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Trade Policy Reform and Labor Market Dynamics: Issues and an Agenda for Future Research

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1.   Introduction.

Economists from the United States, Austria, France, Germany and Switzerland were once surveyed regarding their opinions on nearly 30 different questions of economic practice.[1]   They were asked if they generally agreed with, agreed with, or generally disagreed with statements such as "the money supply is a more important target than interest rates for monetary policy" or "consumer protection laws generally reduce economic efficiency."   Among the American economists surveyed, more than 97 percent of the respondents either agreed or generally agreed with the statement "tariffs and import quotas reduce general economic welfare."   This degree of consensus was only surpassed by agreement or general agreement by more than 98 percent of those surveyed with the assertion that "a ceiling on rents reduces the quantity and quality of housing available."   This should come as a surprise to no one who has been trained as a neoclassical economist.[2]   This view among practitioners stands in stark contrast to the view from the street where "globalization" is not always embraced.   Indeed, if one subscribes to the view that the World Trade Organization, the World Bank, and the International Monetary Fund seek to promote globalization, then protests within the past year of meetings in Seattle and Washington D.C. indicate that a significant share of the public is frankly hostile to increased globalization.

While those who oppose globalization do not form a monolithic bloc, at least some of the protesters worry that greater trade and investment flows between the United States and low-income countries will lead to an erosion of American wages and perhaps even job loss.   Indeed, having observed an increase in the differential between high-skill and low-skill workers in the United States concurrent with an explosion of trade between the U.S. and low-income countries, many in the economics profession have echoed some of these public concerns and have turned a spotlight on the potential link between trade and wages.   In contrast, research pertaining to more general linkages between trade and labor markets, such as the potential impact of trade on employment, has lagged.[3]   This is undoubtedly due to the belief among most economists that the "level of employment is a macroeconomic issue…depending in the long run on the natural rate of unemployment, with microeconomic policies like tariffs having little net effect."[4]

While it may be possible to argue that the long-run impact of trade on employment is negligible, one can make a strong argument that the short-run effects can be substantial.   After all, trade liberalization causes some sectors to expand while others contract.   As long as factors of production are not able to adjust immediately, there are bound to be adjustment costs characterized by periods of unemployed resources.   As Baldwin, Mutti, and Richardson (1980) note, it is "bad economics" to ignore these potential costs since the near present (when costs are incurred) counts more heavily than the "long run" (when most benefits accrue) as long as economic agents discount the future.

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[1] See Frey, et. al. (1984).

[2] What may be more surprising is that more than a quarter of the French economists generally disagreed with this statement, as did roughly 13 percent of the Austrian economists, 10 percent of the Swiss economists, and 5 percent of the German economists.

[3] There is some evidence, however, that this issue is gaining broader interest in the profession. For example, the Autumn 2000 issue of the Review of Oxford Economic Policy is devoted to the issue of globalization and labor market adjustment.

[4] See Krugman (1993).

If the adjustment costs due to globalization are important for the U.S. economy, which is relatively non-distorted and has been relatively open to trade and investment for many years, they are likely to be doubly important for many developing countries where resource allocation has been grossly distorted by heavy-handed government intervention as well as substantial trade barriers. Presumably, the benefits of policy reform are larger for more distorted economies than for less distorted economies.[5] However, adjustment costs are also likely to be larger in the more distorted economies.[6]

The primary focus of this paper is on examining the adjustment costs that arise due to trade reform. Do the gross benefits of reform outweigh the adjustment costs? How does the *net* benefit of trade reform depend on the existence of other distortions in product and labor markets? One particular set of labor market distortions consist of labor-market policies aimed at softening the potential negative impacts on income distribution. Since overall social welfare certainly depends in some way on the distribution of income, such policies may be desirable even if they tend to increase the magnitude of adjustment costs.

In the next section, I define what I mean by the adjustment costs of trade reform. I then turn in section 3 to a brief survey of the empirical literature that has attempted to measure these costs. I sketch out a simple general equilibrium model with dynamic adjustment to trade reform in section 4. I then turn to a number of unresolved issues and offer some suggestions for future research in section 5. Section 6 concludes the paper.

I offer this model as a means of illustrating a potential methodology for quantifying adjustment costs. I leave out a great deal of (country-specific) institutional detail. As such, numeric results generated by this model ought not to be taken too seriously. With that caveat in mind, I offer some simulation results in the appendix.

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[5] By policy reform, I am referring to a wide range of reforms that also include the liberalization of international trade and investment. Examples of such reforms include the privatization of state-owned enterprises, eliminating legal impediments to interregional migration, allowing for the establishment of well-functioning capital markets, and so on.

[6] We know from the theory of the second best that this need not be true. To the extent that distortions have offsetting effects on resource allocation, the actual distribution of resources in the presence of distortions could be relatively close to the optimal allocation of resources when there are no distortions. While this is a theoretical possibility, it is my sense that most economists would agree that the allocation of resources in, say, China would be quite different if all distortions were eliminated.

2.   Defining Adjustment Costs.

Trade reform, like many types of shocks or policy changes, likely results in changes in relative prices and therefore a reallocation of resources across productive activities.   This reallocation may be associated with a wide array of costs, real and psychic, private and societal. For example, some workers toward the end of their work life may find that the best they can do is continue to work in their present job even though their real wage erodes.   This loss of real income is a private cost borne by the worker, but it need not be a cost to society as long as the worker continues to be paid according to his or her marginal product and as long as his or her marginal product is not higher in some other activity.   On the other hand, some workers may switch jobs, but experience a period of intervening unemployment. The period of unemployment obviously poses a real cost to the individual worker, but it also imposes a real social cost to the extent that the economy is deprived of the output that the worker could produce if employed. Psychic costs may include the loss of self-esteem if a worker is involuntarily separated from his or her job, family disruptions that may result from financial pressures, and the loss of long-term on-the-job friendships when one relocates.   For purposes of this paper, I am only going to focus on the real societal costs generated by trade reform.

The basic idea can be illustrated with the familiar production possibilities diagram.[7]   In Figure 1, X_M represents the import-competing good, and X_E represents the export good.   The price lines represent world prices and I have implicitly assumed that this is a small country.   For simplicity, I have not shown domestic price lines.   Initially, trade is distorted, causing production to occur at point P_0 and consumption to occur at C_0. After reform, domestic prices converge to world prices and production ultimately occurs at P_T and consumption at C_T, where subscripts are used to indicate time period.   However, even if full employment is maintained throughout, it is likely that movement from (P_0, C_0) to (P_T, C_T) will not be instantaneous.   Rather, it is more likely that the production point will slide gradually along the production possibilities curve, moving through points such as P_t. If we measure social welfare by the value of income at world prices, then adjustment costs can be measured by the present discounted value of the difference between steady state income at the free trade equilibrium and income at production point P_t for every time period $t = 0 \ldots T$.[8]   By contrast, the gross benefits of trade reform are measured by the present discounted value of the difference between steady state income at the free trade equilibrium and income at production point P_0.[9]   The net benefit of reform is then the difference between the gross benefits and the adjustment costs.   If there are no unemployed resources, so that the production point always lies on the production possibilities frontier as in Figure 1, the net benefits of trade reform are always non-negative.   However, the magnitude of the net benefit is an open question. A lengthy period of adjustment could result in erosion of virtually all of the gross benefits, leaving only a small net benefit in the end.   In this case, the potential for a tiny net benefit may not be worth pursuing reform if such reform also results in undesired side effects, such as a deterioration in the distribution of income.

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[7] The analysis here is very similar to that presented by Baldwin, Mutti, and Richardson (1980) and Neary (1982).

[8] This is an overstatement of welfare in the initial tariff-distorted equilibrium because of the existence of the consumption distortion.

