Diminishing Returns to Real Depreciation in Achieving Macroeconomic Goals

Patrick Conway

Exchange rate devaluation is a central component of stabilization programs proposed for debt-burdened developing countries. It has also become a key element of export promotion strategies undertaken by these countries to enhance their products' "competitiveness" on world markets. A number of countries, most notably Turkey, have taken this policy to extreme lengths. The exchange rate for Turkish lira vis-à-vis the US dollar has risen from 3 to 900 over the last 10 years; real devaluation (i.e., devaluation after adjustment for the differential between Turkish and US inflation rates) is roughly 60 percent for that period. Despite this extreme swing, there are advisors who suggest that even more rapid devaluation is called for; one piece of evidence given is a stubbornly resistant trade deficit in goods and non-factor services.

Real devaluation is of course not sufficient to ensure external balance, but as most recently noted by Helpman and Razin (1987) must act in tandem with expenditure management. I argue in this paper that the real devaluation will have diminishing returns in accommodating expansion of expenditure consistent with a constraint on foreign borrowing given a degree of nominal wage rigidity in the economy. Proposed real devaluations are especially effective in accommodating expenditure under borrowing constraints and ultimately eliminate the borrowing constraint through export expansion and import reduction. Once the borrowing constraint has been surmounted, however, continued real devaluation can lead to slower or even negative expansion of domestic expenditure.

I use an open economy analysis with aggregate supply curve and foreign borrowing constraint to make two points:

— Real devaluation will be successful, up to a point, in accommodating increased expenditure and increasing real output. This will be the economy's constrained in its foreign borrowing.

— After that point, real devaluation will offer a smaller impetus to growth as domestic expenditure becomes a binding growth constraint. This Keynesian outcome will have the stimulus from increased exports offset by the drag of falling domestic demand, including private investment.

Real devaluation improves domestic-good competitiveness on international markets through reduction of the real wage (and of the return to other non-traded factors of production) by final-good price increases. Continuing devaluation will thus also cause functional income inequality within the economy and a stubborn inflation.

Thanks to Eran Krumel and Tsvi Nas for useful discussions on this question.
L. MODEL STRUCTURE

I consider an open economy model with an aggregate supply relation. There are two final goods: a non-tradeable good N produced with labor L and a tradable final good T produced with labor L and an imported input I. The foreign-currency price of T is taken as numeraire. The exchange rate e adjusted by the tariff rate τ is then the domestic price of tradable final goods e(1 + τ), and the wage rate w is without loss of generality also the non-tradeable price. The intermediate tradable input I has price qa, tariff τa, and domestic price qa(1 + τa). Starred variables have values denominated in foreign currency.

The supply of T can be represented by a concentrated form of the production function, and reflects the negative impact of both real wage and real input price increases on desired final-good supply. Supply of N depends simply on the availability of labor, with persistent unemployment, the supply of N will be demand-determined.

\[ T = T(\omega e(1 + \tau), q^a(1 + \tau_a)) \]
\[ N = L \]

The real exchange rate, or price of tradable to non-tradeable goods, and is hereafter denoted by p. Real devaluation will increase \( T \), but not at the expense of \( N \) so long as unemployment persists. This is a best-case scenario for the effectiveness of devaluation, as reductions in \( N \) due to real devaluation would lessen the attractiveness of the policy.

The consumer price index \( P \) of the economy is defined in terms of tradable and non-tradeable goods prices, with \( \rho \) the share of tradable goods in consumption.

\[ P = \rho(1 + \tau) + (1 - \rho)q^a \]

Domestic expenditure \( E \) is composed of tradeable and non-tradeable goods and is defined by \( P \). It will rise with expansionary monetary policy (M) or fiscal policy (G) and will fall with rises in the real exchange rate (due to real balance effects). Expenditure on tradeable goods \( E^T \) rises with the level of \( E \) and falls with increases in the real exchange rate. A share \( \lambda \) of government expenditure is on tradeable goods. Expenditure on non-tradeable goods \( E^N \) is then the residual.

