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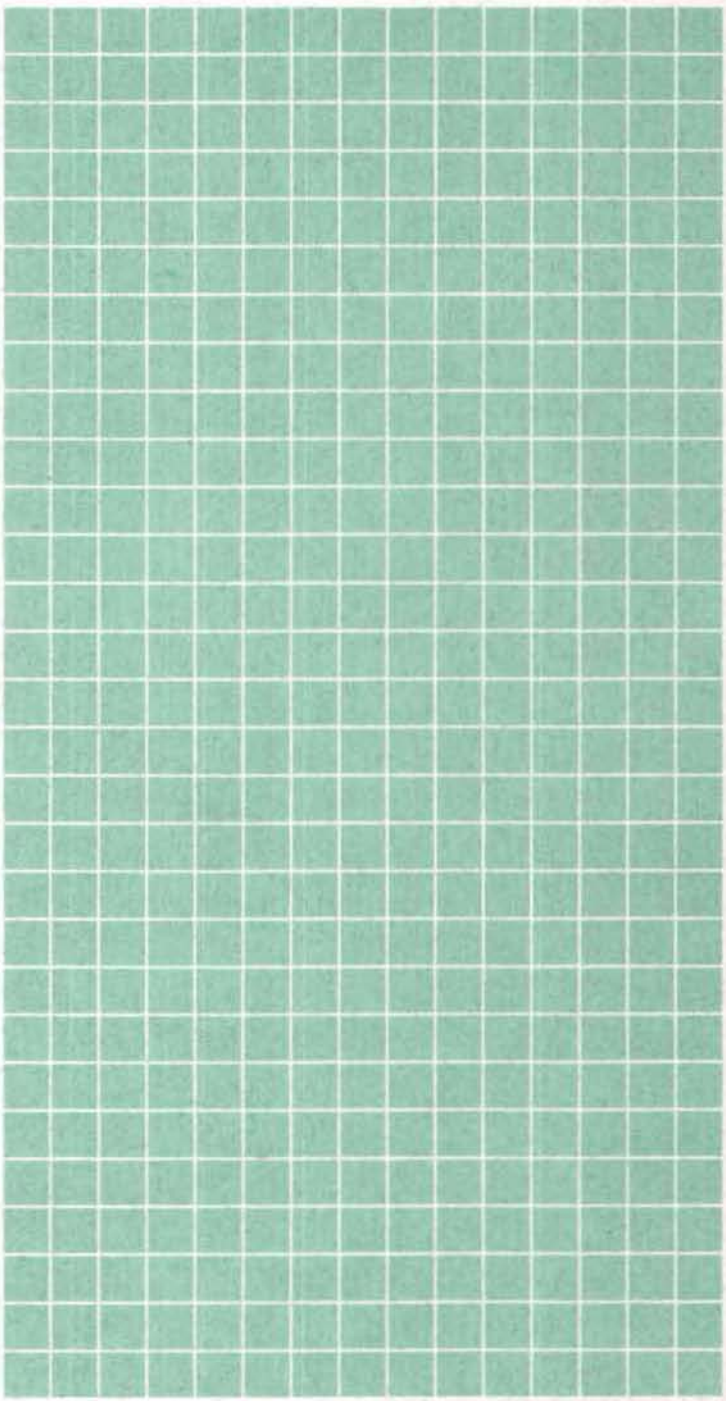
Economic Review



The Case of the Missing M2

John V. Duca

Monetary Policy in a Small Open Economy: The Case of Singapore

John H. Wood

Regional Effects of Liberalized Agricultural Trade

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Economic Review

Federal Reserve Bank of Dallas

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The Case of the Missing M2

For more than a year, the M2 monetary aggregate has been unusually weak. For example, the Federal Reserve Board staff model of M2, referred to as the *FRB M2 model*, overpredicted M2 growth by an average of 1.8 percentage points over 1990:3–91:4, and an M2 model developed at the Federal Reserve Bank of San Francisco overpredicted M2 growth in late 1990 (Furlong and Trehan 1990). Figure 1 presents results from estimating M2 growth with the FRB M2 model, where the estimated shortfall in M2 growth is the gap between estimated M2 growth and actual M2 growth.

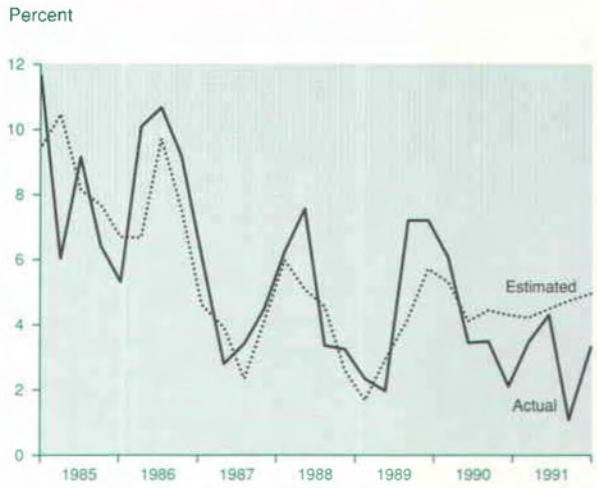
This study assesses two competing explanations for this phenomenon. One is that the missing M2 merely reflects substitution by households into bond and equity mutual funds, which are very liquid (Farrell and McNamee 1991). Indeed, coincident with the missing M2 have been runoffs in small time deposits, unusual weakness in money market mutual funds and large inflows into bond and equity mutual funds. The other explanation is that the missing M2 reflects households' reaction to the activities of the Resolution Trust Corporation (RTC). Indeed, the missing M2 has coincided with the efforts of the RTC to resolve failed thrifts.

The shortfall in estimated M2, or missing M2, has policy implications because monetary aggregates are often used as indicators of economic activity. From the equation of exchange,

$$M \times V = P \times Y, \tag{1}$$

where M = money, V = velocity (gross national product /M), Y = transactions (usually measured by inflation-adjusted GNP), and P = the price level. People typically reduce their money holdings as the spread between the rates that they can earn on nondeposit assets (for example, U.S. Treasury securities) rises over rates paid on deposits. As a result, when this spread, or *opportunity cost*, of money rises, the velocity of money rises because people hold lower average money balances to conduct their transactions.

Figure 1
Estimated Shortfall in M2 Growth



If velocity is very predictable, then nominal GNP ($P \times Y$) can be inferred from money and interest rates. This inference is important for policy-making because estimates of prices and inflation-adjusted GNP typically are available after a considerable lag, whereas interest rate and money supply data are available more quickly. If *money demand*—the relationship between

I would like to thank, without implicating, Steven Prue and Matthew Turner for providing excellent research assistance, and Richard G. Anderson, W. Michael Cox, Kenneth M. Emery, Evan F. Koenig, Harvey Rosenblum, David Small, Pat White, and Kevin Yeats for their suggestions during the progress of this research.

money, interest rates, and nominal GNP—is stable, then policymakers can use current money supply and interest rate data to roughly estimate current nominal GNP.

At one time, the demand for the M1 monetary aggregate was stable, and for this reason, M1 was used as an indicator of economic activity. However, there was a "missing money" period during the mid-1970s when M1 was unusually weak and suggested that nominal income was much lower than it actually was. Moreover, the link between M1, interest rates, and nominal GNP has become looser since the deregulation of deposits in the early 1980s. In particular, substantial shifts of deposits between those classified within M1 and those classified within the broader M2 monetary aggregate have resulted from deposit deregulation.[1] For these reasons, M1 has been used less and less as an indicator of nominal GNP.

Evidence that the demand for M2 is more predictable than the demand for M1 is mounting (Hetzel and Mehra 1989, and Moore, Porter, and Small 1990). Not surprisingly, economists and policymakers increasingly are turning to M2 as an indicator of economic activity and as a guide to long-run price developments (Hallman, Porter, and Small 1991). However, in recent quarters M2 growth has been unusually weak.

Using the FRB M2 model, this study documents the missing M2 evident since 1990 and finds that RTC activity, rather than inflows into bond and equity funds, appears to account for much of M2's recent weakness. In essence, the RTC's method of resolving failed institutions has lowered the perceived return on thrift deposits in ways not typically explained by models of M2. In response, investors have shifted from M2 deposits to other assets, including but not limited to bond and equity mutual funds.

This study is organized as follows. I first describe what bond funds are, explain how they may theoretically affect M2, and show that bond fund effects cannot account for the missing M2. Then I describe the activities of the RTC, explain how RTC activity may theoretically affect M2, and show how these activities appear to account for most of the missing M2. I conclude by summarizing the findings and discussing their policy implications.

Bond funds and the missing M2

This section begins with a review of the characteristics of bond and equity funds and then presents several theories on how bond and equity funds could be depressing M2 by becoming more attractive relative to M2 deposits. Next, I describe how bond fund adjustments to M2 were made and use the FRB M2 model to show that the missing M2 does not mainly owe to bond and equity fund effects.

Characteristics of bond and equity funds. Developed in the mid-1970s, bond funds are mutual shares of bond portfolios. Bond funds are a good substitute for direct bond holdings because bond funds typically are more liquid and more diversified than are direct bond holdings. Bond funds also substitute for M2 deposits. One reason is that many bond funds are in mutual fund families that allow investors to shift their assets among bond, equity, and checkable money market mutual funds (MMMFs) at little or no cost. Indeed, some market analysts have suspected that the 1991 slowdown in MMMF growth owes to shifts into bond and equity funds (*Figures 2 and 3*). Bond funds also provide investors with credit lines and credit cards. Thus, rather than putting one's savings into a small time deposit, an investor might choose to use a bond fund that permits one to either tap a credit line or shift funds into a MMMF when the need to write a check arises.

Similarly, equity mutual funds potentially substitute for both direct holdings of equity and for other assets, such as M2 balances. However, equity funds differ from M2 balances in one important way that bond funds do not. Specifically, equity funds carry a substantial degree of investment risk, which makes them much less substitutable for M2 deposits than bond funds. Moreover, in contrast to bond funds, available data do not allow one to easily measure shifts from directly held equities to equity funds. For these reasons, this study focuses more on bond

[1] *M1 includes currency, demand deposits, and other checkable deposits (NOW accounts). M2 includes M1, passbook savings deposits, small time deposits, MMMFs, money market deposits accounts, overnight Eurodollars, and overnight repurchase agreements.*

Figure 2
Bond and Equity Fund Net Changes

Billions of dollars

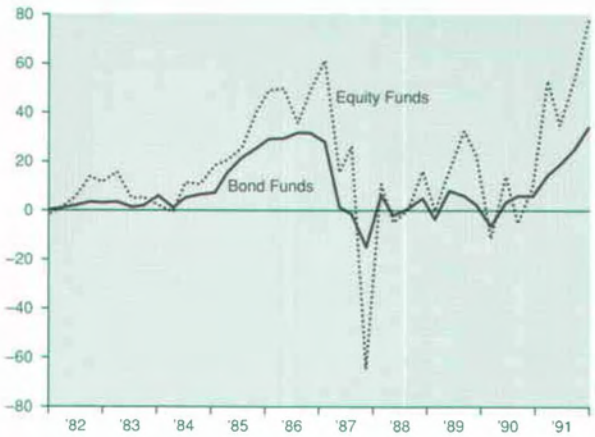
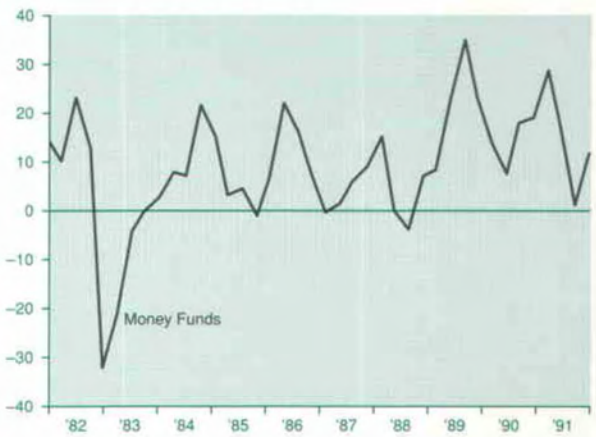


Figure 3
Money Fund Net Changes

Billions of dollars



SOURCES: Investment Company Institute and Federal Reserve Board.

fund rather than equity fund effects.

Bond and equity mutual funds since the mid-1970s. At this point, it is useful to review the history of bond and equity funds. As shown in Figure 4, equity funds grew moderately over the late 1970s and early 1980s. During the stock market boom of the mid-1980s, equity funds surged, reflecting higher prices of existing shares and inflows spurred by substantial price appreciation. Equity funds fell sharply during the stock market crash of 1987 and then recovered to pre-crash levels by late 1989. More recently, equity funds have grown rapidly as investors have reacted to declining yields on short-term debt securities and small time deposits.

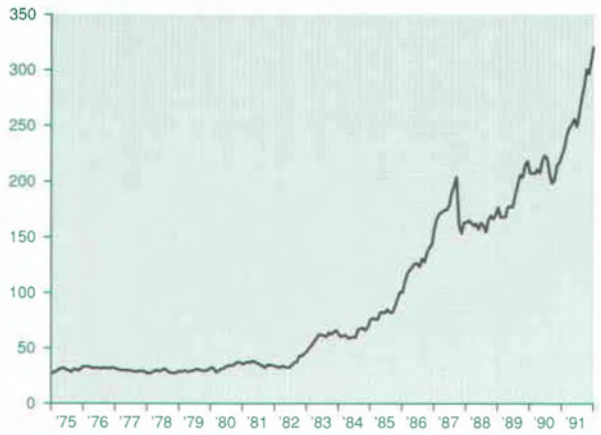
As illustrated in Figure 5, bond funds grew modestly over the late 1970s and early 1980s. These funds then grew rapidly during 1985–86, were almost flat over 1987–89, and then grew rapidly in early 1991. Over 1985:1–86:4, household bond funds (seasonally adjusted—SA, Investment Company Institute data) rose by $143.4 billion, which is much greater than the $80.4 billion increase in overall holdings of government securities (less savings bonds), tax exempt securities, and corporate bonds (Flow of Funds data, NSA). These data suggest that much of the mid-1980s surge in bond funds reflected shifts from directly held bonds to bond mutual funds. This hypothesis is consistent with tax incentives that encouraged households to shift funds from long-term financial assets to individual retirement accounts (IRAs), for which mutual funds are more suitable.

Beginning in 1987 when the Tax Reform Act of 1986 severely restricted the eligibility requirements for IRAs, bond fund holdings changed little for the remainder of the decade. Although bond fund inflows have recently accelerated, the current spurt differs from that of the mid-1980s. Over 1990:3–91:2, bond funds (SA) held by households rose $32.5 billion, while household holdings of government securities (less savings bonds), tax exempt securities, and corporate bonds increased by $100.5 billion. Thus, the surge in bond funds during the early 1990s mainly reflected shifts away from nonbond assets (that is, M2 deposits), rather than shifts away from direct bond holdings.

Indeed, the most recent surge in bond funds appears to reflect shifts from M2 deposits, particularly small time deposits, which fell sharply in 1991. In addition, because the costs of transferring assets between bonds and MMMFs within an asset management account are small, one would expect that some substitution between M2 and bonds would occur more specifically between bond and money market funds. Consistent with this view,

Figure 4
Household Equity Funds

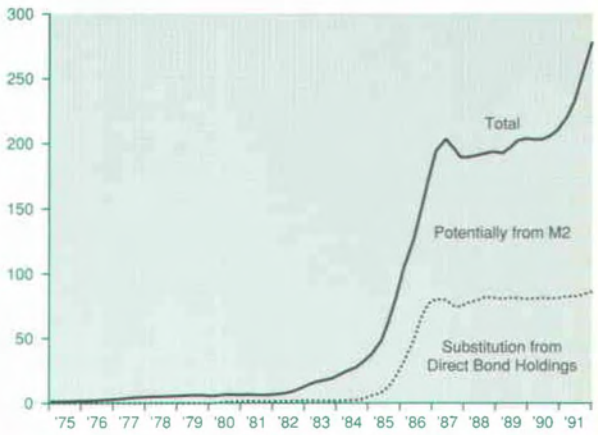
Billions of dollars



SOURCES: Investment Company Institute and Federal Reserve Board.

Figure 5
Household Bond Mutual Funds

Billions of dollars



SOURCES: Investment Company Institute and Federal Reserve Board.

bond inflows over 1990–91 have coincided with some weakness in MMMFs outflows, as shown earlier in Figure 3. Although bond funds are still small relative to the stock of M2, their rapid growth in 1990 and 1991 may account for some of the recent unusual weakness in M2 growth as suggested by press reports (Clements 1991).

Why bond funds may affect M2: a theoretical framework

This discussion of why bond funds may theoretically affect M2 relies on the model of money demand developed by William Baumol (1952) and James Tobin (1956). This framework stresses that households and firms must choose between holding their assets in money or bonds. Bonds are attractive because their yield exceeds that on money. This yield differential is called the *opportunity cost of money*. On the other hand, if the need to purchase a good arises, a household or business must pay the cost of transferring assets from bonds to money. In the Baumol–Tobin model, people balance these considerations by holding some money and some bonds. Not surprisingly, the demand for money in this model is lower if the opportunity cost of money rises, if spending falls, or if the cost of converting bonds into money falls.

Within this framework, the recent popularity of bond funds can be attributed to two main factors. First, there has been a reduction in the costs of transferring assets from bonds (now bond funds) into transactions accounts, on which households can write checks.[2] A second factor is the recent large spread of long-term interest rates over short-term rates, often referred to as a *steep yield curve*. The expected return on bond funds reflects long-term interest rates, rather than short-term interest rates as with small time deposits. As a result, the recent decline in short-term interest rates relative to long-term interest rates has been accompanied by a fall in M2 deposit rates relative to yields on bond funds.[3]

[2] *Ross Milbourne (1986) developed a model to analyze the impact of certain financial innovations on the demand for different monetary aggregates. His model gives a more complete treatment of how a decline in the costs of transferring assets from bonds to money can decrease the demand for money.*

[3] *The maturities of most small time deposits are less than 1 year and typically range up to 2-1/2 and 5 years. The effective maturities of bond funds primarily fall into the range from 3 to 10 years.*

Theoretical aspects of the empirical analysis of bond fund effects

Shifts from M2 to bond funds, however, likely require high spreads of long-term over short-term rates because such shifts entail fixed costs to households. These costs include commission (load) fees, time needed to gain information on mutual funds, and fixed annual fees (typically $75 to $100). In addition, mutual fund family accounts that allow shifts among bond, equity, and checkable money market mutual funds have minimum required investments (typically $10,000) that usually are much higher than those of simple bond fund accounts.[4] As a result, M2 may not be affected much over the short term by a modest decline in the cost of shifting from bond to money market funds or by a modest rise in the spread between bond and small time deposit yields. It is thus plausible that M2 will be substantially affected only by large or persistent changes in transfer costs or the slope of the yield curve.