[9] Again, this is an underestimate of the gross benefit since trade reform removes both the production distortion *and* the consumption distortion.

What if resources are released from the shrinking import-competing sector faster than they are absorbed by the expanding export sector? An extreme version of this case is illustrated in Figure 2. Here, the real value of income at period t is actually *lower* than the real value of income prior to reform.

Figure 3.a shows the path taken by real income in the case illustrated by Figure 1, whereas Figure 3.b shows the path taken by real income given the circumstances underlying Figure 2. The method of measuring adjustment costs in this case is identical to the full-employment case. In terms of Figures 3.a and 3.b, the adjustment costs are measured by the (appropriately discounted) area between the horizontal dashed line at Y_T and the solid line (which represents real income at each period after reform). The gross benefit of reform is the same in Figures 3.a and 3.b. This is captured by the (appropriately discounted) area between the horizontal dashed lines at Y_0 and Y_T. Figure 3.b makes it plain that the existence of unemployed resources may cause the magnitude of the adjustment costs to exceed the magnitude of the gross benefits of reform. This follows from the fact that adjustment costs in the periods immediately after reform are actually larger than the gross benefits of trade. With a high enough discount rate, this negative net benefit early in the process may outweigh any positive net benefit that emerges later.

At a superficial level, the adjustment cost described in the preceding paragraphs is most appropriately associated with advanced market economies where open unemployment is non-trivial and where there exits reasonably strong social safety nets. By contrast, open unemployment is relatively rare in developing countries.[10] In these economies it may be more appropriate to speak of "underemployment." However, the concept of adjustment cost outlined here are still applicable. In this case, a worker who finds himself or herself retrenched from a job with high private and social returns may experience a spell of underemployment (requiring significantly less human capital than he or she possesses) before ultimately returning to a job in which he or she would be considered fully employed. In this case, official employment statistics would continue to show full employment along the transition path yet the value of national output would fall before eventually attaining a higher level.

3.   Previous Empirical Implementation.

While there exists a fair amount of anecdotal evidence suggesting that the adjustment costs of trade reform are relatively small, surprisingly few studies attempt to actually quantify these costs in a systematic way.[11] Moreover, the small handful of more rigorous studies that do exist pertain primarily to the United States or other industrialized economies. In this section, I first describe the findings of the more rigorous attempts at capturing adjustment costs. I then turn to some anecdotal evidence regarding adjustment costs in developing countries.

A.   *Relatively Formal Studies of Adjustment Costs.*

The first attempt at treating this issue formally was undertaken by Magee (1972). In his paper, Magee divided traded goods into a number of broad categories and then asked what the

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[10] For example, the 1993 unemployment rate in India was under 2 percent.
[11] See Matusz and Tarr (2000) for a fairly comprehensive review of both the anecdotal and more formal evidence regarding the size of these costs.

gross welfare gain would be if the United States unilaterally eliminated all trade restrictions. The welfare calculations followed the standard "textbook" treatment of the elimination of deadweight loss, being careful however to understand that the benefits would proceed into the infinite future. To estimate adjustment costs, he first estimated the number of workers that would have to be shuffled between sectors, then he assumed that 20 percent of these workers would move each year until adjustment was complete. Furthermore, he assumed that the workers who would be forced to move would have to spend some time unemployed.[12] He then multiplied the amount of time unemployed by the average wage within a sector to obtain lost wages. This number was calculated for the first five years after trade reform, then discounted back to the start of reform. By his estimates, the gross welfare benefits of trade reform in the first year alone were larger than the present discounted value of all adjustment costs, even when the future was lightly discounted.[13] In other words, his estimates for the United States were consistent with something like Figure 3.a rather than Figure 3.b.

Baldwin, Mutti, and Richardson (1980) took a more sophisticated approach to the problem. First, they constructed a highly disaggregated model of the U.S. economy based on an input-output analysis. Having constructed the model, they calculated the amount by which each of 327 sectors would expand or contract if there was a 50 percent multilateral tariff reduction. Like Magee, they assumed that workers exiting contracting sectors would have to spend some time unemployed before finding new employment. As such, expanding sectors were assumed to draw new employees from the pool of unemployed.[14] In their model, contraction and expansion occurs immediately upon liberalization. The number of unemployed may either increase or decrease, depending on the net effect. Moreover, the *mix* of unemployed may change. In particular, they undertook statistical analysis to calculate the average duration of unemployment for a worker based on that worker's demographic characteristics (age, sex, race, and education). They then used the demographic makeup of each sector to calculate the number of days of unemployment added to the pool (in the case of a contracting sector) or subtracted from the pool (in the case of an expanding sector). The net effect was then multiplied by the sector-specific wage to calculate lost wages due to adjustment. Using this procedure, they found that adjustment was almost always a relatively short process, taking less than one year to complete and the associated costs were again trivial compared with the present discounted value of the stream of benefits.

The primary weakness shared by both of these studies is that the conceptual framework underlying the empirical implementation is, from a formal point of view, static whereas the question of adjustment is inherently dynamic. In both cases, there is an ad hoc assumption that a certain number of workers are dropped into the pool of unemployed, spends a fixed amount of time there, and then exits. But we know that the process of job turnover is more complicated than that. In any economy, jobs are continuously being created and destroyed. For some economies, we have some reasonable estimates of the rates at which these events occur.[15] Furthermore, the "average duration of unemployment" does not adequately capture the

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[12] Depending on the particular sector, he assumed durations of unemployment ranging from roughly 8 weeks to 16 weeks.
[13] He calculated his results assuming discount rates of 4, 7, and 10 percent.
[14] They also allow for adjustments of the capital stock, but that is not my focus in this paper.
[15] For example, see Davis, Haltiwanger, and Schuh (1996).

experience of any particular worker. The average duration may be only 16 weeks, but some workers may be unemployed for much longer periods of time.

One study that is closer in spirit to taking a truly dynamic approach to the problem was conducted by Takacs and Winters (1991). In their study, the authors examine the consequences of removing protection from the British footwear industry. They explicitly consider the natural rate of job turnover in this industry, which they find to be quite high. The upshot of their analysis is that the downsizing of the industry in response to tariff removal could occur very quickly simply by the process of natural job loss. While this analysis takes a more dynamic view of the labor market, it suffers from the fact that it is partial equilibrium in nature. In a steady state, new employees are hired as existing employees are separated. Shrinking the number of steady-state jobs means that workers who would have found jobs in this industry must now look elsewhere. The analysis by Takacs and Winters does not account for this.

In one of the few formal analyses of adjustment costs in a developing country, de Melo and Roland-Holst (1994) built a general-equilibrium model of the Uruguayan economy in which they incorporated rigidities in the labor market as well as protection from international trade. They chose to focus on administered protection, which generates strong incentives for rent-seeking activity and therefore is generally associated with larger efficiency losses than comparably restrictive tariffs. After building and calibrating their model, the authors estimate that removal of all trade protection would likely entail the eventual relocation of five percent of the labor force and (in one scenario), the ultimate welfare gain would be valued at approximately eight percent of GDP. However, it is not easy to interpret these results. Since the authors do not have a truly dynamic model, they have provided no estimate of the time that it would take for the labor force to reallocate across activities. In other words, it is not possible to figure out how long it would take before the new steady state is reached. Furthermore, the authors do not furnish any information regarding the normal rate of labor turnover, making it difficult to judge the difficulty with which five percent of the labor force can be moved between sectors.