\[ E = E(\rho, M) + G \]
\[ E^T = E^T(\rho, E) + \lambda G \]
\[ E = E^T + E^N \]

There are three material balance conditions in the economy. In (7), tradable-good supply is equal to tradable expenditure minus net exports (NX). Net export demand is specified in terms of demand functions. Exports are rising in the tariff-adjusted real exchange rate and foreign expenditure \( E^* \). Final-good imports are a fraction \( \beta \) of \( E^* \).

\[ \rho^* = (T - NX) - E^T + \lambda G \]
\[ NX = X(E^*, \rho(1 + \tau)) - \beta E^*(\rho, E) \]

Equilibrium in the non-tradeable market in (9) determines the level of non-tradeable employment for given \( \rho \) and \( E \).

\[ I N P^* = E^T \]
through devaluation will allow increases in E consistent with the BB curve and consequent increases in tradeable output and expenditure. The growth of E slows once the devaluation pushes ρ above ρ, because the economy is then constrained by domestic tradeable expenditure rather than the availability of foreign borrowing. If the TT curve is downward-sloping, the result may well be falling domestic expenditure with real depreciation due to demand insufficiency and a need for stimulative fiscal policy.

There are three stages to the impact of real devaluation in an economy with appreciated ρ. Consider the case of no borrowing constraint as stage I, with the economy able to satisfy all desired expenditures. A borrowing constraint with appreciated exchange rate is stage II, leading to some combination of austerity, increased tariff and non-tariff barriers to imports and possible excess capacity in the traded sectors due to insufficient demand or rationing of imported inputs. Stage III is one of continued real depreciation while ρ is higher than "equilibrium" level, and leads to a reduced "p-multiplier" effect due to lagging domestic expenditure.

III. EVIDENCE FROM THE TURKISH ECONOMY

The Turkish economy in the 1980s provides an example of an aggressive real devaluation policy beginning from an appreciated ρ. Figure 2 illustrates the movements in ρ over the last 20 years.

II. DEVALUATION UNDER BORROWING CONSTRAINTS

Real devaluation is an effective method for stimulating tradeable output and allowing increased aggregate expenditure. It will have a magnified impact in borrowing-constrained cases like equilibrium A in Figure 1. The initial impact of the borrowing constraint for fixed ρ is a need for austerity and protection to limit tradeable final good expenditure.
years in Turkey: clearly, the recent devaluation policy has pushed ρ much higher than in previous periods.

The macroeconomic results of these policies are striking: moderate growth, stubborn inflation and stagnant private investment. These are all consistent with stage II in the model above, and the characteristics of stage III also may present themselves in the near future.

More systematic empirical investigation for evidence of these effects is difficult because of the "switching" nature of observed variables. In some stages, observed variables are equal to desired (as indicated by the behavioral functions); in others, the observed variables are in fact the outcome of rationing, and bear little resemblance to desired.

