Economic Review

Federal Reserve Bank of San Francisco

1993 Number 1

Table of Contents

The Federal Reserve Bank of San Francisco's Economic Review is published three times a year by the Bank's Research Department under the supervision of Jack H. Beebe, Senior Vice President and Director of Research. The publication is edited by Judith Goff. Design, production, and distribution are handled by the Public Information Department, with the assistance of Karen Flamme and William Rosenthal.

For free copies of this and other Federal Reserve publicatons, write or phone the Public Information Department, Federal Reserve Bank of San Francisco, P.O. Box 7702, San Francisco, California 94120. Phone (415) 974-2163.

Printed on recycled paper with soybean inks.

Adaptive Forecasts, Hysteresis, and Endogenous Fluctuations

George W. Evans and
Seppo Honkapohja

Professors of Economics, University of Edinburgh and University of Helsinki, respectively. We are indebted to the Economics Research Department of the FRBSF for numerous helpful comments. The first draft of this paper was written while Evans was a Visiting Scholar at the Federal Reserve Bank of San Francisco. The research was also partially funded by the SPES program of the EC. The first author acknowledges support from the National Science Foundation.

This paper considers fluctuations and policy in an economic model with multiple steady states due to a production externality. In the absence of policy changes, the driving forces generating fluctuations are exogenous random productivity shocks. However, because there are multiple steady states, large productivity shocks can shift the economy between high- and low-level equilibria, providing an additional endogenous source of fluctuations. The scope for macroeconomic policy is large since changes in policy can also shift the economy between equilibria. In this setting macroeconomic policy exhibits hysteresis (irreversibilities) and threshold effects and can be used to eliminate endogenous fluctuations.

A relatively recent major focus of macroeconomic theories has been on nonlinear models with multiple self-fulfilling equilibria and the potential for "endogenous fluctuations." This category can be interpreted quite broadly to encompass models with solutions following regular periodic cycles, "sunspot" solutions depending on extraneous random variables, or multiple steady states arising from coordination failures.[1]

These models may be contrasted with the recent "real business cycle" theory and more generally with linear models with exogenous random shocks generating business cycles around a unique equilibrium. Such models do not generate as wide a range of dynamic time series patterns as is possible in nonlinear models which can generate asymmetries endogenously and manifest additional types of persistence. Models with multiple equilibria are also a potential explanation for the empirical results that the economy appears to exhibit regime-switching.[2]

In the model below we combine aspects of both approaches. In the absence of policy changes, the driving forces generating fluctuations are exogenous random productivity shocks. Without policy changes or productivity shocks, the economy would settle down to a nonstochastic steady state. Clearly productivity shocks will generate fluctuations around a steady state even if it is unique. However, for some cases of the model below, the economy has multiple steady states and large shocks can shift the economy between them. This provides an additional source of fluctuations which is endogenous in the sense that it arises from the structure of the model.

1. A very limited selection of well-known papers includes Azariadis (1981), Diamond (1982), Grandmont (1985), Cooper and John (1988), and Woodford (1990). See also the survey paper by Guesnerie and Woodford (1991). The endogenous fluctuations in our model are closest to those described in Howitt and McAfee (1992). Their "animal spirits" cycles are generated by an extraneous sunspot variable, whereas the fluctuations considered here are generated by intrinsic productivity shocks. They do not consider the impact of policy, which is a major focus of this paper.

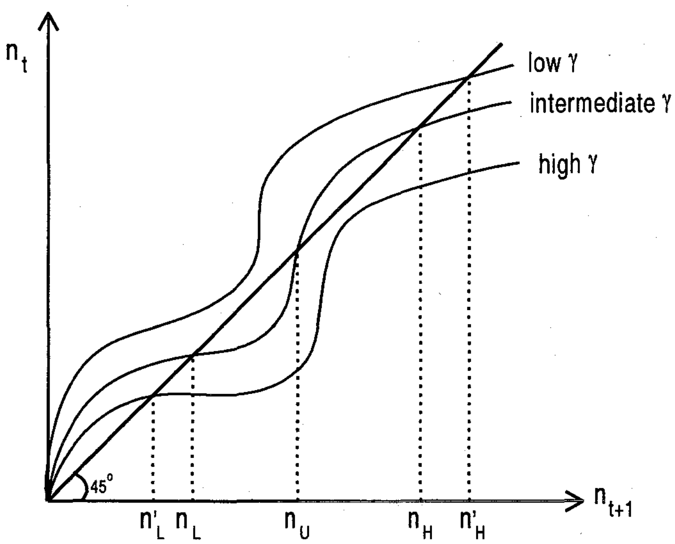
2. Such results are documented by Hamilton (1989), Boldin (1990) and Potter (1992). They show that real GNP appears to switch probabilistically between high and low growth regimes.

The scope for policy in models with multiple equilibria is potentially large, since the levels of policy variables can affect the likelihood of the economy being in alternative equilibria and since changes in policy can shift the economy between equilibria. This is a fundamental issue for policy. In linear models there is a continuous map from control variables to the expected values of targets. This is no longer so in these nonlinear models. Although policy changes within a certain range have a continuous response, beyond some threshold the economy may be displaced from one equilibrium to another.

In this paper our objective is to consider these issues in a specific model which has multiple stochastic steady state equilibria arising from an aggregate production externality. In the model we develop below, the level of economic activity in the current period is positively related to the level expected in the following period. Figure 1 shows the relationship between current and future aggregate employment, $n_t = F(n_{t+1})$ for different values of the policy parameter γ (γ measures government purchases financed by seignorage, that is, by printing money). The shape of the curve arises from the positive production externality: Each agent's productivity is higher when aggregate output is higher. At low n, diminishing returns yield the usual concave shape to F. Above some threshold the production externality generates increasing social returns and a steeper slope to F. This leads to the nonconcavity shown, though F again becomes concave at sufficiently high n since the magnitude of the external effects is bounded.

FIGURE 1

EFFECT OF POLICY ON STEADY STATES



$n_t = F(n_{t+1})$ for nonstochastic model

There is thus the possibility of multiple interior steady states, shown in Figure 1 for the intermediate γ case. Because the model is forward-looking, the evolution of the economy is determined in part by the forecast rules employed by agents, and following recent literature we assume that forecasting is based on adaptive learning algorithms. The steady states labeled n_L and n_H are stable under adaptive learning, while n_U is not. These steady states can be stochastic in the sense of there being fluctuations around them due to productivity shocks. Furthermore, endogenous fluctuations can arise, under certain learning rules, when productivity shocks are large enough (and of the right sign) to move the economy between n_L and n_H. These endogenous fluctuations could be eliminated by using policy to shift up F until only the high-level steady state n_H remained.

Adaptive learning also makes the economy path dependent in the sense that the current equilibrium is determined by initial expectations, the forecast rules, and the shocks. In such environments economic policy can exhibit hysteresis (irreversibilities). Suppose the economy starts at n_H (with intermediate γ) as shown in Figure 1. As γ is increased n_H will decrease and this will be tracked by actual employment under adaptive learning. When γ is large enough, n_H and n_U disappear and employment falls to n_L. If γ is decreased to its original (intermediate) value, employment will only increase to n_L instead of returning to n_H. Thus, since a change in policy can move the economy to a different equilibrium, reversing the policy need not restore the equilibrium that prevailed before the change.

This paper develops in detail the results sketched above. Section I specifies the model and in Section II we describe the forecast rules and how they adapt to forecast errors under learning. Sections III and IV present simulations which illustrate hysteresis effects and endogenous fluctuations, respectively.

I. THE MODEL

The Basic Overlapping Generations Model

We use a generalization of the overlapping generations model incorporating a production externality, developed in Evans and Honkapohja (1991), to derive the model outlined above.[3] The externality leads to social increasing returns over a certain range so that, for some structural parameter values, there is the possibility of multiple steady states. In

3. For brevity we will subsequently denote the references to our own work by EH91, EH92a, EH92b, and EH92c.

the version employed here we will also allow for random productivity shocks and for fiscal–monetary policy.

Before turning to the detailed specification, we emphasize that we will be considering a highly stylized model. No attempt has been made in this paper to make either the structural parameters or the time series properties of the solution paths empirically realistic, though we think that the time series properties for output are "suggestive." Our main objectives are to show the potential of such models to exhibit endogenous fluctuations generated by intrinsic random shocks and to illustrate the effects of policy in this setting.

In the basic overlapping generations (OG) model representative agents (who are producers—consumers) live two periods. An agent born at time t maximizes utility $W=U(c_{t+1})+Z(g_t,g_{t+1})-V(n_t)$, where c_{t+1} is private consumption when old, n_t is labor supply when young, and g_t is public consumption at t. g_t and g_{t+1} are taken as exogenously determined by the government. The budget constraints for the agent are $p_{t+1}c_{t+1}=M_t$ and $p_t q_t=M_t$, where M_t is the money stock, q_t is the quantity of output produced, and p_t is the price of output. In the standard formulation of the OG model, one unit of labor produces one unit of output, that is, $q_t=n_t$, but we will modify this assumption below. The household thus works and produces output when young, and exchanges the goods produced for money (held by the old) at price p_t. This money is then carried forward to the following period when it is exchanged at the possibly different price p_{t+1} for goods to consume when old. In the standard version of the OG model, the stock of (fiat) money is held constant and there are no government purchases.

We choose to analyze a version of the OG model because it is one of the simplest fully specified dynamic general equilibrium models in which expectations matter. The young agent must decide how hard to work, or equivalently, since all income is saved as money, how much to save when young. Since the rate of return on money (the only permitted vehicle for saving in the model) is p_t/p_{t+1}, the expected price in the following period, or more accurately the probability distribution of p_{t+1}, is crucial to the agent's optimal decision.

It should be pointed out that the standard OG model has the disadvantage that the time unit serves several distinct purposes: the length of the working life, the length of the retirement, and the frequency at which economic data are generated. Clearly, we adopt such a model only for tractability and ease of exposition. In principle there is no difficulty constructing analogous models with distinct horizons for these different time periods, as is done in some empirical models. We anticipate that all the phenomena illustrated in this paper will arise in such more realistic models.

The Model with Increasing Social Returns

We now introduce two modifications to the standard OG model. First we allow for government consumption. The government is assumed to purchase the proportion γ_t of output at t, that is, $g_t=\gamma_t q_t$. For convenience we assume that there are no explicit taxes, so that these purchases are entirely financed by seignorage.[4] Thus the government budget constraint is

$$M_{t+1} = M_t + p_{t+1}g_{t+1}.$$

Using $p_t q_t=M_t$ it follows that

$$M_{t+1}/M_t = (1-\gamma_{t+1})$$

and

$$p_t/p_{t+1} = (1-\gamma_{t+1})\, q_{t+1}/q_t.$$

The other modification concerns the production function. A positive externality is introduced into production. Moreover, we allow for random productivity shocks. Thus the production function is assumed to have the form

$$q_t = f(n_t, N_t)\nu_t, \tag{1}$$

where $N_t=Kn_t$ is aggregate employment, K is the number of households in each generation, and ν_t is a positive identically and independently distributed random productivity shock.

The N_t term represents a positive production externality, and we adopt the particular form developed in EH91:

$$f(n, N) = An^{\alpha}\{\max(I^*, \lambda N(1 + a\lambda N)^{-1})\}^{\beta}.$$

This form arises as follows. Individual output is assumed to depend on "ideas" as well as labor effort. Ideas are generated (and "broadcast" to other agents) at a rate λ proportional to labor effort, and the "complementary" ideas obtained from other agents, beyond some threshold I^*_t exert a positive external effect on productivity. This effect generates increasing returns over a range at the aggregate level. However, because there is a fixed time cost, a, for accessing a suitable complementary idea, the range of increasing returns is bounded.

Because $0 < \alpha < 1$, the individual faces diminishing marginal returns to individual labor effort (taking N as exogenous) and we adopt a competitive model. The parameterization of the model is completed by assuming the isoelastic forms for the utility functions $U(c)=c^{1-\sigma}/(1-\sigma)$

4. Only a minor modification would be required to allow for using lump-sum taxes to raise part of the revenue.

and $V(n)=n^{1+\epsilon}/(1+\epsilon)$. It can be shown that the law of motion for the economy satisfies[5]

$$E_t((1-\gamma_{t+1})q_{t+1})^{1-\sigma} = n_t^{1+\epsilon}/\alpha. \tag{2}$$

Here E_t denotes the expectations held by agents at time t. In a rational expectations equilibrium this will be equal to the true conditional expectation at time t.

Since by (1) output next period is given by $q_{t+1}= f(n_{t+1},Kn_{t+1})\nu_{t+1}$ it can be seen that (2) determines current employment as a function of the expected state of the economy next period (together with the current productivity shock this also determines current output and the price level). That is, the reduced form of the model can be written as

$$n_t = H(E_tX(n_{t+1}, \nu_{t+1}, \gamma_{t+1})), \tag{3}$$

where H and X depend on the utility function and production technology parameters according to:

$$X(n, \nu, \gamma) = ((1-\gamma)f(n, Kn)\,\nu)^{1-\sigma}, \tag{4}$$

and

$$H(X) = \alpha X^{1/(1+\epsilon)}. \tag{5}$$

Multiple Steady States and Coordination Failures

The economics of the model can be most easily understood by examining the nonstochastic case in which (1) reduces to $q_t=f(n_t,Kn_t)$. Under perfect foresight, (3) relates n_t to a function of n_{t+1}, that is, $F(n_{t+1})=n_t$, where we have also incorporated a constant policy parameter $\gamma_{t+1}=\gamma$ into F. Provided $\sigma<1$ the substitution effect dominates the income effect and function F is upward sloping. The S-shape shown in Figure 1 arises because of the production externality: Below the "kink" point (corresponding to the threshold of "free" ideas I^*) F is concave because of diminishing returns. Above this point social increasing returns set in, generating a nonconcavity in F. However the region of increasing social returns is bounded, and F eventually again becomes concave.

If the externality is sufficiently strong relative to other parameters there can be multiple steady states. Depending on the various parameters, the model can have 0, 1, 2, or 3 interior perfect foresight steady states and the number can be affected by the policy parameter γ. Similar results arise in the stochastic case with random productivity shocks. Provided the range of the shocks is not too "large,"[6] each of the perfect foresight steady states will, in the stochastic case, correspond to a rational (stochastic) steady state $n_t = \bar{n}$[7] and $q_t=f(\bar{n},K\bar{n})\nu_t$.[8]

When there are three steady states, the welfare in the three steady states depends on the value of government consumption. If government consumption yields no (or sufficiently low) utility, then steady states with high n Pareto dominate those with lower n and the n_L and n_U steady states represent coordination failures. The interpretation of the multiple steady states is straightforward: When other agents work hard, this raises the marginal product of individual effort and induces a higher work effort. At n_L and n_U agents work less hard than at n_H only because *other* agents are working less hard than at n_H. It would be more efficient if agents could coordinate on the high effort level n_H.

The Effect of Policy on Steady States

An increase in γ rotates the F function down around the fixed origin. Figure 1 illustrates one possibility, which we will focus on in this paper: For γ sufficiently small, there is only one interior steady state, the high-level equilibrium n_H. As γ is increased we at some point enter a regime with three interior steady states, n_H, n_U, and n_L. Finally, when γ is sufficiently large, only the interior steady state n_L remains.

Recalling that the policy parameter γ represents a mixed fiscal–monetary policy, it will be noted that, interpreted as fiscal policy, the effects are anti-Keynesian in the following sense. As we discuss below, only the steady states n_L and n_H are stable under learning. If the economy is at a stable steady state, for example, n_L, an increase in γ lowers the level of steady state employment (and output). This result is due to a supply side effect. The higher money growth required to finance increased government consumption leads to a higher level of inflation and therefore a

5. The first order condition for utility maximization is

$$E_tU'(p_tq_t/p_{t+1})(p_t/p_{t+1})f_1(n_t, N_t)\,\nu_t = V'(n_t),$$

where $f_1(\cdot)$ is the partial derivative with respect to n. Using the market clearing condition $p_t/p_{t+1} = (1-\gamma_{t+1})\,q_{t+1}/q_t$ we obtain

$$E_tU'((1-\gamma_{t+1})\,q_{t+1})(1-\gamma_{t+1})\,q_{t+1} = V'(n_t)f(n_t, N_t)/f_1(n_t, N_t).$$

Substituting the assumed parametric forms for U, V and $f(\cdot,\cdot)$ we obtain (2).

6. Technically suppose that ν_t has bounded support. Then not "large" essentially means that the length of the support is sufficiently small. See EH92a.

7. If the productivity shock were not proportional, then in a rational steady state n_t itself would be a function of ν_t.

8. The model can also have other rational expectations solutions, solutions which depend on exogenous sunspot processes and nonstationary solutions. Consideration of these solutions is not needed for the analysis in this paper.

lower rate of return on work and saving. Because we assume the substitution effect dominates the income effect, this leads to less work effort at higher γ.

