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## Can compensation save free trade? <sup>☆</sup>

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### Abstract

When the median voter loses from trade reform, liberalization is blocked. Allowing the electorate to vote for compensatory subsidies may reverse this outcome. However, the order of the agenda may matter. The winners who pay the compensation may be sufficiently powerful to block compensation if trade is first liberalized. Seeing the inevitable outcome of sequential votes, the median voter realizes he will not be compensated for his losses and opposes liberalization. In contrast, liberalization can be achieved if compensation is placed first on the agenda. Finally, there is a significant chance that the least efficient compensation scheme will be chosen.

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### 1. Introduction

Welfare economics generally, and the welfare economics of international trade in particular, has long understood that there is a close connection between liberalization and the need for compensation. While liberalization generally implies gains, it also implies adjustment, and, loosely speaking, the bigger the gains, the bigger the adjustment. For a country unable to influence its terms of trade, we have a sizable number of results, under quite general conditions,

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showing that free trade dominates limited trade and, under more restricted conditions, that existing forms of protection could be liberalized in such a way as to produce an increase in aggregate economic welfare. These results, however, rely on two fundamental abstractions: first, these are long-run/comparative static results that do not consider the short-run costs of adjustment from the distorted to the undistorted equilibrium; and, second, these results implicitly or explicitly assume that compensation is carried out in such a way as to ensure that a potential welfare gain is made actual. While both sorts of questions have produced research seeking to evaluate the robustness of gains from trade results to their concerns, in this paper we are interested in the positive political economy of the second question.<sup>1</sup>

The great majority of research on the positive political economy of domestic trade policy can be seen as an attempt to answer the question: if protection is so bad, why is there so much of it? The key result, presented most clearly in Mayer's (1984) fundamental paper: under the assumptions of the 2-good, 2-factor small HOS model, with heterogeneity in household factor ownership, and determination of equilibrium policy by simple referendum, except in the razor's edge case in which the median household factor ownership happens to be identical to that of the economy as a whole, free trade will not generally be an equilibrium policy.<sup>2</sup> This result, of course, relies on an assumption that the government does not possess a redistributive instrument (or does not choose to use it). Given the goals of that paper, and the plausible empirical claim that governments do not, in fact, seem to do much in the way of trade-contingent redistribution, this was an appropriate strategy.

In this paper, we follow Mayer's lead and adopt a referendum-based approach to the political economy of trade policy in which both protection and redistribution are essential components. Specifically, we construct a simple model in which a continuum of heterogeneous agents is inefficiently distributed between two industries due to protection. We assume that these agents face a choice between liberalization and protection, in which they will also choose whether to redistribute (some of) the gains from trade from (some of) the gainers to (some of) the losers. The particular institution involves three stages of voting: in the first stage, voters decide whether to liberalize trade. If liberalization is chosen, then in the second stage they vote on whether to provide compensation to the dislocated workers. Finally, if compensation is chosen, then in the third stage the workers vote on the method of compensation. We then compare the outcome of this political process with the outcome that would emerge if the only choices were uncompensated free trade or no liberalization. As in Mayer, the continuum assumption and the median voter framework allow us to focus on the fundamental question of policy choice/sustainability without getting bogged down in institutional details that have little claim to descriptive accuracy and even less claim to generating additional insight. That is, we can see the referendum as a reduced form for a more detailed representation of the political process.

In the context of this model, we address two interesting questions. First, would coupling trade liberalization measures with policies aimed at compensating dislocated workers increase the chances that free trade will emerge as the outcome of the political process? Many economists have argued that, in addition to moving trade liberalization in the direction of actual, as opposed to

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<sup>1</sup> See Davidson and Matusz (2004) for an overview and extension of research on the first question. Fundamental normative research on the second question goes back to debates on the status of potential gain criterion of the Kaldor–Hicks sort, eventually evolving into questions about the feasibility of, and limits to, various compensation schemes. Examples of this latter research include Dixit and Norman (1986), Kemp and Wan (1986), Brecher and Choudhri (1994), Feenstra and Lewis (1994), Hammond and Sempere (1995), Guesnerie (2001), and Spector (2001).

<sup>2</sup> For all of the massive boom in research on the political economy of trade policy, there is surprisingly little substantive content beyond this result.

simply potential, Pareto improvement, compensation makes liberalization politically more sustainable (Lawrence and Litan, 1986). However, most attempts to evaluate this claim proceed under the assumption that the government seeks to maximize national welfare, but is constrained politically in the pursuit of this goal (Feenstra and Bhagwati, 1982; Magee, 2003). Our approach proceeds by considering the simple referendum model in the institution described above.<sup>3</sup> Second, we ask whether or not the optimal compensation policy will be chosen if workers are allowed to vote on the design of that policy. In the context of our model, we consider three policies that have received some attention in the policy debates on compensation: unemployment compensation, wage subsidies, and employment subsidies. We show that in this model the wage subsidy is preferred to the other two policies on efficiency grounds and then ask whether the wage subsidy is preferred in the referendum.<sup>4</sup>

Our results offer much hope for those that favor compensating displaced workers; but, they also raise one small concern. On the positive side, we find that in many instances allowing for compensation increases the likelihood that liberalization will emerge as the equilibrium outcome regardless of the order of the agenda. There does, however, exist a non-trivial portion of the parameter space for which the sequencing of decisions determines the outcome. In this portion of the parameter space, liberalization can be achieved if compensation is agreed upon beforehand, but not if the vote to compensate post dates the vote to liberalize. Finally, the one new concern that we uncover has to do with the choice of the compensation policy. We find that in some instances in which the agents vote in favor of liberalization with compensation, they also select an inefficient compensation policy.

## 2. The model

### 2.1. Overview

We assume that labor is the only input, but workers differ by ability ( $a$ ). We assume that ability is uniformly distributed over the unit interval, implying that (with exceptions spelled out below) the worker for whom  $a=1/2$  is the median voter and is therefore decisive.

Workers can produce one of two goods. We refer to the first good as the “low-skill” good and assume that each worker, regardless of ability, can produce 1 unit of this good. We call the other good the “high-skill” good and assume that a worker with ability  $a$  can produce  $a$  units of this good. Workers are perfectly mobile across sectors and can immediately find employment in the low-skill sector, but must search for a job in the high-skill sector. We assume that time is continuous and that job offers arrive according to a Poisson process in the high-skill sector, with  $e$  representing the rate at which unemployed workers find jobs. Moreover, jobs in the high-skill sector do not last forever, with involuntary separations also following a Poisson process. We use  $b$  to denote the rate of job separation.

We assume that all markets are perfectly competitive and choose the high-skill good to serve as numeraire. All employed workers are paid the value of their marginal product.<sup>5</sup>

<sup>3</sup> We return to a comparison of our results with those of Feenstra/Bhagwati and Magee in the conclusion.

<sup>4</sup> In a slightly more complex model, Davidson and Matusz (2006) provide a detailed analysis of the relative efficiency of all three instruments.

<sup>5</sup> This assumption is used to ensure that the free trade equilibrium will be efficient. As is well known, search models are generally rife with externalities generated by the search process. We want to make sure that our results are not driven by how different compensation policies affect these search-related externalities.

We assume that the country under study has a comparative advantage in the high-skill good, and that the initial equilibrium (status quo) is distorted by a tariff levied on imports of the low-skill good. Following Mayer (1984), we assume that tariff revenue is neutral in that it is rebated to workers in proportion to their wage income. We describe below how the tariff rate is initially determined.

