Transition and Compensation in Efficient Trade Agreements

Eric Bond

Department of Economics

Vanderbilt University

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I. Introduction

Trade agreements have two common features. One is that the reduction in trade barriers typically takes place gradually in a series of smaller steps, rather than having tariffs be reduced immediately. The second feature is a "safeguard clause," which allows for departures from this schedule in the event that an import-competing sector suffers undue harm as the result of an import surge following the reduction in trade barriers. The North American Free Trade Agreement (NAFTA) provides a prominent example of this structure. Under NAFTA, goods were divided into 4 categories. The tariffs on goods in category A were eliminated immediately. Goods in categories B, C, and C+ had tariffs removed in annual stages spread over periods of 5, 10, and 15 years, respectively. Chapter 8 of the agreement specified the conditions for emergency actions, which would allow for the suspension of tariff reductions or the increasing of tariffs (within specified limits) if a good "is being imported into the territory of another Party in such increased quantities, in absolute terms, and under such conditions that the imports of the good from that Party alone constitute a substantial cause of serious injury, or threat thereof, to a domestic industry producing a like or directly competitive good." These safeguard actions are limited to the transition period for the agreement.

A similar pattern of gradual liberalization with safeguards during the transition period was built into the WTO Agreement on Textiles and Clothing. The purpose of this agreement was to integrate textile and clothing products, whose trade had previously been restricted by a system of bilateral country quotas that had been set up under the Multifibre Arrangement, into the GATT system. The agreement specified that an increasing fraction of the products should be integrated into the GATT system over the period of the agreement (1995-2005). In addition, the agreement specified minimum growth rates for imports of products that were still under MFA restriction. Although this agreement was specified in terms of quantities rather than prices, it certainly suggests a gradual reduction in the tariff-equivalents of these quotas, with all of the restrictions to be eliminated by the end of the agreement. Coupled with this relaxing of quantitative restrictions was a system of safeguards for the transition period, which allowed for departures from this schedule when “it is demonstrated that a particular product is being imported into its territory in such increased quantities as to cause serious damage, or actual threat thereof, to the domestic industry producing like and/or directly competitive products.” These protective measures could either be the result of a mutual agreement on the part of the countries involved, or by a unilateral action on the part of the importing country. In the latter case, the safeguard was subject to review by a Textiles Monitoring Body that was set up for that purpose.

The purpose of this paper is to examine the form of efficient trade agreements in which a country makes two types of promises as part of a trade agreement. First, it promises to liberalize trade with the other country. This promise is beneficial to both countries because it allows resources in each country to be moved from sectors in which it is relatively inefficient to sectors where it is efficient, resulting in an increase in world outputs of all goods. The second promise is that resources that are specific to the import-competing sector will receive some compensation for their losses from trade liberalization. The reason for this promise will not be explicitly modeled, although it could arise from a political economy motivation or from a desire to provide social insurance to resource owners in the import-competing sector. The objective will be to characterize the agreements that are Pareto efficient for the countries involved, and in particular to examine how the promises and the tariffs chosen under these agreements evolve over the life of the agreement.

The analysis will be conducted using a (symmetric) specific factors model of trade, which highlights the impact of trade liberalization on the earnings of factors that are tied to the import-competing sector. Dynamics are introduced into the model by assuming that the mobile factor owners employed in the import-competing sector are faced with increasing marginal costs of adjustment, so that the movement of resources out of the import-competing sector will be gradual. The design of the trade agreement is treated as a planner’s problem, in which the planner chooses the time path of results show that the time path of the policy instruments is chosen to maximize the welfare of a representative country. The resulting agreement will simultaneously deal with the cross-country spillovers created by the use of tariffs and the constraints on income distribution, resulting in an agreement that is constrained Pareto efficient.

The time path of policies under a trade agreement depends critically on the instruments that are available to the planner to redistribute income. If lump sum transfers are available, then the efficient agreement will call for the immediate elimination of tariffs when there are no externalities in the adjustment process. This result is consistent with those obtained by Mussa (1978, 1982) for the small country case. The result continues to hold in the case of an efficient trade agreement between large countries because the planner neutralizes all terms of trade effects in designing the agreement. The second case considered is one in which the planner does not have access to lump sum transfers, but can use sector specific labor market taxes/subsidies to influence the movement of labor. These policies have the potential to paly the role of adjustment assistance that are frequently discussed in relation to trade liberalization. In this case it is shown that the efficient agreement will result in partial elimination of the tariff, because a positive tariff will be maintained in the steady state. A sector specific labor market policy will also be used, although this policy may be either a subsidy or tax on labor in employed in the exportable sector. The fact that labor is complementary to sector specific capital in the adjustment process provides an incentive to decrease the tariff along the adjustment path, although this effect seems to be small.

