses this issue of finding tariff reforms that increase both welfare and market access. However, we depart from the usual practice of only considering tariff reductions and focus instead on finding locally optimal tariff reforms. Accordingly, we allow for both raising and reducing tariffs and, importantly, ensure that reforms are constructed to maximize the chosen objective. In this sense, we continue the analysis of the steepest ascent tariff reform (SATR) concept developed in Raimondos-Møller and Woodland (2014).[4]

An interesting duality property of steepest ascent tariff reforms emerges from our analysis. As an example, a SATR based upon welfare as the objective function affects market access in exactly the same way that a SATR based upon market access as the objective function affects welfare. We refer to this duality outcome as indicating that market access and consumer welfare are *weakly compatible*. This concept of weak compatibility between the two objectives is distinguished from that of *strong compatibility*, by which we mean that a tariff reform that increases one of the objective functions (say, market access) will also increase the other objective function (say, consumer welfare). Within the context of SATRs, we show that strong compatibility occurs

[1] International trade negotiations provide the best examples for cases where market access is paramount; see Bagwell and Staiger (1999).

[2] For a recent survey of this extensive literature see Falvey and Kreickemeier (2011).

[3] This conflict between the two objectives was also confirmed in Kreickemeier and Raimondos-Møller (2008), who examined integrated reforms of tariffs and consumption taxes, and in Falvey and Kreickemeier (2009), who looked at different reforms in the presence of wages rigidity.

[4] In that paper, we defined the concept of a SATR in terms of the size of the welfare improvement. We demonstrated how inefficient well-known tariff reform rules (that focus only on the sign of the welfare effect) can be compared to our SATR.

under certain conditions. Specifically, we show that a sufficient condition for strong compatibility is that the initial tariffs are of a uniform ad valorem rate. We also derive and discuss the necessary and sufficient conditions for the strong compatibility of market access and welfare.

2. STEEPEST ASCENT POLICY REFORM: CONCEPT AND DUALITY

Consider an objective function $U(t)$ and a policy instrument vector t. The gradient of the objective function at an initial level of the instrument is $\nabla U(t)$ and the directional derivative (in direction δ) at this initial point is $D(t,\delta) = \nabla U(t)'\delta$ (the notation $'$ denotes the transpose of a vector). This directional derivative indicates the slope of the objective function in the direction δ. Specifically, if the differential of the policy instrument is $dt = \delta d\alpha$, where $\alpha > 0$, the differential objective change is $dU(t)/d\alpha = D(t,\delta)$. The idea of the piecemeal reform literature is to determine reform directions, δ, such that this directional derivative is positive. However, rather than searching for reforms with positive directional derivatives, we characterize the direction vector, δ, that *maximizes* the differential change in our objective. The locally optimal policy reform problem is expressed formally as

$$\max_{\delta} \left\{ \nabla U(t)'\delta \right\}. \tag{1}$$

Accordingly, we define the solution for δ to the problem above as the *steepest ascent policy reform direction.* The solution for δ is

$$\delta^S = \theta \nabla U(t), \quad \theta = \|\nabla U(t)\|^{-1} > 0, \tag{2}$$

where $\nabla U(t)$ is the gradient vector, whose elements are the partial derivatives $\partial U(t)/\partial t_i$, $i = 1, 2, ..., n$, and θ is the Euclidean length of the gradient vector.

Having defined our steepest ascent policy reform, we establish the following general *duality* result.

