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The Trade Balance and the Real Exchange Rate

John K. Hill

Reduced Defense Purchasing: Anticipating the Impact on State and Industry Employment

Lori L. Taylor

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Contents

John K. Hill examines how the trade balance and the real exchange rate interact after an economic disturbance. Hill explains how, for disturbances likely to have a significant effect on the trade balance, real exchange rate movements are more the result of a shift in the trade balance than the cause of it. The impetus for change in the trade balance is the disturbance itself. Exchange rate movements are accommodative and, by themselves, account for only part of the total change in the trade balance. Hill concludes that to ask "How far must the dollar fall to balance the trade account?" is to seriously overestimate the extent of needed dollar depreciation.

Despite Iraq's invasion of Kuwait, budgetary pressures in the United States make significant cuts in defense purchasing seem inevitable. Lori L. Taylor analyzes the employment consequences of cutting billions of dollars in defense purchasing. She finds that while certain industries and areas would experience some economic difficulties, job losses would be negligible nationwide.

Taylor estimates the near-term and long-term effects of a 10-percent cut in real defense purchasing. Using input–output analysis, she determines which industries are defense dependent and identifies the impact on employment in each industry. She finds that all industries would lose some employment, but that job losses in certain defense-dependent industries could reach 7.5 percent. Taylor estimates that over time, however, labor displaced by defense cuts would be reabsorbed by other industries. She also finds that all states would lose at least a few jobs in the near term, but that no state would lose more than 0.5 percent of its employment if real defense purchasing declined by 10 percent. Taylor estimates that no state would gain more than 0.35 percent of its employment nor lose more than 0.25 percent of its employment in the long term.

John K. Hill
Senior Economist and Policy Advisor
Federal Reserve Bank of Dallas

The Trade Balance and the Real Exchange Rate

What role did the real exchange rate play in the deterioration of the U.S. trade balance during the 1980s? The standard view during the first half of the decade—a view often associated with Martin Feldstein—was that the federal budget deficit caused the trade deficit but that it did so through an appreciation of the dollar. To repeat the well-known chain of logic, the budget deficit raised U.S. interest rates, which caused the dollar to appreciate, which drove the trade account into deficit. During the second half of the decade, after an enormous depreciation of the dollar failed to eliminate the trade deficit, the U.S. trade problem came to be viewed increasingly as a U.S. savings problem. The trade deficit was a direct consequence of a spending binge. Little mention is made of the exchange rate. Indeed, in the view of Ronald McKinnon and other global monetarists, the exchange rate is unimportant to trade balance determination.[1]

The disparity in views on the evolution of the U.S. trade deficit points to a need for a better understanding of the relationship between a nation's trade balance and its real exchange rate. The theory of how the trade balance and the real exchange rate are jointly determined under conditions of open capital markets was worked out and published in professional journals during the early 1980s. That theory is not easily accessible, however. The purpose of this article is to provide a simplified exposition of the theory and to use it to shed light on recent and prospective events in U.S. trade history.

The central feature of the modern theory of trade balance determination is an explicit recognition of the intertemporal choices that underlie a trade imbalance. With open capital markets, aggregate spending in an economy may deviate from aggregate income, and it may do so by a significant amount for a significant period of time. The separation of spending from income is the essential meaning of a trade imbalance. To interpret trade imbalances properly, therefore, we need to understand why a nation would choose to spend beyond (or short of) its current income. So, we come to view the trade balance as a reflection of intertemporal choice.

In the intertemporal approach, disturbances with the greatest potential for generating large and persistent trade imbalances are those involving a shift in the time distribution of domestic demand or supply. Examples include a shift in preferences for consumption over time or a change in the world interest rate. In contrast, disturbances that produce a permanent change in income and spending have only small effects on the trade balance. Thus, a long-term decline in a nation's external terms of trade—due, for example, to technological advancement in other countries or the imposition of foreign trade barriers—is not likely to affect the trade balance significantly.

As commonly defined, the real exchange rate is the ratio of aggregate price levels in two countries expressed in a single currency. The real

[1] *See McKinnon and Ohno (1986). Mundell (1987) expresses similar views. Paul Krugman was the first to notice the wide disparity in views on the importance of the exchange rate to the determination of the trade balance. See Krugman (1987) and Krugman and Baldwin (1987).*

exchange rate is more meaningfully thought of, however, as a composite of two types of relative prices: a rate of exchange between tradeable goods in world markets and a rate of exchange between tradeable and nontradeable goods in local markets. In this article, I deal exclusively with the relationship between the trade balance and the domestic relative price of nontraded goods. This complements an article in the September 1989 issue of the *Economic Review*, in which Evan Koenig examined the interaction between the trade balance and the terms of trade.

Theory continues to provide a role for the real exchange rate in trade balance determination. An appreciation of the real exchange rate, as reflected in a fall in prices of goods that are traded relative to those that are not, reduces the trade balance by encouraging a movement of resources out of production of traded goods and by inducing households to substitute toward traded goods in consumption. Theory also makes clear, however, that real exchange rate movements are often simply accommodative—more the result of a shift in the trade balance than the cause of it. A nation wishing to absorb goods at a rate that exceeds its ability to produce them internally would generally like to run trade deficits across a broad spectrum of commodities. Relative prices of nontraded goods rise to ensure that any excess of demand over supply is reflected only in tradeable goods. These price adjustments serve the economic function of signaling people in the borrowing country to produce less (consume more) of what can be obtained and more (less) of what cannot be obtained from the lending country.

There are basic reasons, then, to believe that the forces causing a nation to run a trade deficit will also induce a real exchange rate appreciation and that the appreciation itself will affect the size of the deficit. How much of the total change in the trade balance can be explained by real exchange rate movements? For disturbances that cut evenly across commodities but unevenly across time, the fraction of the change in the trade balance that is induced by an accommodating adjustment in the real exchange rate is somewhat less than the share of nontraded goods in national production. In the United States, nontraded goods account for about 60 percent of gross national product (GNP). This leaves us near the middle of the two extreme positions taken by Feldstein and McKinnon. Perhaps one-half of the U.S. trade deficit can be thought of as the result of movements in the real exchange rate. But the fundamental cause of the deficit has been an autonomous shift in domestic spending, and the other half of the trade deficit is a direct consequence of that disturbance.

The model

Two ingredients are essential to a model of how the trade balance and the real exchange rate are jointly determined: (1) a framework of intertemporal optimization that provides the basic motivation for trade imbalances and (2) an explicit recognition of two types of goods—those with high transport costs and those with low transport costs—whose relative prices constitute the real exchange rate. The model I now develop is the minimal-sized model with these features. It is a simplified version of a model analyzed by Razin (1984) and Greenwood (1984).

The model is defined by the following assumptions.

1. There are two goods—one that can be costlessly shipped between countries and another that cannot be traded. The two goods are consumption goods, and they are perishable.

2. Consumers plan with perfect foresight over a two-period horizon. The domestic capital market is perfect and is fully integrated with the world capital market. The home country is small in world markets, so world interest rates are not affected by domestic disturbances.

3. Domestic production possibilities are fixed within each period. There is no capital investment, and resources are always fully employed.

4. Household preferences are separable and homothetic across time, and they are identical and homothetic across goods consumed within a period.

5. The net international asset position of the home country is initially zero.

The model recognizes only one type of intertemporal decision: household allocation of consumption over time. There is no investment. Thus, the sign of the trade balance is determined solely by the sign of national saving. The capital market is a market for consumption loans. Two individual interest rates can be defined—one for loans involving the traded good, r_T, and another for loans of the nontraded good, r_N. Arbitrage between countries equates r_T with the world interest rate on traded goods, r_T^*. International arbitrage is nonexistent in the nontraded good, however, so there is nothing to force r_N to equal r_N^*. As a result, the domestic interest rate on aggregate consumption may be influenced by conditions in local markets.

The assumptions made about household preferences help to simplify the analysis. When preferences are temporally separable, the decision concerning what total consumption expenditures should be in a period (that is, the savings decision) can be separated from the decision about how those expenditures should be divided among individual commodities. The assumption of homotheticity in preferences for goods consumed within a period ensures the existence of a cost-of-living index, *P*, that can be used to convert nominal expenditures into units of aggregate consumption. In the analysis, I express all nominal values in units of the traded good. As a result, *P* is uniquely determined by the relative price of the nontraded good.

I will use the term *p* to denote the relative price of the nontraded good. Since *p* is the only component of the real exchange rate recognized in the model, I will also refer to *p* as the real exchange rate. (See the accompanying box for a more complete discussion of the meaning of the real exchange rate.)

Chart 1 shows the conditions for intertemporal equilibrium. A representative consumer seeks the highest lifetime indifference curve by choosing a combination of present and future aggregate consumption that is financially feasible. Because of our assumption that net foreign assets are initially zero, the intertemporal budget line passes through the aggregate production point *Y*. Aggregate production in period *i* is defined by taking the value of national product in period *i* and deflating it by the cost-of-living index $P(p_i)$. The slope of the budget line represents the opportunity cost of present consumption and is given by the following:[2]

(1) $$1 + r = (1 + r_T^*)P(p_1)/P(p_2).$$

Equation 1 defines the domestic interest rate on composite goods, *r*. That rate is a product of both the world interest rate on loans of tradeable goods and a term reflecting any expected change in the domestic cost of living. Because of the nontraded good, openness of the domestic capital market is insufficient to cause an equalization of domestic and foreign aggregate interest rates. Domestic disturbances that produce an expected change in the local price of the nontraded good will be reflected in domestic interest rates but need not have an effect on rates in world markets.

Optimal aggregate consumption is determined by finding the point on the budget line that yields the highest lifetime utility. The solution occurs at point *C*, where the indifference curve labeled *W* is tangent to the budget line. In Chart 1, domestic consumers collectively choose an aggregate consumption point that lies to the southeast of the domestic production point. This means that consumers are borrowing on their future incomes to extend present consumption beyond what is provided by domestic production. National dissaving in the first period is given by $(c_1 - y_1)$. Because of the budget constraint, consumers must save next period in an amount sufficient to pay interest plus retire principal.

