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Unemployment and the Welfare Effects of Trade Policy

by

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Abstract

This paper derives and compares the welfare effects of tariffs and import quotas in the presence of involuntary unemployment. The framework used is the standard model of a competitive small open economy with many goods and factors. Optimum levels of the respective trade policy instruments are derived, as well as welfare increasing reform strategies. In all cases, the labour intensity of the import competing sectors turns out to be a crucial variable for deriving the welfare effects.

JEL classification: F11, F13, F16

Keywords: Optimal Trade Policy, Trade Policy Reform, Unemployment

Outline

Non-Technical Summary

This paper analyses the welfare effects of trade policy in the presence of involuntary unemployment. The analysis in conducted in the framework of a many-sector, many-factor model of a competitive small open economy where unemployment is the consequence of a binding minimum wage above the market clearing level. Using this set-up, the welfare effects of tariff reforms and quota reforms are analysed. To round off the paper, we briefly look at labour market reforms, i.e. changes in the minimum wage.

From the existing literature on the welfare effects of trade policy, there are some general results for both tariff reforms and quota reforms with full employment. In the case of tariffs, the concertina result says that in the presence of net substitutability between the import goods, both lowering the highest import tariff and introducing a small tariff on a previously freely traded import good are welfare increasing. In addition, lowering all import tariffs proportionately increases welfare. In the case of binding import quotas, increasing any one of them increases welfare. Using these results from the full employment model as reference point, the present paper shows how they have to be modified in the presence of minimum wages. A general feature of the specific results derived in the paper is the following: Any reform that was welfare enhancing in the full employment model continues to be welfare enhancing in the present framework if it increases economy-wide employment. However, it is possible for trade reforms to be welfare enhancing even if they lead to a decrease in the economy-wide level of employment. This is true whenever the efficiency gains from tariff or quota reform, holding the level of employment constant, outweigh the induced losses in labour income.

1 Introduction

In the political arena, trade policy is a fiercely debated topic. Most prominently in any discussion of changes in tariffs or other trade policy instruments figure typically the employment effects of these policies.[1] The focus of the theoretical literature on this topic is very different. There is a vast theoretical literature which seeks to identify welfare enhancing, stepwise reforms of protection instruments. While the early literature focused on the welfare effects of tariffs, Corden and Falvey (1985) were the first to analyze quota reforms, and Falvey (1988) allowed for the coexistence of tariffs and quotas, focusing on the case of a small open economy. Neary (1995) synthesizes many of the results in a very general model allowing for both large and small economies, import tariffs and quotas, and an arbitrary number of goods and factors. But as in all preceding contributions to this strand of the literature, the analysis is conducted in a full-employment framework.

In the face of the prominent role that the prospective employment effects play in virtually every political discussion of trade reforms it is arguably warranted to analyze these reforms in a framework that does not exclude employment effects by assumption. There is however virtually no example in the trade reform literature for this type of model. Hatzipanayotou and Michael (1995) and Michael and Hatzipanayotou (1999) analyse welfare and employment effects of "small" trade distortions in a model with variable labor supply. Useful as it is, this approach suffers – with respect to the question to be analyzed – from the weakness that the employ-

[1] While this appears to be true in general, it is particularly well documented in a study of voting behavior in the U.S. Congress on NAFTA approval by Baldwin and Magee (2000). They find that 44 per cent of the House members who voted for NAFTA did so primarily because they claimed NAFTA would "increase jobs and wages", and 70 per cent of those who voted against it did so primarily because they claimed it would "decrease jobs and wages". While these statements do not allow to disentangle factor price changes on the one hand and employment changes on the other hand, they indicated that anticipated employment effects were important in the decision making.

ment effects follow from optimizing agents' preferences. In other words: there is no involuntary unemployment. Consequently, the employment effects analyzed are not what one usually has in mind when asking what the consequences of trade reform for the employment situation in a particular country might be. In the present paper, involuntary unemployment is introduced into the standard neoclassical model of trade reform in the simplest way possible: labor is paid a minimum wage above the market clearing level. Because of its transparency, this approach, pioneered by Brecher (1974), has again become quite popular among trade theorists recently in a somewhat different context, namely the debate on trade, wages and employment. Examples include Davis (1998) and Oslington (2002).

