

**EXCHANGE-RATE AND
EXTERNAL-BALANCE CONSEQUENCES OF
ASYMMETRIC DEMOGRAPHIC TRANSITIONS:
KEY DETERMINANTS OF
CROSS-BORDER SUBSTITUTABILITY**

Ralph C. Bryant
and
Marc de Fleurieu

Brookings Institution
February 2005

Possible Levels of Discussion:

-- Background:

Aims of the Project

Progress in the Past

What is New in This Paper

-- Analytical Framework:

- Basics

- **Recent Refinements**

- Strengths and Weaknesses

-- Illustrative Shocks: Asymmetric Declines in Fertility (Birth Rates):

- Benchmark Analysis

- **Sensitivity Analyses**

-- **General Observations** about Key Determinants of the Cross-Border Transmission of Shocks (non-demographic as well as demographic) and How Cross-Border Transmission Influences Welfare Consequences

-- **Implications for Japan**

One of the basic points in our earlier papers:

An open economy proceeding faster and more intensively than other economies in its demographic transition benefits from transmitting part of its larger shock abroad.

Motivation for this new research:

Did our earlier papers perhaps mislead?

Too large a real appreciation in the currency of the country with the larger demographic shock?

Thereby distorting our inferences about cross-border transmission of macroeconomic effects and the associated welfare consequences?

How to Think about our Analytical Framework

The model, an abridgement of a larger empirical model containing many separate countries and regions, is a research environment that facilitates systematic analysis.

The simplifications of the model limit its applicability.

But this framework has a great overriding merit: it reveals, in a genuine general-equilibrium analysis, the endogenous determination of domestic and cross-border macroeconomic interactions.

Figure 1. Asymmetric Decline in Birth Rates and Endogenous Growth Rates of Populations