Charts 2 and 3 show the conditions for within-period equilibrium. The utility curves labeled U_1 and U_2 represent different combinations of traded and nontraded goods that yield given amounts of aggregate consumption. The lines that are drawn concave to the origin are production-possibilities schedules. Combinations of goods that provide a constant value of total expenditure or total product are represented by straight lines with a slope equal to the relative price of the nontraded good.

Equilibrium requires that any excess aggregate demand or supply be reflected solely in traded goods. Charts 2 and 3 depict this case.

[2] Equation 1 can be derived by asking how much additional future composite consumption is made available by the sacrifice of one unit of present composite consumption. A unit of present consumption costs $P(p_1)$ units of the traded good. A loan of this amount at the going interest rate, r_T^*, will yield $(1 + r_T^*)P(p_1)$ units of the tradeable good in the next period. Deflated by next period's cost-of-living index, this is equivalent to $(1 + r_T^*)P(p_1)/P(p_2)$ units of future composite consumption.

What Is the Real Exchange Rate?

As commonly defined, the real exchange rate is the ratio of aggregate price levels in two countries expressed in a single currency. As commonly interpreted, the real exchange rate is an implicit rate of exchange between the market baskets of goods produced in the two countries. The real exchange rate is more accurately thought of, however, as a composite of two types of relative prices: a rate of exchange between tradeable goods in world markets and a rate of exchange between tradeable goods and nontradeable goods in local markets.

To make things concrete, suppose that two countries—the home country and the foreign country—each produce three goods: goods X and M, which are traded in world markets, and good N, which is not traded internationally because of high transportation costs. Let E denote the foreign exchange value of the home country's currency, e the real exchange rate, and P_j and P_j^* the own-currency price of good j in the home country and in the foreign country, respectively. To keep the algebra simple, assume that price indexes are constructed using simple geometric averages of individual prices. Then, if all variables are expressed in logarithms, the real exchange rate can be written as

$$\text{(B.1)} \quad e = E + [aP_N + (1 - a)P_T] - [a^*P_N^* + (1 - a^*)P_T^*],$$

where

$$P_T = bP_X + (1 - b)P_M$$

and

$$P_T^* = b^*P_X^* + (1 - b^*)P_M^*.$$

In the above expressions, a and a^* represent the shares of the nontraded good in aggregate domestic production, and b and b^* are the shares of good X in total tradeable goods production.

The relationships in equation B.1 can be further simplified if we assume that international trade in goods X and M is frictionless. Cross-country arbitrage will then ensure that the common-currency prices of goods X and M are equalized across countries. Using this result, we have

$$\text{(B.2)} \quad e = a(P_N - P_T) - a^*(P_N^* - P_T^*) + (b - b^*)(P_X^* - P_M^*).$$

Equation B.2 reveals that the real exchange rate is a composite of three relative prices: the relative price of the nontraded good in the home country, the relative price of the nontraded good in the foreign country, and the rate of exchange between the two tradeable goods in world markets. Each price has a clear economic function. The internal terms of trade equilibrate local markets for nontraded goods; the external terms of trade equilibrate the world market for traded goods. To speak meaningfully about the real exchange rate, we must be specific as to which of its individual components we are referring.

The above remarks point out a basic difficulty with the theory of "purchasing power parity." According to this view, the real exchange rate tends toward a constant value over the long run, making it possible to assess the degree of overvaluation or undervaluation in a given exchange rate. It is clear from equation B.2, however, that to assume constancy in the real exchange rate is tantamount to denying the need for relative price adjustment in the face of changes in world economic conditions. As a practical matter, the real exchange rate may revert to a mean value over long periods of time. But this would be an empirical regularity, not a theoretical necessity. For a recent survey of the empirical literature on the long-run behavior of real exchange rates, see Coughlin and Koedijk (1990).

Intertemporal and Within-Period Equilibrium

Chart 1

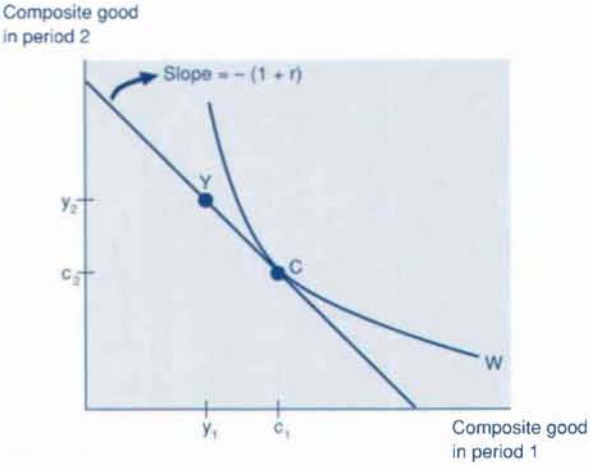


Chart 2

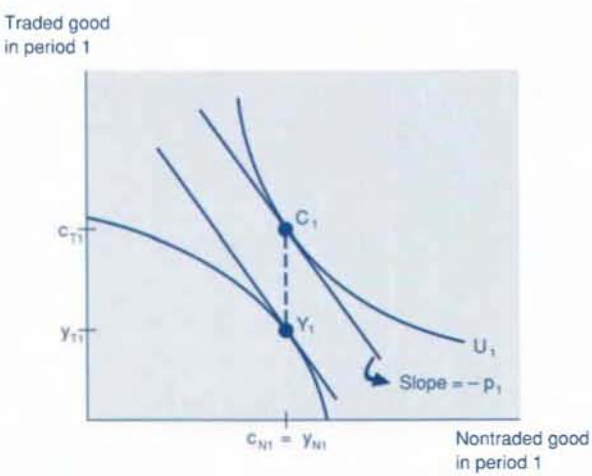
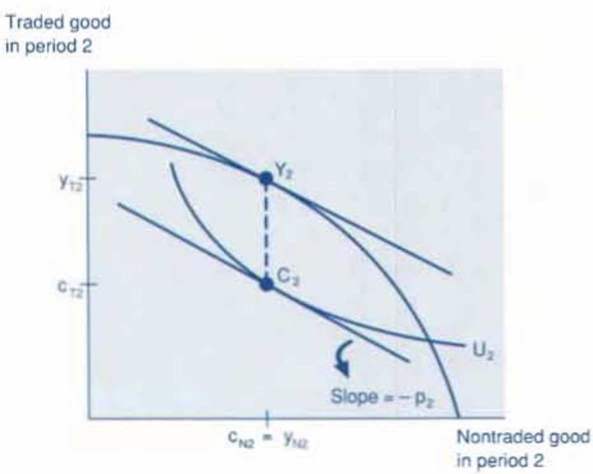


Chart 3



Given relative prices, the cheapest way of reaching utility level U_i is to consume at point C_i. The most profitable combination of product outputs occurs at point Y_i. Points C_i and Y_i involve identical quantities of the nontraded good and, therefore, are feasible. The excess domestic demand for tradeable goods in the first period is satisfied by running a trade deficit. In the second period, there is an excess domestic supply of the traded good. This is the future trade surplus that pays for the international loan received in the first period.

A general equilibrium requires that all the information in Charts 1 through 3 be mutually consistent. The aggregate consumption point C in Chart 1 must agree mathematically with points C_1 and C_2 in Charts 2 and 3. Likewise, the aggregate production point Y in Chart 1 must be consistent with points Y_1 and Y_2 in Charts 2 and 3. And the real exchange rates given by the slopes of the straight lines in Charts 2 and 3 must combine with r_T^*, through equation 1, to produce the slope of the budget line in Chart 1.

Algebraic solution of the model

The diagrams are useful in defining the equilibrium conditions of the model and in showing the first-round effects of a given disturbance. Because the diagrams are interrelated, however, they are inadequate as a general tool of analysis. For a more rigorous analysis, we must represent the equilibrium conditions by mathematical equations and solve the equations simultaneously.

The particular solution method I use highlights the two-way relationship between the trade balance and the real exchange rate. In one set of equilibrium equations, I take the real exchange rates as given and use the conditions for producer and consumer optimality to solve for the desired trade balances. In a second set of equilibrium equations, I take the trade balances as given and determine what the real exchange rates must be if local markets for nontraded goods are to clear. The two sets of equations can be solved together to find the general equilibrium. (See the Appendix for additional material relating to the algebraic solution of the model.)

How the real exchange rate affects the trade balance. If values for the real exchange rate are given, each period's trade balance can be determined from the conditions for producer and consumer optimality. The following equations describe this relationship between the trade balance and the real exchange rate:

$$(2)\text{–}(3) \qquad t_i = y_{Ti}(p_i) - c_{Ti}[p_i, c_i(p_1, p_2)], \quad \text{for } i = 1,2.$$

The trade balance, t_i, is defined as the difference between domestic supply of tradeable goods, y_{Ti}, and domestic demand for tradeable goods, c_{Ti}. Given the relative price of nontraded goods, y_{Ti} is determined by maximizing the value of national product along the production-possibilities frontier. Knowing p_1 and p_2, we can also define each period's cost of living and, therefore, the domestic interest rate. Aggregate demand, c_i, is found by maximizing lifetime utility along the intertemporal budget line. With c_i determined, a corresponding indifference curve shows alternative combinations of traded and nontraded goods that yield that particular quantity of aggregate consumption. Optimal demand for the traded good, c_{Ti}, is determined by finding the cheapest way of obtaining c_i at prevailing prices.

Equations 2 and 3 are similar to equations typically used in econometric studies of the trade balance. The crucial difference is that, in these equations, the intertemporal nature of the aggregate spending decision is explicitly recognized. In the traditional approach, current spending is expressed as a function of current income. In the intertemporal approach, current spending depends on the interest rate and permanent income.

