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## VARIABLE LABOR SUPPLY AND THE THEORY OF CUSTOMS UNION

Michael S. MICHAEL and Panos HATZIPANAYOTOU

*Abstract:* This paper reexamines the traditional results of customs union theory in a model where labor supply is variable and wages are taxed. In the absence of wage taxes, trade creation improves welfare while trade diversion may or may not. When the imported good is labor intensive and a complement to leisure in consumption, then variable labor supply increases the welfare gains from trade creation. In the presence of wage taxes, trade creation and trade diversion have ambiguous welfare effects. In this case, the paper identifies conditions under which welfare improves or deteriorates as a result of a trade creating or a trade diverting customs union.

### I. INTRODUCTION

The literature on preferential trading agreements including customs union theory is extensive. Early studies by Meade (1955), and Lipsey (1957) demonstrate in a two-good three country framework that trade creation improves welfare while trade diversion may or may not. More recent studies of customs unions using a two-good three-country framework, in a Harris-Todaro model with intersectorally mobile capital (Parai and Batra, (1987)), in a Harris-Todaro model with internationally mobile capital (Michael and Miller, (1992)), in a model with many internationally mobile factors and nontraded goods (Michael, (1991)), confirm these earlier welfare effects of customs unions theory. Within a two-good three-country framework, however, the formation of a customs union may lead to perverse welfare effects, in a model of generalized unemployment due to a minimum wage (Yu, (1982)), with variable returns to scale (Choi and Yu, (1984)), and in a Harris-Todaro model with economies of scale (Beladi, (1989)).

This paper reexamines the traditional effects of the customs union theory using a two-good model, where labor supply is variable and wages are taxed. It demonstrates that in the absence of wage taxes, trade creation improves welfare while trade diversion may or may not. When the imported good is labor intensive and a complement to leisure in consumption, then variable labor supply increases the welfare gains of trade creation. But, in the presence of wage taxes, trade

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creation may reduce welfare while trade diversion may increase it. The paper identifies conditions under which welfare improves or deteriorates as a result of a trade creating or a trade diverting customs union. Given the present framework, our results apply to trade models such as the two-good two-factor, two-good three-factor, or two-good specific-factor models, which all are special cases of the present model.

## 2. THE MODEL

Consider a small open economy producing two traded goods—one exported and one imported—using  $m$  factors of production whose endowments are fixed. The country is also endowed with a constant number of identical individuals whose work hours are variable.<sup>1</sup> Let  $L$  denote the variable domestic labor supply. No taxes or subsidies are levied on the exported good, but a tariff is levied on the imported. The country is small in world goods markets, so that changes in its tariff rate does not affect the world price of the imported good.

With no tax or subsidy on the exported good its world price is normalized to one. The domestic relative price of the imported is  $p^*(1+t)$ , where  $p^*$  denotes the exogenous world price, and  $t$  denotes the country's tariff on imports.

Individual utility depends on the consumption of the two goods and leisure, all of which are normal goods. The aggregate expenditure function is  $E = E(p, u, L)$ , which denotes the minimum expenditure needed to achieve a utility level  $u$  at relative price  $p$  and employment  $L$ . The expenditure function is increasing in  $p$  and  $L$ , strictly concave in  $p$  (i.e.,  $E_{pp} < 0$ ), and strictly convex in  $L$  (i.e.,  $E_{LL} > 0$ ). The derivative of the expenditure function with respect to  $p$  (i.e.,  $E_p$ ) gives the compensated demand for the imported good, and with respect to  $L$  (i.e.,  $E_L$ ) gives the reservation wage,  $\tilde{w}$  (see Dixit and Norman 1980).

The gross domestic product (revenue) function is  $R(p, L)$ , which denotes the maximum output at  $p$  and  $L$ , given the stock of the factors in fixed supply. The fixed factors are omitted from the revenue function since they do not affect the analysis. The derivatives of the revenue function with respect to  $p$  and  $L$  are the economy's supply of the imported good (i.e.,  $R_p = \partial R / \partial p$ ) and the value of marginal product of labor (i.e.,  $R_L = \partial R / \partial L$ ).