B. Less Formal Studies of Adjustment Costs.

During the past three decades, numerous countries in South America, Asia, Africa, and Eastern Europe have undertaken significant liberalization of their trade policies. As a group, these countries can be characterized as relatively labor abundant. According to the Heckscher-Ohlin model of trade, we would expect trade liberalization to increase labor demand, and therefore wages in these countries. Modifying the Heckscher-Ohlin model to allow for changes in aggregate employment, the increased demand for labor might manifest itself as an increase in overall employment. To my knowledge, there are no formal estimates of the impact of liberalization on aggregate labor demand in developing countries. However, there are several studies that examine changes in employment before, during, and after periods of significant liberalization.[16] In almost all cases, employment is higher immediately after reforms when compared with employment levels prior to the implementation of such reforms. The natural conclusion to reach is that adjustment costs are relatively insignificant even in the face of very large policy reforms. While more careful analysis may yield this result, several reasons suggest

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[16] See, for example, Papageorgiou, Choksi, and Michaely (1990), Parker, Riopelle, and Steel (1995), and Harrison and Revenga (1995). These studies are reviewed in Matusz and Tarr (2000).

that it is probably best to interpret the overall employment trends with a grain of salt. First, the employment figures usually only represent manufacturing employment. Gains in manufacturing could, in principle, be offset by losses in non-manufacturing sectors. Second, these figures do not account for the possibility that reforms generate a significant amount of underemployment even as overall measured employment increases. Third, there is no well-specified counterfactual. It may be that manufacturing employment would have grown even faster in the absence of reforms. Alternatively, manufacturing employment might have stagnated, or even declined, had reforms not been adopted. The bottom line is that, in the absence of a well-specified model, these results fall well short of providing conclusive evidence.

4. A Model of Adjustment With A Dynamic Labor Market.

My purpose in this section is to build a simple general equilibrium trade model that explicitly incorporates a dynamic labor market. Doing so, I will then be able to explicitly solve for the dynamic adjustment path that is entailed in moving from one steady state (e.g., a tariff distorted steady-state) to another (e.g., a free trade steady state). The development of the model illuminates the type of empirical information that would be necessary to estimate the adjustment cost of trade reform.

Consider the labor market of a two-sector economy. To fix ideas, call the two sectors the export sector (X) and the import-competing sector (M). Assume that the labor market is dynamic in the sense that employed workers randomly become separated from jobs while unemployed workers randomly find jobs.[17] This process occurs continuously throughout time. Further assume that transitions between employment and unemployment follow a Poisson process, where b_i is the rate at which workers are separated from employment in sector i and where a_i is the rate at which those looking for a job in sector i become employed.[18] Using a dot over a variable to denote the derivative of that variable with respect to time, the equations of motion governing the transition between employment and unemployment are provided in the following two equations:

(1) $\qquad \dot{L}_X^E = a_X L_X^U - b_X L_X^E$

(2) $\qquad \dot{L}_M^E = a_M L_M^U - b_M L_M^E$

where L_i^E represents the number of workers employed in sector i, and L_i^U is the number of unemployed workers searching for employment in sector i.[19]

Define L_i as the number of workers who are either employed in sector i or who are searching for employment in sector i. Then $\dot{L}_i = \dot{L}_i^E + \dot{L}_i^U$ and in a steady state,

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[17] Once again, one could substitute the term "underemployment" for "unemployment" without in any way affecting the flavor of the results. The important aspect of the model is that workers spend time in different activities with alternative social (and private) values, and there is a well-specified process by which workers make the transition from one activity to another.

[18] At this point, I assume that these transition rates are parametrically given and are independent of time. However, I will discuss below possible determinants of these rates.

[19] Bear in mind that the variables L_i^E and L_i^U are functions of time.

$\overline{L}_i = \overline{L}_i^E + \overline{L}_i^U$ where a bar over a variable indicates that the variable equals its steady state value. For now, assume that the values of $\overline{L}_i$ are known. Then using (1) and (2) along with the adding up condition, the steady-state values of sector-specific employment and unemployment can be easily determined:

(3) $\qquad \overline{L}_i^E = \dfrac{a_i}{a_i + b_i} \overline{L}_i$

(4) $\qquad \overline{L}_i^U = \dfrac{b_i}{a_i + b_i} \overline{L}_i$.

How are the steady-state values of $\overline{L}_i$ determined? In order to solve for this steady-state allocation of labor, I need to say something about how workers decide upon the sector in which to seek employment.

In a standard full-employment model and in the absence of distortions, equilibrium in the labor market is attained when $w_X = w_M$. In this case, the equilibrium condition is more complex. To see this, consider a worker who is currently unemployed. He or she has to decide upon a sector in which to seek employment.[20] In making that decision, the wage that would be paid once employment is secured is certainly an important consideration. However, the likelihood of finding a job, and the expected duration of a job once found are both considerations as well. Furthermore, if the economy is not currently in a steady state, the worker must evaluate future wage prospects. Formally, the expected lifetime income for a worker searching in either sector can be found by solving the following two equations:

(5) $\qquad rV_i^E = w_i - b_i \left\{ V_i^E - V_i^U \right\} + \dot{V}_i^E$

(6) $\qquad rV_i^U = a_i \left\{ V_i^E - V_i^U \right\} + \dot{V}_i^U$

were r is the discount rate, V_i^E is the expected lifetime income of a person employed in sector i, and V_i^U is the expected lifetime income of an unemployed worker searching for a job in sector i. In an equilibrium, the marginal searcher must be indifferent regarding choice of sector. That is, the labor-market equilibrium condition is $V_X^U = V_M^U$.

To interpret (5) and (6), we can think of a job as an asset, where V_i^E is the value of that asset. The flow value of the asset (the discount rate multiplied by the stock value) is then the flow income provided by that asset (w_i) plus the expected appreciation of that asset ($\dot{V}_i^E$), less the expected capital loss that would occur if the agent were to become unemployed ($b_i \left\{ V_i^E - V_i^U \right\}$). Similarly, the value of being unemployed is the flow income provided to the

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[20] This is not an irrevocable decision. Indeed, a searcher can flip back and forth between sectors at any time. However, in a continuous time framework, a searcher can only "knock on one door" at a time.

unemployed (assumed to be zero in this case) plus the expected appreciation of the asset ($\dot{V}_i^U$) and the expected capital gain that would obtain if the agent were to become employed ($a_i\{V_i^E - V_i^U\}$).

Solving (5) and (6) for V_i^E and V_i^U yields

(7)
$$V_i^E = \frac{1}{r}\frac{r+a_i}{r+a_i+b_i}w_i + \frac{1}{r}\frac{r+a_i}{r+a_i+b_i}\dot{V}_i^E + \frac{1}{r}\frac{b_i}{r+a_i+b_i}\dot{V}_i^U$$

(8)
$$V_i^U = \frac{1}{r}\frac{a_i}{r+a_i+b_i}w + \frac{1}{r}\frac{a_i}{r+a_i+b_i}\dot{V}_i^E + \frac{1}{r}\frac{r+b_i}{r+a_i+b_i}\dot{V}_i^U{}_i.$$

The intuition underlying (7) and (8) is quite clear. Expected lifetime income for employed or unemployed workers is increasing in the wage paid, increasing in the rate at which jobs are found, and decreasing in the rate at which separations occur.

At this point, it is necessary to make some assumptions regarding the production side of the economy in order to characterize $\dot{V}_i^E$ and $\dot{V}_i^U$. In a steady state, both of these values are zero. However, they may be non-zero during a period of transition between steady states. Lifetime incomes depend on wages and transition probabilities, all of which may reasonably assumed to be time dependent. Unfortunately, allowing wages or transition probabilities to vary with time imparts a significant degree of complexity to the model.[21] In order to keep the model simple and to focus on the essential aspects of adjustment costs, I shall therefore continue to assume that transition probabilities are parametrically given. In addition, I assume that labor is the only input in the production process and that technology is characterized by constant returns to scale. This last assumption implies that wages do not depend on the distribution of workers between sectors. While sector-specific wages may differ from their pre-reform values, the change is discrete. That is, wages move immediately to the new steady-state values upon liberalization even though the movement of labor between sectors takes time.