The final case is one in which the only instrument available to the planner to redistribute income is the tariff. In this case the tariff is required to achieve two conflicting targets: it must transfer income to the owners of the specific factor and it must induce the mobile factor owners to move out of the import-competing sector. It is shown that the distorting effect of the tariff on the migration decision increases over time, since tariffs in the early periods affect the migration decision only of those workers who move immediately. This creates an incentive to load the tariff protection in the early period of the agreement, when it has the greatest effect of transferring income but the smallest impact on the migration decision.

It will be assumed in what follows that the countries involved are able to commit to their promises. Ths approach contrasts with the literature, initiated by Staiger (1995), which examines how the requirement that trade agreements be self-enforcing can lead to gradual tariff reduction. In this literature, the incentives to deviate are larger the greater the stock of factors employed in the import-competing sector. As resources leave the sector, the no deviation constraint is relaxed, making further trade liberalization sustainable. Furusawa and Lai (1997) examine a model with adjustment costs of moving sectors between sectors, and show that the efficient trade agreement between welfare maximizing governments will involve gradual tariff reduction. Bond (2008) considers a model with multiple sectors in each country, and shows that the minimum discount factor for supporting simultaneous liberalization of all sectors is higher than that for liberalizing sectors sequentially in the presence of sectoral adjustment costs.[1]

Section II of the paper presents the basic model in the case where labor is fully mobile between sectors. Section III introduces adjustment costs, and derives the efficient trade agreement when countries have access to both tariffs and sector specific labor taxes/subsidies. These results are then compared with those that arise when trade agreements only cover tariffs.

II. A Symmetric Two Country Specific Factor Model with Full Labor Mobility

The trade model studied here is a standard specific factor model of trade with identical and homothetic preferences across countries. Symmetry assumptions will be added to simplify the analysis by allowing for treatment of the problem as that of choosing the trade agreement that is welfare maximizing for a representative country. We thus abstract from between country distributional issues that might arise in cases where the countries differ in size or market power. The analysis in this section assumes that the

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[1]Bond and Park (2002) show that gradualism can arise in the absence of adjustment costs when countries are asymmetric and the agreements must be self-enforcing. Asymmetries between countries lead to the possibility that the no deviation contraint is binding in one country, but not in the other. In this case the no deviation constraint is relaxed by offering the incentive constrained country a higher payoff in the future, which leads to a delay in achieving free trade under the agreement.

mobile factor is instantaneously and costlessly mobile across sectors, and thus can be used to link the model considered here to the standard static model of trade agreements. These results will serve as a useful benchmark for the following sections, because the results in the static model will correspond to the steady state behavior in the model with adjustment costs.

The home country is assumed to have has an endowment $\bar{L}$ of labor, which is used in both sectors of the economy and is costlessly mobile between sectors. It also has an endowment K (λK) of capital specific to sector 1 (2), where $\lambda < 1$. The production functions in the two sectors are assumed to be identical and denoted by $F(K_i, L_i)$. With perfect labor mobility, the equilibrium employment level in the exportable sector, 1, will be the value $\tilde{L}^X(p_2/p_1)$ that equates the marginal revenue product of labor across sectors. The production side of the economy can then be described by the mobile labor revenue function,

$$\tilde{R}(p_1,p_2) = p_1 F(K,\tilde{L}^X(p_2/p_1)) + p_2 F(\lambda K, L - \tilde{L}^X(p_2/p_1)) \qquad \textbf{(1)}$$

The foreign country is assumed to have the same endowment of the mobile factor as the home country, but its endowments of the specific factors are the mirror image of those in the home country. Specifically, the foreign country has λK (K) units of capital in sector 1 (2). The equilibrium employment level in sector 2 in the foreign country with perfectly mobile labor is denoted $\tilde{L}^{X*}(p_2/p_1)$, which satisfies $\tilde{L}^{X*}(x) = \tilde{L}^X(1/x)$. The symmetry of home and foreign endowments is reflected in the symmetry of the revenue functions of the home and foreign countries, which have the property that $\tilde{R}^*(x,y) = \tilde{R}(y,x)$. The relatively large supply of sector specific capital for good 1 in the home country means that it will produce a relatively larger supply of good 1, so that at a relative price of unity for the two goods we have $\tilde{R}_2(1,1)/\tilde{R}_1(1,1) = \tilde{R}_1^*(1,1)/\tilde{R}_2^*(1,1) = \lambda$.

The demand side of the model is assumed to be characterized by identical and homothetic preferences for all households. The aggregate expenditure can be described the expenditure function $e(p_1$

$,p_2)U$, where U denotes aggregate welfare and $e(p_1, p)$ is homogeneous of degree 1 and strictly concave in prices. It will be assumed that the goods enter symmetrically in the expenditure function, so that $e(x, y) = e(y,x)$ for all $x, y \geq 0$. Choosing good 1 to be the numeraire, the autarky relative price for good 2, p^A, solves $\tilde{R}_2(1,p^A)/\tilde{R}(1,p^A) = e_2(1,p^A)/e(1,p^A)$. The above assumptions ensure that $\tilde{R}_2(1,1)/\tilde{R}(1,1) = \lambda/(1 + \lambda) > e_2(1,1)/e(1,1) = 1/2$, so $p^A = 1/p^{A*} > 1$. The home country will export good 1 under free trade, and the symmetry assumptions yield the result that the relative price of good 2 will be 1 in a free trade equilibrium.