We only consider a subset of all possible parameterizations of the model. In particular, we are interested in exploring situations in which the median voter is initially employed in the protected low-skill sector and decides to switch sectors and search for a high-skill job in the event of liberalization. That is, we are interested in situations where the group of trade-displaced workers includes the median voter. It will become evident as we present the details of the model that other parameterizations are less interesting. For example, if the median voter is initially employed in the export sector, the status quo will be characterized by free trade (see below), and policies aimed at compensating trade-displaced workers cannot affect the political equilibrium if the median voter is trapped in the import-competing sector subsequent to liberalization.

To determine the status quo, we note that each worker has a most-preferred tariff. There are three groups that we must consider. First, there are those who would choose to work in the import-competing sector under free trade. For these workers, there exists a strictly positive tariff  $\tilde{t}$  which leads to their globally optimal outcome. This is due to the fact that a tariff raises the wage of a worker in the import-competing sector and (to a point) increases tariff revenue. Thus,  $\tilde{t}$  is higher than the tariff that maximizes tariff revenue. Indeed, the optimal tariff for these workers may be prohibitive, but need not be if tariff revenue constitutes a significant portion of income. Note that  $\tilde{t}$  is independent of ability since the import-competing wage does not depend on ability.

The second group consists of the workers that would choose to seek employment in the export sector with  $\tilde{t}$  in place. For this group, a zero tariff always leads to their most-preferred outcome.

This leaves us with the third group: those that would seek employment in the export sector under free trade but would work in the import-competing sector when the tariff is set at  $\tilde{t}$ . For these workers, preferences are not single-peaked and the optimal outcome is found by comparing utility with  $\tilde{t}$  in place with utility under free trade.

To summarize to this point,  $\tilde{t}$  and 0 are two obvious candidates for the status-quo tariff. Since we are concerned with the problem of liberalization, we assume that the status-quo tariff is  $\tilde{t}$ . With trade preferences determined by the median voter, this will in fact be the status-quo tariff if the median worker prefers  $\tilde{t}$  over free trade. In this case, a simple referendum on liberalization unaccompanied by any compensating policies is doomed to fail.

However, there are parameterizations of the model for which the globally optimal tariff for the median worker is zero. Consequently a referendum on liberalization will succeed even in the absence of compensating policies. In these cases, we can justify our assumption that the status-quo tariff is  $\tilde{t}$  in a variety of ways. For example, we could appeal to an un-modeled history where the initial distribution of ability may have been skewed in favor of low-skill workers, where import-competing workers may have had political power disproportionate to their numbers, or where the government may have had some non-economic objective for protecting the low-skill sector. Alternatively, this could be viewed as a short cut to a more complicated problem in which the economy recently experienced a significant improvement in the terms of trade, causing the median worker to switch his preference in favour of uncompensated liberalization. In this latter case, the status-quo tariff would differ slightly from the value of the status-quo tariff modelled in this paper (in that it would depend on the initial terms of trade), but the substance of the analysis would not be affected.

Starting from the status quo, we consider a series of votes. The first vote is on the issue of trade liberalization, consisting of complete removal of the initial tariff. If the majority votes for

liberalization, a second vote occurs. The issue addressed by the second referendum is whether displaced workers ought to be compensated for their losses. If the majority votes in favor of compensation, a final vote is held to select the instrument by which compensation is undertaken. As usual, the solution method requires us to start at the end of the process and work backwards. In most cases, the order of the vote is irrelevant. However, we highlight one case where the agenda does indeed matter.

## 2.2. Status-quo equilibrium

Workers choose between finding a low-paying job with certainty in the low-skill sector or searching for a high-paying job in the high-skill sector. Our assumption that tariff revenue is rebated to workers in proportion to their wage implies that the distribution of tariff revenue does not distort this decision, though the tariff itself clearly does create a distortion.

In order to determine the allocation of workers between sectors, we first begin by formulating the asset–value equations for each group of workers: those employed in a low-skill job (L), those who are unemployed and looking for a high-skill job (U), and those employed in a high-skill job (H). In doing so, we use  $w_i(a)$  to denote the ability-specific wage, measured in terms of the numeraire, paid to a sector  $i$  worker, where  $i=L,H$ , and we simplify the exposition by assuming that all workers have identical, Cobb–Douglas preferences, spending a fraction of their income ( $\beta \leq 1$ ) on the low-skill good and their remaining income on the high-skill good. Defining the discount rate as  $\rho$ , the asset–value equations are then written as

$$\rho V_L(a, P_{sq}) = w_L(a)(1+r)P_{sq}^{-\beta} \quad (1.a)$$

$$\rho V_U(a, P_{sq}) = e[V_H - V_U] \quad (2.a)$$

$$\rho V_H(a, P_{sq}) = w_H(a)(1+r)P_{sq}^{-\beta} - b[V_H - V_U] \quad (3.a)$$

where  $P_{sq}$  is the status-quo price (i.e., the domestic price inclusive of the tariff  $\tilde{t}$ ),  $P_{sq}^{-\beta}$  is the price index, and  $r$  is the ratio of tariff revenue to total wages. Each of the above equations is formulated in the standard way, namely the right hand side of each represents the instantaneous real income earned by the worker adjusted for expected capital gains or losses.

The status-quo tariff is implicitly defined by the difference between the status-quo price and the free-trade price ( $P_{ft}$ ) of the low-skill good. Moreover, given the world price,  $r$  is clearly a function of the status-quo price. For example, tariff revenue is zero (and therefore  $r=0$ ) if the status-quo price equals the autarky price (a prohibitive tariff) or the world price (free trade).

Using the assumptions  $w_L(a)=P_{sq}$  and  $w_H(a)=a$ , we can solve Eqs. (1.a), (2.a), and (3.a) to obtain:

$$V_L(a, P_{sq}) = (1+r) \frac{P_{sq}^{1-\beta}}{\rho} \quad (1.b)$$

$$V_U(a, P_{sq}) = (1+r) \frac{e}{\rho + b + e} \frac{aP_{sq}^{-\beta}}{\rho} \quad (2.b)$$

$$V_H(a, P_{sq}) = (1+r) \frac{\rho + e}{\rho + b + e} \frac{aP_{sq}^{-\beta}}{\rho} \quad (3.b)$$

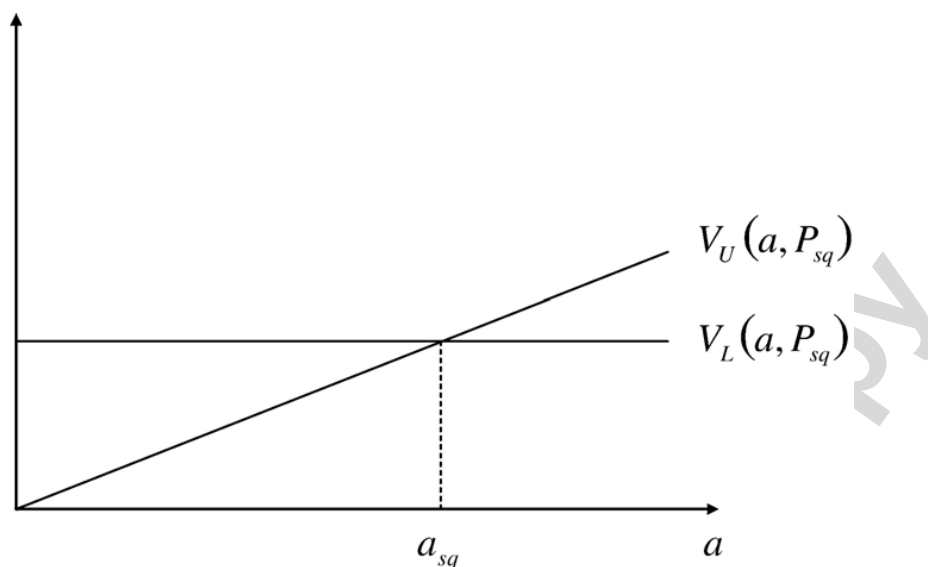


Fig. 1. Determining the status-quo distribution of workers.

