Perspectives on Trade Balance Adjustment and Dynamics

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Lecture Notes for Econ 280C

Overarching question: **What is the connection between exchange rate changes**, **the trade balance**, **and economic growth**? Facets of this question broad question relate to many issues in international macroeconomics. For example:

- Will the terms of trade of relatively fast growing economies tend to deteriorate over time?
- Does trade grow primarily due to new products or higher volumes of existing products?
- How much real depreciation and/or terms of trade change is needed to close a large current account deficit?
- Do long-run import and export demand elasticities with respect to price differ from their short-run values? Is there a *J*-curve?
- How does monetary policy affect the economy under a floating exchange rate?
- Do permanent and transitory shocks have different effects?

Background

A basic and influential finding is that in the paper by Hendrik Houthakker and Steve Magee, “Income and Price Elasticities in World Trade,” *Review of Economics and Statistics* 51 (May 1969): 111-25.

One widely publicized finding at the time was that the income elasticity of U.S. demand for imports (1.51, over 1955-65) exceeded that of the foreign demand for U.S. exports (0.99).

Seeming implication: If the U.S. were to maintain a growth rate commensurate with that of its main trading partners, balanced trade could be assured only by a steadily depreciating dollar. This finding seemed to confirm the growing consensus that the U.S. dollar needed to be devalued — and arguably contributed to subsequent speculation.

This finding — and findings of elasticity differences for other countries — suggests we should see distinct terms of trade trends among industrial countries. These are, however, hard to find in the data.

In his May 1989 *European Economic Review* paper, Paul Krugman suggests an elegant explanation. Its broader significance is to show how, over the longer run, expansion of trade via the creation of new products may dampen the relative-price effects of permanent shocks that affect trade.

Thus the conventional Armington-type assumption may be invalid over the longer term.

This idea fits in with a more recent research agenda seeking to understand the micro-dynamic foundations of national imports and exports.

Plan of the lecture

- Empirical motivation for Krugman's model.
- The model itself.
- Recent empirical applications of the idea.
- Other work on trade-flow dynamics.
- The general issue of assessing trade elasticities and using them in policy analysis.

Motivation

Let τ be the terms of trade: the price of imports in terms of exports.

The trade balance then is

$$b = x(\tau, y^*) - \tau m(\tau, y).$$

As usual, we may express the change in the trade balance as

$$\begin{aligned} \mathrm{d}b &= x_\tau \mathrm{d}\tau + x_{y^*} \mathrm{d}y^* - \tau(m_\tau \mathrm{d}\tau + m_y \mathrm{d}y) - m\mathrm{d}\tau \\ &= x(\varepsilon_x \hat{\tau} + \zeta_x \hat{y}^*) - \tau m(\hat{\tau} - \varepsilon_m \hat{\tau} + \zeta_m \hat{y}). \end{aligned}$$

If initially trade is balanced, so that $b = x - \tau m = 0$, what must be true in order that it remain so?

We must have d$b = 0$, or:

$$0 = \zeta_x \hat{y}^* - \zeta_m \hat{y} + \underbrace{(\varepsilon_x + \varepsilon_m - 1)\hat{\tau}}$$

Marshall-Lerner

Assuming the Marshall-Lerner condition, we find that the terms of trade of a faster-growing economy would deteriorate secularly if $\zeta_x = \zeta_m$:

$$\hat{\tau} = \frac{\zeta_m \hat{y} - \zeta_x \hat{y}^*}{\varepsilon_x + \varepsilon_m - 1}.$$

D. Acemoglu and J. Ventura, *QJE*, May 2002: there is no (unconditional) relationship between GDP growth and terms of trade growth (see figure).

From: Acemoglu and Ventura, QJE, May 2002.

