Tariff Reforms with Rigid Wages

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Abstract

This paper analyses the effects of tariff reforms on welfare and market access in a competitive small open economy that is characterised by involuntary unemployment due to non-market clearing wages that are set in either nominal or real terms. There is an inherent tension between reforms that increase welfare and market access, respectively, if we consider integrated changes of tariffs and the wage rate. We also derive welfare increasing tariff-reform strategies that keep the wage rate (nominal or real) constant, and show that this tension between welfare- and market-access-increasing reforms may be attenuated.

JEL-Classification: F11, F13, F16

Key words: Tariff Reform, Unemployment, Small Open Economy

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1 Introduction

The analysis of piecemeal trade policy reform has evolved in – at least – three significant directions in recent years. First, Ju and Krishna (2000) supplement the traditional focus on welfare improvements as the objective of the reforms with considerations of market access. This is an important and policy-relevant extension, given that access to export markets, rather than welfare improvements per se, is the language in which negotiations over international trade policy reform are conducted. Their main result is that both market access and welfare cannot fall when tariffs are reduced, but that we cannot be sure that the standard welfare-improving reforms will also increase market access.

Second, Anderson and Neary (2007) significantly expand the range of reforms known to be welfare or market access improving. They formalize the notion that higher tariffs on average or a higher dispersion of tariffs for a given average are both likely to be welfare decreasing for a small country. They do this by defining a generalized mean and a generalized variance for a tariff structure and then demonstrate that the welfare effect of an arbitrarily small change in tariffs is fully described by its effects on these two moments of the tariff distribution. An increase in the generalised mean or generalised variance reduces welfare in general. Anderson and Neary then extend their investigation to market access and show that import value is generally declining in the generalised mean but increasing in the generalised variance of the tariff structure.

Finally, Kreickemeier (2005) uses the standard model of a competitive small open economy to consider the welfare effects of trade policy reform in the presence of involuntary unemployment. The source of unemployment is the downward rigidity in the nominal (numeraire) wage, as pioneered by Brecher (1974). This distortion in the labour market

gives trade policy a second-best welfare role, and implies that the labour-intensity of import-competing industries will be crucial in designing programs of piecemeal trade policy reform. Tariff cuts reduce domestic producer prices and have employment effects whose sign depends on whether importables production is labour-intensive. This implies, for example, that the standard gains from a proportional tariff reduction will be supplemented by an additional welfare gain from increased aggregate employment as long as importables are not labour-intensive. But if importables are labour-intensive, which is the case that is arguably relevant for developed economies, then the adverse labour market effects could make a proportional tariff cut welfare reducing.

The present paper builds on all three contributions and derives new results for the welfare and market access effects of tariff reforms in the presence of rigid wages. It goes beyond the analysis of tariff reforms in Kreickemeier (2005) in two significant ways: First, it looks at the case of rigid real wages in addition to the standard case of a fixed nominal wage, and second it uses the tools developed in Anderson and Neary (2007) to derive a larger set of welfare increasing reforms in the theoretically interesting case where the importables are labour intensive, and therefore trade liberalisation tends to lower domestic employment. Furthermore, it looks at the effect of trade liberalisation on market access, thereby extending the work by Ju and Krishna (2000) and Anderson and Neary (2007) to the case of labour market imperfections.

After setting up the model in Section 2, we consider integrated tariff and labour market reforms in Section 3. There, we show generalised radial reforms of goods market and labour market distortions that are welfare improving and market access increasing, respectively. We then focus on tariff reforms only, where the labour market distortion is a constant

nominal wage in Section 4 and a constant real wage in Section 5. Section 6 concludes.

2 The Model

Consider a competitive open economy, consuming and producing $n+1$ tradable goods. There is a single export good, labelled 0, which is traded freely with the rest of the world.[1] Its domestic output and price are denoted by y_0 and p_0, respectively. The export good serves as *numéraire*, i.e. $p_0 \equiv 1$ throughout. In addition, there are n import goods with outputs y and prices p. There are $m+1$ internationally immobile factors of production, where the vector v comprises m factors for which fully flexible factor prices ensure full employment of the exogenously given respective endowments.

There is an additional factor, labour, which is paid a minimum wage that may be fixed in either nominal or real terms and that is assumed to be binding throughout the analysis. Therefore, the employment of labour, L, is smaller than the economy's labour endowment $\bar{L}$. Nominal wage w and real wage W are related via the price index P: $w = WP$, where $P \equiv \sum_j \sigma_j p_j$ and σ_j is the average expenditure share on good j in the domestic consumption bundle. In order to simplify the notation, we normalise the world market prices of all goods to one. Hence, the price index under free trade is equal to one as well, and $w = W$ under free trade. Using this result, the nominal wage can be written as follows:

$$w = W(\sigma' p + \sigma_0) = W(1 + \sigma' t) \tag{1}$$

[1] Alternatively, the export good may be reinterpreted as a bundle of freely traded goods with constant relative world market prices.