The data are generally consistent with this view. Although the cost of shifting assets between bond and money market funds generally fell in the late 1980s and early 1990s, bond funds have only risen noticeably during two periods since 1982—periods when the yield curve has been very steep. As shown in Figures 6 and 7, the growth rate of bond funds adjusted for inflation has only been substantial during the periods 1985–86 and 1990–91.[5] However, of these two periods, the mid-1980s surge was much larger relative to the slope of the yield curve, and partly reflected shifts from direct bond holdings to IRAs/401Ks invested in bond funds when tax requirements were more generous. Further evidence that bond fund growth has not consistently reflected spreads between short-term and long-term rates is that bond fund growth was weak in 1987 despite a fairly large yield spread. This weakness likely reflected the enactment of the Tax Reform Act of 1986, which greatly curtailed the number of households eligible to contribute to IRAs and which imposed much more restrictive limits on the amounts of 401K contributions.

Thus, including the spread between rates on long-term and short-term Treasury securities in M2 regressions is unlikely to detect surges in bond funds that result from changes in the tax code and the unusually fast growth of new instruments during periods of innovation.[6] In the past, these sorts of empirical difficulties have been handled by expanding the definition of M2 (such as adding MMMFs and money market deposit accounts [MMDAs] to M2), rather than by solely relying on adjusting the opportunity cost terms in money demand models. Indeed, Figure 8 illustrates the importance of including past innovations, such as MMMFs and MMDAs, in M2.[7] Taking this approach, I compare the behavior of M2 with that of M2 plus adjustments for bond and equity mutual funds.

Theoretical aspects of measuring bond fund effects

The institutional characteristics of bond funds suggest that they are substitutes for directly holding bonds and for M2 balances.

Substitution between bond funds and direct bond fund holdings. Bond funds offer three main advantages over directly held bonds. First, bond funds enable an investor to acquire shares in a well-diversified portfolio with only a modest investment. Portfolio diversification partially protects investors by enabling them to not be overly exposed to the risk that the value of a particular firm's bonds will fall greatly. A second advantage is that bond funds in mutual fund families are more liquid than directly held bonds. That is, bond funds can be converted into checkable assets such as MMMFs more quickly and with less expense than can directly held bonds.

A third incentive to hold bond funds rather than bonds relates to taxes. During the mid-1980s, U.S. tax laws created incentives for households to open individual retirement (IRA) and Keogh

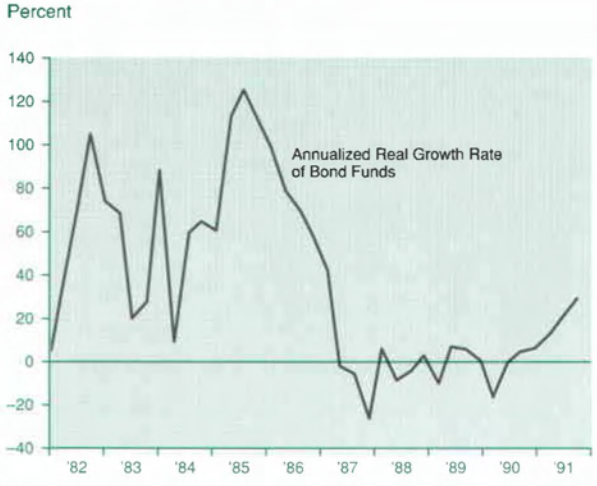
[4] *Minimum balances to open just a bond mutual fund account are as low as $500–$1,000, but do not allow shifting into money market mutual funds.*

[5] *The GNP deflator was used to adjust bond funds for inflation.*

[6] *Indeed, the spread between yields on 10- and 1-year Treasury securities was insignificant when added to the M2 models used in this study.*

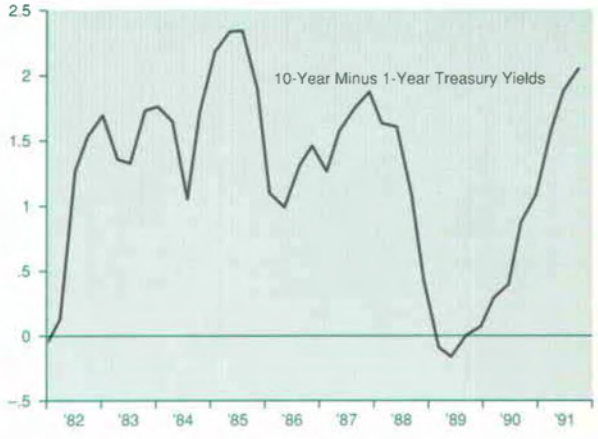
[7] *For a discussion of how and why the definition of M2 has evolved over time, see the study by W. Michael Cox and Harvey Rosenblum (1989).*

Figure 6
Growth in Real Bond Funds



SOURCES: Investment Company Institute and Federal Reserve Board.

Figure 7
Yield Spreads



accounts for which bond and equity funds were better savings instruments than directly held bonds. Mutual funds can be more attractive tax shelters because many funds complete and provide all of the tax-related accounting information for investors and bond funds allow investors to make the maximum annual IRA contribution, $2,000–$4,000, which is less than the $10,000 minimum denomination of most bonds.[8]

The major drawback of bond funds is that for rich investors, the costs of directly investing in bonds may be less than bond fund fees. Nevertheless, bond funds are a more attractive means of holding bonds for many investors.

Substitution between bond funds and M2. Several characteristics of bond funds suggest that they are also substitutes for M2. To evaluate the "moneyness" of bond funds, however, it is helpful first to review the salient features of M2 deposits.

M2 deposits generally share three important characteristics. First, because they are federally insured, investors need not worry about the risk that their M2 deposits may fall in nominal value. By contrast, many corporate bonds (especially noninvestment grade or junk bonds) pose default risk to investors because the firms may not be able to pay back investors. A second characteristic of M2 deposits is that they generally have smaller minimum denominations than many bonds and commercial paper issues, which typically come in $10,000 increments. As a result, many more households are able to invest in M2 deposits than in bonds. Another important feature of M2 deposits is that households can either write checks on many M2 deposits or shift noncheckable M2 deposits into checkable accounts.[9]

How do bond funds compare with M2 deposits? First, many bond funds typically have little or no credit risk because they are heavily invested in U.S. government-guaranteed, mortgage-backed securities and high-grade corporate bonds.[10] As a result, bond funds are relatively safe and can substi-

[8] *The maximum contribution is $2,000 for most eligible individuals and $4,000 for most eligible families.*

[9] *In practice, many institutions do not penalize households significantly if they must prematurely withdraw small time deposits in an emergency.*

[10] *Of $354 billion in bond funds in September 1991, $146 billion was invested in municipal bonds, $123 billion in U.S. government securities (including U.S. government-guaranteed, mortgage-backed securities), $25 billion in junk bonds, and $50 billion in mixed bond funds (primarily, Treasury, municipal, collateralized mortgage obligations, and high grade corporate bonds).*

tute for small time deposits. Second, many bond funds have minimum investment sizes less than $10,000 and do not require households to invest in $10,000 increments. Third, many bond funds enhance the liquidity of investors by offering check-writing privileges, credit lines, and credit cards. Fourth, many bond fund holdings are in mutual fund families, which allow investors to readily shift assets across bond, equity, and checkable money market mutual funds at very low transactions costs.[11] This last feature heightens the extent to which investors shift funds between bond or equity funds and MMMFs when relative rates of return between these assets change. Indeed, the missing M2 has been accompanied by weakness in MMMFs, as well as in small time deposits.

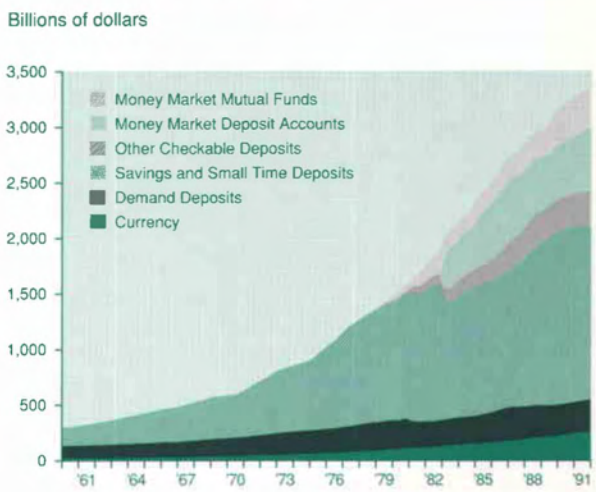
Bond funds differ from M2 deposits in several ways. First, unlike M2 accounts bond funds are *marked-to-market*, meaning that a change in interest rates affects an investor's balances by altering market price of these assets. Bonds bear a fixed coupon and, thus, indirectly so do bond funds. When long-term interest rates rise, therefore, the prices of existing bonds fall, allowing the yield to rise. Thus, the market value of bond funds falls as long-term rates rise. For this reason, bond funds pose interest rate (price) risk.

A second way that bond funds differ from M2 deposits concerns taxes. Because of the marked-to-market feature of bond funds, investors must consider the capital gains tax consequences of shifting out of bond funds into money market funds. These tax considerations entail costs that may hamper substitution between bond funds and money market funds.

A third difference is that bond funds include many IRA and Keogh accounts, which are excluded from M2 because their tax-deferred status reduces their liquidity. Finally, annual fixed fees and minimum balance requirements for bond funds effectively limit the relevance of these instruments to more affluent households. (One reason is that many less well-off households may find that these fixed fees are large relative to the interest income on the amounts that they can invest.)

Overall, the characteristics and recent behavior of bond funds imply that while they are not perfect substitutes for M2 deposits, their degree of substitutability may be substantial. Expanding M2 to include bond funds would internalize such substitution effects, and thus, at least theoretically, might make M2 more stable. However, including bond funds in M2 could create several complications. First, many bond fund assets have substituted for direct bond holdings. Second, the marked-to-market valuation of bond funds would introduce an interest rate sensitivity that is not a direct "money demand" effect. For example, a rise in bond yields would cause bond fund balances to fall through marked-to-market valuation. It is unclear to what extent households would replenish their bond-fund holdings following such a change in bond prices. Finally because they are long-term investments, the degree of substitution between bond funds and equity may exceed that between M2 deposits and equity. This implies that putting bond funds in M2 may make M2 less stable as investors shift between stocks and bond funds.

Figure 8
Selected M2 Components



[11] *Mutual fund families usually allow investors a limited number of free transfers among money market, bond, and equity funds within the same family (*Donoghue's Mutual Funds Almanac, 1987–1988, *16–17). Recently, Citibank has enabled households to easily shift funds among MMDA, checking, MMMF, bond mutual funds, and equity mutual funds, thereby increasing the substitutability of bond (and equity) funds with liquid M2 deposits.*

Empirical analysis of bond and equity fund effects on M2

This section creates bond and equity fund series that are used to adjust M2 for bond and equity fund effects. First, estimates of total household bond and equity fund holding are presented. Then, these data are adjusted for substitution between bond funds and direct bond holdings.

Data and variables. Bond and equity fund data since 1975 are available from the Investment Company Institute (ICI). Federal Reserve Board staff has classified mutual fund holdings into several asset groupings that can be categorized into bond, equity, and mixed bond and equity funds (Duca 1992a). In general, the mixed funds tend to hold more equity than bonds, and for this reason, mixed funds are treated as equity funds.[12]

One difficulty with the ICI data is that they aggregate holdings by households and institutions, whereas MMMFs held by institutions are not in M2, but in M3. It was assumed that 75 percent of all bond funds were owned by individuals on grounds that the share of bond and equity funds held by households has remained around 75 percent according to available year-end data for 1983–90. These monthly bond and total mutual fund outstandings were then seasonally adjusted with an X'11 procedure.

Because bond funds are substitutes for direct bond holdings and M2 deposits, we must distinguish between these substitution possibilities to assess the impact of bond funds on M2. For example, to the extent that the mid-1980s surge in bond funds likely reflected shifts away from directly held bonds, M2 is unaffected. For this reason, a bond fund series was added to M2 that adjusts bond funds for shifts with direct bond holdings ("SBFM2", see Appendix A for details). In addition, two other adjusted M2 series were created. One adds total household bond funds to M2 (BFM2), and the other adds equity and substitution adjusted bond funds to M2 (BEFM2).[13] Each of these three expanded M2 aggregates have grown faster than M2 since 1990:2. However, it important to note that the estimated growth rates of the three expanded M2 aggregates would likely be higher than that of M2 because the opportunity cost of the bond and equity funds added is lower than that of M2 deposits.

Estimating whether bond and equity funds account for the missing M2. Using the FRB M2 model as a benchmark, this subsection estimates M2 and M2 adjusted for bond and equity mutual funds. Three adjusted M2 series were evaluated: these used total household bond funds (BFM2), substitution adjusted bond funds (SBFM2), and equity plus substitution adjusted bond funds (BEFM2). This approach was taken because the riskiness of equity returns may make equity funds less substitutable for M2 deposits than are bond funds. The bond and equity adjustments also enable one to assess the advantage of internalizing any substitution between these two types of funds.

The procedure used in creating these series implicitly makes the strong assumption that any estimated changes in bond or equity funds completely represented substitution effects with M2 deposits. This strong assumption is consistent with results from the Federal Reserve's August 1991 Survey of Senior Financial Officers. Of the large banks in this survey who characterized retail deposit growth as unusually weak between May and July 1991, the most frequently cited reason for this weakness were "returns on nondeposit instruments, such as bond funds or Treasury securities."[14] Nevertheless, because of the strong implicit substitution assumption, the mutual fund adjustments are best viewed as yielding upper

[12] *Mixed funds also include Investment Company Institute mutual fund categories whose definitions with respect to bonds and equities have changed over time using data organized by Pat White of the Federal Reserve Board staff.*

[13] *Adding total household bond and equity funds to M2 produced an aggregate that was even less explainable than BEFM2 and M2. Note that because equity funds and directly held equity rose together during the 1980s, it was impossible to adjust equity funds for substitution away from directly held equities along the lines that adjustments to bond funds were made.*

[14] *Furthermore, in a survey conducted by National Securities & Research Corp. during the summer of 1991, more than 90 percent of surveyed mutual funds indicated that net inflows from households came partially at the expense of MMMFs and bank deposits, while 50 percent indicated that some of the net inflows came from substitution out of insurance company assets (Clements 1991, C9).*

Table 1
Selected Results of Estimating M2 Growth Rates, 1976:1–91:4

		Model		
Selected Variables	**M2**	**Subst.Adj. Bond Fund Adj. M2**	**Bond and Equity Fund Adj. M2**	**Simple Bond Fund Adj. M2**
$\log(M2_{t-1})$–$\log(GNPAV_{t-1})$	–.19069** (–4.35)	–.18551** (–4.97)	–.18923** (–5.29)	–.14391** (–4.38)
long-run *OC* elasticity	–.048	–.060	–.074	–.068
S.S.E. (Quarterly, not a percentage)	.0008652	.0007768	.0009824	.0008906
R^2 (corrected)	.77969	.79528	.75457	.78427
Durbin–H	–.58816	–.79233	–.11087	–.72293

** Significant at the 99-percent confidence level.
(*t* statistics in parentheses)

Definitions

GNPAV = $(GNP_t + GNP_{t-1})/2$, measure of permanent income used as a long-run proxy for transactions.

OC = Opportunity cost of M2, defined as the spread between the 3-month Treasury bill rate and the average interest rate paid on M2 balances.

NOTE: A negative coefficient on $[\log(M2_{t-1})–\log(GNPAV_{t-1})]$ implies that M2 balances adjust (error correct) toward their desired levels.

bound estimates of the impact of bond and equity funds on M2 growth.

Selected statistics from estimating the FRB's M2 model and mutual fund data are presented in Table 1 (see Duca 1992a for more details). The sample period begins in 1976:1 because mutual fund data start in 1975:1 and because the FRB error-correction model uses a few lags of the dependent variable. The FRB M2 equation contains variables that control for the volume of spending with GNP and personal consumption expenditures, and for the opportunity cost of holding money with the spread between a market interest rate (the six-month Treasury bill rate) and the average rate earned on M2 balances. Changes in the cost of shifting between money and other assets are not in this model because they are not measured across time in practice.

The FRB M2 model is an "error-correction" model which tracks both the long-run and short-run responses of M2 to changes in spending and in its opportunity cost (for further discussion see Moore, Porter, and Small 1990 and the box titled *"The Form of the M2 Regression Model"*). The main advantage of this approach is that it better estimates short-run and long-run movements than other approaches. Owing to its econometric form and the expertise of the Federal Reserve Board staff in modeling M2, the FRB model is considered state of the art. For this reason, it is used to document and is modified to account for the missing M2. Although the four different M2 series are estimated with the same type of model, they differ in the how the opportunity cost of money is measured. Conceptually, the FRB model measures

The Form of the M2 Regression Model

The M2 model developed by the Federal Reserve Board staff has this form:

$$[\ln(M_t) - \ln(M_{t-1})] = C + EC[\ln(M_{t-1}) - \ln(Y_{t-1})] + \sum_{i=0}^{i=2} \alpha_i [\ln(Y_{t-i}) - \ln(Y_{t-i-1})] + \beta_1 \ln(OC_{t-1}) + \beta_2 [\ln(OC_t) - \ln(OC_{t-1})] + \alpha_m [\ln(M_{t-1}) - \ln(M_{t-2})] + \delta_j \text{Regulation dummy variables,}$$

where:

ln = the natural log of a variable.

M_t = M2 at time t.

$[\ln(M_t) - \ln(M_{t-1})]$ = the growth rate of M2 at time t.

