Real Exchange Rates, National Price Levels, and the Peace Dividend

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The crumbling of the Berlin Wall in Germany in 1989, the dismantling of Communist Party control of Central and Eastern European governments in 1990, and the dissolution of the Soviet Union in 1991 have created the opportunity for substantive reductions in military expenditures in the United States and Europe. This paper addresses conceptually and empirically some of the issues surrounding the potential structural impacts of disarmament upon an open economy's allocation of capital and labor between tradable and nontradable goods, upon the relative price of tradables and nontradables, and upon the nation's price level relative to a world average. Theoretically, the effects of military spending reductions on these variables is ambiguous: the effects depend upon the relative factor intensities in production of civilian versus military goods *and* those of civilian tradable versus nontradable goods, as well as upon the relative importance in utility of civilian tradable versus nontradable goods. Empirically, the model suggests that the effects of disarmament on the relative demand for and relative supply of nontradables to tradables are economically and statistically significant. However, because military spending reductions will tend to increase the relative supply only slightly more than the relative demand, their relative price (i.e., the real exchange rate) is predicted to decline by only a small amount. Consequently, lower military expenditures are predicted to result in a small real depreciation of a country's currency and, thus, only a minor fall in the national price level relative to the world average.

I. Fiscal Policies and Real Exchange Rates

Since U.S. national defense expenditures ($314 billion in 1990) comprise 74 percent of all U.S. federal government purchases of goods and services ($424 billion in 1990), a large cut in military expenditures would cause a substantive reduction in government purchases, the so-called "peace dividend." The effects of arms reductions on the economy depend, of course, upon how this potential peace dividend is used. The potential impacts upon national outputs, real interest rates, real exchange rates, and national price levels may differ significantly if military spending reductions are used to reduce the federal budget deficit, as opposed to decreasing taxes or increasing transfer payments.

International macroeconomic analysis of changes in government purchases has typically considered the cases in which such changes alter the government's budget surplus or deficit. Using a traditional asset-market analysis, such as in William Branson (1985), a reduction in government military

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expenditures would reduce the (assumed prevailing) federal budget deficit, reducing the supply of government bonds. In the goods market, a reduction in public dissavings causes a decline in real interest rates, shrinking the difference between private savings and gross private domestic investment, and it also causes a decline in the real exchange rate, shrinking net foreign borrowing. However, if the military expenditure reduction is accompanied by an equivalent tax reduction (i.e., a balanced-budget military spending reduction), there would be no impact on the real interest rate or the real exchange rate in this traditional asset-market approach.[1]

More recently, economic analysis of fiscal policies has addressed international and intertemporal considerations simultaneously based upon microeconomic foundations. For instance, Jacob Frenkel and Assaf Razin (1986) construct a model with tradable and nontradable goods. The real exchange rate is (the inverse of) the relative price of the nontradable in terms of the tradable. The assumption of perfect world capital markets ensures that national real interest rates equal the world rate. Government and representative consumers' budgets are intertemporally balanced; tastes are homothetic. Equilibrium necessitates that in the current period *exogenous* domestic and foreign outputs of the tradable are demanded, with government absorption exogenous. Also, in each country in each period, *exogenous* outputs of the nontradable are demanded, with government absorption again exogenous.

Both of these approaches share a common emphasis upon intertemporal considerations, detailing the relationship between the real interest rate (the intertemporal relative price) and the real exchange rate (the intratemporal relative price). However, both approaches also share a common deemphasis on intratemporal *supply* considerations; national outputs are determined exogenously. Maurice Obstfeld (1989) recently emphasized this point by noting that factor markets and endogenous supplies of tradables and nontradables also can be a major channel for transmitting fiscal-policy shocks internationally. The present paper addresses this issue by considering theoretically the impact of balanced-budget reductions in government (military) expenditures upon the relative price of nontradables in terms of tradables (i.e., the real exchange rate) with endogenous production decisions of competitive firms and factor mobility between the two sectors, but not internationally.[2] I also enhance the demand side by considering *nonhomothetic* preferences, in contrast to the assumption of homothetic utility common to most previous analyses. In order to make the issues of endogeneity of production and nonhomotheticity of tastes more transparent, I forgo intertemporal considerations, since these considerations have been dealt with extensively in the studies mentioned above and references therein. My analysis results in estimable structural and reduced-form equations for relative prices and outputs of nontradables to tradables using the carefully constructed data of the United Nations' International Comparisons Project (ICP). The empirical results suggest that intratemporal demand and supply channels have potentially important impacts upon relative national price levels.