To analyze movements in the trade balance, it is useful to express equations 2 and 3 in percentage changes. To keep the algebra simple, I will assume that, in the initial equilibrium, trade balances are zero and elasticities and budget shares are equal across time.

$$(4) \qquad \%\Delta t_1 = \%\Delta t_1^{ex} - a\varepsilon(\%\Delta p_1) - a\gamma(\%\Delta p_1) + (1 - v)\sigma[a(\%\Delta p_1) - a(\%\Delta p_2)].$$

$$(5) \qquad \%\Delta t_2 = \%\Delta t_2^{ex} - a\varepsilon(\%\Delta p_2) - a\gamma(\%\Delta p_2) + v\sigma[a(\%\Delta p_2) - a(\%\Delta p_1)].$$

Equations 4 and 5 describe any change in the trade balance (written as a percentage of initial supply of the traded good) either as the direct result of an exogenous disturbance or as a response to movements in the real exchange rate. The term $\%\Delta t_i^{ex}$ represents the direct effect of the disturbance. That is, $\%\Delta t_i^{ex}$ is the change in the trade balance that occurs independently of movements in the real exchange rate.

Exchange rate effects occur through three channels. First, the change in relative prices implied by a real exchange rate movement alters domestic production of traded goods. The size of this effect depends on the share of nontraded goods in the domestic economy, a, and the elasticity of substitution around the production-possibilities frontier, ε. Second, a change in relative prices alters the demand for traded goods by shifting the commodity composition of domestic spending. The size of this effect depends on the relative importance of nontraded goods and the elasticity of commodity substitution in consumption, γ. The first two price effects reinforce one another and contribute to an inverse relationship between the real exchange rate and the trade balance. An appreciation of the real exchange rate reduces the trade balance both by encouraging a movement of resources out of production of traded goods and by inducing households to substitute toward traded goods in consumption.

The final price effect in equations 4 and 5 is less familiar. It represents the effect of exchange rate movements on aggregate spending. An increase in the first-period real exchange rate raises the cost of living in the amount of $a(\%\Delta p_1)$. If this change is thought to be temporary, the domestic interest rate will rise. Consumers will save more in the first period and reduce their demand for both traded and nontraded goods. The strength of this effect depends on the share of present consumption in total (discounted) lifetime consumption, v, and the elasticity of intertemporal substitution, σ.

Note that the third price effect disagrees in sign with the first two. By raising the domestic interest rate, an appreciation of the real exchange rate discourages current spending and thereby *improves* the trade balance. For this effect to be significant, however, the exchange rate movement must be temporary. If it were permanent, so that $\%\Delta p_1$ equaled $\%\Delta p_2$, then the domestic interest rate would not change, and there would be no effect on aggregate spending.

How the trade balance affects the real exchange rate. The real exchange rate is not an exogenous variable. In my analysis, the real exchange rate adjusts to clear the local market for nontraded goods. This condition can be expressed in equation form as

$$(6)\text{–}(7) \quad y_{Ni}(p_i) = c_{Ni}(p_i, t_i), \quad \text{for } i = 1,2.$$

As indicated in the equations, the value of the real exchange rate that clears local markets depends on the trade balance. This relationship can be explained with reference to Charts 2 and 3. The total supply of goods to be allocated among domestic consumers consists of goods produced internally plus the net quantity of goods obtained from other countries through international borrowing and lending. In the charts, the point of total domestic supply is found by locating the domestic production point and then moving vertically up or down by the amount of the trade balance. Consumer demand is found by maximizing utility along the expenditure line that passes through the point of total domestic supply. The equilibrium real exchange rate is the relative price ensuring that domestic markets clear.

The trade balance affects the real exchange rate by altering the relative availability of goods in the economy. Trade deficits contribute to a relative shortage of nontraded goods. The real exchange rate must then rise to encourage greater production and lower consumption of nontraded goods. Trade surpluses, on the other hand, create a domestic surplus of nontraded goods and put downward pressure on the real exchange rate.

A formal statement of how changes in the trade balance affect the real exchange rate is provided in the following equations:

$$(8)\text{–}(9) \quad \%\Delta p_i = -[(\%\Delta s_i^{ex}) + (1 - a)(\%\Delta t_i)] / [(1 - a)(\varepsilon + \gamma)], \quad \text{for } i = 1,2.$$

The reciprocal of the denominator in equations 8 and 9 indicates the amount of change in p_i needed to eliminate an excess supply of nontradeables in the amount of 1 percent of initial supply. The required price adjustment is larger the more important the nontraded good is to the economy and the smaller are the elasticities of substitution in production and consumption. The term in brackets in the numerator of the equations shows the change in excess supply of nontraded goods expressed as a percentage of initial supply. Exogenous shifts in excess supply are denoted $\%\Delta s_i^{ex}$. The other source of change in excess supply is the trade balance. A rise in the trade balance in the amount $\%\Delta t_i$ lowers national expenditures by $(1 - a)(\%\Delta t_i)$ and the demand for nontradeables by an equal percentage. Shifts in the trade balance then cause a change in the real exchange rate that is opposite in sign to the change in the trade balance.

Equations 4, 5, 8, and 9 provide a general framework for analyzing movements in the trade balance and the real exchange rate. As is clear from the equations, both the trade balance and the real exchange rate are endogenous to the domestic economy. Neither can change without an initiating disturbance or shock. In the analysis to follow, I will classify disturbances into two types: *intertemporal shocks*—those that directly affect the trade balance but have no direct effect on the real exchange rate—and *commodity shocks*—those that directly affect the real exchange rate and may or may not affect the trade balance.

Analysis of intertemporal shocks

Intertemporal shocks are disturbances that alter the trade balance without directly affecting relative prices within a period. Examples include a shift in intertemporal preferences, a change in the world interest rate, or a change in domestic production possibilities that is even across commodities but uneven across time. In algebraic terms, an intertemporal shock is defined by the following conditions: $\%\Delta t_1^{ex} \neq 0$, $\%\Delta t_2^{ex} \neq 0$, $\%\Delta s_1^{ex} = 0$, and $\%\Delta s_2^{ex} = 0$ with $v(\%\Delta t_1^{ex}) + (1 - v)(\%\Delta t_2^{ex}) = 0$.

Charts 4 through 6 illustrate the effects of a fall in the world interest rate. To keep things simple, I assume that the trade account is balanced initially. A decline in r_T^* affects the domestic economy by lowering the domestic interest rate. The intertemporal budget line in Chart 4 rotates counterclockwise through the aggregate production point. Optimal consumption moves from point C to point C'. Households decide to con-

Effects of a Decline in the World Interest Rate

Chart 4

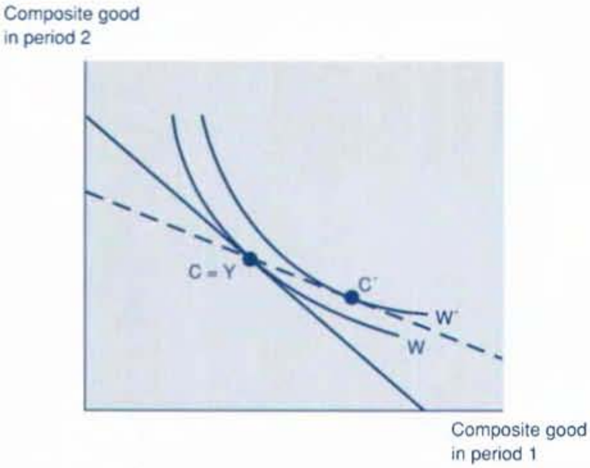


Chart 5

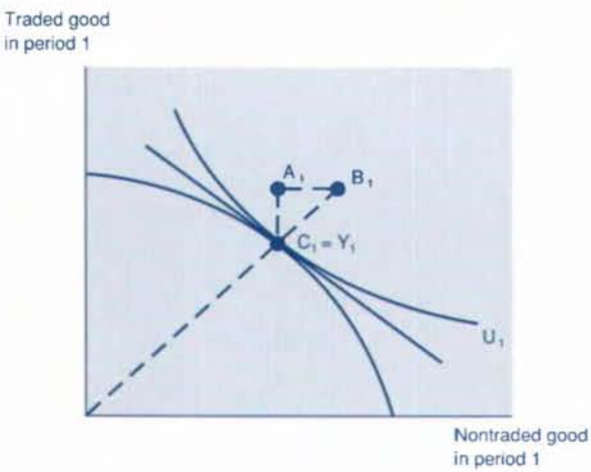
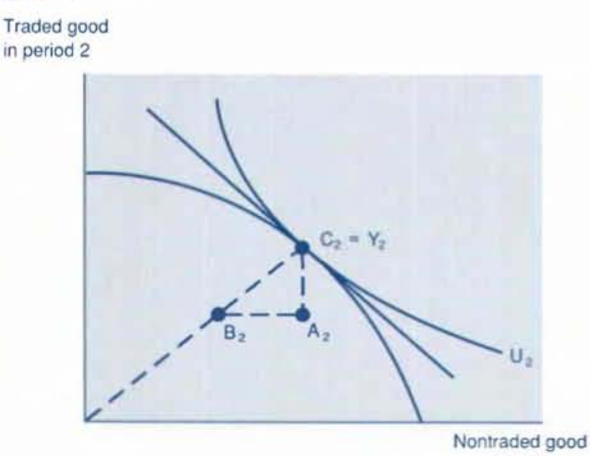


Chart 6



sume more in the present period by borrowing in the international capital market. The loan will be reflected in a balance of trade deficit. The cost of the trade deficit is not reduced domestic output. Aggregate production remains at point Y. The real cost of the trade deficit is that future consumption must fall to provide the future trade surplus that must be used to pay off the loan.

The drop in the world interest rate affects the real exchange rate through its effect on aggregate spending. At constant relative prices, commodity demands shift from C_i to B_i in Charts 5 and 6. Any excess demand or supply of tradeable goods can be satisfied in world markets. The home country can simply run a trade deficit in the first period equal to the distance A_1C_1 and a trade surplus in the second period equal to A_2C_2. Supplies of nontraded goods, on the other hand, are limited by domestic production capacity. At constant prices, there will be a present shortage and a future surplus of nontraded goods. For local markets to clear, the relative price of nontraded goods must rise in the first period and fall in the second period.

While the diagrams are accurate in defining the direction of movement in the trade balance and the real exchange rate, they fail to account for a variety of feedback effects. When relative prices change, so will the domestic interest rate; a change in the interest rate will affect aggregate spending; this, in turn, will prompt a further adjustment in relative prices; and so on. For questions requiring an explicit recognition of feedback effects, the analysis must be carried out using equations 4, 5, 8, and 9.

