Economic Review
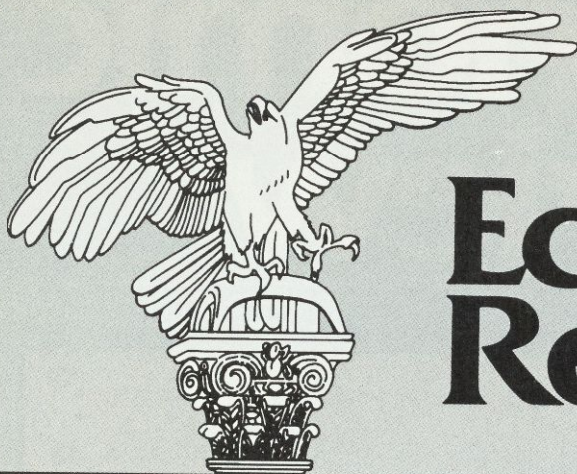
MORTGAGE-BACKED SECURITIES
Analyzing Risk and Return

U.S. Population Migration

New Farm Bill Provisions

Economic Review

Analyzing Risk and Return for Mortgage-Backed Securities

Mortgage-backed securities and their derivative products have become a major component of banks' and other financial firms' investment holdings. Calculating risk and return measures for these securities is complicated by the fact that homeowners have an option to prepay their debt obligation at any time. Because this prepayment option increases the risk of lower returns, new methods have been developed for adjusting the yields on mortgage-related instruments. The author describes one of these techniques—the option adjusted spread approach—which, unlike more conventional methods, adjusts for both the timing and level of potential prepayment.

Stephen D. Smith

T he growth of an active secondary market for home mortgages was one of the many important innovations in financial markets over the past decade. Although organizations such as the Federal National Mortgage Association (FNMA or "Fannie Mae") have been buying securities backed by the Veterans Administration and the Federal Housing Administration for decades, only recently have mortgage-related securities become an integral component of financial statements for a number of banks and other intermediaries.[1] The growth of these securities has led to a dazzling array of derivative and hybrid products produced by repackaging the basic cash flows from a pool of fixed-rate mortgages.[2] Equally bewildering to potential investors in these products is the technology invented to calculate adjusted yields or, equivalently, adjusted spreads over Treasury yields.

Yield adjustments for mortgage-backed securities, or MBSs, are necessary primarily because of the law allowing homeowners to prepay the principal balance on their mortgages without penalty.[3] Since such prepayments occur primarily when market rates fall substantially below existing coupon rates (that is, contract rates) on the mortgages, investors in the mortgages face the risk that, after having paid a premium for a high coupon security, they will be saddled with money that must be reinvested at lower (current market) rates. Investment banks and other financial firms have developed methods for adjusting the yields on mortgage-related instruments to reflect this possibility of prepayments and the corresponding lower yields.

Regulators are becoming cognizant of these issues as they build a framework for analyzing the risk profiles of an increasingly large pool of securi-

ties with unconventional cash flow characteristics. Indeed, the Comptroller of the Currency has recently provided some specific guidelines for the holdings of collateralized mortgage obligations (see William B. Hummer 1990).

The purpose of this article is to provide a nontechnical introduction to the methods used to analyze the risks and returns associated with investing in mortgage-related securities. This information should help potential investors better compare the cash flow and yield measures for mortgage-backed securities with those on alternative investments.

The Prepayment Problem

The problem of prepayment on a mortgage (an asset) is in some ways the reverse of the problem of early withdrawal of a fixed-rate certificate of deposit (CD; a liability). Imagine that a banker has issued a fixed-rate CD for some period of time, and suppose the depositor has the right to withdraw his or her funds at any time before maturity, without penalty. The depositor might withdraw early for two general reasons. If market rates on CDs rose substantially above the current rate on the CD, the CD holder might choose to withdraw early and reinvest the funds in a higher-yielding account. Whether funds are actually removed or simply rolled over into a new account at the current bank, the banker will be replacing this relatively low-cost CD with funds that will cost substantially more than the old deposit. The second reason for early withdrawal would fall into a "catch-all" category that includes noninterest factors like the depositor's moving or developing an unexpected need for funds. In either case, the bank suffers a cost if it imposes no early withdrawal penalty.

Prepayment on a mortgage is analogous to the CD example and may occur because rates fall substantially below the mortgage rate the homeowner is paying. Prepaying the mortgage for this reason is called "rational exercise" of the option. Exercising the prepayment option in other cases (such as moving for a new job) is called "irrational exercise" because such behavior is not tied directly to interest savings.[4]

Rational exercise of prepayment options forces mortgage holders to reinvest their funds at rates substantially below those they would have earned if prepayment had not occurred. Moreover, since mortgages typically have maturities much longer than those of most other assets or liabilities, the earnings loss is felt over a longer period of time. Uncertainty concerning repayment of principal makes conventional yield measures unreliable indicators of the return to be expected from holding mortgage-backed securities, as discussed below.

Shortcomings of Static Yield

Assuming that payments are guaranteed against default by a government agency such as the Government National Mortgage Association (GNMA or "Ginnie Mae"), a standard fixed-rate mortgage is, in the absence of the prepayment clause, nothing more than an annuity contract. Given a remaining life, a market price, and the promised payments per period, it is possible to find the contract's yield to maturity (YTM), or "static" yield. Static is used to denote the fact that an investor will earn the yield to maturity per period if all of the promised payments are made when due and are reinvested at the same rate (that is, rates do not change over the life of the loan). The latter condition is a well-known shortcoming of using the yield-to-maturity method to calculate the expected return on any security. It is the first condition that makes the yield-to-maturity approach particularly unattractive for analyzing mortgage-backed securities. In short, the static yield treats the payments from a mortgage-backed security as a sure thing over time, which they clearly are not.

The static yield approach will also distort calculations commonly used to measure the interest-rate risk of a security. Duration and convexity are two such measures. However defined, the duration of a fixed-income security is basically a measure of the percentage change in a security's price if interest rates change by a small amount.[5] Securities with shorter durations experience smaller price decreases, in percentage terms, for a small increase in rates than do securities with longer duration. Likewise, smaller increases occur for shorter duration securities when rates decrease.

However, duration is itself a function of the level of interest rates. In fact, duration declines as interest rates rise (and vice versa) for standard fixed-income securities. This relationship is simply a result of the fact that price changes are not symmetric. The percentage change in bond prices as rates increase is smaller than the price changes associated with equal rate decreases. Thus, the risk measure (duration) is

inversely related to the interest-rate level. *Convexity* is the term usually applied to this "drift" in the duration. However, unlike fixed-income securities, mortgage-related securities' prepayment option makes cash flows a function of interest rates. Risk measures such as duration need to be adjusted to reflect this fact.

To summarize, the standard yield-to-maturity approach for calculating risk and return is inadequate when analyzing mortgage-related securities primarily because prepayment risk causes cash flows to be a function of interest rates and other factors. By treating the promised cash flows as certain, an investor is likely to overstate seriously the return from holding mortgage-backed securities. The option adjusted spread (OAS) approach discussed in the following section is an attempt to adjust the cash flows to reflect prepayment risk.[6]

The Logic of the Option Adjusted Spread Approach

The basic premise of the option adjusted spread approach is that prepayments, and therefore cash flows, will be a function of both the evolution of interest rates and other (for example, demographic) factors that could cause irrational prepayments on pools or portfolios of mortgages. A distribution of future cash flows (or prices) is generated by assigning probabilities to plausible alternative future interest-rate scenarios. Finally, in a step analogous to finding the discount rate (the static yield) that equates the present value of the promised cash flows to the current price, a yield measure can be found that equates the average present value of these option adjusted cash flows to the current price. The difference between this adjusted yield and that on a base security—a comparable duration Treasury bond, for example—is considered the option adjusted spread. Although this analogy is not exactly correct unless the yield curve is flat (see the appendix for general definitions of option adjusted spread), the general idea is that similar calculations result in a yield measure for mortgage-backed securities that has been adjusted for the expected level (and timing) of prepayments over the life of the mortgage pool.[7]

The critical steps to be taken in the option adjusted spread process appear in Chart 1. Although each practitioner is faced with a number of specific choices (some of which are discussed below), the steps outlined in Chart 1 must be followed for almost all of the option adjusted spread models currently in use.

Raw input is provided from a number of sources. Interest rate information is gathered from the current Treasury term structure of interest rates or yield curve. Typically, the implied one-period future interest rates (or forward rates) from the Treasury curve are used as the mean, or expected value, around which a distribution of future short-term interest rates is constructed.[8] Future mortgage rates are either constructed as a markup over the short-term rates or, in more complex models, a markup over a long-term Treasury rate that does not move exactly in concert with short-term rates. A volatility (or variance) estimate is also needed to construct a distribution of future interest rates. This parameter restricts the degree to which rates may deviate from the current term structure (the mean). Estimated prepayments are critically dependent on the volatility estimates, which may come from historical data or more exotic forms, such as implied volatilities from options contracts.