Proposition 1. *Consider a policy instrument vector, t, and two different objective functions, $U^i(t)$ and $U^j(t)$, with corresponding steepest ascent policy reforms, δ^i and δ^j. The effect of a steepest ascent policy reform δ^i upon objective function $U^j(t)$ and the effect of a steepest ascent policy reform δ^j upon objective function $U^i(t)$ are related by*

$$\left\|\nabla U^i(t)\right\| \frac{du^j}{d\alpha}|_{\delta^i} = \left\|\nabla U^j(t)\right\| \frac{du^i}{d\alpha}|_{\delta^j} = \nabla U^i(t)' \nabla U^j(t).$$

Proof. The effect of the steepest ascent policy reform, $dt = \delta^i d\alpha, d\alpha > 0$, on objective function $U^i(t)$ is $\delta^i = \nabla U^i(t) \ \left\|\nabla U^i(t)\right\|^{-1}$, making use of the general result in (1) and (2). The effect of this reform on objective function $U^j(t),\ j \neq i$, is

$$\begin{aligned} \left.\frac{du^j}{d\alpha}\right|_{\delta^i} &= D^j(t, \delta^i) \\ &= \nabla U^j(t)' \nabla U^i(t) \ \left\|\nabla U^i(t)\right\|^{-1}, \end{aligned}$$

where $D^j(t, \delta^i) = \nabla U^j(t)' \delta^i$ is the directional derivative for objective function $U^j(t)$ in direction δ^i.Clearly, this last expression is symmetric in i and j except for the positive distance scalar. Reversing the roles of i and j leaves the first part of the expression unchanged and will only alter the last term. Accordingly, it follows that

$$\left\|\nabla U^i(t)\right\| \left.\frac{du^j}{d\alpha}\right|_{\delta^i} = \left\|\nabla U^j(t)\right\| \left.\frac{du^i}{d\alpha}\right|_{\delta^j} = \nabla U^j(t)' \nabla U^i(t),$$

proving the proposition. ■

This proposition shows that the effect of steepest ascent policy reform i upon objective function j is the same, up to a positive factor of proportionality, as the effect of steepest ascent policy reform j upon objective function i. The reason for this result is that the steepest ascent reform direction is the normalized gradient vector for the objective function. Then, the effect of this reform on the other objective function is obtained as the inner product (directional derivative) between this reform direction and the gradient of the other objective function. Since the inner product of the two gradient vectors represents cross effects, the cross effect of one reform on the other objective, and vice versa, are exactly the same (apart from a positive scalar). Thus, if the steepest ascent policy reform designed with objective function U^i in mind also increases objective function U^j, then it must be the case that the steepest ascent policy reform designed with objective function U^j in mind also increases objective function U^i.

3. SATR WITH CONSUMER WELFARE AND MARKET ACCESS OBJECTIVES

Proposition 1 applies to any two objective functions arising from any model and involving any policy instruments. Here, we consider a model of tariff reform where the two objectives are welfare and market access.

The framework that we use is standard in the literature on piecemeal tariff reform, viz. that of a small economy trading N goods with the rest of the world. The model may be specified

using the zero balance of trade equation

$$p'E_\pi(\pi, u) = 0, \tag{3}$$

expressed in terms of the world price vector, p, the domestic price vector, π, the representative household's utility level, u, and the net expenditure function, E. The world and domestic price vectors are related by $\pi = P(\iota + t)$, where t is a vector of ad valorem trade tax rates, ι is the unit vector with all elements equal to unity and $P = diag(p)$ is a diagonal matrix with the world price vector along the diagonal.

It is assumed that goods are divided into two groups. Goods in group 1 (exportable goods) do not to have any trade taxes, while those in group 2 (importable goods) are subject to import tariffs. Following the market access literature, it is assumed that all exported goods are aggregated into a single composite commodity, which is chosen as the numeraire good.[5] Let $E_{\pi\pi}$ be the net substitution matrix and $E_{\pi u}$ be a vector of 'income' effects. It is assumed that the Hatta normality condition, $H \equiv p'E_{\pi u} > 0$, holds. The matrix $E_{\pi\pi}$ may be partitioned between the exported good and the imported goods, the net substitution matrix for imported goods being denoted E_{22}. Similarly, E_{2u} denotes the income effect vector for imported goods.