Following Neary (1985), the production side of the economy is conveniently described by the restricted profit function:

$$g(p,w) \equiv \max_{y_0,y,L} \left\{ y_0 + p'y - wL \,|\, (y_0,y,L) \text{ feasible} \right\}, \tag{2}$$

where the price of the numeraire good and the endowments of the flexprice factors are suppressed as arguments of $g(\cdot)$ as they are held constant throughout the analysis.[2] It is assumed that $m > n$, i.e. that there are at least as many flexprice factors as traded goods in order to ensure the differentiability of $g(\cdot)$. From Hotelling's lemma, the partial derivatives of the restricted profit function are $g_p = y$ and $g_w = -L$. The allocation described by $g(\cdot)$ maximizes the income of the fully employed factors, not the economy's value of production (GDP). The latter is given by

$$\text{GDP} = g(p,w) + wL(p,w) \equiv r(p, L(p,w)) \tag{3}$$

where $r(\cdot)$ is the standard revenue function (Neary 1985). The equivalence stated in (3) has a straightforward interpretation: The GDP in a minimum wage economy equals the GDP of an economy with full employment whose labor endowment is equal to the equilibrium labor demand in the minimum wage economy. With $L < \bar{L}$ in the case of unemployment, this shows that GDP is not maximized in the minimum wage economy. This illustrates the distortion imposed by the binding minimum wage.

Following Kreickemeier (2005), we define the minimum wage trade expenditure function

$$E(p,w,u) \equiv e(p,u) - g(p,w), \tag{4}$$

[2] All vectors are column vectors, their transposes are denoted by a prime.

which gives the excess expenditure over the income of the flexprice factors. The derivative properties of $E(\cdot)$ follow from the standard properties of $e(\cdot)$ and $g(\cdot)$. In addition, $E(\cdot)$ is linearly homogeneous in (p_0, p, w). Equilibrium for the small open economy is given by

$$E(p, w, u) = wL + t'm \tag{5}$$

$$E_p(p, w, u) = m \tag{6}$$

$$E_w(p, w) = L \tag{7}$$

Totally differentiating (5), using (6) and (7) gives

$$E_u du = t'dm + wdL \tag{8}$$

Substituting for dm and dL leads to

$$\mu^{-1}du = \left[t'E_{pp} + wE_{wp}\right]dp + \left[t'E_{pw} + wE_{ww}\right]dw, \tag{9}$$

Here $\mu \equiv (E_u - t'E_{pu})^{-1}$ is the shadow price of foreign exchange. Following common practice it is assumed to be positive.[3] Hence, any policy reform which leads to the right hand side of (9) being positive is welfare increasing. With a constant nominal wage $dw = 0$, while with a constant real wage $dw = W\sigma' dp$. In the latter case, the term in the second brackets is the effect of the induced change in the nominal wage that is necessary to keep the real wage W constant.

3 Integrated Tariff and Labour Market Reforms

We focus on the case of a fixed nominal wage first and start by looking at integrated reforms of tariffs and the minimum wage. Let $\pi' \equiv (p', w)$ denote the price vector including the

[3] See Neary (1995, p. 540) for a collection of arguments justifying this assumption.

minimum wage, but excluding the numeraire. Assuming some substitutability between the numeraire and non-numeraire goods is sufficient to ensure that the matrix $E_{\pi\pi}$ is negative definite.[4] The standard welfare equation can then be written as

$$\mu^{-1}du = (\pi - \pi^*)' E_{\pi\pi} d\pi, \tag{10}$$

where $\pi^{*\prime} \equiv (p^{*\prime}, 0)$ is the vector of shadow prices, taking into account that the shadow price of labour in the presence of minimum wage unemployment is zero (Kreickemeier, 2005). Hence, $(\pi - \pi^*)' = (t', w)$ is the vector of *shadow premia* (Neary 1995), defined as the difference between the market price of a good or factor and the respective shadow price. Dividing the shadow premia by the respective market prices gives the vector of *shadow premium rates* $T \equiv [D(\pi)]^{-1}(\pi - \pi^*)$, where $D(x)$ stands for a diagonal matrix with the elements of vector x on the main diagonal. Note that the shadow premium rate for labour, T_w, is equal to one, whereas $0 < T_i < 1$ for all importables. Hence, we have the following lemma from Kreickemeier (2005):

Lemma 1. *In a small open economy with a binding minimum wage, the shadow premium rate for labor is higher than any of the shadow premium rates on importables.*

We can now rewrite (10) as

$$(\mu\bar{s})^{-1}du = -T\mathrm{S}dT \tag{10$'$}$$

where $\mathrm{S} \equiv -\bar{s}^{-1}D(\pi)E_{\pi\pi}D(\pi)$, with $\bar{s} \equiv -\pi' E_{\pi\pi}\pi > 0$, is a normalised substitution matrix. It is positive definite, with all elements summing to one. In contrast to the otherwise identical matrix in Anderson and Neary (2007), it is defined for a price vector that includes the wage rate.