Equating Eq. (1.b) with Eq. (2.b), we solve for the ability of the marginal worker who, given the status-quo price, is just indifferent between working in the low-skill sector (earning  $V_L$ ) or searching for a job in the high-skill sector (earning  $V_U$ ). Defining this marginal worker's ability as  $a_{sq}$ , we have:

$$a_{sq}(P_{sq}) = \frac{\rho + b + e}{e} P_{sq}. \quad (4)$$

Workers with less ability choose to work in the low-skill sector, those with higher ability are either looking for a job in the high-skill sector or are actually employed in that sector. This outcome is illustrated in Fig. 1, where we graph Eqs. (1.b) and (2.b) as functions of worker ability, taking as given the parameters of the model and the status-quo price.

For purposes of numeric analysis, we set the status-quo price equal to the price that would maximize present discounted utility for a low-skill worker. Our choice is based on the assumption that the median worker is employed in the low-skill sector in the status quo. That is, we only look at parameterizations such that  $a_{sq} \geq 1/2$ . From Eq. (1.b), it is clear that the real wage of a low-skill worker is monotonically increasing in the status-quo price, but tariff revenue first increases and then decreases as the domestic price increases from equality with the world price to the autarky price. The status-quo price therefore lies between the price that maximizes tariff revenue and the autarky price. While there is no closed-form solution for this price, it can be shown that the status-quo price is implicitly a function of  $P_{ft}$  and  $\beta$ .<sup>6</sup> We lighten the notation by suppressing this functional dependence.

### 3. Liberalization and compensation

Suppose that this economy now liberalizes trade, allowing the domestic relative price to fall to the exogenously-given free-trade price. We illustrate in Fig. 2 the resource-allocation and welfare

<sup>6</sup> In our numeric analysis, we solve for the *status-quo* price for every parameter pair by first calculating the equilibrium outcome (including tariff revenue) as a function of  $P_{sq}$ ,  $P_{ft}$  and  $\beta$ . We then allocate aggregate tariff revenue (found as the difference between domestic and world prices multiplied by the quantity of imports) to workers in proportion to their wage income. Finally, we search over all  $P_{sq}$  to find the value that maximizes the utility of a worker employed in the low-skill sector.

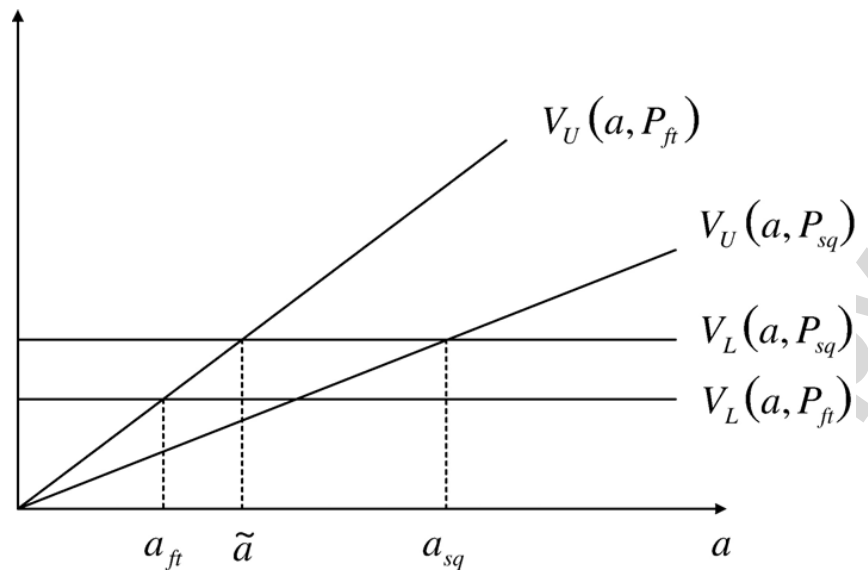


Fig. 2. Effects of liberalization.

effects of uncompensated liberalization. Clearly, low-skill employment now generates lower discounted utility than before since liberalization simultaneously reduces the real wage and removes any tariff revenue that low-skill workers might have been receiving in the status quo. In contrast, high-skill workers benefit from liberalization. This necessarily follows since liberalization benefits the economy as a whole (there are no distortions other than the tariff) and the only other group in the economy is harmed by liberalization.

We use  $a_{ft}$  to represent the ability of the marginal worker who is just indifferent between sectors under a regime of free trade. This value is calculated by substituting the free trade price into the right hand side of Eq. (4).

Several different groups of workers can be identified in Fig. 2. All workers with  $a > a_{sq}$  unambiguously benefit from liberalization. These workers are originally tied to the high-skill sector (either employed or searching for a job) and remain there after liberalization. We refer to this group of workers as the “incumbents”. On the opposite end, all workers with  $a < a_{ft}$  are harmed by liberalization. Their real wage decreases and they receive no tariff revenue. Moreover, their ability is too low to make it worthwhile to switch sectors. These workers are trapped in the low-skill sector. We refer to this group as the “stayers”. Finally, we refer to those with ability  $a \in [a_{ft}, a_{sq}]$  as “trade-displaced” workers, an expression in line with the terminology used by Jacobson et al. (1993), Kletzer (2001) and others who have attempted to measure the financial impact that globalization has had on this group of workers. Among trade-displaced workers, those with  $a \in [a_{ft}, \tilde{a}]$  are harmed by liberalization, while the remaining workers in this group benefit. That is, trade-displaced workers with lower ability can soften the blow of liberalization by switching sectors, but they cannot completely eliminate their losses. However higher-ability trade-displaced workers actually benefit. This is entirely consistent with Kletzer’s (2001) empirical findings.<sup>7</sup>

Some of the losses suffered by the trade displaced workers are due to the adjustment costs that they must incur to switch occupations. We have chosen to model these adjustment costs in the form of search costs, but, in reality, these workers often face retraining and other costs as well.

<sup>7</sup> Kletzer (2001) reports that more than one third of re-employed workers earn the same or higher wages at their new job compared with their pre-displacement job.



Recent research suggests that these costs may be significant. For example, [Jacobson, LaLonde and Sullivan \(1993\)](#) found that the average dislocated worker suffers a loss in lifetime income of roughly \$80,000 (see also [Kletzer, 2001](#)). Concerns about the magnitude of these costs have led many in the policy community to call for programs aimed at compensating these workers for their losses.<sup>8</sup> For this reason, in this paper we restrict attention to programs aimed at compensating all trade displaced workers for the losses they incur due to liberalization. That is, we do not consider policies aimed at compensating those that remained trapped in the previously protected sector. However, it should be clear that our analysis can easily be extended to consider the policy implications of compensating those trapped in the low-skill sector.