One such question is the one with which I began the article: What is the role of the real exchange rate in explaining movements in the trade balance? As the equations clearly show, the real exchange rate plays a significant yet distinctly accommodative role. For disturbances involving a shift in the time distribution of demand or supply, the original impetus for a movement in the trade balance comes from the disturbance itself. Changes in the real exchange rate occur in response to and can be explained in terms of shifts in the trade balance. Movements in the real exchange rate reflect relative price adjustments that help to streamline the process of intertemporal exchange in the face of frictions arising from the nontradeability of some goods and services. In turn, these price adjustments *do* feed back upon the trade balance. The price effects will, however, explain only part of the total change in the trade balance.

How much of the change in the trade balance can be attributed to exchange rate movements? The answer is given below.

$$(10) \qquad (\Delta t_1 - \Delta t_1^{ex})/\Delta t_1 = a - a[\sigma/(\varepsilon + \gamma)].$$

Provided that σ is less than $(\varepsilon + \gamma)$—so that the aggregate spending effect in equation 4 is relatively small—exchange rate effects will be reinforcing, moving the trade balance in the same direction as the initial disturbance did. How large is the right side of equation 10 likely to be? Empirical estimates indicate that σ is very low, near zero. Suppose we use a value of 0.2 for σ. The parameters ε and γ are not well estimated, but they are thought to be somewhat larger than σ, especially the elasticity of transformation in production. For the sake of calculation, assume that $(\varepsilon + \gamma)$ equals 1. The final parameter, a, is the share of nontraded goods in national production. For the United States, a is close to 0.6.[3] Where does this leave us? The answer is, about 0.5. Roughly one-half of the movement in the trade balance can be attributed to movements in real exchange rates.

Analysis of commodity shocks

Commodity shocks are disturbances with a direct effect on relative prices within a period. In the context of my model, commodity shocks involve an exogenous shift in excess supply of the nontraded good. In some cases, there may also be an exogenous shift in the trade balance. In general, we may have $\%\Delta t_1^{ex} \neq 0$, $\%\Delta t_2^{ex} \neq 0$, $\%\Delta s_1^{ex} \neq 0$, and $\%\Delta s_2^{ex} \neq 0$.[4]

Charts 7 and 8 illustrate the effects of an exogenous drop in production of tradeable goods that occurs at the same rate in the two periods. In Chart 7, aggregate production moves from point Y to point Y'. Optimal consumption, which begins at point Y, ends up at point Y'. All the decline in national output is absorbed by consumption; saving remains constant (at zero). We can use Chart 8 to reason through the effect of the disturbance on the real exchange rate. At constant prices, production moves from Y_i to Y_i'. Commodity demands shift from C_i to B_i. There is an excess supply of nontraded goods and an excess demand for traded goods. Thus, the relative price of nontraded goods must fall in each period.

The diagrams suggest the following conclusion: A permanent drop in tradeable goods production lowers the real exchange rate but has no effect on the trade balance. How is this possible? The key is that the disturbance has a direct effect on the trade balance. At constant prices, the trade balance falls by ad percent, where d is the rate of decline in output of traded goods. The shock also lowers the relative price of nontraded goods by $d/(\varepsilon + \gamma)$ percent in each period. These price changes improve the trade balance by encouraging greater production and lower consumption of traded goods. But the price effects, which are represented by the second and third terms on the right side of equations 4 and 5, simply combine to offset the direct effect of the disturbance.

In general, commodity shocks that are even across time have strong implications for the real exchange rate but little or no effect on the trade

[3] *The share of nontradeables in domestic economic activity is often measured by the fraction of gross domestic product (GDP) accounted for by construction, transportation and public utilities, wholesale and retail trade, financial services, business services, social and community services, and government. In the United States, these industries constitute roughly 70 percent of GDP. I adjust this number downward somewhat to account for the increasing tradeability of some services.*

[4] *These terms may, of course, not be independent. They should be specified from a more primitive description of the disturbance. Consider, for example, the case of exogenous economic growth. Let g_{ji} denote the exogenous rate of increase in production of good j in period i. Then,*

$$\%\Delta t_i^{ex} = g_{Ti} - [v(\%\Delta y_1) + (1 - v)(\%\Delta y_2)]$$

and

$$\%\Delta s_i^{ex} = g_{Ni} - (\%\Delta y_i),$$

where

$$\%\Delta y_i = a g_{Ni} + (1 - a) g_{Ti}.$$

balance. Consumers do not borrow in the face of a permanent decline in income because they believe themselves to be equally poorer in all periods. If the decline in income is expected to be temporary, however, consumers will borrow to maintain their present consumption. In this case, the trade balance will worsen.

An important class of commodity shocks is that defined by a change in a country's external terms of trade. Events that affect an economy by altering its terms of trade include the imposition of foreign trade barriers, a decline in international competitiveness due to foreign economic growth, and oil price shocks. From an analytical viewpoint, the effects of a decline in the terms of trade are analogous to the effects of an exogenous drop in domestic production of tradeable goods.[5] Thus, our previous exercise has a surprisingly broad range of application.

Consider the case of foreign trade barriers. Whether they are in the form of import tariffs, quotas, or restrictive internal marketing agreements, foreign trade barriers reduce demand for products exported by other nations and, consequently, lower their price. Is there reason to think that a nation faced with a deterioration in its terms of trade will respond by running a trade deficit? Repeating our previous conclusion, foreign trade barriers will cause trade deficits in exporting nations only if the barriers are temporary. If they are considered permanent, trade barriers will have little effect on trade balances. Exporters are, of course, not indifferent to foreign trade restraints. Their real incomes will be lower as a result. But the response to a permanent fall in income is to reduce consumption, not to run a trade deficit.[6]

Effects of a Decline in the Production of Tradeable Goods

Chart 7

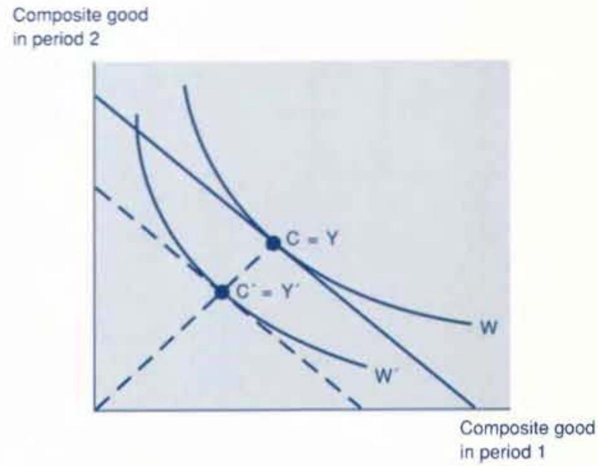
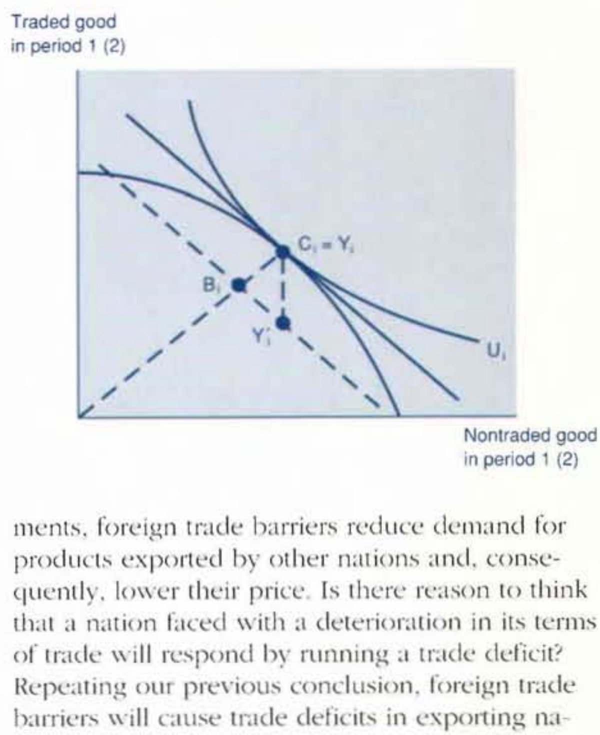


Chart 8



[5] Additional assumptions are required to make this analogy precise. One approach is to assume that preferences for consumption within a period are separable in traded and nontraded goods and that the subutility function over individual traded goods is homothetic. The indifference map in Charts 2 and 3 then will show household preferences for composite consumption of traded goods and consumption of the nontraded good. The "production-possibilities" schedule will show combinations of the two composite goods the country can consume if it is allowed to trade with other nations within a period but not over time. The schedule will depend not only on the state of technology and domestic resource supply but also on the external terms of trade. If the terms of trade deteriorate, less y_{T_1} is available for any given y_{N_1}. For a general analysis of the effects of changes in the terms of trade on the trade balance, see Svensson and Razin (1983).

[6] This line of argument is precisely that used by Sachs (1981) to explain the lack of a persistent correlation between relative oil dependence and the size of the trade deficit in individual countries after the 1973 oil price hike. Immediately after the price increase, many oil importers, including the United States, saw their trade accounts deteriorate. Given perception lags and the costs of adjusting consumption, this fact is not surprising. During the 1975–78 period, however, the deficits of many oil-importing nations returned to previous levels. In the end, oil dependence determined the extent of a nation's real income loss but not the size of its trade deficit.

Understanding the 1980s

The behavior of the U.S. trade balance changed radically during the 1980s (Chart 9). In the previous decade, trade imbalances were relatively small (within 1 percent of GNP), and they were temporary. Then, the U.S. trade account steadily deteriorated from a position of approximate balance in 1980 to a deficit of more than 3 percent of GNP by 1987. The trade balance has improved somewhat since that time, but it remains between –1 percent and –2 percent of GNP.