Using the duality approach to trade theory, the analysis is conducted in the familiar framework of a small open economy with a representative consumer. We follow Falvey (1988) in analyzing the welfare effects of trade policy in the case where there are both tariffs and quotas in place. We confine the analysis to the case of the small open economy in order to emphasize the main contribution of the paper, namely the difference that the consideration of involuntary unemployment makes for the welfare effects of trade policy.[2] Krishna and Panagariya (2000), in a recent paper that systematized much of the existing literature, emphasized the principal difference between price and quantity distortions in trade models. Tariff and quota reforms in the presence of minimum wage unemployment cannot be easily fitted into the respective categories in their paper, though. This is because the minimum wage in itself constitutes a price distortion in the model, and hence the distinction between price and quantity distortions on the trade policy side gives a less clear-cut distinction in the results than would be the case in a full employment framework.

The outline of the paper is as follows. After the development of the theoretical

[2]The analysis could be expanded to allow for endogenous world market prices following the example given in Neary (1995).

framework with both tariffs and quotas in section 2, section 3 derives welfare effects for integrated tariff and labor market reforms. It is shown that a variant of the radial reduction result familiar from the full employment models holds in this case. The remainder of the paper analyzes reforms of each policy instrument in isolation. Section 4 is devoted to tariff reforms, section 5 focuses on the welfare effects of quota reforms. Section 6 shows the welfare effects of a change in the minimum wage. Section 7 concludes.

2 Equilibrium in the Domestic Economy

Consider a competitive open economy, consuming and producing n tradable goods. There is a single export good, labelled 0, which is traded freely with the rest of the world.[3] Its domestic output and price are denoted by y_0 and p_0, respectively. In addition, there are two groups of import goods. Goods in group T are subject to import tariffs (which may be zero), while goods in group Q are subject to binding import quotas. The export good serves as *numéraire*, i.e. $p_0 \equiv 1$ throughout. Domestic outputs and prices of the importables are denoted by the vectors y^T, p^T, y^Q, and p^Q, respectively. There are m internationally immobile factors of production, where the vector v comprises $m-1$ factors for which fully flexible factor prices ensure full employment of the exogenously given respective endowments. There is an additional factor, labor, which is paid a minimum wage p^L in terms of the *numéraire*. The minimum wage is assumed to be binding throughout the analysis. Therefore, labor supply is infinitely elastic at p^L and the employment of labor, L, is smaller than the economy's labor endowment $\bar{L}$. Following Neary (1985), the production side of the economy is conveniently described by the restricted profit

[3] Alternatively, the export good may be reinterpreted as a bundle of freely traded goods with constant relative world market prices. In this case, not all of them have to exported. The assumption of a single export good is only made for notational and terminological convenience.

function π:

$$\pi(p, v) \equiv \max_{y_0, z} \{y_0 + pz \,|\, (y_0, z, v) \text{ feasible}\} \tag{1}$$

where $p \equiv (p^T, p^Q, p^L)$ and $z \equiv (y^T, y^Q, -L)$.[4] 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 $\pi(\cdot)$. From Hotelling's lemma, the partial derivatives of the restricted profit function are $\partial\pi/\partial p^i = z^i$. The allocation described by $\pi(\cdot)$ maximizes the income of the fully employed factors, not the economy's value of production (GDP). The latter is given by

$$\text{GDP} = \pi(p, v) + p^L L(p, v) \equiv g(p^T, p^Q, v, L(p, v)) \tag{2}$$

where $g(\cdot)$ is the standard revenue function (Neary 1985). The equivalence stated in (2) 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.

The behavior of the household sector is summarized by the standard expenditure $e(p^T, p^Q, u)$ with u representing aggregate welfare. As consumers derive utility only from the consumption of goods, all unemployment is involuntary. From Shephard's lemma, the price derivatives of the expenditure function are $\partial e/\partial p^i = x^i$, where x^i is the vector of Hicksian demand functions for the goods in group i. The scalar $\partial e/\partial u$ is the inverse of the marginal utility of income, and following common practice it is normalized to one.