The primary policy used for compensation in the U.S. is trade adjustment assistance (TAA) which is essentially an extension of unemployment insurance for trade displaced workers. This program has been criticized in the policy community because of its unintended consequences: since unemployment insurance lowers the cost of remaining unemployed, it tends to lengthen jobless spells. Many in the policy community have suggested replacing TAA with a wage subsidy program (often referred to as ‘wage insurance’), a program that rewards workers for finding new jobs and encourages them to return to work relatively quickly.<sup>9</sup> Following the success of the “reemployment bonus experiments” sponsored by the federal government during the 1980s, others have argued in favor of employment subsidies (often referred to as ‘reemployment bonuses’).<sup>10</sup> For example, a reemployment bonus program was included in President Clinton’s 1996 Workforce Investment Act and the Bush Administration recently introduced legislation (referred to as the ‘Growth and Jobs Plan’) that includes provisions for the establishment of “personal reemployment accounts” which would provide cash bonuses for unemployed workers who return to work within 13 weeks of losing their jobs.

The challenge for the government is to craft policies that fully compensate all trade-displaced workers and that can be implemented with minimal information.<sup>11</sup> In this paper we focus attention on the program currently in use (TAA) and the two types of programs that have been suggested: wage subsidies and employment subsidies. Thus, we consider three distinct policies: unemployment compensation ( $\mu$ ), an employment subsidy ( $\eta$ ) or a wage subsidy ( $\omega$ ). To the extent that unemployment benefits are based upon a worker’s previous wage, they are, in this model, independent of the displaced worker’s ability (all displaced workers earn the same wage in the status quo). Similarly, the magnitude of the employment subsidy is independent of ability. In this sense, the two policies are isomorphic. However, at least some workers have incentive to “cheat” with unemployment compensation. For example, unemployment compensation is likely to be higher than the value of the marginal product of labor for the lowest ability workers, suggesting a strong incentive to remain unemployed even when a job offer arrives. We therefore

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<sup>8</sup> See, for example, [Baily et al., 1993](#); [Jacobson et al., 1993](#); [Brander and Spencer, 1994](#); [Brecher and Choudhri, 1994](#); [Feenstra and Lewis, 1994](#); [Burtless et al., 1998](#); [Parsons, 2000](#); [Hufbauer and Goodrich, 2001](#); [Kletzer, 2001](#); [Kletzer and Litan, 2001](#).

<sup>9</sup> See the papers referenced in the previous footnote.

<sup>10</sup> For more on the reemployment bonus experiments see [Woodbury and Spiegelman \(1987\)](#) or [Robins and Spiegelman \(2001\)](#).

<sup>11</sup> In our simple two-sector model it would be fairly easy for a government to implement a [Dixit and Norman \(1986\)](#) type of scheme whereby consumption taxes are levied so that consumers face pre-liberalization prices while producers face world prices. The resulting budget surplus could then be redistributed among all consumers to generate a Pareto gain. However, the complexity of this sort of scheme increases dramatically as the number of goods expands. By comparison, the complexity of a system of worker subsidies is relatively insensitive to the number of goods. The primary reason for the difference lies in the very demanding informational requirements for the former policy.

argue in the next section that unemployment compensation will never be the outcome of the political equilibrium and confine our analysis to a comparison of wage and employment subsidies.<sup>12</sup>

Policies can either be permanent or temporary. From the point of view of the recipient, all that matters is the expected discounted value of the subsidy, taking any expected termination into account. In the numeric examples constructed for this paper, we model policies as temporary. In particular, we assume that each subsidy (wage or employment) is given only to a displaced worker during his first spell of employment subsequent to liberalization. One can show that expected discounted utility for a displaced worker searching for his first job subsequent to liberalization is then<sup>13</sup>

$$V_{U\eta}(a, P_{ft}) = \left[ \frac{\rho}{\rho + b}(a + \eta) + \frac{b}{\rho + b} \frac{e}{\rho + e + b} a \right] \left[ \frac{e}{\rho + e} \right] \frac{P_{ft}^{-\alpha}}{\rho} \quad (5.a)$$

$$V_{U\omega}(a, P_{ft}) = \left[ \frac{\rho}{\rho + b}(1 + \omega) + \frac{b}{\rho + b} \frac{e}{\rho + e + b} \right] \left[ \frac{e}{\rho + e} \right] \frac{aP_{ft}^{-\alpha}}{\rho} \quad (5.b)$$

where the subscript signifies either an employment subsidy ( $\eta$ ) or wage subsidy ( $\omega$ ).

All trade-displaced workers are unemployed immediately subsequent to liberalization. All compensation packages work by increasing the discounted utility for unemployed workers. The idea is to choose the size of the policy parameter (e.g., the magnitude of  $\eta$ , the employment subsidy) such that the worker with ability  $a_{ft}$  is indifferent between searching for a high-skill job under free trade and being employed in the low-skill sector when that sector is protected by a tariff. The effects of the two compensating policies are illustrated in Fig. 3.

The employment subsidy results in a parallel upward shift of the curve representing the discounted utility earned by an unemployed worker. This follows from the observation noted above that the employment subsidy does not depend upon worker ability. In contrast, the wage subsidy shifts this curve up while simultaneously increasing its slope. In this case, the marginal trade-displaced worker earns a wage of  $a_{ft}(1 + \omega)$  while the subsidy is in effect. Each displaced worker is subsidized by the same percentage, implying that the actual magnitude of the subsidy increases with ability.

We assume that compensation is calibrated to the marginal trade-displaced worker, but it is given to any worker who switches sectors subsequent to liberalization. This gives rise to a class of policy-displaced workers: that is, workers who would continue to maintain employment in the low-skill sector in the absence of compensation, but who find that searching for a job in the high-skill sector is more attractive if compensation is being offered.<sup>14</sup>

In terms of Fig. 3, all workers with ability  $a \in [a_{\omega}, a_{ft}]$  are characterized as policy-displaced if a wage subsidy is used to compensate trade-displaced workers, while an employment subsidy expands this set to include all of those workers with  $a \in [a_{\eta}, a_{\omega}]$ .

<sup>12</sup> Unemployment compensation would be isomorphic to a wage subsidy if the marginal product of workers varies with ability in both sectors and if unemployment compensation is related to a worker's wage prior to the spell of unemployment. This case was modeled in Davidson and Matusz (2006). It would still be the case, however, that some recipients of unemployment compensation would find it in their interest to cheat, suggesting that a majority would always prefer a wage subsidy to unemployment compensation in this case.

<sup>13</sup> See Appendix A for details.

<sup>14</sup> Davidson and Matusz (2006) refer to these workers as *temporary movers* because they return to the low-skill sector once their initial spell of high-skill employment terminates.

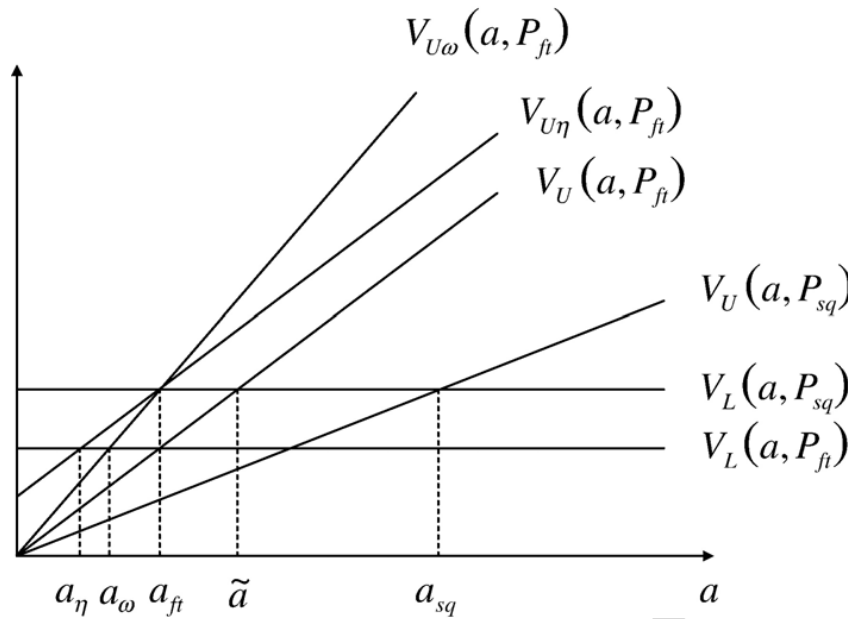


Fig. 3. Liberalization with compensation.