If I add to the above an assumption that all workers are alike, the model has the undesirable feature that specialization will result for any relative price other than the autarkic relative price. To get around this problem, I assume that workers are indeed different, and the difference lies in individual-specific worker productivities in the export and import-competing sectors. In particular, I assume that worker j can produce one unit of the import-competing good, or q_j units of the export good. Without loss of generality, I choose the index j such that q_j is decreasing in j. That is, I assume that workers identified by a low index number have a comparative advantage over workers with a high index number when it comes to producing the export good. With this added assumption, equilibrium wages are easily seen to be

$$(9a) \qquad w_X(q_j) = p_X q_j$$

$(9b)$ $\qquad w_M = p_M$

Substituting (9) into (8), the labor-market equilibrium condition becomes

(10) $\qquad \dfrac{a_X}{r + a_X + b_X} p_X q_z = \dfrac{a_M}{r + a_M + b_M} p_M$

where q_z is the productivity in the export sector of the marginal worker. All workers indexed $j\boldsymbol{e}(0, z)$ would prefer when unemployed to search for jobs in the export sector, while all workers indexed $j\boldsymbol{e}(0, L]$ would prefer when unemployed to search for jobs in the import-competing sector.[22] In a steady state, $\overline{L}_X = z = L - \overline{L}_M$. Therefore, steady-state employment and unemployment can be solved from (3), (4), and (10).

Suppose that trade is now liberalized, reducing the domestic price of the import-competing good until that price is equated with the exogenous world price. This causes an immediate fall in the wage in the import-competing sector, therefore inducing the marginal searcher to switch sectors. In terms of (10), the right-hand side becomes smaller. To restore equality, the productivity of the marginal worker in the export sector must fall. That is, the new steady-state value of z must fall.

There are two possible cases to consider. First, assume that the price shock is insufficient to induce workers who are actually employed in the import-competing sector to actually quit and start searching for jobs in the export sector. Let Δz represent the number of workers who ultimately move to the export sector. Some fraction of these workers are unemployed at the moment of liberalization and therefore immediately begin searching for employment in the export sector rather than continue searching in the import-competing sector. From (4), this number is $\dfrac{b_M}{a_M + b_M} \Delta z$. The remaining fraction is employed at the moment of liberalization, however these workers eventually become separated. Upon separation, these workers find it in their interest to switch their search to the export sector.

All of the movement (and therefore all of the adjustment costs) occurs in the neighborhood of the marginal worker. Those who begin in the export sector (either searching or employed) continue to be associated with that sector with no net change in output produced by this mass of workers. Those who have sufficiently low productivity in the export sector begin in the import competing sector and stay in that sector even after liberalization. To focus on those workers who switch, define S_M^E as the number of workers who eventually switch to the export sector but who are temporarily employed in the import-competing sector. Similarly, define S_X^E as the number of workers who were employed or searching in the import-competing sector prior to trade reform but who are now employed in the export sector. Finally, define S_X^U as the number of workers who were employed or searching in the import-competing sector prior to trade reform but who are now searching for employment in the export sector. Movement between sectors is

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[22] Assume that q_j is monotonically decreasing in j so that the solution to (10) is unique.

then governed by the following system of two differential equations and one adding-up constraint:

$$(11) \qquad \dot{S}_M^E = -b_M S_M^E$$

$$(12) \qquad \dot{S}_X^E = a_X S_X^U - b_X S_X^E$$

$$(13) \qquad \Delta z = S_X^E + S_X^U + S_E^M .$$

Equation (11) simply expresses the fact that employment among eventual switchers in the import-competing sector falls at a constant proportional rate. Equation (12) describes how the number of switchers employed in the export sector varies with time. The first term on the right-hand side of this equation is the flow into employment from the pool of unemployed, while the second term is the flow out of employment into the pool of unemployed. Finally, (13) simply accounts for all switchers. Solving this system yields the following:

$$(14) \qquad S_M^E = \left(\frac{a_M}{a_M + b_M} \right) e^{-b_M t} \Delta z$$

$$(15) \qquad S_X^E = \left\{ \left(\frac{a_X}{a_X + b_X} \right) \left(1 - e^{-(a_X + b_X)t} \right) - \left(\frac{a_M}{a_M + b_M} \right) \left(\frac{a_X}{a_X + b_X - b_M} \right) \left(e^{-b_M t} - e^{-(a_X + b_X)t} \right) \right\} \Delta z .$$

The solutions themselves are not particularly informative. What is important is to recognize that it is possible to derive an explicit, closed-form solution for the entire adjustment path. Moreover, the determinants of that path are (in principle) empirically observable parameters. Going one step further, the adjustment path for *output* can be completely determined if one assumes an explicit distribution of worker abilities.[23]

In two recent papers, Carl Davidson and I implemented a similar model in order to estimate the adjustment costs of an economy that removed a small import tariff.[24] We chose parameters for job turnover roughly consistent with U.S. experience. In particular, we assumed that in the export sector (which we characterized as a high-tech sector) jobs had an average duration of 10 years, implying $b_X = 1/10$. We assumed that jobs in the import-competing sector (which we characterized as a low-tech sector) had an average duration of 1 year, implying $b_M = 1$. We chose job acquisition rates and other parameters so that the steady-state unemployment rate was in the neighborhood of four percent.[25] In this context, we found that adjustment costs were substantial share of the gross benefits of trade liberalization. In our base

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[23] Suppose, for example, that $a_X = a_M$ and $b_X = b_M$. Then total employment remains unchanged along the entire adjustment path. However, the mix of output is only optimal at the new steady state. This situation corresponds to Figure 3.a.

[24] See Davidson and Matusz (2000a, 2000b).

[25] Our model was a bit more complex than the one presented in this paper. The main departure from the present model is that we assumed that workers needed to train for a particular line of employment before searching for a job. However, the underlying concepts were all the same.

case, the net benefits of trade liberalization were less than 15 percent of the gross benefits with adjustment costs eating up a bit more than 85 percent of the benefits.[26]

5.   Open Questions.

The model presented above provides a starting point for thinking about adjustment costs in the context of a rigorous general-equilibrium framework. Indeed, armed with a few simple parameter estimates it is possible to use this simple model to generate some rough estimates of adjustment costs. However, a number of issues need to be addressed before more refined estimates of adjustment costs can be obtained.

Perhaps the most important question to ask is how the transition probabilities are themselves determined. For purposes of simplification, I treated them as parametrically given, analogous to the parameters of a production function. More realistically, these variables are endogenously determined within the confines of the search technology by the interaction of cost-minimizing and utility-maximizing behavior by firms and consumers. Allowing for this possibility opens up an entire set of new issues. For example, how are the equilibrium values of these parameters affected by labor-market policies such as laws governing circumstances under which firms may lay off or fire workers, experience-rated unemployment insurance, or government-sponsored programs to train workers and assist in job search?[27] Are the equilibrium values of the transition probabilities efficient? If they are and if government policies affect these values, then the policies themselves are distortionary. On the other hand there may be scope for government intervention if some market failure exists so that the endogenously determined transition probabilities are inefficient. Government intervention that impacts the transition probabilities may be desirable based on equity considerations even if the intervention distorts the transition probabilities.

In a related issue, it is likely that the transition probabilities depend on the degree of openness of the economy. For example, removing trade protection exposes the economy to greater competitive pressure, perhaps causing turnover rates to increase.[28] In a recent series of

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[26] It is important to note that there are no distortions in this model and so equilibrium is dynamically efficient. All losses are solely due to adjustment costs.