C = a constant.

EC = estimated coefficient on the error correction term.

Y = transactions (often measured by GNP or consumption).

OC = the opportunity cost of M2.

α_i's = estimated short-run effects of transactions.

α_m = estimated short-run effect of previous M2 growth.

β_1 = estimated long-run effect of OC on M2 growth.

β_2 = estimated short-run effect of OC on M2 growth.

δ_j's = estimated effects of changes in regulations.

Also, note that the first difference of the log of a variable is the growth rate of that variable. More detailed variable definitions are provided in the tables.

Before examining regression results, a brief review of key assumptions and each component of the model is helpful. Because of its error-correction specification, this model can estimate the short-run and long-run effects of economic variables on M2 growth and, in particular, how M2 growth responds to previous deviations of the level of M2 from its long-term determinants. Over the long term, it is assumed that the growth rate of M2 matches that of GNP. This assumption is justified on grounds that the long-run velocity of M2 (that is, the ratio of GNP to M2) appears constant. (For evidence, see Hallman, Porter, and Small 1991.)

Of the components, the estimated "error-correction" coefficient, EC, is expected to have a negative sign. The reason is that the difference between the log-level of M2 and that of GNP is expected to converge to the log of the inverse of M2's long-term velocity (adjusted for M2's opportunity cost). For example, suppose that $\ln(M2_{t-1})$ is above the long-term level associated with $\ln(GNP_{t-1})$ and $\ln(OC_{t-1})$. In this case, one would expect M2 to fall until $[\ln(M_{t-1}) - \ln(Y_{t-1})]$ declines to its long-run level holding all other variables constant. As the magnitude of EC rises, this adjustment, or error-correction occurs at a faster speed.

Another variable in the model, $\ln(OC_{t-1})$, measures the long-run effect of a change in M2's opportunity cost. Because M2 holdings are likely to fall as its opportunity cost rises, this term is expected to have a negative sign.

(Continued on the next page)

The Form of the M2 Regression Model—*Continued*

Dividing the coefficient on $\ln(OC_{t-1})$ by *EC* yields the long-run elasticity of M2 with respect to its opportunity cost. This statistic is very useful. For example, an elasticity of –5 percent indicates that a once-and-for-all (permanent) 100-percent rise in the opportunity cost of M2 will eventually cause M2 to fall 5 percent from its initial level.

Because M2 responds differently in the short run than in the long run, several other types of variables are included. First, lags of the growth rate of transactions are included, which the Board model measures with the growth rate of personal consumption expenditures. These variables are expected to have positive signs, as a rise in transactions would tend to boost the need to hold assets in the form of M2.

Second, the lag of last period's M2 growth rate is included. This variable helps control for momentum in how people adjust their M2 balances and is expected to have a positive sign. Note that because it is assumed that the velocity of M2 is constant over the long-run (controlling for M2's opportunity cost), M2 and transactions (GNP or consumption) will grow at the same long-run rate. To be consistent with this assumption, the sum of the coefficient on lagged M2 growth and the coefficients on the lags of the growth rate of consumption are constrained to equal 1.

Third, the current growth rate of M2's opportunity cost is included to measure the initial effect of a change in M2's opportunity cost. As with the sign of $\ln(OC_{t-1})$, it is expected to have a negative sign.

Finally, several dummy variables are included to control for the impact of changes in bank and thrift regulations that unusually affected M2 holdings. These variables control for the introduction of MMDAs in late 1982, deposit rate deregulation in early 1983, and the imposition of credit controls in 1980:2. (See Table 1 for more details.)

M2's opportunity cost as the difference between a risk-free market interest rate and the average rate on M2 balances. For consistency, the weighted average yields on the adjusted M2 series were calculated to reflect the risk-adjusted return on mutual funds and that on M2 deposits. The risk-adjusted return on mutual funds was set equal to the three-month Treasury bill rate on grounds that these funds likely yield the market rate of return on assets having similar market, credit and prepayment risks.

Looking at the results, the R^2s of the two bond fund adjusted series are somewhat better than those of M2, with the substitution-bond adjusted series yielding the best fit. By contrast, the bond and equity fund adjusted model yields a worse fit than the regular M2 model, likely reflecting that equity funds are much less substitutable for M2 than are bond funds.

Table 2 presents in-sample residuals for the subsample period 1990:3–91:4. The sum of squared errors (*S.S.E.*, a measure of unexplained movements) of the substitution-adjusted and simple bond adjusted M2 series are 26 percent and 29 percent lower over this period than the S.S.E. of the unadjusted M2 series, respectively. The bond and equity adjusted M2 model also produces a lower S.S.E. over this subsample period (9 percent lower) than the FRB M2 model. One measure of the missing M2 is the average growth rate shortfall of an M2 series over 1990:3–91:4. Results indicate that adding substitution-adjusted bond funds accounts for 27 percent of the missing M2; adding total bond funds, for 28 percent of the missing M2; and adding equity and substitution-adjusted bond funds, for 43 percent of the missing M2. Of course, each mutual fund adjustment implicitly makes the strong assumption

Table 2
In-Sample M2 Growth Rate Errors Over 1990:3–91:4, 1976:1–91:4)

(Percent, Seasonally Adjusted Annual Rate, Negative Entries Reflect Weaker-Than-Predicted M2 Growth)

Quarter	M2	Subst.Adj. Bond Fund Adj. M2	Bond and Equity Fund Adj. M2	Simple Bond Fund Adj. M2
1990:3	–.96	–1.06	–1.79	–1.10
1990:4	–2.19	–2.41	–3.17	–2.29
1991:1	–.75	–.93	.65	–.95
1991:2	–.02	–.02	–.56	–.04
1991:3	–3.63	–2.85	–2.32	–2.78
1991:4	–1.64	–.74	.87	–.76
NOTES:				
Growth Rate Residuals, 1990:3–91:4:				
Average	–1.83	–1.34	–1.05	–1.32
Percentage of Missing M2 explained	—	27	43	28
S.S.E. over 1990:3–91:4, (Quarterly rate):				
Total	.000139	.000103	.000126	.000099
Relative to FRB S.S.E.	—	26% lower	9% lower	29% lower

that all portfolio substitution involving bond and stock funds are completely internalized within their expanded definitions of M2. For this reason, these estimates are best viewed as upper bounds. Even with this qualification in mind, bond and equity funds can potentially account for only a small part of the missing M2.

This result likely reflects three things. First, the "missing M2" began appearing in 1990:3, whereas bond and equity fund inflows were not substantial until the spring of 1991. Second, if M2 is becoming less attractive to investors because of troubles in the thrift industry, bond and equity mutual funds are not the only alternatives to holding M2. Third, even though simply adding bond and equity funds to M2 may seem to account for much of the missing M2 in 1991, such a calculation is misleading. One reason is that one-fourth of bond and equity funds are held by institutions. Another is that because these assets have lower opportunity costs than M2 deposits, adding them to M2 in a logically consistent manner means that the opportunity cost of this new aggregate is lower than that of M2, and thus the demand for the new aggregate should be somewhat higher. Hence, even though the growth of adjusted M2 may be higher than that of M2, so is the estimated growth of the adjusted series.

RTC activity and the missing M2

In this section, I review the activities of the Resolution Trust Corporation and describe two ways these activities may create a missing M2 phenomenon. I also present RTC variables that are added to the FRB M2 model and estimation

results that show that RTC effects appear to account for the missing M2.

The RTC was created in 1989 by Congress under the Financial Institutions Reform, Recovery, and Enforcement Act to close bankrupt thrifts. Through early January 1992, the RTC had resolved 535 thrifts, which entailed handling insured deposits and selling assets seized. The most important RTC activities with respect to M2 are those relating to the resolution of deposits. Between 1989 and early 1992, the RTC had sold or paid off about $183 billion in insured deposits. When the RTC resolves deposits at a bankrupt thrift, it either pays insured depositors directly and closes their accounts or sells the deposits to another institution that has the right to reset deposit rates after providing a two-week notice.

RTC closings of insolvent thrifts can create a missing M2 phenomenon by affecting M2 in two related ways that are not reflected in standard money demand variables.[15] First, when closing a thrift, the RTC's actions force depositors to reassess their M2 balances because the RTC either pays depositors directly and closes their accounts or sells the deposits to another institution that has the right to reset deposit rates after providing a two-week notice. For this reason, the M2 balances of depositors at failed thrifts are likely to more quickly adjust to changes in M2 opportunity costs than they would be in more normal circumstances. According to industry sources, most cases where small time rates are reset involve "brokered" small time deposits.[16]

As a result of actual "calls" of small time accounts, the short-term adjustment of M2 to changes in its opportunity cost may not be adequately estimated using an error-correction model with conventional money demand variables. This effect on the speed of adjustment can, theoretically, either boost or depress M2 growth. However, such an effect could be creating a missing M2 problem in the early 1990s because small time accounts initiated at bankrupt thrifts during the late 1980s are being prematurely "called" in a period of lower interest rates. As a result, the decline in small time deposit rates and the pace of nominal activity (GNP) since the late 1980s can lead to a much quicker adjustment in small time and M2 balances than in the pre-RTC days. Empirically, this "call" effect may be tracked in an M2 model by the volume of deposits at newly resolved institutions as either an independent variable that is implicitly interacted with one or more opportunity cost variables or an extra variable that is directly interacted with M2's opportunity cost.

A second way the resolution process can create a missing M2 phenomenon is by creating uncertainty about deposit yields, which depresses the demand for M2. Depositors, especially those who shop for higher-than-normal yields (often through brokers), face a repricing risk that arises because the high yield earned on deposits (fully covered by deposit insurance) at a troubled thrift either may be lowered (repriced) by a purchasing institutions or will no longer be in effect if the RTC directly reimburses depositors. This risk is similar to the "call" risk posed by many corporate bonds, because in an environment of falling interest rates, many firms would exercise their option of paying off old bonds having high interest rates with new bonds having lower interest costs. For this reason, investors in corporate bonds often do not expect to earn the posted interest rate on a bond for the full period of stated maturity even if they did not expect the corporate bond issuer to default.[17]

As a result of increased uncertainty over nominal deposit yields, conventional measures of

[15] *See Duca (1992a) for why two other RTC-based explanations for the missing M2 are not plausible.*

[16] *These accounts are arranged by brokers for investors who shop for high yields and do not entail much of a relationship between banks and depositors. Industry sources indicate that nonbrokered, small time accounts that are sold by the RTC are much less likely to have their rates reset because the purchasing institutions want to acquire a customer relationship with "nonbrokered" depositors, who are less apt to switch to a competitor.*

[17] *For example, interest rates on mortgage-backed securities that are government guaranteed exceed yields on comparable maturity Treasury bonds. The reason is that investors demand a higher rate on such mortgage-backed securities because some of these bonds would be retired early if households refinance their mortgages at lower interest rates, which would force investors to reinvest funds in an environment of lower rates.*

M2's opportunity cost do not consistently track its true opportunity cost. For example, if a credit-risk free market rate exceeds the *stated* average yield on M2 balances by a given amount in an environment of RTC resolutions, the same spread in a pre-RTC environment would not mean that the true opportunity cost of M2 was identical in both periods. Indeed, in this example, when investors factor in the call risk posed by the RTC, the true opportunity cost of M2 is higher in the RTC environment. Thus, current spreads between the average rate paid on M2 balances have understated M2's opportunity cost since the RTC became very active. By understating the apparent opportunity cost of M2 in this way, most M2 models have overestimated M2 growth, thereby giving rise to a missing M2 phenomenon.

Empirical analysis of RTC effects on M2

Data and variables. This subsection describes how to test for RTC effects and the variables used in such testing. Empirically, the call risk created by thrift resolutions is difficult to measure because people are adapting to a new environment, and markets have had little experience in measuring this call risk. However, the effects may be loosely proxied by the volume of deposits at newly resolved thrifts. Many depositors may not become aware of this new risk until the RTC resolves their deposits or those of people they know because, with deposit insurance, the depositors may falsely assume they only need to know posted deposit rates.

To assess the impact of RTC activity on M2, the FRB M2 model was modified in three ways. The first (model 2) adds a variable measuring the change in the quarterly average running sum of deposits at resolved thrifts (*RTCDEP*). The second and third (models 3 and 4) add terms (*RTCOC* and *RTCDOC*), which respectively interact *RTCDEP* with an M2 opportunity cost term and the first difference of this variable to see if RTC activity affects the long-run or short-run elasticity of M2 with respect to its opportunity cost. See Table 3 for data on *RTCDEP* and Appendix B for details on these three variables.

I should note that since 1989:3, the variable *RTCDEP* has generally been larger than the estimated shortfall in M2 growth produced by the FRB M2 model. This evidence implies that RTC resolution activity may account for the missing M2.

The estimated impact of RTC effects on M2. The impact of RTC activity was assessed by estimating four versions of the FRB model over the period 1976:1–91:4. To compare RTC and mutual fund results, the sample period begins in 1976:1.[18] Because RTC did not begin closing thrifts until 1989:3, the RTC variables (*Table 3*) all take the value zero before 1989:3. As a result, variation in the RTC proxies occurs in only ten quarters, which makes it unfeasible to conduct simulations with RTC variables. Thus, the results should be viewed with caution given that results based on a short-period may not stand the test of time.

Selected statistics from estimating several models are provided in Table 4 (see Duca 1992a for more details). Results from model 2, indicate that *RTCDEP* is negatively and significantly related to M2 growth. The negative but insignificant coefficient on *RTCOC* in model 3 implies that the sensitivity of M2 to its opportunity cost is not significantly heightened by RTC activity. In model 4, *RTCDOC* is statistically significant, but has a positive, rather than the hypothesized negative, sign. Consistent with the significance levels of *RTCDEP*, *RTCOC*, and *RTCDOC*, the full-sample R^2 of model 2 (0.828) is better than that of the FRB model (0.780), while those of models 3 and 4 (0.787 and 0.794) are only slightly better. In addition, M2 adjusts (error-corrects) to desired levels at faster estimated speeds in models 2, 3, and 4 (25 per-cent, 20 percent, and 22 percent per quarter, respectively) than in the FRB model (19 percent per quarter). This is considered a good result because models with higher speeds of adjustment tend to model the desired stock of money better than those having lower speeds.

Although the R^2 of model 2 is somewhat better than that of the FRB model, any improvement in full-sample fit is limited by the short interval during which the RTC has been active. Thus, any RTC effect is likely to be reflected in recent years. This point is borne out by the in-

[18] *The qualitative results with respect to the three RTC variables were similar using a longer sample period (1964:1–91:4).*

Table 3
Changes in Quarterly Average Levels of Cumulated Deposits at Resolved Thrifts

(In Billions)

Quarter	RTCDEP	RTCDEPO	QRTC	Simple Quarterly Total of Newly Resolved Deposits[1]
1964:1–89:2	0	0	0	0
1989:3	.5	.5	.5	1.8
1989:4	9.3	9.8	8.0	8.8
1990:1	4.3	14.1	3.5	7.4
1990:2	15.4	29.5	11.5	38.0
1990:3	33.6	63.1	7.0	30.9
1990:4	29.7	92.8	5.9	14.4
1991:1	17.2	110.0	8.7	17.6
1991:2	14.9	124.9	6.0	12.0
1991:3	25.2	150.1	19.2	42.1
1991:4	26.6	176.6	3.7	5.4

Definitions

RTCDEP change in the quarterly average volume of cumulated deposits at resolved thrift institutions. Main proxy for RTC effects on M2.

RTCDEPO measure of the quarterly average volume of cumulated deposits at resolved thrift institutions (used to create *RTCDEP*).

QRTC quarterly average volume of deposits at newly resolved thrifts that occurred within that quarter.

[1] Note that because resolutions tend to occur in the third month of the quarter,

i) the quarterly average of newly resolved deposits (*QRTC*) is much smaller than the simple sum of newly resolved deposits during an entire quarter (the last column), and

ii) the potential impact of RTC activity during quarter t on M2 is mainly felt in quarter $t+1$, owing to quarter-averaging effects. For this reason, the average size of *RTCDEP* tends to be larger than that of *QRTC*, and *RTCDEP* sometimes surges in the quarter following a surge in *QRTC*.

sample errors from the models during the period since the RTC has been active (*Table 5*). Over 1990:3–91:4, the S.S.E.'s of models 2, 3, and 4 are 42 percent lower, 2 percent lower, and 12 percent higher than that of the FRB model, respectively. In addition, if the missing M2 is measured by the average estimated growth rate shortfall over 1990:3–91:4, then the RTC variables in models 2, 3, and 4 account for 83 percent, 37 percent, and 44 percent of the missing M2, respectively.

Tables 4 and 5 suggest several conclusions. First, models 3 and 4 indicate that the neither the long-run nor the short-run responsiveness of M2 to changes in its measured opportunity cost are significantly heightened by RTC activity (the coefficient on *RTCDOC* has the wrong sign). Second, model 2 produces the best full-sample fit, and error-corrects faster than models 3 and 4. Third, model 2 accounts for much more of the missing M2 than either model 3 or model 4. The performance of model 2 is consistent with the hypotheses that RTC actions create a missing M2 phenomenon directly by creating an early "call" on high-yielding small time deposits in a period of

Table 4
Selected Results of Estimating M2 Growth Rates, 1976:1–91:4

Selected Variables	FRB Model	Model 2	Model 3	Model 4
$\log(M2_{t-1})$–$\log(GNPAV_{t-1})$	–.19069** (–4.35)	–.24819** (–6.00)	–.19502** (–4.52)	–.22164** (–4.96)
RTCDEP		–.00034** (–3.95)		
RTCOC			–.00020 (–1.68)	
RTCDOC				–.00083* (2.16)
long-run *OC* elasticity	–.048	–.051	–.049	–.051
S.S.E. (Quarterly, not a percentage)	.0008652	.0006621	.0008196	.0007925
R^2 (corrected)	.77969	.82808	.78719	.79423

** Significant at the 95-percent confidence level.
** Significant at the 99-percent confidence level.
(*t* statistics in parentheses)

Definitions

GNPAV ($GNP_t + GNP_{t-1}$)/2, measure of permanent income used as a long-run proxy for transactions.

OC Opportunity cost of M2, defined as the spread between the 3-month Treasury bill rate and the average interest rate paid on M2 balances.