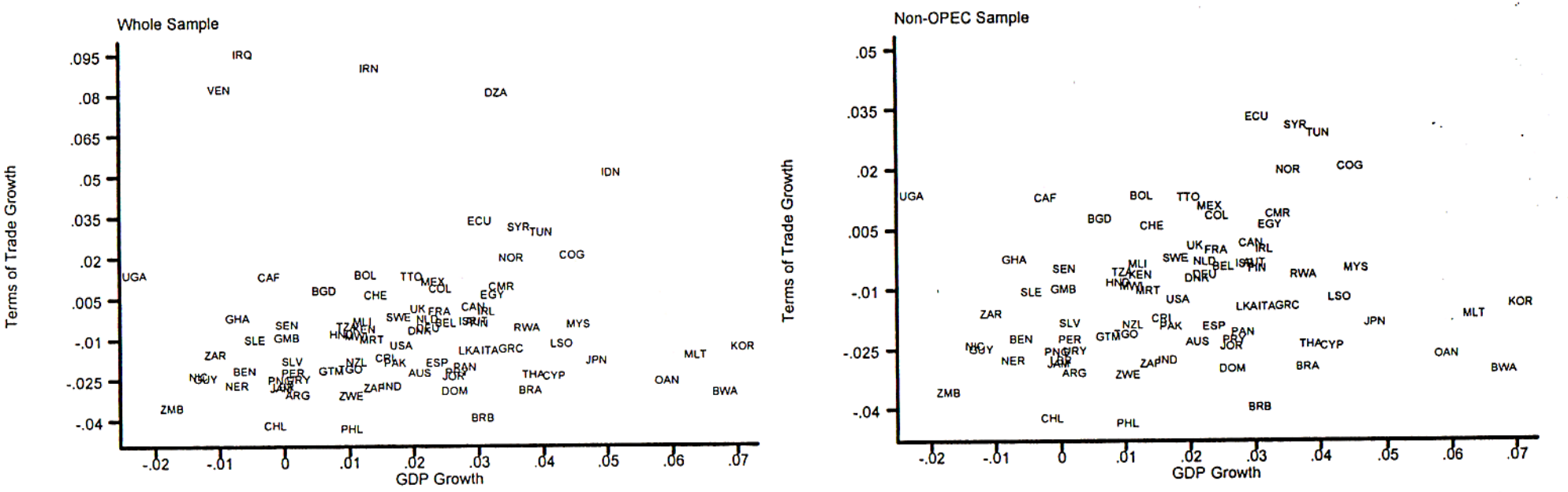

FIGURE II

Changes in Terms of Trade 1965–1985 versus GDP Growth 1965–1985

Is there some systematic relationship between relative growth rates and the elasticities that removes terms of trade trends?

Countries would have constant terms of trade ($\hat{\tau} = 0$) if the following ratio condition just happens to hold:

$$\frac{\zeta_x}{\zeta_m} = \frac{\hat{y}}{\hat{y}^*}.$$

In words, *relatively slow growing economies have higher import than export income elasticities of demand*. (And by just the right amount!)

Return to Houthakker and Magee. This was certainly true of the U.S. — its trading partners generally were growing faster due to convergence, $\hat{y}/\hat{y}^* < 1$, and also they found that $\zeta_x/\zeta_m < 1$.

But consider what they found for the fastest growing economy, Japan. The situation was reversed — the world income elasticity of demand for Japanese exports was 3.55, versus a Japanese import demand income elasticity of only 1.23.

Indeed, regressing the Houthakker-Magee estimates of ζ_x/ζ_m on $\hat{y}/\hat{y}^*$ over 1955-65, Krugman found:

$$\log \zeta_x/\zeta_m \quad = \quad -1.81 \quad + \quad \underset{(0.21)}{1.21} \quad \log \hat{y}/\hat{y}^*, \quad R^2 = 0.75, \quad \text{se} = 0.21 \; .$$

He estimated a similar relationship over 1970-86 (but with less confidence). This “45-degree rule” is a startling empirical regularity. What can possibly explain it?

The Model

The basic idea is that fast-growing countries expand the range of goods they export as they grow. This raises the apparent income elasticity of foreign demand for their exports — although in reality this is just a shift in foreign demand that makes room for the new goods.

The utility function of a representative global consumer, in a world with N differentiated goods, is

$$U = \left(\sum_{i=1}^{N} c_i^{\frac{\phi-1}{\phi}} \right)^{\frac{\phi}{\phi-1}}, \ \phi > 1.$$

Above, ϕ is the consumption substitution elasticity.