Now, we define a "minimum wage trade expenditure function", giving the excess

[4]For simplicity, no distinction is made in notation between row and column vectors. All vector products are meant to be inner products.

expenditure over the income of the flexprice factors:

$$E(p,u,v) \equiv e(p^T, p^Q, u) - \pi(p,v) \tag{3}$$

The derivative properties of $E(\cdot)$ follow from the properties of $e(\cdot)$ and $\pi(\cdot)$. In addition, $E(\cdot)$ is linearly homogeneous in (p_0, p). Equilibrium for this small open economy is then given by

$$E(p,u,v) = p^L L + \sum t^i m^i \qquad i = T, Q \tag{4}$$

$$E_i(p,u,v) = m^i \qquad i = T, Q \tag{5}$$

$$E_L(p,v) = L \tag{6}$$

where E_i is shorthand for E_{p^i} in (5) and (6). Equation (4) is the economy's budget constraint, stating that at domestic prices the excess of expenditure over the income of the flexprice factors must equal the sum of labor income and the revenue from trade restrictions. Here, t^T is the vector of tariffs for imports in group T while t^Q is the vector of implicit tariffs for imports in group Q. Accordingly, m^i denotes the import vector for goods in group i. Equation (5) gives equilibrium conditions for the markets of non-numeraire goods. Equation (6) is an application of Hotelling's lemma and states that a change in excess expenditure following a change in the minimum wage rate equals the level of employment.

Totally differentiating (4), using (5) and (6), gives

$$E_u du = \sum_{i \in (T,Q)} t^i dm^i + \sum_{i \in (T,Q,L)} p^L E_{Li} dp^i \tag{7}$$

where E_{Li} is shorthand for E_{Lp^i} and it gives the economy-wide change in employment following a change of the respective price in the vector p^i. Many of the results derived below depend on the sign of the partial derivatives E_{Li}. In analogy to Neary (1993), they are interpreted as a general equilibrium measure of sector i's labor intensity: if

and only if $E_{Li} > 0$, sector i is said to be labor intensive.[5] Otherwise, sector i is said to be not labor intensive. Two things are worth noting here. First, in the present model with more than two factors, being "not labor intensive" is not equivalent to being "capital intensive". Second, it is possible in principle for all goods at the same time to be labor intensive. This is true, for example, in the case where all fully employed factors are sector specific while labor is intersectorally mobile.[6]

With imports in group T being tariff constrained and imports in group Q being quota constrained, dp^T and dm^Q are policy variables while dm^T and dp^Q are endogenous. If we consider integrated reforms of trade and wage policy, dp^L becomes an additional policy instrument, while $dp^L = 0$ otherwise.

In the next step, we eliminate the endogenous variables from (7) in order to derive an explicit relationship between the change in the policy variables and the welfare change. To this end, (5) is differentiated for $i = T$, holding constant v. This gives

$$dm^T = E_{TT}dp^T + E_{TQ}dp^Q + E_{TL}dp^L + E_{Tu}du \tag{8}$$

where the $n \times n$ matrix

$$S \equiv E_{pp} = \begin{pmatrix} E_{TT} & E_{TQ} & E_{TL} \\ E_{QT} & E_{QQ} & E_{QL} \\ E_{LT} & E_{LQ} & E_{LL} \end{pmatrix} \tag{9}$$

[5]Neary (1993) considers the case of internationally mobile capital in a small open economy and interprets the analogous partial derivative as a measure of general equilibrium capital intensity.

[6]From (2) we can derive $\partial^2\pi/\partial p^i \partial p^L = (\partial^2 g/\partial p^i \partial L)(\partial L/\partial p^L)$, where $\partial^2 g/\partial p^i \partial L$ is a measure of general equilibrium labor intensity in the full employment model (Dixit and Norman, 1980). With each of potentially many sectors having a fixed factor and labor being intersectorally mobile, it is well known that in the full employment model $\partial^2 g/\partial p^i \partial L > 0$ for all i, i.e. an increase in the labor endowment leads to an increase in all outputs. Since we have $\partial L/\partial p^L < 0$ and $E_{Li} = -\partial^2\pi/\partial p^i \partial p^L$, the above result follows.