RTCDEP measure of quarter-to-quarter change in the quarterly average volume of cumulated deposits at resolved thrift institutions.

RTCOC variable interacting *RTCDEP* and $\log(OC_{t-1})$, controls for whether the long-run opportunity cost elasticity of M2 is sensitive to *RTCDEP*.

RTCDOC interacts *RTCDEP* and del(log(*OC*)), controls for whether the short-run opportunity cost elasticity of M2 is sensitive to *RTCDEP*.

NOTE: A negative coefficient on $[\log(M2_{t-1})–\log(GNPAV_{t-1})]$ implies that M2 balances adjust (error correct) toward their desired levels.

lower interest rates and indirectly by creating a call risk on other, not-yet-called deposits.

Given that model 2 is preferable to the other RTC-modified M2 models, the variable *RTCDEP* was added as a separate regressor to each of the bond and equity fund adjusted M2 models.[19] Results indicate that *RTCDEP* is significant in all three models. Of these, the substitution-bond adjusted

[19] *Another reassuring aspect of model 2 is that its coefficients on non-RTC variables (not shown) are more similar to those obtained by estimating the FRB model up through 1989:4 than are those obtained by estimating the FRB model through 1991:4. Of these variables, the most noteworthy are the error correction, long-run opportunity cost, and short-run consumption terms.*

Table 5
In-Sample M2 Growth Rate Errors Over 1990:3–91:4, 1976:1–91:4

(Percent, Seasonally Adjusted Annual Rate, Negative Entries Reflect Weaker-Than-Predicted M2 Growth)

Quarter	FRB Model	Model 2	Model 3	Model 4
1990:3	–.96	2.30	.91	–.33
1990:4	–2.19	.02	–.91	–1.12
1991:1	–.75	–.44	–.52	.26
1991:2	–.02	–.34	–.43	–.50
1991:3	–3.63	–2.52	–3.95	–4.80
1991:4	–1.64	–.92	2.02	–.30
NOTES:				
Growth Rate Residuals, 1990:3–91:4:				
Average	–1.83	–.32	–1.15	–1.03
Percentage of Missing M2 explained	—	83	37	44*
S.S.E. over 1990:3–91:4, (Quarterly rate):				
Total	.000139	.000080	.000136	.000155
Relative to FRB S.S.E.	—	42% lower	2% lower	12% higher

*Not particularly meaningful given the "incorrectly" signed coefficient on *RTCDOC* in model 4.

model outperforms all the others in terms of full-sample fit, as shown in Table 6. With respect to the missing M2, the average M2 growth rate shortfall over 1990:3–91:4 is 0.24 percentage points with the substitution-bond adjusted model, 0.26 percentage points with total bond funds, and a somewhat smaller 0.10 percentage points with the equity and substitution-bond adjustments. Similar to the mutual fund regressions that excluded RTC effects, these findings indicate that adding substitution adjusted bond funds yields the most explainable monetary aggregate, but that adding in equity funds seems to account for somewhat more of the missing M2.

Summary and policy implications

The closing of thrifts by the RTC can plausibly depress M2 by actually forcing calls of high-yield small time deposits in an environment of lower interest rates and by creating call risk for other small time deposits. The volume of deposits at newly resolved thrifts can be correlated with unexplained weakness in M2 growth not only because roll-over effects are tracked by this variable, but also because knowledge of the risk to nominal rate returns may move with the level of RTC activity as more households experience these risks first-hand.

Consistent with these possible effects, regression analysis indicates that most of the missing M2 appears to be associated with thrift resolutions. Although some of the missing M2 may be reflected in substitution by households away from retail deposits toward bond and equity mutual funds, it is unclear to what extent these shifts stem from RTC policies that can plausibly reduce the attractiveness of M2 deposits or from a steepening yield curve. Moreover, bond and

Table 6
Selected Results from Combining RTC and Bond and Equity Fund Effects, 1976:1–91:4

(Runs add *RTCDEP* to M2 and bond and equity fund adjusted M2 models in Table 1)

		Model		
Selected Variables	**M2**	**Subst.Adj. Bond Fund Adj. M2**	**Bond and Equity Fund Adj. M2**	**Simple Bond Fund Adj. M2**
$\log(M2_{t-1})$–$\log(GNPAV_{t-1})$	–.24819** (–6.00)	–.23524** (–6.57)	–.20732** (–5.94)	–.19011** (–5.88)
RTCDEP	–.00034** (–3.95)	–.00031** (–3.77)	–.00023* (–2.46)	–.00033** (–3.59)
Long-run *OC* elasticity	–.051	–.063	–.077	–.072
S.S.E. (Quarterly, not a percentage)	.0006621	.0006075	.0008781	.0007107
R^2 (corrected)	.82808	.83676	.77633	.82447

** Significant at the 95-percent confidence level.
** Significant at the 99-percent confidence level.
(*t* statistics in parentheses)

NOTES:

Growth Rate Residuals, 1990:3–91:4:				
Average (avg. FRB error = –1.83)	–.32	–.24	–.10	–.26
Percentage of Missing M2 explained	83	87	95	86
S.S.E. over 1990:3–91:4, (Quarterly rate):				
Total (FRB S.S.E. = .000139)	.000080	.000047	.000053	.000050
Relative to FRB S.S.E.	42% lower	66% lower	62% lower	64% lower

equity mutual funds do not appear to account for more than a small part of the missing M2.

While the results indicate that equity funds are not good substitutes for M2, I find that bond funds are a good substitute for M2 balances on two grounds. First, the characteristics of bond funds are similar to those of M2 balances. Second, because a bond fund adjusted M2 aggregate is more explainable than M2, it appears that an expanded aggregate internalizes substitution between bond funds and M2. These results suggest that the Federal Reserve may need to monitor an M2 monetary aggregate that is expanded to include some bond funds. Nevertheless, findings indicate that in considering an expanded M2 aggregate, it is empirically important to differentiate bond fund inflows associated with shifts out of direct bond holdings from those out of M2.

This study suggests that the case of the missing M2 is similar to two previous episodes of missing money; all three instances appear to be linked to regulations. The first case of missing money—weak M1 and demand deposit growth in the mid-1970s—was identified by Stephen Goldfeld (1976) and has been linked to two factors. One stemmed from businesses' switching from demand deposits to overnight repurchase agreements spurred by high interest rates and the prohibition on interest on business deposits (Tinsley, Garrett, and Friar, 1981). The other factor stemmed from declines in compensating balances (zero-interest bearing accounts of firms that partially compensate banks for providing services and loans) that owed to shifts away from bank loans to commercial paper. These shifts in business credit sources were induced by banks' rationing credit during a period of Regulation Q-induced disintermediation and passing along the higher cost of reserve requirements during a period of high interest rates (Duca 1992a).

During the late 1970s and early 1980s, a missing M2 phenomenon appeared as high market interest rates, coupled with Regulation Q ceilings on deposit rates, drove households away from deposits toward money market mutual funds. This case of the missing money was solved by later adding MMMFs (and MMDAs) to M2, which internalized any substitution between MMMFs and other M2 components. The current missing money episode can also be interpreted as reflecting the changing impact of regulations. Specifically, the RTC's actions can be viewed as removing the deposit insurance subsidy indirectly paid by taxpayers to investors holding high yielding accounts at troubled thrifts.

Although results link the missing M2 to RTC activity, the short subsample period of RTC activity makes this study's findings subject to qualification. The reason is that without a long track record, it is possible that some other development that happened at the same time as RTC resolutions could be the real cause of M2 weakness. Nevertheless, the results suggest that until its completion, the thrift resolution process could continue to create a missing M2 phenomenon. These findings do not imply that the RTC is incorrectly resolving bankrupt thrifts. Rather, the results simply suggest that RTC activity is affecting M2 growth in ways not captured in conventional econometric models of M2. An important implication of this study is that if economists are to infer the general pace of economic activity from M2, M2 may need to be viewed in conjunction not only with spreads between deposit and market interest rates, but also with the pace at which the RTC resolves troubled thrifts.

Appendix A

Constructing a Substitution Adjusted Bond Fund Series

This appendix describes how a bond fund series was adjusted for inflows from directly held bonds. This series, *BF*, was then added to M2 to construct one of the two bond fund adjusted M2 series that are assessed. As described at the end of this appendix, all three bond and equity fund adjusted series were converted into quarter average equivalents (using the same procedure) because M2 growth is typically measured on a quarter average basis.

BF was calculated as the difference between bond fund outstandings and cumulative bond fund inflows attributable to shifts away from direct bond holdings (*BFS*). *BFS* was calculated in two steps. First, direct bond fund holdings are estimated. Using the Federal Reserve Board's flow of funds data, total household bond holdings (*BT*) were defined to equal the sum of the household sector's corporate bonds, government securities (excluding savings bonds), and tax-exempt securities. Note that household assets in commercial paper or in money market mutual funds were not counted as bond holdings, but that owing to data limitations, this figure includes Treasury bill holdings. Direct holdings of bonds ("*BD*," i.e., nonmutual funds) were estimated as the difference between total household bond holdings (*BT*) less total estimated bond fund holdings (*TBF*).

The second step entailed estimating the extent to which direct bond holdings fell as a result of substitution toward bond funds. This was done as follows. If bond fund holdings rose while direct bond holdings fell, then bond fund holdings attributable to substitution between bond assets equaled the minimum of the size of the decline in direct bond holdings and the increase in bond funds. Given data limitations, bond fund holdings attributable to substitution between bond assets were conservatively calculated as equaling the cumulative sum of such measured substitutions:

$$(1a) \qquad BFS_t = \sum_{i=0}^{t} SUB_{t-i},$$

where $SUB_t \equiv \min([BD_{t-1} - BD_t], [TBF_t - TBF_{t-1}])$,

if $(TBF_t - TBF_{t-1}) > 0$ and $(BD_t - BD_{t-1}) < 0$, and

$$(2a) \qquad = 0, \text{ otherwise.}$$

This measure likely understates substitution from directly held bonds to bond funds because it does not account for the extent to which direct bond holdings would have *grown* in the absence of bond funds. However, the relatively sluggish growth of total bond holdings in the mid-1980s implies that the degree to which *BFS* underestimates these shifts is minor.

Next, bond funds substituting for M2 (*BFU*) were calculated as the difference between total household bond funds (*TBF*) and *BFS* (see Figure 4):

$$(3a) \qquad BFU_t \equiv TBF_t - BFS_t.$$

Finally, this bond fund component was converted from an end-day-of-quarter number to

(Continued on the next page)

Appendix A

Constructing a Substitution Adjusted Bond Fund Series—*Continued*

a quarterly average number to create an adjustment (*BF*) that was comparable to quarterly average M2 data. This was done by defining

(4a) $BF_t \equiv [BFU_t + BFU_{t-1}]/2$, and

$SBFM2_t \equiv BF_t + M2_t$.

In creating the two other mutual fund adjusted M2 series, total household bond funds were added to M2 (*BFM2*), and equity and substitution adjusted bond funds were added to M2 (*BEFM2*). As with *BFM2*, these adjustments were converted into quarter average equivalents following equation 4a.[1] Note that although bond fund data are available on a monthly (end-day-of-month) basis, the adjustments in equation 4a had to be calculated on an end-month-of-quarter basis because the flow of funds data used are end-month-of-quarter data. To compare the M2 series adjusted with substitution adjusted bond fund data (*SBFM2*) with the other two bond and equity fund series, the two other series were converted into quarter averages using the method in equation 4a even though monthly data are available. The qualitative nature of the results was unchanged when *BFM2* and *BEFM2* were constructed by averaging monthly data instead of using just end-month-of-quarter data points.

[1] These quarterly adjustments are averages of constructed month average data. Monthly averages for each month t were created by averaging end-day-of-month outstandings for months t and $t-1$.

Appendix B

Formulas Used in Measuring the Impact on M2 of Deposits at Resolved Thrifts

RTCDEP was calculated in several steps to create a variable comparable to the way M2 growth rates are typically calculated. Two specific considerations were taken into account. First, the growth rate of M2 usually is measured based on quarterly averages of month average balances. For this reason, a once-and-for-all deposit runoff in the first month of a quarter depresses M2 growth that quarter by a greater magnitude than does a comparable decline in the third month. Second, due to quarter-averaging, inflows occurring in quarter $t-1$ are likely to have a greater impact on the quarterly M2 growth rate in the following quarter (t). Thus, resolutions of deposits that occur in one quarter can affect the growth rate of the following quarter. For this reason, the impact of deposit resolutions on quarterly M2 growth is best measured if the variable *RTCDEP* is defined as the *change* in the quarterly average level of current and prior RTC resolutions rather than by the contemporaneous volume of deposits at newly resolved thrifts.

Reflecting these considerations, *RTCDEP* and *RTCOC* were constructed in several steps using available monthly data on total deposits at thrifts resolved by RTC.[1] First, the monthly volume of deposits at newly closed thrifts (*RTC*) was converted into a contemporaneous month-average effect by dividing it by 2 (*MRTC*). Next, these monthly data were converted into quarterly average flows (*QRTC*). This was done by weighting each contemporaneous month-average flow by one-third, and then adding the weighted monthly averages to two-thirds of RTC from the first month and one-third of RTC from the second month of each quarter. In the third step, a quarterly average cumulated stock of resolved deposits (*RTCDEPO*) was created by adding the cumulated sum of resolved deposits in prior quarters (*CUMRTC*) with the quarterly average level of newly resolved deposits (*QRTC*). Next, *RTCDEP* was calculated as the first difference in *RTCDEPO*. Fifth, *RTCOC* was created by multiplying *RTCDEP* with the lagged opportunity cost of M2 deposits (*OC*) defined as the difference between the three-month Treasury bill rate and the weighted-average return on M2 balances.[2] Finally, *RTCDOC* was created by multiplying *RTCDEP* with the contemporaneous first difference of M2's opportunity cost (*OC*).

Definitions

RTC	deposits at thrifts newly resolved during a month.
MRTC	month average of newly resolved deposits.
QRTC	quarterly average of newly resolved deposits.
CUMRTC	cumulated sum of deposits resolved in prior quarters.
RTCDEPO	quarterly average cumulated stock of resolved deposits.
RTCDEP	change in quarterly average cumulated stock of resolved deposits.
RTCOC	*RTCDEP* interacted with the opportunity cost of M2.
M2OC	spread between 3-month T-bill rate and average yield on M2 balances.

Subscript m denotes month m.
Subscript q denotes quarter q.
Subscript g denotes first, second, or third month of quarter.

(Continued on the next page)

Appendix B

Formulas Used in Measuring the Impact on M2 of Deposits at Resolved Thrifts—*Continued*

Formulas

$$MRTC_m \equiv RTC_m/2$$

$$QRTC_q \equiv (1/3)MRTC_{g=1} + (1/3)MRTC_{g=2} + (1/3)MRTC_{g=3} + (2/3)RTC_{g=1} + (1/3)RTC_{g=2}$$

$$= (5/6)RTC_{g=1} + (1/2)RTC_{g=2} + (1/6)RTC_{g=3}$$

$$CUMRTC_{q=j} \equiv \sum_{t=0}^{t=j-1}[RTC_{g=1,q=t} + RTC_{g=2,q=t} + RTC_{g=3,q=t}]$$

$$RTCDEPO_q \equiv CUMRTC_q + QRTC_q$$

$$RTCDEP_q \equiv RTCDEPO_q - RTCDEPO_{q-1}$$

$$RTCOC_q \equiv RTCDEP_q \times M2OC_q$$

[1] The author owes a special debt to Richard Anderson of the Federal Reserve Board staff, who compiled these monthly data.

[2] This was done in order to compare results with the Fed's error correction model of M2, which lags the log-level *OC* term by one quarter.

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Monetary Policy in a Small Open Economy: The Case of Singapore

During the past quarter century, Singapore has combined the fastest growth with the lowest inflation of any industrial economy.[1] This record has been accompanied by conservative monetary and fiscal policies, as well as free trade and unrestricted capital flows, reminiscent of nineteenth-century liberalism. The primary concern of this article is Singapore's monetary policy, which is interesting and perhaps instructive in several ways. First, Singapore is the best available example of the small open economy that occupies a central place in international trade theory; it has few protective tariffs or exchange controls and is too small to influence the prices of internationally traded goods. Second, the constancy with which the Singapore monetary authorities have pursued price stability for 170 years, as a colony and as an independent state, may be unique. Third, because Singapore's monetary officials have been forthright in articulating their methods and objectives, we are provided with a rare opportunity to evaluate the success, or otherwise, of the policies of a central bank.

A country's economic policies are political variables subject to many influences and cannot be understood without knowledge of their history and the institutional framework within which they are conducted. The first section of this article traces the history of Singapore's monetary institutions and policies from its establishment as a British trading post in 1819. These institutions and policies have changed less than in most countries, and the present commitment to stable prices may be attributed to the belief that past economic successes have in large part been due to Singapore's record of price stability. The second section presents the structure of the economy and government wage, fiscal, and trade policies—the *real* background that sets the requirements and limitations of monetary policy. We will see that the Singapore monetary authority has been spared most of the internal constraints, such as government deficits and aggressive unions, that have plagued central banks in other countries, giving it the freedom as well as the desire to pursue price stability.

Singapore's recent monetary policy is examined in the third section. The authorities have continued to adapt to changes in world monetary conditions. As a colony and during the first few years after independence from Great Britain in 1963, Singapore aimed at price stability and a stable exchange rate

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[1] *Between 1965 and 1990, the average annual growth rate of Singapore's per capita real gross national product (GNP) was 7.2 percent, compared with 6.7 percent and 6.4 percent for South Korea and Taiwan, Singapore's closest competitors. Singapore's average rate of consumer price inflation was 3.6 percent, compared with 4.2 percent for West Germany, which had the second-lowest inflation, 5.6 percent for the United States, and 6.7 percent for Organization for Economic Cooperation and Development (OECD) countries (based on data from* World Bank Development Report 1990, International Financial Statistics, *and* Financial Statistics: Taiwan District, The Republic of China*).*

by tying its currency to that of a larger country on the gold standard—the United Kingdom until its devaluation in 1967 and then the United States until it left gold in the early 1970s. Since then, Singapore has continued to achieve low inflation through close control of its money stock and letting its exchange rate rise relative to most of the inflationary outside world. Some possible lessons of the Singapore experience are considered in the last section.