All goods have the same production function: the labor required to produce x_i units of variety i is

$$\ell_i = \alpha + \beta x_i.$$

Let w be the wage (in some numeraire). Then marginal cost is $w\beta$, so the price of a representative good (all are the same) is given by the markup formula

$$\frac{p}{w} = \frac{\phi}{\phi - 1}\beta.$$

A key assumption in Krugmanesque monopolistic competition models is that with fixed production costs, the range of goods produced and the scale of production of each is pinned down by a zero-profit condition. (Of course, the horizon must be long enough for free entry to be a reasonable assumption.)

Here, zero-profits for firm i mean

$$px_i = w\alpha + w\beta x_i \Leftrightarrow \begin{cases} x_i = \frac{\alpha}{\beta}(\phi - 1) \\ \ell_i = \alpha + \beta x_i = \alpha\phi \end{cases}.$$

Having determined the amount of a variety that will be produced in a zero-profit equilibrium, the labor force L (size) of a country determines how many varieties n it will produce:

$$n\ell_i = L \Leftrightarrow n = \frac{L}{\ell_i} = \frac{L}{\alpha\phi}.$$

At the world level, of course, $n + n^* = N$.

Effects of international trade: Let Home, Foreign labor forces be L and L^*. Wages and prices are equalized (due to symmetry, absence of trade impediments).

Each consumer worldwide spends a fraction n/N of income on Home varieties, fraction n^*/N on Foreign varieties.

Home income (for example) is given by

$$\frac{wL}{p} = L\frac{(\phi - 1)}{\phi\beta} = y,$$

so

$$\hat{y} = \hat{L},\ \hat{y}^* = \hat{L}^*.$$

Also

$$M = \text{ Home imports } = \frac{n^*}{N} y,$$

$$X = \text{ Home exports } = \frac{n}{N} y^*.$$

Given the model's assumptions, terms of trade never change. If Home grows, n grows in proportion, so X grows.

Note that X and M are both proportional $LL^*/(L + L^*)$, so:

$$X, M \propto \frac{yy^*}{y + y^*}.$$

with fixed proportionality constants.

Thus

$$\hat{X} = \hat{M} = \left(\frac{y^*}{y+y^*}\right)\hat{y} + \left(\frac{y}{y+y^*}\right)\hat{y}^*.$$

We now ask how an econometrician would estimate the export and import income elasticities. He/she would calculate

$$\zeta_x = \frac{\hat{X}}{\hat{y}^*} = \frac{\hat{M}}{\hat{y}^*} = \left(\frac{\hat{y}}{\hat{y}^*}\right)\frac{\hat{M}}{\hat{y}} = \left(\frac{\hat{y}}{\hat{y}^*}\right)\zeta_m.$$

This implies the “45-degree rule,”

$$\frac{\zeta_x}{\zeta_m} = \frac{\hat{y}}{\hat{y}^*}.$$

This is expected: in this model, terms of trade never change.

Extension: With transport costs, there would be some consumption home bias, and some relative price effects. The take-home message, though, is that entry into trade (as well as exit) is likely to dampen significantly “transfer effects” over the longer term.

Empirical Applications

There are a number of empirical studies that relate to this account. I will mention just two.

Hummels and Klenow (AER, June 2005) distinguish between trade growth on the “intensive margin” (more exports of the same stuff) and on the “extensive margin” (exports of new goods).

Looking at 1995 data on shipments by 121 exporters to 59 importers in thousands of product categories (data UNCTAD TRAINS), they find that big countries ship more in absolute terms, and ask whether in general they do so by shipping more within each product category, or more types of goods than do smaller countries.

They find that the extensive margin accounts for about 60% of the higher exports of bigger countries. They also find an important role for quality – rich countries export the same product at higher prices than do poor countries.

Gagnon (reading list): In this model, country i's imports from j are

$$m_i = \left(\frac{y_j}{y_w} \right) y_i,$$

where y_w is world income (cf. gravity model).

Gagnon looks at data on U.S. manufacturing imports from a variety of exporters (Feenstra el al. NBER data).