is negative definite, assuming some substitutability between the numeraire and non-numeraire goods (Dixit and Norman 1980). The endogenous variable dp^Q can be eliminated from both (7) and (8) by differentiating (5) for $i = Q$ and rearranging terms appropriately. This yields

$$dp^Q = E_{QQ}^{-1}(dm^Q - E_{QT}dp^T - E_{QL}dp^L - E_{Qu}du) \tag{10}$$

Now, substituting (10) into (8) and then both (10) and (8) into (7), eventually leads to the central equation of this paper:

$$\begin{aligned}\mu^{-1}du = \big(t^T\widetilde{E}_{TT} + p^L\widetilde{E}_{LT}\big)dp^T + \big(t^T\widetilde{E}_{TL} + p^L\widetilde{E}_{LL}\big)dp^L \\ + \big(t^Q + (t^TE_{TQ} + p^LE_{LQ})E_{QQ}^{-1}\big)dm^Q\end{aligned} \tag{11}$$

where

$$\begin{aligned}\mu &\equiv \big(E_u - t^T\widetilde{E}_{Tu} - p^L\widetilde{E}_{Lu}\big)^{-1} \\ \widetilde{E}_{ij} &\equiv E_{ij} - E_{iQ}E_{QQ}^{-1}E_{Qj}\end{aligned}$$

Here μ is the shadow price of foreign exchange for the present model with tariffs and quotas.[7] Following common practice it is assumed to be positive.[8] Hence, any policy reform which leads to the right hand side of (11) being positive is welfare increasing. The matrices $\widetilde{E}_{ij}$ differ from their respective counterparts E_{ij} by the effects resulting from the induced price changes on the quota constrained imports (Neary 1995).

3 Integrated Tariff and Labor Market Reforms

In a first step, we allow for integrated changes in tariffs and the minimum wage. This amounts to an integrated reform of all price distortions in the model. Begin

[7] This generalizes results in Kreickemeier (2001) where the shadow price of foreign exchange in the presence of either quotas or tariffs was derived for a small open economy with minimum wages.

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

with the reference case where there are no binding import quotas in place. So all importables are either imported freely or they are subject to import tariffs. In this case, (11) becomes

$$\mu^{-1}du = \left(t^T E_{TT} + p^L E_{LT}\right)dp^T + \left(t^T E_{TL} + p^L E_{LL}\right)dp^L \tag{11'}$$

where

$$\mu \equiv \left(E_u - t^T E_{Tu}\right)^{-1}.$$

More compactly, this can be written as

$$\mu^{-1}du = \left(t^T, p^L\right) S_{LT} \begin{pmatrix} dt^T \\ dp^L \end{pmatrix}, \tag{12}$$

$$S_{LT} \equiv \begin{pmatrix} E_{TT} & E_{TL} \\ E_{LT} & E_{LL} \end{pmatrix}$$

where S_{LT}, being a principal submatrix of S, is negative definite. Therefore, a reform of the type

$$\begin{pmatrix} dt^T \\ dp^L \end{pmatrix} = -a \begin{pmatrix} t^T \\ p^L \end{pmatrix}$$

increases welfare. This yields the following.

Proposition 1. *A reduction of all tariffs and the minimum wage rate in proportion to their initial levels raises welfare.*

This result is related to the radial reduction result from the full employment model where reducing all tariffs in proportion to their initial levels is welfare increasing. Clearly, a reform like this can never lead to free trade because the model is valid only as long as the minimum wage rate is strictly binding.

Having established the reference scenario with tariffs only, we now analyze the case of tariff reforms where there are import quotas as well as tariffs in place. In a full employment framework, reforms of this type have been analyzed by Falvey (1988) for a small open economy and by Neary (1995) for a large open economy. Setting $dm^Q = 0$ in (11) and using matrix notation yields

$$\mu^{-1} du = \left(t^T, p^L\right) \widetilde{S} \begin{pmatrix} dt^T \\ dp^L \end{pmatrix}, \tag{13}$$

where

$$\widetilde{S} \equiv \begin{pmatrix} \widetilde{E}_{TT} & \widetilde{E}_{TL} \\ \widetilde{E}_{LT} & \widetilde{E}_{LL} \end{pmatrix}$$

is negative definite as it is a principal submatrix of S^{-1}. Therefore, the result that lowering tariffs and the wage rate in proportion to their initial levels is welfare increasing remains valid in the presence of import quotas.