Since our interest is in the country's net imports, the model is easily specified in terms of the trade expenditure function that equals the excess of domestic expenditure over the country's GNP. That is,

$$Z(p, u, L) = E(p, u, L) - R(p, L). \quad (1)$$

The properties of the trade expenditure function are related to those of the

<sup>1</sup> Among others, Kemp and Jones (1962), Dixit and Norman (1980), and Woodland (1982) develop models with variable labor supply. Recently, Mayer (1991), using a two-good, two-factor model with variable labor supply, examines among other things, the employment effects of changes in the tariff rate and the terms of trade.

expenditure and revenue functions. Thus, the  $Z$  function is strictly concave in  $p$  (i.e.,  $Z_{pp} < 0$ ), and strictly convex in  $L$  (i.e.,  $Z_{LL} > 0$ ). The derivative of the  $Z$  function with respect to  $p$  (i.e.,  $Z_p = E_p - R_p$ ) gives the country's imports demand function.

In equilibrium, the home country's expenditure equals the revenue from production plus net tariff revenue, which is redistributed to consumers through lump-sum transfers. That is,

$$E(p, u, L) = R(p, L) + tp^*Z_p(p, u, L). \quad (2)$$

Using equation (1), equation (2) can be rewritten as

$$Z(p, u, L) = tp^*Z_p(p, u, L). \quad (3)$$

Equilibrium in the labor market requires that the reservation wage ( $\tilde{w}$ ) equals the net wage received by workers. The net wage equals the value of the marginal product of labor (i.e.,  $R_L$ ) minus the wage tax. Thus,

$$E_L(p, u, L) = R_L(p, L) - \tau, \quad \text{or} \quad Z_L(p, u, L) = -\tau, \quad (4)$$

where  $\tau > 0$  ( $< 0$ ) denotes a tax (subsidy) on wages. Wage tax revenue (subsidy cost) is redistributed to households in a lump-sum fashion.

Differentiating equations (3) and (4) with respect to the world price of the imported good, the tariff rate, and the wage tax yields the following:

$$\begin{bmatrix} (1 - tp^*Z_{pu}) - (\tau + tp^*Z_{pL}) \\ Z_{Lu} & Z_{LL} \end{bmatrix} \begin{bmatrix} du \\ dL \end{bmatrix} = (1+t) \begin{bmatrix} (-Z_p/(1+t)) + tp^*Z_{pp} \\ -Z_{Lp} \end{bmatrix} dp^* \\ + p^* \begin{bmatrix} tp^*Z_{pp} \\ -Z_{Lp} \end{bmatrix} dt + \begin{bmatrix} 0 \\ -1 \end{bmatrix} d\tau, \quad (5)$$

where by choice of units  $Eu = 1$ .

Solving this system results in

$$du = (A + B + C)/\Delta, \quad (6)$$

where  $A = (1+t)[(-Z_p/(1+t)) + tp^*\tilde{Z}_{pp} - \tau Z_{LL}^{-1}Z_{Lp}]dp^*$ ,

$$B = p^*[tp^*\tilde{Z}_{pp} - \tau Z_{LL}^{-1}Z_{Lp}]dt,$$

$$C = -[\tau Z_{LL}^{-1} + tp^*Z_{LL}^{-1}Z_{Lp}]d\tau,$$

$$\Delta = 1 - tp^*(Z_{pu} - Z_{pL}Z_{LL}^{-1}Z_{Lu}) + \tau Z_{LL}^{-1}Z_{Lu} \quad \text{and} \quad \tilde{Z}_{pp} = Z_{pp} - Z_{pL}Z_{LL}^{-1}Z_{Lp}.$$

$\Delta$  is positive if the system is stable, and  $\tilde{Z}_{pp}$  is negative.

The term  $A$  in equation (6) captures the welfare effects of changes in the country's terms of trade while holding the tariff rate and the wage tax constant. The term  $[-Z_p/(1+t)]$  represents the income effect on welfare due to changes in the terms of trade. The term  $(tp^*\tilde{Z}_{pp})$  contains the effect on tariff revenue of a change in imports due to a change in the domestic price of the imported good. Finally, the term  $(-\tau Z_{LL}^{-1}Z_{Lp})$  captures the effect on tax revenue due to changes in employment

induced by changes in the terms of trade. The sign of this last term depends on the factor intensity of the imported good, and on its relationship to leisure in consumption (substitutes or complements).

The term  $B$  in equation (6) captures the welfare effects of changes in the tariff rate, assuming a constant terms of trade and a wage tax. For small departures from free trade, the income effect of a tariff on welfare disappears. The tariff induced welfare changes are captured by the price induced changes in the wage tax and tariff revenue.

Finally, the term  $C$  in equation (6) captures the welfare effect of changes in the wage tax.