Prepayments are estimated as a function of the deviation of current coupon rates in the mortgage pool from estimated market rates and other currently available information such as the average age of the mortgage pool and other known factors (for example, the region of the country in which the mortgages originated). Future cash flows are then generated as a function of the evolution of interest rates and the demographic factors. The fact that future cash flows are dependent on the entire interest rate process is commonly referred to as *path dependency*.

Consider the case in which a downward movement in mortgage rates will prompt a prepayment. If rates increase next period and return to their original level in period two, no prepayment will occur. By the same token, if rates should fall next period and then increase to their original level, prepayment will occur. The level of rates in period two is the same in both scenarios, but the cash flow in period two is not. In this case the period two payment is either the promised payment or zero and is clearly a function of earlier interest rates (in this case interest rates in period one). Therefore, each path of rates can generate a different cash flow pattern for the mortgage.

The next step in the process is to find a constant discount factor which, when applied to every path of future short-term Treasury rates, equates the cash outflow's present value (the current market price of the mortgage) to the average present value of the cash inflows. This constant discount factor is the option adjusted spread.

The final step in Chart 1 involves shocking interest rates up and down by some amount. Combined with the current price, the new prices provide sufficient information to calculate option adjusted duration and convexity measures.

Chart 1
Steps in Option Adjusted Spread Calculation

```
┌──────────────────────────┐                    ┌──────────────────────────┐
│  Current Treasury Curve   │                    │      Rate Volatility      │
│         (Mean)            │────────────────────│        Estimates          │
│                           │         │          │       (Variance)          │
└──────────────────────────┘         │          └──────────────────────────┘
                                      ▼
                          ┌──────────────────────┐
                          │    Distribution of    │
                          │    Interest Rates     │
                          └──────────────────────┘
                                      │
┌──────────────────────┐             │
│  Other Prepayment     │─────────┐   │
│     Factors           │         ▼   ▼
└──────────────────────┘   ┌──────────────────────┐
                           │     Prepayment        │
                           │       Model           │
┌──────────────────────┐   └──────────────────────┘
│  Security-Specific    │             │
│   Information:        │─────────────┤
│   Coupon Rate,        │             ▼
│   Maturity, etc.      │   ┌──────────────────────┐
└──────────────────────┘   │  Possible Cash Flows  │
                           │  from Mortgage Security│
                           └──────────────────────┘
                                      │
                                      ▼
┌──────────────────────┐   ┌──────────────────────┐
│   Market Price of     │   │  Find Spread over Trea-│
│  Mortgage Security    │──▶│  sury Rates Such That  │
│                       │   │  Market Price = Present│
│                       │   │   Value of Cash Flows  │
└──────────────────────┘   └──────────────────────┘
                                      │
                                      ▼
                           ┌──────────────────────┐
                           │  Option Adjusted Spread│
                           └──────────────────────┘
┌──────────────────────┐             │
│   Shock Rates Up      │─────────────┤
│     and Down          │             ▼
└──────────────────────┘   ┌──────────────────────┐
                           │  Calculate Duration   │
                           │    and Convexity      │
                           └──────────────────────┘
```

Computational Choices

The procedure outlined in Chart 1 has at least two different versions, depending on the practitioners' choice of techniques for generating interest rates and discounting the cash flows.

Interest Rates. Probably the most widely used approach for generating a distribution of interest rates is the simulation method. Using forward rates embodied in the term structure as the means, the investigator inputs a variance estimate and draws a series of short-term rate paths. Resulting cash flows are generated and the process is repeated for another drawing from the distribution of rates. The simulation approach is sometimes ad hoc in the sense that the method need not be based directly on a rigorous link to the term structure of interest rates.[9] An alternative is given by the binomial, or lattice, approach, which starts with today's term structure and assigns probabilities to scenarios wherein rates increase or decrease (or possibly remain the same). Cash flows are calculated at each point in the interest rate tree. (See the next section for an example.) A volatility estimate is needed for this technique as well, because it determines the amount by which rates are allowed to vary from point to point.

Discounting. The most intuitively appealing method for discounting involves finding the expected cash flow for each period (over all possible rates) and discounting back at rates contained in today's Treasury curve. However, the most popular method in use today (see, for example, Alan Brazil 1988) involves discounting back each cash flow at the simulated rate (as opposed to today's term structure rates). To the extent that rates and cash flows are correlated—correlation being the whole premise of rate-sensitive cash flows—the two techniques will yield different results. An example in the next section illustrates the difference between these approaches.

Properties of the Option Adjusted Spread. The foremost benefit of the option adjusted spread approach is that it provides a yield measure that more accurately reflects the timing and level of payments that an investor might expect to receive from holding a mortgage-backed security. A second advantage is that risk measures calculated from prepayment adjusted cash flows provide a better indicator of the security's true interest-rate risk properties. For example, although the price of a standard fixed-income security will vary inversely with the level of interest rates, it is possible for prepayment adjusted prices to change in the same direction, no matter which way rates move. The key to this concept is that, should rates fall, the possibility of mortgage prepayments may go up, in which case investors may bid *down*

the mortgage-backed security's price. This action is, of course, the opposite of what would happen with a truly fixed-income security like a Treasury bond. This "whipsaw" effect is particularly evident in mortgage-backed securities that are selling at a premium from par value.

Finally, the option adjusted spread methodology is often put forth as one method for identifying "rich" (overpriced) and "cheap" (underpriced) mortgage-backed securities. Typically, the option adjusted spread on securities with similar adjusted durations and coupons are compared. Matching durations is an attempt to hold constant the differences in the risks of the assets. Note, however, that such comparisons tell the investor nothing to give direction about whether he or she should purchase *either* of the securities.

Suppose, for example, that the yield for a stream of expected cash flows is greater than that for a comparable duration Treasury security. This situation is analogous to the case of a positive option adjusted spread (OAS > 0). A risk neutral investor—one who demands no compensation for the variability of the cash flows (read "variability of prepayments")—would certainly find such an investment attractive. However, a positive option adjusted spread alone would not generally provide a risk averse investor with enough information to determine whether or not the extra yield would exceed the investor's desired risk premium.

Another (and equivalent) way to view this ambiguity is to recognize that if two mortgage-backed securities have the same expected cash flows but the variability is greater for, say, the second one, risk-averse investors will bid a lower price for the second mortgage-backed security. The result will be that the second mortgage-backed security has a higher option adjusted spread. The meaning is clearly not that the second security is a better one, however. In short, establishing that the expected return on a risky security is greater than the Treasury rate, or even greater than the expected return on some other security of comparable risk, does not imply that it is a good buy unless you happen to be neutral toward risk (because it could be the case that neither of the securities has a high enough premium to cover its risk). Such "risk neutral" information is exactly the sort the option adjusted spread methodology provides.

Examples of Option Adjusted Spread Technology

In the following examples, noninterest rate "irrational" factors that might influence prepayments are

ignored for simplicity. Moreover, for simplicity the examples will deal with a case where the term structure is flat.

Consider a mortgage-backed security for which the underlying fixed-rate mortgages are identical. The total principal balance on the pool is $1,000,000, and the mortgages carry an 11 percent coupon and have a maturity of four years. The latter assumption, while unrealistic, allows analysis of the process without changing the qualitative results. Promised payments on this annuity contract amount to $322,326 per year. Shortly after issue, rates decline in such a fashion that the mortgage pool is now selling for a current market price of $1,044,246.

It is always possible to find a rate, the static yield, that will discount back the promised cash flows to the current market price. In this case the rate turns out to be 9 percent (see the appendix). If Treasury rates are 8 percent, the "static spread" is 9% − 8% = 100 basis points. Assume that because of refinancing costs and other factors prepayment will not occur unless the spread between the coupon rate and market rates on mortgages is 300 basis points (3 percent). In this case prepayment will occur if mortgage rates are less than or equal to 11% − 3% = 8%.

Interest Rates. A simple binomial (or two-state) process is used to model changes in interest rates.[10] Rates can move up and down with equal likelihood from their current levels. The assumed change is equivalent to a rate volatility estimate. Let this be 50 basis points. In this situation, mortgage rates will be either 9.5 percent (9% + .5%) or 8.5 percent (9% − .5%) next year. In year two rates will be either 9.5 percent ± .5 percent or 8.5 percent ± .5 percent. So in year two there is a 25 percent [(.5)(.5)] chance that rates will be either 10 percent (go up twice) or 8 percent (go down twice) and a 50 percent chance the rates will return to 9 percent (that is, a 25 percent chance they will increase and then decline and a 25 percent chance they will decline and then increase). Chart 2 provides a graphic representation (a "tree") of all possible rates over the four-year life of the mortgage pool.