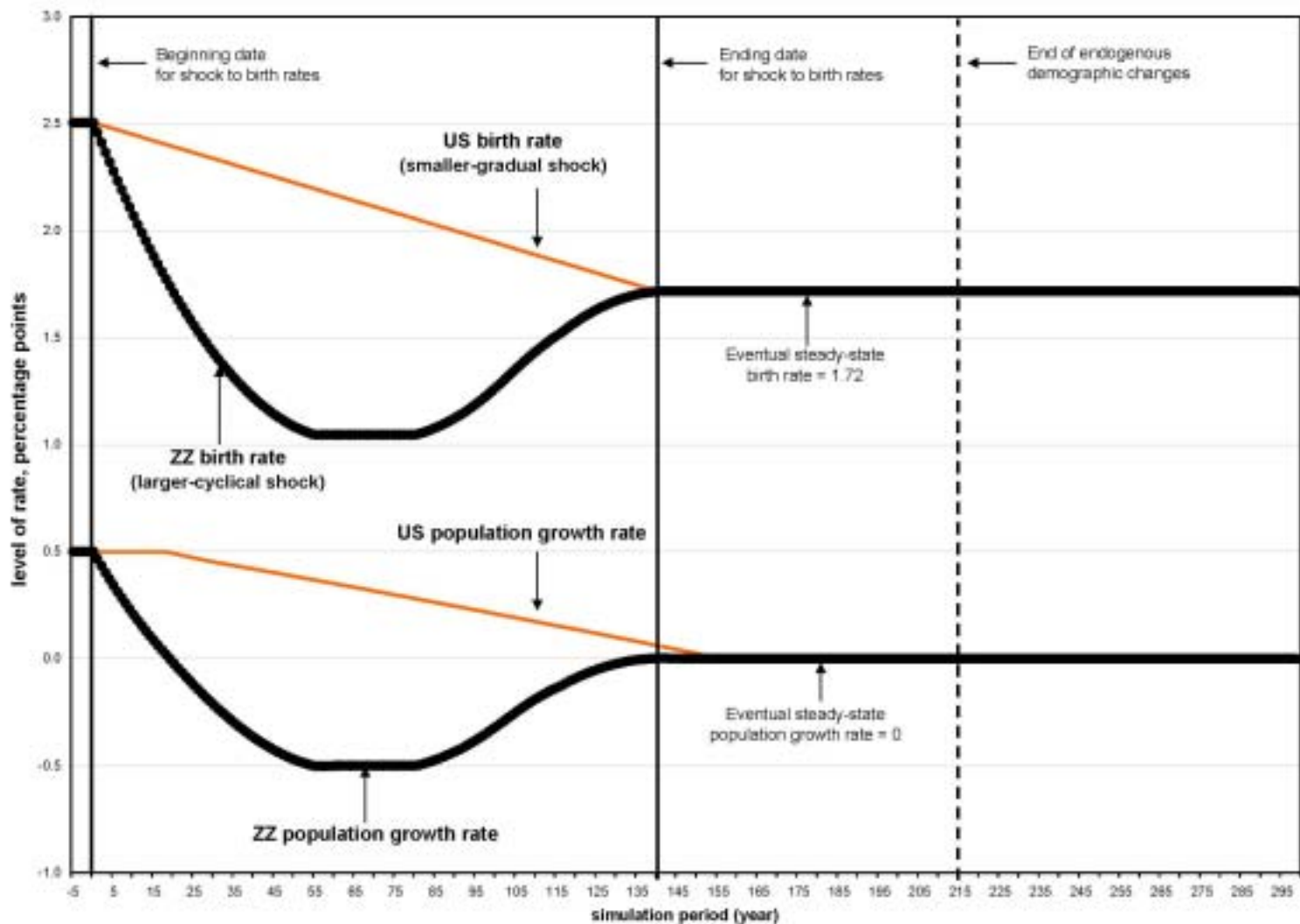


Figure 1. Asymmetric Decline in Birth Rates and Endogenous Growth Rates of Populations