The creation of policy-displaced workers distorts the equilibrium, partially offsetting the gross gain from liberalization. This raises two questions. First, what is the most efficient way to compensate displaced workers? That is, which policy creates the smallest distortion while fully compensating the marginal trade-displaced worker? Second, could the deadweight loss generated by the compensation policy outweigh the gains from free trade? Both of these issues are addressed in Davidson and Matusz (2006). Regarding the second issue, while it is clearly an empirical question as to whether the distortion is larger or smaller than the gross gain from liberalization, Davidson and Matusz (2006) show that it is highly unlikely that the distortion can outweigh the gross gain. In any event, the net gain from liberalization is always positive for all of the parameterizations explored in this paper.

As for the first issue, Davidson and Matusz (2006) show that a wage subsidy program is the most efficient way to compensate trade displaced workers. While it is not quite this simple, the gist of the argument is as follows: since it is the creation of the policy-displaced workers that creates the distortion, then for any given compensation goal, the program that generates the smallest group of policy displaced workers is the most efficient policy. Fig. 3 shows that the wage subsidy is therefore superior to the employment subsidy, since it leads to a smaller set of policy-displaced workers.

Clearly, the compensation that we are analyzing has to be net of any taxes paid in order to effectively increase the discounted utility of trade-displaced workers. It is simplest, therefore, to assume that this group of workers is untaxed. Moreover, it seems unreasonable to tax stayers, who have lower income than trade-displaced workers. Therefore, all taxes used to pay for compensation come from the group of incumbents.<sup>15</sup> In essence, our tax scheme is a stylized progressive income tax where the marginal tax rate is zero for workers with income below some

<sup>15</sup> This is an entirely innocuous assumption. We could assume instead, as we did in Davidson and Matusz (2006), that the compensation scheme is financed by taxing all workers at a constant marginal rate without altering our qualitative results.

critical wage and  $t > 0$  for workers with higher income.<sup>16</sup> The results of our numeric example follow directly as long as the critical wage is below  $a_{sq}$ .<sup>17</sup>

#### 4. Preferences over policies

We start by assuming that two votes have been completed, resulting in a majority of voters opting for compensated liberalization. The third vote determines the form of compensation.

We argue that unemployment compensation, which is currently the primary instrument used to compensate trade displaced workers (through TAA), will never be the choice for the majority. Unemployment compensation and the employment subsidy both have the same effect on the utility of a trade-displaced worker; hence trade-displaced workers are indifferent between these two policies.<sup>18</sup> The two policies differ, however, for at least some policy-displaced workers. In instances in which the expected duration of unemployment is short relative to the expected duration of a high-skill job, the magnitude of the unemployment benefit necessary to fully compensate the marginal trade displaced worker is likely higher than the wage that would be earned by a low-ability worker employed in a high-skill job. Indeed, this compensation may even be higher than the low-skill wage. As such, there may be some workers who would continue to collect unemployment benefits for as long as possible; refusing any job offers that might come their way. Unless the unemployment program is perfectly monitored, the ultimate cost of providing fully compensating unemployment benefits will exceed the cost of a fully-compensating employment subsidy. By offering a slightly higher employment subsidy, incumbents can entice trade-displaced workers to vote for an employment subsidy over unemployment compensation. These two groups together constitute more than half of the population. As such, we eliminate unemployment compensation from further consideration, focusing instead on comparing the wage and employment subsidies.

We next observe that workers with  $a \in [0, a_\eta]$  have no stake in the outcome of the political process. These workers do not pay taxes nor do they receive compensation. Therefore the voting population consists only of workers with  $a \in [a_\eta, 1]$ . Trade-displaced workers clearly prefer the wage subsidy, since this generates a larger transfer than the fully-compensating employment subsidy for all but the marginal trade-displaced worker. On the other side, workers with  $a \in [a_\eta, a_{ft}]$  prefer the employment subsidy, since this policy generates for them a larger transfer than the equivalent wage subsidy (see Fig. 3). Incumbents prefer the policy that generates the smallest aggregate subsidy, since this generates the smallest tax burden. While the wage subsidy is more generous to trade-displaced workers, an employment subsidy creates more policy-displaced workers, raising the aggregate cost of the transfer. In the next section (and Appendix A), we show that it is possible to divide the parameter space such that incumbents prefer the wage subsidy for

<sup>16</sup> A worker in the high-tech sector who faces the positive marginal tax rate has a net wage of  $a(1-t)$ . Eqs. (2.b) and (3. b) are then simply modified by multiplying the right hand side of each by  $(1-t)$ .

<sup>17</sup> Workers with ability between  $a_{ft}$  and  $a_{sq}$  are net recipients of transfers, and therefore are unaffected by the tax structure. Those with ability below  $a_{ft}$  care about the tax structure, but the tax structure itself does not change their ranking of policy instruments, nor does it change their preferences regarding the status quo versus liberalization. Liberalization becomes more difficult if the critical value is above  $a_{sq}$ , since a smaller share of the population bears the burden of compensation. It is conceivable in this case that the magnitude of the transfer is larger than the gross gain from liberalization that is captured by this group of taxpayers, inducing them to vote against liberalization in instances where they foresee a majority in favor of compensation. We leave analysis of this case for future work.

<sup>18</sup> See Davidson and Matusz (2006) for a more complete discussion of the equivalency of various compensation policies.

one set of parameters, while preferring the employment subsidy for another set of parameters. Our numeric exercise indicates that none of the three groups form a majority on their own, therefore the preferences of incumbents are decisive in this vote.

We now back up to the vote on whether compensation should be offered, assuming that liberalization has been approved. Rational agents look forward to see the form of compensation that would be offered in the event that a majority favors compensation. If the perfect-foresight outcome is an employment subsidy, all workers with  $a \in [a_\eta, a_{sq}]$  prefer compensation, while all incumbents oppose it. The remaining workers have no stake in the outcome, since they do not pay taxes nor receive compensation. The outcome is only modestly different if the perfect-foresight outcome is a wage subsidy, in which case all workers with  $a \in [a_\omega, a_{sq}]$  prefer compensation, all incumbents continue to oppose it, and the remainder are indifferent.

Finally, consider the vote on whether or not to liberalize. Forward-looking agents anticipate whether or not compensation will be offered. They also anticipate the form that the compensation will take in the event that it is offered. Workers with  $a \in [0, a_{ft}]$  lose relative to the status quo even when compensation is offered; therefore these workers always oppose liberalization. Workers with  $a \in [a_{ft}, \tilde{a}]$  join in the opposition in the event that compensation is not offered, while all remaining workers support liberalization. All trade-displaced workers with  $a \in [a_{ft}, a_{sq}]$  support liberalization with compensation, regardless of the form that the compensation takes. Incumbents join in support for liberalization if the total transfer required under compensation is smaller than the gross gains from liberalization that accrue to them.

## 5. Constructing the parameter space

The nature of the political equilibrium depends on the parameters of the model. Taking labor market turnover rates and the discount rate as given,  $a_\eta$ ,  $a_\omega$ ,  $a_{ft}$ ,  $\tilde{a}$ , and  $a_{sq}$  can all be written as functions of the free trade price ( $P_{ft}$ ) and the preference parameter ( $\beta$ ).