Cash Flows. In any given year the realized cash flows will be either (a) the promised payment ($322,326), (b) the promised payment plus prepayment of the remaining principal ($322,326 + principal balance) or (c) zero. Case (b) occurs if and when mortgage rates fall below 8 percent, while case (c) is the cash flow in subsequent periods should prepayment take place.

Chart 2
Interest Rate Tree
Current Mortgage Rate = 9.0%
Volatility = 50 Basis Points
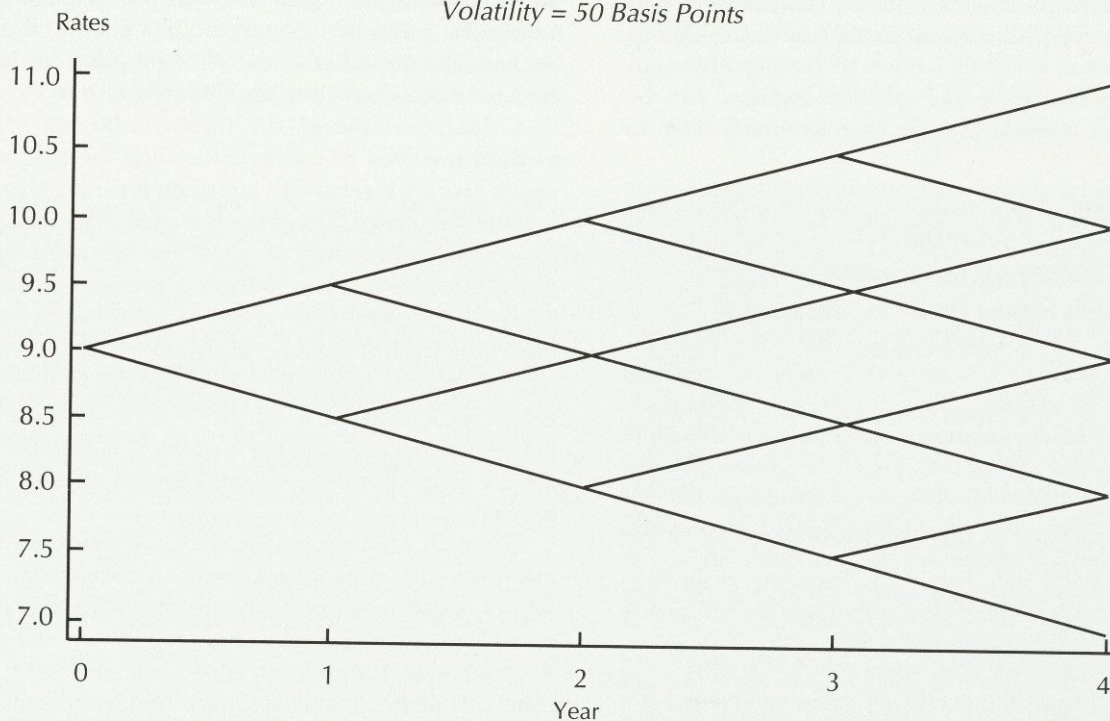
Given the volatility estimate of 50 basis points there is no chance of prepayment in period one because rates can only fall as low as 8.5 percent. The cash flow is certain to be $322,326. However, in period two there is a 25 percent chance that rates will drop to 8 percent and prepayment will occur. Should this happen, the cash flow will be $322,326 + $551,992 = 874,318, where $551,992 is the remaining principal balance on the mortgage. Once prepayment has occurred, the cash flow in years three and four will be zero.

The expected (or average) cash flow from the pool can also be calculated by multiplying each possible cash flow by the probability that it will occur. In year one, for example, there is a 0 percent chance of prepayment because rates will always be above 8 percent. Alternatively, in year two there is a 25 percent chance the mortgage rate will be 8 percent and the corresponding cash flow $874,318. There remains a 75 percent chance the rates will be above 8 percent and the cash flow will be $322,326. Thus, the expected cash flow is $874,318 (.25) + $322,326 (.75) = $460,324. Table 1 provides the possible and expected cash flows by period.

In this special case, the option adjusted yield can be calculated by finding a discount factor that equates the discounted value of the expected cash flows (see Table 1) to the current price. The rate that solves this discounting problem is about 8.85 percent, somewhat less than the static yield of 9 percent. Finally, the option adjusted spread in this simple example is given by subtracting the Treasury rate (8 percent) from the adjusted yield; the option adjusted spread is 8.85% – 8% = 85 basis points.

This importance of the volatility measure can be seen by first considering the case in which rates in each period can change by only 25 basis points rather than 50. The mortgage rates now have no chance of falling to 8 percent before the mortgage matures. Therefore, the expected cash flow is $322,326 in every period and the option adjusted spread will be the same as the static spread (100 basis points). Alternatively, the option adjusted spread is actually negative (–12 basis points) if the volatility estimate is doubled to 100 basis points.

Option adjusted spread estimates are also extremely sensitive to the discounting method used by the investigator. The calculation procedure described above can be viewed as a "discounted average cash flow" approach. Alternatively, as mentioned earlier, many investment houses prefer what could be called an "average discounted cash flow" (or average price) approach. This method differs from the discounted average cash flow approach because the cash flows are discounted back at the realized interest rates in Chart 1, as opposed to today's rate. In this case, low cash flows are, on average, associated with lower discount rates (the prepayment problem) and vice versa for higher rates. The net result is that the option adjusted spread will be different (typically lower). For this particular example the option adjusted spread is actually a negative 2 percent (–200 basis points) when using the average price method.

The appendix contains equations (2) and (3), which show the mathematical distinction between the approaches.[11] This rather large difference in results comes from the fact that the high cash flows are discounted at higher rates in the average price approach.[12] The benefits are not symmetric, though, because the zero cash flow after prepayment is still zero no matter how low the discount rate is.

A final example of the option adjusted spread method involves its use in calculating the risk an investor faces for relatively large interest-rate changes. A potentially useful exercise is to see how mortgage prices would change if rates are shocked up or down by some amount in the current period. For example, if Treasury and mortgage rates increased immediately by 100 basis points, there would be a zero chance that the mortgage rate could fall to 8 percent before year four (that is, 9% + 1% = 10% and the volatility is 50 basis points a year). It is possible, using the original option adjusted spread, to calculate a new price.

Consider, for simplicity, the average cash flow method. The option adjusted spread is 85 basis points, while current mortgage and Treasury rates are 9 percent and 8 percent, respectively. Suppose rates increase immediately to 10 percent and 9 percent, respectively, and volatility remains constant at 50 basis points. Then, using the average cash flow method, the new price is $1,025,057, which is less

Table 1
Possible and Expected
Cash Flows from Mortgage by
Period

Period	Possible Cash Flow	Expected Cash Flow
1	$322,326	$322,326
2	$322,326 or $874,318	$460,324
3	$322,326 or $0	$241,745
4	$322,326 or $0	$241,745

than $1,044,246 because the present value of the future cash flows has been reduced.

Alternatively, if rates should immediately fall by 100 basis points, prepayment will occur as soon as possible (probably in period one), because the new mortgage rate is 8 percent. In this case the new price is $1,029,208, which is also lower than the original price. This whipsaw effect occurs because the lower interest rate causes earlier prepayment, more than offsetting the present value added from having a lower rate with which to discount back the cash flows. These examples should make clear that, while it is conceptually an averaging technique, the actual option adjusted spread is extremely sensitive to a variety of input and methodological decisions practitioners make.

Conclusion

The calculation of yields on mortgage-backed securities is complex primarily because of the difficulty of valuing an owner's option to prepay the mortgage. Despite their computational complexities, current approaches to mortgage valuation are still just averaging techniques. As shown in this article, cash flows, and therefore returns, depend on the entire path of interest rates; that is, they are path dependent. Therefore, the interest-rate history over the life of a mortgage-backed security is an important piece of information. An additional complicating factor arises from the difficulty in determining whether a mortgage that looks "cheap" is really undervalued or whether it is selling at a discount because of above-average risk. Two other caveats merit attention. It is possible, especially for mortgage securities selling at premium above par, to encounter interest-rate changes that "whipsaw" the investor; that is, prices may fall if rates either decline or increase. The adjusted yield measures can be very sensitive to the inputs used—for example, the assumed volatility of interest rates.

The option adjusted spread has become a favored technology for dealing with this problem because it adjusts for both the timing and level of potential prepayments. In fact, the approach can be used in a variety of settings because many assets and liabilities have options of some sort embedded in their structure.[13]

While potentially useful, the option adjusted spread is not a panacea for investors hoping to find undervalued assets on a risk-adjusted basis. No formal model currently provides a basis for decomposing the option adjusted spread into compensation for risk and excess returns. Viewed properly as a yield (or yield spread over Treasury), however, the option adjusted spread measures are probably clearer indicators of the likely return than conventional static yield calculations. The trade-off here involves the option adjusted spread's sensitivity to inputs (such as volatility and the prepayment model) and the valuation framework the investigator employs. Potential purchasers, as well as regulatory personnel, should be aware of these facts. Asking potential sellers for information concerning the actual risk/return profiles of previously analyzed mortgage-backed securities would be useful in this regard.[14]

Appendix

This appendix contains the general formulas used for calculations in the text. As noted below, the actual examples usually involve simplified versions of these equations (for example, the term structure is flat).