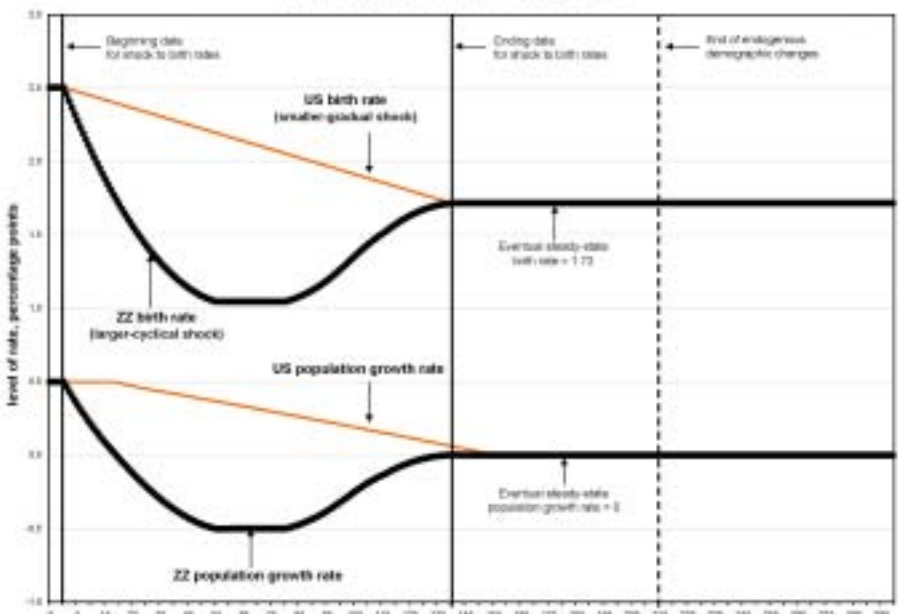


Figure 3. Adult Populations and Effective Labor Forces

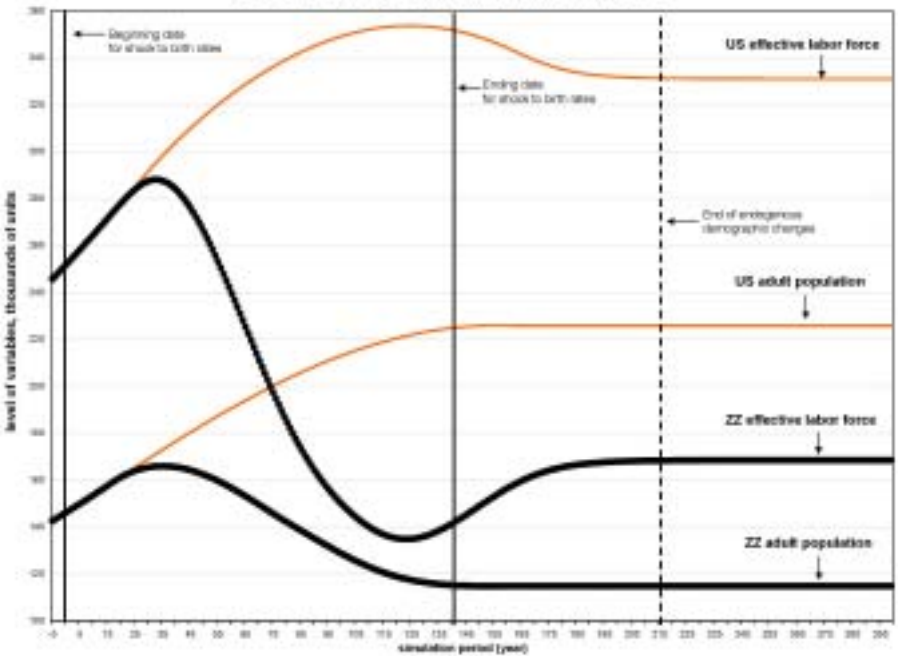