II. Forecast Rules and Learning

Expectations and Learning Rules

The possibility of multiple rational expectations solutions (for example, multiple steady states) appears awkward for the pure rational expectations approach. A now widely used approach which overcomes the "multiple equilibria" problem is to replace the assumption of rational expectations with the specification of a learning rule for expectation formation.[9] This may in any case be a more realistic view of expectation formation. The model is thus written as

$$n_t = H(X(n_{t+1}, \nu_{t+1}, \gamma_{t+1})^e), \tag{6}$$

where the superscript e denotes the expectations of X held by the agents at time t on the basis of a forecasting rule which has been estimated using observed data.[10]

This way of looking at the economy converts a rational expectations model with multiple equilibria into a model with path dependence in which the actual evolution of the economy depends on:

(i) the adaptive forecast rules used by the agents,
(ii) the initial parameter estimates and forecasts held by the agents, and
(iii) the sequence of stochastic shocks and structural shifts.

It may be noted that typically not all equilibria are stable outcomes of adaptive learning processes. Requirement of convergence provides a stability condition which may be used to select equilibria of interest.[11]

We thus depart from strict rational expectations, though for appropriate adaptive forecast rules, expectations may converge to rational expectations over time. Consider forecast rules in which agents treat the law of motion as a stochastic steady state with an unknown mean. Suppose agents estimate the unknown population mean using the sample mean. Such forecast rules are adaptive in the sense that key parameters are altered in response to forecast errors.

A convenient way to write this forecast rule is:

$$X^e_{t+1} = X^e_t + \delta_t (X_{t-1} - X^e_t), \tag{7}$$

where $\delta_t = 1/t$ and $X^e_0 = X_0$. The formula (7) is the same as the conventional adaptive expectations formula,[12] except that the coefficient specifying the size of the revision to the forecast error, δ_t, goes to 0 at rate $1/t$. This reflects the fact that each new data point provides proportionately less information compared to the history of data.[13] δ_t will be referred to as the "gain" parameter at time t.

Will this learning rule converge to a rational steady state? The problem is not straightforward to answer, since the system is "self-referential" in the sense used by Marcet and Sargent (1989): Agents change their expectations in response to the evolution of the system, and the evolution of the system depends in turn on the expectation rules the agents use.

For the case at hand it is possible to characterize the possible asymptotic outcomes when there are three steady states (see EH92a). The adaptive rule which forecasts X by means of the average of its past values can lead n_t to converge to either n_H or n_L, depending on initial conditions and the sequence of random shocks. That is, either of these two rational steady states can be the outcome of an adaptive learning rule. In contrast, the middle steady state n_U is not stable under learning. When there is only one steady state it will be stable under learning.[14]

Structural Change and Constant Gain Estimators

In the learning rule just described (estimation using the sample mean), the gain parameter δ_t decreases at rate t. The choice $\delta_t \to 0$, often referred to as "decreasing gain," is appropriate if agents confidently believe that they are in an economy in which X_t, the variable being forecasted, has a constant mean over time. While this would be reasonable if agents believe that the structure of the economy never changes, such an assumption does not seem realistic in practice.

How should the learning rule be modified if agents

9. See EH92c for a recent review of the literature.

10. Note that in considering learning rules we are straining the overlapping generations interpretation of the model. Implicitly we are assuming that agents inherit forecast rules from their "parents," which they then update. Alternatively, it may be possible to reinterpret the model in terms of infinitely lived agents facing finance constraints, as in Woodford (1988).

11. However, more than one equilibrium may be stable under learning; see below for an example.

12. We have introduced a one-period lag into the expectation formula (7) in order to avoid simultaneity between (6) and (7).

13. For an early discussion of the adaptive expectations formula with a possibly nonconstant gain, see Turnovsky (1969).

14. More exotic equilibria, for example, periodic solutions and "sunspot" solutions depending on extraneous variables, can be stable under learning for certain parameter values and appropriate choices of learning rules. See EH92a,b for details.

believe that the structure of the economy may be subject to change? In the context of recursive algorithms for parameter estimation, this is a general problem which has been considered in the statistical and engineering literature; see Benveniste, et al. (1990, ch. 1 and 4, part I). There are two approaches. The first is for agents to build a model, with hyperparameters, of how the system is evolving over time, and to estimate simultaneously both parameters and hyperparameters. This approach requires knowledge of the form of structural change.

The alternative approach, which appears more robust and which we will adopt in this paper, is to replace the assumption $\delta_t \to 0$ by the assumption that δ_t is equal to (or approaches) some fixed value $\delta > 0$. This procedure, known as "constant gain," involves a trade-off between bias and variance when used to adapt to an exogenous time-varying process. A larger value of δ will allow changes in structure to be tracked more rapidly, but will also produce more noisy forecasts.

Although the choice of the gain parameter δ is subject to this trade-off, and the optimal choice of δ will depend on the size and frequency of structural change, the use of a constant gain learning rule, in preference to a decreasing gain rule, is clearly indicated when the structure is subject to change.

An Example with a Time-Varying Policy

To illustrate the importance of using constant gain estimators when structural change is present, consider the behavior of the economy if the monetary–fiscal policy parameter, γ_t, varies systematically over time. In particular, suppose that the share of government purchases is made to vary according to:

$$\gamma_t = \alpha_0 + \alpha_1 \cos(\omega t). \tag{8}$$

Here α_0 specifies the mean level of γ_t, $2\alpha_1$ is the range over which γ_t varies, and ω is the frequency.

Agents are assumed not to know the path (8), but to allow for the structural change by using a constant gain estimator in (7). Of course, a regular sinusoidal pattern in γ_t should be easy to detect, but our point would apply just as well if the pattern for γ_t were highly irregular and difficult to predict.[15] In the simulations of this section we choose α_0 and α_1 so that, given the other parameters of the model, there is a unique steady state n_L.[16]

The other crucial part of the specification is the distribution of the iid proportional productivity shock ν. We choose

$$\nu_t = 1 + \tau(0.5 - u_t),$$

where u_t is iid uniform over the unit interval (τ is restricted to $0 \leq \tau \leq 2$). We set $\tau = 0.20$.

Figure 2 shows a simulation over 1,000 periods when the policy parameters are $\alpha_0 = 0.07$, $\alpha_1 = 0.02$, and $\omega = 0.04$ and when agents use the gain parameter $\delta = 0.15$. The path of employment over time reflects the combined effects of the time variation of policy, random productivity shocks, and the adaption of expectations through the learning rule.

To see the importance of using a constant gain learning rule rather than a decreasing gain rule (such as averaging, that is, $\delta_t = 1/t$) we can compare the quality of the forecasts. For convenience we adopt the mean square forecast error criterion $MSE = T^{-1}\Sigma_{t=1}^{T}(X_t - X_t^e)^2$ and we choose $T = 10{,}000$ periods. Suppose first that agents use a constant gain estimator with $\delta = 0.15$. Then simulations indicate that an individual agent would obtain a much higher MSE with a decreasing gain estimator (0.0206 vs. 0.0149). Even if all other agents were using a decreasing gain estimator, a single agent could somewhat lower his MSE by using an appropriate constant gain estimator (for example $\delta = 0.05$ yields 0.0148 vs 0.0150 with decreasing gain). Thus with time-varying structure there is a forecasting advantage in using a constant gain estimator. We discuss the choice of $\delta = 0.15$ in the next subsection.

Equilibria in Learning Rules

The point just developed merits some further discussion. Is a gain parameter $\delta = 0.15$ a good choice from a statistical point of view? On the basis of the data shown in Figure 2, agents could consider whether another choice of the gain parameter δ would have been better in terms of the mean square forecast error,[17]

$$MSE(\delta) = T^{-1}\Sigma_{t=1}^{T}(X_t(\delta_0) - X_t^e(\delta))^2. \tag{9}$$

Equation (9) is interpreted as follows: The data are generated by the model (4)-(8) with agents using the gain

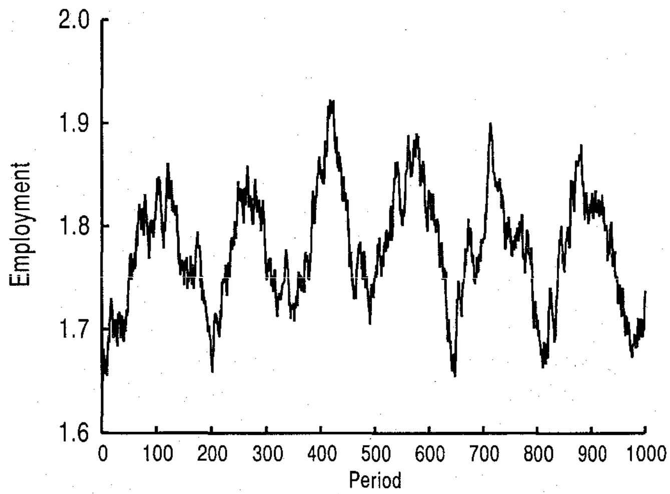
15. We are not allowing agents to condition their forecasts of X_t on γ_t. This assumption is justifiable if the data on γ_t are infrequent (compared to data on X_t) and of poor quality. Recent data on X_t would then provide most of the information relevant for forecasts.

16. Throughout the paper we use the following structural parameters: $\epsilon = 0.25$, $\sigma = 0.1$, $A = 0.0805$, $a = 0.025$, $\alpha = 0.9$, $\lambda = 0.5$, $K = 40$, $I^* = 19.5$, $\beta = 1.007$.

17. Other possible criteria could be devised based on utility losses.

FIGURE 2

EFFECT OF TIME-VARYING POLICY



parameter $\delta=\delta_0$ (in our case $\delta_0=0.15$). At the end of T periods, agents consider whether they have made a good choice of the gain parameter, *given* the data (that is, given the choice of the gain parameter $\delta=\delta_0$ made by other agents).

Indeed, we can take this line of thought one step further. For each δ_0 we can look for the value of δ which minimizes (9). If the minimum of (9), given δ_0, is attained at δ_0 itself, then we have an equilibrium learning rule with parameter δ_0, in the usual sense. No agent would want to alter his gain parameter δ (based on the MSE criterion), given the choice made by others.

We make no attempt to establish the formal existence of such an equilibrium, but present the evidence for the case at hand, using sample estimates of the MSE for $T=4{,}000$. Table 1 provides the simulation results. Table 1 shows MSE(δ_0) for various values of δ_0 and also the value of δ, and corresponding MSE, which minimizes (9) for each choice of δ_0. It can be seen that there does appear to be an equilibrium learning rule with a gain parameter of approximately $\delta_0=0.15$. This is no accident: We chose our value of δ on the basis of Table 1. It is also worth noting that a wide range of δ_0 would be "reasonable" choices in the sense that the MSE loss of using the wrong δ would be small.

We close this section with one final point: The "equilibrium" δ will depend on the policy parameters. For example, a higher frequency of change ω can be expected to lead to a higher equilibrium value of δ.

TABLE 1

MSE WITH TIME-VARYING POLICY

ACTUAL δ_0	MSE (δ_0)	ARGMIN MSE (δ)	MIN MSE (δ)	DIFFERENCE IN MSE, %
0.01	0.0169	0.07	0.0155	8.89
0.05	0.0149	0.09	0.0146	2.01
0.10	0.0147	0.13	0.0146	0.48
0.15	0.0146	0.15	0.0146	0.00
0.20	0.0147	0.18	0.0147	0.15
0.25	0.0147	0.20	0.0147	0.49
0.30	0.0149	0.23	0.0147	0.85
0.35	0.0150	0.26	0.0148	1.17
0.40	0.0151	0.31	0.0149	1.40
0.45	0.0152	0.36	0.0150	1.53
0.50	0.0154	0.41	0.0151	1.62
0.55	0.0155	0.46	0.0153	1.69
0.60	0.0157	0.51	0.0154	1.74
0.65	0.0158	0.56	0.0156	1.78
0.70	0.0160	0.61	0.0157	1.81
0.75	0.0162	0.66	0.0159	1.84
0.80	0.0163	0.71	0.0160	1.86
0.85	0.0165	0.76	0.0162	1.87
0.90	0.0166	0.81	0.0163	1.89
0.95	0.0168	0.86	0.0165	1.89

NOTE: Table shows MSE for gain δ when data generated in a model with time-varying policy and agents use actual gain δ_0. Simulations are over 4,000 periods.

III. HYSTERESIS EFFECTS

In the preceding section the variation in γ_t was restricted to a range over which the system had a unique steady state n_L. Over this range, neglecting random shocks and transitional learning dynamics, there is a continuous relationship between policy and employment and the policy is "reversible." However, an important feature of our model is that certain variations in the policy parameter γ_t will induce discontinuous responses. To illustrate this aspect of policy we again investigate the effects of a time-varying policy of the form (8), but now set $\alpha_0=0.04$, $\alpha_1=0.02$, and $\omega=0.01$. γ_t thus varies continuously over the range 0.02 to 0.06. We use a gain parameter of $\delta=0.35$, which is approximately the equilibrium value in the sense of the preceding section.

The values of $\gamma=0.02$, 0.04, and 0.06 correspond to the "low," "intermediate," and "high" γ cases shown in Figure 1. Consider the effects as policy moves from a low value of γ to a high one. Starting from the low γ case of

Figure 1, estimators will continuously track the mean of $X(n_H,\nu,\gamma)$ as we move through the low and intermediate γ cases. However, when γ becomes sufficiently high, n_H and n_U coalesce and then disappear. The system bifurcates to the high γ case, inducing a discontinuous change in the attracting steady state employment level to n_L (a "catastrophe" phenomenon).

From a policy point of view, some of the more interesting features are the hysteresis effects illustrated in Figure 3. Here we show the relationship between γ_t and n_t over one complete cycle of γ_t (from 0.06 to 0.02 to 0.06). Over most of this range there are two distinct branches to the policy relationship, with the lower branch corresponding to the n_L steady state and the upper branch corresponding to n_H.

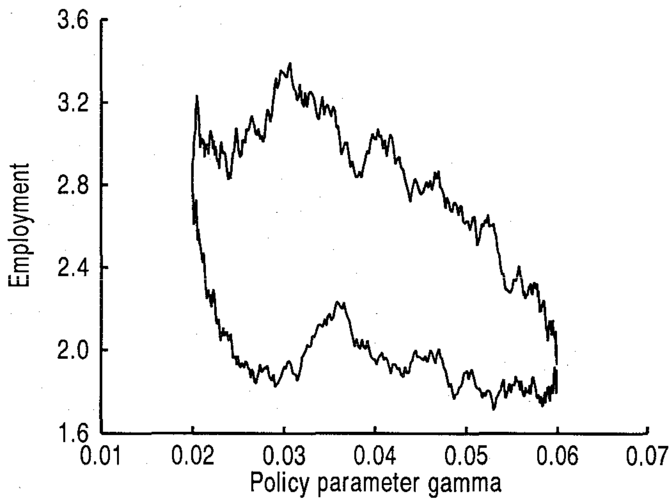
The branch on which the system lies at some point in time is determined by history. On a given branch, over a range of γ, policy is reversible in the sense that an increase in γ followed by an equal decrease in γ will return the system to its original position (if an allowance is made for random productivity shocks and for transitional learning dynamics).

However, changes in γ_t beyond a certain point induce policy irreversibilities when the system is forced onto the other branch. Starting with $\gamma_t = 0.06$ and $n_t \approx 1.9$, the system moves (clockwise) along the lower branch until at low values of γ_t employment becomes forced onto the upper branch (when the low steady state disappears). When γ_t begins to increase from its minimum of 0.02, it remains on the upper branch until γ_t is sufficiently high.

The message for policy is this: If the system is trapped into a low-level steady state, the policy variable can have a strongly nonlinear response. Decreases in γ may have initially small effects on employment, while beyond some threshold value the induced response can be much larger as the economy is pushed from the low-level to the high-level steady state.

FIGURE 3

HYSTERESIS EFFECTS



IV. Endogenous Cycles

Endogenous Shifts in Expectations

In the foregoing we have considered a model in which a key driving force is variation in the policy variable γ_t. However, the qualitative results obtained suggest the following additional possibility. Suppose that agents use a constant gain forecast rule. Could random productivity shocks lead to shifts between high-level and low-level steady states, via induced changes in forecasts, even in the absence of structural or policy shifts? As we will see, the answer can be yes.

Thus consider the system (4)-(7) with γ_t fixed at $\gamma =$ 0.04. With this value of the policy parameter there are two stable rational steady states. If agents use (7) with decreasing gain, for example, with $\delta_t = c/t$, for some constant c, then, as pointed out in Section II, the system will converge to one of the two rational steady states corresponding to n_L or n_H (and expectations will converge to the corresponding fixed rational forecast).

However, if agents use a constant gain $\delta_t = \delta > 0$ this will not be so—agents' forecasts X^e_{t+1} will retain some randomness even in the limit because of their sensitivity (through $\delta_t X_{t-1}$) to random productivity shocks. Furthermore, there is now the possibility that, say, with the system starting near the low-level steady state, a large favorable productivity shock leads to a sufficiently large revision in X^e_{t+1} so that in subsequent periods the system is drawn, for an extended period of time, to the high-level steady state.