M = market price of the mortgage-backed security
C = promised payment per period on a fixed-rate contract
Y = static yield to maturity
N = remaining maturity of the contract

The static yield is the rate that equates the present value of the promised cash inflows (Cs) to the current market price. That is, Y solves

$$M = \frac{C}{(1+Y)} + \frac{C}{(1+Y)^2} + \ldots + \frac{C}{(1+Y)^N}. \quad (1)$$

If G is the yield on a comparable maturity (more specifically, duration) Treasury security, the static spread is just $Y - G = S$. For the example in the text, $C = \$322,126$; $N = 4$; $M = \$1,044,246$, so $Y = 9\%$ and $S = 9\% - 8\% = 1\%$.

More notation and calculations are needed to calculate the option adjusted spread. Let f_t = one-period forward rate for government securities in period t, $f_t = (1 + R_t)^t/(1 + R_{t-1})^{t-1}$, where R_t is the current spot rate for a government security that makes one payment in period t and zero otherwise. Define r_t = actual interest

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rate on one-period government securities in period t. Note that this number is unknown today if $t > 1$. With this notation, $f_1 = r_1 = R_1$. Finally, let C_t = actual cash flow realized from the mortgage in period t. Notice that there are two general cases: $C_t = C$ (promised payment) if there is no prepayment, or $C_t = C$ + remaining principal balance $> C$ if there is prepayment. In this case $C_{t+1} = C_{t+2} = \ldots = C_N = 0$. For notational purposes let $E(\bullet)$ denote expectation (or expected value) of the term inside the parenthesis. The expected value of x, for example, is given by the sum of the possible outcomes for x, multiplied by the probability that each outcome will occur. There are two approaches to calculating the option adjusted spread.

Expected Cash Flow Approach

Search for a discount factor, O_c, such that O_c solves

$$M = \frac{E[C_1]}{(1+f_1+O_c)} + \frac{E[C_2]}{(1+f_1+O_c)(1+f_2+O_c)} \quad (2)$$

$$+ \ldots + \frac{E[C_N]}{(1+f_1+O_c)(1+f_2+O_c)\ldots(1+f_N+O_c)}.$$

The term $E[C_t]$, $t = 1, \ldots 4$ is given by the right-hand column of Table 1. These terms can be calculated by multiplying the possible cash flows by the probability that rates will be above or below the cutoff rate for prepayment. In particular, with equal probabilities (.5) of an increase or decrease in rates and volatility = 50 basis points, $E[C_1] = \$322,326\,(1)$. Because there is a 25 percent chance $[(.5)(.5) = .25]$ that the Treasury rate will fall to 7 percent in year two (mortgage rate = 8%), the expected cash flow in period two is given by multiplying the possible cash flows in Table 1 by their respective probabilities. This calculation gives the expected value, or $E[C_2] = \$322,326\,(.75) + \$874,318(.25) = \$460,324$. Likewise, because the cash flow in period three is zero if prepayment occurs, the expected cash flow in this case is $E[C_3] = \$322,326(.75) + \$0\,(.25)$. The expected cash flow in period four will be the same, so $E[C_4] = \$322,326(.75) + \$0\,(.25)$. Solving (2) for the option adjusted spread yields $O_c = 85$ basis points. Notice that when the term structure is flat, the forward rates will be the same. Thus, solving (2) is the same, in this case only, as the simpler approach used in the text—solving for the yield first and then subtracting the (constant) Treasury rate.

Expected Price Approach

Find a discount factor, O_p, that solves the following equation:

$$M = E\left[\frac{C_1}{(1+r_1+O_p)} + \frac{C_2}{(1+r_1+O_p)+(1+r_2+O_p)} \right. \quad (3)$$

$$\left. + \ldots + \frac{C_N}{(1+r_1+O_p)(1+r_2+O_p)\ldots(1+r_N+O_p)} \right]$$

In this case the rs are the realized one-period Treasury rates from the tree in Chart 2. For this example, the current Treasury rate is 8 percent and the term structure is flat; therefore, $r_1 = 8\%$. However, next-period rates will be either 7.5 percent or 8.5 percent, so $r_2 = 7.5\%$ with probability (.5) and $r_2 = 8.5\%$ with probability .5. Interest rates for future periods are calculated in a similar fashion. The possible Cs are found in the first column of Table 1. Using (3), O_p can be calculated as $O_p = -2.0\%$ or -200 basis points.

Calculating New Prices

The new prices are calculated by fixing O_c (or O_p), adding a constant amount ($\pm$ 100 basis points) to each f_t (or r_t), and finding the new cash flows associated with these rates. The new M is then given by simply using the discount formula. For the expected cash flow approach, a 100-basis-point increase in rates will result in a zero probability of prepayment, so

$$E[C_1^+] = E[C_2^+] = E[C_3^+] = E[C_4^+] = \$322,326,$$

where C_t^+ is the cash flow for a rate increase. The discount rates in equation (2) are $(1 + f_1 + .01 + .0085)$ for period one, $(1 + f_1 + .01 + .0085)(1 + f_2 + .01 + .0085)$ for period two, and so forth. The new price can be calculated using equation (2). The rate decrease is the same problem except that, if rates should fall by 100 basis points, prepayment occurs immediately, and

$$E[C_1^-] = \$1,110,000 \text{ and } E[C_2^-] = E[C_3^-] = E[C_4^-] = O.$$

The discount factors are $(1 + f_1 - .01 + .0085)$ and so on. An analogous approach would also be used if one were applying the expected price methodology.

Notes

1. The book value of domestic bank holdings of guaranteed and nonguaranteed mortgage-backed securities was about $200 billion at the end of 1989. About $35 billion of these assets was held by banks in Alabama, Florida, Georgia, Louisiana, Mississippi, and Tennessee.

2. See Sullivan and Lowell (1988) for an introduction to the mechanics of the mortgage securities market and the major participants.

3. For convenience the terms *mortgage* and *mortgage-backed security* will, when there is no ambiguity, oftentimes be used interchangeably.

4. See, for example, Hendershott and Van Order (1987) for a formal options approach to modeling rational exercise.

5. Interestingly, duration can also be viewed as a weighted average time to maturity, where the weights for each period t are equal to the present value of period t's cash flow divided by the total present value (the market value, or price). Shorter-term securities are those that have relatively large cash flows in earlier periods. For fixed-rate mortgages, however, the promised cash flows are a level annuity, so the weights are simply the present value factor for each period relative to the present value interest factor for an annuity.

6. It should be noted that some adjustment for early prepayments is typically incorporated into the static yield framework. For example, yield quotes provided by investment banks will often incorporate a constant prepayment rate per month for the remaining mortgage balance.

7. Those familiar with options pricing theory will realize that this method is only loosely based on conventional option pricing models. Although it is true, for example, that an option's value can, under certain circumstances, be viewed as the expected payoff over a transformed (or "risk neutral") probability distribution, the approach used here is based on the original probabilities. In essence, such a formulation amounts to assuming that investors are, in some sense, truly indifferent to risk. See notes 8 and 11 for additional comments on this point.

8. Such a formulation is equivalent to assuming that investors demand no risk premium for holding longer-term bonds. See Abken (1990) for a review of this "expectations" hypothesis of the term structure.

9. Schwartz and Torous (1989) provide a good example of a method for explicitly linking interest rate processes to a theory of the term structure in the context of valuing mortgage-backed securities.

10. See Abken (1990) for a discussion of binomial processes in the context of the term structure of interest rates.

11. From a somewhat more technical perspective this choice of assumptions may be viewed as one of choosing between "global" and "local" risk neutrality on the part of investors. With local risk neutrality investors expect to earn the same return from all securities over any one period of time. It can be shown by repeated substitution that this results in the expected price approach discussed in the text. See Cox, Ingersoll, and Ross (1985) for a mathematical discussion of the "local" expectations hypothesis.

12. Part of the difference may also come from the fact that in this example the average realized rate is set equal to today's rate. This approach is different from the more mathematically correct one, which would be to make the average realized one-period bond price equal to today's one-period bond price.

13. See, for example, Ayaydin, Richard, and Rigsbee (1989) for a discussion.

14. For example, Toevs (1990) provides evidence on the return characteristics of various mortgage-backed securities when compared to duration-matched Treasury securities.