Figure 2. Youth and Elderly Dependency Ratios

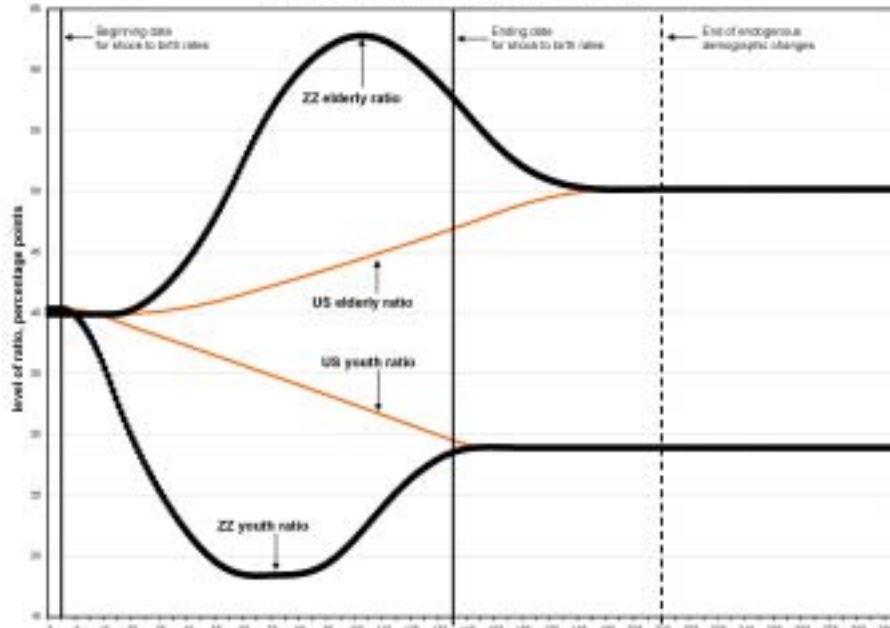


Figure 4. Ratio of Effective Labor Forces to Adult Populations