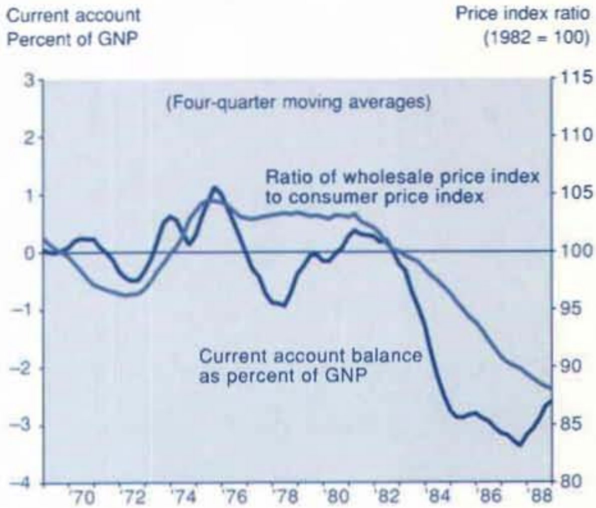
What can account for the growth in the trade deficit? As we have seen, the disturbances with the greatest potential for generating large and persistent shifts in the trade balance are intertemporal shocks—those with a direct effect on the time distribution of demand or supply. Discussed below are three intertemporal shocks frequently cited as contributing to the U.S. trade deficit. Each has the effect of encouraging foreign indebtedness, which is manifest in a trade deficit.

Growth in the U.S. federal budget deficit. Budget deficits raise aggregate spending when the implied future tax liabilities are not fully recognized by households. In effect, deficit spending brings about a substitution of present consumption for future consumption. This process could be represented in Chart 1 by a shift in intertemporal preferences toward greater current consumption.

Decontrol of capital flows. As discussed in Frankel (1989), a liberalization of controls on capital outflow by Japan and other major countries during the late 1970s and early 1980s was also an important factor behind the flow of funds to the United States. The deregulation of foreign capital flows reduced U.S. interest rates from what they otherwise would have been. This fact may explain why the massive U.S. budget deficits failed to produce a noticeable rise in U.S. interest rates.[7]

Cyclical movements in investment. As noted by Koenig (1989) and others, some of the movement in the U.S. trade balance during the first half of the 1980s can be attributed to cyclical swings in U.S. investment demand. Investment spending was weak during the 1981–82 recession. It then showed unusual strength in 1983–84

Chart 9
U.S. Current Account and Relative Price of Tradeable Goods



SOURCES OF PRIMARY DATA: International Monetary Fund. U.S. Bureau of Labor Statistics.

(partly in response to temporary tax incentives) before returning to more normal levels. In our model, investment can be thought of as an activity that siphons resources from the production of consumption goods. A temporary surge in investment reduces the nation's capacity to produce consumption goods in the present period and thereby encourages international borrowing.

Concurrent with the decline in the U.S. trade balance was a fall in the domestic relative price of traded goods (Chart 9). This price movement contributed to the trade deficit by squeezing domestic manufacturing industries and encouraging households to consume more foreign products. In isolation, these effects seem arbitrary and capricious. This perception, I suspect, is the source of much public confusion regarding the origin of the trade deficit—for example, attributing the deficit to un-

[7] This analysis leaves unexplained why, in the presence of barriers to capital outflow, interest rates would be lower in Japan and other countries than in the United States. As I have shown elsewhere (Hill 1990), the relatively high level of U.S. interest rates can be predicted simply on the basis of differences in the age distributions of the populations of the major industrialized countries.

fair foreign trade practices or a loss of international competitiveness.

If the shocks that produced the U.S. trade deficit were primarily intertemporal in nature, however, the fall in the relative price of traded goods was more the result of the trade deficit than the cause of it. And the domestic adjustments in production and consumption caused by this price change were, in themselves, desirable. If you are going to run a trade deficit, it is preferable that you produce less and consume more of what you can get from the other party. If there is any problem with the whole process, it is with the root cause—the shock itself. Thus, one may reasonably object to the loss of future consumption that is implied by a government budget deficit. But trying to block the microeconomic adjustments without reducing the budget deficit will only exacerbate the welfare loss.

Conclusion

In this article I have tried to provide a simple exposition of the theory of how the trade balance and the real exchange rate are determined in a country with an open capital market. The theory offers some important general principles that can help us interpret past and future developments in the international sector of the economy.

Of the numerous principles revealed in the theory, two are especially noteworthy. First, both the trade balance and the real exchange rate are *endogenous* to the domestic economy. Neither can change without an initiating disturbance in domestic preferences, domestic production possibilities, or prices in world markets. Since the disturbance itself is likely to have direct effects, movements in either the trade balance or the exchange rate generally cannot be explained solely as a response to movements in the other.

A second important principle is that the relationship between the trade balance and the real exchange rate is *bidirectional*. Too much emphasis is often placed on the causality that runs from the exchange rate to the trade balance and not enough on the causality that runs the other way. Indeed, for disturbances that primarily involve a shift in the intertemporal distribution of demand or supply—disturbances that are most capable of explaining large and persistent shifts in the trade balance—the more primitive direction of causality is the one that runs from the trade balance to the real exchange rate. Intertemporal disturbances have a direct effect on the trade balance but no direct effect on the real exchange rate. Movements in the exchange rate accommodate shifts in the trade balance.

These basic principles must be well appreciated if we are to anticipate correctly future developments in the economy. For example, the factors having the greatest potential to reverse the U.S. trade deficit—including reductions in the federal budget deficit, an aging of the population, or a cutoff in foreign lending—are all intertemporal disturbances. Accordingly, the initial impetus for deficit reduction will come from the disturbances themselves. A decline in the trade deficit *is* likely to be accompanied by a depreciation of the real dollar. But that depreciation itself will explain only part of the ultimate improvement in the deficit. Studies that ask "How far must the dollar fall to balance the trade account?" are likely to overestimate seriously the extent of needed dollar depreciation.

Appendix

Derivation of the Algebraic Solution Technique

This Appendix demonstrates how the algebraic solution technique used in the text can be derived from a basic set of equilibrium conditions. The basic conditions are given below, together with comments about the nature and meaning of the conditions.

Intertemporal consumer optimality

(A.1) $MRS\,(c_1,c_2) = 1 + r.$

[Marginal rate of intertemporal substitution equated to $(1 + r)$]

(A.2) $1 + r = (1 + r_T^*)P(p_1)/P(p_2).$

[Equation 1 in text]

(A.3) $(1 + r)c_1 + c_2 = (1 + r)y_1 + y_2,$

where

$y_i = (y_{Ti} + p_i y_{Ni})/P(p_i).$

[Intertemporal budget constraint]

Within-period producer optimality

(A.4)–(A.5) $G_i(y_{Ni},y_{Ti}) = 0,$ for $i = 1,2.$

[Production-possibilities frontier]

(A.6)–(A.7) $G_{Ni}/G_{Ti} = p_i,$ for $i = 1,2.$

[Marginal rate of transformation equated to p_i]

Within-period consumer optimality

(A.8)–(A.9) $c_i = U(c_{Ni},c_{Ti}),$ for $i = 1,2.$

[Periodic utility function]

(A.10)–(A.11) $U_{Ni}/U_{Ti} = p_i,$ for $i = 1,2.$

[Marginal rate of commodity substitution equated to p_i]

Market-clearing conditions

(A.12)–(A.13) $c_{Ni} = y_{Ni},$ for $i = 1,2.$

Definition of trade balance

(A.14)–(A.15) $t_i = y_{Ti} - c_{Ti},$ for $i = 1,2.$

Equations A.1–A.15 constitute a set of 15 equations in as many unknowns. To solve the model, I reduce the complete system to a set of four equations in the four unknowns t_1, t_2, p_1, and p_2. These equations are represented in the text by equations 2–3 and 6–7.

To obtain equations 2–3, I ignore the requirement that domestic markets for nontraded goods must clear and use the conditions for consumer and producer optimality to express the desired trade balances in terms of given values for the real exchange rate. This process can be accomplished through the following steps. First, use equations A.4–A.7 to express optimal product supplies in terms of the real exchange rates. We then

(Continued on the next page)

Appendix—*Continued*

have the first half of the expression for the trade balance, as defined in equations A.14–A.15. Second, combine the product supply functions with equations A.1–A.3 to find optimal aggregate consumption. Then use this result, together with equations A.8–A.11, to define demand for the traded good. These calculations provide the second half of the trade balance equation.

Equations 6–7 in the text, in effect, express each period's real exchange rate in terms of given values for the trade balance. In deriving these equations, local markets for nontraded goods are required to clear, and consumers and producers are assumed to have optimally allocated resources within a period. But it is not necessary that wealth be optimally allocated between consumption in different time periods. In equations 6–7, expressions for the supply of nontraded goods again come from equations A.4–A.7. Expressions for the demand for nontraded goods are derived by combining the supply functions with equations A.10–A.15. This problem is equivalent to one of maximizing periodic utilities subject to the following budget constraints:

$$\text{(A.16)–(A.17)} \quad c_{Ti} + p_i c_{Ni} = y_{Ti}(p_i) - t_i + p_i y_{Ni}(p_i), \quad \text{for } i = 1,2.$$

By formulating the problem in this way, we see that trade imbalances affect the market for nontraded goods by altering the general level of expenditures and, therefore, the demand for nontraded goods.

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Lori L. Taylor
Economist
Federal Reserve Bank of Dallas

Reduced Defense Purchasing: Anticipating the Impact on State and Industry Employment

The prospect of cutting defense purchasing by billions of dollars has some people concerned about significant job losses nationwide. Such concerns overstate the role of defense purchasing in the U.S. economy. Although the U.S. Department of Defense spends nearly $150 billion a year on defense contracts, these expenditures represent less than 3 percent of gross national product (GNP). Therefore, some workers and firms may experience considerable difficulty adjusting to the new economic environment, but substantial cuts in defense purchasing would affect the nation's economy only marginally.

Defense purchasing may play only a minor role in the national economy, but it plays a major role in some industries and states. In this article, I use input–output analysis to estimate by industry the near-term effect on employment of a uniform cut in defense purchasing. Using the industry results and data about each state's industrial mix, I also estimate the near-term effect on employment of defense purchasing cuts on a state-by-state basis. I find that if real defense purchasing fell by 10 percent, defense-dependent industries, such as aircraft or ordnance manufacturing, could lose up to 7.5 percent of their employment, but no state would lose more than 0.5 percent of its employment in the near term.