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Population Migration in the United States: A Survey of Research

William J. Kahley
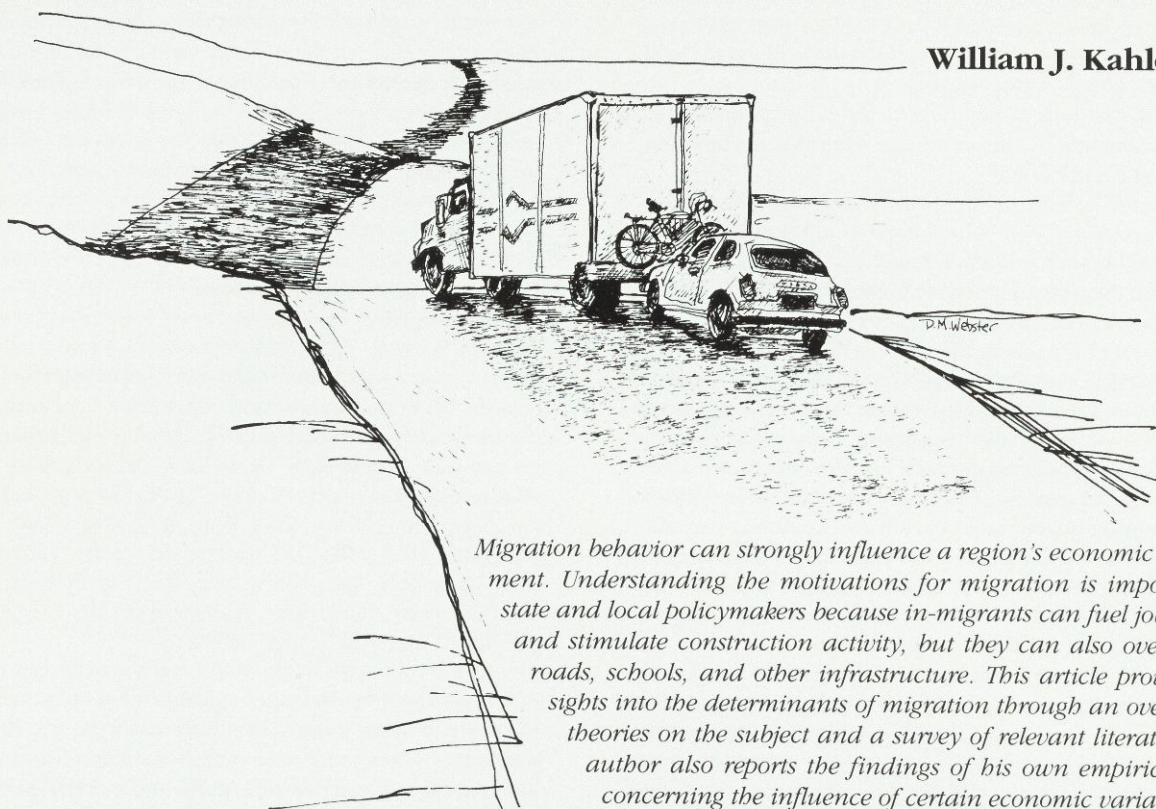
Migration behavior can strongly influence a region's economic development. Understanding the motivations for migration is important to state and local policymakers because in-migrants can fuel job growth and stimulate construction activity, but they can also overburden roads, schools, and other infrastructure. This article provides insights into the determinants of migration through an overview of theories on the subject and a survey of relevant literature. The author also reports the findings of his own empirical work concerning the influence of certain economic variables.

People move from one community or region to another for many reasons. Understanding this movement of population is important because it alters an area's potential for economic growth by directly affecting the size and composition of regional labor forces. State or local government officials, who see in-migration as fueling job growth and the demand for housing and other types of construction, work to attract (or keep) high-income earners, skilled workers, or wealthy retirees with good pensions.

Rapid population growth resulting from in-migration can also create burdens for state and local governments, however. Congestion, pollution, and increased need for public transportation, schools, and other infrastructure investment can drain a local economy. The goal of planners and policymakers is to lure migrants who will add less to the social burden than they return in taxes and other receipts, thereby raising the area's quality of life.

A number of studies that deal with the effects of migration shed light on the subject of regional growth and differentials in economic performance. Because of the contribution of worker and retiree migration to Florida's and Georgia's above-average economic growth compared with the nation's, improved understanding of the causes and consequences of migration is of special interest in southeastern states. At the same time, recessionary economic conditions have caused other southeastern states such as Louisiana and Mississippi to lose population in recent years. As the amount of natural increase (number of births minus number of deaths) in the United States declines in the years ahead, population change via redistribution will become an even more important demographic influence on state economies.

The considerable research in recent decades on the factors motivating migration is reviewed in this article along with several important issues that continue to demand attention. Research concerning the overall qualitative or quantitative impact of migration is more limited and generally beyond the scope of this article. However, this summary includes a report

on some progress in the study of the impact of migration when it is narrowly viewed as a process of adjustment to regional labor market differences.

Following an overview of theoretical perspectives on the factors that motivate migration, the article includes a brief review of the literature dealing with the relationship between migration and employment growth. The succeeding section contains important survey results concerning specific determinants of inmigration. The final two sections consist of tentative findings on some unresolved migration issues based on the author's empirical work and a summary of the principal conclusions and policy implications of information presented in this survey of migration research.

Migration Theories

In early migration studies researchers viewed the issue of labor migration primarily from either the neoclassical economic perspective or in light of the mechanical gravity model. As succinctly stated by John R. Hicks, neoclassical economic theory assumes that "differences in net economic advantages, chiefly differences in wages, are the main causes of migration" (1932, 76). In this view, migration is seen as part of the process whereby workers adjust to differences among regional labor markets. Labor is expected to flow from low-wage, labor-surplus areas to high-wage, labor-short regions until wage levels converge.

The mechanical gravity model—like Newton's law of universal gravitation, which states that the force of attraction between two bodies is directly proportional to their respective masses and inversely proportional to the square of the distance between them—holds that migration between two regions is related to links between regional populations and intervening distances. These gravity models originally hypothesized that gross migration interchange would be directly related to the size of the population in the areas people were moving between and inversely related to distance.[1] Distance is seen as a barrier and larger population masses, a magnet. More recently, the original mechanical view has been expanded beyond physical qualities. For example, population and distance might really reflect the economic influences of market size and transportation costs, respectively.

Recent research has exposed both of these views of why migration occurs as oversimplifications. Comprehensive surveys by Michael J. Greenwood (1975, 1985) and Charles Mueller (1982) of more recent economic theorizing and empirical findings reveal that migration decisions are complex and multidimensional, made by individuals with a variety of considerations. In fact, individuals (or a family unit) can be viewed as making not one but two decisions, in sequence. The first is the basic determination of whether or not to relocate, the second, the choice of destination.

Theorists favoring a human capital approach to the question of whether to move (Larry A. Sjaastad 1962; Gary S. Becker 1964) have argued that individuals will "invest" in migration only if it is profitable— that is, if the present value of perceived benefits from moving exceeds the present value of costs associated with moving (earnings minus migration costs).[2] Individuals can be expected to move to the place that offers them the highest net advantage, more broadly defined than in the definition by Hicks cited earlier. According to Sjaastad, migration distance generates several costs beyond the monetary expenses of moving, including earnings forgone and other costs related to the job search, the psychological cost of leaving the current environment, and uncertainty about prospective income because of the possibility of imperfect information.

Subsequent theorizing has added that the decision to migrate is also multidimensional because of the many factors involved in perceived benefits. For example, a family or individual's personal characteristics will affect the value placed on what a new location has to offer. In addition, characteristics of the places themselves—the migrant's place of origin and the potential destination—help determine whether or not a move will occur.

Individual or personal qualities like age, sex, race, education and skills, earnings and employment status, and health, as well as life-cycle characteristics such as completion of schooling and entry into the work force, marriage or divorce, birth and aging of children, and retirement, influence the individual or family unit making the migration decision. Individuals or families with different traits will weight the net advantage of one place over another differently, depending upon both the individual's or family's traits and the characteristics of the place being evaluated.

Numerous factors figure in when calculating the net advantage of one place over another. Among economic factors, job opportunities (or the lack thereof) and potential living standards adjusted for cost differences are obvious considerations. Noneconomic benefits such as topological (mountain, plain,

The author is an economist in the regional section of the Atlanta Fed's research department.

or seashore), climatological (sunshine and temperature), and environmental (clean air and water) amenities may also be important. Additionally, the levels of public services provided, along with the relative cost of certain items like food, housing, and taxes, may be key concerns influencing migration decisions.

Characteristics that lure or attract migrants to a place are "pull" factors. Surf, sun, and availability of jobs, for example, invite new residents. For reasons that will become clear in the next section, in-migration itself is a pull factor. Qualities that repel migrants—such as a high unemployment rate and stagnating regional economy—are called "push" factors.

Migration in Regional Growth and Development Models

A key issue in regional growth theory is whether or not interregional factor mobility leads to convergence of regional per capita incomes.[3] As noted, Hicks and the basic neoclassical economic model suggest that convergence is likely. Assuming two regions, one with relatively abundant labor and the other with capital, the low-wage region with a relative abundance of labor should attract capital. That is, because capital is relatively scarce in the low-wage region, it will be comparatively productive and profitable to use more capital there. Equivalently, the higher-wage and lower-return-to-capital region will attract labor. In short, factor mobility arbitrages away differences in returns to labor or capital geographically.