4 Tariff Reforms

While the radial reduction result just stated is useful in showing the formal similarities between the full employment and the minimum wage model, it is arguably interesting to derive results for the case where only trade policy instruments are at hand. To this end, we first derive the optimum tariff vector, given the binding minimum wage p^L. Again, we begin by analyzing the reference case without import quotas. From (11′), the optimum tariff vector in this case is given by

$$t^{To} = -p^L E_{LT} E_{TT}^{-1} \tag{14}$$

While the elements of t^{To} cannot be signed in general, there are results for special cases.

Proposition 2. *Let all goods in T be net substitutes for each other. Then, all optimal tariffs are positive (negative) if the goods in T are labor intensive (not labor intensive).*

This is seen as follows. With all goods in T being net substitutes for each other, all elements of E_{TT}^{-1} are negative (Hatta 1977). If in addition goods in T are labor intensive ($E_{LT} > 0$), all elements of $E_{LT}E_{TT}^{-1}$ are negative. If all goods in T are not labor intensive ($E_{LT} < 0$), all elements of $E_{LT}E_{TT}^{-1}$ are positive. This establishes the proposition.

Substituting (14) into (11′) yields

$$\mu^{-1}du = (t^T - t^{To})E_{TT}dp^T. \tag{15}$$

As E_{TT} is negative definite, a reform of the type $dp^T = -a(t^T - t^{To})$, i.e. moving all tariffs radially towards there optimum levels, is welfare increasing. This result does not depend on assumptions on either net substitutabiliy or labor intensities. On the other hand, (15) shows that moving a single tariff towards its optimum level does not necessarily increases welfare because the off-diagonal elements of E_{TT} cannot be signed.

In order to proceed, it is useful at this stage to introduce the concept of "shadow premia" (Neary 1995). They are defined as the difference between the market price of a good or factor and the respective shadow price. It is well known that the shadow prices of goods in T are these goods' world market prices (Neary 1995). On the other hand, the shadow price of labor in the present model with a binding minimum wage is zero: adding one unit to the economy's labor endowment would leave domestic income unchanged. Taken together, this shows that $t \equiv (t^T, p^L)$ is a vector of shadow premia. The shadow premia t_i are now transformed into shadow premium rates $\tau_i = t_i/p_i$, expressed in terms of domestic prices. Note that the shadow premium rate for labor, τ_L, is equal to one, whereas $0 < \tau_i < 1$ for all goods

$i \in T$. Hence, we have the following lemma which is crucial for many of the results derived below.

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.*

Now, using (11) and considering the change of a single tariff t_k, we have

$$\mu^{-1} du = \sum_i t_i E_{ik} dp_k \tag{16}$$

where the summation term includes $t_L = p^L$, the shadow premium on labor. Transforming the shadow premia into shadow premium rates gives

$$\begin{aligned} \mu^{-1} du &= \left(\tau_k + (p_k E_{kk})^{-1} \sum_{i \neq k} t_i E_{ik} \right) p_k E_{kk} dp_k \\ &= \left(\tau_k + \sum_{i \neq k} \frac{p_i E_{ik}}{p_k E_{kk}} \tau_i \right) p_k E_{kk} dp_k \\ &= \left(\tau_k - \sum_{i \neq k} \omega_{ik} \tau_i \right) p_k E_{kk} dp_k \end{aligned} \tag{17}$$

where

$$\omega_{ik} \equiv -\frac{p_i E_{ik}}{p_k E_{kk}} \qquad\qquad \sum_{i \neq k} \omega_{ik} = 1$$

The ω_{ik} sum to 1 because from the linear homogeneity of E in $\pi \equiv (p_0, p)$, we have $\sum_i p_i E_{ik} = 0$. That is, the sum of the constant-utility change in net import value at domestic prices and the change in labor income, both induced by a change in the price of good k, is zero. With all other goods being net substitutes for good k and good k being labor intensive, all ω_{ik} are positive.

It is instructive to compare (17) to the analogous formula in a full employment model, as given in equation (8) of Neary (1998). The formula in this case is identical

to (17) but for the fact that $\omega_{Lk}\tau_L$ is excluded. In its full employment version, the equation can be used to illustrate the two variants of the well known concertina result. With all goods being substitutes for good k, and hence all $\omega_{ik} > 0$, lowering τ_k would be welfare increasing if it was the highest shadow premium rate (i.e., the highest ad valorem tariff). This is because τ_k is larger than a true weighted average of the other ad valorem tariffs, and therefore the expression in brackets is positive. On the other hand, if there are import tariffs in place, introducing a tariff on a previously freely traded good must be welfare increasing as zero is smaller than a true weighted average of the existing tariffs, and hence the term in brackets is negative.

