A Neoclassical Analysis of the Asian Crisis

Business Cycle Accounting for a Small Open Economy

Keisuke Otsu

Bank of Japan IMES

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- Sudden Economic Downturn in 1998 in Hong Kong, Korea, Singapore and Thailand

Per Adult Output Growth Rates (%)

	1960-97	(std.)	1998
Hong Kong	4.9	(4.0)	-6.3
Korea	5.2	(2.8)	-8.0
Singapore	5.4	(3.3)	-4.1
Thailand	4.3	(2.7)	-12.5

- This Paper Uses Business Cycle Accounting (BCA), à la Chari, Kehoe and McGrattan (CKM (2007)), to Understand Why This Happened.

- BCA Uses Equilibrium Conditions To Measure The Size of Distortions In Relevant Markets That Cause The Observed Fluctuations
- BCA Serves as a Foundation to Effectively Construct a Sophisticated Model (Not to Deduce Policy Implication)
  - CKM (2007) Shows that Distortions in the Labor Market and TFP are Important in Explaining The Great Depression.

Introduction

Key Results

- TFP is Important in All Countries in Explaining The Sudden Output Drop

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- Distortions in The Labor Market do NOT Have Contractionary Effects (Contrary to CKM)

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Key Results

- TFP is Important in All Countries in Explaining The Sudden Output Drop
- Distortions in The Labor Market do NOT Have Contractionary Effects (Contrary to CKM)
- Distortions in the Foreign Debt and Investment Markets Are not Important in Explaining the Recessions

- Many Existing Literature Focus on The Cause and Resolution of The Financial Crisis
  - Burnside et al (2000) Corsetti et al (1999)—Government Insurance
  - Chang and Velasco (2000)—Bank Run
  - Krugman (1999)—Balance Sheet Effect
- Few Quantitative Analyses on The Recession Patterns in Asia
  - Meza and Quintin (2007)—TFP and Factor Hoarding
  - Cook and Devereux (2006)—Nominal Interest Rate Shock with Sticky Prices and A Non-Tradable Sector
  - Gertler et al (2007)—Interest Rate Shocks with Sticky Prices, Financial Accelerator and Fixed Exchange Rate

This Paper:

- Applies BCA to a Small Open Economy Model
- Focuses on "WHERE" The Important Shocks Are Rather than "WHAT" They Are Regarding The Asian Crisis

- Introduction
- Asian Crisis
- Business Cycle Accounting Model
- Quantitative Analysis
- Conclusion

Per Adult Growth Rates in 1998 (%)

	Y	C	I	L
Hong Kong	-6.3	-7.1	-8.7	-2.5
Korea	-8.0	-12.1	-27.0	-8.0
Singapore	-4.1	-5.0	-9.4	-2.1
Thailand	-12.5	-11.3	-59.9	-0.4

Business Cycle Accounting Model

Framework

- A Standard Neoclassical Small Open Economy Model à la Mendoza (1991) and Correia et al (1995)
- Consists of Household, Firm, Government and Foreign Sector
- The Household Owns Capital and Labor, Consumes, Invests and Borrows from Abroad with One-Period Non-State-Contingent International Debt
- The Firm Produces A Single Final Good from Labor and Capital
- The Government Collects Distortionary Taxes

$$\max U = E_0 \sum_{t=0}^{\infty} \beta^t u(c_t, l_t)$$

subject to $$\frac{w_t}{\tau_t^l} l_t + r_t k_t + \tau_t + \frac{\Gamma d_{t+1}}{R\tau_t^d} = c_t + \tau_t^x i_t + d_t + \Phi(d_{t+1}) + \Pi(\Delta k_t)$$

$$\Gamma k_{t+1} = i_t + (1-\delta)k_t$$

where

$$\Gamma = (1+n)(1+\gamma)$$

$$\Phi(d_{t+1}) = \frac{\phi(d_{t+1} - d)^2}{2}$$

$$\Pi(\Delta k_t) = \frac{\pi(k_{t+1} - k_t)^2}{2}$$

- GHH Preferences (Greenwood, Hercowitz and Huffman (1988)):

$$u(c_t, l_t) = \log\left(c_t - \chi l_t^{\nu}\right)$$

  - Standard Preference in The Small Open Economy Literature
  - Has No Income Effect on Labor Supply
  - Different From CKM Specification (Cobb-Douglas Preferences)

$$u(c_t, l_t) = \Psi \log c_t + (1-\Psi)\log(1-l_t)$$

Business Cycle Accounting Model

Firm's Problem

$$\max \pi_t = y_t - w_t l_t - r_t k_t$$

where

$$y_t = z_t k_t^{\theta} l_t^{1-\theta}$$

Business Cycle Accounting Model

Government Budget Constraint

$$\tau_t = \left(1 - \frac{1}{\tau_t^l}\right) w_t l_t + \left(\tau_t^x - 1\right) x_t$$