Over time, the economy will find new uses for the labor displaced by cuts in defense purchasing. I use a modified input–output model to estimate the long-term reabsorption of labor by industries and find that some industries, such as wholesale and retail trade, will absorb more labor in the long term than they lose in the near term. I estimate that reabsorption will also mean smaller employment losses in the long term than in the near term in all states. Some states, like some industries, will absorb more labor in the long term than they lose in the near term. Extrapolating from each state's history of job creation, I estimate that no state will gain more than 0.35 percent or lose more than 0.25 percent of its employment in the long term.

The economic impact of a decrease in consumer demand

A cut in defense purchases of a product, such as aircraft, would have the same qualitative effects as any substantial decrease in civilian demand for the product. Firms that produce aircraft or their component parts lay off part of their work force. Marginal firms in the industry go out of business. Sales decline for firms that supply the industry. People who lose work in aircraft-related industries reduce their spending and start looking for other work, thereby putting downward pressure on wages, retail sales, and housing prices. Meanwhile, as taxable incomes and property values decrease, displaced workers demand more social services, such as family counseling or unemployment assistance. Because the sources of revenue fall at the same time that demand for government services increases, budgetary pres-

I would like to thank Stephen P. A. Brown, William C. Gruben, and Gerald P. O'Driscoll for their comments and suggestions. All remaining errors are my responsibility. I would also like to thank Paul Dalberth and Edith Adams for their research assistance.

sures may increase for local governments.

Over time, however, the economy finds new uses for the labor displaced by purchasing cuts. Some workers migrate in search of work, while others find local jobs in a different industry. Migration and reemployment reduce demand for local social services and put upward pressure on local wages. Housing and retailing recover. Firms learn to produce goods for new customers, and state economies diversify. The only lasting impact of the cut in purchasing is the redistribution of capital and labor among industries and across states.

The near-term effects on industry

Because defense budgeting is a highly political and protracted process, many defense contractors can anticipate cuts well in advance and can adjust their purchases of inputs accordingly. Defense contractors may cancel purchases of raw materials or component parts in anticipation of cuts. Defense employees who anticipate layoffs may start saving for a period of unemployment, causing retail sales to fall. Thus, the advanced warning disrupts the usual timing of direct effects followed by indirect (or multiplier) effects. Therefore, I will treat the near-term effects on industries and states jointly rather than separating them into direct and multiplier effects.

The most recent input–output model of the United States identifies industries that sell final goods and services to the U.S. Department of Defense.[1] The model also describes the historical relationships among industries that produce defense goods and services, industries that produce component parts, and industries that produce consumer goods and services for the employees of the other two categories. The model indicates, for example, that every $100 the government spends directly on airplanes initially generates $4 worth of indirect business in the electronics industry and $6 worth of indirect business in wholesale and retail trade. Further, through multiplier effects, the $4 in the electronics industry leads to 2 cents worth of business in the electrical supplies industry and an additional 35 cents worth of business in wholesale and retail trade.[2]

Because the input–output model describes the interrelationships in the economy, I use it to calculate the effect of a uniform, 10-percent reduction in real defense purchasing on the output of each industry, compounded by the changes in output of every other industry.[3] I use employment data for each industry to translate those output losses into job losses.

Not surprisingly, the industries that would be most affected by a cut in defense purchasing produce arms and ammunition. The ordnance industry would lose almost 7.5 percent of its employment if defense purchases were cut by a uniform 10 percent. The aircraft manufacturing industry would lose slightly more than 5 percent of its employment. Other strongly affected industries manufacture communication equipment, electronic components, ships, and tanks. In the near term, the percentage of job losses in these industries would be more than ten times the average losses in all other industries. Chart 1 illustrates the percentage of job losses for selected industries.

Cuts in aircraft manufacturing would have the greatest effect on the national economy. Although the ordnance industry would lose a greater percentage of jobs than the aircraft industry, the aircraft industry is at least eight times larger than the ordnance industry. If real defense purchasing were cut by a uniform 10 percent, no industry would lose more jobs than aircraft manufacturing. Job losses in the aircraft industry would account for almost 13 percent of total job losses in the country.

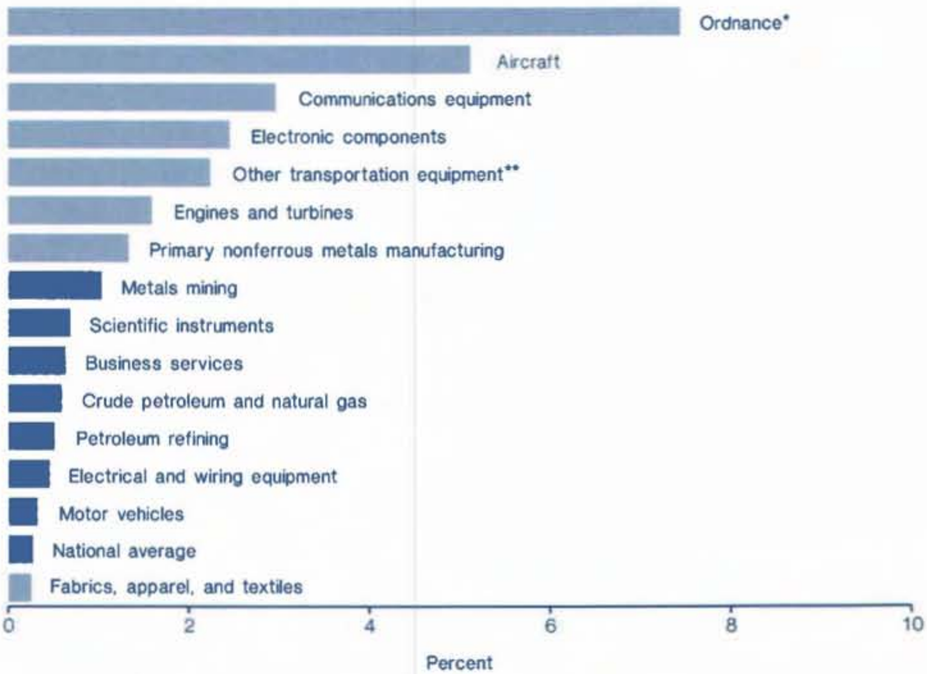
Industries that supply the most-affected industries would experience moderate job losses. Manufacturers of engines and turbines—suppliers

[1] *For a more detailed description of input–output analysis, see Appendix A.*

[2] *This example uses numbers from the 1977 input–output model of the U.S. economy.*

[3] *I assume that cuts in defense purchasing will be uniform. In actuality, Congress will cut some programs dramatically and leave other programs virtually untouched. If the cuts in any program are substantially greater than 10 percent, then the industries involved in that program would lose more than the estimated number of jobs. Similarly, if the cuts are substantially lower than 10 percent, then the job losses would be below the estimate. Changes in industry estimates would, of course, translate into new estimates for state job losses.*

Chart 1
Employment Losses from a 10-Percent Cut in Defense Purchases for Selected Industries



* Ordnance includes arms, ammunition, tanks, guided missiles, and space vehicles.
** Boats, ships, railroad equipment, motorcycles and bikes, travel trailers, and mobile homes.

to the aircraft, ship, and tank industries—would lose 1.6 percent of their employment. Steel and iron manufacturers would lose 0.86 percent of their employment, while the manufacturers of other metals—such as aluminum—would lose 1.34 percent of their employment. Manufacturers of electrical and wiring equipment stand to lose 0.46 percent of their employment if defense purchasing falls by a uniform 10 percent.

Even industries that sell little to the U.S. Department of Defense or its suppliers would lose jobs through multiplier effects. Demand for consumer goods and services would fall slightly while the former employees of defense-related industries look for new work. For example, retail and wholesale trade stands to lose 0.17 percent of its employment in the near term if real defense purchases decrease by 10 percent.

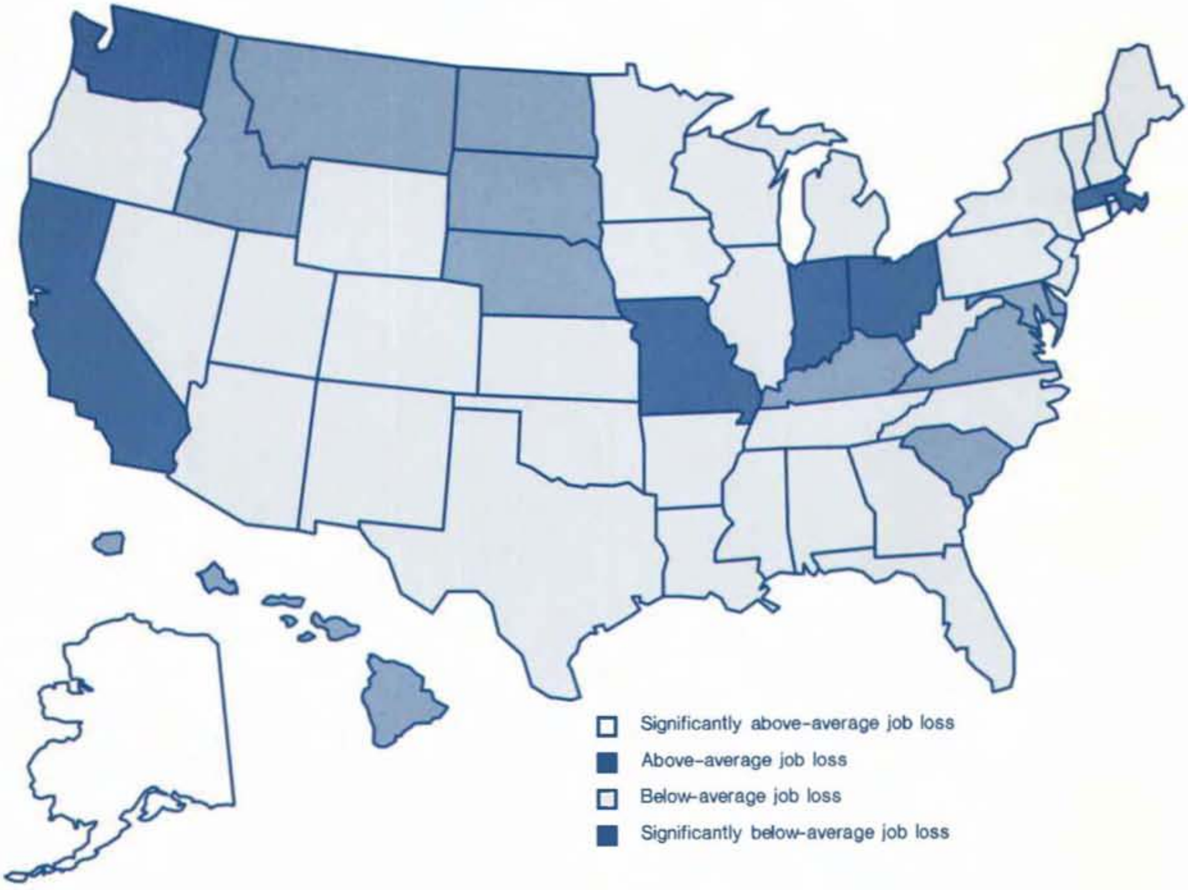
Across industries, a substantial cut in defense purchasing would lead to a small, near-term reduction in total employment nationwide. A 10-percent cut in real defense purchasing would displace approximately 300,000 employees, or less than 0.28 percent of total employment. Since 1985, national employment has increased by an average of 300,000 jobs every six weeks.