The evolution of monetary attitudes and institutions

> *What made Singapore different in the 1960s from most other countries of Southeast Asia was that she had no xenophobic hangover from colonialism. The statue of the founder of Singapore, Sir Stamford Raffles, still stands in the heart of the city to remind Singaporeans of his vision in 1819 of Singapore becoming, on the basis of free competition, the emporium of the East, on the route between India and China. There were then 120 people on the island. They lived by fishing. Within five years of its founding, there were 5,000 traders, British, Arab, Chinese, Indian, and others drawn in by this principle of free and equal competition.*
>
> *Had the Dutch who governed the then Netherlands East Indies accorded these same ground rules for trade and commerce in the Indonesian Archipelago, Singapore might never have got started. These were our origins. So we have never suffered from any inhibitions in borrowing capital, know-how, managers, engineers, and marketing capabilities.*
>
> —Prime Minister K. Y. Lee (1978)

Singapore's colonial heritage also includes the determination to select the monetary institutions most conducive to price stability. The development of those institutions and their relationship to the present framework are discussed below.

The silver standard and the Currency Board system. In 1819, the island of Singapore, *lion of the sea*, at the tip of the Malay peninsula (*see the map*) was acquired by the British East India Company from a local sultan. Singapore was joined with two ports on the west coast of Malaya, Pinang and Malacca, in a single administrative unit called the *Straits Settlements*. The liberal economic environment extended to acceptance of the competitive, full-bodied currency then in general use in the East—Spanish and Mexican silver dollars. More than 2 billion of these coins were minted by the Spanish from Mexican silver between 1535 and 1821, and 1.5 billion were minted by the Mexican government during the remainder of the nineteenth century. They "were the most widely circulated coins in history, [perhaps] closer than any other to being a truly international currency" (Chiang 1967, 1–2).[2]

Government monetary involvement was limited to minting subsidiary coins until 1899, when private note issues were terminated and a Board of Commissioners of Currency was established to issue paper currency in exchange for silver coin and to redeem this currency in coin on request. The operations of the Currency Board were patterned after boards established in other British and French colonies. Fifty percent of the value of its notes were held in silver and the remainder was invested in British government securities, the income from which defrayed the expenses of the Board and supplemented the reserve until it attained 110 percent of the note issue. Additional sums were paid into the general revenues of the colony. The reliance on sterling was finally broken by the British devaluation of 1967, but Singapore's currency continues to be more than fully backed by gold and foreign exchange (there was a shift from a silver to a gold standard in 1906).

Straits Settlements notes came to be widely used in British Borneo, Sumatra, the independent sultanate of Brunei, and the Malay peninsula, which had come under British control although administered separately from the Straits Settlements. In 1938, the Settlements joined the nine Malay States and Brunei in a currency union, the Straits dollar became the Malayan dollar, and the Currency Board distributed its profits in line with currency use in the various parts of the union.

[2] Dollar *is a variation of the German word* thaler, *a sixteenth-century coin struck from Bohemian silver.* Thaler *and its variations came to be generally applied to silver coins. The Spanish* peso, *or piece of eight, was known in the English-speaking world as the* dollar, *and the name was extended to the similar U.S. silver coin minted in 1792.*

The gold exchange standard. Germany, the United States, and several other countries adopted the gold standard in the last third of the nineteenth century, and these increases in the demand for gold, combined with silver discoveries, caused a depreciation of silver relative to gold. The value of the Straits silver dollar in the London market fell from 60 pence (a quarter of a pound sterling, which was fixed to gold and until decimalization in 1971 had 20 shillings of 12 pence each) in 1872 to 31 pence in 1893.[3] The Indian silver rupee

[3] *Britain had been on the gold standard since the early eighteenth century. The gold standard was based on the willingness of banks and governments to exchange their note and deposit liabilities for fixed amounts of gold; for example, the Bank Charter Act of 1844 required the Bank of England to purchase with notes all gold offered for 3.8875 per ounce of standard gold and to sell gold for 3.89375 per standard ounce.*

suffered similarly. India and the Straits Settlements traded predominantly with gold standard countries, and both were liable for substantial payments to London fixed in gold. Foreign investment was discouraged, inflation instigated labor disputes, and the resulting agitation for the gold standard eventually overcame the opposition of those who argued that a depreciating currency stimulated exports.

India was first to develop what came to be called the *gold exchange standard.* Silver coins continued to circulate, and the local currency was not easily redeemable in gold, but gold was "available for payments of international indebtedness at an approximately constant rate [that is, within the *gold points*] in terms of the national currency" (Keynes 1913, 30). The reserve was kept abroad, partly in gold but mainly in British government securities. The system benefited India and Great Britain. India earned interest by investing resources that otherwise would have been circulating as full value gold or silver coin, and the market for British securities was enlarged. Because the reserve was held principally in British securities, the system was referred to as the *sterling exchange standard.* A similar system established by the United States in the Philippines in 1903 was called the *dollar exchange standard.* In addition to maintaining an adequate gold reserve, the local government's main tasks were to insure that silver and other subsidiary coins were worth less melted down than their nominal values so that they would remain in existence and that the quantities of notes and coin in circulation were such that their value in the foreign exchange markets did not fluctuate. The Indian system was extended to the Straits Settlements in 1906 at the rate of one Straits silver dollar to 28 pence, which was maintained by Singapore until it left the pound to keep parity with gold and the U.S. dollar when Britain devalued in 1967.

Currency Board or central bank? The Federation of Malaya became independent in 1957, and Singapore gained internal self-government in 1959. In 1959, Malaya established a central bank that performed various regulatory functions and served as the government's banker. But the central bank did not issue currency. That remained the responsibility of the Currency Board. Singapore and British Borneo joined Malaya to form Malaysia in 1963, and in 1965 Singapore left Malaysia, but the currency union continued until 1967. Currency boards were widely admired by the colonial peoples for whom they had been established:

> From this history of monetary developments one point stands out, namely the overriding importance of commercial relations with the outside world. It was through international trade that modern money came to Malaya. It was the safeguarding of international trade and investment which motivated the currency reformers and provided Malaya with a monetary system which was simple, inexpensive and "ideally suited to a period of colonial expansion and capital migration."[4]

However, Malaysia felt the time had come for a more active monetary policy. In correspondence with the Singapore Ministry of Finance, the Malaysian central bank agreed that "the Currency Board system has not restrained orderly development so far" but expressed concern that its continuation might interfere with desirable monetary actions in the future.

> [S]hould the economy deteriorate and should the Malaysian and Singapore Governments be obliged to maintain levels of expenditure in spite of deteriorating revenues, the Currency Board system will certainly be a serious restraining factor in the orderly development of Malaysia and Singapore because of the rigidities of the system which prevents the use of foreign exchange reserves other than for backing the currency....
>
> The Board cannot in any way influence the money supply and, even in normal times, it is powerless to make credit available to meet the growing needs of an expanding economy, nor can it influence the cost of credit in the country. The system cannot in any way influence the country's economy when it is subjected to pressures due to swings in the country's balance of payments. Its rigidity imposes an undue hardship on the economy in periods of crisis. A defla-

[4] *Drake (1969, 27), with a quotation from Gunaskera (1954).*

> tionary situation caused by a deficit in the balance of payments...can be accentuated by a contraction in the supply of money at a time when the proper remedy for such a situation would be an increase in the money supply and a lowering of the cost of credit in the country. [5]

The Singapore Minister of Finance responded,

> [I]t must be remembered that the present stability of the Malaysian dollar...is due in quite large measure to the in-built financial discipline which a Currency Board system imposes. The main point to ask is whether the Currency Board system has restrained orderly development in Malaysia and Singapore to date....The point [of our earlier letter] is that taking into account the effects of sudden separation of Singapore from Malaysia, it may be more prudent for both our countries to continue with a known trusted existing currency system, rather than to introduce structural changes now.[6]

These differences could not be bridged, and in 1967 Malaysia and Singapore began to issue separate currencies. The old currency board was extinguished, and Singapore and Brunei established a new one. Currency boards had existed in nearly fifty British, French, and American colonies. But by 1970, among those gaining independence only Singapore had elected to keep that system.[7] Perhaps Singapore's decision to preserve its monetary constitution was as much as anything a signal of its continued commitment to price and exchange rate stability.[8] However, the simultaneous achievement of these goals is possible only as long as other countries pursue the same ends. Growing world inflation, the increasing frequency of exchange rate realignments, and finally, in the early 1970s, the end of the Bretton Woods system rendered Singapore's 1967 decision obsolete. Henceforth, Singapore would have to choose between the conflicting goals of price and exchange rate stability.

The Monetary Authority of Singapore (MAS). The Currency Board still exists, but effectively as a department of the MAS, which was established in 1971 with all the formal powers and responsibilities possessed by modern central banks.[9] In practice, however, purchases and sales of foreign exchange are its only significant instrument of monetary policy. Open market operations in government securities on a significant scale have not been possible because of the absence of a good secondary market.[10] Most government securities are held by the Central Provident Fund (the government pension fund) and other institutions that tend to hold them to maturity. There is no active discount rate policy because it is believed that interest rates are determined externally. Of the three traditional instruments of monetary policy, this leaves the reserve requirement ratio on bank deposits, which in the face of large capital inflows was raised in 1973 from 5 percent to 9 percent and then lowered during 1974–75 to 6 percent, where it has remained.

Figure 1 shows that most MAS actions are purchases of foreign exchange to offset drains caused by government surpluses.[11] In the third section, the exchange rate and the money stock are sometimes treated, for convenience, as alternative instruments of monetary policy. But the exchange rate and money are only proximate instruments; some might call them *intermediate targets.* The immediate instrument is always operations in foreign exchange.

[5] *From letters of January 10, 1966, and April 8, 1966, reproduced in Annexes A.6 and B.4 to Republic of Singapore,* White Paper on Currency *(1967).*

[6] *Republic of Singapore,* White Paper on Currency *(1967), Annex B.3, March 21, 1966.*

[7] *The only other currency board still in existence is that of Hong Kong, which is still a colony.*

[8] *It should be noted that Malaysia's inflation rate since 1965 has been almost as low as Singapore's.*

[9] *The chairman of the MAS is normally also the chairman of the Board of Commissioners of Currency.*

[10] *However, the government has encouraged greater activity in the Treasury bill market since 1986. See Emery (1991, 226).*

[11] *Also see Moreno's (1988) Chart 1, "Sources of Reserve Money."*

The economic framework: the real background to monetary policy

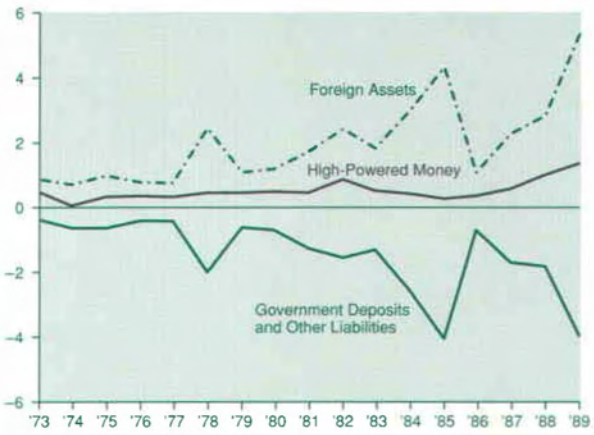
> *In Singapore, we found that the best fiscal and monetary policy to underpin a major investment promotion effort is to turn a deaf ear to the seductive appeals of the New Economics, which preaches that economic growth can be achieved by over-spending and manipulating the supply of money.... [W]e have found that the old-fashioned conservative policy of balancing the government budget—in fact of budgeting for a substantial surplus on current account to finance development expenditure—produces the best results in the long run.*
>
> —Minister of Finance K. S. Goh (1973)

Singapore may be the world's most open economy.[12] There are few exchange controls or protective tariffs, and the government has sought to provide an attractive climate for foreign investment.[13] It has one of the world's largest and busiest ports (the location of its massive deep-water port on the main sea lane between East Asia and the Middle East and Europe is its greatest natural advantage) and one of the largest refinery centers. It is a major financial center, trailing only London, New York, and Hong Kong in the number of commercial banks (135), and it is the center of the Asian Dollar Market, with 190 financial institutions soliciting nonresident deposits. Singapore's foreign trade in relation to the size of its economy leads the world (*Table 1*).

The continuation of the colonial free trade regime and commitment to monetary stability have undoubtedly been important factors in Singapore's economic success. Its leaders were educated in England shortly after World War II, but they were unaffected by popular Keynesianism, believing that growth is best achieved by an open economy, foreign investment, domestic saving, and fiscal and monetary conservatism. However, Singapore is not a *laissez faire* state. The government sets economic goals and unhesitatingly interferes with market forces to achieve those goals. Some of those government activities and their implications for monetary policy are discussed below.

Figure 1
Sources of High-Powered Money:
MAS Purchases of Foreign Assets Less Changes in Government Deposits and Other Liabilities

Billions of Singapore dollars



SOURCE: *International Financial Statistics.*

Land use and the pattern of production. Singapore has approximately the area and population of the city of Chicago, and government is most obvious in its regulation of land use. The space required for roads is limited by a 225 percent tax on new car purchases (recently supplemented by quotas), cremation is encouraged, outlying villages have been razed and their inhabitants moved to the high-rise housing blocks that dominate the Singapore landscape, and agriculture has been reduced. Cheap food is available from nearby agricultural economies, and "[r]ecognising that [Singapore's] comparative advantage lies in less land intensive activities like trade, manufacturing, and provision of services, the government has over the years steadily reduced both the number of farms and the area they occupy..." (Lim 1988,

[12] *Singapore is rivaled by only Hong Kong for this distinction.*

[13] *Most exchange controls were dropped in 1978, but the authorities have retained the right to interfere in some cases. For example, banks intending to extend loans in Singapore dollars for more than S$500,000 to nonresidents or residents for use outside Singapore must obtain the approval of the MAS. See Emery (1991, 211).*

Table 1
International Trade-GDP Ratios for Selected Countries, 1984

Country	Total Trade/GDP	Exports/GDP	Imports/GDP
Singapore	2.89	1.32	1.57
Malaysia	1.04	.56	.48
Indonesia	.44	.27	.17
Thailand	.43	.18	.25
Philippines	.36	.16	.19
Hong Kong	1.86	.93	.93
Taiwan	.92	.53	.39
South Korea	.72	.35	.37
Australia	.25	.12	.12
New Zealand	.50	.24	.26
Belgium	1.37	.66	.71
Denmark	.59	.28	.30
West Germany	.53	.28	.25
Japan	.24	.14	.11
United States	.15	.06	.09

NOTE: GDP is gross domestic product.
SOURCE: Lim (1988, 5).

96). Between 1965 and 1989 the share of agriculture and fishing in gross domestic product (GDP) fell from 3.1 percent to 0.3 percent. Nearly 80 percent of the land is government-owned, a substantial part of which is now vacant in anticipation of commercial and industrial development by high-tech foreign firms. Various tax incentives "promote the use of foreign technology," and the government has provided a superb infrastructure and a "responsible trade union movement" (Lim 1988, 257), but otherwise firms receive little government protection or assistance. There is no room for activities, foreign-owned or Singaporean, that require tariff protection, subsidies, or help from the central bank in the form of low interest rates or other policies likely to cause inflation or a depreciating exchange rate. Even public utilities and other government enterprises earn profits.

Fiscal policy. The government enforces substantial private saving and manages a surplus on its own account.[14] The most striking aspect of the top portion of Table 2 is the high rate of investment—more than 40 percent of GDP during the 1970s and 1980s. Saving also exceeds 40 percent of income. Most private saving is through the Central Provident Fund (CPF), a mandatory plan under which employers and employees contribute specified proportions of wages for the future use of employees. Withdrawals are permitted only for home purchase (the main use), retirement income, home repair, and hospital expenses. Current contribution rates are 18 percent and 22 percent of wages for employers and employees, respectively.

Wage policy. The government's attitude toward wages has been influenced by the conflicting desires for international competitiveness (by means of low wages), long-term growth (implying high wages to force out low-wage industries), and economic stability (calling for flexible wages). An example of the second influence was the "wage corrective policy" launched in 1979 in combination with an "industrial restructuring program...to promote skill-intensive, high-value-added industries" (Lim 1988, 140). Because reductions in unemployment and increases in labor-force participation had been exhausted as sources of growth, increased emphasis was placed on "qualitative improvement in

[14] Figure 1 shows the effect of this surplus on bank reserves.

Table 2
Gross Domestic Product and Related Data (Millions of Current S$, Unless Indicated Otherwise)

	1960	1970	1980	1989
Private consumption	1,922	3,920	12,911	25,781
Government consumption	162	693	2,447	5,901
Gross fixed capital formation				
Private	145	1,521	7,710	16,897
Government	60	367	2,493	3,708
Change in inventories	40	356	1,425	–1,036
Net exports of goods and services	–301	–1,179	–2,216	4,153
Gross domestic product	2,027	5,678	24,771	55,404
Gross domestic product (1985 prices)	4,907	11,826	28,466	53,076
Population at mid-year (thousands)	1,646	2,075	2,414	2,613
Per capita real GDP (thousands 1985 S$)	2,981	5,699	11,792	16,407
Employment (thousands)	449	644	1,073	1,277
Unemployment rate (percent)	4.9	6.0	3.0	2.2
Area (square miles)*	225	226	239	242
Per capita GDP (US$)				
United States	2,833	4,918	11,787	18,301
West Germany	1,300	3,039	13,217	18,305
Japan	458	1,953	9,071	19,463
South Korea	156	272	1,634	2,883
Singapore	431	916	4,706	7,623

* Increase due to landfills.

SOURCES: Singapore data are from *Economic Survey of Singapore*. Per capita GDP (US$) data are from International Monetary Fund, *International Financial Statistics*.

labour and access to modern technology" (Lim 1988, 139).[15] Tax incentives were introduced "to promote investments in more technologically sophisticated industries and to emphasise research and development" (Lim 1988, 257). The wage-corrective policy was an attempt by the government—as a large employer and regulator of CPF contributions and through its influence on private wage bargaining—to reinforce these incentives and "to phase out low quality labour intensive industries" by raising wages and other labor costs (Lim 1988, 257).