In order to focus on situations where the group of displaced workers contains  $a=1/2$ , we have to limit the range of  $P_{ft}$ . If  $P_{ft}$  is too high, the worker with  $a=1/2$  would prefer to remain in the low-skill sector after liberalization, and if  $P_{ft}$  is too low, that worker would locate in the high-skill sector even under the status quo. Therefore, we assume that  $P_{min} \leq P_{ft} \leq P_{max}$ . The maximum price is the price at which the worker with  $a=1/2$  is just indifferent between low-skill employment and searching for a high-skill job under free trade, and is found by replacing  $a_{sq}(P_{sq})$  in Eq. (4) with  $1/2$  and letting  $P_{sq}=P_{max}$ , so that

$$P_{max} = \frac{1}{2} \frac{e}{\rho + e + b}. \quad (6)$$

The minimum price is the price at which the worker with  $a=1/2$  is just indifferent between low-skill employment and searching for a high-skill job assuming that this worker's most-preferred tariff is levied. To solve for this price, we first observe that if the autarky price ( $P_a$ ) is too low, even a prohibitive tariff could not dissuade a worker with  $a=1/2$  from seeking employment in the high-skill sector. We show in Appendix A that

$$P_a(\beta) = \sqrt{\frac{e}{\rho + b + e}} \sqrt{\frac{\beta e}{(2-\beta)(b+e) + \beta \rho}} \quad (7)$$

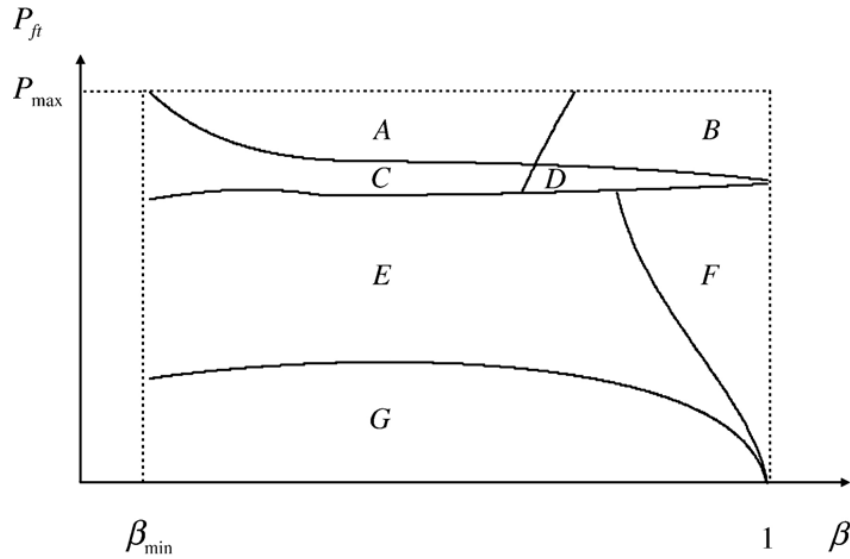


Fig. 4. Division of the parameter space.

so that the autarky price is increasing in the preference parameter. A minimum value of the autarky price therefore translates to a minimum bound on  $\beta$ , which can be found by replacing  $a_{sq}(P_{sq})$  in Eq. (4) with  $1/2$  and letting  $P_{sq} = P_a(\beta)$ . Doing so and solving for  $\beta$ , we obtain

$$\beta_{\min} = \frac{2(b+e)}{3\rho + 5(b+e)}. \quad (8)$$

We can then use Eq. (4) to solve for  $P_{\min}$  when  $\beta > \beta_{\min}$ . To see this, first recall that  $P_{sq}$  depends upon  $P_{ft}$  and  $\beta$ . Then  $P_{\min}$  is a function of  $\beta$  and is implicitly defined as the free trade price that solves Eq. (4) when  $a_{sq} = 1/2$ .

Note that  $P_{\max} = P_a(\beta_{\min})$ , from which it follows that  $P_{\max} \leq P_a(\beta)$  for all  $\beta \geq \beta_{\min}$  since the autarky price is increasing in  $\beta$ . Therefore, our restrictions guarantee that  $P_{ft} \leq P_a(\beta)$  for all  $\beta \geq \beta_{\min}$  so that the economy has a comparative advantage in the high-skill good.

Finally, for every  $\beta$  there exists a free trade price at which the worker for whom  $a = 1/2$  is indifferent between the status quo and uncompensated free trade. Let  $P_I(\beta)$  represent this price. Then  $P_I(\beta)$  is implicitly defined as the solution to  $V_U(a, P_{ft}) = V_L(a, P_{sq})$  evaluated at  $a = 1/2$ , where we once again recognize that  $P_{sq}$  depends upon both  $P_{ft}$  and  $\beta$ . The median worker strictly prefers the status quo (uncompensated liberalization) for  $P_{ft} > (<) P_I(\beta)$ . This follows because the status-quo price is chosen to maximize discounted utility, so a small change in the free trade price has only a second-order effect on discounted utility of a low-skill worker under the status quo, whereas the utility of a high-skill worker is strictly decreasing in  $P_{ft}$ .

We illustrate the relevant parameter space in Fig. 4, which we divide into seven regions. This figure was computer generated based on a particular parameterization of the model, however experimentation with a wide range of parameters suggests that the qualitative features of the figure are not sensitive to the choice of parameters.<sup>19</sup>

<sup>19</sup> Specifically, we constructed this figure assuming that  $\rho = 0.05$ ,  $b = 0.1$ , and  $e = 4$ . The parameter value for  $b$  implies that the expected duration of a high-skill job is 10 years, while the parameter for  $e$  suggests that the expected duration of a spell of unemployment is 3 months.

Region G in Fig. 4 represents combinations of  $P_{ft}$  and  $\beta$  for which the median worker would locate in the high-skill sector under the status quo (and remain there after liberalization). In contrast, in regions A–F the median worker starts out in the low-skill sector and moves to the high-skill sector after liberalization. The border dividing G from E is defined by  $P_{\min}(\beta)$ . For our purposes, G is uninteresting, since a majority of agents would clearly prefer uncompensated liberalization. We therefore restrict attention to A–F for the remainder of the paper.

In regions C, D, E, and F the median worker would prefer uncompensated liberalization to the status quo; whereas in regions A and B, the median worker would prefer the status quo to uncompensated liberalization.<sup>20</sup> The border separating C and D from A and B (respectively) is defined by  $P_1(\beta)$ . It follows that a simple referendum on liberalization would result in free trade in C–F and the status quo in A and B. It follows that if the parameters lie in A or B, liberalization can only be obtained as a political outcome if compensation is provided to displaced workers.<sup>21</sup>

Finally, we turn to preferences over compensation policies. As we noted in the previous section, we need to know how the magnitude of the aggregate transfer associated with an employment subsidy compares with that associated with a wage subsidy in order to determine the incumbents' preferences over the compensation programs. In contrast, we know that trade-displaced workers always prefer the wage subsidy, whereas policy-displaced workers always prefer the employment subsidy.

The border separating regions E and F from C and D (respectively) is defined as the set of parameters for which the two policies generate the same discounted value of the transfer.<sup>22</sup> The employment subsidy generates a smaller aggregate transfer for all parameter combinations lying above this border, with the wage subsidy generating the smaller transfer for all combinations lying below this border. Therefore, incumbents prefer the employment subsidy if parameters lie in regions A, B, C, or D, while they prefer the wage subsidy otherwise.