3.1. Targeting Utility. When the government employs a tariff reform to target consumer welfare, the objective function is expressed as $u = U^W(t)$. The change in utility arising from a differential tariff reform is obtained by differentiating (3), yielding

$$\begin{aligned} p'E_{\pi u}du &= -p'E_{\pi 2}d\pi_2 \\ &= t_2'P_2'E_{22}P_2dt_2 \\ &= t_2'\mathcal{S}_{22}dt_2, \end{aligned} \tag{4}$$

where $\mathcal{S}_{22} \equiv P_2'E_{22}P_2$ is the 'normalized' substitution matrix for imported goods at the initial equilibrium. The gradient of the utility function $U^W(t)$ with respect to t_2 is

$$\nabla_2 U^W(t) = \frac{\mathcal{S}_{22}t_2}{p'E_{\pi u}}. \tag{5}$$

When the government uses $u = U^W(t)$ as its objective function, the SATR is calculated

[5] Thus, the price and trade tax vectors are partitioned as $p = (p_1, p_2)$, $\pi = (\pi_1, \pi_2)$ and $t = (t_1, t_2)$ with $t_1 = 0$.

using the general expression (2) and the gradient (5) to yield[6]

$$\delta_2^W = \frac{\nabla_2 U^W(t)}{\|\nabla_2 U^W(t)\|} = \frac{\mathcal{S}_{22} t_2}{\|\mathcal{S}_{22} t_2\|}. \tag{6}$$

3.2. Targeting Market Access. Market access is defined as the value of imports at world prices, i.e., $M_2 = p_2' E_2(\pi, u)$, where $E_2(\pi, u) \equiv \partial E(\pi, u)/\partial \pi_2$ is the vector of import demand functions. The change in market access as a result of a differential tariff change is

$$\begin{aligned} dM_2 &= p_2' E_{22} d\pi_2 + p_2' E_{2u} du \\ &= (\iota' \mathcal{S}_{22} + M_{2u} t_2' \mathcal{S}_{22}) dt_2, \end{aligned} \tag{7}$$

where $M_{2u} = p_2' E_{2u}/p' E_{\pi u}$ is the marginal propensity to spend on importable commodities using world price valuations. The gradient of the market access function $U^M(t)$ with respect to t_2 is

$$\nabla_2 U^M(t) = \mathcal{S}_{22}\iota + M_{2u}\mathcal{S}_{22} t_2. \tag{8}$$

When the government employs a differential tariff reform to maximize the impact upon market access, it uses $M_2 = U^M(t)$ as its objective function. The corresponding SATR, obtained using the general expression (2) and the gradient (8), is

$$\delta_2^M = \frac{\nabla_2 U^M(t)}{\|\nabla_2 U^M(t)\|} = \frac{\mathcal{S}_{22}\iota + M_{2u}\mathcal{S}_{22} t_2}{\|\mathcal{S}_{22}\iota + M_{2u}\mathcal{S}_{22} t_2\|}. \tag{9}$$

4. COMPATIBILITY OF SATRS FOR MARKET ACCESS AND WELFARE

We now ask the question of how each of the two steepest ascent tariff reforms, obtained using welfare and market access as the objective functions, affects the alternative objective function. To answer this, we first take the SATR for market access given by direction (9) and compute its welfare implications using the expression

$$H du = t_2' \mathcal{S}_{22} dt_2. \tag{10}$$

[6] As Raimondos-Møller and Woodland (2014) prove, the steepest ascent reform with respect to a subset of policy variables (here t_2) is expressed in terms of the gradient with respect to this subset. Consequently, we partition the full gradient vector as $\nabla U^W = (\nabla_1 U^W,\ \nabla_2 U^W)$ and use only the second component. Similarly, the direction vector is partitioned as $\delta^W = (\delta_1^W, \delta_2^W)$ with $\delta_1^W = 0$.