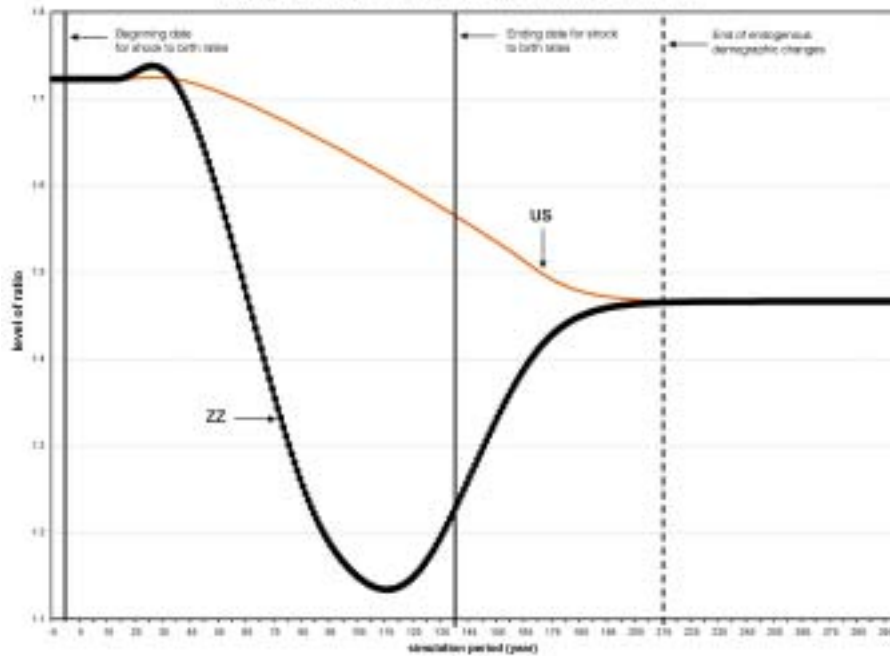


Figure 7. Real Exchange Rate

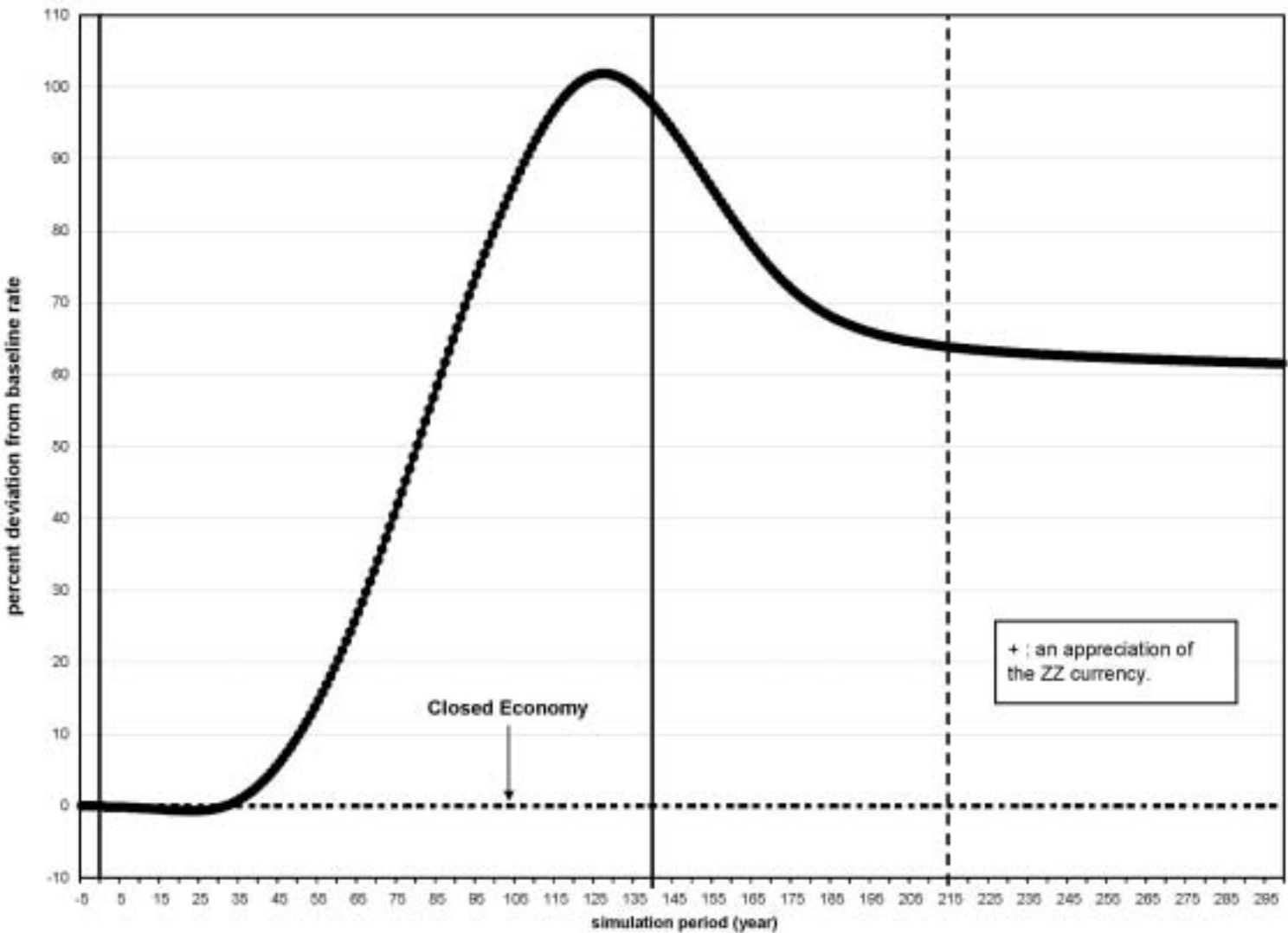