II. Relative National Price Levels and Military Expenditures

Theories of exchange-rate determination have been long intertwined with the notion

[1]In Branson's analysis, national output is held constant "at a standardized "full-employment" level of output, in order to exclude cyclical effects" (Branson, 1985 p. 36).

[2]The assumption of balanced-budget reductions in government expenditures is consistent with current U.S. policy proposals to reduce defense expenditures and tax liabilities proportionately, and it focuses on structural impacts of reduced military spending in isolation from budget-deficit changes. Frenkel and Razin (1987), although largely addressing impacts of budget-deficit changes, also consider balanced-budget government changes (pp. 321–7). In their analysis, effects of balanced-budget changes in government spending depend on relative intertemporal and intratemporal *spending* parameters.

of purchasing power parity (PPP); for excellent surveys, see Lawrence Officer (1982) and Rudiger Dornbusch (1988). PPP is traditionally expressed in either absolute or relative terms. The absolute version of PPP states that, in the absence of transport costs and similar frictions, the general price *level* in the home country (say, in dollars) should equal that in the foreign country (say, in marks) divided by the exchange rate (marks/dollars). The relative version of PPP states that *changes* in the general price level in the home country over a period of time should equal that in the foreign country, adjusted for exchange-rate changes.

Empirical evidence compiled from the United Nations' ICP and discussed in Irving B. Kravis and Robert E. Lipsey (1988) and Robert Summers and Alan Heston (1991) suggests that countries' relative national price levels depart systematically from absolute PPP across pairs of countries and from relative PPP for prolonged periods between pairs of countries. The notion that countries' national price levels should depart systematically from absolute PPP is not new. Officer (1982 p. 125) notes that Pigou "was the first to criticize absolute price parity on the grounds that, if one decomposes the general price level of each country into the price level of traded and that of nontraded commodities, there is no reason for the ... tradable/nontradable price ratio to be the same in each country."

In this paper, I consider how changes in government military expenditures might alter the real exchange rate and general price level of a small open economy through both intratemporal supply and demand channels, similar in spirit to the analysis in Bergstrand (1991). On the supply side, I assume a standard simple general-equilibrium framework similar to that in Ronald W. Jones (1965) for the production of two goods: tradables (T) and nontradables (N). Tradables and nontradables are consumed by both civilian (X_T^C, X_N^C) and military (X_T^M, X_N^M) sectors. Military absorption is exogenous, similar to government absorption in the framework of Frenkel and Razin. Tradables and nontradables are produced using two factors: capital (K) and consumer-workers (L), the endowments of which are fixed intratemporally. Factors are mobile between industries, but not internationally. Perfectly competitive firms are assumed to minimize costs given the constant-returns-to-scale technology, yielding the optimum input requirements per unit output β_{ij} ($i = \mathrm{K,L}$; $j = \mathrm{N,T}$). Each β_{ij} is a function of the relative factor price (i.e., the wage rate, W, relative to the rental rate on capital, R) and the state of productivity of factor i in industry j (τ_{ij}). An assumption of full employment of both factors yields:

$$(1)\qquad \beta_{LT}X_T^C + \beta_{LT}X_T^M + \beta_{LN}X_N^C + \beta_{LN}X_N^M = L$$

$$(2)\qquad \beta_{KT}X_T^C + \beta_{KT}X_T^M + \beta_{KN}X_N^C + \beta_{KN}X_N^M = K.$$

In a competitive equilibrium with tradables and nontradables produced, unit costs must reflect market prices of the goods:

$$(3)\qquad \beta_{LT}W + \beta_{KT}R = P_T$$

$$(4)\qquad \beta_{LN}W + \beta_{KN}R = P_N$$

where all factor prices (W, R) and goods prices (P_N, P_T) are expressed in terms of a monetary unit.