In the present minimum wage model, net substitutability between good k and the other goods is not sufficient to ensure that lowering the highest shadow premium rate increases welfare. Instead, we have the following.

Proposition 3. *Let good k be a net substitute for all other goods. Then, if k is the good with the highest ad valorem tariff, lowering this tariff may lower welfare if and only if k is labor intensive. If there is free trade initially, introducing an import tariff (import subsidy) on k will increase welfare if and only if k is labor intensive (not labor intensive).*

This is seen as follows. Consider first the case where good k is labor intensive. Then, assuming τ_k (which is necessarily smaller than 1) is the highest ad valorem tariff does not imply that it is larger than a true weighted average of all other shadow premium rates including $\tau_L = 1$. Hence, the sign of the bracketed term in (17) is indeterminate. With minimum wage unemployment, the highest ad valorem tariff is necessarily only the second largest shadow premium rate, and hence one cannot be sure that lowering it is welfare increasing. On the other hand, with free trade the bracketed term in (17) is negative and hence introducing a tariff leads to an increase in welfare. The intuition follows the concertina logic: compressing the

shadow premium rates is welfare increasing.

For the case where good k is not labor intensive, it is easy to see that with τ_k being the highest ad valorem tariff, the term in brackets becomes necessarily positive, and hence lowering τ_k is welfare increasing. Note that technically speaking this is a non-concertina type result because τ_k is not the largest shadow premium in the model, but reducing it raises welfare. Similarly, one can see from (17) that under the assumptions made, introducing an import subsidy increases welfare if all goods are freely traded initially. This is again a non-concertina result because the range of shadow premia is widened rather than compressed. The analogue to these results in the full employment model is the case of good k being a complement to at least one other good. This makes non-concertina results of the type just stated possible.

In the next step, we allow for the presence of binding but unchanged import quotas. As in the absence of quotas, we can derive an optimum tariff vector, given the existence of the minimum wage rate and the quotas on the Q goods. From (11) the optimum tariffs are given by

$$t^{To} = -p^L \widetilde{E}_{LT} \widetilde{E}_{TT}^{-1} \tag{18}$$

Note that the optimum tariff vector does not depend on the implicit tariffs of quota constrained goods, t^Q. This is just another illustration of the familiar result that the distortions created by quotas do not spill over into other markets (Falvey 1988). It is possible to derive the sign pattern of the optimal tariff vector for special cases. In doing so, we follow the terminology of Neary (1995) and call two goods $i, j \in T$ "constrained net substitutes" if $\widetilde{E}_{ij} > 0$, i.e., if an increase in the price of good j leads to an increase in the net import demand for good i, taking into account the endogenous price changes for the quota constrained goods. Analogously, we will say that good $j \in T$ is "constrained labor intensive" if $\widetilde{E}_{Lj} > 0$, i.e., if an increase in the price of good j leads to an increase in the economy-wide labor demand, taking into

account the endogenous price changes for the quota constrained goods. In analogy to proposition 2 from the model without quotas, we then have the following.

Proposition 2a. *Let all goods in T be constrained net substitutes for each other. Then, all optimal tariffs are positive (negative) if all goods in T are constrained labor intensive (not constrained labor intensive).*

If all goods in T are constrained net substitutes, all elements of $\widetilde{E}_{TT}^{-1}$ are negative. Hence, the elements of $\widetilde{E}_{LT}\widetilde{E}_{TT}^{-1}$ are negative (positive) if all goods in T are constrained labor intensive (not constrained labor intensive).

A radial reduction result analogous to (15) can be derived by substituting (18) into (11). This gives

$$\mu^{-1}du = (t^T - t^{To})\widetilde{E}_{TT}dp^T, \tag{19}$$

and because of the negative definiteness of $\widetilde{E}_{TT}$ we have that moving all tariffs radially towards their optimum levels is welfare increasing. The presence of quotas does not interfere with that result from the previous section.