### 3. WELFARE EFFECTS OF A CUSTOMS UNION

Within the two-good three-country framework, the welfare effects of a customs union depend on whether the union causes trade creation or trade diversion. In a full employment, constant return to scale world, trade creation improves welfare while trade diversion may or may not.

Following Yu (1982), we define two types of trade creation and trade diversion. Trade creation I ( $dt < 0, dp^* = 0$ ) occurs when country A forms a customs union with country C, the lowest cost producer country, by lowering its tariff on imports from that country, and shifting its consumption of the imported from higher-cost domestic producers to lower-cost producers in C. Trade creation II ( $dp^* < 0, dt = 0$ ) occurs when country A that already has a customs union with country B, the second lowest cost producer, forms a customs union with country C and shifts its imports from country B to country C, thus improving its terms of trade. Trade diversion I ( $dp^* > 0, dt < 0$ ) occurs when country A forms a customs union with country B, reduces its tariff on imports from this country, and now imports from country B instead of C, thus deteriorating its terms of trade. Finally, trade diversion II ( $dp^* > 0, dt = 0$ ) occurs when country A that already has a customs union with countries B and C imposes a tariff on its imports from country C and shifts its imports from C to B, thus deteriorating its terms of trade.

Using equation (6), we evaluate the welfare effects of the two types of trade creation and trade diversion within the present model of endogenous labor supply and wage taxes. Consider the case where the government does not tax wages ( $\tau = d\tau = 0$ ). Here equation (6) reveals that both types of trade creation and trade diversion lead to the traditional welfare results. That is, type I and II trade creation improve welfare, trade diversion II reduces welfare while trade diversion I may or may not improve welfare. But, when labor supply is variable and  $\tau = d\tau = 0$ , the welfare effect of trade creation I is  $\Delta^{-1}tp^{*2}\tilde{Z}_{pp}$  compared to  $\Delta_1^{-1}tp^{*2}Z_{pp}$  when the supply of labor is fixed, where  $\Delta_1 = 1 - tp^*Z_{pu}$ . Since  $\Delta - \Delta_1 = tp^*Z_{pL}Z_{LL}^{-1}Z_{Lu}$  then  $\Delta - \Delta_1 \geq 0$  if  $Z_{pL} \geq 0$ . Note also that  $\tilde{Z}_{pp} - Z_{pp} = -Z_{pL}Z_{LL}^{-1}Z_{Lp}$  is negative. Thus, if  $Z_{pL} < 0$ , that is, if the imported good is labor intensive and a complement to leisure in consumption, then the welfare gains of trade creation I are greater

when labor supply is variable than when not. Similarly, the welfare gains of trade creation II and the welfare losses of trade diversion II are also greater when labor supply is variable. Lastly, although the welfare effect of trade diversion I remains ambiguous, the probability that welfare improves is greater when labor supply is variable. For trade diversion to emerge the country's price of the imported good must decrease (i.e.,  $|p^*dt| > |(1+t)dp^*|$ ). Using terms  $A$  and  $B$  of equation (6), given changes in the tariff rate and the country's terms of trade lead to a greater welfare increase or to a smaller welfare decrease when labor supply is variable. That is, given changes in the tariff and terms of trade that reduce welfare when labor supply is fixed may increase welfare when labor supply is variable.<sup>2</sup>

**PROPOSITION 1.** *When labor supply is variable and wages are untaxed, both types of trade creation and trade diversion lead to the traditional welfare effects. When the imported good is labor intensive and a complement to leisure in consumption, then variable labor supply increases the welfare gains of trade creation, and the welfare losses of type II trade diversion. Variable labor supply also increases the probability of a welfare improving type I trade diversion.*

Michael (1991), in a model with international capital mobility but fixed labor supply, shows that the welfare gains (losses) of trade creation (trade diversion II) are greater when capital is internationally mobile than when not. International capital mobility also increases the probability of a welfare improving type I trade diversion. Variable labor supply, however, may not increase the welfare gains of trade creation. This result may emerge when the imported good is capital intensive and a substitute for leisure in consumption. The difference between the welfare effects of trade creation (diversion) under variable capital supply and labor supply is due to the fact that variable labor supply affects utility directly while capital supply does not.