Some observers have argued that this policy was applied too vigorously, that the rise in real wages between 1979 and 1984 (8.7 percent per annum, compared with a productivity growth rate of 4.6 percent) was partly responsible for the 1985–86 recession, and since that time the government has stepped up efforts to make labor costs more flexible. Adjustments in employer CPF contributions have been an important part of this policy, being reduced from 25 percent to 10 percent in 1986 and gradually being raised in line with economic expansion. Furthermore, in recent years many companies have followed the National Wages Council's recommended "flexible wage policy" by limiting wage increases to 2 percent to 4 percent but giving larger year-end bonuses linked to company performance (Daniel 1989). Table 3 compares wage supplements

[15] *Between 1970 and 1985, the labor-force participation rate rose from 55 percent to 66 percent, entirely due to the rise in female participation from 30 percent to 48 percent.*

Table 3
Average Hourly Compensation of Manufacturing Production Workers, 1985 (US$)

Country	Wage	Ratio of Additional Compensation to Wage	Total Compensation
United States	$9.52	.362	$12.97
Switzerland	$7.11	.330	$9.45
Japan	$5.53	.168	$6.45
United Kingdom	$4.75	.321	$6.27
Singapore	$1.57	.550	$2.44
Hong Kong	$1.61	.110	$1.78
Taiwan	$1.38	.050	$1.45
South Korea	$1.17	.200	$1.41

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics, Office of Productivity and Technology, June 1986; reproduced in Lim (1988, 185).

in Singapore with those of other countries. The largest components of the 55-percent figure for 1985 were the employers' 25 percent CPF contribution and bonus and wage supplements totaling 13 percent. The former is now 18 percent, but the latter has probably grown. In 1989, government workers received a Christmas bonus equivalent to 2.75 months' salary, and many private-sector workers received much more.

The government continues to put pressure on low-wage industries. In addition to limiting the numbers of unskilled foreign workers that firms may employ, a *foreign workers levy* was introduced in 1987. The monthly levy is adjusted in response to economic conditions, but in 1990 it ranged from S$250 to S$300, depending on the industry (the Singapore dollar was worth about 55 U.S. cents).

Finally, it is worth pointing out that labor law and union cooperation are important contributors to wage flexibility. The Employment Act of 1968 "enjoins upon the labour movement more discipline, restraint in wage negotiation and, generally, a greater awareness of the social responsibility of organized labour in the larger framework of the national interest" (Goh 1972). The Industrial Relations Act of the same year reduced the scope of collective bargaining by giving "full discretionary powers to management in matters of promotion, transfer, recruitment, dismissal, reinstatement, assignment of duties and termination of employment for reasons of reorganisation or redundancy." Disputes over other matters must be referred to the Industrial Arbitration Court, whose decisions are binding. There has been one strike since 1977, involving sixty-one workers for two days. In the midst of the labor disputes of the early 1960s, the finance minister complained that overseas industrialists hesitated to open factories in Singapore because of their fear of labor problems (Goh 1963). This impediment to foreign investment has been removed.

Some economists have recommended that wage policy be aimed at the target of employment stability (partly by maintaining export competitiveness) and that monetary policy be directed at price stability.[16] Officials have not articulated a policy model, and their control over wages is not complete, but their behavior has been roughly consistent with this prescription.

Foreign investment. The quotation by Prime Minister K. Y. Lee at the beginning of the first section understates the government's desire for foreign investment, which in fact is preferred to domestic ownership. Officials view Singaporeans as traders and money lenders, with preferences for

[16] For example, see Corden (1984) and Lim (1988, 314–19).

> ...short-term investment in Singapore and in diversification out of Singapore. This is a rational phenomenon, and deep in the instincts of the trader. The future is uncertain; Singapore's comparative advantages in the world change quickly; therefore, take short-term positions and don't put all your eggs in one basket.[17]

Hence, private long-term investment in Singapore must be undertaken by already diversified multinationals. Finance Minister Goh emphasized that large foreign firms bring know-how, established products with world repute, and markets, and Prime Minister Lee pointed out that "the bigger and more established a [multinational corporation] is in his field, the higher his success rate and the bigger his contribution to jobs and GNP" (Lee 1978). Wholly owned firms from the United States, Japan, and Europe had a failure rate of only 6 percent, compared with a 38 percent failure rate for wholly owned Singaporean enterprises (Goh 1963, 16, and Lee 1978, 20). In 1984, foreign manufacturing firms made up 21 percent of establishments, 53 percent of workers, and 65 percent of value-added (Koh 1987). In recent years, about 80 percent of manufacturing investment commitments have come from foreign firms.[18]

Monetary policy

> *The gamut of Singapore's experience in the past four years, of severe imported inflation, mild recession and prompt recovery in the context of international economic and financial instability has strengthened the bases of domestic economic and financial policies. The economy avoided the excesses in fiscal, monetary and wage policies, and their accompanying economic costs, evident in a number of developed and developing countries today.*
>
> —Monetary Authority of Singapore, *Annual Report 1976/77*, p. 2

Singapore's policymakers were slow to adjust to the new monetary environment following the breakdown of the Bretton Woods system and failed to insulate the economy from the monetary expansions undertaken by a large part of the world in response to the oil-price shock.[19] But the experience redoubled their determination to find ways to achieve stability at home despite the instability around them. The MAS has repeatedly affirmed that "price stability [is] the prime objective, ...aimed at sustaining confidence in the domestic economy and mitigating external inflationary pressures, as well as safeguarding export competitiveness."[20] It has been able to pursue this objective with a single-mindedness that must be the envy of other central bankers because of a pliable labor force and a conservative fiscal policy and bolstered by the belief that the authorities' best contribution to growth is the maintenance of a stable environment for investment.

In this section, I examine the means by which Singapore has achieved price stability. I first consider exchange rate management because MAS officials state that since 1981 they have preserved stable prices by manipulating the value of the Singapore dollar to offset foreign inflation.[21] However, such a policy would require the continuous

[17] *George Yeo (minister of state, finance, and foreign affairs), speech reported in* The Straits Times, *February 9, 1990.*

[18] *Ministry of Trade and Industry, Republic of Singapore,* Economic Survey of Singapore, *various issues.*

[19] *Singapore's consumer prices rose 20 percent in 1973 and 22 percent in 1974. Average annual inflation since 1974 has been 2.7 percent.*

[20] *MAS* Annual Report 1981/82, *p. 4, and* Annual Report 1984/85, *p. 1. Similar statements have appeared in almost every* Annual Report.

[21] *For example, the MAS* Annual Report 1983/84 *stated that "[g]iven the openness of the Singapore economy, especially the high integration of domestic and international financial markets, it is not possible to pursue an independent monetary policy, although there is some flexibility in influencing domestic conditions in the short run. Thus, the focus of the Authority's policy is on the exchange rate rather than on movements of monetary aggregates" (p. 4). Similar statements may be found in every* Annual Report *since 1981–82. Lee (1987) and Moreno (1988) also have argued that Singapore operates with an exchange rate target rather than money or interest rate targets. The MAS's statement will surprise those who believe that a flexible exchange rate increases a country's control of its money stock.*

Table 4
Model of a Small Open Economy

(1) $p = x + p^* + s$	Purchasing power parity
(2) $R = R^* + x^e + v$	Interest rate parity
(3) $r = r^* + v - s$	Equal expected real rates of interest, where $r = R - p$ and $r^* = R^* - p^*$
(4) $y = y_n + (p - p^e) + u$	Aggregate supply
(5) $m - p = a + by - \delta R + w$	Money demand
(6) $m = \mu + h$	Money supply

satisfaction of purchasing power parity (PPP, which requires the rate of exchange between the currencies of countries A and B to vary equally with the difference between their rates of inflation), when in fact Singapore's exchange rate, like those of other countries, has deviated greatly from PPP and for long periods. The data suggest that the MAS has instead followed a constant-money-growth rule.[22]

Exchange rate management under purchasing power parity. In light of Singapore's size, dependence on foreign trade and investment, and freedom from currency or trade restrictions, the simple model of a small open economy in Table 4 may be more appropriate for Singapore than for any other country. It is a conventional description of an open economy under the assumption of PPP.[23] PPP is an example of the law of one price; specifically, identical goods should sell for the same price in different countries. Equation 1 asserts that the rate of change of Singapore's price level (p) equals the sum of the rates of change of the Singapore dollar price of foreign exchange (x) and an average of the price levels of Singapore's trading partners (p^*), and a random error term (s); s and other errors to be introduced have zero expected values.[24] Equation 2 is the interest rate parity (IRP) relationship, according to which, subject to the random error (v), investors require the nominal rate of interest on Singapore investments (R) to equal the foreign rate of interest (R^*) plus the expected rate of depreciation of the Singapore dollar (x^e). PPP and IRP imply the expected equality of Singapore (r) and foreign (r^*) real interest rates, as indicated in equation 3. Equation 4 is an aggregate supply function such that the rate of growth of Singapore's output (y) equals the trend or natural rate of growth of output (y_n) plus a random error (u) and a constant times the excess of realized inflation (p) over expected inflation (p^e). Equation 5 is the demand for money, where m is the rate of change of the domestic money stock, δR is the change in the rate of interest, and w is a random error. The supply of

[22] *Several theoretical papers have considered optimal monetary policies for open economies; for example, Boyer (1978), Roper and Turnovsky (1980), and Henderson (1979). This study is not concerned with Singapore's optimal combination of policies but with those actually pursued.*

[23] *For example, see Marston's model with capital mobility and flexible wages and exchange rates (1985, 889).*

[24] *The following numerical example of PPP between two countries is based on data from the period of my empirical analysis, 1981–90. The average annual rates of change of the Singapore and U.S. consumer price indexes during this period were 2 percent and 4 percent, respectively. In 1981, US$1 was worth S$2.10. If PPP had worked perfectly, that value would have fallen 2 percent per annum to S$1.73 by 1990. In fact, it fell only 1.2 percent per annum, to S$1.89.*

money is given by equation 6, where μ and b are rates of change of the money multiplier and high-powered money. The constants α, a, b, and c are nonnegative.

Given expectations, the natural rate of growth of output, the money multiplier, and the variables determined abroad, the model consists of six equations in seven unknowns— p, x, R, r, y, m, and b. The system is completed by MAS's instrument choice—x, R, or b. Suppose that, as asserted by the MAS, its instrument is x. If the inflation objective is p^o (which is zero if price stability is desired), equation 1 implies $x = p^o - p^*$, so that realized inflation is $p = p^o + s$ and expected inflation is $p^e = p^o$. The stock of money is demand-determined in this situation (largely by p, which also determines y and R) and follows from the MAS's choice of x. High-powered money, b (provided mainly by MAS purchases of foreign exchange; *see Figure 1*), is determined by equation 6, given m from equation 5.

Regression R.1 in Table 5 assumes that the MAS's policy instrument is the exchange rate and reports the response of x to p^* and three seasonal dummy variables. x is a weighted average (an *effective exchange rate*) of Singapore's exchange rates with its principal industrial trading partners, the weights being relative GDPs valued in U.S. dollars. The same weights were used to compute p^* from consumer price indexes. Several weighting schemes were used, along with various lag distributions of p^*, but regression R.1 produced the best fit.[25] Regression R.2 adds y and f, both lagged one period, as explanatory variables to determine whether the MAS has tempered its stable price policy by depreciating the exchange rate (raising x) in reaction to slowdowns in the growth of output and foreign exchange reserves.[26] The sample period begins with 1981 because the MAS indicated a policy shift (from money to exchange rate management) in that year.

The coefficients of regressions R.1 and R.2 are significant (except the seasonals) and have the expected signs. However, the large deviations of the estimated coefficients of p^* from –1 raise problems for the hypothesis that the MAS aims at domestic price stability by exchange rate management in a PPP world.[27] Statements by the authorities and equation 1 imply $dx/dp^* = -1$, suggesting that the model is misspecified, the MAS's policy is different from that announced, or both.

In view of the accumulation of knowledge of exchange rate movements since the advent of floating rates in 1973, it would have been surprising if Singapore had been able to control p by manipulating x according to equation 1. PPP should hold in a one-good, free trade, frictionless world. But there is no theoretical justification for its satisfaction in terms of standard price indexes.[28] Large inflations are usually accompanied by large exchange rate movements, but changes in the patterns of

[25] *The weights underlying x and p* were suggested by Deputy Managing Director of the MAS K. P. Teh (1988) in a paper on Singapore's monetary policy. Teh used an index of OECD consumer price inflation as the indicator of p*. Weights for quarterly series were obtained by regressing his annual 1976–87 series for p* on the ps of the nine largest OECD countries and selecting the countries with significant coefficients (listed in Table 5). These coefficients approximated relative GDPs. Regressions of the form of R.1 and R.2 were tried using these fixed weights as well as weights varying with relative GDPs. The latter had higher $\bar{R}^2$'s and are reported in Table 5. They also had higher $\bar{R}^2$'s than regressions based on trade-weighted indexes. All regressions had coefficients of p* significantly greater than –1 in absolute value.*

Trade-weighted indexes might be most useful in explaining exchange rates—unless, as it asserts, the MAS manipulates an OECD-weighted index. This assertion is the hypothesis under examination in regression R.1. The MAS's preference for an OECD-weighted index over a trade-weighted index is a result of its concern for the international competitiveness of Singapore industry. The main difference between the two indexes is the exclusion of food, textile, and handicraft imports from Malaysia, Indonesia, and Thailand.

[26] *The Authority, in managing the trade-weighted exchange rate, was able to play a supporting role in the important adjustment measures undertaken by the government since mid-1985 to revive economic activity (MAS* Annual Report 1985/86, *4).*

[27] *Variations of regressions R.1 and R.2, including different or additional independent variables, as well as alternative lag structures for the independent variables and alternative weighting schemes for x and p*, had coefficients less than –1.9. These results also are similar to those generated by Tehs annual data, for which the estimated coefficient of p* is –3.7 (Teh 1988).*

[28] *See Manzur (1990) for a discussion of investigations of the empirical validity of PPP.*

Table 5

Estimates of Exchange Rate, Money, and High-Powered Money Reactions (Quarterly Data, 1981:1–1990:1)

Eq. no.	Dep. var.	Independent Variables: cons.	p^*	y_{-1}	f_{-1}	S2	S3	S4	$\bar{R}^2$ DW	Q Sig
R.1	x	.028	−3.536			.021	−.002	.008	.508	36.3
		(3.43)	(6.23)			(2.31)	(.25)	(.91)	1.75	.006
R.2	x	.059	−3.284	−.733	−.253	−.027	−.007	.006	.651	15.2
		(5.35)	(6.50)	(3.32)	(2.46)	(1.81)	(.77)	(.70)	(2.16)	.650
		cons.	**p**	**y**	**δR**	**S2**	**S3**	**S4**		
R.3	m	.034	.096	.890	−.004	−.041	−.037	.009	.444	9.4
		(2.91)	(.02)	(2.70)	(.86)	(1.83)	(1.75)	(.44)	1.69	.949
R.4	h	.015	.224	.210	−.006	−.018	−.005	.037	.435	16.3
		(1.26)	(.05)	(.64)	(1.50)	(.82)	(.23)	(1.83)	2.47	.573
R.5	h^s	−.008	.319	.093	−.005				−.014	14.3
		(1.58)	(.80)	(.67)	(1.32)				2.34	.711
		cons.	**AR(1)**	**AR(2)**	**MA(1)**	**MA(2)**				
BJ.1	h^s	−.004	.435	.414	−.626	.391			−.089	14.2
		(.68)	(1.03)	(.10)	(1.58)	(.98)			2.40	.717

Definitions and sources

Except when indicated otherwise, the data are from International Monetary Fund, *International Financial Statistics*, with price and GDP series made intertemporally consistent by linking data with different (1980 and 1985) bases.

x, p^* — Rates of change of effective exchange rate (quarterly average of S$ per unit of foreign currency) and foreign consumer price level; weighted averages with weights determined by GDPs in US$ of Canada, France, Italy, Japan, the United Kingdom, the United States, and West Germany.

p, m, y, h, h^s — Rates of change of Singapore consumer price index, money stock (currency in the hands of the public and total domestic commercial bank deposits), real GDP (*Yearbook of Statistics*, *Economic Survey of Singapore*, and Liew 1989), high-powered money (currency of the public and bank reserves), and high-powered money seasonally adjusted by linear regression on seasonal dummies.

f — Rate of change of Singapore foreign exchange reserves, in US$ end of quarter; mainly monetary authorities' claims on nonresidents in bank deposits, government securities, European currency units, "and other claims usable in the event of balance of payments need..." (*International Financial Statistics*, line 1d.d).

δR — Change (in basis points) in the three-month interbank rate (Monetary Authority of Singapore, *Monthly Statistical Bulletin*).

(Continued on the next page)

Table 5—*Continued*

Estimates of Exchange Rate, Money, and High-Powered Money Reactions (Quarterly Data, 1981:1–1990:1)

Definitions and sources—*continued*

Si	Seasonal dummies; unity in the *i* th quarter, zero otherwise.
AR(*i*) *MA*(1)	Box–Jenkins estimates of *i* th-order autoregressive and moving-average coefficients.
$\bar{R}^2$	Coefficient of determination adjusted for degrees of freedom.
DW	Durbin–Watson statistic; in no case is the null hypothesis of zero first-order autocorrelation of the errors rejected with 95 percent confidence.
Q, Sig	Ljung–Box *Q* statistic for a test of general autocorrelation, distributed as χ^2 with eighteen degrees of freedom. *Sig* is its significance level. In only one case, R.1, is the joint hypothesis of all zero auto-correlations rejected with more than 42.7 percent confidence. (See Pindyck and Rubinfeld 1981, 500–01.)

Student's *t* statistics in parentheses; 2.04 and 2.75 indicate coefficients different from zero at thirty degrees of freedom with 95 percent and 99 percent confidence.

production in different countries imply that there is no unique relationship between price indexes. Furthermore, foreign currencies are assets as well as means of payment, which means that their values may change rapidly in response to expectations regarding their future values in ways not explained by PPP.