[4] See Dixit and Norman (1980, p. 130).

We are now in a position to express the welfare effect of trade reforms in terms of generalised moments of the distortion vector, which in our case comprises not only all tariffs but also the wage rate. In analogy to Anderson and Neary (2007), we define the average shadow premium rate $\bar{T} \equiv \iota' \mathrm{S} T$ with ι denoting an $(n+1) \times 1$ vector of ones, and the generalised variance of shadow premium rates $V \equiv T' \mathrm{S} T - \bar{T}^2$. All weights in the determination of $\bar{T}$ are strictly between zero and one and sum to one if all importables are substitutes in net import demand for the numeraire, and furthermore the numeraire is labour intensive. This is what we assume henceforth.

The changes of the generalised moments are defined as $d\bar{T} = \iota' \mathrm{S} dT$ and $dV = 2T' \mathrm{S}(dT - \iota d\bar{T})$, respectively.[5] Substitution into $(10')$ gives

$$(\mu \bar{s})^{-1} du = -\bar{T} d\bar{T} - \frac{1}{2} dV. \tag{11}$$

Hence, welfare increases with a decreasing average shadow premium rate and a decreasing variance of shadow premium rates.

The market access equation in the case of a minimum wage can be written as

$$\begin{aligned} dM \equiv p^{*\prime} dm &= \left[\pi^* + m_b(\pi - \pi^*)\right]' E_{\pi\pi} d\pi \\ &= \left[\pi - (1 - m_b)(\pi - \pi^*)\right]' E_{\pi\pi} d\pi, \end{aligned} \tag{12}$$

where m_b is the marginal expenditure share of importables, which is assumed to be strictly between zero and one. Eq. (12) is formally identical to the analogous expression in Anderson and Neary (2007), and hence it can be rewritten in terms of shadow premium rates

[5] As explained in Anderson and Neary (2007), the changes thus defined should be interpreted as Laspeyres-type approximations of the true changes (which would account for changes in S and π).

as follows

$$\bar{s}^{-1}dM = -[\iota - (1 - m_b)T]'\mathrm{S}dT, \tag{13}$$

and in terms of average shadow premium rates and the variance of shadow premium rates as

$$\bar{s}^{-1}dM = -[1 - (1 - m_b)\bar{T}]d\bar{T} + \frac{(1 - m_b)dV}{2} \tag{14}$$

Hence, market access is increasing with a decreasing average shadow premium rate and an *increasing* variance in the shadow premium rates.

In Kreickemeier (2005), only two definitely welfare improving trade liberalisation strategies could be devised in the presence of a binding minimum wage:

(i) (*Radial Reduction*) Reducing all tariffs and the nominal wage rate proportionally increases welfare.

(ii) (*Modified Concertina*) Reducing the highest tariff increases welfare if the good with the highest tariff is *not* labour intensive.

In this paper, we focus on trade liberalisation in the case where all importables are labour intensive, as this is the case about which not a lot could be said in Kreickemeier (2005). We look at reforms that increase welfare and market access, respectively.

3.1 The Generalised Radial Reform of Shadow Premium Rates

In analogy to Anderson and Neary (2007), we can look at the generalised radial reform of shadow premium rates

$$dT = -[\gamma T + (1 - \gamma)\iota]d\alpha, \qquad 0 \leq \gamma \leq \frac{1}{1 - T_{\min}}, \qquad d\alpha > 0. \tag{15}$$

This reform is a weighted average between a uniform proportionate reduction in shadow premium rates and a uniform absolute reduction of shadow premium rates, where notably the weight on the proportional reduction term can exceed one, and hence the weight on the absolute reduction term can be negative. For $\gamma = 0$, domestic prices and the nominal wage are reduced proportionally (recall $d\pi = D(\pi)dT$), which implies that higher shadow premium rates are reduced *less* than proportionally. The higher γ, the greater the relative reduction in higher shadow premium rates. The shadow premium rates are lowered proportionally for $\gamma = 1$, and a value $\gamma > 1$ indicates that higher shadow premium rates are lowered more than proportionally. The extreme case $\gamma = 1/(1 - T_{\min})$ is the super-concertina reform where all shadow premium rates are moved radially towards the lowest one. Higher values for γ are compatible with welfare increasing reforms, but they would entail the increase of some shadow premium rates (see Anderson and Neary (2007) for a discussion).