Business Cycle Accounting Model

Foreign Sector

$$tb_t = d_t - \frac{\Gamma d_{t+1}}{R\tau_t^d} + \frac{\phi(d_{t+1} - d)^2}{2}$$

A Competitive Equilibrium is,
$\left\{c_t, l_t, k_{t+1}, d_{t+1}, y_t, i_t, tb_t, w_t, r_t, \tau_t^d, \tau_t^l, \tau_t^x, z_t\right\}_{t=0}^{\infty}$ such that;

1. Household Optimizes given $\left\{w_t, r_t, \tau_t^d, \tau_t^l, \tau_t^x\right\}_{t=1}^{\infty}$ and d_0, k_0
2. Firm Optimizes given $\left\{w_t, r_t, z_t\right\}_{t=1}^{\infty}$
3. Markets Clear and The Government Budget Constraint Holds
4. The Resource Constraint Holds:

$$y_t = c_t + i_t + tb_t + \frac{\pi(k_{t+1} - k_t)^2}{2}$$

5. Shocks Follow the Process

$$s_t = P_{0(4\times 1)} + P_{(4\times 4)} s_{t-1} + \varepsilon_t, \varepsilon_t \sim N(0_{(4\times 1)}, Q_{(4\times 4)})$$

where $s_t = \left(\ln \tau_t^d, \ln \tau_t^l, \ln \tau_t^x, \ln z_t\right)'$ and $\varepsilon_t = \left(\varepsilon_{dt}, \varepsilon_{lt}, \varepsilon_{xt}, \varepsilon_{zt}\right)'$.

- Foreign Debt Wedge

$$U_{ct}\left(\frac{\Gamma}{R}\frac{1}{\tau_t^d}-\phi(d_{t+1}-d)\right)=\beta E_t\left[U_{ct+1}\right]$$

  - Neumeyer and Perri (2005), Uribe and Yue (2003)—Country Specific Interest Premium Shocks
  - CKM (2006)—International Borrowing Constraint and a Sudden Stop
  - Domestic Financial Imperfection etc.

- Labor Wedge

$$(1-\theta)\frac{y_t}{l_t}\frac{1}{\tau_t^l} = \chi \nu l_t^{\nu-1}$$

  - CKM (2007)—Sticky Wages and Monetary Shocks
  - Cooley and Hansen (1989)—Cash in Advance Constraint and Monetary Shocks
  - Christiano and Eichenbaum (1992)—Working Capital on Labor

- Investment Wedge

$$\begin{aligned} & \tau_t^x U_{ct}(\Gamma + \pi(k_{t+1} - k_t)) \\ = \ & \beta E_t \left[U_{ct+1} \left(\theta \frac{y_{t+1}}{k_{t+1}} + (1-\delta)\tau_{t+1}^x + \pi(k_{t+2} - k_{t+1}) \right) \right] \end{aligned}$$

  - CKM (2007)—Financial Friction a la Bernanke et al (1999) and Calstrom and Fuerst (1997)
  - Greenwood et al (1988)—Investment Efficiency
  - Note: It's Important That The Model Is Stochastic!

- TFP

$$y_t = z_t k_t^{\theta} l_t^{1-\theta}$$

  - CKM (2007)—Input Frictions with Intermediate Goods
  - Ohanian (2001)—Organizational Capital
  - Greenwood et al (1988), Burnside et al (1993)—Input Mismeasurement

1. Calibrate and Estimate Parameter Values from Data Over The 1960-2003 Period
2. Solve for Linear Decision Rules (à la Uhlig (1999))
3. Compute Wedges Over The 1990-2003 Period
4. Plug The Wedges One by One into The Decision Rules and Compare The Outcome with Data