This phenomenon is illustrated in Figure 4, which presents the results of a simulation with $\delta = 0.15$, $\gamma = 0.04$ and $\tau = 0.20$ (other parameters are unchanged). The system appears to alternate between two noisy steady states, centered near n_H and n_L. Occasionally productivity shocks are sufficiently large and in the right direction to move actual and thus subsequent expected aggregate economic activity from one region of attraction to the other.

Why should agents use a constant gain expectations rule in this situation? There are two reasons. First, although in the simulation presented the policy parameter was held fixed, agents may use a constant gain forecast rule because they are concerned about the *possibility* of structural or policy shifts. It seems plausible that agents would want to make some allowance for this by maintaining δ above some minimum positive level.

FIGURE 4

ENDOGENOUS CYCLES
WITH CONSTANT GAIN ESTIMATOR

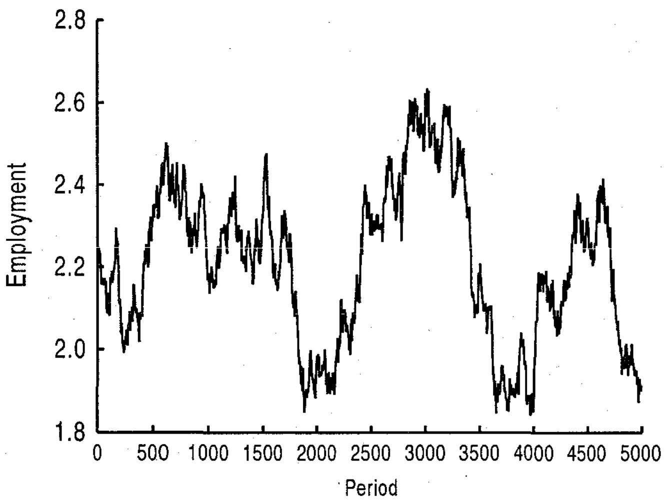


TABLE 2

MSE WITH ENDOGENOUS CYCLES

δ	MSE
0.05	0.0268
0.10	0.0248
0.15	0.0246
0.20	0.0248
0.25	0.0253
0.30	0.0258
0.40	0.0272
0.50	0.0288
0.60	0.0307
0.70	0.0329
0.90	0.0386

NOTE: The MSE for a model with endogenous cycles was generated by a fixed policy parameter $\gamma = 0.04$ and constant gain $\delta_0 = 0.15$. Simulations are over 4,000 periods.

Second, and more fundamental, the choice of a constant gain learning rule may be an equilibrium learning rule in the sense defined in Section II. That is, the choice δ minimizes the forecast mean square error for each agent, given that other agents use that δ. In this case we would have a self-fulfilling prophecy in learning rules, with expectations adapting to fluctuations in economic activity, and the changes in expectations in turn inducing fluctuations in the economy. Even if δ is not strictly an equilibrium value, it may still yield an MSE which is nearly optimal. Table 2 shows that this is indeed true for $\delta = 0.15$.[18]

Although the model is highly stylized, the results of this section are attractive as a model of economic fluctuations in the following sense: Unlike "sunspot" equilibria, in which the solution depends on extraneous variables, the precipitating variables here, as in real business cycle (RBC) models, are productivity shocks. The difference from RBC models is that a sequence of large shocks can induce a self-fulfilling overreaction in which the economy moves between its two stable steady states.

The policy implications are again straightforward. Faced with an economy undergoing endogenous fluctuations, the policy parameter γ can be shifted to a level at which there is a unique steady state.

Regime-Switching Models

But would agents stick with a constant gain estimator if they observe the process shown in Figure 4? They might, since the existence of two regimes may not be apparent in the presence of the random shocks, and since the use of a constant gain estimator is designed to allow for and adapt to unspecified structural shifts. However, it is of interest to know whether endogenous cycles would continue to exist if agents *did* infer the existence of two regimes (corresponding to n_L and n_H) and estimated a regime-switching model in an attempt to improve their forecasts.

Thus suppose that agents believe that the conditional mean level of X follows a two-state Markov process. We will assume that agents believe the regime is triggered by the recent average level of economic activity, rather than by some hidden variable, and so use the "self-exciting" framework of Potter (1992). Based on Figure 4, we choose a regime switching parameter X^* corresponding to $n = 2.1$ ($X^* = 2.1^{(1+\epsilon)/\alpha}$). Agents assume that the economy is in state 1 if $\bar{X}_{t-1}$, the average of X of the recent past, is less than X^* and in state 2 if it exceeds X^*. We again use a recursive estimation procedure, but now assume that agents estimate both the conditional mean value of X in each state and the conditional probability of being in each state. Let p_i for $i = 1,2$ be the probability, given that we are in state i at s, of staying in state i at $s+1$. p_i at time t is essentially estimated by the corresponding actual proportion $p_{i,t}$ through time t.[19] The conditional means in the two

18. The choice of $\delta_0 = 0.15$ is only approximately an equilibrium, because the δ that minimizes MSE for this δ_0 lies between 0.14 and 0.15.

19. The estimation is actually done using the associated recursive formula and initial estimates $p_1 = p_2 = 1$.

states are estimated by

$$\left.\begin{aligned} X1_{t+1} &= X1_t + \delta(X_t - X1_t) \\ X2_{t+1} &= X2_t \end{aligned}\right\} \quad \text{if } \bar{X}_t \leq X^*$$

$$\left.\begin{aligned} X2_{t+1} &= X2_t + \delta(X_t - X2_t) \\ X1_{t+1} &= X1_t. \end{aligned}\right\} \quad \text{if } \bar{X}_t > X^*$$

For simplicity, the switch point X^* is fixed exogenously and not estimated. In the simulations we assume that $\bar{X}_t$ is computed using the average over the last three periods. We continue to use a constant gain estimator,[20] on the assumption that agents still want to allow for the possibility of structural/policy shifts.

Agents then forecast X_{t+1} at time t according to

$$X^e_{t+1} = p_{1,\,t} X1_t + (1 - p_{1,\,t}) X2_t \quad \text{if } \bar{X}_{t-1} \leq X^*,$$

and

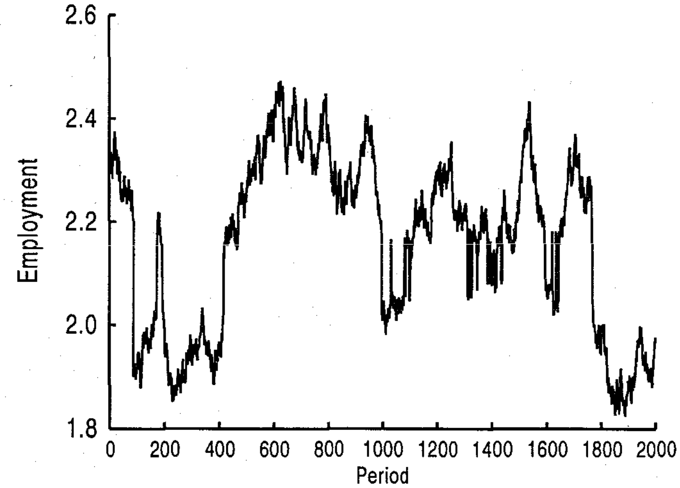
$$X^e_{t+1} = (1 - p_{1,\,t}) X1_t + p_{2,\,t} X2_t \quad \text{if } \bar{X}_{t-1} > X^*.$$

Figure 5 shows the results of a simulation (over 2,000 periods) with unchanged structural parameters and with the same values for γ and δ. It is apparent that the broad pattern of endogenous cycles remains. The main effect of the "more sophisticated" forecast procedure is to speed up the transition between regimes.

There are numerous other ways in which agents might attempt to capture the dynamics of the system, but the broad point seems clear. If agents allow for the possibility of changes in regime when making their forecasts, this reinforces the potential of productivity shocks and other sources of intrinsic noise to induce, periodically, large self-fulfilling changes in the level of economic activity.

FIGURE 5

Endogenous Cycles with Regime-Switching Estimators



V. Conclusions

We have considered a macroeconomic model, incorporating production externalities and random productivity shocks, which has the potential to generate two stable stochastic steady states. For the structural parameter values chosen, the number of stable steady states depends on the monetary—fiscal policy parameter γ. When γ is low (high), only the high- (low-) level steady state exists. Both steady states coexist for intermediate values of γ.

If γ_t varies sufficiently over time, and if agents use adaptive forecasts with an appropriate constant gain parameter, aggregate economic activity will periodically shift between the high-level and low-level regimes. The economy will exhibit hysteresis effects over the "business cycle" in the response of output to policy. If instead γ_t is held fixed at an intermediate value, the economy can still exhibit fluctuations between the two regimes, driven now by the productivity shocks themselves.

There is thus the potential for models with multiple steady states to explain the empirical regime-switching results documented by Hamilton (1989), Boldin (1990) and Potter (1992).[21]

In our model the "switches" are determined by fundamentals, either by intrinsic productivity or taste shocks or by policy changes. We emphasize, however, that no attempt has been made in this paper to use empirically realistic parameters or to fit macroeconomic data.[22] A large gap currently exists between theoretical models of endogenous fluctuations and their empirical implementation, and it may be desirable to attempt calibration to observed fluctuations in future research.

We have emphasized the possibility that policy may have a highly nonlinear response in these models, since it can sometimes shift the economy between high-level and low-level steady states if the policy variable exceeds some threshold. This is clearly an important phenomenon and indicates that it would be worthwhile to examine the performance of monetary feedback rules in such models.

20. If agents use a decreasing gain estimator, the system might converge to a self-fulfilling solution in which the regime is a function of the productivity shock.

21. Howitt and McAfee (1992) and Boldin (1990) have also noted this potential connection.

22. A wider range of policy variables also could be incorporated.

References

Azariadis, C. 1981. "Self-fulfilling Prophecies." *Journal of Economic Theory* 25, pp. 380-396.

Benveniste, A., M. Metivier, and P. Priouret. 1990. *Adaptive Algorithms and Stochastic Approximations*. New York: Springer Verlag.

Boldin, M. D. 1990. "Characterizing Business Cycles with a Markov Switching Model: Evidence of Multiple Equilibria." Research Paper No. 9037. Federal Reserve Bank of New York.

Cooper, R., and A. John. 1988. "Coordinating Coordination Failures in Keynesian Models." *Quarterly Journal of Economics* 113, pp. 441-464.

Diamond, P.A. 1982. "Aggregate Demand Management in Search Equilibria." *Journal of Political Economy* 90, pp. 881-894.

Evans, G., and S. Honkapohja. 1991. "Increasing Social Returns, Learning and Bifurcation Phenomena." Discussion Paper. London School of Economics. (Forthcoming in *Learning and Rationality in Economics*, ed. A. Kirman and M. Salmon. Oxford: Basil Blackwell.)

__________, and __________. 1992a. "Local Convergence of Recursive Learning to Steady States and Cycles in Stochastic Nonlinear Models." Mimeo.

__________, and __________. 1992b. "On the Local Stability of Sunspot Equilibria under Adaptive Learning Rules." Mimeo.

__________, and __________. 1992c. "Adaptive Learning and Expectational Stability: An Introduction." Discussion Paper. London School of Economics. (Forthcoming in *Learning and Rationality in Economics*, ed. A. Kirman and M. Salmon. Oxford: Basil Blackwell.)

Grandmont, J-M. 1985. "On Endogenous Competitive Business Cycles." *Econometrica* 53, pp. 995-1045.

Guesnerie, R., and M. Woodford. 1991. "Endogenous Fluctuations." Mimeo. Paris: DELTA.

Hamilton, J. 1989. "A New Approach to Economic Analysis of Economic Time Series." *Econometrica* 57, pp. 357-384.

Howitt, P., and P. McAfee. 1992. "Animal Spirits." *American Economic Review* 82, pp. 493-507.

Marcet, A., and T. Sargent. 1989. "Convergence of Least Squares Learning Mechanisms in Self-referential Stochastic Models." *Journal of Economic Theory* 48, pp. 337-368.

Potter, S. 1992. "A Nonlinear Approach to U.S. GNP." Mimeo. UCLA.

Turnovsky, S. 1969. "A Bayesian Approach to the Theory of Expectations." *Journal of Economic Theory* 1, pp. 220-227.

Woodford, M. 1988. "Expectations, Finance Constraints and Aggregate Instability." In *Finance Constraints, Expectations and Macroeconomics*, eds. M. Kohn and S.C. Tsiang, pp. 230-261. New York: Oxford University Press.

__________, 1990. "Learning to Believe in Sunspots." *Econometrica* 58, pp. 277-307.

FDIC Improvement Act and Corporate Governance of Commercial Banks

James R. Booth

Arizona State University and Visiting Scholar, Federal Reserve Bank of San Francisco.

This paper examines provisions of the FDIC Improvement Act related to corporate governance of banks. These provisions focus on the composition and independence of the audit committee and on increased regulatory influence over executive compensation. The composition of audit committees for a sample of banking firms for 1990 is compared with those of industrial firms and with the provisions of FDICIA. The findings suggest only minor differences between banks and other firms; however, under FDICIA provisions, large changes in the composition of bank audit committees are likely. Provisions related to compensation have focused on CEOs. To address this issue, I compare the 1990 levels and factors explaining differences in CEO compensation for a sample of banks and industrial firms. The findings suggest that bank CEOs earn slightly less than their industrial counterparts and that cross-sectional differences in CEO compensation in banking and other industries are explained by similar factors.

Most aspects of corporate governance have traditionally been beyond the scope of corporate law and bank regulation. Recent problems in the savings and loan industry are credited with motivating the FDIC Improvement Act of 1991 (hereafter FDICIA) provisions related to the role of boards of directors in governing banks. Specific provisions are designed to strengthen the audit function of the board and to have regulators develop guidelines for compensating directors and officers. Both provisions can be viewed as increased regulatory influence on the previously largely unregulated area of corporate governance in banks.[1]

This article explores the provisions of FDICIA that directly affect the board of directors' role in corporate governance.[2] After reviewing the issues of debate related to compensation for boards of directors and CEOs, I compare the composition of board audit committees for a sample of banking and nonbanking firms. Additionally, I examine whether the provisions of FDICIA related to the audit committee will substantially alter the composition of this committee.

The provisions related to director and officer compensation appear to reflect the current national concern that CEO pay is excessive. While the answer to this question is beyond the scope of this paper, the focus here is to compare levels of compensation for nonmanagement directors and CEOs for the sample of banks and industrial firms. Additional analysis of CEO compensation is undertaken to determine if cross-sectional differences in CEO compensation reflect the same factors in banks as in industrial firms.[3]

---

1. Nationally chartered banks have faced a minimal amount of regulation related to the size of the board and to stock ownership by the board per the Banking Act of 1935 (see Brickley and James 1987 for a discussion).

2. While one can argue that virtually all of the provisions will affect the board, the focus here is on the impact of provisions related to the composition of the audit committee and to guidelines for officer and director compensation.

3. Recent controversy has developed in Japan over bank employee and officer compensation relative to industrial firms. Some evidence suggests that, on average, Japanese bank executives earn 20 to 30 percent more than their industrial counterparts.

This will allow us to evaluate bank CEO compensation relative to that of less regulated firms.

The empirical findings of this paper suggest that the provisions of FDICIA related to the composition of the audit committee may cause major changes in current practices. For a sample of large banks I show that the audit committee is composed of independent directors as traditionally defined. However, as interpreted under FDICIA, considering outside directors of bank customers as a bank customer likely will exclude current bank audit committee members. The evidence related to compensation practices suggests that, on average, CEOs of banks earn less than their industrial counterparts. In analyzing cross-sectional differences in CEO compensation between banks and industrial firms the evidence presented suggests similar factors appear to explain levels of CEO compensation for banks and for industrial firms. These findings suggest that banks do not appear to differ significantly from their industrial counterparts in terms of the role of corporate governance in board audit committees and CEO compensation.

The remainder of the paper is structured as follows: In Section I, a brief description of the debate about the role of boards of directors in corporate governance is summarized, followed by a brief review of the debate over executive compensation. Section II describes the provisions of FDICIA related to the independence of the audit committee and executive compensation. Section III presents the empirical analysis of the composition of audit committees of banks, followed by the analysis of CEO compensation for sample bank and industrial firms. The article concludes with a discussion of the policy implications of these findings.

I. Board of Directors, Corporate Governance, and CEO Compensation

Board of Directors and Corporate Governance

Corporate governance has traditionally been beyond the scope of corporate law and bank regulations. Regulations related to transactions between directors and banks are specific, but it is unlikely that these materially affect the composition of bank boards of directors.

The last decade has seen numerous proposals for reforms in director selection and board composition.[4] The traditional role attributed to corporate boards of directors is to resolve conflicts of interest among decisionmakers and residual risk-bearers. Their power arises from their ability to hire, fire, evaluate, and compensate senior management teams. It is frequently argued that the selection of directors is left almost totally to the discretion of the managers whose behavior they are supposed to monitor (Dunn 1987, Mace 1987, Vancil 1987). As a result, reform proposals focus on greater board independence from firm managers. These have ranged from requiring a majority of independent directors to requiring that no current or past employees be on the board of directors with the exception of the CEO.