The impact of reform (15) on the generalised tariff moments is given by

$$d\bar{T} = -(\gamma\bar{T} + 1 - \gamma)d\alpha \quad \text{and} \quad dV = -2\gamma V d\alpha, \tag{16}$$

and it is easily checked that both moments (weakly) decrease for $d\alpha > 0$ and γ in the given parameter range. Hence we have:

Proposition 1. *The generalised radial reform of shadow premium rates described in (15) increases welfare.*

Note that due to the fact that T_w is the largest shadow premium rate, among the reforms described in (15) the one with $\gamma = 0$ entails the smallest decrease in the nominal wage. Even this reform, however, lowers the real wage, given our assumption that the marginal

expenditure share of importables is strictly smaller than one.[6]

Alternatively, we can look at the following reform:

$$dT = -[\delta(\iota - T) + (1 - \delta)\iota]d\alpha, \qquad 0 \leq \delta \leq 1, \qquad d\alpha > 0. \tag{17}$$

This reform is a weighted average between a reduction of shadow premium rates in proportion to their difference from one (*inverse proportional reduction*) and a uniform absolute reduction of shadow premium rates. For $\delta = 0$, domestic import prices and the nominal wage are reduced proportionally, which implies that higher shadow premium rates are reduced less than proportionally. The higher δ, the smaller the relative reduction in higher shadow premium rates. For $\delta = 1$ we get the anti-concertina reform, where all tariffs are reduced in proportion to their distance to the highest shadow premium rate $T_w = 1$. The impact of reform (17) on the generalised tariff moments is given by

$$d\bar{T} = -(1 - \delta\bar{T})d\alpha \quad \text{and} \quad dV = 2\delta V d\alpha, \tag{18}$$

and it is easily checked that the average tariff decreases and the variance (weakly) increases for $d\alpha > 0$ and δ in the given parameter range. Hence we have the following:

Proposition 2. *The generalised radial reform of shadow premium rates described in (17) increases market access.*

Note that the radial reforms (15) and (17) coincide for $\gamma = \delta = 0$. This observation implies, together with propositions 1 and 2

Corollary 1. *A uniform radial reduction of all shadow premium rates increases welfare and market access.*

[6]Reform (15) with $\gamma = 0$ lowers all importables prices and the nominal wage proportionally. The real wage must fall as long as some exportables (whose prices stay constant) are consumed domestically.

In the context of rigid wages, the market access increasing reforms have useful interpretations. As just noted, the anti-concertina reform holds the nominal wage constant, and hence we know that it increases market access, given our assumptions on substitutability. There is another useful result for reforms with a constant real wage. To this end, consider the so-called Ju-Krishna reform, which by Ju and Krishna (2000) has been shown to increase market access irrespective of any assumptions on substitutability between goods. As shown by Anderson and Neary (2007), it is a special case of (17), with $m_b = 1 - \delta$. Hence, we can formulate a modified Ju-Krishna reform of tariffs and the minimum wage rate as follows:

$$d\pi = D(\pi)dT = -\left[m_b\pi + (1 - m_b)\pi^*\right] d\alpha \tag{19}$$

or, equivalently, using $p^* = \iota$,

$$dp = dt = -\left[m_b(\iota + t) + (1 - m_b)\iota\right] d\alpha \tag{20}$$

$$dw = -m_b w d\alpha \tag{21}$$

We now compare the change in the nominal wage implied by a Ju-Krishna reform of all price distortions with a tariff-only Ju-Krishna reform that is accompanied by a change in the nominal wage with the purpose of keeping the real wage constant. In this case, we have $dw = W\sigma' dt$, and substituting for dt from (20) gives

$$\begin{aligned} dw &= -W\sigma'\left[m_b(\iota + t) + (1 - m_b)\iota\right] d\alpha \\ &= -\left[m_b W\sigma' t + W\sigma'\iota\right] d\alpha \\ &= -\left[m_b(w - W) + W\sigma'\iota\right] d\alpha \\ &= -\left[m_b w + W(\sigma'\iota - m_b)\right] d\alpha \end{aligned} \tag{22}$$