With some mathematical manipulation (derivations are available from the author upon request), the production framework can be solved for the supplies of civilian tradables and civilian nontradables as functions of the price of nontradables relative to tradables (or real exchange rate [p]), endowments of capital and labor, and productivity levels of capital and labor. Moreover, the function for the supply of civilian nontradables relative to civilian tradables $(X^C)^S$ can be derived in readily estimable (inverse) form:

$$(5)\quad \ln p = \alpha_0 + (1/\alpha_1)(\ln X^C)^S + (\alpha_2/\alpha_1)\ln K - (\alpha_3/\alpha_1)\ln L - (\alpha_4/\alpha_1)\ln \Pi_N + (\alpha_5/\alpha_1)\ln \Pi_T + (\alpha_6/\alpha_1)(\ln x_T^M + \ln x_N^M)$$

where Π_T (Π_N) is the productivity level in tradables (nontradables) and x_T^M (x_N^M) is per capita military expenditures on tradables (nontradables). In this model, α_1 is the elasticity of transformation in civilian production. Formally,

$$\alpha_1 = \big[\lambda_K^C(\lambda_{LT}\theta_{KT}\sigma_T + \lambda_{LN}\theta_{KN}\sigma_N) + \lambda_L^C(\lambda_{KT}\theta_{LT}\sigma_T + \lambda_{KN}\theta_{LN}\sigma_N)\big] / \lambda^C(\theta_{LN} - \theta_{LT})$$

which is positive, where λ_i^C is the share of factor i in civilian (tradables and nontradables) production, λ_{ij} is the share of factor i in producing (civilian and military) good j, θ_{ij} is the share of good j's price going to factor i, σ_j is the elasticity of substitution of factors in producing good j (defined positively), and $\lambda^C = \lambda_{KT}^C\lambda_{LN}^C - \lambda_{LT}^C\lambda_{KN}^C$.[3] The parameter α_2 equals λ_L^C/λ^C, and α_3 equals λ_K^C/λ^C; both are positive (negative) if civilian nontradables are labor-intensive (capital-intensive) in production. The parameter α_4 equals $\alpha_1 + [\lambda_K^C(\lambda_{LN} - \lambda_{KN})/\lambda^C]$, and α_5 equals $\alpha_1 + [\lambda_L^C(\lambda_{LN} - \lambda_{KN})/\lambda^C]$; both are positive. Finally, α_6 equals $(\lambda_L^M - \lambda_K^M)/\lambda^C$. If civilian nontradables are labor-intensive in production, then α_6 will be positive if the share of labor used for military production exceeds the share of capital for such production. The effect of military expenditures on the relative price and outputs of civilian tradables and nontradables depends upon relative factor intensities of civilian versus military goods and of civilian tradables versus nontradables.

On the demand side, I assume that a representative consumer maximizes the nonhomothetic Stone-Geary utility function for civilian goods:

$$(6) \qquad u = \left(x_T^C - \bar{x}_T^C\right)^{\delta}\left(x_N^C - \bar{x}_N^C\right)^{1-\delta} \qquad 0 < \delta < 1$$

[3]I assume that a good's factor intensity is consistent between physical-factor and factor-reward definitions; stability requires the denominator of α_1 to be positive.

where x_T^C (x_N^C) is the per capita amount consumed of tradables (nontradables) in the civilian sector and $\bar{x}_T^C$ ($\bar{x}_N^C$) is an exogenous minimum-consumption requirement for the civilian sector for the tradable (nontradable). As in the framework of Frenkel and Razin, the consumer derives no utility from the government purchases. Assume the budget constraint

$$(7) \qquad y = x_T^C + px_N^C + \text{taxes}$$

where y is per capita income and taxes $= x_T^M + px_N^M$, both expressed in terms of the tradable (the numeraire). Per capita military expenditures are $x_T^M + px_N^M$.