In the 1960s, the basic approach of Cicely Blanco (1963), I.S. Lowry (1966), and Warren F. Mazek (1969) to explain regional economic growth assumed that increases in demand for goods a region produces and exports to other regions leads to an increase in labor demand locally, inducing in-migration. In this export-based view of growth, where "people follow jobs," in-migration or net migration gain occurs in the high-wage region when a disequilibrium is created via the increase in demand for goods; the key to change is the increased demand for products and the profitability of a region's industries that serve outside markets. In Chart 1, L_d' represents increased demand for labor in region Alpha resulting from increased demand for exports produced there. The difference between L and L' represents in-migration induced by job opportunities (reflected in the shift in labor demand, $L_d \longrightarrow L_d'$). Labor supply is assumed to be abundantly available from another region to meet the increased demand for labor in Alpha. New jobs that become available both attract migrants and trigger faster growth.

In response to this view, an alternative theory emerged that held that migration itself could also induce job growth and development or that "jobs follow people." George H. Borts and Jerome L. Stein (1964) explained regional economic growth from this contrary, supply-side perspective. For them, migration to a higher-wage region was the driving force behind regional population and employment growth. In Chart 2, the shift in labor supply ($L_s \longrightarrow L_s'$) represents migration from a low-wage region. The important assumption underpinning this approach is that labor demand in area Beta will accommodate workers from the low-wage area without depressing wages. (Demand for labor is assumed to be perfectly elastic, and it is as if "jobs follow people.") Also, in-migration is likely to induce more local investment, shifting the labor demand curve upward and raising wages still higher. Historically, supply-driven growth may have occurred in the United States with movement of workers out of agriculture and into urban manufacturing.

Push and pull influences discussed earlier correspond to these supply- and demand-driven models of regional employment growth. According to the supply approach, low wages push workers out of a region. Job opportunities lure workers, as stated by the demand theory. Both are equilibrium-type models in that the tendency is for wages between regions to converge. Another potential implication of the demand-driven model is that job or income opportunities associated with places may better explain in-migration than out-migration. Economic prosperity will be a dominant factor affecting the choice of where to move. On the other hand, personal characteristics such as age, stage of education, and beginning work or retiring seem more important in explaining out-migration (within the supply-driven theoretical framework).

In the 1970s, two theoretical developments important for this review occurred, one by Richard F. Muth and the other by Philip E. Graves and Peter Linneman. The demand- and supply-driven models briefly described above can be viewed as alternative perspectives analogous to the "which came first—chicken or egg?" debate. In fact, Muth (1971) made a major contribution to the migration debate with an article titled "Migration: Chicken or Egg?" He concluded that attention should be focused on the interdependence of migration and job opportunities in explaining regional growth and development. While acknowledging that either factor can generate growth, Muth maintained that typically both do so simultaneously. In Chart 3, the labor supply or labor demand curves (or both) could shift, triggering employment growth. Additionally, the initial supply or demand shifts ($L_s \longrightarrow L_s'$ or $L_d \longrightarrow L_d'$) cause further

shifts in the curves (to L''_s or L''_d). Unfortunately, comparative static-type diagrams cannot adequately capture these dynamic interactions and feedback effects.

Graves and Linneman (1979) argued that rising income levels may cause migration by prompting new demands for amenities that may be location-specific. Changes in individual or family demands for amenities related to marriage or divorce, birth, death, or retirement can also trigger migration. Moreover, according to Graves (1983), the mobility of firms as well as households is an impetus for regional development. It is also the way by which location-specific factors such as amenities are capitalized, or their values incorporated, into land and labor markets.

Graves and Linneman's argument is that the only way an individual's or family's demands for nontraded amenities can be satisfied is by relocation. However, migration will also change wages and prices in resource and product markets to reflect the value of amenities. A major implication is that regional wage differences can persist in the long run because of the capitalization of regional amenities. For example, employers may be able to pay persistently lower wages for a given job and still attract workers to a region because it possesses desired amenities in abundance. A regional divergence of wages can also be created when growing incomes permit consumers to seek new amenities (such as a sudden popularity of snow skiing), with a wage divergence compensating for regional differences in the value of amenities. In short, labor markets can be in equilibrium in two regions, yet wages can differ because of disparities in the availability of amenities. The result is that unadjusted wage differences will not necessarily equalize as migration occurs.

Thus far, the consequences of migration have been analyzed primarily within the narrow framework of regional economic development as a process of adjustment in regional labor markets. Labor tends to move from low-wage, labor-surplus regions to high-wage, labor-scarce regions unless differences in amenities compensate for wage differences. At a broader level, though, migration can be viewed as a process that significantly affects the local economies migrants leave behind and those into which they move in ways beyond the direct impact on incomes. For example, selective out-migration of young, educated people from a low-wage region can have cumulative, adverse effects on labor demand that can more than offset the positive impact of reduced aggregate labor supply in raising wages. Alternatively, crowding or other deleterious effects can reduce or eliminate the presumed benefits to an area from in-migration. The effects of migration are complex, and any in-depth discussion of them would require
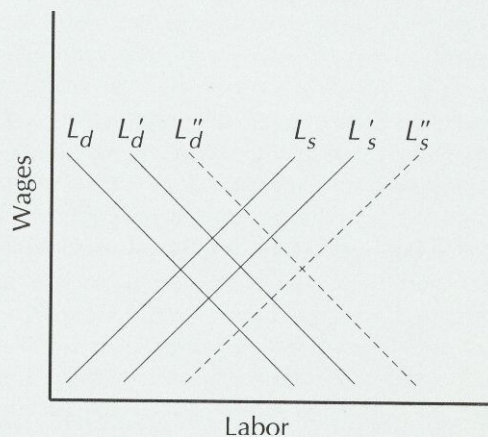
Chart 1
The Demand Approach

Alpha
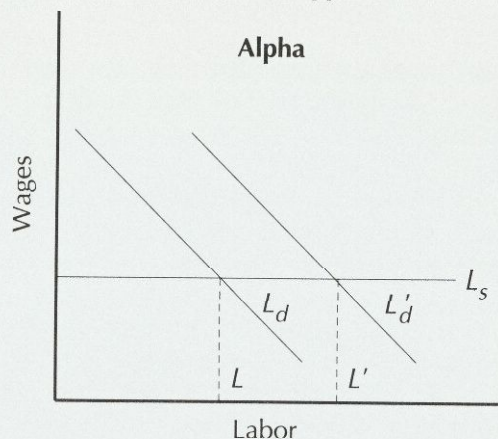
Chart 2
The Supply Approach

Beta
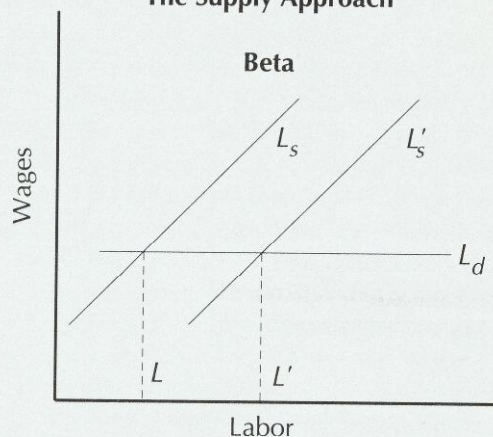
Chart 3
Supply and Demand Interactions

review of an enormous segment of economic literature that is beyond the scope of this article's focus on the determinants of migration.

Personal Characteristics Affecting Migration

Demographers, economists, and other researchers attracted to the study of migration have noted several patterns in the demographic, social, and economic characteristics of migrants. Comparisons of the profiles of movers and nonmovers have led to generalizations about the relationship between moving and the life cycle. Several tendencies regularly reported in *Geographical Mobility*, an annual report from the Census Bureau, are illuminating, even though they are based on simple univariate or bivariate tabulations from U.S. population surveys.[4] For instance, moving rates appear to be related directly to age, with persons in their twenties most likely to move to another state. A secondary age spike in migration occurs among the very young (who tend to be accompanying parents in their twenties), and there is an uptick when persons enter retirement. The census figures also show that more men tend to be interstate migrants than women, in part because men are more often in the military, a group with a higher rate of moving than people in other occupations.

Moving rates for civilians also vary by labor force status. Among the unemployed, migration is quite a bit higher than it is for persons with jobs. The lowest migration rate is for individuals not in the labor force, such as retirees or students. Another factor correlated with migration rates is education level. Rates rise with educational attainment, peaking for persons with four years of college. Race is also a variable: non-Hispanic whites have higher rates of long-distance moving than Hispanics and blacks.