## 6. The political equilibrium

We now combine information on policy preferences with information summarized in Fig. 4 to solve for the equilibrium outcome. As noted earlier, the solution technique is backwards induction.

Suppose that the majority has already voted in favor of compensated liberalization. All that remains is to determine the form of the compensation program. In describing policy preferences, we argued that all trade-displaced workers (of whom there are  $a_{sq} - a_{ft}$ ) prefer the wage subsidy, while all policy-displaced workers (of whom there are  $a_{ft} - a_{\eta}$ ) prefer the employment subsidy. Since those trapped in low-skill jobs are not affected by the form of compensation, they do not vote, implying that the voting population consists of  $1 - a_{\eta}$  workers. In all of our numeric analysis, neither trade-displaced workers nor policy-displaced workers alone form a majority of this population. The policy that wins the majority is therefore the policy

<sup>20</sup> Refer back to our discussion in Section 2.1 where we justify the initial tariff in C, D, E, and F as a legacy from past circumstances.

<sup>21</sup> The existence of regions A and B indicates that, as Mayer (1984) emphasized, free trade may not be the equilibrium outcome when the median voter's preferences determine trade policy. Our approach here is a bit different from Mayer's. In his model, agents have preferences over tariffs and he shows that the equilibrium tariff is the one preferred by the median voter. Since this tariff is zero only if the median voter's factor ownership is identical to that of the economy as a whole, his result is that free trade is not likely to be the outcome when agents vote on the level of protection. In contrast, we are assuming that protection is already in place and ask under what conditions society will choose to liberalize.

<sup>22</sup> In Appendix A we show how to solve for this border.

avored by the group of incumbents who align themselves with trade-displaced workers if parameters lie in regions E or F (where the wage subsidy is less costly to finance), or align themselves with policy-displaced workers if parameters fall into regions A, B, C, or D (where the employment subsidy is less costly).<sup>23</sup>

Knowing the outcome of the final stage of voting, we now step back to ask whether a majority would favor compensation in the event of liberalization. There are two cases to consider. Suppose first that parameters lie in A, B, C, or D, so that the final stage of voting results in an employment subsidy. In this case, workers with  $a \in [a_\eta, a_{sq}]$  favor compensation, while those with  $a > a_{sq}$  are opposed. Workers at the very bottom of the ability distribution have no stake in the outcome, since they would not be affected either way. The border in Fig. 4 that divides regions A and C from regions B and D (respectively) is defined as the set of parameters for which  $1 - a_{sq} = a_{sq} - a_\eta$ . If the parameters lie in B or D, displaced workers constitute a majority of the voting population and therefore compensation will be approved, whereas compensation will be defeated if the parameters lie in regions A or C.

Similar reasoning separates E from F. The difference here is that the wage subsidy will carry the day in the event that compensation is approved. Under these circumstances, workers with  $a < a_\omega$  have no stake in the outcome, so the voting population is smaller. The border between E and F is therefore the set of parameters for which  $1 - a_{sq} = a_{sq} - a_\omega$ . Displaced workers have a majority if parameters fall in F, whereas the incumbents are in the majority if the parameters fall in E.

To summarize to this point, no compensation will be offered if parameters lie in A, C, or E. If parameters lie in B or D, an employment subsidy will be used to compensate displaced workers, while a wage subsidy will be used to compensate these workers if parameters fall in F.

Turning to the initial vote, it is easy to see now that the status quo wins out if parameters fall in A. In this case, the median worker who opposes uncompensated liberalization recognizes that incumbents are strong enough to block all compensation if trade is liberalized. Therefore the median worker opposes liberalization.

If parameters lay in C or E, the median worker will vote to liberalize. Despite the recognition that there will ultimately be no compensation, the median worker prefers uncompensated liberalization to the status quo.

For parameters in A, C, or E, placing the issue of compensation on the table does not affect the outcome. However, the outcome is affected if parameters lie in B, D, or F. Compensation does buy liberalization in B, where the median worker opposes uncompensated liberalization but realizes that compensation will be forthcoming if trade is liberalized. Regions D and F will also result in liberalization, as they would in the absence of compensation, however the outcome will not be a complete removal of all distortions. In these two cases, compensation will be offered, distorting the equilibrium by creating a class of policy-displaced workers. In all of our numeric analysis, however, the distortion created by offering compensation is smaller than the distortion generated by the status-quo tariff. Hence, the net gain is positive.

We close this section by noting that the order of voting only matters in A. To see this, suppose that the economy first voted on compensation. This would be defeated in C and E, where incumbents hold a majority, but the median worker prefers uncompensated liberalization to the status quo, so liberalization would still occur. In B, D, and F, incumbents are in the minority, so compensation passes and liberalization occurs. Incumbents prefer compensated liberalization to

<sup>23</sup> As already noted, region G will be associated with uncompensated liberalization since the median worker is an incumbent. We therefore need not consider choice of instrument in this region.



the status quo, they would therefore find it in their interest to vote for compensation if parameters lie in A, since this is the only way to assure a favorable vote on liberalization.

## 7. Discussion

We see this paper as making two contributions. First, we have extended the standard referendum model of political economy of trade policy to incorporate compensation. Second, our specific application considered the issue of whether compensation can “save free trade”.

Our first contribution involves the extension of a Mayer-type referendum model to endogenize the compensation, as well as the trade policy, decision.<sup>24</sup> Although there is a sizable literature on the common-sense notion that compensation, in addition to moving a potentially Pareto-improving policy in the direction of an actual Pareto improvement, increases the political sustainability of trade liberalization, there is very little in the way of systematic political economic analysis on this question. Early work by [Johnson and McCulloch \(1973\)](#) argued that a welfare maximizing government that was politically constrained to offer protection might gain relative to a tariff by using the distribution of quota revenues to support lower levels of protection. [Feenstra and Bhagwati \(1982\)](#) apply similar reasoning in a model in which a welfare maximizing government uses tariff revenues to induce lower levels of lobbying on the part of a protection-seeking labor union. While Feenstra and Bhagwati do present an explicit model of political-economic interaction, the assumption of a welfare-maximizing government seems broadly inconsistent with the underlying goals of political economic analysis. More closely related to our work is [Magee \(2003\)](#). As with Feenstra and Bhagwati, in Magee’s model the government is an active player, but unlike Feenstra and Bhagwati, instead of seeking purely to maximize welfare the government is of the [Grossman and Helpman \(1994\)](#) sort. Contrary to Feenstra and Bhagwati, Magee finds that, precisely because it lowers the cost of any given level of protection, the presence of compensation permits the government to offer more protection.<sup>25</sup> In particular, at low levels of protection (such as those currently applied in virtually all industrial countries) compensation may hinder further liberalization.<sup>26</sup>

There are two major differences between Magee’s analysis and ours. First, where Magee’s analysis evaluates the contribution of compensation to liberalization at the margin, our analysis focuses on the contribution of compensation to the overall sustainability of liberalization. That is, our model considers a choice between fixed, finite policy options. Second, and perhaps more importantly, Magee’s analysis, like Feenstra and Bhagwati’s, is really only indirectly about liberalization. As in Grossman and Helpman, what is really for sale is protection. In our analysis the issue on the agenda is liberalization. We think it is worth noting that trade policy in the post Second World War era has been overwhelmingly about liberalization, and that arguments about compensation have been directly related to this policy and not to protection per se. Furthermore, this commitment to liberalization has been only very indirectly related to the sorts of forces modeled in standard work on political economy ([Nelson, 2003](#)). Thus, while the details of intersectoral variation in protection may be well-modeled in something like a Grossman–Helpman

<sup>24</sup> See [Mayer \(1984\)](#).