With some mathematical manipulation, this utility structure can be solved for the demands for civilian tradables and civilian nontradables as functions of the price of nontradables in terms of tradables, real per capita income, and per capita military expenditures. The function for the demand for civilian nontradables relative to civilian tradables $(X^C)^D$ can be derived in readily estimable (inverse) form:

$$(8) \quad \ln p = \phi_0 - (1/\phi_1)(\ln X^C)^D + (\phi_2/\phi_1)\ln y - (\phi_3/\phi_1)\ln(x_T^M + px_N^M).$$

In this context,

$$\phi_1 = 1 + \left\{\left[(1-\delta)p^{-1}(x_T^M + px_N^M) - \delta\bar{x}_N^C\right]/x_N^C - \left[\delta(\bar{x}_N^C + x_N^M)p\right]/x_T^C\right\}$$

which is likely positive and close to unity. Next,

$$\phi_3 = \left(x_T^M + px_N^M\right) \times \left[(1-\delta)x_T^C - \delta px_N^C\right]/px_N^Cx_T^C$$

which can be positive or negative. Finally,

$$\phi_2 = \phi_3 + \left(x_T^C + px_N^C\right) \times \left[(1-\delta)\bar{x}_T^C - \delta p\bar{x}_N^C\right]/px_N^Cx_T^C$$

which should tend to have the same sign as ϕ_3.

The relative price of nontradables in terms of tradables, or real exchange rate, can now be solved for as a reduced-form function of the intratemporal supply and demand factors:

$$(9)\quad \ln p = (\alpha_1 + \phi_1)^{-1}\big[(\phi_0\phi_1 - \alpha_0\alpha_1) + \alpha_5 \ln \Pi_T - \alpha_4 \ln \Pi_N + \alpha_2 \ln K - \alpha_3 \ln L + \phi_2 \ln y + (\alpha_6 - \phi_3)\ln(x_T^M + p x_N^M)\big].$$

First, higher productivity in tradables (nontradables) will be associated with a higher (lower) real exchange rate, consistent with Bela Balassa's (1964) productivity-differential model. Second, a higher capital (labor) stock will be associated with a higher (lower) real exchange rate if nontradables are labor-intensive, consistent with Jagdish N. Bhagwati's (1984) relative-factor-endowments theory. Third, a higher per capita income will be associated with a higher real exchange rate if tastes are nonhomothetic and nontradables (tradables) are luxuries (necessities). Fourth, higher per capita military expenditures will alter the real exchange rate, depending upon the relative factor intensities of civilian and military goods and of civilian tradables and nontradables and depending upon whether civilian nontradables (tradables) are luxuries or necessities in consumption.[4]

III. Empirical Evidence

Although such factors should be investigated for both absolute and relative departures from PPP, the limited scope of this paper provides some empirical evidence only for absolute, or cross-sectional, departures from PPP at a point in time. Using the data set and countries described in Bergstrand (1991), estimation of reduced-form equation (9) yielded

$$(10)\quad \ln p = \underset{(3.10)}{-\,1.10} + \underset{(2.05)}{0.12}\ln \Pi_T \underset{(3.19)}{-\,0.28}\ln \Pi_N + \underset{(1.11)}{0.09}\ln K \underset{(1.24)}{-\,0.11}\ln L + \underset{(2.00)}{0.28}\ln y + \underset{(0.74)}{0.04}\ln(x_T^M + p x_N^M)$$

(SEE = 0.10; $R^2 = 0.95$; adjusted $R^2 = 0.93$) where numbers in parentheses are absolute values of t statistics.[5] A 1-percent reduction in per capita military spending tends to reduce the real exchange rate by only 0.04 percent. Note that all other coefficient estimates' signs conform to the productivity-differential, relative-factor-endowments, and nonhomothetic-tastes theories for departures from absolute PPP, and estimates for Π_T, Π_N, and y are statistically significant at the 10-percent level (two-tail t tests).