[27] Many economists cite institutional differences between the United States and the countries of Western Europe as the underlying reason that unemployment rates in the two regions are so dramatically different. Siebert (1997) provides an overview of the more important institutional features of European labor markets. Empirical work by Nickell (1997) correlates European unemployment rates with a host of labor market characteristics. He finds significant correlations between unemployment and the degree of unionization, the level of unemployment compensation, and a number of other variables. While the unemployment rate (and not turnover) is dependent variable in his regressions, it is clear that the equilibrium unemployment rate is determined in part by equilibrium job turnover. In another paper, Meyer (1995) surveys the results of a variety of experiments in Illinois, Washington, New Jersey, and Pennsylvania designed to reduce the duration of unemployment. In the context of the model above, the duration of unemployment would be the inverse of a_i, the rate at which workers exit the pool of unemployment. As reported by Meyer, certain forms of incentives can reduce the expected duration of unemployment (that is, result in higher values of a_i).

[28] Furthermore, large policy changes such as trade liberalization may generate congestion due to the large numbers of workers who find it advantageous to switch sectors or to re-train. Any bottlenecks emerging in this situation would add to the costs of adjustment.

papers, Bhagwati has suggested the possibility that increasing globalization has led to greater turnover due to a phenomenon that he calls "kaleidoscopic comparative advantage."[29] The idea here is that technological information travels so fast and global markets are so competitive that profit margins are razor thin. Very small changes in production costs can push existing firms out of the market or allow new firms to break into the market. To date, there is no solid evidence confirming this hypothesis.[30] However, I know of no work that explicitly tries to examine the potential relationship between turnover and the degree of an economy's openness. Of course, an additional layer of complexity is presented if the transition rates are themselves time-dependent.

It would appear that the model presented above provides a fairly explicit relationship between transition rates and adjustment costs. At one level of analysis, this relationship is quite explicit. Suppose, however, that there are two economies where the only difference between them is that labor markets are uniformly more dynamic in one economy compared with the other. That is, assume that the a_i and b_i terms in the more dynamic economy are proportionately higher than the corresponding terms in the other economy. Which economy would have greater adjustment costs due to liberalization? The answer would seem obvious. The economy with the less dynamic labor market would take a longer time to adjust to the new equilibrium and therefore have higher adjustment costs. However, there are subtle effects present that might actually imply that the *more* dynamic economy is beset by higher adjustment costs. The intuition can be explained by reference to (10). Differentiate (10) with respect to transition rates. Let $\hat{a}_X = \hat{b}_X = \hat{a}_M = \hat{b}_M > 0$, where the circumflex indicates the percentage change in the variable. It is straightforward to show that equality in (10) is maintained if and only if

$$(16) \qquad \frac{1}{a_X + b_X} = \frac{1}{a_M + b_M}.$$

If (16) is not true, then the equality in (10) is disturbed, causing the expected lifetime income in one sector to exceed that in the other for the (initially) marginal worker. Suppose, for example, that the left-hand side of (10) increases. Then the worker who is initially indifferent between sectors strictly prefers to search for employment in the export sector if turnover rates increase proportionately. In the new steady state, more workers are affiliated with the export sector. Therefore, the economy with the more dynamic labor market devotes a larger share of its workforce to the export sector, while the economy with the less dynamic labor force devotes a larger share of its workforce to the import-competing sector.[31] Now consider a small change in price due to import liberalization. The right-hand side of (10) falls by the same percentage in both economies. But restoration of equality might entail movement of different numbers of workers in the two economies. This follows from the fact that the two economies start from different initial conditions. I illustrate this point in Figure 4 where I have graphed the

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[29] For example, see Bhagwati and Dehejia (1994) and Bhagwati (1998).

[30] At least some evidence suggests otherwise. Greenaway, Upward, and Wright (2000) find evidence that turnover in the U.K. was higher between 1970 and 1990 than it has been since 1990.

[31] Note that I am not assuming that these two economies are trading with each other. Rather, I am comparing two different economies facing identical circumstances in order to imagine how each might respond to trade liberalization.

comparative productivity of workers in the export sector as a function of the index number j.[32] As drawn, a small reduction in q needed to restore equality in (10) is associated with a very large number of workers who would shift between sectors. The reason is that many workers are very similar in terms of their productivity in the export sector along this range of the productivity distribution. By contrast, an economy operating along a steeper part of this curve would have to shift relatively few workers before equality is restored in (10). That is, (if the distribution of comparative advantage is that portrayed in Figure 4), the economy that begins with many workers in the export sector will end up shifting many more workers to this sector if trade is liberalized compared with the shift that would occur in the other economy.

Putting the pieces together, the more dynamic economy starts with more workers in the export sector compared with the less dynamic economy. Given the implicit assumptions underlying Figure 4, this means that upon liberalization, more workers will ultimately shift sectors in the more dynamic economy compared with the less dynamic economy. There are then two opposing forces at work when trying to compare adjustment costs. On the one hand, workers in the more dynamic economy move more quickly through labor markets. This effect alone tends to reduce adjustment costs compared with the less dynamic economy. On the other hand, there are simply more workers to move through the system, thus tending to increase adjustment costs for the more dynamic economy.[33]

The specifics of this example are dependent upon the particular assumptions of the model.[34] However, the more general lesson is that the magnitude of adjustment costs (and the gross benefits of trade reform) depends in an important and intricate way on the dynamism of the economy's labor markets. Further research is required to determine just how robust this result is and to determine its empirical relevance.

Finally, the model presented in this paper is free of distortions. This may be a reasonable first approximation for getting at the adjustment costs associated with trade liberalization in advanced market economies, but not for developing countries that may be riddled with a variety of market distortions. Further research is necessary to explore the behavior of labor market dynamics and the associated adjustment costs in the presence of a variety of distortions.[35]

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[32] Recall, I have assumed that worker j can produce q_j units of output in the export sector, and I have chosen to number workers such that q_j is decreasing in j.

[33] To say that more workers must move upon liberalization is equivalent to the statement that a given amount of price distortion leads to a larger distortion of resources in the more dynamic economy than in the less dynamic economy.

[34] Davidson and Matusz (2000b) develop a model where adjustment costs are at their smallest for an intermediate range of transition rates, being the largest for the least dynamic and most dynamic economies

[35] Congestion externalities are a particularly interesting distortion to consider. Karp and Paul (1994) derive the optimal path of liberalization in an economy where marginal adjustment costs are increasing in the number of workers who switch sectors. They argue that under specified circumstances, the optimal path is immediate liberalization followed by a gradual phasing *in* of tariff protection, and then a gradual phasing out of that protection.

6. Conclusion.

There is no question that trade reform has significant implications for income distribution. All arguments supporting trade reform emphasize issues of efficiency. That is, absent terms-of-trade effects, the size of the economic pie is maximized when there are no trade distortions. While this may be true in a steady state, there is a real issue regarding the overall effects along the transition between steady states. If the associated adjustment costs are large enough to eradicate the lion's share of efficiency gains, then concerns over an adverse impact on income distribution might make the status quo a preferred option. Getting a sense of the overall adjustment costs, particularly as they relate to the gross benefits of trade reform, is then critically important. Surprisingly, the number of formal studies directed at this topic is extremely small. Moreover, the methodologies that have been employed have been rather rudimentary.

After a brief review of some existing evidence on adjustment costs, my purpose in this paper was to show how one might go about merging rather standard elements of general equilibrium trade theory with a dynamic labor market. The result is an explicit way to capture adjustment costs based on a small number of empirically observable parameters. The model is fairly basic, and future research should focus on elaborating both the elements of the labor market (e.g., the determinants of the transition rates) and elements of the production side of the economy (e.g., incorporating multiple factors of production and allowing for wage dynamics in addition to employment dynamics).