### TABLE 1
Regression Results: Full Sample and Sub-Periods (T-statistics in parentheses)

<table>
<thead>
<tr>
<th>Coef Stage I</th>
<th>Stage II</th>
<th>Full Sample</th>
<th>Coef Stage I</th>
<th>Stage II</th>
<th>Full Sample</th>
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</thead>
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<tr>
<td>a₀</td>
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<td>1.12</td>
<td>.01</td>
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<td>-8.03</td>
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<tr>
<td>a₁</td>
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<td>16.06</td>
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<td>(29.83)</td>
<td>(18.10)</td>
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<td>a₅</td>
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<td>(8.97)</td>
<td>(3.20)</td>
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<td>a₆</td>
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<td>3.90</td>
<td>3.90</td>
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<tr>
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<td>(3.90)</td>
<td>(3.90)</td>
<td>(2.90)</td>
<td>(2.90)</td>
</tr>
<tr>
<td>b₀</td>
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<td>(5.74)</td>
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<td>(0.85)</td>
<td>(0.64)</td>
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<tr>
<td>c₄</td>
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<td>-0.16</td>
<td>-0.16</td>
<td>0.90</td>
<td>0.90</td>
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<tr>
<td>c₅</td>
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<td>(0.40)</td>
<td>(0.40)</td>
<td>(0.36)</td>
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<td>c₆</td>
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<tr>
<td>c₇</td>
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<td>(1.49)</td>
<td>(1.49)</td>
<td>(3.54)</td>
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<table>
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<th>Observations</th>
<th>11</th>
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<th>22</th>
<th>11</th>
<th>11</th>
<th>22</th>
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<td>Durbin-Watson Statistic</td>
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<td>1.95</td>
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<td>T²</td>
<td>2.20</td>
<td>2.03</td>
<td>0.78</td>
<td>2.54</td>
<td>1.97</td>
<td>0.84</td>
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<td>IM²</td>
<td>1.77</td>
<td>2.44</td>
<td>1.52</td>
<td>1.77</td>
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<td>1.52</td>
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</table>

The most elegant and precise way to investigate these issues econometrically is the "switching regression" methodology. This determines endogenously the probability that the economy was in one or another stage in any period. In this paper I use a cruder technique, and separate a priori annual data for Turkey during 1963-1984 into periods with and without foreign borrowing constraints. Krueger (1974) and Aksoy (1982) identify the period 1963-1969 as a borrowing-constrained period, with the large devaluation of 1970 ending that episode. Oksan (1983) identifies 1978 as the beginning of a second constrained subperiod, and I treat this period as extending through 1984. The other years in the interval 1963-1984 are considered unconstrained. Note from Figure 2 that these have little correspondence to "high" vs. "low" ρ, although periods of constraint are usually followed by large real deprecations.

I maintain the assumption in estimation that the Turkish economy was either in stage I or stage II from 1963-1984. Table 1 presents estimation results for log-linear equations based upon the theoretical specifications in equations (1) through (10). The data used are described in the appendix. To reduce the size of the simultaneous system, I have used gross domestic product (GDP) as a proxy for E. This also allows direct comparison of present results with conventional equations.

Under the null hypothesis of price adjustment to borrowing constraints, desired behavior (i.e., the functions above) will be observed at all times. The decomposition of data into stages I and II will yield similar estimates of the behavioral parameters in each sub-period. Table 2 presents F-tests of this null hypothesis against the alternative that different behavioral parameters are observed in the two periods.

Theory suggests that export behavior will be unconstrained in all stages. This cannot be rejected. Imported-input use and tradable production, however, give evidence of a structural shock between periods. A hypothesis of unchanged demand behavior in E cannot be rejected, indicating that expenditure and ρ elasticities of demand have been fairly constant. Import demand, by contrast, suggests a discontinuity of behavior due to non-tariff forms of rationing this demand.

There are too few observations for the parameter estimates to be taken as definitive. Those for stage II regressions do not represent behavioral parameters, while those for stage I will look precise. In the stage I parameter estimates, ρ does enter as anticipated in all cases. The parameter estimates indicate acceptance of the Marshall-Lerner condition with ρ elasticities of final-good imports, input imports and exports equal to −10, −57 and 24 respectively. Analysis of residuals does not indicate systematic correlation.

Using stage I parameter estimates, the derived slopes of TB and BB in Figure 1 are (in)