Empirical support for the benefits of board independence is reflected in a number of studies that have examined market responses to changes in the composition of the board and other managerial actions. Rosenstein and Wyatt (1990) document a positive stock price response to the appointment of an additional outside director but no significant price response to the appointment of an additional inside director. Byrd and Hickman (1991) examine takeover activity and find a positive relationship between board independence of bidding firms and wealth effects associated with tender offers. Additionally, Lee, et al. (1992) find that greater board independence is associated with more positive stock price response for firms undertaking leveraged buyouts.

Direct evidence on the monitoring actions of boards is reported in Weisbach (1988) who finds that as the level of board independence increases, the likelihood that the board will replace the CEO after a period of poor performance increases. Brickley and James (1987) examine measures of perquisite consumption for a sample of banks and conclude that a greater presence of outside directors reduces managerial consumption of perquisites when the takeover market is limited by the presence of state regulation. They note that this may reflect differences in the cost of producing banking services in the presence of increased state banking regulations. In a more recent study of the life insurance industry, Mayers, Shivdasani, and Smith (1992) find evidence that for the companies where the takeover market is absent (i.e., mutuals) outside directors are used more extensively to monitor management.

Although virtually all previous studies have addressed the composition of the entire board, many of the activities of boards of directors are accomplished in smaller groups or committees. A survey of the Fortune 1000 firms by Kesner (1988) showed an average of 4.3 committees, with 70 percent of sample firms maintaining between three and five committees.

Kesner found that virtually all boards have audit, nominating, compensation, and executive committees, and that their most common duties are as follows: The audit committee sets the scope and reviews audits with the external auditors; the compensation committee reviews and makes recommendations on compensation for senior management; the nominating committee considers stockholder

4. See Baysinger and Butler (1985) for a discussion of these proposals.

recommendations and selection of nominees for directors; the executive committee acts in lieu of the full board if immediate action is required and counsels the CEO on ideas and proposals prior to disclosure to the full board.

CEO Compensation Debate

The motivation for incorporating regulatory oversight into bank compensation appears to reflect congressional reaction to a few widely publicized abuses in the savings and loan industry and to a growing sentiment that CEOs are overpaid. The criticisms of CEO pay focus on concerns that the level of pay in recent years is too high and that cross-sectional differences do not reflect differences in firm performance.

The concern about the level of CEO pay is not new. Brownstein and Panner (1992) note that in 1939 President Roosevelt railed against the "entrenched greed" of corporate executives. They also note that at that time the U.S. Treasury published a list of executives earning more than $15,000 dollars per year and the Securities and Exchange Commission (SEC) started requiring corporations to submit detailed disclosure of executive compensation to shareholders.

The recent concern over pay has led to the SEC decision that it will no longer permit corporations to exclude from their proxy statements nonbinding shareholder proposals concerning executive and/or director compensation. New reporting requirements related to noncash compensation are also an outcome of this round of concern over CEO pay. Additional pressure is forthcoming from large institutional shareholders and shareholder rights groups that have negotiated changes in executive compensation at several companies.

While FDICIA potentially affects a broad range of compensation contracts, the primary focus is on CEO compensation. Previous studies have focused on economic explanations for cross-sectional differences in CEO compensation and the degree to which compensation reflects relative performance. Studies generally find that firm characteristics are able to explain 20 to 30 percent of the variation in cash compensation (see Jensen and Murphy 1990b for a discussion). However, studies of the relationship between performance and compensation are mixed.[5] Generally, studies attempting to explain CEO compensation control for firm size, profitability, job tenure, plus measures of ownership and control.

5. For a discussion of the issues, see *Performance and Compensation: An Issue of Corporate Governance* pp. 1-102. Conference proceedings from Northwestern University, January 13, 1992.

II. Provisions of FDICIA Related to Board Structure and Compensation

While enhanced regulation likely will affect the composition of the entire board, proposals specifically focus on the composition of the audit committee and on the activities of the compensation committee. FDICIA introduces two regulations that potentially affect the structure and actions of boards of directors in banks. The changes reflect the desire to protect the soundness of the deposit insurance fund through increased managerial accountability to the board of directors and restrictions on employee compensation.

In an effort to improve accountability, the legislation focuses on the composition and structure of the audit committee of the board of directors. Specifically, under the new legislation banks are required to have audit committees composed of outside directors that are independent of the management of the institution. Additional requirements are imposed on "large" institutions: Their audit committees must be composed of members who are not large customers of the institution, who have banking or related financial management expertise, and they must have access to the committee's own outside counsel. The magnitude of the changes in the composition of this committee likely will reflect how precisely regulators define "large customers" of the institution.

The legislation prescribes that the audit committee shall review the external audit with management and the independent accountants. These actions are designed to increase the independence of the audit committee, thereby strengthening its ability to monitor management and curtail its risk-taking behavior.

The impact of FDICIA on board compensation committees is less direct. The activities of this committee typically include reviewing and making recommendations to the board, and in some cases setting senior management compensation. The provisions do not specify the composition of compensation committees, but do provide more oversight by regulators. The legislation calls for each appropriate federal banking agency to prescribe guidelines for reasonable compensation. Specifically the agencies are to prohibit as unsafe and unsound any employment contract that could lead to a material financial loss to the financial institution. Employment contracts are to include any compensation or benefit agreement, fee arrangement, perquisite, stock option plan, post-employment benefit, or other compensatory arrangement that would provide any executive officer, employee, director, or principal shareholder of the institution with excessive compensation, fees, or benefits. Additionally, the appropriate regulatory agency is required to specify when compensation, fees, or benefits are excessive. The factors to be considered include the combined value of all cash and noncash benefits provided to the individual, the compensation history of the individual and other individuals with comparable expertise at the institution, the financial condition of the institution, and compensation practices at comparable institutions, based on such factors as asset size, geographic location, and complexity of the loan portfolio or other assets. For post-employment benefits regulators must consider the projected total cost and benefit to the institutions, any connection between the individual and any fraudulent act or omission, breach of trust or fiduciary duty, or insider abuse with regard to the institution, and other factors that the agency determines to be relevant, and such other standards relating to compensation, fees, and benefits as the agency determines to be appropriate. These provisions potentially restrict much of the power of board compensation committees in determining senior executives' salary and board of directors' fees. Not surprisingly, this aspect of FDICIA has been widely criticized within the industry.

III. Empirical Analysis

To gauge the potential impact of FDICIA on bank boards I examine the characteristics of boards for a sample of 22 banks and 367 nonbanking firms included in the S&P 500 in 1990. Public utility firms are excluded as a result of the strict regulatory burden these firms face. Nonbank depository institutions are excluded from the banking firm sample.[6] Additional exclusions are due to incomplete data. Sample data are based on 1990 proxy statements compiled by the Investor Responsibility Research Center.

Summary statistics for sample firms are presented in Table 1. Banks tend to have larger boards of directors than nonbanking firms. The directors of banking firms meet more frequently and are compensated at a slightly higher level than those of nonbanking firms. Additional benefits that may be provided to outside directors of corporations include retirement plans, stock purchase plans and deferred compensation plans. Under a retirement plan, nonemployee directors receive all or part of their annual retainer fee for a certain period of time after they retire from the board. In a stock purchase plan, the company grants nonemployee directors stock or stock options on a regular basis, in addition to their regular compensation. Deferred compensation plans generally allow nonemployee directors to defer cash compensation (retainer and meeting fees) until after they retire from the board, but only if the funds are invested in shares of common stock or stock equivalents.

6. Two savings and loan holding companies are excluded. Including these firms does not materially affect the results.

TABLE 1

Firm and Board Characteristics

	Banking Firms[a]	Nonbanking Firms[b]
Sample Characteristics		
Size	22	367
Sales ($ millions)	7,211.1	7,355.2
Total Market Value ($ millions)	4,172.4	5,805.2
Profit ($ millions)	293.7	307.5
Number of Board Members	18.6	12.2
Board Compensation		
Annual Fee	18,277	20,021
Meeting Fee	1,185	923
Meetings per Year	10.1	7.7
Retirement Plan	68%	45%
Deferred Compensation Plan	34%	16%
Stock Purchase Plan	35%	34%
Board Affiliation and Ownership		
Ownership (mean)	3.05%	9.46%
Nonmanagement	81%	73%
Independent	65%	54%
Affiliated	16%	19%
Interlocking Directorships	55%	20%
Board Chairman is CEO	89%	70%

[a]Includes two savings and loans.
[b]Excludes communications, electricity, water, and gas utilities.

The data in Table 1 indicate that banks use all three methods of indirect compensation at least as frequently as nonbanking firms and have director retirement plans and deferred compensation plans more frequently than nonbanking firms. Data on the dollar value of each of these plans are not available, but the frequency of their use suggests that the benefits to being a bank director are understated relative to nonbanking firms. However, it should be noted that bank directors face increased potential liability due to the presence of a maze of potentially litigious regulatory authorities.

Bank boards have a larger percentage of nonmanagement directors (81 percent) than nonbanking boards in the sample (73 percent). Nonmanagement directors are divided into those affiliated with and those independent of the company. To be classified as affiliated, a director must hold one of the following relationships with the firm: member of an insiders' stockholder group (10 percent or more of voting stock); part of an interlocking directorship; former employee; related to an officer; member of a professional firm that provides services to the company; a significant supplier/customer relationship; derive personal benefit from the company. By these criteria, on average, 16 percent of banks' outside directors are affiliated and 19 percent of nonbanks' outside directors are affiliated.

These results are consistent with greater board independence for banking than for nonbanking firms. In contrast, evidence in favor of less independence for bank boards is that the CEO is also chairman of the board in 89 percent of sample banks compared to 70 percent of nonbanking firms. Interlocking directorships are present in 55 percent of sample banks versus 20 percent for the nonbank firms. This difference likely reflects regulation-induced bank holding company structure under which most banks operate. This structure encourages legally separate corporations under a bank holding company umbrella.

Although sample data are limited to a a small set of large banks, they do suggest differences between the composition of boards of banks and nonbanking firms. The provisions of FDICIA are intended to increase the independence of bank boards in general and the audit committee in particular. To gauge potential consequences of this legislation on board of director audit committees, I next consider this committee in greater detail.

Evidence on Audit Committee Composition

Table 2 contains summary statistics for the composition of the audit committees of sample firms. Commercial bank audit committees average six directors as compared to four for nonbanking firms. None in the sample report management directors on the audit committee. However, on average both banking and nonbanking firms have one affiliated outside director on this committee. This indicates that in percentage terms the audit committees of bank boards are more independent than those of nonbanking firms. Whether the composition of these committees meet the requirements of FDICIA is unclear since it does not exclude affiliated directors from this committee unless they are judged to have a significant direct supplier/customer relationship. If ultimately directors with indirect relationships are considered to be de facto customers then the composition of this committee will likely change substantially. For example, if outside directors of a bank customer cannot serve on the audit committee of the bank, then many current bank directors will be precluded from this committee.

TABLE 2

AUDIT COMMITTEE COMPOSITION

	Banking Firms		Nonbanking Firms	
Number of Members (mean)	6.0		4.2	
Independent	5.3		3.5	
Affiliated	.7		.7	
	Number	Percent	Number	Percent
Affiliated Directors—Form of Affiliation				
Interlocking directorships	5	27.8	32	11.5
Former employee	6	33.3	79	28.4
Member of professional firm that provides services to the company	4	22.2	99	35.6
Derives personal benefit from company	3	16.7	21	7.5
Supplier/customer	0	0	15	5.3
Significant stockholder	0	0	32	11.5
Independent Directors—Occupation				
CEO or other executive of large company	59	42.1	344	23.3
CEO or other executive of small company	21	15.0	205	13.9
Retired business person	34	24.3	444	30.0
University official	9	6.4	85	5.8
Academic	4	2.9	83	5.6
Works for non-profit	4	2.9	57	3.9
Self-employed	4	2.9	48	3.2
Investment and commercial bankers and insurers	—	—	76	5.1
Other	5	3.5	136	9.2

NOTE: Because data were available on audit committee composition for more nonbanking firms in the S&P 500, the size of that portion of the sample in this table is 462; the size of the sample of banking firms remains the same.

Table 2 presents the form of director affiliation for the members of the audit committees. For bank audit committees, most affiliated directors are former employees (33.3 percent); in 27.8 percent of the cases, these directors are part of an interlocking directorship; the remaining affiliated directors are either members of professional firms that provide services to the firm (22.2 percent) or directors that derive personal benefit from the company (16.7 percent). Nonbanking firms have fewer audit committee members that are part of interlocking boards of directors (11.5 percent) or are former employees (28.4 percent). Firms in the nonbanking sample more frequently have members of professional firms providing services to the firm (35.6 percent), significant stockholders (11.5 percent), and representatives of organizations that have significant supplier/customer relationships with the firm (5.3 percent). For sample banks, independent director members of the audit committee are composed more of current CEOs and executives and relatively less of retired business persons than are nonbanking firms. If independent directors having affiliations with customers of the bank are considered to be customers of the bank for regulatory purposes, as has been suggested, this is not reflected here.

Under a standard interpretation of customers these findings suggest that the composition of audit committees of large banks in the sample generally satisfies the spirit of the related provisions of FDICIA. Under a more strict interpretation through third-party (outside director) affiliations, the analysis here understates the likely impact of these provisions. While it is not possible to draw inferences regarding smaller banks on this question, the provisions are most strict for large banks. FDICIA guidelines likely will lead to greater independence in the composition and the operations of this committee. It is specified the committee will have access to its own outside counsel and thus may provide a greater degree of direct monitoring of management by this committee.

Evidence on CEO Compensation

No aspect of FDICIA has caused as much industry uproar as the provisions related to officer and director compensation. Under FDICIA the appropriate federal banking agency must prescribe compensation standards for all insured depository institutions by August 1, 1993. The standards are to apply to all forms of compensation for any executive officer, employee, director or principal shareholder of the institution. The standards are to specify when compensation, fees, or benefits are excessive, unreasonable, or disproportionate to services performed by the individual after considering a long list of factors including all cash and noncash benefits, compensation history of the individual compared to others of comparable expertise, financial condition of the institution, compensation practices at comparable institutions, size, location, complexity of loan portfolio, and other assets, and total projected cost of post-employment benefits. Most of the debate in the press has focused on CEO pay. In this study I focus on CEO and board of director compensation.

Table 3 presents data on CEO compensation for the sample of bank and industrial firms. CEOs of sample banks have mean and median salaries of $936,000 and $740,000 respectively, for 1990. Sample industrial firm CEOs earned mean and median salaries of $1,183,000 and $980,000 respectively, for the same period.

Assessing the value of noncash compensation is a difficult task subject to much debate. The most difficult component of compensation to value are stock option grants. For the purposes of this paper I use the valuation technique and data presented by Crystal (1991). This procedure assumes the stock price will increase at the normally expected rate for eight years, deducting the strike price and discounting

TABLE 3

CEO COMPENSATION—SUMMARY STATISTICS

	BANKING FIRMS	NONBANKING FIRMS
NUMBER OF CEOs	22	367
MEDIAN SALARY + BONUS ($ thousands)	$740	$980
RANGE OF SALARY + BONUS ($ thousands)	$420–1,580	$150–14,820
MEAN COMPENSATION ($ thousands)		
Salary + Bonus	$936	$1,183
Stock Options	$267	$1,246
Restricted Stock	$409	$208
Preferred Grants	$93	$190
Total	$1,705	$2,827
USE OF NONCASH COMPENSATION		
Stock Options	19%	71%
Restricted Stock	86%	24%
Preferred Grants	52%	26%
All Forms	19%	5%
COMPENSATION COMMITTEE COMPOSITION		
Number of Members	6.0	4.1
Independent	84%	79%
Affiliated	14%	17%

the future gain. For restricted stock the value is assessed as the product of the annualized number of restricted, or free, shares granted to the executive and the market price per share at the time of the grant. Performance grants include awards of both stock-based performance shares and performance units paid in cash. While these procedures likely add some noise to the measure of total CEO compensation, the direction of any bias in the true value across banks versus industrial firms as a result of these assumptions is unclear. Adding these components of compensation to the salary and bonus provides a measure of total compensation for the sample of nonbanking firms of $2,828,000, while for the sample of banking firms the average is $1,705,000. This indicates that the addition of noncash compensation further increases the divergence between the total CEO compensation of nonbanking and banking firms.

Table 3 also provides statistics on the percentage of each group of sample firms using each type of noncash compensation. The sample of banking firms uses more forms of compensation on average. Restricted stock is a particularly popular form of compensation for bank CEOs, but as indicated in the table, the size of these awards for 1990 are a fraction of total compensation. Popular press accounts of the excessive CEO pay debate suggest the lack of independence of the compensation committee is a factor. To address this, the final section of Table 3 presents the composition of the audit committees for sample banks and industrial firms.