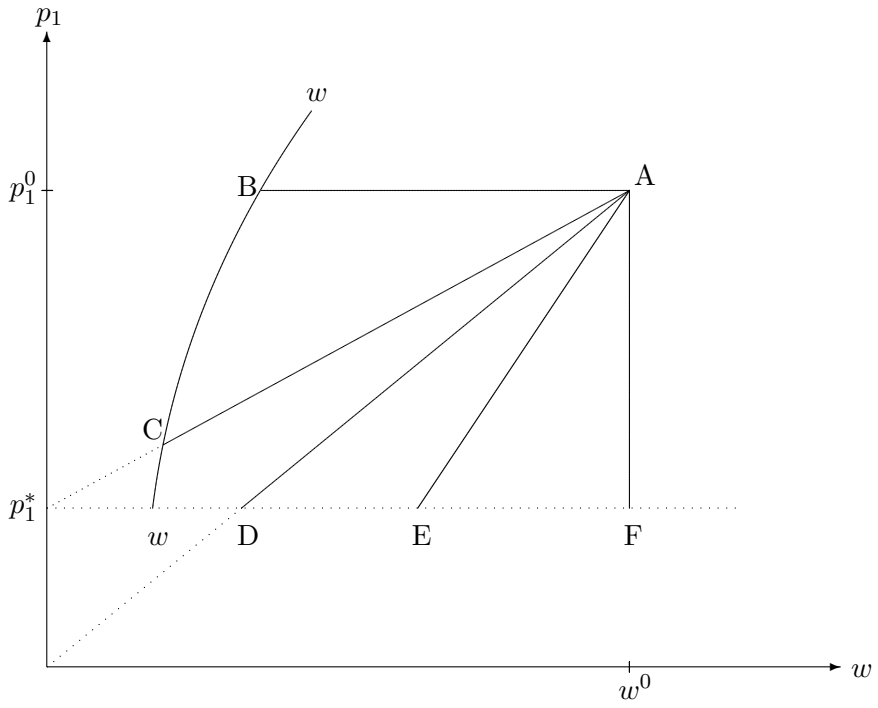

Figure 1: Integrated Tariff and Wage Reforms

where we have used $w = W(1 + \sigma' t)$ in line three. Note that $\sigma' \iota - m_b$ is the difference between the average and the marginal expenditure share of importables. These two coincide with homothetic preferences, and hence comparing (21) and (22) gives the following:

Lemma 2. *With homothetic preferences, the Ju-Krishna reform of importables prices and the nominal wage leaves the real wage constant.*

The reform possibilities are illustrated in figure 1 for the case where only a single importable is subject to a tariff. The pre-reform domestic price and wage are given by p_1^0 and w^0, respectively. The locus ww gives combinations of p_1 and w for which the minimum wage is just binding. It is implicitly defined by $E_w(p_1, w) = \bar{L}$, and hence its slope is $dp_1/dw = -E_{ww}/E_{1w}$, which is strictly positive if good 1 is labour intensive. Reforms described in proposition 1 as welfare increasing are represented by movements in (south-

)west direction inside the cone spanned by AB and AD. The radial reduction of tariffs and the wage rate, shown by Kreickemeier (2005) to be welfare increasing, is represented by a movement along AC.

Reductions described in proposition 2 as market access increasing are represented by movements in south(-west) direction inside the cone spanned by AD and AF. The anti-concertina reform is represented by a movement along AF, while the Ju-Krishna reform is represented by a movement along AE. Hence we know that all reforms inside the sub-cone spanned by AE and AF increase market access as well as the real wage.

4 Tariff Reforms with a Constant Nominal Wage

Now, consider reforms that are restricted to tariff changes. We start by deriving the constrained optimal tariff vector t_n^o, for a given level of the nominal wage. Setting $dw = du = 0$ in (9) and solving for t gives

$$t_n^{o\prime} = -wE_{wp}\left(E_{pp}\right)^{-1} \tag{23}$$

and substituting back into (9) gives

$$\mu^{-1}du = t^{d\prime}E_{pp}dt, \tag{24}$$

with $t^d \equiv t - t_n^o$. In analogy to the previous section, we define a normalised substitution matrix $\widetilde{\mathrm{S}} \equiv -\tilde{s}^{-1}D(p)E_{pp}D(p)$, with $\tilde{s} \equiv -p'E_{pp}p > 0$, and the vector of deviations from the optimum ad valorem tariffs $\tau \equiv [D(p)]^{-1}t^d$. Furthermore, the average deviation from the optimum ad valorem tariff vector is given by $\bar{\tau} \equiv \iota'\widetilde{\mathrm{S}}\tau$, the variance of deviations from the optimum tariff vector by $V_\tau \equiv \tau'\widetilde{\mathrm{S}}\tau - \bar{\tau}^2$, and their respective changes by $d\bar{\tau} = \iota'\widetilde{\mathrm{S}}d\tau$

and $dV_\tau = 2\tau'\widetilde{\mathrm{S}}(d\tau - \iota d\bar{\tau})$, again in direct analogy to the previous section. Substituting into (24) and using $d\tau_i = dT_i$ gives

$$(\mu\tilde{s})^{-1}\, du = -\bar{\tau} d\bar{\tau} - \frac{1}{2} dV_\tau. \tag{25}$$

The assumption that all importables are substitutes for the numeraire is sufficient for the weights in the computation of $\bar{\tau}$ to be positive, smaller than one, and sum to one. Noting that (25) is formally identical to (11), with the average deviation from the optimum ad valorem tariff vector replacing the average shadow premium rate from the previous section, and the variance of deviations from the optimum ad valorem tariff vector replacing the variance of shadow premium rates, we know by analogy to proposition 1 that the reform

$$d\tau = -[\gamma\tau + (1-\gamma)\iota] d\alpha, \qquad 0 \leq \gamma \leq \frac{1}{1-\tau_{\min}}, \qquad d\alpha > 0 \tag{26}$$

increases welfare.