- Utility Parameters are Calibrated Using Steady State Equations
  - Simply Normalize $\bar{s} = (0, 0, 0, 0)'$
- Shock Process Parameters in

$$s_t = P_{(4\times4)} s_{t-1} + \varepsilon_t, \varepsilon_t \sim N(0_{(4\times1)}, Q_{(4\times4)})$$

Are Estimated by Bayesian Estimation

- Use Bayesian Estimation to Estimate Persistence Parameters and Variance Covariance Parameters of the Shock Process

$$
\begin{aligned}
\begin{pmatrix} \ln \tau_t^d \\ \ln \tau_t^l \\ \ln \tau_t^x \\ \ln z_t \end{pmatrix} &= \begin{pmatrix} \rho_{dd} & \rho_{dl} & \rho_{dx} & \rho_{dz} \\ \rho_{ld} & \rho_{ll} & \rho_{lx} & \rho_{lz} \\ \rho_{xd} & \rho_{xl} & \rho_{xx} & \rho_{xz} \\ \rho_{zd} & \rho_{zl} & \rho_{zx} & \rho_{zz} \end{pmatrix} \begin{pmatrix} \ln \tau_{t-1}^d \\ \ln \tau_{t-1}^l \\ \ln \tau_{t-1}^x \\ \ln z_{t-1} \end{pmatrix} + \varepsilon_t \\
\varepsilon_t &\sim N(0_{(4\times1)}, Q_{(4\times4)}) \\
Q &= \begin{pmatrix} \sigma_{dd} & \sigma_{dl} & \sigma_{dx} & \sigma_{dz} \\ \sigma_{ld} & \sigma_{ll} & \sigma_{lx} & \sigma_{lz} \\ \sigma_{xd} & \sigma_{xl} & \sigma_{xx} & \sigma_{xz} \\ \sigma_{zd} & \sigma_{zl} & \sigma_{zx} & \sigma_{zz} \end{pmatrix}
\end{aligned}
$$

from Data on $\{y_t, c_t, l_t, x_t\}$(Note: Short Data Period Because of l_t)

- Once All Parameter Values Are Specified, The Model Can be Solved
- Solve for Linear Decision Rules With the Method of Undetermined Coefficients(Uhlig (1999))

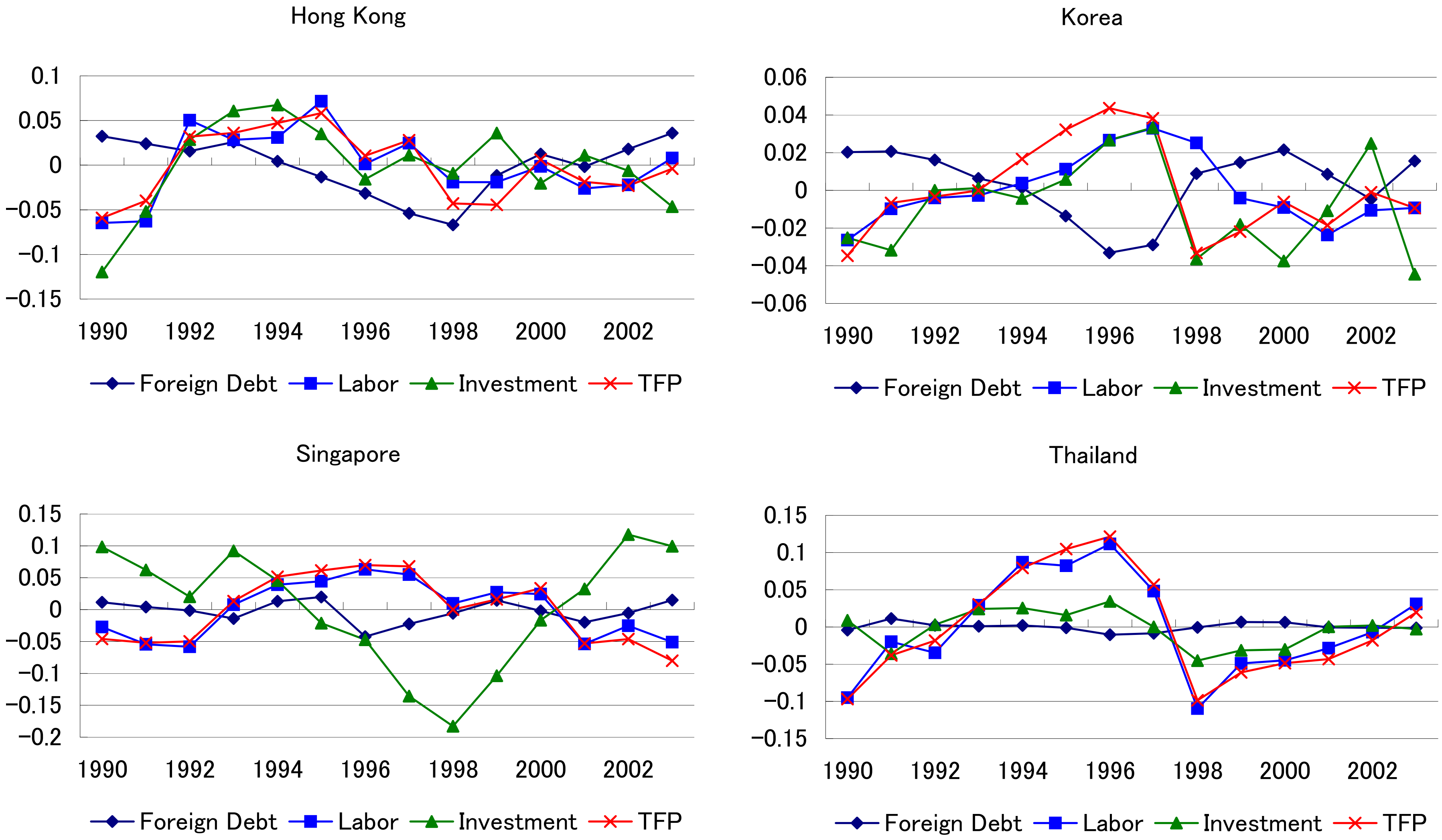
- Since $\{y_t, c_t, l_t, x_t\}$ are Observable, The Values of $\{\tau_t^d, \tau_t^l, \tau_t^x, z_t\}$ can be Computed Using The Linear Decision Rules