The data presented in Table 3 are used to determine whether cross-sectional differences in the level of compensation between these two groups can be explained by firm characteristics. Previous studies of the determinants of CEO compensation suggest that among the factors important in explaining cross-sectional differences are firm size, CEO tenure, whether the CEO is also chairman of the board, ownership by insiders, and firm performance. These studies have generally concluded that firm and performance characteristics have relatively low power to explain cross-sectional differences in CEO pay. Since it is difficult (and somewhat controversial) to value non-cash compensation the analysis initially will focus on cash compensation and on a measure of total compensation. The cash compensation measure includes salary plus bonus as reported in Crystal (1991) and is cross-checked against the data for the same period from other sources. The estimates of the value of non-cash compensation are those provided in Crystal (1991).

The results from regressing CEO cash compensation (salary + bonus) on firm characteristics are reported in Table 4. Consistent with previous studies, cash compensation is a positive function of firm size measured by

TABLE 4

DETERMINANTS OF CROSS-SECTIONAL DIFFERENCES IN THE LEVEL OF CEO CASH COMPENSATION

	Regression		
Variable	(1)	(2)	(3)
Constant	4.59 (18.78)*	4.58 (18.44)*	4.57 (18.44)*
Log (Sales)	0.12 (3.71)*	0.14 (3.77)*	0.14 (3.92)*
Log (Market Value)	0.15 (4.18)*	0.14 (3.97)*	0.14 (3.90)*
CEO Years	0.01 (1.99)*	0.01 (2.00)*	0.01 (1.94)*
Chairman	0.12 (1.98)*	0.12 (1.93)*	0.12 (1.87)*
Board Ownership	0.01 (2.51)*	0.01 (2.50)*	0.01 (2.66)*
Bank	−0.04 (0.38)	−0.17 (0.08)	−2.94 (0.84)
Bank × Sales		−0.18 (0.90)	−0.15 (0.70)
Bank × MV		0.23 (0.93)	0.48 (1.51)
Bank × Chairman			0.01 (0.02)
Bank × Board Ownership			−0.04 (1.93)*
R^2	.32	.32	.32
F-value	19.41	14.03	11.06

*Indicates the *t*-value is statistically different from zero at the 0.01 level.

NOTE: Values are corrected for heteroscedasticity using the procedure by White (1980). Dependent variable: Salary + Bonus.

market value and total sales. Cash compensation is also higher for those CEOs that also serve as chairman of the board. CEO pay is a positive function of the number of years the CEO has been in the job, and the percentage of the firm owned by the board. The binary variable indicating that the CEO is managing a banking firm is negative though not statistically significant. These results suggest that bank CEOs earn cash compensation similar to that of nonbank CEOs. To determine whether CEO pay is more or less sensitive to firm characteristics the binary variable bank is interacted with sales, market value, and return. None of the interacted variables is statistically significant at the 0.10 level.

In (3) the binary variable called "Bank" is interacted with ownership percentage by the board of directors, with whether the CEO is Chairman, and with the number of years as a CEO. The coefficient on bank board ownership percentage is negative and significant indicating that salary and bonus of CEOs decline as ownership by the board increases. This result is the opposite than that for nonbanking firms.

Using the measure of total compensation from Table 3 we are able to examine how the same independent variables relate to cross-sectional variation in CEO total compensation. The regression results are presented in Table 5. Consistent with earlier findings for cash compensation, total compensation is a positive function of firm size as measured by sales and market value of equity. Total pay is a positive function of CEO's tenure in the job and whether he also serves as chairman of the board (though the coefficient on "Chairman" is not statistically significant). The coefficient on total pay is negative, though not statistically significant, relative to ownership percentage by the board of directors. The coefficient on Bank indicates that total pay for banks is not statistically different from total pay for nonbanking firms. The coefficient on the ownership percentage by bank boards indicates that as board ownership increases total compensation decreases (although the significance level on this coefficient is at the 0.11 level).

These results suggest that CEOs of banks earn levels of cash and total compensation that are comparable to those earned by nonbank CEOs. The most significant differences between banks and nonbanking firms related to CEO compensation are related to how cross-sectional differences in levels vary with ownership percentage by the board of directors. For the sample as a whole, cash compensation is a positive function of ownership percentage for the board of directors. The measure of total CEO compensation is a negative function of the ownership percentage by the board of directors. For commercial banks total salary is less sensitive to ownership percentage by the board and total CEO compensation is more sensitive (negatively related) than for the sample as a whole.

IV. Conclusions

This paper examined the provisions of the FDIC Improvement Act related to the corporate governance of banks. Specifically, the composition of the board audit committee for a sample of banks was compared to industrial firms and to the guidelines under the Act. For 1990 the 22 depository institutions included in the S&P 500 show that for the most part audit committees are composed of outside directors, and typically one outside director has a direct affiliation to the bank. These are likely to be replaced by more independent outside directors as a result of FDICIA. It has been

TABLE 5

Determinants of Cross-sectional Differences in the Level of CEO Total Compensation

	Regression		
Variable	(1)	(2)	(3)
Constant	4.55 (12.70)*	4.53 (12.42)*	4.51 (12.46)*
Log (Sales)	0.13 (2.57)*	0.14 (2.59)*	0.14 (2.62)*
Log (Market Value)	0.221 (4.20)*	0.21 (4.03)*	0.21 (4.07)*
CEO Years	0.01 (1.73)	0.01 (1.70)	0.01 (1.73)
Chairman	0.12 (1.27)	0.11 (1.20)	0.14 (1.47)
Board Ownership	−0.01 (1.32)	−0.01 (1.31)	−0.01 (1.11)
Bank	−0.09 (0.54)	1.12 (0.33)	5.12 (1.00)
Bank × Sales		−0.21 (0.72)	0.36 (1.18)
Bank × MV		0.08 (0.22)	−0.16 (0.32)
Bank × Chairman			−0.30 (0.52)
Bank × Board Ownership			−0.05 (1.63)
R^2	.27	.26	.27
F-value	15.92	10.65	9.02

*Indicates the t-value is statistically different from zero at the 0.01 level.
Note: See Note to Table 4.

indicated that directors with affiliations as outside directors to customers of the bank are ineligible for the audit committee. This suggests FDICIA will likely have a large impact on composition of these committees for large banks.

Potential consequences of provisions related to officer and director compensation are examined by focusing on the levels of CEO and outside director compensation. A comparison is made between banking and industrial firms regarding the level and form of compensation. Cross-sectional differences in the levels of CEO compensation are examined to determine if firm characteristics can explain cross-sectional variation in CEO compensation for banks and nonbanking firms. The results indicate factors important in explaining CEO compensation for the S&P 500 firms also explain cross-sectional differences in CEO compensation for banking firms. Differences between banking and nonbanking firms are primarily related to the relationship between equity ownership by the board of directors and the level of CEO compensation. Both cash and total compensation for bank CEOs is a negative function of equity ownership by the board of directors. For the sample as a whole, CEO cash compensation is a positive function of ownership by the board, while total compensation is a negative (though statistically insignificant) function of ownership by the board of directors.

One interpretation of the findings of this study is that the provisions of the FDIC Improvement Act of 1991 related to corporate governance and CEO compensation were unnecessary. The basis for this is that audit committees for large banks, the apparent target of this legislation, are already composed mainly of outside directors. Secondly, the compensation of bank officers (CEOs) and directors (outside) appears to be at similar levels and largely determined by characteristics similar to those of nonbanking firms. While it is beyond the scope of this paper to determine whether the overall level of CEO pay is excessive, it does conclude that there appears to be nothing special about banks in this regard.

References

Baysinger, B.D., and H.N. Butler. 1985. "Corporate Governance and the Board of Directors: Performance Effects of Changes in Board Composition," *Journal of Law, Economics, and Organization* (Spring) pp. 101-124.

Brickley, J.A., and C. James. 1987. "The Takeover Market, Corporate Board Composition, and Ownership Structure: The Case of Banking." *Journal of Law and Economics* (April) pp. 161-181.

Brownstein, A., and M. J. Panner. 1992. "Who Should Set CEO Pay?" *Harvard Business Review* (May-June) pp. 28-32.

Byrd, J., and K. Hickman. 1991. "Do Outside Directors Monitor Managers? Evidence from Tender Offer Bids." Working Paper. Washington State University.

Crystal, G. 1991. *Executive Compensation in Corporate America '91.* Washington, D.C.: The United Shareholders Association Foundation for Research and Education.

Dunn, D. 1987. "Directors Aren't Doing Their Jobs." *Fortune* (March 16) pp. 117-119.

Hermalin, B., and M. Weisbach, "The Determinants of Board Composition." *Rand Journal of Economics* (Winter 1988), pp. 589-606.

Jensen, M.C., and K. Murphy. 1990a. "Performance Pay and Top-Management Incentives." *Journal of Political Economy* (April) pp. 224-264.

Jensen, M.C., and K. Murphy. 1990b. "CEO Incentives-It's Not How Much You Pay, But How." *Harvard Business Review* (May-June) pp. 138-153.

Kesner, I. 1988. "Directors' Characteristics and Committee Membership: An Investigation of Type, Occupation, Tenure, and Gender." *Academy of Management Journal* (March) pp. 66-84.

Lee, C., S. Rosenstein, N. Rangan, and W. Davidson. 1992. "Board Composition and Shareholder Wealth: The Case of Management Buyouts." *Financial Management* (Spring) pp. 58-72.

Mace, M.L. 1971. *Directors: Myth and Reality.* Boston: Harvard Business School Press.

Mayers, D., A. Shivdasani, and C. Smith. 1992. "Board Composition in the Life Insurance Industry." Working Paper. University of Rochester.

Rosenstein, S., and J.G. Wyatt. 1990. "Outside Directors, Board Independence, and Shareholder Wealth." *Journal of Financial Economics* (August) pp. 175-192.

Vancil, R. 1987. *Passing the Baton: Managing the Process of CEO Succession.* Boston: Harvard Business School Press.

Weisbach, M. 1988. "Outside Directors and CEO Turnover." *Journal of Financial Economics* (January/March) pp. 431-460.

White, H. 1980. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *American Economic Review* (May) pp. 817-838.

Do Capital Controls Affect the Response of Investment to Saving? Evidence from the Pacific Basin

Sun Bae Kim

Economist, Federal Reserve Bank of San Francisco. I am grateful to Reuven Glick, Michael Dooley, and the editorial committee of Brian Cromwell, Mark Levonian, and Ramon Moreno, for their numerous helpful comments and suggestions. I also wish to thank Gregory Holmes for his valuable research assistance.

This paper examines the effect of capital controls on the response of investment to savings in Pacific Basin countries. A robust finding is that the size of the savings coefficient tends to be smaller (larger) in countries with relatively higher (lower) capital controls. Additionally, relaxation in capital controls for the most part had no discernible impact on the savings-investment relationship in individual country time-series regressions. At least a partial resolution to these puzzles is found in the government policy response: Countries with a relatively high saving-investment correlation tended to have governments that countered widening current account imbalances with fiscal policy; the reverse generally held true for countries with low saving-investment correlation. In fact, for this latter group of countries, financing the government deficit through foreign borrowing was a major factor in loosening the link between national saving and investment.

The last two decades have witnessed a successive wave of deregulation of international capital markets. How has this greater freedom of movement of capital among countries affected national saving and investment, two key macroeconomic variables? Theoretically the answer is relatively straightforward: With greater capital mobility, the level of investment a country can undertake need not be constrained by the level of domestic saving, since any shortfall can be financed by foreign saving. In other words, the dismantling of capital controls would loosen the link between national saving and investment.

The empirical evidence, on the other hand, has been more controversial. Most notably, Feldstein and Horioka (1980) found that among industrial countries, the investment rate is highly correlated with the saving rate, thus suggesting that capital is less mobile internationally than commonly presumed. The study subsequently spawned two additional puzzles: First, the saving-investment correlation does not appear to decline over time despite the continued relaxation of capital controls (Feldstein 1983, Penati and Dooley 1984); second, the saving-investment correlation appears to be weaker for developing countries than for industrial countries, despite the generally accepted view that the latter group of countries tend to have more developed financial markets with comparatively fewer restrictions on international transactions (Dooley, et al., 1987, Wong 1990). In sum, available evidence to date suggests that the degree of capital control has relatively little bearing on the observed response of investment to national saving.

This paper examines the effect of capital controls on the response of investment to saving in Pacific Basin countries. The exercise is of interest for at least two reasons. First, a frequently emphasized factor in the economic dynamism of the Pacific Basin is the growing integration of the region, in terms of flows of both goods and capital. Whether one can find a systematic link between progressive dismantling of capital controls and loosened saving-investment linkages in the region is an empirical question that has not been addressed to date. Second, the Pacific

Basin encompasses a broad array of countries in varying stages of economic and financial development, degree of capital controls, and speed of dismantling these controls. The region therefore provides us with substantial cross-country variation to assess the impact of capital controls on saving-investment linkages.

This study uses the Feldstein-Horioka (FH hereafter) methodology with due adjustments made to address some of the econometric criticisms levied against it. Unlike most empirical work in the area, the paper focuses on time series correlation between savings and investment. This approach allows cross-country comparisons in the response of investment to national savings, as well as analysis of the relationship over time in a given country. The advantage of this approach is that it makes it possible to exploit our knowledge of the divergent history of capital controls of the countries in the region.

The analysis reveals that capital controls have had little impact on saving-investment relationships in the Pacific Basin. In fact, the estimated size of the savings coefficient tends to be smaller (larger) in countries with relatively higher (lower) capital controls, and this result is robust across several specifications. Additionally, relaxation in capital controls for the most part had no discernible impact on the saving-investment relationship in individual country regressions. At least a partial resolution to these puzzles is found in government policy response. Most notably, countries with a relatively high saving-investment correlation, despite low capital controls, tended to have governments that countered widening current account imbalances with fiscal policy. The reverse generally held true for countries with low saving-investment correlation, despite relatively high capital controls. In fact, for this latter group of countries, financing the government deficit through foreign borrowing was a major factor in loosening the link between national saving and investment.

The balance of the paper is organized as follows. Section I surveys changes in capital controls in the Pacific Basin countries over the past three decades. Section II briefly discusses the FH test of capital mobility and reviews some of the major criticisms leveled against it. Section III then undertakes various tests of saving-investment correlation in the Pacific Basin countries and interprets the results in light of what we know about the history of capital controls in the region. Section IV concludes.

I. Deregulation of Capital Controls in the Pacific Basin

In order to provide a more concrete context for the empirical analysis that follows, this section highlights some of the important policy changes affecting capital flows that have occurred in the thirteen Pacific Basin countries up until 1991 (Australia, Canada, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, Taiwan, Thailand, and the U.S.). The purpose here is not to provide an exhaustive and comprehensive account of financial deregulation in the region. Rather, the basic aim is to sketch out the salient features of the regulatory environment of the countries under review, then draw some cross-country comparisons on the degree of capital mobility and how such mobility may have changed over time in individual countries as a result of policy reforms.

Until at least the late 1970s, most Pacific Basin countries maintained tight regulation and administrative control over their financial systems, including interest rate restrictions, segmented financial markets and institutions, underdeveloped money and capital markets, and credit allocation and control mechanisms.[1] These policies reflected the then widely held view that economic growth and other national goals would be better served by restraining market forces in the pricing as well as the allocation of credit.

In order to prevent domestic entities from circumventing these regulations through overseas transactions, most Pacific Basin countries also applied, to varying degrees, controls over international capital movements. Capital controls curbed capital flight, insulated domestic interest rates from the rest of the world, and maintained the compartmentalization of domestic financial markets. Additionally, these controls buttressed the fixed exchange rate system and helped to achieve balance-of-payments objectives.

As is evident from the summary of capital controls in the Appendix, Pacific Basin countries diverge considerably as to when liberalization of capital controls was intiated, as well as with respect to its speed once the process was under way.[2,3] At one end of the spectrum are four coun-

1. For overviews of financial markets and liberalization in the Pacific Basin up to the mid-1980s, see Cargill, Cheng and Hutchison (1986), Mathieson (1986), Patrick and Cole (1986), and Greenwood (1986).

2. Countries also have diverged in the sequencing of deregulation; that is, whether relaxation of international capital accounts followed or preceded liberalization of the domestic financial sector. According to the so-called sequencing theory (McKinnon 1991, Edwards 1990), international liberalization, particularly of the capital account, should come at the last stage of economic liberalization. Within the Pacific Basin, Singapore, Korea, and Taiwan have broadly conformed to this theory by liberalizing the domestic financial sector while maintaining a considerable degree of capital control. Indonesia, Malaysia, Japan, and Thailand appear to have adopted a reversed order of financial liberalization. See Santiprabhob (1992).

3. Emphasis differs on what has been the prime impetus to relaxing exchange and capital controls. Cargill, Cheng, Hutchison (1986) contend that strict exchange and capital controls were not compatible with

tries, consisting of Canada, the United States, Hong Kong, and Singapore, which traditionally have imposed few restrictions on international capital flows or removed any existing restrictions relatively swiftly. The U.S. and Canada have long had a large and sophisticated financial system relatively unencumbered by regulations, domestically as well as internationally. The U.S. imposed no exchange controls in principle except for the period of 1963–1974 when some restrictions applied to capital outflows; these restrictions were removed in 1974. Canada, the first industrialized country to shift to a floating exchange rate regime in 1970, also has been free of exchange controls. Over the years, the country also streamlined procedures for foreign direct investment flows which were quite liberal to begin with by international standards. For both countries, therefore, regulatory changes pertaining to international capital flow since the 1970s have been small by international standards.