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Appendix

In order to simulate the model described in Section 3 of the text, I must first make some assumptions regarding the distribution of worker productivities in the export sector. Toward that end, I shall assume that

$$(A.1) \qquad q_j = q - j$$

where q is an exogenously-specified parameter, and where j is distributed uniformly on the interval $[0, q]$. In the numeric results that follow, I set $q = 2$ so that the average worker can produce one unit of the export good, which equals the quantity of the import-competing good producible by each worker.

I further simplify the model by assuming that $a_X = a_M$ and $b_X = b_M$. As pointed out in note 23, this simplification implies that the overall rate of unemployment is independent of the mix of workers between sectors. In particular, the unemployment rate remains constant throughout the entire transition path.

Finally, I assume that the economy under study is small and that the world prices of both the exportable and the import-competing good are equal to unity. With an import tariff (T), the domestic price of the import-competing good is then $(1 + T)$.

Define $l_i(T)$ as the share of the labor force (including both the employed and unemployed) associated with sector i in the steady state equilibrium. Combining (10) with the above assumptions, it is a simple matter to deduce

$$(A.2) \qquad l_X(T) = 1 - \frac{1+T}{q}$$

$$(A.3) \qquad l_M(T) = \frac{1+T}{q}.$$

Furthermore, from (A.2) and (A.3), it is evident that complete trade liberalization ultimately results in the fraction $\dfrac{T}{q}$ of the workforce moving out of the import-competing sector and into the exportable sector.

Once again turning to (10), the worker who is just indifferent between sectors has a marginal productivity $q_Z = 1 + T$. This is the same result that would obtain in a full-employment model since turnover rates in the two sectors are assumed identical. In this situation, workers only consider the wage rates in the two sectors, searching for employment in the sector with the higher wage.

Given the assumed uniform distribution of productivity, the average product of labor in the export sector (Ω_X) equals

$$(A.4) \qquad \Omega_X = \frac{q}{2} + \frac{1+T}{2}$$

while the average product of labor in the import-competing sector is simply 1. Finally, the average product of labor of those workers who switch sectors (Ω_S) is

$$(A.5) \qquad 1 + \frac{T}{2}$$

To calculate the value of output (measured at world prices) at time t, simply multiply the number of employed workers in each sector by the average product of labor of those workers.

In the numeric exercise that follows, I assume that the initial tariff rate is 10 percent and that the discount rate is 3 percent. I choose ranges for the turnover parameters in order to explore the robustness of the results.

Table A.1 shows two pieces of information. The entries contained in the first five rows of the table represent the simulated unemployment rates that emerge in the model based on the various combinations of job-acquisition (a) and job-breakup (b) rates.[36] In order to avoid the appearance of precision, I have rounded the results to the nearest whole number.

The entries in this table behave as predicted. Unemployment rates vary directly with job acquisition rates and inversely with breakup rates.

Table A.1				
	$b = .1$	$b = .2$	$b = .25$	$b = .4$
$a = 1$	9	16	20	29
$a = 2$	5	9	11	17
$a = 3$	3	6	8	12
$a = 4$	2	5	6	9
$a = 6$	2	3	4	5
ratio	23	13	11	7

The last row in the table is labeled *ratio*. Entries in this row represent the ratio of adjustment costs to gross benefits. In this context, the gross benefits of trade reform equal the present

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[36] As a reminder, these rates are not subscripted because they are assumed to be the same across sectors.

discounted value of the difference between the value of GDP subsequent to reform and the value of GDP prior to reform, where both values are computed using world prices. The adjustment costs are the present discounted value of the difference between the value of GDP prior to reform and the actual value of GDP at each instant between from the moment of liberalization through the infinite future. This ratio is almost completely insensitive to changes in job-acquisition rates but are highly sensitive to breakup rates.[37] For example, when the job breakup rate is .10 (corresponding to an average job tenure of 10 years), adjustment costs are 23 percent of gross benefits. At the other extreme, when the breakup rate is .4 (corresponding to an average job tenure of 2.5 years), adjustment costs are only 7 percent of gross benefits. Of course, the model presented here is for illustrative purposes only and these numbers should be taken with a heavy dose of salt.

Before concluding, I wish to turn to one final simulation. Data from India's National Sample Survey Data for Urban Households indicates that more than 80 percent of unemployed individuals find employment within 6 months. A back-of-the envelope calculation reveals that the average duration of unemployment is roughly 4.4 months, corresponding to a value of $a = 2.7$. The data also show that the rate of open unemployment during the period 1993-94 was very low, hovering just under 2 percent. Finally, the data indicate that breakup rates are extremely low. Fewer than 4 percent of those surveyed indicated that they changed either the nature of their work or their establishment during the preceding two years. This would correspond to a value of $b = .02$. In other words, expected job duration is 50 years.

Using $a = 2.7$ and $b = .05$, the calculated unemployment rate is 0.7 percent, which is not far from the reported value. Furthermore, the ratio of adjustment costs to gross benefits is calculated to be 60 percent. This is a very high number and results from the very slow adjustment process. The slowness of the adjustment process is evident in Figure 5, where I have graphed the calculated path taken for GDP for 10 years after liberalization.[38] In this figure, the dashed line represents the post-reform steady-state level of GDP, while the solid line represents the period-by-period level of GDP subsequent to liberalization.

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[37] The reason that the ratio does not vary with breakup rates is that the number of workers who switch sectors and ultimately become employed in the exportable sector is proportional to e^{-bt}. This is only true under the assumptions that $a_X = a_M$ and $b_X = b_M$.