$$\left(\widetilde{y}_t, \widetilde{c}_t, \widetilde{l}_t, \widetilde{x}_t, \widetilde{k}_{t+1}, \widetilde{d}_{t+1}\right)' = DR_{(6\times 6)}\left(\widetilde{k}_t, \widetilde{d}_t, \widetilde{\tau}_t^d, \widetilde{\tau}_t^l, \widetilde{\tau}_t^x, \widetilde{z}_t\right)'$$

where $\widetilde{a}_t = \ln a_t - \ln \overline{a}$

1. Assume $\widetilde{k}_{1990} = \widetilde{d}_{1990} = 0$.
2. Compute $\left\{\widetilde{\tau}^{d}_{1990}, \widetilde{\tau}^{l}_{1990}, \widetilde{\tau}^{x}_{1990}, \widetilde{z}_{1990}\right\}$ from $(\widetilde{y}_{1990}, \widetilde{c}_{1990}, \widetilde{l}_{1990}, \widetilde{x}_{1990})' = DR_{(4\times 6)}\left(0, 0, \widetilde{\tau}^{d}_{1990}, \widetilde{\tau}^{l}_{1990}, \widetilde{\tau}^{x}_{1990}, \widetilde{z}_{1990}\right)'$
3. Use Computed $\left\{\widetilde{\tau}^{d}_{1990}, \widetilde{\tau}^{l}_{1990}, \widetilde{\tau}^{x}_{1990}, \widetilde{z}_{1990}\right\}$ to Obtain $\left\{\widetilde{k}_{1991}, \widetilde{d}_{1991}\right\}$ from $(\widetilde{k}_{1991}, \widetilde{d}_{1991})' = DR_{(2\times 6)}\left(0, 0, \widetilde{\tau}^{d}_{1990}, \widetilde{\tau}^{l}_{1990}, \widetilde{\tau}^{x}_{1990}, \widetilde{z}_{1990}\right)'$
4. Use Obtained $\left\{\widetilde{k}_{1991}, \widetilde{d}_{1991}\right\}$ to Compute $\left\{\widetilde{\tau}^{d}_{1991}, \widetilde{\tau}^{l}_{1991}, \widetilde{\tau}^{x}_{1991}, \widetilde{z}_{1991}\right\}$ from $(\widetilde{y}_{1991}, \widetilde{c}_{1991}, \widetilde{l}_{1991}, \widetilde{x}_{1991})' =$
$DR_{(4\times 6)}\left(\widetilde{k}_{1991}, \widetilde{d}_{1991}, \widetilde{\tau}^{d}_{1991}, \widetilde{\tau}^{l}_{1991}, \widetilde{\tau}^{x}_{1991}, \widetilde{z}_{1991}\right)' \dots$