> [F]oreign exchange markets exhibit behavior that is characteristic of other asset markets. Exchange rates react quickly to news; rates are volatile and difficult to forecast. Both spot and forward rates can be modeled as anticipatory prices, but the exact parameters are unknown. (Levich 1985)[29]

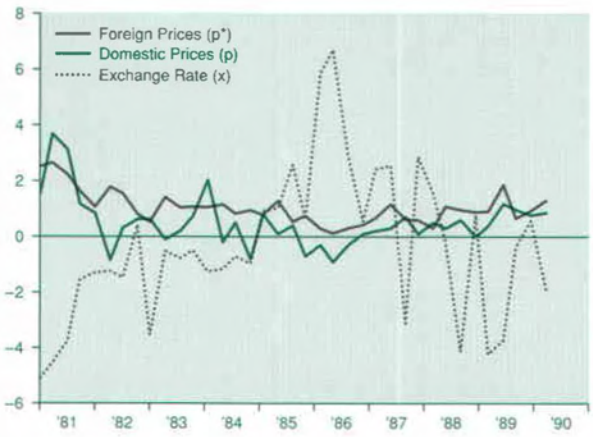
The tendency of floating exchange rates (x) to fluctuate more widely than differences between rates of inflation ($p - p^*$) is illustrated for Singapore in Figure 2. If the MAS attempted to combat a speculative appreciation of the Singapore dollar by buying foreign exchange, it would lose control of its money supply and probably its price level.[30]

Monetary control. Suppose the MAS seeks stable prices through control of the money stock. Letting the instrument be b and eliminating equation 1 from Table 4, the resulting system consists of five equations in five unknowns (R, r, y, p, m), which are determined by foreign data (R^*, r^*), expectations of the unknowns (p^e, x^e), the coefficients and random errors of the system (α, a, b, c, v, s, u, w), the money multiplier (μ), and the instrument (b). Exchange rate expectations (as well as the current exchange rate) might or might not be closely

[29] *See Dornbusch (1976), McKinnon (1979), Buiter and Miller (1981), and Cottrell (1986) for theoretical explanations of the high volatility of exchange rates relative to differences in inflation.*

[30] *Dornbusch (1982) argued that the PPP exchange rate policies adopted by some developing countries have increased the volatility of their prices and output.*

Figure 2
Rates of Change of the Exchange Rate, Domestic Prices, and Foreign Prices (Quarterly Percentages)



SOURCE: See Table 5.

related to current and expected $p - p^*$.

The central bank can choose h each period subject to its forecasts of these data, or it can choose a path for h independent of such forecasts. Regressions R.3–R.5 in Table 5 are inconsistent with the former policy and consistent with the latter policy. If the MAS chooses h based on reasonably accurate forecasts of p, y, and R, then h and m will be closely related to these variables.[31] Such a relationship is rejected by regressions R.3 and R.4. In fact, seasonally adjusted h, h^s, has the characteristics of a white noise process. It is not significantly related to prices, output, or interest rates, and its error terms are not serially correlated. The Box–Jenkins expression BJ.1, in which first- and second-order moving-average and autoregressive terms are insignificant, reinforces this conclusion. Movements in h^s are consistent with a money-growth rule in which the MAS offsets all but unpredictable influences on h^s.[32]

Conclusion

It is dangerous to draw lessons from the experience of one country for the conduct of policy in another because the possibility and success of any policy are conditioned by the history, politics, and institutional framework of the country in which it is employed. However, three aspects of Singapore's monetary policy are worth consideration by others.

First, Singapore's commitment to price stability is not limited to the monetary authorities but is part of a total macroeconomic approach that avoids budget deficits or the protection and stimulation of industries (by means of low interest rates and exchange rate devaluations, as well as tariffs and quotas) unable to compete in world markets. Second, Singapore has achieved stable prices by means of monetary control. This is a telling blow for the argument that control of the money stock is impossible in the United States, where the difficulties of such control are less than in a smaller and more open economy. Third, Singapore has adapted to changes in the world monetary environment, tying its currency to the predominant full-bodied coins circulating in the East (Mexican silver) during the nineteenth century, shifting to a sterling (gold exchange) standard in 1906 when silver depreciated, linking the Singapore dollar to the U.S. dollar with the devaluation of sterling in 1967, and finally, after the breakdown of fixed exchange rates in the 1970s, turning to the rigorous control of money that is made possible by a flexible exchange rate. Clearly, price stability in Singapore has been the consequence of determined policy rather than an accidental outcome of auspicious circumstances.

[31] *This may be illustrated by a simple case in which the MAS directly controls* m, y *is exogenous, and I abstract from* R. *Equation 5 implies* $EP = m - a - bEy = p^\circ$, *where* p° *is the goal, so that the policy choice is* $m = m^\circ = p^\circ + a + Eby$. *Realized* $p = p^\circ + b(Ey - y) - w$.

[32] *Write* $h = Eh + z$, *where* z *is the unanticipated portion of* h. *If the MAS makes* Eh *grow at the constant rate,* h°, *realized* $h = h^\circ + z$.

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Regional Effects of Liberalized Agricultural Trade

In recent years, the United States has worked aggressively, through both bilateral and multilateral negotiations, to open trade. Although negotiations have addressed trade in a myriad of goods and services, nowhere has liberalization proved more intractable than in agriculture. In the United States and many other countries, agriculture is protected not only from foreign competition through tariffs and quotas but also through heavy subsidies. These policies have encouraged agricultural production in many relatively high-cost areas, increasing the overall cost of food and reducing overall gross national product (GNP). (*See the box titled "Free Trade in Agriculture Has Been Elusive."*)

Most economic analysts agree that agricultural subsidies and protectionism distort prices and give rise to high-cost producers that would otherwise be forced out of the competitive market. While the benefits of changing to a free market are well-known, the effects of such changes on different regions are neither well-understood nor often debated.

Eliminating world subsidies and barriers to trade would lower the cost of food and increase gross national product by encouraging reallocation of resources toward those producers who are most efficient. Countries will specialize in producing goods and services in which they are world class. One of the benefits of freer trade—be it in agriculture, manufacturing, or services—is that GNP increases because resources are reallocated to the most productive firms. Many agricultural producers, however, have become accustomed to protection and realize that their production could become unprofitable without government support. Consequently, these producers lobby against freer trade.

In the following discussion, I examine the impact international agricultural trade liberalization —such as the reforms possible under the General Agreement on Tariffs and Trade (GATT)—would have on regions of the United States. I begin with a generalized discussion of protectionism and then analyze the effects of multilateral free trade on U.S. agriculture. I conclude by examining the wide range of implications such changes present for the agricultural sector in each state.

The impact of freer agricultural trade would vary among regions in the United States both because the types of agricultural outputs differ by region and because some agricultural products are protected much more than others.

The consequences of market interference

Market interference in agriculture is not unusual. Most governments have chosen to interfere with free markets by protecting their agricultural production from foreign competition. Different policies around the world either increase or decrease the price of agricultural products within countries. But all these policies reduce the efficiency of agricultural production.

U.S. sugar policies, for example, use quotas to protect domestic producers from lower-priced foreign competition. Quotas limit the importation

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Free Trade in Agriculture Has Been Elusive

Despite a worldwide movement toward freer trade, agriculture remains protected and subsidized around the world. For more than forty years, agriculture was excluded from multilateral negotiations to reduce trade barriers. But after being included in the most recent round of the GATT, agriculture quickly became the focus of negotiations.

Although a GATT agreement is close in several areas, a consensus on agriculture has been elusive. Negotiators have risked abandoning agreements on textiles, services, dispute settlement, and intellectual property in an attempt to encourage an accord to liberalize agricultural trade. For many countries, agricultural liberalization would be the main benefit of a free trade agreement.

Difficulties have resulted from disagreements between the United States and the European Community. The United States has called for the complete elimination of trade-distorting subsidies and protection, while the European Community has resisted large reductions in agricultural support. Progress has been made toward a compromise. Recently, GATT watchers have become hopeful that an agreement can be reached to reduce trade-distorting barriers in agriculture.

of sugar, keeping domestic sugar prices higher than world prices and raising the price of sugar to U.S. consumers. In 1990, the average world price for sugar was 12 cents per pound, while the average U.S. price for sugar was 23 cents per pound. Government support for U.S. sugar producers places almost all the cost of producer support on consumers. U.S. taxpayers finance many other crop programs, such as deficiency payments and price guarantees.

For instance, U.S. taxpayers pay for wheat policies that support producer prices and income. Wheat producers who participate in acreage-reduction programs are offered price guarantees that, in the past, have created a domestic floor price below which the federal government would purchase wheat.[1] Wheat producers also receive taxpayer-funded deficiency payments that guarantee income when farm prices fall below a preset target level. Target price-deficiency payment programs implicitly have subsidized exports because target prices help support producer incomes at high and stable levels. These policies also create an incentive for higher wheat production that reduces world wheat prices.[2]

Although the wheat subsidy program lowers the price of wheat while the sugar quota increases the price of sugar, both policies distort resource allocation, raising the cost of food and lowering overall economic output. These distortions occur both within and outside the agricultural sector.

Within the agricultural sector, protectionism distorts production because protection is not uniform across products. Some types of products—such as wheat and sugar—are heavily protected, while others—such as beef and pork—are not. As a result, a farmer who produces only wheat and sugar will benefit greatly from the existing combination of subsidies and trade barriers, while someone who produces only beef and pork will not benefit at all.[3]

Why, then, do all farmers not produce sugar

[1] *U.S. price guarantees have been raised. Currently, they do not act as a floor price.*

[2] *Harwood and Bailey (1990, 18).*

[3] *Although livestock producers benefit from subsidies that reduce the price of feed grains, these producers would have higher incomes if there were no agricultural subsidies and trade barriers.*

or wheat? Even though subsidies and trade barriers provide incentives that encourage some less efficient producers to remain in business, some regions could not produce these commodities even with protection. Thus, it may still be more profitable for some regions to produce only beef and pork, even though these sectors are not subsidized.

Agricultural protection also distorts production outside agriculture. Protective policies attract resources to protected sectors, thereby reducing the resources available to other sectors. In other words, farm programs artificially increase farm profit and attract to subsidized farm production resources that would be otherwise invested in more productive activities.

While society may choose to transfer wealth to the agricultural sector, protective policies are not the most efficient means for supporting producers. Society currently supports agriculture with protection by fixing prices and quantities and by limiting foreign competition through tariffs and quotas. These policies distort the prices paid by both consumers and producers and reduce output by disturbing market forces. Writing checks to producers would be a more efficient way to support producers.

Reduced output of some agricultural products and excessive production of other products caused by distorted consumer and producer prices raise the cost of providing agricultural programs above the benefit to producers. The U.S. Department of Agriculture (USDA) determined that every dollar U.S. producers received in 1986 cost consumers and taxpayers $1.38.[4]

The effect of trade liberalization

Determining the results of eliminating farm programs is not simple. Each country may have several farm programs that affect the price and output of each crop. Further, farm subsidies and trade barriers in other countries affect domestic prices and output.

The result of removing domestic farm subsidies has, in most cases, a straightforward effect on prices and quantities (*Table 1*). Reducing or removing a subsidy would reduce the price producers receive and decrease production. The price consumers pay would increase, and the quantity demanded would fall. Removal of subsidies in foreign countries, however, can have the opposite effect on domestic markets. Domestic producer prices and output would increase if a foreign country is a major producer of an imported crop.

Reducing or removing a tariff or import quota would reduce both domestic producer and consumer prices. U.S. production would fall in response to lower prices, but consumer demand would increase and imports would rise. The magnitude of price and quantity changes would depend on the size of U.S. consumption in relation to world market consumption. When U.S. consumption is large enough to affect world prices, lifting trade protection does not reduce domestic prices and output as much as when U.S. consumption is too small to affect world prices. When U.S. consumption is great enough to affect world prices, foreign producers bear some of the tariff burden. As with subsidies, the removal of tariffs or quotas in foreign countries would have the opposite effect on producer prices and output when U.S. consumption has no impact on world prices.

Thus, simultaneously reducing foreign and domestic subsidies and tariffs could push prices and output in different directions. Many researchers have used general-equilibrium models to determine the net effect of full multilateral liberalization. In a USDA project, researchers Roningen and Dixit used an eleven-region, twenty-two-commodity partial-equilibrium world net trade model to determine the economic implications of full trade liberalization in industrial market economies. (*See the box titled "The USDA Model."*) Supply, demand, and trade data for 1986–87 were used to determine an approximation of the resulting adjustment in production, consumption, trade, and prices of agricultural commodities to be expected after five years of free trade. The values of all products not covered by the Roningen and Dixit study, such as fruits, vegetables, and nursery crops, were assumed to remain constant. (*See the box titled "The Effect of Trade Liberalization on Fruit and Vegetable Producers."*)

World effects of full trade liberalization

Full agricultural trade liberalization would eliminate all trade-distorting agricultural policies,

[4] Roningen and Dixit (1989, 25).

Table 1
Effects of Trade Liberalization on Domestic Prices and Output

	Removal of Domestic Subsidy	Removal of Domestic Tariff or Import Quota
Effect on Producer	P↓ Q↓	P↓ Q↓
Effect on Consumer	P↑ Q↓	P↓ Q↑
	Removal of Foreign Subsidy	**Removal of Foreign Tariff or Import Quota**
Effect on Producer	P↑ Q↑	P↑ Q↑
Effect on Consumer	P↑ Q↓	P↑ Q↓

NOTES: Although tariffs and import quotas have simliar effects on prices (P) and output (Q), tariffs have the beneficial effect of generating revenue.The effects of removing subsidies do not refer to export subsidies for foreign producers. Those subsidies would have opposite effects on domestic prices and output.

including subsidies. Each country would tend to specialize in producing those goods—both farm and nonfarm—in which it has a comparative advantage. Countries would import commodities in which they have a comparative disadvantage. Resources would be channeled from uses of low productivity to those of high productivity, permitting higher levels of consumption and investment.[5]

With full agricultural trade liberalization, world prices would increase for most farm products, at least in the short run. An important distinction exists between the price the consumer pays and the price the producer receives. Subsidies are funded by taxpayers. Even though subsidies misallocate resources and raise the overall cost of output, in practice subsidies and trade barriers hold down the consumer price of most farm products.

Although eliminating market-distorting subsidies throughout the world would increase prices in the short run, in the long run competition would increase, which would raise efficiency and mitigate price increases. Even in the short run, however, the end of subsidies would mean a decline in the overall cost of all products when governments save tax dollars that otherwise would pay for subsidies. Prices would likely not increase as much as tax dollars would go down, because the costly government bureaucracies that now administer market-distorting programs would disappear.

Moreover, while subsidies lower prices, trade barriers raise prices by reducing the effects of foreign competition. Thus, price increases resulting from the removal of both subsidies and trade barriers would be smaller than price increases resulting from the removal of subsidies only.

Multilateral agricultural trade liberalization would stimulate a profound change in where agricultural commodities are produced and would cause trade among countries to increase greatly. Most industrialized market economies, including the United States, would curtail agricultural production because of reduced protection. However, increased production in developing countries would offset this production loss. In industrialized market economies, the largest output declines would be for rice, sugar, and

[5] *The United States could unilaterally eliminate market-distorting agricultural policies, removing farm support and trade protection, while other countries maintain their programs. U.S. resources would be utilized more efficiently, and the economy as a whole would benefit. The U.S. farm sector, however, would experience a greater reduction in income than if all countries removed their programs because U.S. producers would not benefit from the boost in demand that would occur with free trade.*

The USDA Model

In a U.S. Department of Agriculture study, Roningen and Dixit used an eleven-region, twenty-two commodity world net trade model to study the economic implications of agricultural policy reform in industrial market economies. In their model, unlike that presented in this article, a region is no smaller than a country and may constitute a group of countries. The Roningen and Dixit model does not consider states or other subnational regions.

Roningen and Dixit performed their analysis in the Static World Policy Simulation Modeling (SWOPSIM) framework established by Roningen in 1986. A SWOPSIM model is characterized by three basic features. It is a nonspatial price equilibrium model, meaning that prices do not vary within regions. It is an intermediate-run static model that represents world agricultural markets for a given year, and it is a multicommodity, multiregion partial-equilibrium model. That is, although the model is international and considers many commodities, it does not take into consideration the impacts on economic sectors not directly related to the agricultural sector.

The model makes three assumptions. First, world agricultural markets are competitive. That is, countries behave as if they have no market power and cannot control world prices by withholding production. Second, domestic and foreign products are perfect substitutes in consumption; consumers do not care where their agricultural products come from, and importers do not distinguish commodities by origin. Third, even though a single geographic region may contain many countries, the model still treats the region as just one market place.

wheat, with the U.S. accounting for much of the decline in sugar production. Currently, U.S. sugar producers have an effective lobby that has acquired heavy subsidies and protection. Expanded world demand, on the other hand would stimulate an increase in livestock production.

State by state effects of agricultural trade liberalization

According to the USDA study, full multilateral trade liberalization would only slightly reduce overall U.S. agricultural output, but the composition of production would change significantly. The state by state effects of this change in production, however, could be substantial.

Like countries, states are not equally well-suited to produce all agricultural commodities. The profitability of agricultural production depends on natural factors such as soil and climate and on the proximity to large metropolitan centers or transportation.[6]

Current agricultural subsidies and trade protection generally do not affect each state's inherent efficiency characteristics.[7] Rather, these programs merely alter the costs of operation.[8] In most cases, costs have been reduced, permitting some marginally less productive farms to remain in business.

[6] *Other factors affecting production are individual state taxes and subsidies. These will remain unchanged by free trade.*

[7] *Unlike most subsidies, dairy subsidies alter the relative efficiency of production. Eliminating these subsidies would change the relative efficiency of dairy production among states. Measuring the effect of eliminating these types of farm programs is very difficult and was not undertaken in this analysis.*

[8] *Agricultural programs such as federal crop insurance and disaster assistance reduce the risks associated with recurring natural phenomena. Trade liberalization is not likely to affect this government assistance.*

The Effect of Trade Liberalization on Fruit and Vegetable Producers

Moving to a free-market economy would not require as much adjustment for the producers of fresh fruits and vegetables as it would for the producers of other agricultural commodities. Fruit and vegetable producers receive relatively little government support. And because these crops are often perishable, imported fruits and vegetables can only compete during the winter months.