The near-term effects on states

The regional impact of defense purchasing cuts depends on the distribution of affected industries. States with high concentrations of ordnance or aircraft manufacturing would experience much greater employment losses than states without such concentrations.

Data on gross state products (GSP) identify each state's industrial composition. I use these data to translate near-term industry effects into state effects by assigning each state a share of industry employment according to its share of industry output. By assumption, if Alabama produces 10 percent of the country's shoes, 10 per-

Chart 2
The Near-Term Employment Impact of Uniform Defense Purchasing Cuts



cent of the country's shoe manufacturing jobs are in Alabama.[4]

In the near term, defense purchasing cuts would cause relatively large percentage-rate employment declines in Connecticut and Alaska. The rate of employment losses in Connecticut would be almost twice the national average. Connecticut would lose 0.44 percent of its employment, or almost 7,500 jobs, if Congress cut real defense purchasing by 10 percent.

In contrast, states in the Upper Great Plains and the Mid-Atlantic region have relatively small shares of affected industries and should lose few jobs from purchasing cuts. Chart 2 illustrates the relative impacts of decreased defense purchasing on states.

Connecticut would have the greatest percentage of job losses because firms that manufacture military transportation equipment and electronics play dominant roles in the state's economy. On the other hand, South Dakota would have the smallest percentage of job losses from purchasing cuts because it produces few defense-related products and supplies few defense contractors. South Dakota would lose only 0.12 percent of its employment, or less than 400 jobs, if Congress cut real defense purchasing by 10 percent.

[4] *Technically, I assume that the production function for any good is independent of the state in which the factory is located.*

In all but two of the states with above-average employment losses, the transportation equipment industries would lose the most jobs from defense purchasing cuts. In Alaska, the mining industry would lose the most jobs, while in Massachusetts the electronics industry would lose the most jobs.

Multiplier effects push Ohio, Indiana, and Alaska into the category of states with above-average employment losses. In Ohio, for example, total job losses in primary metals manufacturing should exceed losses in electronics or communications equipment. In Indiana, total losses in primary metals manufacturing should exceed losses in ordnance manufacturing.

Because the level of direct defense spending includes military payroll and does not account for subcontracting and multiplier effects, it is a poor indicator of job losses from purchasing cuts. Direct defense spending accounts for roughly 15 percent of Virginia's GSP, but most of those dollars go to military payroll. A 10-percent cut in real defense purchasing would reduce Virginia's employment by less than 0.2 percent.[5] In contrast, Ohio's and Indiana's shares of direct defense spending in GSP are well below the national average, yet multiplier effects would lead to above-average employment losses in those states.

Although average job losses would be negligible in many states, specific communities within those states might still experience significant job losses. Analysis at the state level blurs significant employment changes at the local level. Some communities would experience job losses significantly greater than their state's average. Other communities may lose no jobs at all. The state employment effects are better estimates of local employment effects when all parts of the state are integrated into a single economy. In states with many regional economies, such as California or Texas, local economic effects may differ dramatically from the state average.

The long-term effects on industries

Labor is a very versatile input. Over time, the economy will find new uses for the labor displaced by defense cuts, and the national economy will return to full employment. In the process, the distribution of industries will change slightly. Defense-dependent industries, such as ordnance and aircraft manufacturing, will play smaller roles in the national economy. Industries that absorb significant quantities of displaced labor will play somewhat larger roles.

Two factors will minimize the redistributional effects of defense purchasing cuts on industries. First, the labor displaced by defense purchasing cuts represents only a small fraction of the national labor supply. Second, many industries will reabsorb labor in the long term, diffusing the impact of any cuts. Because a relatively small quantity of labor will be distributed over a wide variety of industries in the long term, no industry's employment would increase by more than 0.33 percent of its initial employment following a uniform 10-percent cut in real defense purchases.

The long-term employment change by industry equals the reabsorbed labor minus labor losses in the near term. I estimate the industry absorption of labor by industry shares in total employment. I assume that each industry will absorb labor in proportion to its share in national employment, after the near-term adjustments. For example, if shoe manufacturers employ 1 percent of the economy's labor after defense purchasing cuts and the multiplier effects, then shoe manufacturing will absorb 1 percent of the displaced labor.

The wholesale and retail trade industry, which employs more workers than any other industry, should absorb the most labor in the long term. Twenty-one percent of the new jobs after redistribution should be in trade. During the adjustment, wholesale and retail trade will recover the 0.17 percent of the employment it lost in the near term, and it will add an additional 0.16 percent to its work force in the long term.

Even defense-related industries should reabsorb some labor in the long term. The aircraft industry should recover 6 percent of its near-term losses through reabsorption. The ordnance and communications equipment industries should recover 4 percent and 11 percent of their near-term losses, respectively.

[5] *Clearly, cuts in military personnel stationed in the state would significantly increase the job losses in Virginia.*

Industries that sell relatively little to the U.S. Department of Defense or its suppliers are most likely to absorb more labor in the long term than they lose in the near term. In general, suppliers of agricultural products would add jobs in the long term. Other industries poised to gain workers are consumer service industries, such as suppliers of entertainment or health services; public enterprises, such as public utilities or transportation agencies; leather goods industries, such as shoe manufacturers and tanners; and manufacturers of household durables, such as furniture and fixtures.

The long-term effects on states

The long-term effects of defense cuts on states equal the reabsorbed labor minus the near-term employment losses (see Appendix B). Some states should absorb more labor in the long term than they lose in the near term. Other states will absorb too little labor to compensate for near-term losses. Each state's absorption of labor depends on its pattern of job creation.

Several state characteristics influence job creation and employment growth (see Wasylenko and McGuire 1985, Wheat 1986, and Carlino and Mills 1987). High wages or high rates of union activity characterize many slow-growth states. Other characteristics of slow growth include high taxes, high energy usage, and cool climates. Characteristics that encourage growth include wealthy populations, good transportation facilities, and high educational expenditures (as a share of income).

Each state's growth rate depends on its combination of characteristics. The state with the nation's lowest growth rate over the past thirty years—New York—combines high energy use, high taxes, and low educational expenditures (as a share of income) to more than counter the slight advantage of a wealthy population and average wages (Wasylenko and McGuire 1985). In Pennsylvania, low educational expenditures, high wages, and high energy use swamp the positive growth effects of low taxes and a wealthy population. Florida benefits from particularly low wages, warm weather, and low taxes that dominate the state's poor educational spending and above-average energy use. In Alaska, very strong educational expenditures and a wealthy population affect employment growth more strongly than the state's high wage costs and energy requirements.

If the geographic distribution of characteristics that significantly influence state employment growth remains stable, then the states that have created the most jobs in the past are the most likely to create jobs in the future.[6] Thus, states with the highest historical growth rates for employment appear to be the states most likely to reabsorb the labor displaced by defense purchasing cuts.

Historically, Nevada, Alaska, Arizona, and Florida created jobs faster than other states. Over the past thirty years, employment in each of these states grew at a rate more than double the national average of 2.4 percent annually. These states should absorb relatively more labor than other states in the long run.