This symmetric model provides a simple way of illustrating the inefficiency of the Nash equilibrium when tariffs are set optimally and the gains from trade agreements between the countries. The home country import demand function will be $m(p_1, p_2, U) = e_2(p_1, p_2)U - \tilde{R}_2(p_1, p_2)$, and the foreign import demand function satisfies $m^*(x, y, U) = e_1(x, y)U - \tilde{R}_1^*(x, y) = m(y,x, U)$. Letting p^W denote the relative price of good 2 at the border and τ the ad valorem tariff, the budget constraint requires that $e(p)U = \tilde{R}(p) + \tau p^W(e_2(p) - R_p(p))$, where $p = p^W(1 + \tau)$. The budget constraint can be solved to obtain an expression for home country welfare as a function of the tariff and border price,

$$\tilde{U}(\tau,p^W) = \frac{\tilde{R}(p) - \tau p^W \tilde{R}_2(p)}{e(p) - \tau p^W e_2(p)} \tag{2}$$

Expression (2) yields the familiar result, $\tilde{U}_\tau = \tau p^W(e_{pp}\tilde{U} - R_{pp})/(e - (p - p^W)e_2)$. An increase in the tariff reduces the volume of trade, which is welfare reducing (increasing) at fixed terms of trade when $\tau > 0$ ($\tau < 0$). Since the home country is large enough to affect the terms of trade, it will have a positive optimal tariff satisfying $U_\tau + U_{p^W}(\partial p^W/\partial\tau) = 0$. Letting the foreign country trade instrument be an ad valorem tariff at rate τ^* that can be imposed on imports of good 1, a foreign country utility function $\tilde{U}^*(\tau^*,p^W)$ can similarly be defined over tariffs. [2]

As a result of the symmetry properties of the model, the Nash equilibrium will be one in which the countries charge a common tariff $\tau^N = \tau^{*N}$ and $p^W = 1$. If countries can commit to tariff rates and bargain efficiently over the set of trade agreements, then the outcome will be contained in the set of agreements that are Pareto efficient and that leave each country at least as well as in the Nash equilibrium. In light of the symmetry of the countries, it is natural to focus on agreements that treat the two countries equally in the sense that $\tau = \tau^*$, which will result in $p^W = 1$ under all trade agreements . If countries choose tariff rates to maximize national income, the efficient agreement can then be obtained by choosing τ to maximize $\tilde{U}(\tau,1)$, which yields a trade agreement with $\tau = \tau^* = 0$. If the planner has access to lump sum redistribution within the country, then these instruments can be used to maximize national income and the tariff should be chosen to maximize national income.

If lump sum instruments are not available, then distorting policy instruments must be used to transfer income to the losers from trade.[3] Suppose that the government promises a minimum level of income to specific factor owners. Let $\Pi(\tau,L^X) = (1+\tau)\lambda K F_K(\lambda K,\bar{L} - L^X)$ be the aggregate income of specific factor owners, where L^X is the quantity of labor employed in the exportable sector. If the government promises an income level $\bar{\Pi}$ to the specific factor owners and the only available instrument for redistribution is the tariff, then the government's objective function becomes $\max_{\tau} \tilde{U}(\tau) + \tilde{\theta}\left(\Pi(\tau,\tilde{L}^X(1+\tau)) - \bar{\Pi}\right)$. This yields the necessary conditions for the optimal tariff to be

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[2]The foreign and home utility functions will have the property that $\tilde{U}^*(x,y) = \tilde{U}(x,1/y)$, which means that the payoffs of the countries from a common tariff will be the same when the world price equals 1.

[3]Since the supply of the specific factor is assumed to be fixed, the transfer could be accomplished by a subsidy to owners of the specific factor. However, it may be difficult in practice to identify specific factor owners in order to pay this subsidy. For example, an important component of sector specific capital is human capital that is specific to the firms or production processes in that sector. It may not be clear to the planner which workers have capital that is specific to the sector and which have human capital that can be utilized in other sectors. Even among workers with significant experience in a sector, the degree of specificity of the accumulated human capital may differ. Thus, a payment tied to remaining in the sector may be the best way of targeting those with significant sector specific capital.