The set of welfare increasing tariff reductions is illustrated in figure 2 for the case of two importables, where we have defined $p_i^{\mathrm{opt}} \equiv p_i^* + t_i^o$, as the domestic price of good i implied by the optimum tariff. The analysis is analogous to figure 1, where now p^{opt} takes over the role of π^*. Note that p^* does not play a role for the analysis (at no point have we used the assumption employed in other parts of the paper that it is normalised to one). However, in the case we are looking at, where all importables are labour intensive, there is a presumption that $p_i^* \leq p_i^{\mathrm{opt}}\ \forall i$, i.e. the optimal tariffs are all non-negative.[7]

Now, look at the effect of tariff reforms with constant nominal wages on market access.

[7] Kreickemeier (2005) shows that this outcome is assured if all importables are net substitutes for each other.

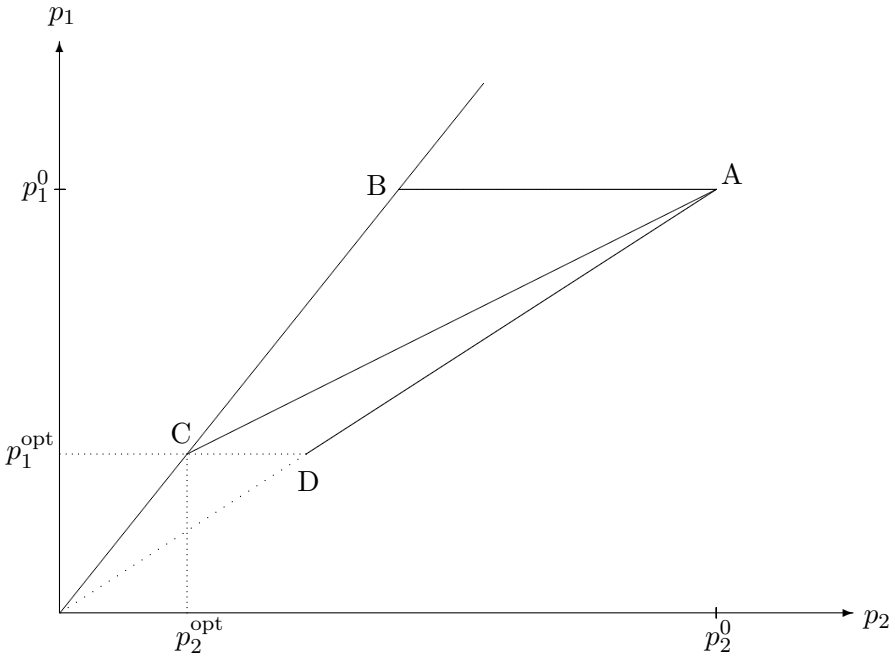

Figure 2: Restricted Tariff Reforms

We find

$$\begin{aligned} dM &= p^{*\prime}(E_{pp}dp + E_{pu}du) \\ &= \left[p^* + m_b t^d\right]' E_{pp}dp, \end{aligned}$$

which can be rewritten as

$$\begin{aligned} dM &= m_b \left[t^d - \tilde{t}^d\right]' E_{pp}dp \\ &= m_b \left[p - \tilde{p}\right]' E_{pp}dp \end{aligned} \tag{27}$$

with $\tilde{t}^d = -(1/m_b)p^*$ as the market access maximising deviation from the optimum tariff vector and $\tilde{p} = p^* + t_n^o + \tilde{t}^d$ the implied domestic price vector. The Ju-Krishna tariff reform for the case of a constant nominal wage is given by $dp = -a(p - \tilde{p})$, $a > 0$, as can easily

be checked by substituting into (27).