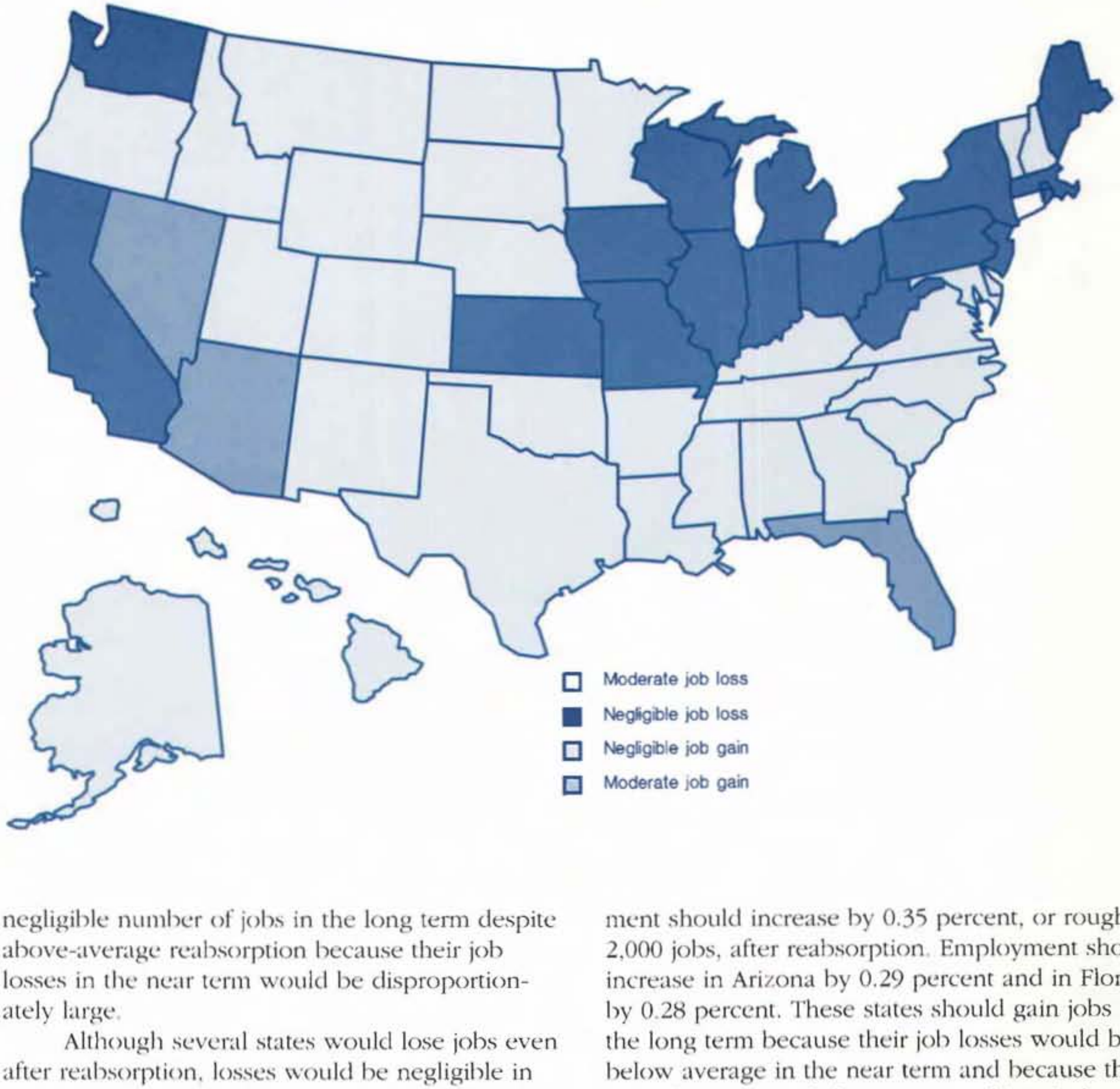
On the other hand, employment growth rates have been lowest in New York, Pennsylvania, and Illinois. Employment in these states grew at a rate less than one-half the national average during the same period. Consequently, they should absorb a smaller share of the labor displaced by cuts in defense purchasing.

Using the relative growth rates of each state to estimate the reabsorption of displaced labor reinforces historical population trends. States in the Sun Belt, and to a lesser extent the Great Plains, absorb more labor in the long term than they lose in the short term, thereby gaining jobs. States in the Midwest and New England lose jobs. Chart 3 illustrates the long-term effect on employment of a cut in defense purchasing.

Long-term reabsorption cannot completely offset near-term job losses in most states with above-average near-term losses. Alaska, one of the fastest-growing states, is the exception. Barring significant changes in the state's growth characteristics, Alaska should gain a negligible number of jobs in the long term. On the other hand, California and Washington would lose a

[6] Of course, if state characteristics changed dramatically in the near term, the pattern of resource reabsorption would also change. However, because the model predicts generally insignificant employment changes in the near term, state characteristics should remain stable.

Chart 3
The Long-Term Employment Impact of Uniform Defense Purchasing Cuts



negligible number of jobs in the long term despite above-average reabsorption because their job losses in the near term would be disproportionately large.

Although several states would lose jobs even after reabsorption, losses would be negligible in every state except Connecticut. Connecticut's industrial mix leads to the greatest proportional job losses in the near term, and the state's employment growth rate historically has been low. Connecticut would lose 0.24 percent of its employment, or roughly 4,000 jobs, in the long term if defense purchasing were cut by 10 percent.

Three states—Nevada, Arizona, and Florida—should gain significantly more jobs than all other states in the long term. Nevada should gain the most jobs, proportionally. Nevada's employment should increase by 0.35 percent, or roughly 2,000 jobs, after reabsorption. Employment should increase in Arizona by 0.29 percent and in Florida by 0.28 percent. These states should gain jobs in the long term because their job losses would be below average in the near term and because they have demonstrated above-average historical growth.

The long-term reallocation of resources increases employment in some states and reduces the impact of defense cuts in adversely affected areas. Although Connecticut would remain the most adversely affected state, reallocation would cut the state's employment losses almost in half. In the long term, no state would lose more than one-fourth of 1 percent of its employment due to defense purchasing cuts.

Conclusions

Because defense purchasing represents less than 3 percent of GNP, even substantial cuts would have a negligible effect on the national economy. A uniform 10-percent cut in defense purchasing would reduce employment nationally by less than 0.3 percent in the near term.

Although all industries would lose at least some jobs in the near term, only five industries—ordnance, aircraft, communication equipment, electronic components, and other transportation equipment—stand to lose more than 2 percent of their total industry employment. Of these industries, most of the jobs lost would be in aircraft.

State economies would experience a variety of job losses from purchasing cuts in the near term. States in the Great Plains would lose fewer jobs than the national average, while states with significant defense-related industries would lose more jobs than the national average. In all states, however, the average impact should be small. In Connecticut—the state most affected by defense purchasing cuts—employment should fall by less than 0.5 percent in the near term.

In the long term, a cut in defense purchasing would force the national economy to redistribute labor slightly. The nation would return to full employment, but the industrial mix of the economy would have changed. Labor migration because of the cuts will have accelerated changes in demographics. States in the Great Plains and Sun Belt would gain some jobs at the expense of states in New England and the Midwest, but even the state with the largest job losses—Connecticut—would lose less than 0.25 percent of its employment in the long term.

Appendix A

Input–Output Analysis: A Simple Description
by Linda C. Hunter[1]

The purpose of input–output analysis is to properly estimate the total amount of a commodity that should be produced by an economy. Because goods are used as inputs in the production of other goods, the total output of one commodity will depend on the input requirements of this commodity by other industries. Because industries are interdependent, input–output analysis requires solving a system of simultaneous equations.

An input table is a matrix that describes the interdependence of industry inputs and outputs.[2] Define a_{ij} as the amount of good i used in the production of good j. The production of commodity j will require a_{1j} amount of good 1, a_{2j} amount of good 2,...., and a_{nj} amount of good n, assuming that there are n commodities in the economy. The symbol a_{ij} is called the *input coefficient*. The analysis assumes that the input coefficients are fixed numbers. The input–output matrix A is made up of the elements of a_{ij}:

$$(A.1) \qquad A = \begin{matrix} a_{11} & a_{12} & a_{13} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & \cdots & a_{2n} \\ a_{31} & a_{32} & a_{33} & \cdots & a_{3n} \\ \cdot & \cdot & \cdot & \cdots & \cdot \\ \cdot & \cdot & \cdot & \cdots & \cdot \\ \cdot & \cdot & \cdot & \cdots & \cdot \\ a_{n1} & a_{n2} & a_{n3} & \cdots & a_{nn} \end{matrix}$$

Each column of A specifies the amount of each commodity required in the production of the good pertaining to that column. In other words, the second column of A defines the amounts of commodities 1 through n required to produce one unit of good 2. The second row of the matrix defines the amount of good 2 required in the production of one unit of commodities 1 through n. In addition to the n industries, an open input–output model contains a household sector that exogenously determines a final demand for the product. This household sector supplies a primary input not produced by the n industries. In an open model, the sum of the input coefficients is less than one.

$$(A.2) \qquad \sum_{i=1}^{n} a_{ij} < 1, \text{ for } i = 1,....,n.$$

The amount of the primary input needed to produce one unit of commodity j equals

$$(1 - \sum_{i=1}^{n} a_{ij}).$$

The total amount of commodity 1 required by an economy is defined by the following equation:

$$(A.3) \qquad x_1 = a_{11}x_1 + a_{12}x_2 + a_{13}x_3 + ... + a_{1n}x_n + d_1,$$

where d_1 is the final demand of good 1. Equation A.3 can be rewritten as:

$$(A.4) \qquad (1 - a_{11})x_1 - a_{12}x_2 - a_{13}x_3 - ... - a_{1n}x_n = d_1.$$

(Continued on the next page)

Input–Output Analysis: A Simple Description—*Continued*

Equation A.4 is generalized for the entire system on *n* equations using the following matrix notation:

$$\text{(A.5)}\quad \begin{bmatrix} (1-a_{11}) & -a_{12} & \cdots & -a_{1n} \\ -a_{21} & (1-a_{22}) & \cdots & -a_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ -a_{n1} & -a_{n2} & \cdots & (1-a_{nn}) \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ \vdots \\ d_n \end{bmatrix},$$

or, more simply,

$$\text{(A.6)}\quad [I-A]X = D.$$

The matrix $[I - A]$ is called the *technology matrix.* The total amount of all commodities that should be produced in the economy is determined by

$$\text{(A.7)}\quad X = [I-A]^{-1}D.$$

[1] *Linda C. Hunter, a former economist at the Federal Reserve Bank of Dallas, is a visiting assistant professor at San Diego State University.*

[2] *For a more detailed description of input–output analysis, see Chiang (1974, 123–30).*

Appendix B

Calculating the Long-Term Effects of Defense Cuts

The long-term redistribution of labor requires separate analysis for industries and for states. Caution should be used, therefore, when interpreting the impact on specific industries in specific states.

Calculating state effects

I use historical patterns of employment growth to estimate geographic reabsorption. Using data from the U.S. Bureau of Labor Statistics, I calculate a constant annual rate of employment growth (β) for each state during the period 1958–88, where

$$\text{Ln(employment)} = \alpha + \beta \cdot \text{(time)}.$$

Labor displaced in the near term is then assigned to states to preserve the relative rates of employment growth.

$$L_i = \Delta L \frac{\beta_i \cdot E_i}{\Sigma(\beta_i \cdot E_i)},$$

where L_i is the number of workers absorbed in state *i*, ΔL is the total number of workers displaced in the near term, β_i is the annual rate of growth in employment for state *i*, and E_i is the total employment in state *i* in the year corresponding to the most recent input–output table of the United States (1983).

Therefore, the long-term percentage change in state employment will be

$$\text{Long-Term Change} = (L_i - \Delta L_i)/E_i,$$

where ΔL_i is the number of jobs lost in the state in the near term.

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