Now, considering the change of a single tariff t_k, we have from (11)

$$\mu^{-1}du = \sum_i t_i\widetilde{E}_{ik}dp_k. \tag{20}$$

Rearranging in an analogous way to (17) above, this can be rewritten as

$$\mu^{-1}du = \left(\tau_k - \sum_{i\neq k}\widetilde{\omega}_{ik}\tau_i\right)p_k\widetilde{E}_{kk}dp_k \tag{21}$$

where

$$\widetilde{\omega}_{ik} \equiv -\frac{p_i\widetilde{E}_{ik}}{p_k\widetilde{E}_{kk}} \qquad\qquad \sum_{i\neq k}\widetilde{\omega}_{ik} = 1$$

The $\widetilde{\omega}_{ik}$ sum to one because of the homogeneity restriction $\sum_i p_i\widetilde{E}_{ik} = 0$. One can see that (21) differs from (17) only insofar as $\widetilde{E}_{kk}$ and $\widetilde{\omega}_{ik}$ have replaced the

respective variables without tilde. Like E_{kk}, $\widetilde{E}_{kk}$ is a negative scalar (Neary 1995, p. 536). The weights $\widetilde{\omega}_{ik}$ are positive if good k is a constrained net substitute for all goods in T, and in addition it is constrained labor intensive. Hence, varying proposition 3, we have

Proposition 3a. *Let good k be a constrained net substitute for all other goods in T and for the numeraire good. Then, if k is the good with the highest ad valorem tariff, lowering this tariff may lower welfare if and only if k is constrained labor intensive. If there is free trade initially, introducing an import tariff (import subsidy) on k will increase welfare if and only if k is constrained labor intensive (not constrained labor intensive).*

5 Quota Reforms

In this section, we turn to the question of welfare increasing quota reforms in the presence of existing tariffs. From (11) we can derive the optimum implicit tariff vector on the quota-constrained goods as

$$t^{Qo} = -\big(t^T E_{TQ} + p^L E_{LQ}\big) E_{QQ}^{-1} \tag{22}$$

It can be seen that in general, the sign pattern of the optimum implicit tariff vector depends in a complex way on the labor intensity of all goods in Q as well as the substitutability between Q goods and all other goods and the shadow premia on goods in T and labor. However, as in the full employment framework of Falvey (1988) and Neary (1995), the implicit tariffs on different goods in Q are independent from each other. Focusing on a standard special case, we can furthermore show the following.

Proposition 4. *Let the goods in Q be net substitutes for all other importables. Then, if the goods in Q are labor intensive, all implicit tariffs are positive.*

The result follows immediately from the sign patterns of the matrices in (22). Note that it is possible for the implicit tariffs to be positive even if the goods in Q are not labor intensive, provided that the substitutability between goods in T and Q is sufficiently large and/or the tariffs on the goods in T are sufficiently high.[9] Substituting (22) into (11) gives

$$\mu^{-1}du = \left(t^{Q} - t^{Qo}\right) dm^{Q} \tag{23}$$

which shows that moving any implicit tariff closer to its optimal level is welfare increasing. This is a stronger result than in the case of tariffs where it was shown in (15) and (19) that only the radial movement of all tariffs towards their optimal level is welfare increasing.

There is a more transparent way to show under which conditions the change in single import quota is welfare increasing. Assuming that the quota on good $l \in Q$ is changed, holding all other import quotas constant, we have from (11), after rearranging of terms,

$$\mu^{-1}du = \left(\tau_l - \sum_{k\in(0,T,L)} a_{kl}\tau_k\right) p_l dm_l \tag{24}$$

with

$$a_{kl} \equiv -\frac{p_k}{p_l}\sum_{j\in Q} E_{kj}E_{jl}^{-1} \qquad\qquad \sum_{k\in(0,T,L)} a_{kl} = 1$$

where E_{jl}^{-1} is an element of E_{QQ}^{-1}, and E_{kj} is an element of E_{kQ}, $k \in (0, T, L)$. From the above definition of the a_{kl}, one can see that these are all positive if the goods in Q are net substitutes for all other goods, and in addition the goods in Q are labor intensive "on average", which is defined as the case where $\sum_{j\in Q} -E_{Lj}E_{jl}^{-1} > 0$. In

[9] As noted by Falvey (1988), negative implicit tariffs cannot be achieved by an import quota. Hence, with complementarities between goods in T and Q and/or goods in Q being not labor intensive, the full optimum implicit tariff structure may not be attainable.

this case, (24) states that the loosening of the import quota on good l increases welfare if and only if the implicit ad valorem shadow premium rate on that good is higher than a true weighted average of the shadow premium rates of the tariff-constrained importables and labor, where the weights are given by the a_{kl}.