Equation (6) also demonstrates that the welfare maximizing values of the tariff and wage tax are zero. If, however, the value of either instrument is nonzero, then the "second-best" value of the other is also nonzero. That is,

$$t^0 = \tau(p^* \tilde{Z}_{pp})^{-1} Z_{pL} Z_{LL}^{-1}, \quad \text{and} \quad \tau^0 = -tp^* Z_{pL}. \quad (7)$$

Adding and subtracting  $\tau^0 Z_{LL}^{-1} Z_{Lp}$  in terms  $A$  and  $B$  of equation (6), using the definition of  $\tau^0$ , and assuming for our purposes that  $d\tau = 0$  leads to the following expression for changes in welfare due to changes in the country's terms of trade and tariff rate:

$$\begin{aligned} \Delta du = & (1+t) [(-Z_p/(1+t)) + tp^* Z_{pp} - (\tau - \tau^0) Z_{LL}^{-1} Z_{Lp}] dp^* \\ & + p^* [tp^* Z_{pp} - (\tau - \tau^0) Z_{LL}^{-1} Z_{Lp}] dt. \end{aligned} \quad (8)$$

<sup>2</sup> This result is valid when  $\tilde{Z}_{pp}$ ,  $Z_{pp}$ , and the imports demand function are all evaluated at the same initial factor endowments.

When labor supply is endogenous and wages are taxed, the welfare effects of trade creation and trade diversion are ambiguous. In what follows, we examine the conditions under which trade creation and trade diversion still lead to the traditional welfare effects when labor supply is variable and wages are taxed. Equation (8) reveals that the traditional results of both types of trade creation and trade diversion are obtained either when  $Z_{Lp} > 0$  and  $\tau > \tau^0$ , or when  $Z_{Lp} < 0$  and  $\tau < \tau^0$ . To gain a better insight about the role of variable labor supply and wage taxes on trade creation and trade diversion, we examine the welfare effects of such preferential trading agreements using some specific trade models.

Consider the two-good, two-factor model,<sup>3</sup> and assume that the imported is capital intensive (i.e.,  $R_{Lp} < 0$ ) and a substitute for leisure in consumption (i.e.,  $E_{Lp} > 0$ ). In this case, a tariff on the capital intensive imported good, which reduces employment, calls for a second-best policy of a wage subsidy (i.e.,  $\tau^0 = -tp^*Z_{Lp} < 0$ ) to increase employment. When  $\tau > \tau^0$ , the second-best calls for lowering the tariff rate. Thus, any policy that reduces the current tariff rate toward its second-best rate improves welfare by increasing employment. A reduction of the tariff rate reduces the domestic relative price of the good, and since the good is capital intensive, the demand for labor and employment increases. Moreover, since the imported and leisure are substitutes in consumption, an additional increase in employment occurs because the decrease in the domestic price of the imported reduces leisure, and further increases the supply of labor and employment. Thus, a reduction of the current tariff rate caused by a type I trade creating customs union increases welfare since it (i) reduces the distortions in the country's production and consumption patterns, and (ii) increases employment toward the level corresponding to the second-best import subsidy or tariff rate. A similar argument can be presented for a type II trade creating customs union that reduces the domestic price of the imported good. In this case, type I or II trade creating customs unions accompanied by a small wage subsidy or a wage tax (i.e.,  $\tau > \tau^0$ ) are welfare improving. The welfare improvement is inversely related to the size of the wage subsidy. Likewise, when  $\tau > \tau^0$  and  $Z_{Lp} > 0$ , type II trade diversion unambiguously reduces welfare while the welfare effect of type I trade diversion remains ambiguous.

Assume instead that the imported is labor intensive ( $R_{Lp} > 0$ ) and is a complement to leisure in consumption (i.e.,  $E_{Lp} < 0$ ). In this case, with a tariff on the labor intensive imported good, which increases employment, the second-best policy calls for a wage tax (i.e.,  $\tau^0 = -tp^*Z_{Lp} > 0$ ) to decrease employment. When  $\tau < \tau^0$ , the second-best calls for lowering the tariff rate. Thus, any policy that reduces the current tariff rate toward its second-best rate improves welfare by reducing employment. The lower tariff decreases the domestic relative price of the imported good, and since this good is labor intensive, the demand for labor

<sup>3</sup> In the two-good, two-factor model with constant-returns-to-scale, the wage is not affected by changes in employment (i.e.,  $R_{LL} = 0$ ). In this case,  $Z_{LL} = E_{LL}$ .

and employment decrease. Moreover, since the imported and leisure are complements in consumption, an additional decrease in employment occurs because the decrease in the domestic price of the imported good increases leisure, and decreases the supply of labor and employment. Thus, a type I trade creating customs union that reduces the current tariff rate is welfare improving because it (i) reduces the distortions in the country's production and consumption patterns, and (ii) reduces employment toward the level corresponding to second-best import subsidy or tariff rate. A similar argument can be presented for a type II trade creating customs unions. In this case, type I or II trade creating customs unions accompanied by a wage subsidy or a small wage tax (i.e.,  $\tau < \tau^0$ ) are welfare improving. The welfare improvement is inversely related to the size of the wage tax. Likewise, when  $\tau < \tau^0$  and  $Z_{pL} < 0$ , type II trade diversion reduces welfare while the welfare effect of trade diversion I remains ambiguous.