### TABLE 2
F Tests of Varying Parameters in Regression (Critical F value in parentheses)

<table>
<thead>
<tr>
<th>Equation</th>
<th>Stage I</th>
<th>Stage II</th>
<th>Full Sample</th>
<th>Degrees of Freedom</th>
<th>F Statistic</th>
<th>Critical F Value</th>
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</thead>
<tbody>
<tr>
<td>T</td>
<td>0.004</td>
<td>0.001</td>
<td>0.027</td>
<td>(4, 14)</td>
<td>14.74</td>
<td>3.11</td>
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<tr>
<td>T²</td>
<td>0.012</td>
<td>0.001</td>
<td>0.016</td>
<td>(3, 16)</td>
<td>1.23</td>
<td>3.24</td>
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<tr>
<td>IM²</td>
<td>0.073</td>
<td>0.015</td>
<td>0.055</td>
<td>(4, 14)</td>
<td>8.74</td>
<td>3.11</td>
</tr>
<tr>
<td>X</td>
<td>0.083</td>
<td>0.022</td>
<td>0.080</td>
<td>(3, 16)</td>
<td>2.50</td>
<td>3.24</td>
</tr>
<tr>
<td>IM</td>
<td>0.051</td>
<td>0.108</td>
<td>0.048</td>
<td>(4, 14)</td>
<td>5.62</td>
<td>3.11</td>
</tr>
</tbody>
</table>

SSE: sum of squared residuals of regressions. The critical F value is given for 95 percent confidence.
IV. CONCLUSIONS AND EXTENSIONS

I lay out a theoretical model for examining the quantity adjustment necessary in an economy with fixed exchange rate and sluggish nominal wage adjustment in response to foreign borrowing constraints. Theory suggests that, beginning from overvaluation of the real exchange rate, devaluation will be successful in inducing expenditure on domestic goods and economic growth. However, once the real exchange rate becomes "undervalued" in the manner specified above the relevant constraint is no longer a foreign borrowing limit, but rather the level of domestic expenditure. Concurrent with the continuing devaluation will be continuing inflation.

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Theory suggests a number of channels that real devaluation could follow to reduce domestic expenditure. First is the real balance effect of the resulting inflation. Second is the textbook effect of induced foreign demand in raising real interest rates and decreasing investment. Third is the income redistributional effect of real devaluation: the high-spending wage earner losses, while the high-saving capital owner wins. In stage III, as outlined above, the fall in domestic expenditure offsets the gains from export promotion and reduces the export-led growth rate.

Although the theoretical point of the paper is quite general, I do not consider the empirical results of this paper a powerful test of the hypothesis. First, there are too few data points in each sub-period to have confidence in the parameter estimates. Second, the F-test used does not exclude the possibility of alternative forces causing the structural shift. I interpret these results as interesting evidence in favor of a theory of "diminishing returns" to devaluation, and encourage further work in the area.

I also interpret these results as evidence against use of structural models, especially of import demand and aggregate supply, that do not allow for the possibility of changing regime due to borrowing constraints. These parameter estimates will be biased indicators of the underlying behavioral functions.11

I have focused here on the borrowing constraint as the cause of quantity rationing, but recognize that in fact there was substantial political upheaval during the estimation period as well. This upheaval, reaching a breaking point in 1980, is yet another reason for economic behavior to exhibit irregularities. Further research that decomposes these political effects will be quite useful in further outlining the potential and the limitations of real devaluation policies.

DATA APPENDIX

The data are annual, and are taken from World Bank compilations of Turkish government sources. The agricultural and manufacturing sectors are aggregated to provide an approximation to tradable output and net exports. Tradable expenditure is derived by the equation:

\[ E^T = T - NX \]

for these two sectors. Real TL values are calculated using the GDP deflator normalized to a 1963 value of 1.0.

The capital stock is calculated using the perpetual inventory method from an estimate of the average capital-total-output ratio in 1963 for each of three sectors: agriculture (2), manufacturing (2.5) and services (1.5). Final-good imports (including investment goods) are separated from raw-material imports using the decomposition outlined in Conway (1987).

The real exchange rate is formed by the ratio \( eP^T/w \) in Figure 2 and \( eP^T/(1 + \Delta P^T)w \) elsewhere, \( w \) is the daily wage reported by SIEL, \( P^T \) is the US GDP deflator, and \( e \) is the US/TL nominal exchange rate. Tariff rates are calculated from actual tariff revenues. This ratio is normalized to unity in 1972. Import-untariffed tariffs are proxied by realized petroleum tariffs and production duties, while final-good tariffs are drawn from realized tariffs and production duties on all other foreign goods. Foreign prices of imports are derived from domestic prices through backward solution: \( eP^T = (1 + \Delta P^T)w \).