$$\frac{\tau\left(\tilde{R}_{22}(p) - e_{22}(p)U\right)}{e^{W}(\tau)} = \tilde{\theta}\left[\Pi_{\tau}(\tau,L^{\tilde{}X}) + \Pi_{L^{X}}(\tau,L^{X})\frac{dL^{\tilde{}X}}{d\tau}\right] \tag{3}$$

where $e^{W}(\tau) = e(1+\tau) - \tau e_{p}(1+\tau)$ is the expenditure at world prices ($p^{W} = 1$) of the bundle chosen by consumers at prices $(1+ \tau)$. The left hand side of this expression is the marginal deadweight loss due to the tariff, and the bracketed expression on the right hand side is the gain in income to the specific factor owners of an increase in the tariff. The income of specific factor owners is unambiguously increasing in the tariff, because the increase in price raises the return at fixed L^{X} and and induces an inflow of labor into the sector. The optimal tariff uner the agreement in this case will be positive. In this scenario, the trade agreement will result in a reduction of tariffs relative to the Nash equilibrium, but will not result in the complete elimination of tariffs.[4]

Equation (3) characterizes the tariff in the efficient trade agreement when the only instrument available is the tariff. If the governments also have access to sector-specific labor taxes, then they can potentially achieve a superior outcome by including the use of labor market instruments as part of the agreement. The planner wants to compensate sector specific capital, but also to move labor to the exportable sector where it is more efficient. The availability of sector specific labor market taxes gives planner an additional instrument for achieving these two targets. In formulating this version of the problem, it will be convenient to treat the problem as one in which the government chooses the level of employment in the exportable sector. To this end, a short run revenue function can be defined for the home country

$$R((p_1,p_2,L^{X}) = p_1F(K,L^{X}) + p_2F(\lambda K,\bar{L} - L^{X}) \tag{4}$$

[4]The fact that the promised level of income is less than the level enjoyed by the specific factor owners at the Nash equilibrium ensures that the tariff level will be less than that in the Nash equilbrium. Note that a similar outcome would arise if the planner were maximizing weighted social welfare, as might arise when the weights reflect political influence (eg. Grossman and Helpman (1995), Bagwell and Staiger (2002)). In this case the elimination of the terms of trade spillover will result in a lower, but non-zero, tariff under the agreement.

which denotes the value of national income for a fixed allocation of labor between sectors. An employment level of L^X in the exportable sector can be sustained as a competitive equilibrium if labor employed in sector 1 is taxed by an amount $T_L = R_{L^X}(p,L^X)$ per worker.[5]

Substituting this revenue function into (2), we can express the optimization problem for the planner as $\max_{\tau,L^X} U(\tau,L_X) + \theta\left(\Pi(\tau,L^X) - \bar{\Pi}\right)$. The necessary conditions for choice of τ and L^X are

$$\frac{-\tau e_{22}(1+\tau)U}{e^W(\tau)} = \theta\Pi_\tau(1+\tau_t,L_t^X) > 0 \qquad (a)$$

$$\frac{R_{L^X}(1,L_t^X)}{e^W(\tau)} = -\theta\Pi_{L^X}(1+\tau_t,L_t^X) > 0 \qquad (b) \qquad \textbf{(5)}$$

Condition (5a) requires that the marginal deadweight loss from increasing the tariff equal the benefit from transferring income to the specific factor owners, as in the case where the tariff is the only instrument. The difference is that the deadweight loss formula in (5a) includes only the consumption deadweight loss. The production deadweight loss is not included because the employment level is being separately controlled by the planner. Condition (5b) requires that the difference in the marginal social product of a worker between sectors 1 and 2, which is the difference in marginal products between sectors evaluated at the world price, equal it impact on the income of specific factor owners. Since a withdrawal of workers from sector 2 lowers the income of specific factor owners, the marginal product in sector 1 must be higher than that in sector 2 at the optimal choice.

The level of the labor market tax on sector 1 that is required to implement this policy is given by $T_L = R_{L^X}(p,L^X) = e^W(\tau)\theta(1+\tau)\lambda KF_{KL}(\lambda K,\bar{L}-L^X) - \tau F_L(\lambda K,\bar{L}-L^X)$. The sign of the labor market intervention is ambiguous because there are two conflicting effects at work. The fact that the exit of

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[5] There is a similarly defined short run revenue function for the foreign country is denoted $R^*(p_1, p_2, L^{X*})$, that satisfies $R^*(x,y,z) = R(y,x,z)$. The symmetry of the short run functions ensures that it will be efficient for the planner to adopt similar labor market policies for the foreign country, so that the assumption that $p^W = 1$ as part of any trade agreement can be maintained.

workers from sector 2 reduces the return to sector-specific capital in that sector creates an incentive to tax labor in sector 1. However, the fact that there is tariff protection in sector 2 means that the marginal revenue product at domestic prices exceeds that at world prices, creating an incentive to subsidize labor in sector 2. If the elasticity of substitution in consumption is quite high, then the optimal tariff solving (5a) will be relatively low. In this case the tariff is not an effective instrument for compensation, so labor should be discouraged from moving to sector 1. On the other hand, if the elasticity of substitution in consumption is relatively low the planner will choose a relatively high tariff to compensate specific factor owners. A subsidy to workers in sector 1 will then be required to reduce the efficiency cost of the tariff by inducing exit of workers.[6] In this latter case these labor market policies look somewhat like trade adjustment assistance, since they subsidize the movement of workers out of the import-competing sector. Their purpose is somewhat different, however, because the target of compensation here is not the workers themselves but the specific factors that stay behind. The subsidies to workers in the exportable sector are an attempt to partially undo the distorting effects provided by protection. Furthermore, these policies are not transitory since they will persist in the steady state.