Liberalizing world trade would increase demand for fruits and increase off-season import competition for vegetables. Trade liberalization is not likely to result in significant expansion of world production of most fresh fruits and vegetables. However, some shifts in trade patterns would occur, particularly for those commodities that can be stored for relatively long periods, such as apples and potatoes.

U.S. fresh fruit producers generally would benefit from the relaxation of trade barriers. These producers would increase export opportunities, particularly to Japan and other Pacific Rim countries where consumer demand is increasing. Price and production of U.S. fruits are not expected to change much and may actually increase because fruits have few production incentives and low tariff rates.

Free trade would increase import competition for some vegetable producers. Currently, fresh vegetables are produced in most states. Most of these producers would not be affected by trade liberalization because seasonal prices are low enough to discourage imports. However, states producing vegetables for consumption during the winter months, such as Florida and California, would face increasing competition from foreign sources.

Overall, trade liberalization could increase the production of fruits and vegetables because these producers receive relatively less support than producers of other commodities. Currently, resources may be attracted away from fruit and vegetable production and into more heavily subsidized commodities. With trade liberalization, fruit and vegetable production may present viable opportunities for producers seeking to diversify from crops for which they can no longer compete without government assistance.[1]

[1] Buckley (1990).

In the case of livestock, where trade protection has suppressed demand, marginally efficient ranches may have been pushed out of operation.

Liberalizing trade would not alter the characteristics that determine the relative efficiency of commodity production in each state. Liberalization would increase competition and eliminate subsidies that would, in most cases, raise the cost of operation. Profitable businesses may experience a reduction in income but would remain in operation. Marginally profitable farms may choose not to remain in operation.

To evaluate state by state impacts, I multiplied each state's 1987 value of agricultural production by the expected changes in income stemming from world liberalization, as derived from the USDA study by Roningen and Dixit. The results simulate the income changes that would have been expected if free trade had occurred in 1987.

The USDA study determined that worldwide elimination of market-distorting subsidies and barriers would increase consumer prices for most agricultural products. Price increases would be greatest for lamb and corn, with both increasing around 15 percent. Prices for sugar and dairy products would decline. Currently, government policies hold prices for these latter products artificially high to help pay producer subsidies.

For most crops, rising consumer prices would increase farm income from product sales, but not by enough to compensate farmers fully for the loss of agricultural support. While gross income would decline for many producers, farm policy liberalization would also lower some types of production costs, thereby slightly mitigating liberalization's effects on net farm income. As an example, agricultural policy liberalization is likely to lower the price of farmland, for reasons discussed later in this article.

According to the USDA study, current subsidies and trade barriers encourage U.S. farmers to overproduce many grains and to underproduce pork, beef, lamb, and oilseeds. Multilateral trade liberalization would reduce income from most crops and increase income from most livestock. Because each state specializes in the production of a different mix of crops and livestock, changes in income and output would affect each state differently.

Some states already specialize in producing commodities for which multilateral trade liberalization would increase income, but in most states overall farm income would decline (*Figure 1*). The greatest declines in agricultural income would be in states that produce large quantities of sugar, rice, or other subsidized crops but not much livestock.

In general, the farm economies of most states would realize little or no effect from agricultural trade liberalization if 60 percent or more of the state's agricultural income comes from the production of livestock. Livestock production is important because the greatest increases resulting from free trade would be in producer prices, output, and income from the production of livestock. The reason is because beef producers are among those least affected by the U.S. market distortions currently imposed by farm subsidies and would therefore benefit from the elimination of trade protection. Beef producers also would benefit from a multilateral elimination of protection because it could allow them to sell more to foreign markets.

The most negatively affected states. With free trade, fourteen states would reduce agricultural income by 7 percent or more. These states produce large volumes of subsidized or protected crops and low volumes of livestock. Increases in livestock production in these fourteen states would likely not be sufficient to compensate for the reduced production of subsidized commodities.

Hawaii, Louisiana, and North Dakota would have the largest reductions in agricultural income, with declines greater than 20 percent. Currently, more than 35 percent of agricultural income in each of these states comes from the production of grains, cotton, sugar, and rice. Producers of these crops receive large subsidies and trade protection that artificially raise income and producer prices. Elimination of farm support and protection would reduce producer prices, output, and income from these crops.

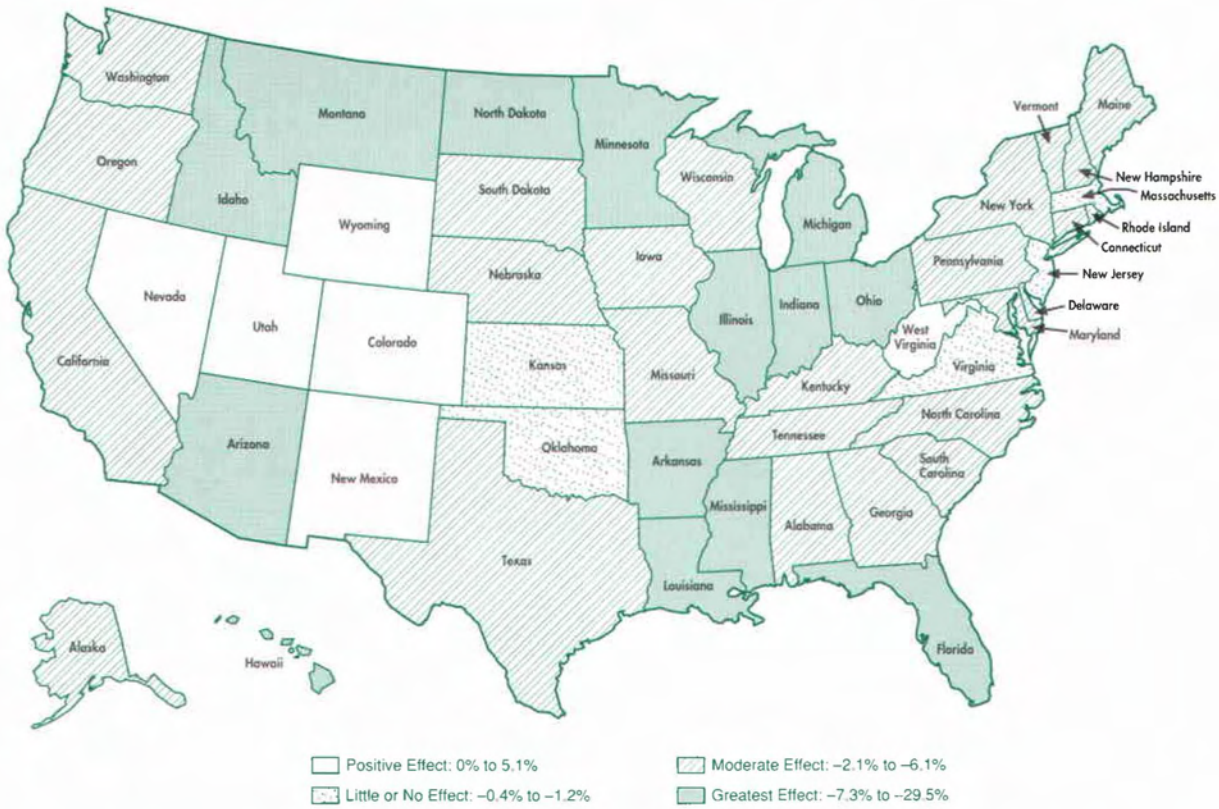
Because sugar production is heavily subsidized and protected, free trade would hurt sugar-producing states, such as Hawaii, Louisiana, Florida, and Idaho. According to USDA estimates, income from sugar production would fall more than 80 percent with free trade, while output would decline more than 40 percent.

Cotton and rice production are also subsidized heavily, and income from these crops would fall 43 percent and 63 percent, respectively, with free trade. Cotton and rice prices would fall significantly because of the loss of support and protection. Producer prices for cotton would fall more than 35 percent, while rice prices would fall nearly 60 percent. Production of rice and cotton would fall about 10 percent. Louisiana would lose income from both of these crops. Reduced cotton income also would affect Mississippi and Arizona, while loss of rice income would affect Arkansas.

The states most negatively affected by free trade also would sustain income losses because of reduced output and producer prices for wheat, corn, and other coarse grains. With free trade, income from wheat production is expected to fall nearly 50 percent. Although wheat output would fall only 5 percent, the loss of government subsidy and protection would reduce producer incentive prices by 45 percent. Corn output would drop only slightly with free trade, but a nearly one-third reduction in producer prices would lower income from the production of corn 34 percent. Loss of corn income would be significant in Illinois, Indiana, and Ohio. Similarly, income from the production of other coarse grains, such as sorghum, oats, and barley, would fall more than 40 percent. Montana and North Dakota would be hurt by the

Figure 1
State by State Effects of Agricultural Trade Liberalization

Change in Gross Agricultural Income



SOURCES: Federal Reserve Bank of Dallas; U.S. Department of Agriculture; U.S. Department of Commerce, Bureau of the Census.

loss of income from wheat and other coarse grains.

Illinois, Indiana, and Ohio also would experience a nearly 10-percent loss in soybean income. A slight increase in the production of soybean output would not compensate for a 12-percent reduction in producer incentive prices.

Although their mixes of crops vary widely, many states that lose most from free trade have one common characteristic: they do not have significant livestock sectors to mitigate the income losses of their crop sectors. Hawaii and Louisiana, for example, are not likely to increase livestock production significantly with free trade because they currently do not produce much cattle, pork, or lamb. In 1987, these states received less than 10 percent of agricultural income from livestock production.

Not all the large losers fit this pattern, however. North Dakota and Montana would both significantly reduce agricultural income with free trade, despite reasonably large livestock sectors. Livestock production contributes 25 percent of agricultural income in North Dakota and 55 percent of agricultural income in Montana. Free trade would increase livestock production 11 percent, not enough to compensate for the loss

of income from heavily subsidized crops such as wheat and other coarse grains. More than 30 percent of agricultural income in North Dakota and 25 percent in Montana comes from the production of wheat. Income losses in Montana would be less severe than those in North Dakota because of Montana's relatively larger livestock sector.

Little effect on some states. Free trade would have little or no effect on agricultural income in Kansas, Massachusetts, New Jersey, Oklahoma, Rhode Island, and Virginia. More than 60 percent of agricultural income in Kansas and Oklahoma already comes from the production of livestock products. Increased income from the production of cattle, hogs, and sheep would compensate for reduced income from wheat, corn, and other coarse grains. Slightly more than one-fourth of agricultural income in Virginia comes from the production of livestock. Although Virginia does not produce large amounts of corn or cotton, reductions in dairy and poultry income would mitigate increases in livestock income. Massachusetts, New Jersey, and Rhode Island produce very little livestock but also do not produce significant amounts of heavily subsidized or protected crops. Roughly 60 percent of agricultural income in all three states comes from the production of nursery products, fruits, and vegetables.

Which states benefit from free trade? Free trade would increase gross agricultural income in six states: Colorado, Nevada, New Mexico, Utah, West Virginia, and Wyoming. Overall, agricultural producers in these states are currently being hurt by world trade protection and subsidies. Nevada, Utah, and West Virginia produce little or no heavily subsidized crops such as cotton, sugar, wheat, or other coarse grains. Colorado, New Mexico, and Wyoming receive a small amount of agricultural income from subsidized crops. All these states already have large livestock sectors that contribute more than 40 percent of agricultural income. With free trade, these already large sectors would expand and benefit. Currently, beef, pork, and lamb production receive virtually no subsidy, and trade barriers limit U.S. producers' access to foreign markets. Increased foreign demand for beef, pork, and lamb would bolster livestock prices. These increases would more than compensate for rising feed grain prices.

Income from the production of sheep and lamb would increase nearly 25 percent with free trade. Production would increase 9 percent, while producer prices would increase 14 percent. Wyoming and Utah, the largest U.S. producers of mutton and lamb, would benefit. Income from the production of beef would increase 11 percent, and income from the production of pork would rise 8 percent. Both would benefit from moderate increases in price and output. Iowa, Indiana, and Illinois would benefit from increased income from the production of hogs, while Wyoming, Kansas, Oklahoma, Colorado, New Mexico, Texas, Nevada, Nebraska and Montana would increase income from the production of cattle and calves.

Effects on the rest of the nation. Agricultural income in the remaining twenty-four states would decline 2 percent to 6 percent with free trade. These states derive less than 25 percent of their agricultural income from crops that would have large reductions in income with free trade. Most of these states also do not have large livestock sectors.

Nebraska, South Dakota, Texas, Iowa, and Missouri have livestock sectors that contribute more than 40 percent of agricultural income. But as could be expected, these states also produce large amounts of grains, cotton, and rice, which would offset income gains in the livestock sector.

Vermont, Wisconsin, New York, and New Hampshire would moderately reduce income from the production of dairy products because of a slight drop in output and a 12-percent drop in producer prices. Kentucky and the Carolinas would have a slight reduction in tobacco production because the loss of subsidies would reduce tobacco prices and income about 5 percent.

Income from the production of poultry products would decline only slightly because production does not receive much support or protection. Delaware, Alabama, Arkansas, Maryland, and Georgia specialize in the production of poultry.

Effects on the price of farmland

Because the price of farmland reflects its income potential, Figure 1 can also be interpreted as a guide to changes in farmland values. Presently, the price of farmland is artificially high in

most states. Because farm support programs increase agricultural income, they raise returns to agricultural land, and therefore its price. The expected changes in various agricultural sectors would have parallel effects in the value of farmland. Reductions in crop income would push down the price of cropland, while increases in livestock income would increase the value of ranchland.

Also, farm programs have removed a great deal of agricultural land from production, boosting land prices by reducing the supply of useable farm acreage. The elimination of output restriction programs would return currently unused agricultural land to production. As a result, the total supply of agricultural land would increase, lowering farmland prices.

Despite a slight decline in overall output, rising market prices would increase the net value added by agriculture and improve the U.S. balance of trade. According to USDA estimates, full multilateral agricultural trade liberalization would increase U.S. nominal agricultural gross domestic product between 15 percent and 20 percent. Further, world farm trade liberalization would improve the U.S. agricultural balance of trade by $3 billion, or nearly 25 percent. Most of this improvement would result from decreases in beef import costs and increased revenues from grain exports made possible by rising world prices. The United States would reduce its exports of grains but increase its exports of meats. Sugar imports would increase.

Although agricultural trade liberalization would reduce agricultural income in most states, the agricultural sector generally is very small. Consequently, sectoral income losses would not cripple state economies. South Dakota, Nebraska, Idaho, and North Dakota have the largest agricultural sectors (*Table 2*). But even in these states, other sectors would benefit from increased resources, which would mitigate losses. States such as Louisiana and Hawaii that would suffer large agricultural income losses from free trade could benefit overall from increased output in the rest of the economy. Both states' agricultural sectors are small contributors to the overall output of their state.

Winners and losers in the nonagricultural sectors of the economy

Free trade in agriculture would benefit most nonagricultural sectors of the U.S. economy because resources that had been attracted to agriculture through subsidies and protection could be invested in other sectors. But the nonagricultural sectors currently benefiting from agricultural subsidies would be hurt by the elimination of protection and subsidies.

More than 35 percent of the beneficial distortionary effects of farm subsidies accrue to nonagricultural sectors of the economy through the lower cost of subsidized commodities.[9] For example, agricultural subsidies hold down input costs to the food processing and apparel industries. The transportation, warehousing, insurance, and retailing sectors also benefit from subsidized commodity prices and the artificially high production they motivate. Free trade would increase input costs for some industries and reduce demand for other industries. Income would decline for all these industries.

For example, a manufacturing firm whose inputs include agricultural commodities would face higher input prices for some commodities under free trade. These increased costs would lead to slight declines in income and output for many food processing, canning, apparel, and textile firms. Reduced agricultural output would reduce demand for services, wholesale and retail trade, as well as demands for banking and insurance firms that focus on agricultural markets.

Producers using livestock byproducts would experience an increased supply and fall in price, which would boost income and output. Transportation of livestock would increase, although transportation of crops would decline.

Conclusion

Free trade in agriculture would remove government farm subsidies and protection, reducing income for most U.S. crop producers

[9] *Kilkenny and Robinson (1990, 548).*

Table 2
Agriculture's Share of Gross State Product for the 50 States, 1989

State	Percent	State	Percent
South Dakota	14.4	**United States**	**1.9**
Nebraska	12.2	Hawaii	1.8
Idaho	10.9	Georgia	1.8
North Dakota	10.2	California	1.8
Iowa	8.7	Utah	1.7
Montana	7.2	Tennessee	1.7
Arkansas	5.8	Illinois	1.7
Kansas	5.1	Texas	1.7
Minnesota	4.0	Maine	1.5
Oklahoma	3.9	South Carolina	1.3
Oregon	3.7	Michigan	1.1
Wisconsin	3.6	Virginia	1.1
Kentucky	3.4	Louisiana	1.1
Mississippi	3.4	Pennsylvania	1.0
Washington	3.1	Ohio	1.0
Colorado	2.7	Maryland	.9
Vermont	2.6	Nevada	.7
Indiana	2.4	West Virginia	.7
North Carolina	2.4	New Hampshire	.5
New Mexico	2.3	New York	.5
Florida	2.3	Rhode Island	.4
Alabama	2.2	Connecticut	.4
Missouri	2.2	Massachusetts	.3
Wyoming	2.1	New Jersey	.3
Delaware	2.0	Alaska	.1
Arizona	2.0	District of Columbia	0

SOURCE: Bureau of Economic Analysis, U.S. Department of Commerce.

and increasing income for U.S. livestock producers. In this article, I analyzed the regional effects of multilateral trade liberalization. Effects would be significantly different with unilateral or bilateral liberalization. Generally, world price increases would be less with unilateral liberalization. Consequently, agricultural income losses would be greater. World prices would increase as more countries liberalize. Thus, agricultural income losses are mitigated the most under multilateral liberalization.

With multilateral liberalization, agricultural income would increase in a few states, although farm income would decline in most states. While adjustment for individual farmers could be significant, for most states income losses in the agricultural sector would likely be mitigated or compensated by increased income in the nonagricultural sector. Overall, U.S. output and income would increase despite the loss of farm income and increases in many commodity prices. The United States would benefit because resources would be reallocated to their most efficient uses.

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