Foreign expenditures \( (\Delta Y) \) are derived by averaging industrial production indices for the US and the European Community.

ENDNOTES

1. The capital stock argument is suppressed for this short-run analysis.
2. With this formulation, the real exchange rate is closely related to the alternative formulation \( e/P \).
3. Precisely, \( (e/P) - (e/\rho) \), but the one is a monotonic transform of the other.
4. Use of the real exchange rate to promote exports is not a "small open economy" strategy. Even for devalued real exchange rates, the economy specified here will generate an important fraction of total expenditure on tradable goods. This is important in the conclusions that follow.
5. Impressive to the extent that services trade depends upon the real exchange rate. However, if that trade reacts similarly to merchandise trade in NX, its effects will be included (improperly) in the model.
6. This is a crucial difference from the existing literature on dis-equilibrium in economies with traded and non-traded goods. These treatments, see, e.g., van Wijhe (1984) assume full employment and thus have resource allocation effects from expanding or contracting non-traded production. With unemployment, such effects disappear. The NX curve is not a constraint on equilibriam, and will thus be ignored in the following presentation.
7. There could also be rationing of import items; this would put the economy of off the supply curve" in tradables.
8. As Sadik (1986) and Conway (1987) note, Turkey's borrowing constraint during the 1970s was not a severe one, since there were net inflows of official capital in each year. However, access to private capital markets was constrained and Turkey could not borrow freely from official sources.
9. This statistic technique indicates any structural shift between sub-periods. It is possible to devise other theorems to account for this shift, including the disruptive nature of the civil unrest during the period before the 1980 military takeover.
10. The parameter estimates for the constrained subperiod are presented for completeness, but do not represent "effective" demands and supplies. Changes in B -- DS are not controlled for, so the parameters confound effective demand coefficients and correlations of existing right-hand variables with net exogenous capital flows.

11. Adding -- 1 to the estimated import elasticity yields the traditional Marshall-Lerner elasticity in "volume" terms.

12. In Conway (1987), the changing effect of tariff and non-tariff barriers in aggregate supply and import demand equations was captured for the 1963-1980 period by allowing the coefficient on the tariff variable to differ from that of the foreign price. This plus the consideration of a more homogeneous period made parameter instability less likely in those results.

BIBLIOGRAPHY


Helyes, I., and A. Kaul, "Exchange Rate Management," American Economic Review 77 (March 1987), pp. 150-


Let us briefly consider the essence of the monetary school of thought that until quite recently have held sway. The Monetarist school espouses close and direct links between changes in the money supply and changes in money incomes. There is causal arrow running from the money supply to either nominal income or the general price level; that is:

\[ \Delta Y = V \Delta M \]

where the \( V \) is the marginal income velocity of money. Although there did arise at times some hint of a feedback mechanism showing the reverse tack, this was submerged under the supposed governing power of money based on the accepted strong relation of \( \Delta M \rightarrow \Delta P \). Though under conditions of less than full-employment, say during cyclical recessions, one also puts forth the link from \( \Delta M \rightarrow \Delta Q \); though there is uncertainty as to how the money income split between \( \Delta Q \) and \( \Delta P \) and \( \Delta Q \), subsequent to \( \Delta M \). But this is glossed over due to the primary emphasis given to the relation between money and prices which is based on the Quantity theory's assumption that the economy tends towards long-run full-employment of output. This attitude rests on the existence of an "orderly labor market" which clears at full-employment and results in an aggregate supply curve as seen in Figure (1). The underlying feature is that the supply curve of labor depends on the real wage, and the labor market adjusts to maintain the real wage and hence the level of employment. Then with given technology the level of output is determined; thus there is no change in equilibrium real output as prices rise, as it is a function of real conditions.

Money matters because inflation is inherently a monetary phenomenon. We do recall Professor Friedman's "money of the blue" example where money is dropped from a