<sup>25</sup> This effect is particularly large in Magee’s simulations because he takes the result of [Goldberg and Maggi \(1999\)](#) that the government’s weight on aggregate social welfare is 50 to 70 times the weight placed on contributions.

<sup>26</sup> This result is contrary to that obtained by [Fung and Staiger \(1996\)](#) who analyze compensation in a model without domestic political competition. Their model treats domestic compensation as part of the *international* political economy of trade policy. In their paper the implicit bribe is not directed to domestic factors of production but to one’s negotiating partners in a trade agreement.

framework, we believe that the issue of overall sustainability of a liberalization policy (adopted for some un-modeled reason) is more clearly treated in a framework such as that developed here.

Directly related to the last comment, our second contribution is an evaluation of claims that a well-constructed compensation program can help “save free trade” (Lawrence and Litan, 1986). In the context of our model we find that allowing for the possibility of compensating trade-displaced workers does lead to liberalization in instances where it would have otherwise been blocked, but there are situations where compensation results in a distorted outcome when a Pareto efficient outcome would have been obtained in the absence of compensation.

We close by offering some suggestions for extensions. With respect to the political economy model: first, it would be interesting to consider alternative structures of referendum; second, introducing an active government with alternative objectives would seem to be a useful extension; and third, it would seem important to consider the sustainability of compensation in the context of less robust information than considered here. Finally, with respect to the specific issue of “saving free trade”, it would be interesting to bring more concrete structure to the analysis to permit some more specific evaluation of the role of compensation (i.e., What part of the parameter space do we find ourselves in?).

## Appendix A

### Autarky

Let  $\bar{a}$  represent the ability of the worker who is just indifferent between low-skill employment and searching for a job in the high-skill sector when the economy is in autarky. Given that ability is uniformly distributed over the unit interval, the allocation of labor implies that  $\bar{a}$  is the fraction of workers employed in the low-skill sector with all remaining workers either employed in the high-skill sector or searching for a job in that sector. Of the  $1 - \bar{a}$  workers affiliated with the high-skill sector, steady-state conditions imply that the fraction  $\left(\frac{b}{e+b}\right)$  are unemployed, with the remaining  $\left(\frac{e}{e+b}\right)$  employed. We can therefore solve for the supplies of the two goods as a function of relative price ( $S_i(P)$ ,  $i=H,L$ )

$$S_L(P) = \int_{0\bar{a}} da = \bar{a} \quad (\text{A.1})$$

$$S_H(P) = \left(\frac{b}{e+b}\right) \int \bar{a}^{-1} a da = \left(\frac{b}{e+b}\right) \left(\frac{1+\bar{a}}{2}\right) (1-\bar{a}) \quad (\text{A.2})$$

Our assumption that all workers share the same Cobb–Douglas preferences implies that the demands for the two goods are related in the following way:

$$PD_L(P) = \frac{\beta}{1-\beta} D_H(P). \quad (\text{A.3})$$

In the absence of trade, the demand for each good must equal its supply. We then use Eqs. (A.1), (A.2), and (A.3) to obtain Eq. (7) in the text.

### Tariff revenue

Let  $R$  represent tariff revenue. Then

$$R(P_{sq}) = (P_{sq} - P_{ft})(D_L(P_{sq}) - S_L(P_{sq})). \quad (\text{A.4})$$

The supply of the low-skill good is given in Eq. (A.1). Demand for the low-skill good has to satisfy Eq. (A.3) for  $P = P_{sq}$  and the economy-wide budget constraint:

$$P_{ft}D_L(P_{sq}) + D_H(P_{sq}) = P_{ft}S_L(P_{sq}) + S_H(P_{sq}) \quad (\text{A.5})$$

Therefore, demand for the low-skill good is:

$$D_L(P_{sq}) = \frac{\beta(P_{ft}S_L(P_{sq}) + S_H(P_{sq}))}{\beta P_{ft} + (1-\beta)P_{sq}} \quad (\text{A.6})$$

where we again note that  $P_{sq}$  is itself a function of  $P_{ft}$  and  $\beta$ .

Tariff revenue is distributed to each worker in proportion to the wage earned by the worker:

$$r(P_{sq}) = \frac{R(P_{sq})}{P_{sq}S_L(P_{sq}) + S_H(P_{sq})}. \quad (\text{A.7})$$

### Discounted utility with a temporary employment subsidy

We assume that the employment subsidy is given to a displaced worker only during the duration of his first post-liberalization job. The asset value equations are then as follows:

$$\rho V_H = aP_{ft}^{-\alpha} - b[V_H - V_U] \quad (\text{A.8})$$

$$\rho V_U = e[V_H - V_U] \quad (\text{A.9})$$

$$\rho V_{H\eta} = (a + \eta)P_{ft}^{-\alpha} - b[V_{H\eta} - V_U] \quad (\text{A.10})$$

$$\rho V_{U\eta} = e[V_{H\eta} - V_{U\eta}] \quad (\text{A.11})$$

Where  $V_{H\eta}$  represents discounted income for a displaced worker employed for the first time in the high-skill sector.

An analogous system can be written for a wage subsidy, replacing  $(a + \eta)$  in Eq. (A.10) with  $a(1 + \omega)$ . The two systems can then be solved for Eqs. (5.a) and (5.b) in the text.

### Discounted value of the employment subsidy

Everyone with ability  $a \in [a_\eta, a_{sq}]$  receives the employment subsidy during the first spell of employment. Let  $\Omega_{U\eta}$  represent the present discounted value of the employment subsidy received by a worker searching for his first job and let  $\Omega_{H\eta}$  represent the present discounted value of the subsidy received by a worker in his first job. Then:

$$\rho \Omega_{U\eta} = 0 + e[\Omega_{H\eta} - \Omega_{U\eta}] \quad (\text{A.12})$$

$$\rho \Omega_{H\eta} = \eta - b\Omega_{H\eta} \quad (\text{A.13})$$

Solving these two equations:

$$\Omega_{U\eta} = \frac{1}{\rho + b} \frac{e}{\rho + e} \eta \quad (\text{A.14})$$

so  $T_\eta$ , the total present discounted value of the transfer at the moment of liberalization is:

$$T_\eta = \left\{ \frac{1}{\rho + b} \frac{e}{\rho + e} \eta \right\} \{a_{sq} - a_\eta\}. \quad (\text{A.15})$$

Eqs. (A.16) and (A.17) are the analogues for a wage subsidy:

$$\Omega_{U\omega} = \frac{1}{\rho + b} \frac{e}{\rho + e} (1 + \omega) P_{ft} a \quad (\text{A.16})$$

$$T_\omega = \frac{1}{\rho + b} \frac{e}{\rho + e} \frac{a_\omega^2 + a_{sq}^2}{2} (1 + \omega) P_{ft}. \quad (\text{A.17})$$

Setting  $T_\eta = T_\omega$  provides the border dividing C and D from E and F in Fig. 4.

We can compare  $T_\eta$  and  $T_\omega$  with the discounted value of the gains from liberalization that accrue to incumbents:

$$G = \frac{b}{e + b} \int_{a_{sq}}^1 \{V_H(P_{ft}, a) - V_H(P_{sq}, a)\} da + \frac{e}{e + b} \int_{a_{sq}}^1 \{V_U(P_{ft}, a) - V_U(P_{sq}, a)\} da. \quad (\text{A.18})$$

In all of our numeric calculations, the discounted gain to the incumbents was larger in magnitude than the discounted value of either subsidy.

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