III. Trade Agreements with Costly Adjustment of labor

The results of the previous section derived the optimal form of trade agreements in a static model, and thus was incapable of explaining why trade policies might change over the life of the agreement. We now turn to the analysis of trade agreements in the case where there is costly adjustment of labor between sectors of the economy in order to characterize how the terms of an agreement may change over time as labor adjusts between sectors. Letting L_t^X denote the quantity of labor in the exportable sector in the home

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[6]Examples with specific functional forms confirm these possibilities. If the production function and utility function are Cobb Douglas with parameters similar to those given in the example in Section III, the optimal labor market policy will be a subsidy to labor in the exportable sector. However, if the elasticity of substitution in consumption is 5 and the elasticity of substitution between factors in production is .5 (with similar values for factor shares and endowments as in the previous example), a tax on labor in sector 1 is called for.

country at time t, the cost of moving L_{t+1}^X - L_t^X units of labor is $C(L_{t+1} - L_t) = .5\gamma\left(L_{t+1}^X - L_t^X\right)^2$. If the initial starting point for the country is the Nash equilibrium, then the analysis of the previous section indicates that initial employment levels in the import-competing sector will exceed the levels that are associated with the competitive equilibrium under free trade. The assumption of a strictly convex cost of adjustment function will ensure gradual adjustment of labor between sectors along this path, with the quadratic specification being adopted to simplify the formulation.

The symmetry of the home and foreign countries will mean that if the countries start with the same amount of labor in the exportable export in each country, $L_0^X = L_0^{X*}$, then a trade agreement that specifies $\tau_t = \tau_t^*$ and $L_t^X = L_t^{*X}$ for all, will hold the world price constant at unity along its path. Therefore, we maintain the assumption that $p^W = 1$ throughout the analysis of this section. Equating national income (net of adjustment costs) to expenditure yields an expression for aggregate home country welfare for a fixed quantity of labor

$$U(\tau, L_t^X, \Delta L_t^X) = \frac{R(p, L_t^X) - \tau R_p(p, L_t^X) - C(\Delta L_t^X)}{e^W(\tau)} \tag{6}$$

where $\Delta L_t^X \equiv L_{t+1}^X - L_t^X$. At fixed world terms of trade, we have $U_\tau = \tau e_{22}(p)U/e^W(\tau)$. As in the case with mobile labor, an increase in the tariff reduces (increases) welfare for $\tau > 0$ ($\tau < 0$). Current period welfare will be maximized by choosing $\tau = 0$. The effect of a movement of labor to the exportables sector is given by L^X is $U_{L^X} = R_{L^X}(1, L^X)/e^W(\tau)$, which is the difference in the marginal product of labor evaluated at world prices.

We will begin with the case in which the governments have the full set of policy instruments, which include lump sum taxes to compensate specific factor owners and sector-specific labor policies to influence the location of workers. With these assumptions, we can characterize an efficient trade agreement by choosing the sequence $\{\tau_t, L_t^X\}$ that maximizes $\sum_{t=0}^{\infty} U(\tau_t, L_t^X, L_{t+1}^X)\beta^t$ given L_0^X and $p_t^W = 1$ for all t. The efficient trade agreement will then be one that specifies tariff rates and labor market polices that achieve the desired sequence $\{ \tau_t = \tau_t^*, L_t^X = L_t^{X*} \}$.

This problem has a recursive structure, so its solution can be obtained from the dynamic programming problem, $\Omega(L_t) = \max_{\{\tau_t, L_t^X\}} U(\tau_t, L_t^X, \Delta L_t^X) + \beta\Omega(L_{t+1}^X)$. The solution to this problem yields the following result:

<u>Proposition 1:</u> *The policy that maximizes welfare is to set* $\tau = 0$ *for all t and to choose the movement of labor between sectors to satisfy*

$$R_{L^X}(p^W, L_t^X) = \gamma\left[\frac{\left(L_t^X - L_{t-1}^X\right)}{\beta} - \left(L_{t+1}^X - L_t^X\right)\right] \quad \textbf{(7)}$$

When the planner has separate policies to control the movement of labor between sectors, then the tariff is chosen to maximize current income and free trade will be optimal. Equation (7) determines the optimal path for labor, and requires that the loss in national income from postponing movement to the exportable sector equal the reduction in moving cost that is gained by postponing movement at each point in time. Condition (7) can equivalently be stated as requiring that the present value of the gain in national income from moving a worker between sectors at time t be equal to the cost of moving,

$$\sum_{s=1}^{\infty} R_{L^X}(p_t^W, L_t^X) = \gamma\left(L_{t+1} - L_t\right) \quad \textbf{(8)}$$

Since domestic prices equal world prices with $\tau_t = 0$, the left hand side of (8) is equal to the difference in the present value of wage income between the exportable and the import-competing sectors at home. If the cost to a worker of moving between sectors equals the marginal social cost, then the social optimum is obtained in a competitive economy when workers make decisions to maximize the discounted wage income net of their adjustment costs.