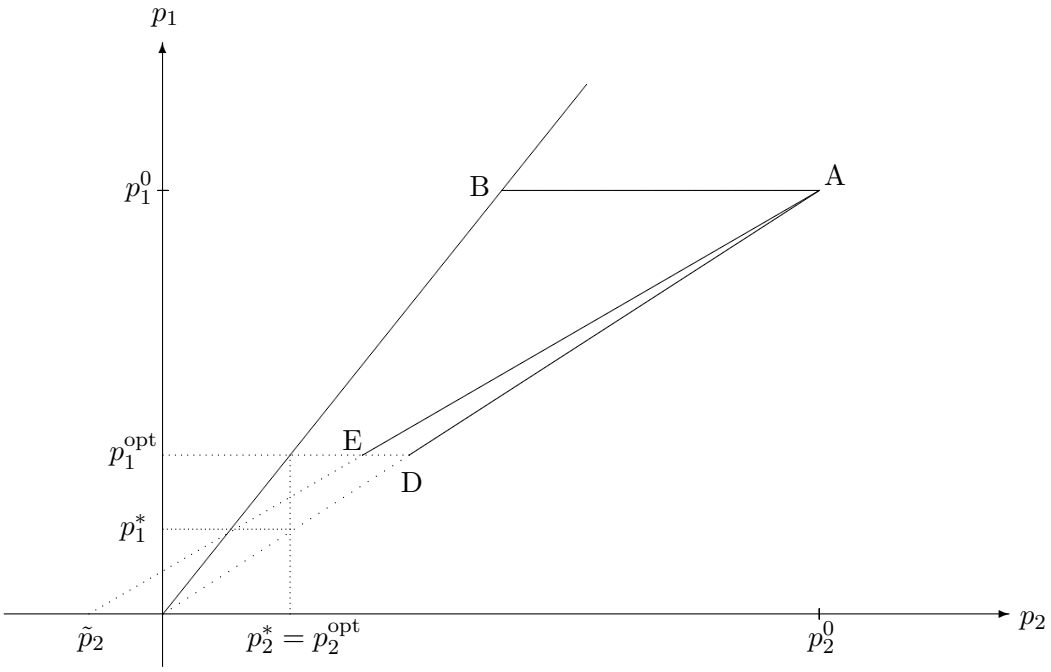

Figure 3: The Ju-Krishna Tariff Reform

It is straightforward to show graphically that the Ju-Krishna reform can lie in the cone of welfare increasing reforms. For simplicity, figure 3 depicts the special case where the optimum tariff on good 2 is zero while the optimum tariff on good 1 is equal to $p_1^*(1 - m_b)/m_b$. This gives $\tilde{p}' = (0, -p_2^*(1 - m_b)/m_b)$, and the Ju-Krishna reform is given by a movement along AE, and hence lies in the cone of welfare increasing reforms, which – as shown above – is spanned by AB and AD.

5 Tariff Reforms with a Constant Real Wage

Trade liberalisation strategies in the presence of a constant real wage can be derived analogously to those for a constant nominal wage, but the optimal tariff vector is different. Substituting $dw = W\sigma' dp$ in (9) and collecting terms leads to

$$\mu^{-1} du = \left[t' \widetilde{E}_{pp} + t' \sigma W \widetilde{E}_{wp} + W \widetilde{E}_{wp} \right] dp \tag{28}$$

with

$$\widetilde{E}_{pp} \equiv E_{pp} + E_{pw} W \sigma'$$

$$\widetilde{E}_{wp} \equiv E_{wp} + E_{ww} W \sigma'$$

$\widetilde{E}_{pp}$ is an augmented substitution matrix that gives the changes in net imports following from a change in domestic prices, taking into account the implied changes in the nominal wage needed to keep the real wage constant. Two importables i and j are said to be augmented net substitutes in import demand if $E_{p_i p_j} > 0$ (i.e. an increase in p_j increases imports of good i, taking into account the adjustment in the nominal wage needed to hold the real wage constant). They are called augmented net complements in import demand if $E_{p_i p_j} < 0$.

$\widetilde{E}_{wp}$ is interpreted as a vector of general equilibrium *real* labour intensities: If and only if $\widetilde{E}_{wp_i} > 0$, i.e. if and only if an increase in p_i, combined with the induced increase in the nominal wage to keep real wages constant, raises economy-wide employment, sector i is said to be labour intensive in real terms. Otherwise, sector i is said to be not labour intensive in real terms. This measure of labour intensity takes account of both the direct effect E_{wp_i}, whose sign is determined by i's labour-intensity in the standard sense (Kreickemeier 2005), and its indirect effect through the induced increase in the nominal wage ($E_{ww} W \sigma_i$),

whose sign is always negative. Clearly the addition of a negative term tends to reduce the incidence of labour intensity.[8]

Going back to eq. (28), the three terms in brackets are characterised as follows: The first term is a modified version of the standard volume of trade effect, giving the effect of a price change (including the induced wage change) on imports in distorted markets. The second and third term combined give the welfare effect of employment changes induced by the change in prices. The second term measures the partial effect that is due to the tariff-induced premium of the nominal wage over the real wage, while the third term measures the partial effect due to the real wage itself.