**PROPOSITION 2.** *Within the two-good, two-factor model, trade creation and trade diversion yield the traditional welfare effects when either (i) the imported good is capital intensive and is a substitute for leisure in consumption, and wages are taxed or slightly subsidized, or (ii) the imported good is labor intensive and a complement to leisure in consumption, and wages are subsidized or slightly taxed.*

Consider now the two-good, sector-specific model, where labor is the intersectorally mobile factor (i.e.,  $R_{Lp} > 0$ ). Within this model, type I or II trade creation and trade diversion yield the traditional welfare effects when leisure and the imported good are complements (i.e.,  $E_{Lp} < 0$ ) and wages are subsidized or slightly taxed (i.e.,  $\tau < \tau^0$ ). The intuition of this argument runs along the lines developed for the two-good, two-factor model when  $\tau < \tau^0$  and  $Z_{Lp} < 0$ .

**PROPOSITION 3.** *Within the two-good, sector-specific model, when labor supply is variable and wages are taxed, trade creation and trade diversion lead to the traditional welfare effects if (i) the imported good and leisure are complements in consumption, and (ii) wages are either subsidized or slightly taxed.*

Finally, in a world with variable labor supply and wage taxes, we examine the conditions under which the formation of a customs union may lead to perverse welfare effects. That is, trade creation may actually reduce welfare, while type II trade diversion may improve it. Observing the terms of equation (8), these perverse welfare effects may arise either when  $\tau < \tau^0$  and  $Z_{Lp} > 0$ , or when  $\tau > \tau^0$  and  $Z_{Lp} < 0$ .

Consider, for example, the two-good, sector-specific model where leisure and the imported good are complements in consumption (i.e.,  $E_{pL} < 0$ ). Since  $R_{Lp} > 0$ , then  $Z_{Lp} < 0$ . With a tariff on imports, which increases employment, the second-best policy calls for a wage tax (i.e.,  $\tau^0 = -tp * Z_{Lp} > 0$ ) to reduce employment. When  $\tau > \tau^0$ , the second-best policy calls for a higher tariff rate. Thus, any policy that reduces the current tariff away from its second-best level reduces welfare by reducing employment. A lower tariff, which reduces the domestic price of the



imported good, reduces the demand for labor and employment. Moreover, since the imported and leisure are complements in consumption, an additional decrease in employment occurs because the decrease in the domestic price of the imported good, increases leisure, and decreases the supply of labor and employment. Thus, the formation of a type I trade creating customs union that reduces the current tariff (i) increases welfare by reducing the distortions in the economy's production and consumption patterns, but (ii) reduces welfare since it reduces employment to a level lower than the one corresponding to the second-best tariff rate. Thus, if the reduction in welfare due to lower employment outweighs the welfare gains due to lower distortions in the country's production and consumption patterns, then type I trade creation reduces welfare. The same argument applies to a type II trade creating customs union. In this case, type I or II trade creation accompanied by large wage taxes (i.e.,  $\tau > \tau^0$ ) may reduce welfare. The possibility of such perverse welfare effects of trade creation increases with the size of the wage tax. Likewise, type II trade diversion, in this case, can improve the country's welfare.

PROPOSITION 4. *In a model with endogenous labor supply and wage taxes, trade creation may reduce welfare while trade diversion II may increase welfare.*

#### 4. CONCLUSIONS

The present paper uses a two-good model with endogenous labor supply and wage taxes to examine the welfare effects of a customs union. In the absence of wage taxes, the analysis demonstrates that the traditional results still hold when labor supply is variable. That is, trade creation improves welfare, while trade diversion may or may not. When the imported good is labor intensive and a complement to leisure in consumption, then variable labor supply increases the welfare gains of both types of trade creation and the welfare losses of type II trade diversion, and the probability of having a welfare improving type I trade diversion.

The traditional results may cease to exist when wages are taxed. In this case, trade creation may reduce welfare and type II trade diversion may improve it. Using specific trade models the analysis identifies conditions under which the traditional results may or may not emerge.

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