No additional labor market interventions are required to achieve the social planner's solution when the private marginal cost of moving equals the social marginal cost and expectations about the future are rational, a point that has been made by was initially made by Mussa (1978). If the private costs of migration differ from the marginal social cost, then the private decisions will not satisfy the necessary condition (5) and a wage subsidy/tax scheme will be necessary to that the private decisions coincide with the socially optimal ones. Free trade will still be the optimal policy, however, when the government has access to labor market policies to correct this distortion. Examples of cases in which labor market interventions are required to achieve the social optimum are provided by Lapan (1976), Cassing and Ochs (1978), and Mussa (1982). In the discussion that follows, the emphasis will be on the use of market interventions when the government has an income distribution motive. In order to focus on the role of played by income distribution, it will be assumed that the cost of moving to workers is the marginal social cost of migration.

A. Compensating Specific Factor Owners Using Tariffs and Labor Market Policies

We now consider the case in which the planner does not have access to lump sum transfers, but can use labor market policies and tariffs. The compensation constraint in this case will require that the present value of payments to the specific factor owners be at least a minimum level,

$$\sum_{t=0}^{\infty} \Pi(\tau_t, L_t^X)\beta^t \geq V_0 \tag{9}$$

This constraint allows the compensation to the specific factor owners to vary over the life of the agreement. The efficient trade agreement in this case will be obtained by choosing $\{\tau_t, L_t^X\}$ to maximize $\sum_{t=0}^{\infty} U(\tau_t, L_t^X, \Delta L_t^X)\beta^t$, subject to (9).

This problem can be formulated by modifying the dynamic programming problem of the previous section to include a new state variable, V_t, which represents the promised payoff to the owners of the specific factor from time t onward. This state variable evolves according to $V_t = \Pi(\tau_t, L_t^X) + \beta V_{t+1}$, and the functional equation is by $\Omega(V_t, L_t^X) = \max_{\{\tau_t, L_t^X\}} U(\tau_t, L_t^X, \Delta L_t^X) + \beta\Omega(V_{t+1}, L_{t+1}^X)$. The following proposition describes the necessary conditions for this solution along the optimal path:

Proposition 2: In order for a trade agreement specifying $\{\tau_t, L_t^X, V_t\}$ *to maximize welfare subject to the payoff constraint (7) for specific factor owners in the import-competing sector, the following conditions must hold for all t:*

$$\frac{-\tau e_{22}(p)U}{e^{W}(\tau)} = \theta \Pi_{\tau}(1+\tau_t, L_t^X) \qquad (a)$$

$$R_{L^X}(1, L_t^X) + \theta \Pi_{L^X}(1+\tau_t, L_t^X) = \gamma\left[\frac{e^{W}(\tau_t)\left(L_t^X - L_{t-1}^X\right)}{\beta e^{W}(\tau_{t-1})} - \left(L_{t+1}^X - L_t^X\right)\right] \qquad (b)$$

(10)

where $\theta \equiv \Omega_V(V_{t+1}, L_{t+1}^X)$ *is constant for all t.*

The constancy of $\Omega_V(V_{t+1}, L_{t+1}^X)$ along the optimal path follows immediately from the envelope condition to the dynamic programming problem. It reflects the assumption of an infinite degree of intertemporal substitution for owners of the specific factor that is implicit in (9), so that only the present value of payoffs matters to specific factor owners. As in the static case, this means that the planner is effectively maximizing weighted social welfare, $U + \theta\Pi$, where the weight is chosen so that the constraint (9) holds with equality.

Equation (10a) characterizes the optimal tariff, and requires that the marginal deadweight loss from the tariff due to its distortion of trade patterns equal the marginal gain obtained from transferring income to the owners of the specific factor. The optimal tariff is positive when $\theta > 0$. Although this condition is the same as that obtained in the static model where labor market policies and tariffs were being used to redistribute income (equation (5a)), the actual chosen value may vary along the path in response to changes in L^X and U. Equation (10b) states that the difference in social marginal product of labor between the exportable and importable sector in period t should be equated to the social cost of postponing adjustment for another period. At the steady state, the right hand side of (10b) will be 0 and this condition coincides with that from the static case in (5b).

Condition (10a) can also be used to provide some insight about the time path of the tariff under the agreement. The right hand side of (8a) is decreasing in L^X, since a lower level of labor in the import-competing sector will reduce the rental on sector specific capital. This reduces the marginal return to increasing the tariff, suggesting that the benefit of increasing the tariff will be decreasing as the adjustment process proceeds. On the other hand, the cost of increasing the tariff (at a given τ_t) may also be changing due to changes in U along the optimal path. If U is increasing along the path, then this will raise the marginal deadweight loss and also provide an incentive to reduce the tariff.