Figure 8. Ratios of Net Foreign Assets to Nominal GDPs

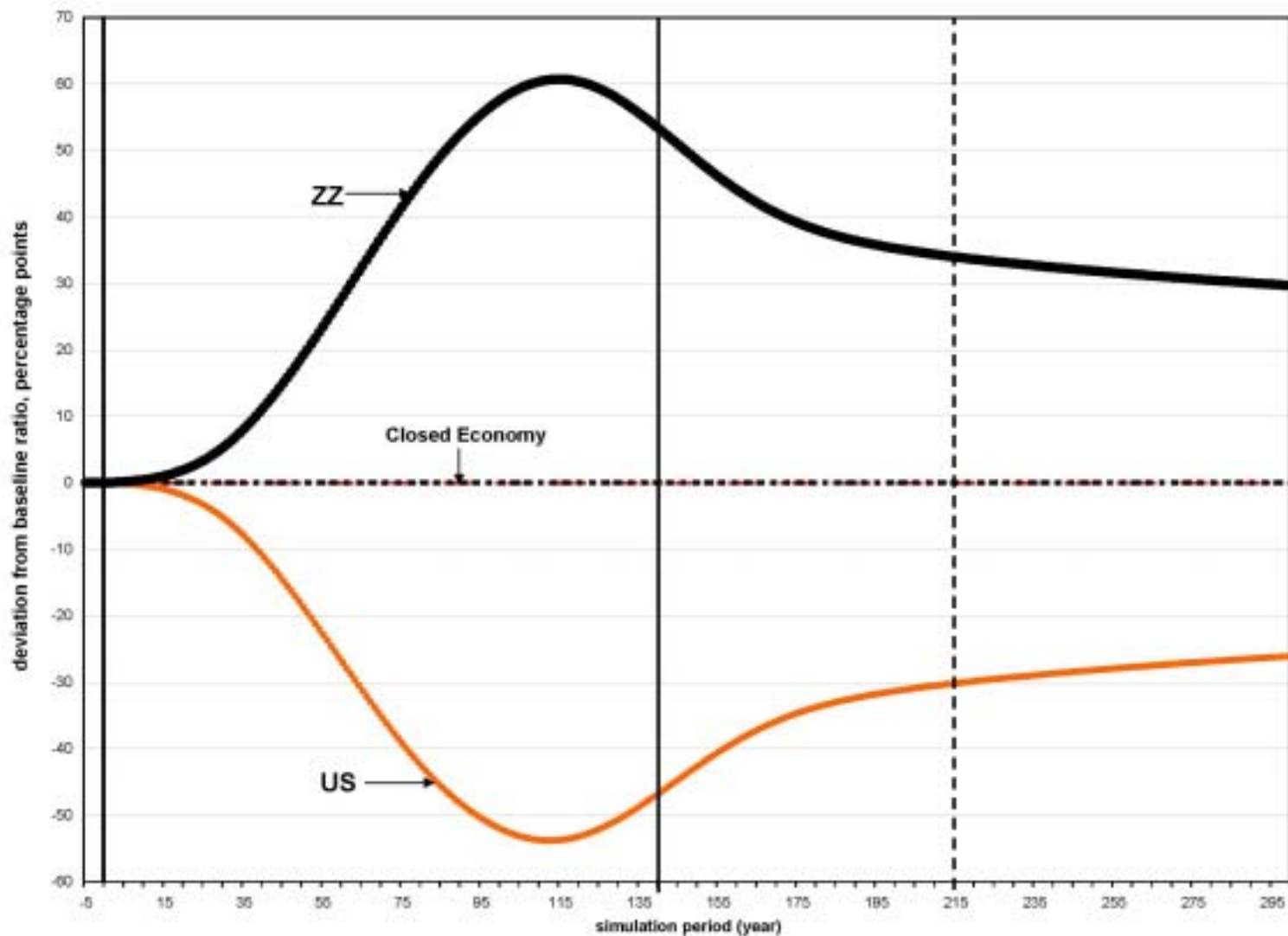
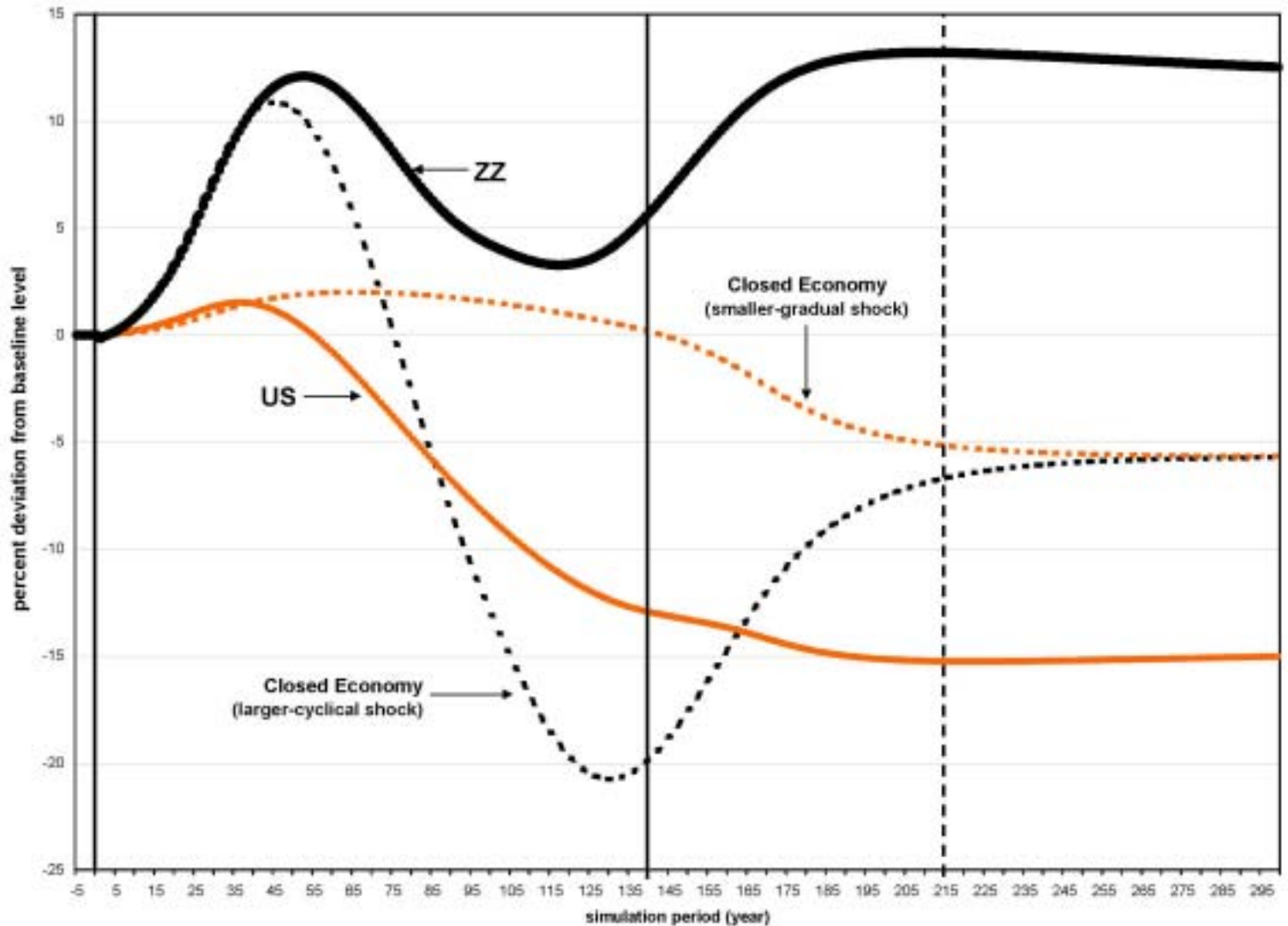