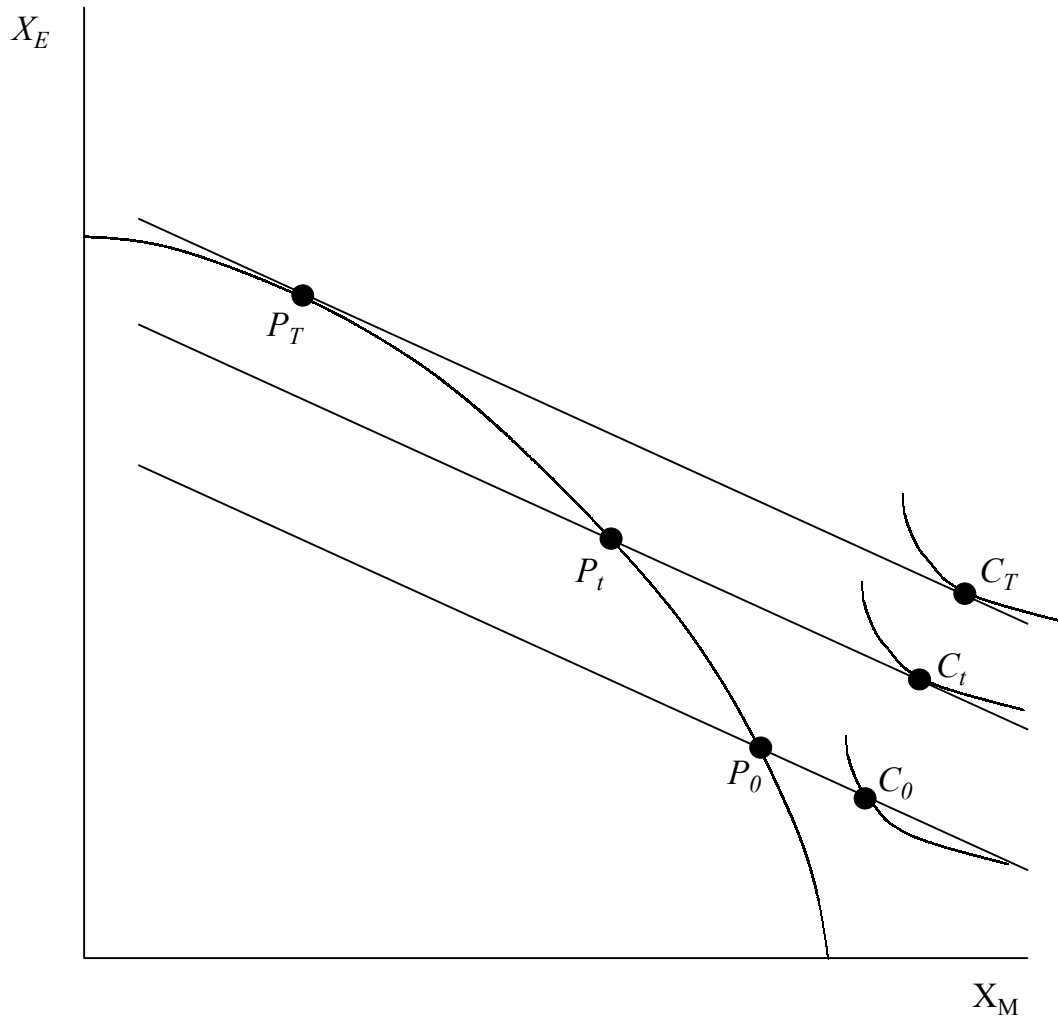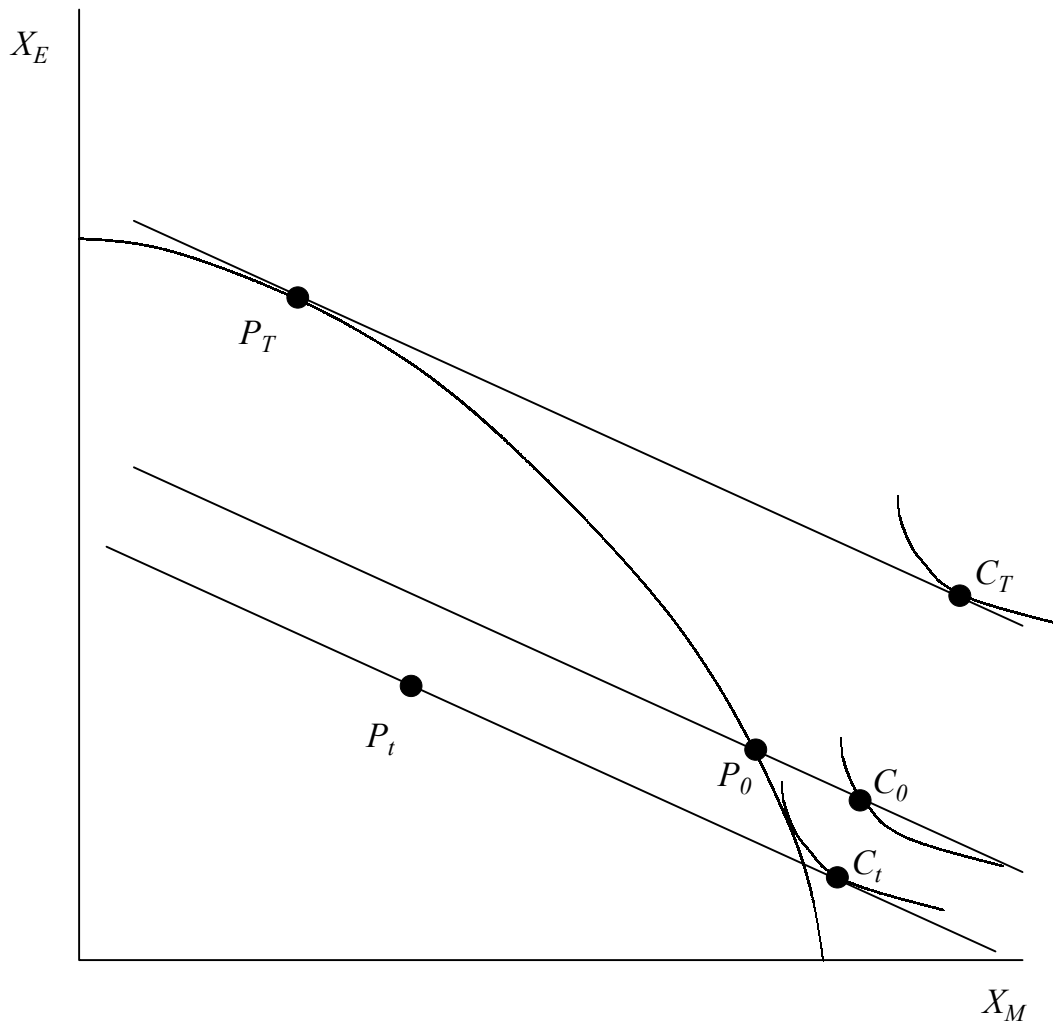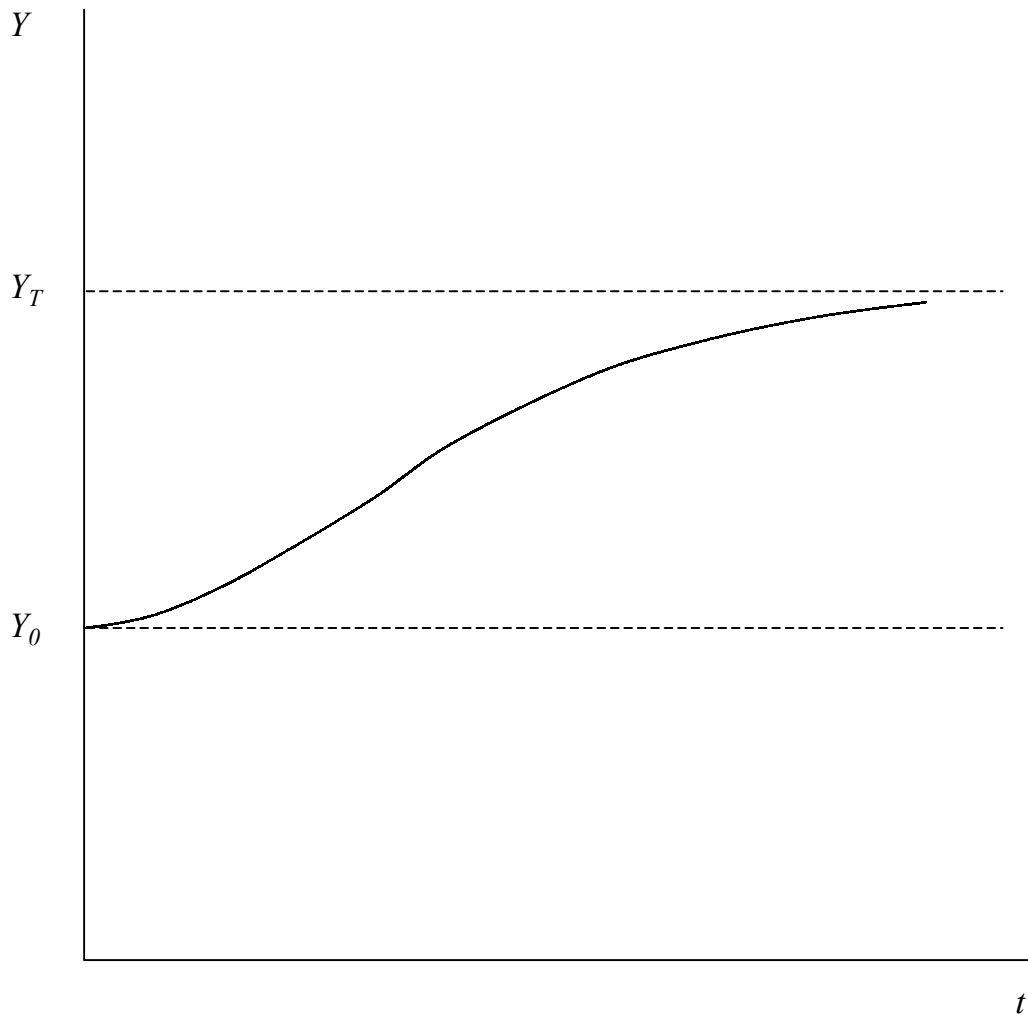[38] I have normalized GDP so that it equals 100 in the base year.