Figure 1 provides a comparison of the path of labor adjustment and tariff in the case where the agreement maximizes national welfare (Proposition 1) with one where the planner makes a promise of compensation to specific owners in the import-competing sector. This example assumes Cobb Douglas functional forms for consumption and production, $U(C_1, C_2) = C_1^{.5}C_2^{.5}$ and $F(K,L) = K^{.25}L^{.75}$. $K = L = 1$, and $\lambda = .5$. This specification yields an autarkic relative price of 1.19, with half of the labor force being located in each sector. Figure 1a shows the adjustment path for labor, assuming $\gamma = 2$ and starting from an initial position in which $\tau = .1$ and $L_0^X = .58$. When lump sum transfers are available, the labor force in the exporting sector increases to the free trade level 2/3 , with the adjustment being accomplished in 7 periods. When lump sum transfers are not available, the steady state labor force is reduced to .656 and the adjustment occurs in 8 periods.[7] Figure 1b shows the path of tariffs in the two cases. The case with lump sum taxes yields free trade every period, while the case with tariffs and labor taxes yields a steady state tariff is .036. This tariff is reached after several periods of tariff reduction, which involve decreases from an initial starting value of .043. Thus, the pattern observed is consistent with the observation of tariffs declining over the life of an agreement, although the magnitude of the decline in this example is quite

[7]The steady state is reached in finite time because of the discreteness of the grid in the simulation.

modest.

B. Compensation without the Use of Labor Taxes

We now consider the case in which the planner does not have access to differential labor market taxes across sectors, so that the tariff is the only tool available to influence the location decisions of workers. Workers will move to the exportable sector if the difference in the present value of wages between sectors is sufficient to cover the cost of moving. In order for workers to be indifferent between moving and not moving at time t, we must have

$$\sum_{s=0}^{\infty}\left[R_{L^X}(1+\tau_{t+s}, L_{t+x}^X)\right]\beta^s - \gamma(L_t^X - L_{t-1}^X) = 0 \qquad \text{for all } t \tag{11}$$

An increase in the tariff at time t′ will thus reduce the incentive to move for workers in the import-competing sector for all t < t′.

The efficient trade agreement in this case is the sequence $\{\tau_t, L_t^X\}$ that maximizes $\sum_{t=0}^{\infty} U(\tau_t, L_t^X, \Delta L_t^X)\beta^t$, subject to (9) and (11). This problem can be formulated as the Lagrangean problem

$$\begin{aligned}&\sum_{t=0}^{\infty}\left\{U(\tau_t,L_t^X,\Delta L_t^X) + \theta\Pi(\tau_t,L_t^X) + \phi_t\left[\sum_{s=1}^{\infty}R_L(1+\tau_{t+s},L_{t+s}^X)\beta^s - \gamma\Delta L_t\right]\right\}\beta^t - \theta V_0 \\ &= \sum_{t=0}^{\infty}\left[U(\tau_t,L_t^X,\Delta L_t^X) + \theta\Pi(\tau_t,L_t^X) + \mu_t R_L(1+\tau_t,L_t^X) - \phi_t\,\gamma\Delta L_t\right]\beta^t - \theta V_0\end{aligned} \tag{12}$$

where θ is the multiplier for (7), ϕ_t is the multiplier for (9) at time t, and $\mu_t = \sum_{s=0}^{t-1}\phi_s$. Since workers are forward looking in their migration decision, the multiplier μ_t captures the impact of changes in the wage differential between sectors at time t on the migration decisions for all *s* < *t*. Defining Z_t = $\sum_{s=0}^{\infty} R_{L^X}(1+\tau_t,L_t^X)$ to be the discounted wage differential between sectors at time t, this problem can also be formulated recursively using the functional equation

$\Omega(Z_t, V_t, L_t^X) = \max_{L_{t+1}^X, \tau_t} U(\tau_t, L_t^X, \Delta L_t^X) + \beta\Omega(Z_{t+1}, V_{t+1}, L_{t+1}^X)$, subject to $Z_t - R_{L^X}(\tau_t, L_t^X) - \gamma\Delta L_t^X = 0$. In this case the planner is promising a level of wage differential to workers contemplating movement to the exportable sector as well as a level of compensation to owners of specific factors.