The resulting change in utility from the market access tariff reform $dt_2 = \delta_2^M d\alpha,\ d\alpha > 0$, is

$$\begin{aligned} H\ du/d\alpha|_{\delta^M} &= t_2' \mathcal{S}_{22} \delta_2^M \\ &= \frac{(\iota + M_{2u} t_2)' \mathcal{S}_{22}' \mathcal{S}_{22} t_2}{\|\mathcal{S}_{22}\iota + M_{2u}\mathcal{S}_{22} t_2\|}. \end{aligned} \tag{11}$$

Similarly, using the SATR for consumer welfare given by direction (6), we obtain its market access implications using expression (7). The resulting change in market access from the welfare tariff reform $dt_2 = \delta_2^W d\alpha,\ d\alpha > 0$, is

$$\begin{aligned} dM_2/d\alpha|_{\delta^W} &= (\iota + M_{2u} t_2)' \mathcal{S}_{22}' \delta_2^W \\ &= \frac{(\iota + M_{2u} t_2)' \mathcal{S}_{22}' \mathcal{S}_{22} t_2}{\|\mathcal{S}_{22} t_2\|}. \end{aligned} \tag{12}$$

A close inspection of (11) and (12) reveals that

$$\|\mathcal{S}_{22} t_2\|\ dM_2/d\alpha|_{\delta^W} = H\ \|\mathcal{S}_{22}\iota + M_{2u}\mathcal{S}_{22} t_2\|\, du/d\alpha|_{\delta^M} = (\iota + M_{2u} t_2)' \mathcal{S}_{22}' \mathcal{S}_{22} t_2. \tag{13}$$

Since the distance coefficients are positive scalars, the two expressions ($dM_2/d\alpha|_{\delta^W}$ and $du/d\alpha|_{\delta^M}$) have the same sign, yielding the following proposition.[7]

Proposition 2. *The effects of a differential utility maximizing tariff reform upon market access and of a differential market access maximizing tariff reform upon utility are proportional, such that* $sign\left(dM_2/d\alpha|_{\delta^W}\right) = sign\left(du/d\alpha|_{\delta^M}\right) = sign\left((\iota + M_{2u} t_2)' \mathcal{S}_{22}' \mathcal{S}_{22} t_2\right)$.

Thus, if it can be established that the SATR with utility as the objective will also enhance market access, then it follows that a SATR with market access as the objective will also increase consumer welfare. Conversely, if the SATR with utility as the objective reduces market access, then a market access based SATR will also reduce consumer welfare. In this sense, the two objectives are *weakly compatible*.

While this result establishes a close connection between the effects of one policy reform upon the other objective function, it does not provide information as to whether the common sign of cross effects is positive (the objectives are *strongly compatible*) or negative (they are *incompatible*). To investigate this, the sign of the right side of (13) needs to be examined, leading to the following proposition.

[7] This should not be a surprise, of course, since our general result in Proposition 1 established just that.

Proposition 3. *Within the context of steepest ascent tariff reforms, the objectives of market access and consumer welfare are strongly compatible if, and only if,* $(\iota + M_{2u}t_2)'\mathcal{S}_{22}'\mathcal{S}_{22}t_2 > 0$.

To sign this condition, we re-write it as

$$(\iota + M_{2u}t_2)'\mathcal{S}_{22}'\mathcal{S}_{22}t_2 = \iota'\mathcal{S}_{22}'\mathcal{S}_{22}t_2 + M_{2u}t_2'\mathcal{S}_{22}'\mathcal{S}_{22}t_2. \tag{14}$$

Whether this expression is positive depends on the sign and size of the first term on the right side, since the second term is positive. One obvious special case where the first term (and hence the whole expression) is positive is where $t_2 = \beta\iota$, $\beta > 0$, meaning that the initial import tariffs are uniform with common ad valorem rate β, since the first term then becomes a positive definite quadratic form. Thus, we establish the following proposition.