Figure 3. Wedges



- $\tau_t^d \uparrow$(Korea)$\longrightarrow tb_t \uparrow, c_t \downarrow, i_t \downarrow$: Intertemporal Terms of Trade
- $\tau_t^l \downarrow \longrightarrow c_t \uparrow, l_t \uparrow$: Relative Price of Labor$\uparrow$
- $\tau_t^x \downarrow \longrightarrow i_t \uparrow, c_t \downarrow$: Relative Price of Investment$\downarrow$
- $z_t \downarrow \longrightarrow y_t \downarrow, l_t \downarrow, c_t \downarrow, i_t \downarrow$

$\longrightarrow$"How Large Are These Effects?"

Figure 4a. Results: Hong Kong

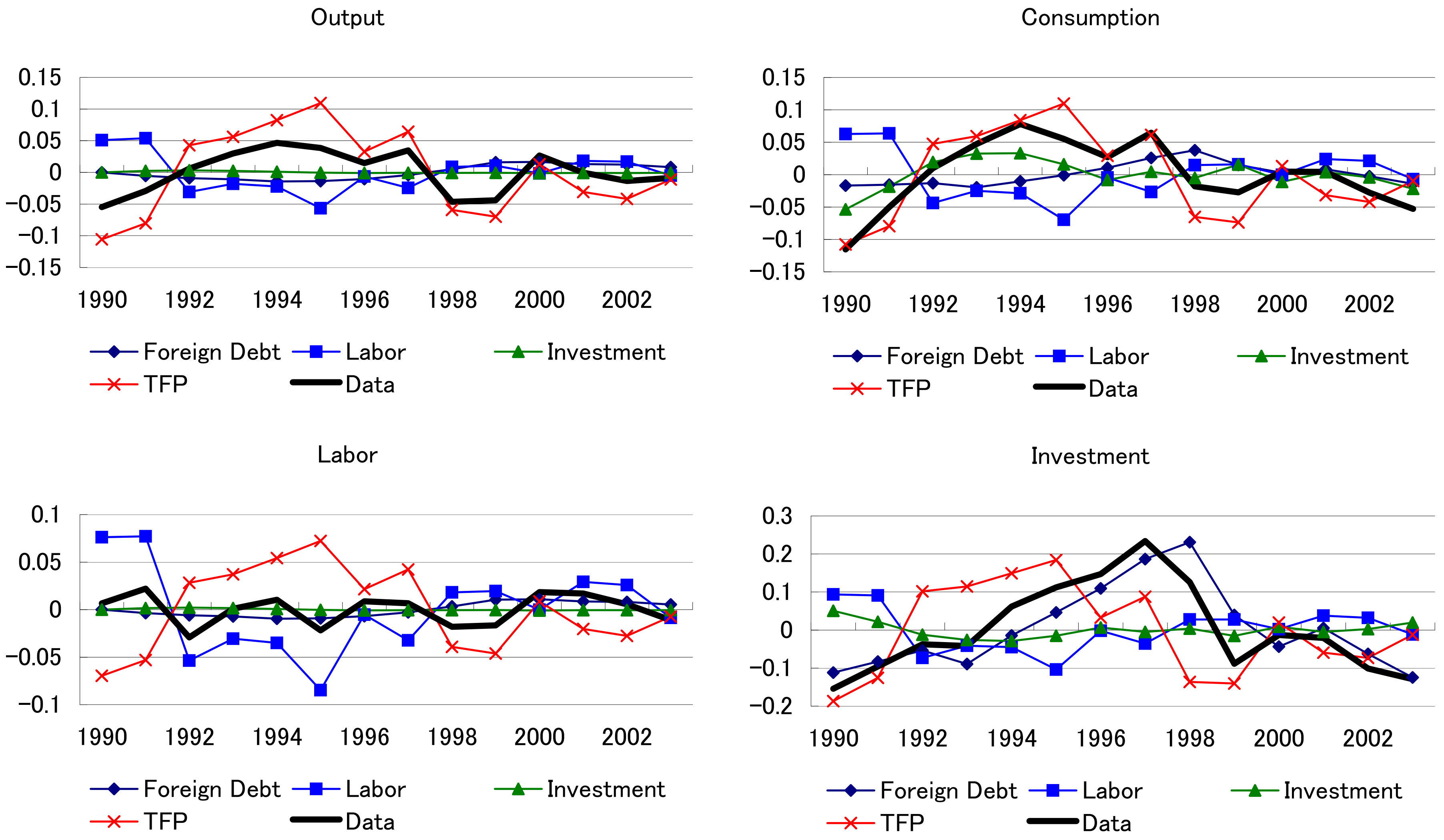


Figure 4b. Results: Korea

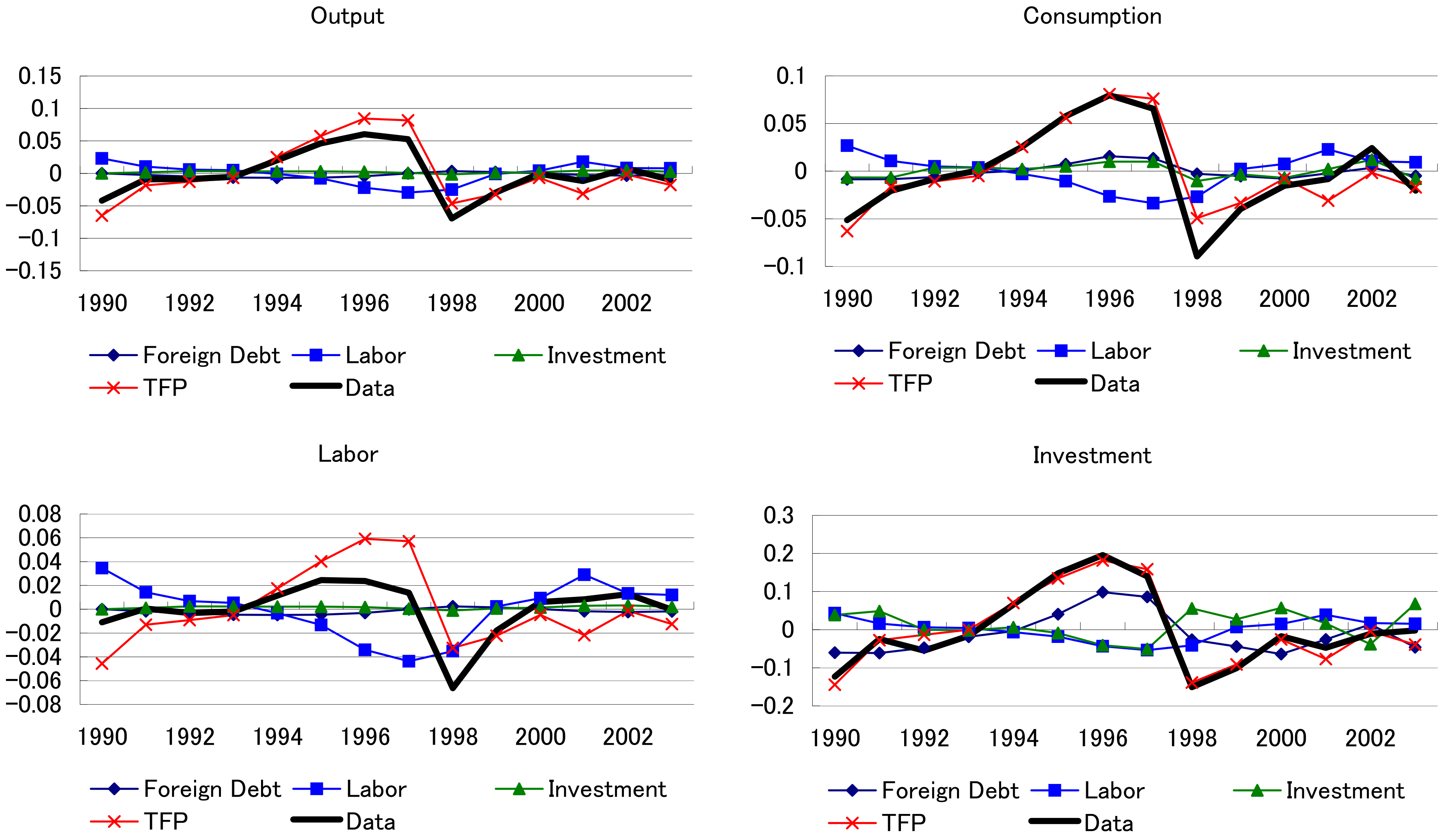


Figure 4c. Results: Singapore

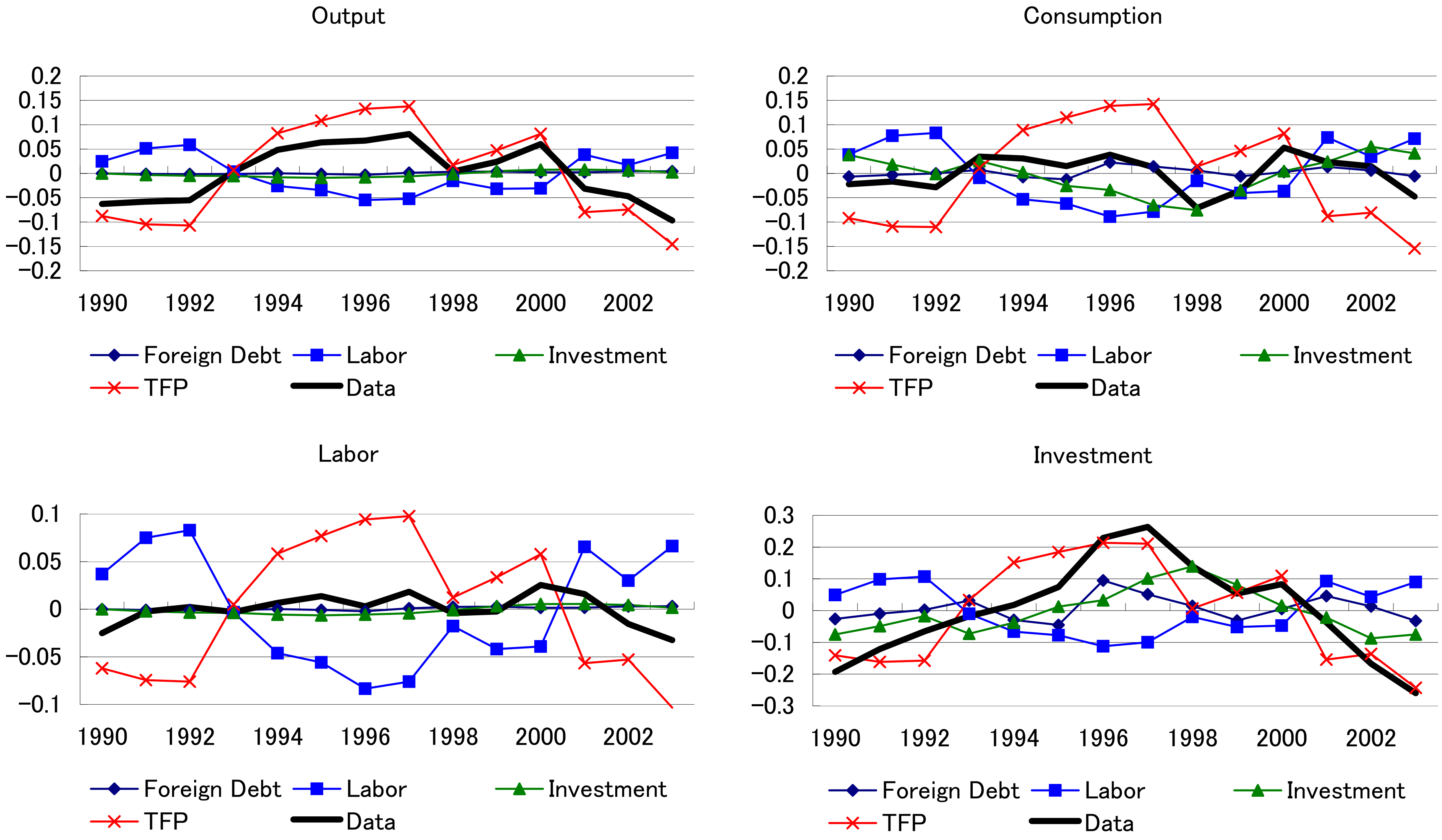
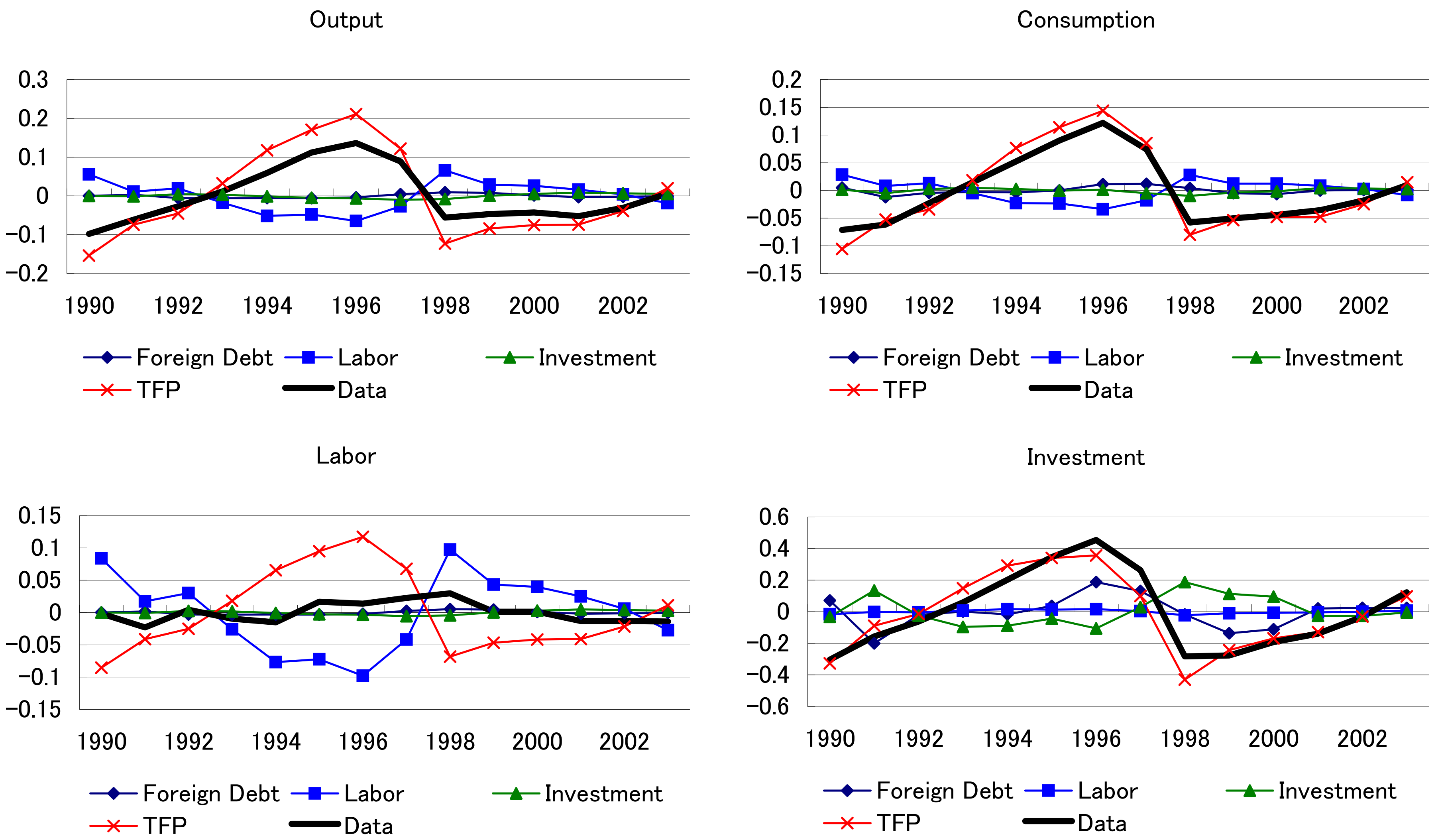


Figure 4d. Results: Thailand



Conclusion

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- Labor Wedges Do NOT Have Contractionary Effects
  - GHH Preferences Are Important
- Foreign Debt and Investment Wedges Are NOT Important in Explaining the Recessions
  - If Financial Distress or Speculative Attacks are Important in Explaining the Recessions, They Must Have Caused A Drop in TFP

Conclusion

Extensions

- What Are The Relationships Between the Shocks?
  - Which Shocks Are Important in Generating TFP?
  - We Need to Investigate the Variance-Covariance Matrix of Shocks
- Is The VAR1 Process Assumption Sensible for a Crisis Period?
  $\cdots$ Alternative Expectation
  - "Perfect Surprise": Perfect Foresight Except for 1998