Hong Kong and Singapore relaxed capital controls relatively early in a bid to become international financial centers. Hong Kong abolished all exchange controls in late 1972, making its capital markets one of the least restricted in Asia. Singapore progressively liberalized exchange controls through the 1970s and finally abolished them in 1978. The city-state also established a favorable policy environment toward foreign direct investment, especially with respect to repatriation of profit. The only notable remaining barrier to capital mobility is the restriction that banks designated to operate in the offshore market are not allowed to transact in Singapore dollars.[4] From the standpoint of regulatory impediments at least, both Hong Kong and Singapore can thus be considered to have had nearly perfect capital mobility since at least the early to mid-1970s.

In contrast to Hong Kong and Singapore, the two other rapidly growing Asian newly industrializing economies (NIEs), Korea and Taiwan, have initiated financial deregulation relatively late and substantial barriers to international capital mobility still remain. Taiwan traditionally has restricted capital outflow and did not liberalize controls on current account transactions until 1987. Although significant progress has been made since 1989 in liberalizing capital inflow and outflow, tight control is still applied on foreign ownership of "strategic" industries, including banking.

Korea began its financial liberalization process in 1981–1983. But government controls remain a pervasive feature of its financial system, particularly in the domain of international financial transactions. The authorities have adopted a gradual step-by-step approach to liberalizing current account transactions and restrictions continue to apply to both capital inflows and outflows.[5] For example, throughout the 1980s, government approval was required for any external borrowing exceeding US$200,000. Beginning in the early 1980s, however, the Korean government initiated a series of steps deregulating foreign direct investment to enhance competition in the domestic market and to encourage transfer of advanced technology from abroad.

The Philippines also still has extensive capital controls. Unlike Korea and Taiwan, the Philippines initially had a fairly liberal regime toward international capital flow. This policy was abruptly reversed, however, with the advent of the international debt crisis in 1983. As the only Pacific Basin country facing serious debt servicing problems, the Philippines reimposed foreign exchange controls in 1983. Although policies have relaxed somewhat since, restrictions remain in virtually all categories of both current and capital account transactions.

The experiences of the remaining six countries (Australia, Indonesia, Japan, Malaysia, New Zealand, and Thailand) fall somewhere between the extremes of the two groups of countries discussed above. All six initially had stringent international capital exchange controls. The speed and the timing of the relaxation of these controls have varied considerably among them, however.

Indonesia and Malaysia liberalized foreign exchange controls in 1970 and 1973, respectively, thus initiating moves toward fairly open capital markets much earlier than Taiwan or Korea. Both countries also progressively relaxed foreign direct investment rules from the mid-1980s on. Some restrictions to capital flow remain, however. In the case of Malaysia, capital outflows cannot be financed by local borrowing and prior approval is necessary for foreign

---

domestic interest rate liberalization and greater exchange rate flexibility. In fact, exchange and capital controls are redundant in the face of flexible interest rates and flexible exchange rates. Greenwood (1986), on the other hand, holds the view that financial liberalization in the seven East Asian countries do not appear to derive from the advent of floating exchange rates in the early 1970s. Most of the changes come *after* 1979, which timing suggests that financial liberalization was prompted more by the volatility of interest rate differentials than by the advent of floating rates.

4. Singapore thus has a bifurcated financial system with various regulations insulating the domestic banking sector from the offshore market. Growth of the offshore sector, in particular the Asian dollar market, has been spectacular since its establishment in 1974.

5. As of December 1991, Koreans were still required to convert export receipts into domestic currency within a specified time period. The main objective of this policy is to prevent the accumulation of foreign exchange above some minimum working balance. In addition, to limit possible disguised capital flight, payments on invisibles were subject to quantitative limits or advance approval.

direct investment or foreign lending or borrowing by financial institutions. Additionally, surrender requirements for export proceeds still remained in place as of December 1991. Indonesia still restricts capital account transactions in three ways: foreign exchange banks and nonfinancial institutions must adhere to Bank of Indonesia directives when borrowing abroad; foreign exchange banks are required to set aside special reserves on foreign borrowing; and finally, prior approval must be obtained for foreign direct investment.[6]

Australia and New Zealand embarked relatively late in financial liberalization, but once initiated, regulatory barriers to capital mobility were dismantled quite quickly. Australia eliminated most exchange controls as of December 1983 when it moved to a flexible exchange rate regime. Beside the frequently encountered requirement of prior approval on foreign borrowing, the only notable restriction to capital flows in Australia is that foreign governments and international organizations are not permitted to borrow in the domestic capital market. New Zealand launched a comprehensive financial liberalization program in 1984 which, within a space of a few months, freed interest rate controls, credit ceilings, and ratio requirements, and floated the New Zealand dollar.[7] In this newly liberalized regime, foreign exchange controls became redundant and were disposed of accordingly. As of the end of 1991, the only noteworthy restriction on capital account transactions is that permission is required for foreign direct investments of amounts NZ$10 million or greater.

Thailand and Japan, the last two countries under review, have both adhered to a program of cautious and measured pace of financial liberalization. Thailand freed inward capital flows in the early 1970s, but strict controls have traditionally applied to capital outflows. This restriction began to be loosened only recently in a stepwise fashion. The first stage (May 1990) eased controls on current account transactions and simplified capital account transactions. In the second stage (April 1991), further liberalization was implemented on current account transactions, limits on outward capital flows without authorization was raised, and banks were allowed for the first time to offer foreign exchange accounts.[8] In the final stage, yet to be scheduled, all remaining foreign exchange controls are to be lifted and residents are to be permitted to purchase overseas property and financial instruments without prior approval from the Central Bank.

Japan traditionally applied capital controls to influence international capital flows in the desired direction, depending upon the prevailing balance-of-payments position and exchange rate objective. Japan amended its Foreign Exchange and Foreign Trade Law in 1980, the official intention being to free, in principle, all international transactions from direct government intervention. In reality, however, the process of financial liberalization, domestic as well as international, was already set in motion by the mid-1970s. For example, interest rates on foreign currency deposit were liberalized in 1974, foreigners were allowed in the gensaki market in May 1979, and Japanese banks were permitted to make short-term foreign currency loans to residents (impact loans) in June 1979, and long-term loans in March 1980. The 1984 Yen/Dollar Agreement provided further impetus to remove barriers to international capital flows, including the abolition of yen-dollar swap limits for foreign banks in Japan and the deregulation of forward exhange transactions. The relaxation of capital controls in Japan, however, as is the case with domestic financial liberalization, has been gradual and is still ongoing.

In summary, what can we say about capital mobility in the Pacific Basin based on the foregoing survey of regulatory changes? First, most liberalization in the region did not begin until the late 1970s or the early 1980s; notable exceptions are Canada, the U.S., and the two city-states. One implication is that saving-investment linkages would be tighter in most Pacific Basin countries than, say, among OECD countries, which began liberalizing in the early 1970s with the advent of flexible exchange rates.[9]

The second point relates to the difference in the degree of capital mobility among the Pacific Basin countries discussed. Any cross-country comparison on capital mobility based on these regulatory considerations is necessarily an imprecise exercise. For one, appraising the impact of a change in policy on potential capital mobility requires a dose of subjective and qualitative judgements. In addition, since these countries have pursued different policies at different points in time, it is difficult to generalize across a long period of time whether one country's policy has been "on average" more restrictive than another with respect to international capital flows. These caveats notwithstanding, one may hazard to divide the Pacific Basin countries into three groups on the basis of how early each deregulated international financial transactions, and on how rapidly

6. Recently, concern about the country's external debt has led Indonesian authorities to set an annual quota of US$2.6 billion for borrowing to finance private projects in 1992 and 1993.

7. New Zealand in fact initiated financial liberalization in 1976-1977, but reversed course in 1981 by reimposing comprehensive controls over interest rates and foreign portfolio investment by domestic residents.

8. According to the International Monetary Fund, Thailand still had, as of December 1991, surrender requirement for export proceeds, advanced import deposits, and limitations on foreign currency deposits by residents.

9. The usual *ceteris paribus* condition applies here.

capital controls were dismantled once deregulation was initiated. The first group, which includes Canada, the U.S., Hong Kong, and Singapore, may be categorized as having a relatively low degree of capital controls, while the second, consisting of Korea, the Philippines, Taiwan, and possibly Thailand, may be deemed to have a high degree of capital controls. It is difficult to assign a precise ranking to the remaining countries; hence they may be grouped under a third category of intermediate degree of capital controls. The balance of the paper investigates the extent to which these varying degrees of capital controls in the region explain observed differences in the response of domestic investment to national saving.

II. The Feldstein-Horioka Test of Capital Mobility

It is natural to expect that the degree of capital controls is an important determinant of investment's response to national saving. Consider two extreme cases. If capital controls prevent a country from borrowing (or lending) internationally, all investment within the country must necessarily be financed out of its own saving; in other words national saving and investment will be perfectly correlated. On the other hand, if there were no impediments to international capital flows, one would expect no systematic relation between national saving and investment. One direct way to test these propositions is to run a regression of the form:

$$(1) \qquad (GDI/GDP)_i = \alpha + \beta(GNS/GDP)_i + \epsilon_i$$

where *GDI* and *GNS* are gross domestic investment and saving, respectively, and *GDP* is gross domestic product. This is in fact the regression that Feldstein and Horioka ran on a cross-section of sixteen OECD countries over the period 1960–1974. The regression using data averaged over the entire sample period yielded a coefficient on saving of 0.88, which is significantly different from zero but not significantly different from unity. Similar estimates of β were obtained when the regression was repeated on shorter subsample periods. FH interpreted these results to mean that about 90 percent of domestic saving is invested in the country of origin, thus leading them to reject the hypothesis of perfect capital mobility.[10] However, this conclusion has been subjected to a number of criticisms.

Criticisms

The most frequently levied criticism against the FH methodology concerns the fact that the explanatory variable in their regression, domestic saving, is itself endogenous. This will be the case, for example, if saving and investment are both procyclical, as they are commonly known to be. Simultaneity problems also will arise if governments are averse to large current account balances and respond endogenously to offset private net capital flows so as to reduce the size of these imbalances (Fieleke 1982, Westphal 1983; Summers 1988). In a time series context, the inclusion of large countries in the sample may be another cause of endogeneity. For instance, if a country is sufficiently large, a decrease in saving in that country would raise the world interest rate, thus reducing investment at home as well as abroad (Murphy 1986).

On the theoretical front, a plethora of models has been constructed to formalize the notion that rather than reflecting any genuine lack of capital mobility, the high saving-investment correlation may arise because saving and investment are influenced in the same direction by common exogenous disturbances affecting the economy. For example, even with perfect capital mobility, exogenous changes in population growth, the growth rate of income, productivity, or terms-of-trade shocks, may all generate co-movements in savings and investment (see, for example, Obstfeld 1985, Summers 1988, Glick and Rogoff 1992).[11]

Co-movements in saving and investment also may be reconciled with perfect financial capital mobility by the presence of nontraded consumption goods or immobile factors of production (Frankel 1985, Murphy 1986; Engel and Kletzer 1987, Wong 1990). The basic intuition here is that the integration of capital markets is not a sufficient condition to break the link between domestic saving and investment; imperfect integration of goods markets or other factors of production may act as a binding constraint and force the economy to behave more like a closed economy in terms of saving and investment.

Finally, several authors have suggested that government policy itself may be a source of endogeneity. Summers (1988) and Bayoumi (1990) among others have suggested that the observed high correlation between saving and investment rates is evidence of a successful balance-of-payment policy on the part of national governments. For instance, governments may impose constraints on cross-border capital flows whenever the deficit (or surplus) in the current account exceeds a predetermined level. Alternatively, they might adjust their budget deficits to offset

10. Feldstein (1983) subsequently estimated the same equation using pooled time series cross-section data. Again, the coefficient on the saving rate did not differ significantly from unity.

11. See Tesar (1991) for a survey of these models.

the gap between investment and saving. Finally, Roubini (1988) argues in the context of an intertemporal model of consumption and taxation that fiscal deficits play an important role in the determination of the current account and the saving behavior.

Robustness of the FH Result

In their original 1980 study, Feldstein and Horioka were in fact cognizant of potential problems that might arise due to the endogeneity of domestic saving. To control for cyclical endogeneity, the authors ran their cross-section regressions using averaged data over sufficiently long periods so as to cancel out any business cycle effects. As an added measure, FH also reran their regressions using instrumental variables that are correlated with saving but not investment.[12] This did not materially alter the results, however. Moreover, instrumental variable estimations were subsequently performed by Dooley, et al. (1987) and Bayoumi (1990) on cross-section data, and by Frankel (1985) on U.S. time series data. But again, all of these studies found that the high savings-investment correlation persisted.

At least for a sample of industrialized countries, the FH finding of a high saving-investment correlation thus seems to have stood up surprisingly well to the econometric critiques levied against it. As noted above, however, numerous theoretical models have cast doubt on whether this empirical finding can be taken as evidence of low capital mobility. To the extent that one questions whether FH's equation is genuinely structural, the high saving-investment correlation may be attributed to a set of "omitted variables," such as some common shocks or the extent of integration of domestic goods and factor markets. However, relatively little empirical work has been done to test directly how sensitive FH's saving-investment correlation is with respect to the inclusion of such variables.

A notable exception is Wong (1990), which examined whether the relative size of the nontraded goods sector of an economy has any effects on the correlation between its saving and investment ratios. Wong ranked a sample of 40 developing countries by their import-GDP ratios, as a proxy for the inverse of the size of the nontraded goods sector. Breaking the sample into two and running separate regressions on them, Wong found that the group with the lower import ratios (that is, larger nontraded goods sector) had a higher regression coefficient on saving and a better goodness of fit. Wong also found that a Chow test rejected at the 5 percent significance level the null hypothesis that the two country groups exhibit the same structural saving-investment relationship. Splitting the sample into finer groups confirmed the basic finding that as countries' import ratios decrease the saving-investment correlation increases.

III. Saving-Investment Correlation in the Pacific Basin

Simple Saving-Investment Correlation

To serve as a benchmark, Table 1 presents the ordinary least squares results for individual country time series regression:

$$(2)\quad \Delta(GDI/GDP)_t = \alpha + \Delta\beta(GNS/GDP)_t + \epsilon_t.$$

The sample period runs from 1961 to 1990 and all data used are nominal annual national account data from the IMF's *International Financial Statistics*. Gross domestic investment, *GDI*, is defined as the sum of gross fixed capital formation and the change in stocks. Gross national saving, *GNS*, is defined as gross domestic saving (*GDS*) plus net factor income and net current transfers from abroad; *GDS*, in turn, is defined as gross domestic product (*GDP*) minus private and government consumption.[13] Since both the saving and investment exhibited a tendency to rise over time in many of the sample countries, the regressions were run on first-differenced data.[14]

One advantage of running individual country time series regressions is that it allows for any possible differences in the degree of capital mobility. Inspection of Table 1 readily reveals the diversity in the size and statistical significance of the regression coefficient. Indeed, F tests rejected the validity of pooling for various combinations of the sample countries: countries with relatively low capital controls (Canada, U.S., Hong Kong, and Singapore); countries with relatively high capital controls (Korea, Taiwan, Philippines, and Thailand); industrialized versus developing countries; and finally, larger versus smaller countries as measured by the size of GDP.

12. The instruments consisted of the proportion of retirees and dependents in the total population, the benefit-earning ratio of the social security program, and the labor force participation rate. All of these variables affect saving according to the income hypothesis, but they have no obvious relevance for investment.

13. As in Feldstein and Horioka (1980), the focus is on gross rather than net saving and investment so as to minimize the possibility of spurious correlation due to measurement errors in depreciation.

14. Dickey-Fuller tests could reject the null hypothesis of a unit root in *GDS/GDP* and *GDI/GDP* only for New Zealand and Philippines. The same test on the first-differenced series rejected this null, that is, year to year changes in saving and investment rates appear stationary.