Figure 10. Real Adult Consumptions per Adult



Why did we get such a large real appreciation of the ZZ currency?

A major part of the explanation is that our analytical model was based on the traditional “elasticities approach” to modeling trade flows in macroeconomic models.

Shock leads to change in relative size of countries' outputs. Changes in relative scarcities requires change in relative prices, which produces improvement in smaller country's terms of trade. Etc.

Two critical assumptions of the standard elasticities approach:

(i) domestically-produced tradable goods in a home economy are imperfect substitutes in demand for tradable goods produced abroad imported into the home economy;

(ii) the preferences underlying the imperfect substitutability between home- and foreign-produced goods are unchanged over time

A problematic implication: relative country size does not matter for goods preferences!

Standard Elasticities Approach Specification:

$$PR_t = \frac{PIM_t}{PGDP_t} \quad PIM_t = \text{¥}_t PXM_t^*$$

$$IM_t = K \left(IM_{t-1}^{\alpha_1} \right) \left(Y_t^{\beta_0} \right) \left(Y_{t-1}^{\beta_1} \right) \left(PR_t^{\gamma_0} \right) \left(PR_{t-1}^{\gamma_1} \right) U_t$$

Logarithmic, error-correction formulation:

$$\begin{aligned} \Delta im_t &= \Phi + \beta_0 \Delta y_t + \gamma_0 \Delta pr_t \\ &+ (1-\alpha_1) \left[\frac{(\beta_0 + \beta_1)}{(1-\alpha_1)} y_{t-1} + \frac{(\gamma_0 + \gamma_1)}{(1-\alpha_1)} pr_{t-1} - im_{t-1} \right] + e_t. \end{aligned}$$

$$\Delta im_t = \Phi + \beta_0 \Delta y_t + \gamma_0 \Delta pr_t + (1-\alpha_1) \left[\frac{(\beta_0 + \beta_1)}{(1-\alpha_1)} y_{t-1} + \frac{(\gamma_0 + \gamma_1)}{(1-\alpha_1)} pr_{t-1} - im_{t-1} \right] + e_t.$$

$$\eta_y = \left(\frac{\beta_0 + \beta_1}{1 - \alpha_1} \right)$$

Long-run elasticity with respect to domestic activity

$$\eta_{pr} = \left(\frac{\gamma_0 + \gamma_1}{1 - \alpha_1} \right)$$

Long-run elasticity with respect to relative price of imports

Challenges to the Traditional Elasticities Approach:

Exchange-Rate Changes:

effects may be too large, or Inferences may be problematic (as with our analysis of asymmetric demographic shocks)?

- e.g., Harry Johnson (1958)
- Paul Krugman (1989), “45-degree rule”

Estimates of the Activity and Relative-Price Elasticities:

- puzzling, in some ways implausible?
- mismeasurement of import prices, related to mismeasurement of new products (“varieties”)

Supplementing the Traditional Approach by Introducing Varieties Effects

Developments in trade theory emphasizing monopolistic competition and increasing returns to scale. E.g., Helpmann and Krugman (1985).