Although the reduced-form estimates suggest that the impact of military spending reductions on the relative national price level would be economically insignificant, this result does not imply that the intratemporal supply and demand channels are unimportant. In fact, the structural equations' estimates suggest that endogenous supply decisions and nonhomothetic tastes are economically significant channels, but their effects on relative prices are offsetting.

[4]The formal theoretical analysis resulted in slightly different military–expenditure variables for the relative demand and supply functions: $\ln(x_T^M + p x_N^M)$ and $(\ln x_T^M + \ln x_N^M)$, respectively. As the former was measurable and the latter was not, all equations are estimated using $\ln(x_T^M + p x_N^M)$.

[5]Productivity in tradables (nontradables) in each country relative to the United States is estimated using productivity in commodities (services) industries, as described in Bergstrand (1991); SEE is the standard error of estimate.

Two-stage least-squares estimation of equations (5) and (8) yields:

$$(11)\quad \ln p = -\underset{(1.71)}{0.97} + \underset{(1.31)}{0.46}\,(\ln X^{C})^{S} + \underset{(3.96)}{0.22}\ln K - \underset{(4.26)}{0.23}\ln L - \underset{(2.16)}{0.31}\ln \Pi_{N} + \underset{(1.59)}{0.14}\ln \Pi_{T} + \underset{(2.60)}{0.14}\ln\left(x_{T}^{M} + p x_{N}^{M}\right)$$

(SEE = 0.15, $R^2 = 0.89$; adjusted $R^2 = 0.84$)

$$(12)\quad \ln p = -\underset{(15.79)}{2.22} - \underset{(2.90)}{0.75}\,(\ln X^{C})^{D} + \underset{(7.46)}{0.58}\ln y - \underset{(1.84)}{0.11}\ln\left(x_{T}^{M} + p x_{N}^{M}\right)$$

(SEE = 0.12, $R^2 = 0.92$, adjusted $R^2 =$ 0.90).

Regarding relative-supply function (11), coefficient estimates all have signs consistent with the model, and all are statistically significant at the 10-percent level except for coefficients on $(X^C)^S$ and Π_T. Coefficient estimates for capital and labor suggest that civilian nontradables (tradables) are labor-intensive (capital-intensive). If civilian nontradables are labor-intensive, then the coefficient estimate for per capita military spending suggests that military production is labor-intensive relative to civilian production.

Regarding relative-demand function (12), the coefficient estimates all have signs consistent with the model, and all are statistically significant at the 10-percent level. The results suggest that, due to nonhomothetic preferences, a rise in per capita income raises the relative demand for nontradables, but a rise in per capita military expenditures lowers their relative demand (by lowering per capita disposable income). Hence, via demand, military spending reductions will tend to raise the relative price of nontradables in terms of tradables and thus the national price level. However, since the intratemporal supply effect of a 1-percent decline in military spending on raising production and lowering the price of nontradables relative to tradables (0.14) exceeds the intratemporal nonhomothetic-tastes effect of increasing demand and raising the price of nontradables relative to tradables (0.11), the net effect of smaller military expenditures is to lower the nation's general price level relative to the world average, although the impact turns out to be economically insignificant.

IV. Conclusions and Caveats

Most theoretical analyses of macroeconomic policy, real exchange rates, and relative national price levels focus on intertemporal and intratemporal relative-demand influences of fiscal policy changes, assuming homothetic tastes and exogenous production. Less attention has been devoted to the roles of endogenous supply decisions, intersectoral factor mobility, and nonhomothetic tastes in ascertaining the real-exchange-rate effects of fiscal policies (but see Obstfeld [1989] for an exception). This study has attempted to complement previous studies, both theoretically and empirically, showing that a change in military expenditures has potentially important impacts upon the intratemporal supply of and demand for nontradables relative to tradables and, consequently, upon their relative price, that is, the real exchange rate.

The scope of this study was limited by design to emphasize certain issues. A broader analysis would integrate these issues into the rich intertemporal models of Frenkel and Razin (1987) and Obstfeld (1989). Other interesting directions would be to relax assumptions of full employment, perfect competition, and exogenous military expenditure allocations.

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