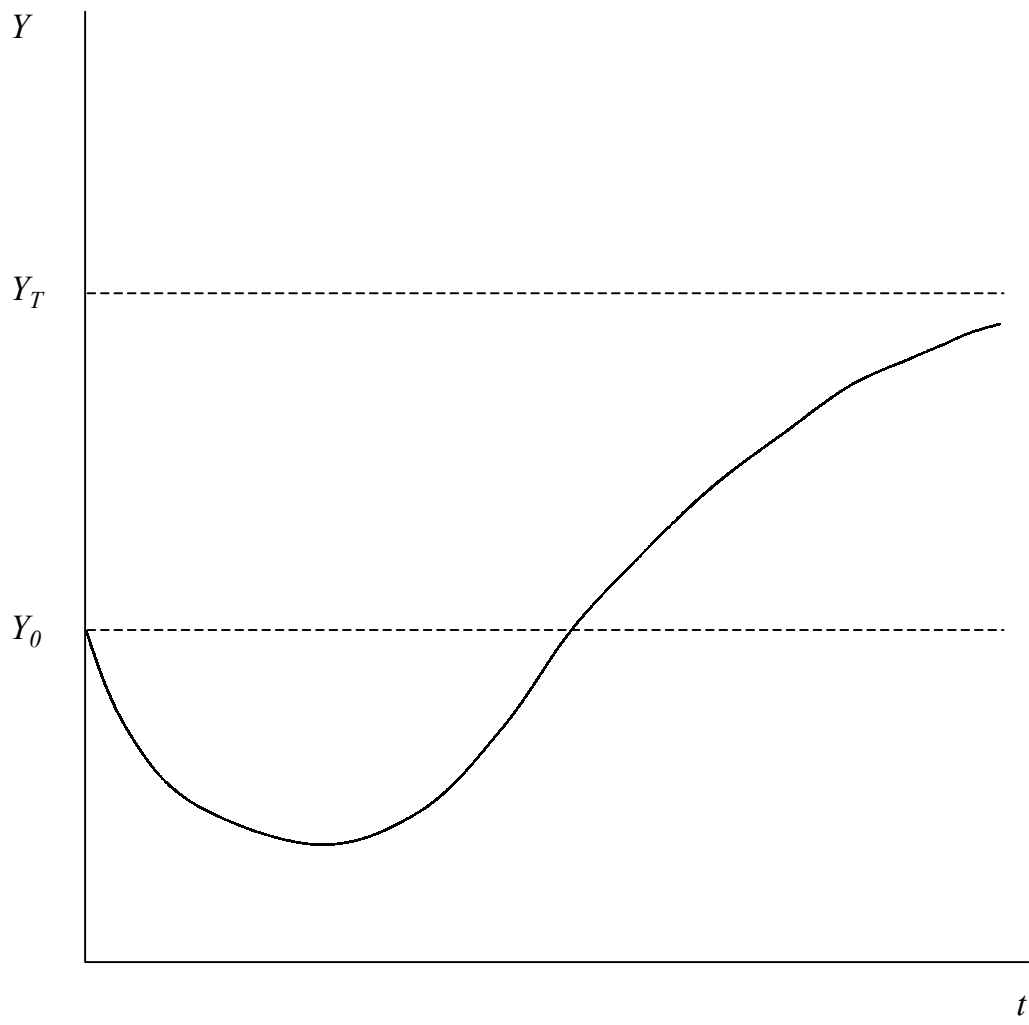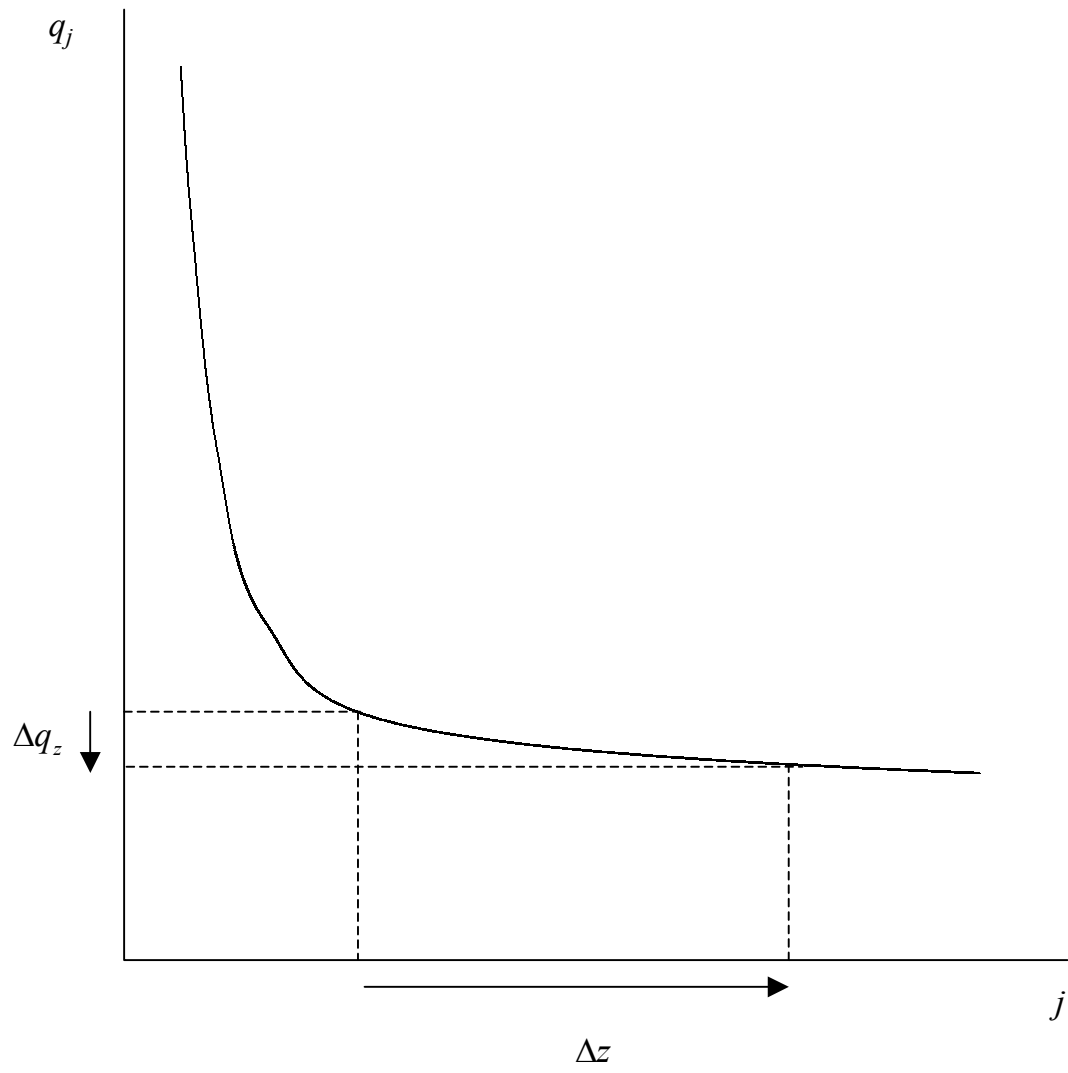
Figure 1

Figure 2

Figure 3.a

Figure 3.b

Figure 4

Figure 5