Some of these differences are linked to economic and life-cycle influences on migration patterns. For example, labor force members are less likely to migrate as they grow older because they expect a shorter remaining working life during which to realize the benefits of migration. Similarly, the more education people attain, the more information about employment and job opportunities they are likely to have so that they are active in a job market more national in scope.

As Larry E. Long has pointed out, "A rather parsimonious set of categories (job transfer, look for work, take a new job, enter or leave armed forces, retirement, attend schools, be closer to relatives, or to seek a change in climate) usually account for 70 or 80 percent of the 'main' reasons for interstate or interregional moves" (1988, 251). Research reviewed by Greenwood (1975, 1985) and Mueller (1982) also tends to support the idea that demographic determinants have impacts like those discussed here.[5]

Although certain personal traits are associated with a greater or lesser probability of migration and can be linked to economic or life-cycle forces in predictable ways (such as completing school, getting married or divorced, taking a job), other personal circumstances entail complex interactions. For example, the effect of race or ethnicity is not self-evident. Racial differences in the probability of interstate migration based upon simple tabulations may not hold up when other influences are held constant. Aggregate differences in interstate migration by race may, for example, be attributable to differences in education levels rather than racial propensity to migrate, and the results are not always clear even in multivariate models. Similar ambiguities confound the study of the effects of gender or family status on interstate migration.

Place Characteristics and Migration

Labor market conditions such as job opportunities and available wages in regions also contribute to workers' decisions to migrate. Moreover, local amenities, costs of living, and fiscal characteristics are likely to influence migration flows, especially of retirees.[6] Researchers have identified several place characteristics, discussed in this section, that affect worker migration.

Gravity Effects. Researchers who use models that include population and distance variables typically find them very robust in explaining migration. Brian J. Cushing (1986, 1987) found that population and distance (as indicated by beta coefficients in regression equations) have the largest relative positive and negative impacts, respectively, on the dependent migration variable when it is measured as the allocation rate of migrants from each state of origin to each of forty-seven other coterminous states. Peter R. Mueser (1989b), however, found that many aspects of the migration structure cannot be tied to geography even though migration flows between states during the periods 1955-60, 1965-70, and 1975-80 reflect geographic distance. His analysis also shows that changes in migration streams, in particular, result from nongeographic push and pull effects.

Cost of Living. Presumably, distance influences migration in part because it serves as a proxy for a cost-of-transportation barrier to movement between places.[7] Mark C. Berger and Glen C. Blomquist (1989), using migration data from the *1 in 1,000 Public Use*

Sample of the 1980 Census, found indirect evidence that moving costs are important in the decision to migrate. Their main focus of attention, however, was the significance of living costs. Their study suggests that people consider the cost of housing but that its importance diminishes with age, "presumably because of shorter time horizons" (2). Curiously, they found that the differences in moving costs grow in importance with age, "reflecting greater attachments to an area as one grows older" (2).

State and Local Fiscal Structure. William F. Fox, Henry W. Herzog, Jr., and Alan M. Schlottman (1989) studied the extent to which migration seems related to variations in local and state government fiscal policies. Using microdata for individuals, their empirical results indicate that high state or local government taxes and other own-source revenue enhancements have the expected effect of discouraging in-migration, as does specific reliance on the income tax. Also as expected, good police and fire protection, as well as park and recreation facilities, are enticements; however, regional education conditions appear not to have a significant effect on in-migration. These researchers conclude that fiscal structure does seem to play an important role in the migration decision.

Income. A finding common to many migration studies is that income opportunities are an important pull factor. Statistically, this variable often has a large relative impact on the dependent migration variable as well as strong statistical significance. Thus, empirical findings support the theoretical view that alternative economic opportunities need to be considered in the analysis of migration.

Simultaneity—Migration and Employment Growth. Researchers have investigated the relationship between migration and employment growth using simultaneous equations techniques since Muth's pioneering work in the early 1970s. These models, estimated to allow employment growth and migration to be determined jointly with two-way causation, generally take the form $M_i = f(E_i, X_i)$ and $E_i = g(M_i, Z_i)$, where M_i and E_i are the dependent migration and employment variables and X_i and Z_i are vectors of location-specific factors affecting migration and employment, respectively. "In an average year two extra jobs attract about one additional net migrant, and one additional net migrant has a direct effect on area employment of almost 1.4 jobs," according to Greenwood, Gary L. Hunt, and John M. McDowell (1986, 231).

These findings mean that migrants do not fully substitute for or take jobs from workers where employment is growing and suggest that migration causes job growth over and above employment of the migrants themselves. In the example above, only one-half of all newly created jobs are taken by in-migrants, while a newly employed in-migrant causes nearly one-half of an additional job to be created. They conclude that their results are very similar to those Muth obtained in his earlier work. They also find some evidence for the notion that migration increases during national business-cycle expansions and falls during downturns.

Regional Wage Arbitrage. Stuart A. Gabriel, Janice Shack-Marquez, and William L. Wascher (1989) evaluated whether interregional migration arbitrages regional wage and unemployment differentials. Their results, based on simulation, suggest that interregional migration reduces regional wage differentials. However, their findings also indicate that the direct effects of migration are insufficient to narrow unemployment rate differences much within a period of less than several years.

Association of In- and Out-Migration Rates. Migration researchers have long noted the positive association between rates of in-migration and out-migration. An often-mentioned explanation for the association is that areas with extensive and sustained in-migration tend eventually to have populations that are more migration prone, thus increasing their out-migration rates. Some other explanations include migration's tendency to induce a counterstream of return migrants and the probability that residents' departure creates an environment conducive to in-migrants as jobs are vacated and homes become available to newcomers. Mueser and Michael J. White (1989) explain the dynamic character of the migration process. An area with high net migration gain experiences population gain. This gain increases the number at risk to depart while also raising the denominator of the in-migration rate.

Unresolved Migration Issues

Numerous factors make it difficult to derive precise estimates of the relationships between migration flows and the personal and place characteristics behind these flows.

Asymmetries. Researchers have noted that some motivation factors explain in-migration better than out-migration, while the reverse is true for other factors. For example, Greenwood (1975, 400) and Mueller (1982, 32) both note that several other researchers found that income and job opportunities generally provide a better explanation of in-migration whereas personal characteristics such as age and education seem to have more effect on migrant departures. From a theoretical economic perspective, it is not clear why migrants seem strongly pulled to

destinations where employment growth is high but not pushed to the same extent from origins where employment growth is low. However, because of these and other asymmetries, better empirical results are obtained from in-migration or out-migration models than from net migration models. (Another problem with net migration models is that the effect of distance, for example, is neutralized because it has the same sign in gross in- and out-migration equations.) Yet, because of data limitations, researchers often have had only net migration data to work with, at the cost of substantial loss of information and insight into the migration process.

Data Limitations. A problem with much migration research is that data refer to aggregate migration flows whereas the migration decision is an individual decision, often reflecting personal characteristics. As a consequence, the more readily identifiable place characteristics such as income or job growth have more often been cited as explanatory factors, and, by definition, the effects of personal characteristics have been underestimated.

Fortunately, new microdata sets increasingly will allow for needed modeling refinements such as focusing on the decision-making unit and studying the life-cycle influences on migration decisions (including measurement of the economic return to migration). These data include the Panel Study of Income Dynamics, the National Longitudinal Survey, and Census Public Use Microdata Samples. Nevertheless, explaining aggregate migration will continue to be a goal because aggregate statistics are relevant for local governments and policymakers concerned with the consequences of migration.

Another data shortcoming has been that researchers too often have had to rely on cross-section data rather than time-series information. This limitation has prevented study of inherent lags in migration such as the time between an individual's recognizing and then acting on new job opportunities (time spent selling the old house and making other arrangements). Moreover, the determinants and consequences of migration both vary cyclically and in the long run, but, lacking appropriate time-series data, researchers have not been able to explain how and why. Fortunately, new time-series state-level data from the Internal Revenue Service are helping to address this issue.

Methodologies and Model Specification. Several conceptual issues in the study of migration are unresolved. They are often linked to statistical methods or the specification of particular migration models.

Mueser (1989a) has noted that cross-sectional studies may be seriously biased because the current geographic population distribution reflects previous migrants' choices. Mueser notes that population, often included in migration models to capture social or economic scale effects, may actually be a proxy for unmeasured characteristics such as place amenities, which might be stable and have been effective in attracting migrants earlier. Under these circumstances, population and the unmeasured variables will be correlated. If population and other explanatory variables also have a correlation not taken into account, complex statistical biases result.

Because of this interrelationship among several determinants of migration, researchers have turned increasingly to simultaneous-equations models of migration's causes. Often, though, data are inadequate for estimating migration models, for reasons beyond even those already mentioned. For example, it has been noted that variables in the gravity model—population and distance—are important factors in explaining migration. However, population and distance can be interpreted in different ways, depending on the size of the city or town in which one lives and normal travel distances. Moreover, sorting out the underlying factors these variables represent is not a straightforward exercise. For instance, population might be an indicator of economies of scale or agglomeration, meaning that larger population leads to lower production cost and thus concentration of activity.[8] In contrast, as mentioned above, population also could be simply a measure of an area's past success in attracting migrants. Similarly, although the fiscal structure of a region or amenities such as climate may cause migration, it is not clear which variables should be used in specific models. Generally, clear structural and behavioral models of the migration process are lacking in this area of economic research.