He does cross-section regressions of import growth on exporter GDP growth, a variety variable (*CATS* — defined as the fraction of 4-digit SIC data with positive entries for a country), and the change in the bilateral real exchange rate.

OLS results are as follows:

Gagnon: Growth of U.S. imports from exporting country i

	GDP_i	$CATS_i$	RXR_i	$Duties_i$	$Costs_i$	R^2
1972 – 2000	1.39^{***}	1.46^{***}	0.23			0.43
Full sample	(0.43)	(0.33)				
1989 – 2000	2.19^{***}	–1.40	-1.24^{**}	-26.01^{***}	3.79	0.80
Industrial sample	(0.29)	(0.88)	(0.47)	(5.08)	(5.22)	

Counterfactual implication of Krugman theory.

Slow-growing economies will become open to trade more quickly than rapidly growing economies!

Numerical example. There are two economies, H and F, both with labor force = 1. In an initial equilibrium, H will spend half its income on F goods, and vice versa. Assume each economy produces 10 varieties. Each economy has an openness index of 0.5.

Now let H ‘s labor force grow to 2. H will then produce 2/3 of the world’s varieties (20 out of 30), and F, 1/3.

F therefore will spend 2/3 of its income on H goods, importing 1/3 of the output of H’s 20 varieties. H consumes 2/3 of F’s 10 varieties, and 2/3 each of its own 20. F’s openness index rises to 2/3, H’s drops to 1/3.

Other Issues in Trade-Flow Dynamics

These results throw some light on the *income* coefficients in import and export coefficients. What about the *price* coefficients? As we saw, both determine the terms of trade response to relative income movements, in general.

The vague impression from the preceding discussion is that, in some sense, long-run price elasticities of demand should be infinite. But as we have noted, there are issues of home bias in consumption, transport costs, etc.

In addition, the concept of demand for a country's exports is itself somewhat amorphous when the composition of those exports is shifting over time.

I see two (related) puzzles:

- Elasticities Puzzle I (Ruhl, reading list): In DGE models of open economies, we need low elasticities to rationalized the observed low volatility of macro aggregates (such as exports) with the high volatility of relative prices (exchange rates). However, in studies of policy changes such as major tariff reductions, quantity responses are big.

- Elasticities Puzzle II: Estimates of aggregate trade equations essentially key off the same macro correlations as in Puzzle I. Yet estimates on micro-level data, such as Broda and Weinstein's recent paper (NBER Working Paper 10314, 2004), and a lot of earlier work, find a range of estimates, with median much higher than the 0.5-to-1 range typical in the macro literature.

As far ago as 1950, Guy Orcutt, in a famous paper written in the IMF research department, expressed skepticism about "elasticity pessimism." Among other reasons, he pointed to aggregation bias, dynamical issues.

Clearly the entry of new products and quality change play a role; empirical work such as the Broda-Weinstein piece tries to address this.

Ruhl's paper suggests an answer for puzzle one. With sunk costs of entry into exporting, the *temporary* shocks that dominate correlations at business-cycle frequencies will not elicit much in the way of quantity responses.

However, permanent reforms such as tariff reduction will lead to new investments in the export sector, allowing quantities to expand more vigorously. These responses will make long-run price elasticities larger, and dampen price movements.

Ruhl's calibrated model predicts a quadrupling of the elasticity with respect to permanent changes, compared to that with respect to temporary changes.

T. Kehoe and Ruhl (2002 Minneapolis Fed working paper) find that after significant trade liberalizations, goods that previously were traded little account for a disproportionate share of the subsequent export creation. They propose a model along Dornbusch-Fischer-Samuelson lines.

On the macro side, Ghironi and Melitz (*QJE*, August 2005) model dynamic changes in national consumption baskets as a result of entry and exit.

These approaches and insights should inform our thinking about macro price elasticities. Clearly the problem is complex, since, in general, we would need to aggregate up micro-level estimates based on trade flows, but combine them with some sense of the responses of firms that might, in historical data, not engage in trade. This requires explicit structural modeling as well as estimation of past responses.