The existence of trade in differentiated products driven by consumers' tastes for variety and innovations that alter the composition of output introduces a direct link between the volume of trade and relative country size. The larger the output of a country, the greater will be the number of varieties of goods produced. Etc.

A faster growing country can experience relatively rapid growth in its exports and less rapid growth in its imports than would otherwise occur; and it can have the faster growth without having to experience the real depreciation in the value of its currency that would be predicted by the standard elasticities approach. Vice versa for slower growing countries.

Introducing “Varieties Effects” in Our Analytical Framework

$$FORGDP\text{SHARE}_t = \frac{GDP_t^* / \mathfrak{R}_t}{GDP_t + GDP_t^* / \mathfrak{R}_t}$$

$$\mathfrak{R}_t = \mathbb{Y}_t \left(\frac{PGDP_t}{PGDP_t^*} \right) .$$

$$IM_t = (IM_{t-1}^{\alpha_1}) (Y_t^{\beta_0}) (Y_{t-1}^{\beta_1}) (PR_t^{\gamma_0}) (PR_{t-1}^{\gamma_1}) (FORGDP\text{SHARE}_t^{\delta_0}) (FORGDP\text{SHARE}_{t-1}^{\delta_1}) U_t .$$

$$\Delta im_t = \Phi + \beta_0 \Delta y_t + \gamma_0 \Delta pr_t + \delta_0 \Delta forGDPshare_t$$

$$+ (1 - \alpha_1) \left[\frac{(\beta_0 + \beta_1)}{(1 - \alpha_1)} y_{t-1} + \frac{(\gamma_0 + \gamma_1)}{(1 - \alpha_1)} pr_{t-1} + \frac{(\delta_0 + \delta_1)}{(1 - \alpha_1)} (forGDPshare_{t-1}) - im_{t-1} \right] + e_t .$$

$$\Delta im_t = \Phi + \beta_0 \Delta y_t + \gamma_0 \Delta pr_t + \delta_0 \Delta forGDPshare_t + (1-\alpha_1) \left[\frac{(\beta_0 + \beta_1)}{(1-\alpha_1)} y_{t-1} + \frac{(\gamma_0 + \gamma_1)}{(1-\alpha_1)} pr_{t-1} + \frac{(\delta_0 + \delta_1)}{(1-\alpha_1)} (forGDPshare_{t-1}) - im_{t-1} \right] + e_t.$$

$$\eta_y = \left(\frac{\beta_0 + \beta_1}{1 - \alpha_1} \right)$$

Long-run elasticity with respect to domestic activity

$$\eta_{pr} = \left(\frac{\gamma_0 + \gamma_1}{1 - \alpha_1} \right)$$

Long-run elasticity with respect to relative price of imports

$$\eta_{fYshare} = \left(\frac{\delta_0 + \delta_1}{1 - \alpha_1} \right)$$

Long-run elasticity with respect to share of foreign exporters' output in world output

Varying the Elasticity of Intertemporal Substitution in Consumption

-- EIS is not a direct reflection of cross-border substitutability, but nonetheless has powerful effects on cross-border spillovers.

$$c(s, t) = \frac{1}{\Psi(t)} [fw(s, t) + hw(s, t)]$$

$$\dot{\Psi}(t) = -1 - \frac{1}{\sigma} [(1 - \sigma)(r(t) + p_n(t)) - (\theta + p_n(t))] \Psi(t)$$

$$\mathbf{EIS = 1 / \sigma}$$

Low value of EIS: less intertemporal smoothing; substitution effect smaller relative to income effect; consumers respond absolutely less to changes in real interest rate.

Higher value of EIS: more intertemporal smoothing; substitution effect larger relative to income effect.

Sensitivity Tests for Key Parameters

$\eta_{fYshare}$ 0 (benchmark), 0.25, 0.50, 0.75, 1.00

η_{pr} -0.8225, -1.000, -1.097 (benchmark), -1.371, -1.6455,
-2.194, and -2.7425

EIS 0.33, 0.50 (benchmark), 0.75, 1.00