TABLE 1

TOTAL INVESTMENT–SAVING CORRELATION, 1961–1990

$\Delta(GDI/GDP)_t = \alpha + \beta\Delta(GNS/GDP)_t$

	β	R^2	D.W.
Australia	0.001 (0.157)	0.00	2.40
Canada	1.017*** (0.160)	0.60	2.27
Hong Kong	0.616*** (0.162)	0.31	2.13
Indonesia	0.211 (0.141)	0.08	2.32
Japan	0.981*** (0.139)	0.65	1.54
Korea	0.446*** (0.154)	0.24	1.76
Malaysia	−0.112 (0.152)	0.02	1.43
New Zealand	0.116 (0.249)	0.01	1.97
Philippines	0.360* (0.218)	0.06	1.54
Singapore	−0.041 (0.263)	0.09	1.92
Taiwan	0.076 (0.249)	0.00	2.10
Thailand	0.639*** (0.181)	0.31	2.36
U.S.	0.939*** (0.126)	0.69	1.56

NOTE: OLS estimation; standard errors in parentheses.
*Significance levels: * = 10 percent
** = 5 percent
*** = 1 percent

An immediately striking pattern in the table is that Canada, the U.S., and Japan have a regression coefficient on saving that is not significantly different from unity; that is, a 1 percent increase in the growth of the national saving rate leads to a 1 percent increase in the growth of the domestic investment rate.[15,16] It is difficult to reconcile this result with what we know about capital controls in these countries. As the earlier discussion stressed, Canada and the U.S. have had among the least restrictive policies with respect to international capital flows while Japan may be considered an intermediate case.

Significantly lower coefficients are obtained for Korea, Thailand, and the Philippines (0.446, 0.639, and 0.360, respectively), despite the fact that these countries traditionally have imposed much greater regulatory barriers to international capital flows. In a similar vein, Australia, New Zealand, and Taiwan—countries which maintained relatively strict capital controls until at least the early 1980s—all have coefficients that are not statistically different from zero.

To investigate whether deregulation of capital controls in the Pacific Basin has increased capital mobility and thereby weakened the linkage between national saving and investment, regressions were run with the coefficient on saving interacted with a dummy variable. This variable took a value of 0 until a given breakdate and a value of 1 thereafter. The breakdates for each country were chosen to coincide with the shift in regulatory regime or, in the case of advanced industrialized countries, the advent of the flexible exchange system after the collapse of Bretton Woods. For a subset of countries where the deregulation process did not yield a strong prior on a single breakdate (Indonesia, Malaysia, and Thailand), two alternative breakdates were considered.

As reported in Table 2, a statistically significant change in savings-investment relationship is detected in only five of the thirteen countries in the sample. Futhermore, where such changes occurred, the results often were difficult to interpret in terms of changes in capital mobility. For instance, Singapore's saving coefficient turns from being negative and statistically insignificant to being positive and significantly different from 0 (at 5 percent) after the breakdate. In the case of the U.S., the coefficient rises from 0.632 to 1.097 after the breakdate, both statistically significantly positive at the 5 percent level. Both of these results appear anomalous in light of our priors based on the regulatory and institutional background on capital mobility in these countries. The results are equally puzzling for the two cases where the saving coefficient declines in size over time. In Korea, β turns from 0.528 (significantly

15. Recall that the regression was performed on first-differenced series of the savings and investment rates.

16. Both the Ljung-Box Q statistic and the generalized LM test (not reported) indicate the presence of serial correlation for only two countries in the sample: Malaysia and Taiwan.

TABLE 2

TOTAL INVESTMENT–SAVING CORRELATION ALLOWING FOR STRUCTURAL BREAK

$$\Delta(GDI/GDP)_t = \alpha + \beta_0\Delta(GNS/GDP)_t + \beta_1 * D * \Delta(GNS/GDP)_t$$

	β_0	β_1	BREAK DATE	$\bar{R}^2$	D.W.
Australia			1983		
Canada			1973		
Hong Kong			1973		
Indonesia	0.604*** (0.213)	−0.035 (0.230)	1970; 1983	0.27	2.64
Japan			1973		
Korea	0.528*** (0.155)	−0.591** (0.278)	1985	0.34	1.94
Malaysia			1973; 1983		
New Zealand			1984		
Philippines	−0.037 (0.257)	0.970** (0.435)	1983	0.27	1.55
Singapore	−0.312 (0.328)	0.327** (0.137)	1975	0.24	2.37
Taiwan			1983		
Thailand			1970; 1983		
U.S.	0.632** (0.215)	1.097** (0.560)	1973	0.74	1.31

NOTE: OLS estimation; standard errors in parentheses. The critical values for β were determined by a bootstrap procedure. D denotes the bivariate dummy variable which takes a value of 1 in the years indicated and a value of 0 in the earlier years. Blank spaces in columns β_0 and β_1 indicate that no statistically significant structural break was found for the break date. For Indonesia, Malaysia, and Thailand, two alternative break dates were tested. The result reported for Indonesia pertains to the 1970 break date. See Table 1 for significance levels.

different from 0 at 1 percent) to −0.591 (significant at 5 percent) after the breakdate. The coefficient on saving in Indonesia also turns negative (but insignificant) after the breakdate.

Finally, for purposes of broader international comparison, Table 3 reproduces time series estimates of β for a number of OECD countries reported by other authors. As can be readily inspected, the size of the coefficient on saving tends to be uniformly larger for the group of OECD countries than for the group of Pacific Basin countries; that is, according to the FH interpretation, capital mobility has been *lower* for the OECD countries than for the Pacific Basin countries. The average size of β for these OECD countries is 0.71 compared to 0.41 for the Pacific Basin countries; excluding the countries that overlap (that is, U.S., Japan, and Canada) brings the average for the Pacific Basin down to 0.23. These comparisons further call into question whether one can draw unqualified inferences about capital mobility on the basis of a simple saving-investment analysis.

Sensitivity of the Saving Coefficient to Endogeneity Problems

As discussed in Section II, the "naive" version of the FH saving-investment analysis may be fraught with endogeneity problems. This could be due to the omission of some third factor, such as growth or the relative size of the nontradable sector. Alternatively, endogeneity may be present in the form of policy responses by a government averse to large external imbalances. This section explores the extent to which the puzzles reported in the preceding section are statistical artifacts of such endogeneity problems.

Controlling for the Cyclicality of Inventory Investment

If saving and investment both respond to some common exogenous shocks, ordinary least squares estimates of β will be upwardly biased. One simple way to correct this problem is to use fixed investment rather than total investment as the dependent variable (Bayoumi 1990).[17] The difference between the two is inventory investment, which arguably is much more susceptible to unexpected shocks to the economy.

The results reported in Table 4 indeed show the size and the significance of the regression coefficient falling for a number of countries when fixed investment is used as the dependent variable. The fall is particularly marked for Canada, Japan, and the U.S., with the size of β roughly half of that obtained from the regression using total investment. A non-neglible decline in the coefficient is also observed for Korea and Hong Kong. These results suggest that for a subset of the sample countries at least, aggregate demand and supply shocks may explain a significant part

17. As mentioned earlier, another method to deal with the endogeneity problem is instrumental variable estimation. For most of the sample countries, however, the variables typically used in the literature as being correlated with saving but not investment (see footnote 12) turned out to be poor instruments. The instrumental variable estimation results are therefore not reported.

TABLE 3

Total Investment–Saving Correlation for Twelve OECD Countries, 1961–1986

$\Delta(GDI/GDP)_t = \alpha + \beta\Delta(GNS/GDP)_t$

	β
Austria[a]	0.72 (0.28)
Belgium	0.63 (0.12)
Canada	0.83 (0.16)
Federal Republic of Germany	0.87 (0.17)
Finland	0.98 (0.30)
France	0.80 (0.26)
Greece	0.73 (0.13)
Italy[a]	0.75 (0.29)
Japan[b]	0.84 (0.15)
Norway[b]	−0.21 (0.31)
United Kingdom	0.33 (0.18)
United States	1.00 (0.10)

Source: Bayoumi (1990), Table 7; data for Austria and Italy taken from Obstfeld (1989), Table 7.6.
Note: Standard errors in parentheses. $\bar{R}^2$ and D.W. statistics are not reported by the authors.
[a]Data for 1967–1984.
[b]Data for 1966–1986.

TABLE 4

Fixed Investment–Saving Correlation, 1961–1990

$\Delta(GDFI/GDP)_t = \alpha + \beta\Delta(GNS/GDP)_t$

	β	$\bar{R}^2$	D.W.
Australia	0.011 (0.085)	0.00	1.76
Canada	0.401*** (0.140)	0.23	1.43
Hong Kong	0.461*** (0.175)	0.20	2.00
Indonesia	0.252 (0.108)	0.17	2.23
Japan	0.522*** (0.130)	0.37	1.31
Korea	0.261** (0.128)	0.13	1.34
Malaysia	−0.338*** (0.117)	0.24	0.91
New Zealand	−0.039 (0.145)	0.00	1.93
Philippines	0.259 (0.195)	0.06	1.29
Singapore	0.176 (0.198)	0.03	1.20
Taiwan	−0.266** (0.128)	0.14	1.09
Thailand	0.203 (0.139)	0.07	1.32
U.S.	0.492*** (0.081)	0.57	1.32

Note: OLS estimation; standard errors in parentheses. See Table 1 for significance levels.

of the time series correlation between total saving and investment.[18] Even adjusting for such an endogeneity problem, however, Table 4 leaves a puzzling pattern: β tends to be largest and statistically significant in Canada, Hong Kong, Japan, and the U.S. With the exception of Japan, these are also countries with relatively lower barriers to capital mobility.[19]

Controlling for Growth and the Role of Nontradables

As noted earlier, a number of formal models demonstrate that saving and investment will be correlated, even with perfect capital mobility, due to factors such as productivity shocks or lack of integration of goods markets. This section explores, albeit in a preliminary fashion, whether any systematic changes in saving-investment correlation can be detected for the Pacific Basin countries when the simple regression equation (2) is controlled for some of these omitted variables.

The analysis focuses on two variables. The first is the rate of growth in GDP, which has been suggested in several studies as a possible spurious variable in the saving-investment regression (for example, Obstfeld 1985, Fry 1986). For instance, countries with rising incomes are likely to exhibit both higher rates of saving and investment over time. If this argument is correct, one would expect the regression coefficient on saving to decline when growth is included as an explanatory variable. Following Wong (1990), the second variable examined is the ratio of imports to GDP, as an inverse proxy for the relative size of the nontraded goods sector. The maintained assumption here is that the larger the ratio of imports to GDP, the more open or integrated is the economy with respect to the goods market. The inclusion of this variable in the regression equation is therefore hypothesized to also reduce the size of β.

The individual country regression equations were of the form:[20]

$$(3)\ \Delta\left(\frac{GDI}{GDP}\right)_t = \alpha + \beta\Delta\left(\frac{GNS}{GDP}\right)_t + \gamma\Delta\left(\frac{M}{GDP}\right)_t + \zeta\Delta\left(\frac{GDP_t}{GDP_{t-1}}\right) + \epsilon_t.$$

The results reported in Table 5 show that the import-to-GDP ratio, or the "openness" variable, turns out to be highly significant for all countries in the sample, with Singapore as the notable exception. The growth variable, on the other hand, is significant in only two countries (Australia and Indonesia). When controlled for these two effects, the linkage between saving and investment appears to weaken for at least a subset of Pacific Basin countries.[21] Again, the decline in β is most conspicuous in Canada and the U.S., from 1.017 to 0.695 and from 0.939 to 0.710, respectively, while in the case of Hong Kong, β turns from 0.616 (significant at 1 percent) to being statistically insignificant. A decline in β is also observed for Japan and Thailand, but the change in the size of the estimated coefficient appears too marginal relative to the size of the standard error to warrant a firm conclusion.

The augmented model thus provides some limited evidence of the omitted variable problem in the simple saving-investment correlation analysis. Some "anomalies" nevertheless remain in the results of the augmented model. Notably, β rises in the Philippines from a marginally significant 0.360 in the simple model to 0.496 (significantly different from zero at the 1 percent level) in the augmented model. For the remaining countries, the regression coefficient on saving is statistically not different from zero in the augmented model as in the basic model. The discrepancy between the earlier assessment of capital controls in the sample countries and the estimated size of β therefore remains largely unaccounted for.

The Role of Policy Response toward External Imbalances

A number of studies have suggested that the high correlation between saving and investment reflects successful

---

18. Similar time series results are reported by Bayoumi (1990) for ten OECD countries over a slightly shorter sample period of 1960-1986.

19. Structural break tests using *GDFI* did not yield results that were materially different from those in Table 4. For the sake of brevity, therefore, these results are not reported.

20. Openness and growth were nonstationary and hence were first differenced. Regressions were run with these variables entered directly as well as interactively, that is:

$$\Delta\left(\frac{GDI}{GDP}\right)_t = \alpha + \left(\beta + \gamma_0\Delta\left(\frac{M}{GDP}\right)_t + \zeta_0\Delta\left(\frac{GDP_t}{GDP_{t-1}}\right)\right) * \Delta\left(\frac{GNS}{GDP}\right)_t + \gamma_1\Delta\left(\frac{M}{GDP}\right)_t + \zeta_1\Delta\left(\frac{GDP_t}{GDP_{t-1}}\right) + \epsilon_t$$

The interactive terms turned out to be statistically insignificant; hence only the model featuring the direct effects of openness and growth is reported.

21. Again, the standard F test rejected the pooling of data. Only the individual country time series results are therefore reported. The Box-Ljung Q statistics indicate the presence of serial correlation only in the Malaysia equation.

TABLE 5

EFFECTS OF IMPORT SHARE AND GROWTH ON THE INVESTMENT–SAVING CORRELATION

$$\Delta\left(\frac{GDI}{GDP}\right)_t = \alpha + \beta\Delta\left(\frac{GNS}{GDP}\right)_t + \gamma\Delta\left(\frac{M}{GDP}\right)_t + \zeta\Delta\left(\frac{GDP_t}{GDP_{t-1}}\right) + \epsilon_t$$

	β	γ	ζ	$\bar{R}^2$	Q-msl
Australia	0.141 (0.082)	1.149*** (0.129)	0.167*** (0.046)	0.750	0.925
Canada	0.695*** (0.210)	0.491*** (0.152)	0.047 (0.070)	0.685	0.909
Hong Kong	0.595 (0.150)	0.174** (0.088)	−0.065 (0.059)	0.468	0.972
Indonesia	0.015 (0.151)	0.404*** (0.139)	−0.007*** (0.002)	0.246	0.266
Japan	0.892*** (0.134)	0.433*** (0.111)	0.042 (0.047)	0.759	0.352
Korea	0.482*** (0.164)	0.457*** (0.160)	−0.001 (0.004)	0.356	0.607
Malaysia	0.015 (0.157)	0.422*** (0.090)	0.012 (0.061)	0.447	0.021
New Zealand	0.237 (0.178)	0.763*** (0.128)	0.025 (0.076)	0.543	0.327
Philippines	0.496*** (0.191)	0.502*** (0.105)	0.077 (0.066)	0.474	0.547
Singapore	0.075 (0.280)	0.082 (0.051)	0.056 (0.114)	0.030	0.251
Taiwan	−0.191* (0.110)	0.691*** (0.081)	−0.036 (0.026)	0.810	0.177
Thailand	0.555*** (0.141)	0.578*** (0.121)	0.106 (0.055)	0.600	0.292
U.S.	0.710*** (0.146)	0.632 (0.279)	0.123 (0.123)	0.736	0.960

NOTE: OLS estimation; standard errors in parentheses. Q-msl is the marginal significance level of the Box-Ljung Q statistics for serial correlation.

balance-of-payment policy on the part of national governments (Fieleke 1982, Summers 1988, Bayoumi 1990).[22] In particular, Summers (1988) argues that if governments are averse to large capital inflows or outflows, they might adjust their budget deficits to offset the gap between private saving and investment.[23]

To see whether such policy responses may account for the puzzling cross-country difference in the size of β, the following set of regression equations was estimated:

(4) $\Delta(DEF/GDP)_t = \alpha + \phi\Delta((PS-GDI)/GDP)_t$,

where DEF is general government budget deficit and PS is private saving. $\phi = 1$ implies that fiscal policy completely offsets any imbalance in private saving and investment so that no capital flow occurs; in the polar opposite case of $\phi = 1$, which is an implicit assumption in FH, deficits are exogenous.

As reported in Table 6, the coefficient ϕ is significantly different from zero and positive in all of the countries except Australia, Taiwan, and the Philippines. More revealing, however, is the cross-country comparison of the size of the estimated regression coefficient. The government's propensity to offset current account imbalances tends to be weaker in countries with lower saving-investment correlation. With the notable exception of Korea, and to a lesser extent New Zealand, countries with high or intermediate cases of capital control (Taiwan, Philippines, Thailand, Malaysia, and Indonesia) have a relatively low or statistically insignificant β (as reported in Tables 1, 4, or 5) and also tend to have a low or statististically insignificant ϕ. By contrast, countries with low or intermediate degrees of capital controls (Canada, the U.S., and Japan) and a relatively high β, tend to have relatively high ϕ; that is, the "endogenous" policy response to maintain external balance tends to be higher in Pacific Basin countries with a high saving-investment correlation.[24] These findings thus do help to reconcile the puzzling pattern that the saving-investment correlation tended to be relatively weaker or insignificant in countries which traditionally imposed higher restrictions on international capital flows.