The necessary conditions for choice of τ_t and L_t^X to maximize (12) are

$$\frac{-\tau e_{22}(p)U}{e^W(p_t)} = \theta\Pi_\tau(1+\tau_t, L_t^X) - \mu_t F_L(\lambda K, \bar{L} - L_X^t) \qquad (a)$$

(13)

$$R_{L^X}(1, L_t^X) + \theta\Pi_{L^X}(1+\tau_t, L_t^X) + \mu_t R_{L^X L_X}(1, L_t^X) - \phi_t\gamma = \gamma\left[\frac{e^W(p_t)\left(L_t^X - L_{t-1}^X\right)}{\beta e^W(p_{t-1})} - \left(L_{t+1}^X - L_t^X\right)\right] \qquad (b)$$

These necessary conditions differ from those in (10) due to the introduction of the constraint (9), which reflects the fact that the only instrument available to influence the migration decision is the tariff. Therefore, we focus on how the introduction of this migration decision affects the necessary conditions.

Equation (13a) is the condition for determining the optimal tariff under a agreement. The second term on the right hand side reflects the fact that an increase in the tariff makes migration less attractive for all $s < t$, because it raises the wage in the import-competing sector relative to that in the exportable sector. When the migration constraint is binding for $s < t$, $\mu_t > 0$ and this term reflects an additional cost of raising the tariff. In the steady sta

One way to see this effect is to use compare the steady state values and initial values for this agreement using the same parameter values as in the example in Figure 1. The steady state level of the tariff for this case is .29, which is below that for the case where both tariffs and labor taxes are available. The tariff for the initial period, where $\mu_0 = 0$, will be identical to the value obtained for the case in Figure 1 where the tariff has no impact on the migration decision. This suggests that the decline in tariffs under the agreement will be larger in the case where only the tariff is covered in a trade agreement. It is also worth noting that the employment level in the exportable sector in the steady state when only tariffs are used is .641, which is actually lower than the value of .656 that was obtained when labor taxes are available. This differential reflects the fact that labor in sector 1 was subsidized when labor taxes were available, which results in a more efficient production outcome.

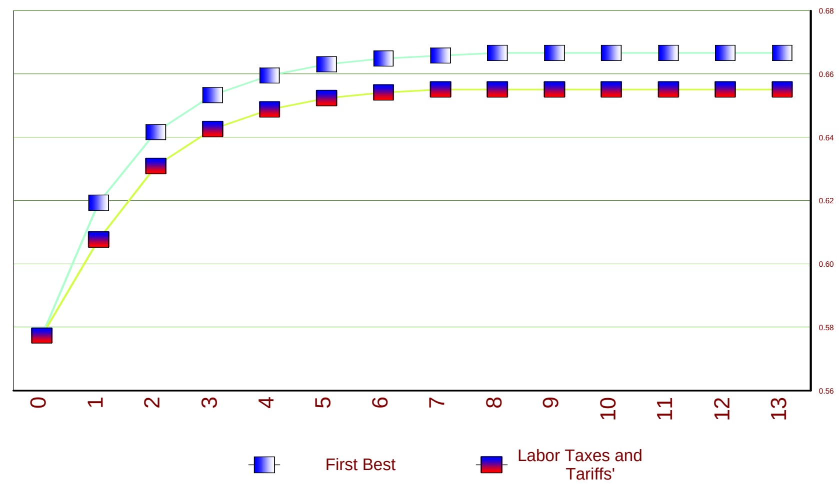

Figure 1a Comparison of Export Sector Employment Under First Best Policy and with Distortionary Taxes

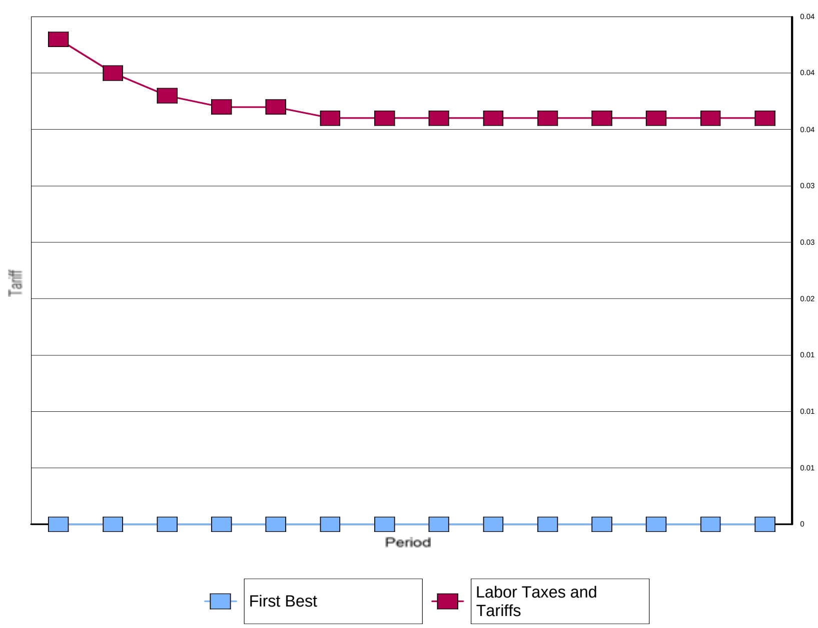

Figure 1b Tariffs Under First Best and with Distortionary Taxes

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