Equation (24) is formally highly similar to equation (7) in Falvey (1988), which holds for quota reforms in a full employment model. The only difference is the exclusion of $a_{Ll}\tau_L$ in the full employment model. As in the case of tariffs, the inclusion of the shadow premium rate on labor blurs the strong results known from the full employment model. In particular, we now have the following.

Proposition 5. *Let each quota-constrained importable be a net substitute for all other importables. Then, loosening the quota for good l is welfare increasing if the implicit ad valorem tariff on l is higher than the highest explicit tariff and the quota-constrained importables are on average not labor intensive. In the absence of tariffs, introducing an import quota on a previously freely traded good will increase welfare if and only if the quota-constrained importables are labor intensive on average.*

From the definition given above, a_{Ll} is positive if and only if the goods in Q are labor intensive on average. Only in this case, τ_l being larger than the highest explicit tariff is *not* sufficient for the term in brackets to be positive, as the summation also includes the shadow premium rate of labor, τ_L, with a positive weight. In the absence of tariffs, and with a quota on good l initially at the free trade level, the term in brackets is negative if and only if the quota-constrained importables are labor intensive on average. In this case, as can be seen from (24), tightening the quota on good l increases welfare. Note that the results derived do not depend on the implicit tariffs on the other quota constrained goods.

6 Labor Market Reforms

Finally, consider the case where trade policy is taken to be exogenous and the minimum wage rate is the policy instrument. In the absence of quotas, we have in analogy to (17)

$$\mu^{-1}du = \left(1 - \sum_{i \neq L} \omega_{iL}\tau_i\right) p^L E_{LL} dp^L \tag{25}$$

where the weights ω_{iL} are defined as in (17), setting $k = L$. The weights are all positive if the goods are all labor intensive. Taking into account that all shadow premium rates on importables are smaller than one, we hence have the following

Proposition 6. *With tariffs as the only trade distortion, lowering the minimum wage rate is welfare increasing if all goods are labor intensive.*

Intuitively, lowering the minimum wage decreases (compensated) net imports of all goods. This negative tariff revenue effect is more than offset by the increase in labor income because the labor market distortion is larger than any of the trade distortions. On the other hand, with some goods being not labor intensive, lowering the minimum wage increases tariff revenue on those goods but opens up the possibility for larger net import declines on other goods. If the latter goods are those with high tariffs, overall welfare may fall as a consequence of lowering the minimum wage.

In the presence of both tariffs and quotas, the welfare effect of changing the minimum wage rate is given by

$$\mu^{-1}du = \left(1 - \sum_{i \neq L} \widetilde{\omega}_{iL}\tau_i\right) p^L E_{LL} dp^L \tag{26}$$

with the weights $\widetilde{\omega}_{iL}$ defined as in (21), setting $k = L$. The weights are all positive if the goods are all constrained labor intensive. Hence, we have the following

Proposition 6a. *In the presence of import tariffs and quotas, lowering the minimum wage rate is welfare increasing if all goods are constrained labor intensive.*

The intuition is the same as above.

7 Conclusion

This paper has shown how the phenomenon of involuntary unemployment can be incorporated into an otherwise standard model of tariff and quota reform in a small open economy. This is, as has been argued above, highly relevant given the importance of the unemployment problem in political discussions of this subject. It has been shown that there is a straightforward link between the well known results for the full employment model and those for the minimum wage model derived here. Using the concept of shadow premium rates to describe the distortions in goods and labor markets, it has been shown that the distortion in the labor market caused by the binding minimum wage is larger than any of the goods market distortions caused by trade policy. Therefore, the question of whether economy-wide employment increases or decreases plays an important role in determining the welfare effect of trade policy. However, employment effects constitute only one part of the welfare effects triggered by a change in the trade policy. It is clear from the analysis that reforms which yield negative employment effects can nevertheless increase overall welfare.

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