TABLE 6

TEST OF THE ENDOGENOUS POLICY RESPONSE HYPOTHESIS

$\Delta(DEF/GDP)_t = \alpha + \phi\Delta((PS-GDI)/GDP)_t$

	SAMPLE PERIOD	ϕ	$\bar{R}^2$	D.W.
Australia	1962–90	0.064 (0.078)	0.02	1.68
Canada	1962–89	0.569*** (0.141)	0.38	2.21
Hong Kong	1972–90	0.232*** (0.107)	0.22	1.91
Indonesia	1962–89	0.237*** (0.059)	0.38	2.13
Japan	1971–89	0.473*** (0.145)	0.38	1.69
Korea	1962–90	0.925*** (0.032)	0.77	1.72
Malaysia	1965–90	0.300*** (0.052)	0.58	1.49
New Zealand	1962–90	0.435*** (0.085)	0.49	2.42
Philippines	1962–90	0.160* (0.094)	0.10	2.62
Singapore	1962–90	0.597*** (0.072)	0.72	2.39
Taiwan	1962–90	−0.072 (0.064)	0.04	2.34
Thailand	1964–90	0.360*** (0.129)	0.24	2.33
U.S.	1962–90	0.786*** (0.110)	0.65	2.11

NOTE: OLS estimation; standard errors in parentheses. DEF denotes general government budget deficit and PS denotes private saving. See Table 1 for significance levels.

22. Possible justifications for discouraging capital outflows include: social return to domestic investment exceeding that of foreign investment, risk of capital expropriation by foreign government or labor, and negative terms of trade effects. Aversion to a large influx of foreign capital may be due to a large appreciation in the real exchange rate and its deleterious impact on the economy's traded goods sector.

23. This is not to say that fiscal policy is determined exclusively, or even primarily, out of balance of payments considerations. Rather, it is when the current account balance exceeds some predetermined level that fiscal or even monetary policies are implemented to reduce or eliminate those deficits or surpluses. One example is efforts initiated by the U.S. in the second half of the 1980s to reduce the budget deficit, and thereby put a check on the ballooning current account deficit. Another example of a policy reaction in the opposite direction is Japan which, in a bid to reduce unprecedented current account surpluses that emerged in the second half of the 1980s, pursued expansionary fiscal and monetary policies.

24. The exception here is Singapore which had an insignificant β but a relatively high ϕ.

TABLE 7

External Debt Indicators

	Indonesia	Korea	Malaysia	Philippines	Thailand
	Public Debt as Percent of GNP				
1970	25.6	20.3	9.5	8.8	4.6
1975	25.5	27.5	14.2	9.2	4.2
1980	20.1	26.3	17.0	19.2	12.4
1985	31.9	32.7	52.0	43.6	26.9
1990	44.0	7.5	39.9	51.7	15.8
	Total Debt as Percent of GNP				
1980	28.0	48.7	28.0	49.5	26.0
1985	43.8	52.5	71.9	83.9	47.8
1990	66.4	14.4	48.3	65.4	32.6
	Government Deficit as Percent of GNP				
1970	3.02	0.77	3.77	0.14	3.66
1975	3.70	1.98	8.47	1.19	2.06
1980	2.42	2.23	13.33	1.39	4.88
1985	0.98	1.17	7.36	1.95	5.46
1990	0.90	0.70	2.70	3.46	4.84
	Foreign Borrowing as Percent of Government Deficit				
1970	87.1	66.6	0.4	100.0	NA
1975	97.0	77.2	47.8	18.7	83.0
1980	92.9	38.3	4.4	66.0	23.5
1985	74.4	46.9	16.8	0.0	32.8
1990	NA	27.2	NA	11.1	0.0

Sources: World Bank, *World Debt Tables*, and IMF, *International Financial Statistics*.

In fact, Table 7 presents evidence suggesting that for this latter group of countries, the government itself has played a central role in the flow of foreign borrowing, thus driving a wedge between national saving and investment. Throughout the 1980s, public or publicly guaranteed debt usually accounted for anywhere between one-half to three-quarters of total foreign borrowing in all five countries,[25] with significant proportions of the foreign borrowing going toward financing the government budget deficit.[26] Though comparable data are unavailable for the earlier period, the relative importance of public borrowing was undoubtedly even higher, and this may constitute an additional reason why saving-investment linkages are weaker in these Pacific Basin countries despite their traditionally more stringent capital controls.[27]

IV. Conclusion

This paper examined the time series evidence on the saving-investment correlation for a group of Pacific Basin countries. Its main findings may be summarized as follows. First, the simple bivariate saving-investment model (as originally formulated by FH) yielded coefficients on saving that often contradicted our priors based on our knowledge of capital controls in the region. Most notably, the saving coefficients were much higher and statistically significant in countries that have traditionally imposed much looser capital controls. Additionally, structural break tests in saving-investment correlation failed to detect the effects of regulatory shifts for most of the sample countries.

Part of this anomalous pattern across countries in the size of the estimated coefficient can be accounted for by simultaneity problems. For a subset of countries, controlling for the procyclicality of inventory investment reduced the size of the estimated coefficient on saving. The growth rate and the openness of the economy (as a proxy of the integration of the goods market) were also found to exert a negative impact on the overall saving-investment correlation. These results thus provide some support to models that emphasize the role exogenous shocks or the nontradable sector play in explaining observed co-movements in savings and investment.

A more significant factor accounting for the puzzling pattern of tighter saving-investment linkages found in countries with relatively lower capital controls, however, appears to be the greater propensity of government policy to counteract large external imbalances. By contrast, such policy reactions appear much weaker in those Pacific Basin countries with relatively higher capital controls. In fact, for this group of countries, the financing of the public sector deficit itself has been an important impetus to capital inflow, and this appears to have helped to weaken the link between domestic investment and savings.

25. The sources cited do not report data for Taiwan.

26. Kharas and Kiguel (1988) provides a systematic analysis on this issue.

27. Again, the Korean evidence is difficult to interpret. The result in Table 6 suggests a very high propensity of the Korean government to engage in fiscal policy that counteracts external imbalances. The evidence in Table 7 appears to contradict this interpretation.

Appendix

Summary of Capital Controls in Pacific Basin Countries

Key:

x Heavy Restrictions:
full surrender of export proceeds; advanced export deposits required; tight restrictions on size of permitted payments for invisibles; foreign currency deposits not allowed; foreign borrowing/lending with prior approval only; taxes or reserve requirements on foreign borrowing.

* Moderate Restrictions:
surrender of export proceeds required above set limit; fractional advanced import deposits required; fewer restrictions or moderate limits on payments for invisibles; foreign currency deposits allowed with set limits and with transaction notification requirements; foreign borrowing/lending permitted within set limits.

o Mild Restrictions:
payments for invisibles subject to verification; fewer restrictions on size and flexibility of foreign currency accounts; foreign borrowing/lending permitted without approval but limits apply to net foreign currency position.

No Restrictions:
indicated by a blank.

	1960 – 1969		1970 – 1979		1980 – 1989		1990 – 1992
Australia							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	xxxxx	xxxxx	xxxxx	xxxxx	xxx		
Advanced Import Deposits							
Payments for/Proceeds from Invisibles	xxxxx	xxxxx	xxxxx	xxxxx	xxx		
Foreign Currency Deposits by Residents	xxxxx	xxxxx	xxxxx	xxxxx	xxx		
Foreign Lending/Borr. by Financial Institutions	xxxxx	xxxxx	xxxxx	xxxxx	xxx		
Tax or Special Reserve Req. on Foreign Borr.							
Canada							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds							
Advanced Import Deposits							
Payments for/Proceeds from Invisibles							
Foreign Currency Deposits by Residents							
Foreign Lending/Borr. by Financial Institutions							
Tax or Special Reserve Req. on Foreign Borr.							
Hong Kong							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	ooooo	ooooo	oo				
Advanced Import Deposits	*****	*****	**				
Payments for/Proceeds from Invisibles	*****	*****	**				
Foreign Currency Deposits by Residents							
Foreign Lending/Borr. by Financial Institutions	*****	*****	**				
Tax or Special Reserve Req. on Foreign Borr.							

	1960 - 1969		1970 - 1979		1980 - 1989		1990 - 1992
INDONESIA							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	xxxxx	xxxxx	xxxxx	xxxxx	x**		
Advanced Import Deposits	xxxxx	xxxxx	xxxxx	xxxxx	**o		
Payments for/Proceeds from Invisibles	*****	*****	*				
Foreign Currency Deposits by Residents	xxxx						
Foreign Lending/Borr. by Financial Institutions	*****	*****	*****	*****	*****	*****	**
Tax or Special Reserve Req. on Foreign Borr.	xxxxx	xxxxx	xxxxx				
JAPAN							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	xxxxx	xxxxx	x*				
Advanced Import Deposits	*****	*oooo	o				
Payments for/Proceeds from Invisibles	*****	*****	*****	**o			
Foreign Currency Deposits by Residents	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	**
Foreign Lending/Borr. by Financial Institutions	*****	*****	*****	****o	ooooo	ooooo	
Tax or Special Reserve Req. on Foreign Borr.	*****	*****	*****	*****			
KOREA							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xx
Advanced Import Deposits	xxxxx	xxxxx	xxxxx	xx			
Payments for/Proceeds from Invisibles	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xx
Foreign Currency Deposits by Residents	*****	*****	*****	****o	ooooo	ooooo	oo
Foreign Lending/Borr. by Financial Institutions	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	*****	**
Tax or Special Reserve Req. on Foreign Borr.							
MALAYSIA							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xx
Advanced Import Deposits							
Payments for/Proceeds from Invisibles	*****	*****	***				
Foreign Currency Deposits by Residents							
Foreign Lending/Borr. by Financial Institutions	*****	*****	*****	*****	**ooo	oo	
Tax or Special Reserve Req. on Foreign Borr.							
NEW ZEALAND							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	xxxxx	xxxxx	xxxxx	xxxxx	xxx		
Advanced Import Deposits	xxxxx	xxxxx	xxxxx	xx			
Payments for/Proceeds from Invisibles	*****	*****	*****	*****	****		
Foreign Currency Deposits by Residents	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx		
Foreign Lending/Borr. by Financial Institutions	xxxxx	xxxxx	xxxxx	xxxxx	xxxxo		
Tax or Special Reserve Req. on Foreign Borr.							

	1960 – 1969		1970 – 1979		1980 – 1989		1990 – 1992
Philippines							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxx
Advanced Import Deposits	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxx
Payments for/Proceeds from Invisibles	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxx
Foreign Currency Deposits by Residents	ooooo	ooooo	o****	*xxxx	xxxxx	xxxxx	xxx
Foreign Lending/Borr. by Financial Institutions	ooooo	o****	*xxxx	xxxxx	xxxxx	xxxxx	xxx
Tax or Special Reserve Req. on Foreign Borr.							
Singapore							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	*****	*****	*****	***			
Advanced Import Deposits							
Payments for/Proceeds from Invisibles	*****	*****	*****	***			
Foreign Currency Deposits by Residents	*****	*****	*****	***			
Foreign Lending/Borr. by Financial Institutions							
Tax or Special Reserve Req. on Foreign Borr.							
Taiwan							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	*****	*****	*****	*****	*****	***	
Advanced Import Deposits	*****	*****	*****	*****	*****	***	
Payments for/Proceeds from Invisibles	*****	*****	*****	*****	*****	***	
Foreign Currency Deposits by Residents	xxxxx	xxxxx	xxxxx	xxx			
Foreign Lending/Borr. by Financial Institutions	*****	*****	*****	*****	****		
Tax or Special Reserve Req. on Foreign Borr.							
Thailand							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xx
Advanced Import Deposits	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxx*	
Payments for/Proceeds from Invisibles	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	**
Foreign Currency Deposits by Residents	xxxxx	xxxxx	xxxxx	xxxxx	xxxxx	*****	**
Foreign Lending/Borr. by Financial Institutions	xxxxx	xxxxx	xxxxx	xxxxx	xxx**	*****	**
Tax or Special Reserve Req. on Foreign Borr.							
United States							
	+----	+----	+----	+----	+----	+----	+--
Required Surrender of Export Proceeds							
Advanced Import Deposits							
Payments for/Proceeds from Invisibles	oo	ooooo	ooooo				
Foreign Currency Deposits by Residents							
Foreign Lending/Borr. by Financial Institutions	oo	ooooo	ooooo				
Tax or Special Reserve Req. on Foreign Borr.							

References

Bayoumi, Tamin. 1990. "Saving-Investment Correlations: Immobile Capital, Government Policy, or Endogenous Behavior?" *IMF Staff Papers* 37, pp. 360-387.

Cargill, T., H. Cheng, and M. Hutchison. 1986. "Financial Market Changes and Regulatory Reforms in Pacific Basin Countries: An Overview." In *Financial Policy and Reform in Pacific Basin Countries,* ed. H. S. Cheng. Lexington, Mass: Lexington Books.

Cole, D., and H. Patrick. 1986. "Financial Development in the Pacific Basin Market Economies." In *Pacific Growth and Financial Interdependence,* ed. A.H.H. Tan and B. Kapur. Winchester, Mass: Allen and Unwin.

Dooley, M., J. Frankel, and D. Mathieson. 1987. "International Capital Mobility: What Do Saving-Investment Correlations Tell Us?" *IMF Staff Papers* 31, pp. 503-530.

Edwards, S. 1990. "The Sequencing of Economic Reform: Analytical Issues and Lessons from Latin American Experiences." *The World Economy* 13 (March) pp. 1-14.

Engel, C., and K. Kletzer. 1987. "Saving and Investment in an Open Economy with Non-Traded Goods." NBER Working Paper No. 2141.

Feldstein, M. 1983. "Domestic Saving and International Capital Movements in the Long Run and the Short Run." *European Economic Review* 21 (March/April) pp. 129-151.

__________, and P. Bacchetta. 1989. "National Saving and International Investment." NBER Working Paper No. 3164.

__________, and C. Horioka. 1980. "Domestic Saving and International Capital Flows." *Economic Journal* 30 (June) pp. 314-329.

Fieleke, N.S. 1982. "National Saving and International Investment." In *Saving and Government Policy* (Conference Series no. 25). Federal Reserve Bank of Boston.

Frankel, J. 1985. "International Capital Mobility and Crowding Out in the U.S. Economy: Imperfect Integration of Financial Markets or Goods Markets?" NBER Working Paper No.1773

Fry, M.J. 1986. "Terms-of-Trade Dynamics in Asia: An Analysis of National Saving and Domestic Investment Responses to Terms-of-Trade Changes in 14 Asian LDC." *Journal of International Money and Finance* 5, pp. 57-73.

Glick, R., and K. Rogoff. 1992. "Global versus Country-Specific Productivity Shocks and the Current Account." Mimeo. Federal Reserve Bank of San Francisco.

Greenwood, J. 1986. "Financial Liberalization in Seven East Asian Economies." In *Financial Innovation and Monetary Policy: Asia and the West,* ed. Y. Suzuki and H. Yomo. University of Tokyo Press.

International Monetary Fund. Various years. *Annual Report on Exchange Arrangements and Exchange Restrictions.*

Kharas, H., and M. Kiguel. 1988. "Monetary Policy and Foreign Debt: The Experiences of the Far East Countries." In *Monetary Policy in Pacific Basin Countries,* ed. H. S. Cheng. Boston: Kluwer Academic Publishers.

Mathieson, D. 1986. "International Capital Flows, Capital Controls, and Financial Reform." In *Financial Policy and Reform in Pacific Basin Countries,* ed. H. S. Cheng. Lexington, Mass: Lexington Books.

McKinnon, R. 1991. *The Order of Financial Liberalization.* Baltimore: Johns Hopkins University Press.

Murphy, R.G. 1986. "Productivity Shocks, Non-Traded Goods and Optimal Capital Accumulation." *European Economic Review* 30, pp. 1081-1095.

Obstfeld, M. 1985. "Capital Mobility in the World Economy: Theory and Measurement." *Carnegie-Rochester Conference Series in Public Policy* 24, pp. 55-104.

Patrick, H., and D. Cole. 1986. "Financial Development in the Pacific Basin Countries." In *Pacific Growth and Financial Interdependence,* eds. A. H. H. Tan and B. Kapur. Winchester, Mass: Allen & Unwin.

Penati, A., and M. Dooley. 1984. "Current Account Imbalances and Capital Formation in Industrial Countries, 1949-81." *IMF Staff Papers.* 31 (March) pp.1-24.

Roubini, N. 1988. "Current Account and Budget Deficits in an Intertemporal Model of Consumption and Taxation Smoothing. A Solution to the 'Feldstein-Horioka Puzzle'?" NBER Working Paper No. 2773.

Santiprabhob, V. 1992. "On the Reverse Order of Financial Liberalization: East Asian Implications from a Political Economy Model." Mimeo. Department of Economics, Harvard University and Federal Reserve Bank of San Francisco.

Summers, L. 1988. "Tax Policy and International Competitiveness." In *International Aspects of Fiscal Policies,* ed. Jacob A. Frenkel. Chicacgo: University of Chicago Press.

Tesar, L. 1991. "Saving, Investment, and International Capital Flows." *Journal of International Economics* 31, pp. 55-78.

Wong, D.Y. 1990. "What Do Saving-Investment Relationships Tell Us about Capital Mobility?" *Journal of International Money and Finance* 9, pp. 60-74.