Proposition 4. *If the initial import tariffs have a uniform rate,* $\beta > 0$, *and* $M_{2u} > 0$, *then the market access maximizing tariff reform will also increase welfare and, conversely, a consumer welfare maximizing tariff reform will also increase market access.*

Proposition 4 is important because it provides a readily understood sufficient condition on the structure of initial tariffs that guarantees the strong compatibility between consumer welfare and market access as policy objectives.[8]

While the uniform tariff case clearly determines the positive sign of the common effect (14), it is not a necessary requirement for this outcome. A weaker sufficiency condition for strong compatibility is that the first term in (14) be positive, i.e., $\iota'\mathcal{S}_{22}'\mathcal{S}_{22}t_2 > 0$, meaning that t_2 and ι are positively correlated in a generalized sense.[9,10] Intuitively, this expression remains positive provided that the initial tariff vector, t_2, does not deviate 'too far' from the vector $\beta\iota$, that is, the initial tariff vector is not 'too far' from uniformity. Conversely, if the initial tariff has wide disparity in ad valorem rates, market access and consumer welfare are more likely to be incompatible objectives.

[8] This result also relates to the discussion by Anderson and Neary (2007, pp. 200-201) presented in and after their Proposition 4. Their proposition shows that *special* reforms based upon welfare and market access objectives are not in conflict, in just the same way that we show above that *steepest ascent tariff reforms* based upon these two objectives are not in conflict. They also note as a special case of their proposition that the two objectives are not in conflict when tariffs are uniform.

[9] Geometrically, this inequality means that vectors ι and $\mathcal{S}_{22}'\mathcal{S}_{22}t_2$ are separated by an acute angle.

[10] More generally, a first term that is negative is consistent with overall positivity provided that is not sufficiently negative to outweigh the positive second term. Geometrically, this inequality means that vectors $\iota + M_{2u}t_2$ and $\mathcal{S}_{22}'\mathcal{S}_{22}t_2$ are separated by an acute angle.

5. Conclusions

Our paper emphasizes the need for finding broader sets of reforms when we want to achieve more than one objective. We apply a new set of tariff reforms to the question of whether the welfare and the market-access objectives are compatible. This new set of reforms is based on local optimality, as in Raimondos-Møller and Woodland (2014). We show that such reforms have a very interesting generic duality property. By discovering the effect a reform designed to optimize objective A has on objective B, we immediately know what effect the reform designed to optimize objective B has on objective A; in this sense, the objectives are weakly compatible. In the special context of tariff reform, our first main result is that the use of steepest ascent tariff reforms guarantees that market access and welfare are weakly compatible objectives. Our second main result is to establish conditions under which steepest ascent tariff reforms designed with one objective in mind are also guaranteed to increase the other objective, an outcome we define as strong compatibility. We establish a simple sufficient condition and necessary and sufficient conditions for this serendipitous outcome.

References

[1] 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, 187-205.

[2] Bagwell, K. and R. Staiger, 1999, An economic theory of GATT, *American Economic Review* 89, 215-248.

[3] Falvey, R., Kreickemeier, U., 2009. Tariff reforms with rigid wages, *Economic Theory* 41, 23–39.

[4] Falvey, R. and U. Kreickemeier, 2011, The theory of trade policy and reform, in *Palgrave Handbook in International Trade*, (eds.) D. Bernhofen, R. Falvey, D. Greenaway, U. Kreickemeier, Palgrave Macmillan, 256-294.

[5] Ju, J., and K. Krishna, 2000, Welfare and market access effects of piecemeal tariff reform, *Journal of International Economics* 51, 305–316.

[6] Kreickemeier, U. and P. Raimondos-Møller, 2008. Tariff-tax reforms and market access, *Journal of Development Economics* 87, 85–91.

[7] Raimondos-Møller, P. and A.D. Woodland, 2014, Steepest ascent tariff reform, *Economic Theory* 55, 69-99.