In order to derive the optimum tariff vector, note that

$$\mathrm{R} \equiv \widetilde{E}_{pp} + \sigma W \widetilde{E}_{wp} = \begin{pmatrix} I_n & \sigma W \end{pmatrix} \begin{pmatrix} E_{pp} & E_{pw} \\ E_{wp} & E_{ww} \end{pmatrix} \begin{pmatrix} I_n \\ W\sigma' \end{pmatrix}, \tag{29}$$

where I_n is the $n \times n$ identity matrix, is a quadratic form in a negative definite matrix and hence is itself negative definite. From (28), the optimum tariff vector in the case of a constant real wage, t_r^o, is then given by:

$$t_r^{o\prime} = -W\widetilde{E}_{wp}\mathrm{R}^{-1} \tag{30}$$

While the elements of t_r^o cannot be signed in general, there is a result for an important special case:

Lemma 3. *Let all importables be augmented net substitutes for each other. Then, all second-best optimum tariffs are positive if all importables are labour intensive.*

[8] I.e., if a good is not labour-intensive in the standard sense, it is not labour-intensive in the real sense either, but a good can be labour intensive in the standard sense and not labour-intensive in the real sense.

Proof. If all importables are net substitutes for each other, all off-diagonal elements of $\widetilde{E}_{pp}$ are positive. If in addition all importables are labour intensive, $\sigma W \widetilde{E}_{wp}$ is a positive matrix, and hence the off-diagonal elements of $\mathrm{R} \equiv \widetilde{E}_{pp} + \sigma W \widetilde{E}_{wp}$ are positive as well, while the diagonal elements of R are negative, as the matrix is negative definite. Hence, R^{-1} is a negative matrix (Hatta 1977). With $\widetilde{E}_{wp} > 0$ the stated result follows. □

It is possible to at least locally compare the size of the optimal tariffs in the cases of fixed nominal and fixed real wages, respectively. Specifically, we ask the question: Starting from the optimal tariff t_n^o, does a reduction in tariff levels increase or decrease welfare in the case of a fixed real wage? To this end substitute t_n^o into eq. (9), and set $dw = W\sigma' dp$. Doing so gives

$$\mu^{-1} du = w(E_{ww} - E_{wp} E_{pp}^{-1} E_{pw}) W \sigma' dp,$$

where the term in brackets is a negative scalar.[9] Hence, lowering any tariff, starting from t_n^o increases welfare in the case of a fixed real wage. Hence, we can infer that t_r^o is strictly smaller than t_n^o.

Substituting from (30) in (28), we get

$$\mu^{-1} du = (t - t_r^o)' \mathrm{R} dp \tag{31}$$

Eqs. (31) and (24) are of an identical form, with negative definite matrix R replacing E_{pp} and t_r^o replacing t_n^o. Hence, the analysis of section 4 can be applied analogously, and the results derived for the case of a fixed nominal wage hold for the case of a fixed real wage as well.

[9] This follows from the observation that it is a main diagonal element of $E_{\pi\pi}^{-1}$, which – being the inverse of a negative definite matrix – is itself negative definite.

6 Conclusion

Import competing sectors in developed countries tend to be labour intensive, and domestic job losses as a consequence of increased foreign competition in these sectors typically is a major concern to politicians in these countries. Most of the theoretical literature on piecemeal trade policy reforms does not allow to address this concern, however, due to the assumption of perfectly competitive labour markets that ensure full employment. In this paper, we derive welfare increasing trade liberalisation strategies in a framework that allows for the occurrence of these employment effects due to the assumption of non-market clearing wages that are fixed in either nominal or real terms. In doing so, we draw on Anderson and Neary (2007), who derive new welfare increasing reform strategies in a model without factor market distortions, and show how suitably modified variants of the tools developed in their paper – the generalised mean and variance of the distortions in the model – can be used to expand the set of welfare increasing liberalisation strategies known from the previous literature. We furthermore show that the principal tension between welfare increasing and market access increasing liberalisation strategies remains valid in our framework with involuntary unemployment if we consider integrated reforms of all price distortions in the model.

References

Anderson, J.E., Neary, J.P., 2007. Welfare versus Market Access: The Implications of Tariff Structure for Tariff Reform. Journal of International Economics 71, 187–205.

Brecher, R.A., 1974. Minimum Wage Rates and the Pure Theory of International Trade. Quarterly Journal of Economics 88, 98–116.

Dixit, A.K., Norman, V., 1980. Theory of International Trade. Cambridge: Cambridge University Press.

Hatta, T., 1977. A Recommendation for a Better Tariff Structure. Econometrica 45, 1859–69.

Kreickemeier, U., 2005. Unemployment and the Welfare Effects of Trade Policy. Canadian Journal of Economics 38, 194–210.

Ju, J., Krishna, K., 2000. Welfare and Market Access Effects of Piecemeal Tariff Reform. Journal of International Economics 51, 305–316.

Neary, J.P., 1985. International Factor Mobility, Minimum Wage Rates, and Factor-Price Equalization: A Synthesis. Quarterly Journal of Economics 100, 551–70.

Neary, J.P., 1995. Trade Liberalisation and Shadow Prices in the Presence of Tariffs and Quotas. International Economic Review 36, 531–54.