At least a few other practical specification issues cloud statistical and conceptual understanding of migration relationships. Economic factors thought to be important in explaining migration behavior are often correlated with each other or with noneconomic migration influences. As a consequence, channels of influences among the factors are blurred statistically, a problem known as multicollinearity. Because the probability of migration is a function of levels of certain variables, such as movement cost, and changes in the absolute levels of explanatory variables, another practical difficulty is created. When changes in the absolute levels of variables and their levels at one place relative to all others are examined as determinants of migration, the issue of multicollinearity among variables is heightened.

Statistical Findings. Differences in methodologies used, model specification, and the functional form imposed on variables in migration models have resulted in some significant statistical differences of opinion concerning the direction and strength of in-

fluence of migration determinants. One of the most vexing and perplexing issues for migration scholars is the erratic finding concerning the regional unemployment rate's influence. When viewed with the individual in mind, the notion that the unemployed are more likely to move than the employed has strong theoretical appeal and statistical support. However, at the aggregate level unemployment rates have frequently had nonsignificant coefficients and even unanticipated signs, suggesting either that this finding is eroded during the aggregation process or that the model specification or form of data used is faulty. As noted below, results from the author's empirical research suggest that model specification is key to the issue.

Other empirical findings in dispute include the relative importance of jobs versus amenities in migration. This disagreement may be more a matter of difference in interpretation than a disagreement of substance, though. For example, Greenwood and Hunt (1989) conclude that location-specific amenities do not appear to have an important direct effect on migration when employment growth is taken into account. They say that these results differ considerably from Graves's (1983) findings. Greenwood and Hunt agree with Graves that the influence of amenities is positive, but for them the primary impact of amenities is via the stimulation given to job growth. State and local government fiscal variables and climate variables are other influences for which either ambiguous statistical results have been found or for which interpretation of meaning or channel of influence is difficult to make.

Author's Empirical Research

In an effort to help develop insight into some of the unsettled issues in migration research, the author is analyzing new U.S. Internal Revenue Service estimates of historical state-to-state migration flows that are based on income tax returns. Preliminary statistical analyses of these data for the 1980-87 period are revealing. The summary results reported below are based on regression equations estimated for each of the eight years. Altogether, these new data provide strong evidence concerning the influence of certain economic variables in determining migration and shed new light on some issues that have been cloudy. For example, this work has led to several conclusions:

- A state's income growth, lagged one year to reduce simultaneity bias, positively influences in-migration.

- Expected pay, measured as average state pay lagged one year and weighted by a state's unemployment rate, has a positive influence on in-migration.
- The higher the cost of living index for a state, the less in-migration it will experience.
- The greater the number of annual cooling degree days—the warmer the climate—the greater in-migration will be.
- The greater the amount of in- and out-migration the state experienced in the 1975-80 period, the greater in-migration was in the 1980s.

All of the directions of influence for these determinants are as expected. In addition, these results are very robust as measured by the stability and significance of the statistical coefficients relating in-migration to these explanatory variables and the significance of the entire equation explaining state in-migration. Altogether these variables explain from 96 percent to 99 percent of the variation in state in-migration for the eight years for which migration equations were estimated.

It is encouraging that statistical results using this new data set conform so well with economic theory and with the central tendencies found in a review of the migration literature. For example, there is a strong theoretical expectation that fast income growth should attract migrants. Also, according to theory in-migration should tend to be toward regions that pay higher wages, other factors remaining equal. Important "other factors" that must be accounted for include the probability of getting a job (suggesting that pay should be weighted by the region's unemployment rate) and cost-of-living differentials (indicating that individuals respond to real, not nominal, wage differences). Additionally, it is obvious that amenities such as warm and sunny days should lure migrants. Finally, migrants are likely to inform friends and relatives about the merits and shortcomings of their new place of residence and, having experienced migration, are more likely to move again themselves.

Besides finding support for the factors thought to motivate migration, a few other noteworthy findings have surfaced in the author's work. One is that the determinants of in-migration do not perform well in explaining state out-migration in the 1980-87 period. This discovery is consistent with the common, yet somewhat perplexing, finding that economic conditions in destinations explain in-migration better than such variables in origin localities explain out-migration. Another finding supportive of previous research is that there appears to be a tendency for migration to slow down in recession and speed up during economic expansions. This finding suggests

that migration can have countercyclical effects over the course of the business cycle at the regional and even national level. All in all, although the migration puzzle has yet to be totally solved, it nevertheless seems clear that this research supports important theories regarding motivations.

Policy Implications and Conclusions

Because regional development is expected to be influenced strongly by the mobility behavior of firms and individuals, understanding the determinants of their migration is important. Benefit to a region from expanding its export base, or its capacity to sell products and services outside the local economy, is an underlying focus of state and local programs designed to draw firms or jobs to an area. The assumption is that migration will follow at the same time that such programs will offer members of the local work force new job opportunities.

Current research findings indicate that personal or life-cycle influences strongly motivate individual migration with or without reference to economic conditions at specific locations. Although this information

is helpful, what is really needed for policy purposes related to regional economic development is to know which areas individuals will choose.

Based on the research reviewed in this article, it appears that economic development efforts that spur income growth in a region increase in-migration. In addition, environmental policies and others that protect an area's amenities would appear to have a pay-off. Finally, state and local policies that keep down the cost of living, including perhaps the promotion of affordable housing, can be expected to meet with success.

Much research into migration influences remains to be done. The relative importance of origin and destination characteristics in explaining migration still is not adequately known. Also, the full extent to which migrant-attracting policies will be effective cannot be quantified. Nor are the timing and extent to which migration causes wage convergence known, and very little hard evidence exists concerning other consequences of migration. Continued research is needed that will increase our understanding of migration's determinants and its consequences and lead to development of more effective ways to address critical policy issues.

Notes

1. See Isard (1960) for a thorough review of the gravity model. The simple formulation of the model that would be analogous to Newton's law of universal gravitation would be $M_{ij} = k(P_i * P_j)/(d_{ij})^2$, where M_{ij} is migration between places i and j, P_i and P_j are the populations of i and j, d_{ij} is the distance between them, and k is a constant. Thus, the greater the population mass between two places, the greater will be gross migration, but the greater the distance, the less migration there will be. In modern work, functional rather than geographic measures of distance and population are used so that the distinction between gravity models and economists' econometric models incorporating influences such as labor market conditions, amenities, and so forth, has been blurred.

2. If the present discounted value of the earnings stream in place j compared to place i is

$$\sum_{t=1}^{n} (E_{jt} - E_{it})/(1 + r)^t$$

and the comparable present discounted value of costs of being at these places is

$$\sum_{t=1}^{n} (C_{jt} - C_{it})/(1 + r)^t,$$

then movement to j from i will occur when earnings minus costs exceed zero. Individuals move to the place with the highest net present value (PV_{ij}), where

$$PV_{ij} = \sum_{t=1}^{n} \frac{(E_{jt} - E_{it})}{(1 + r)^t} - \sum_{t=1}^{n} \frac{(C_{jt} - C_{it})}{(1 = r)^t},$$

and E = earnings, C = costs, r = discount rate, and t = time period.

3. This issue, generally referred to as "factor-price equalization," has been central to the discussion of the effect of international trade as well. In the context of trade between nations, complete equalization of the prices of production factors internationally also requires mobility of the factors. Free trade of goods will only partially substitute for factor mobility and only tend to equalize relative factor prices internationally.

4. Primarily because of data limitations, generalizations about migration have tended to be drawn from cross-sectional and aggregate population data rather than from information about individuals over time.

5. A recent paper by White and Mueser (1989) specifically tests for changes in the demographic determinants of U.S. residential mobility in the 1940-80 period using a multinominal logit model. Their results also are consistent with the literature. Educational attainment promotes migration, the influence of education declines with age, blacks are less migratory than whites, and women are less migratory than men.

6. As might be expected, the place characteristics that influence retiree migration differ from those that affect worker migration. Studies conducted by researchers at

Florida State University—Fournier, Rasmussen, and Serow (1988); Rasmussen, Fournier, and Charity (1989); and Serow (1987)—support plausible notions concerning differences in what workers and retirees are looking for in a new place. Labor market conditions such as employment opportunities, for example, are important to workers but not to retirees, whereas cost-of-living considerations are more important to retirees. Apparently, regional disparities in cost of living give elderly households on fixed incomes an incentive to move in much the same way that job opportunities motivate workers to migrate. Besides being sensitive to cost-of-living variations, the migration decisions of the elderly also seem to be especially attuned to amenity variables, such as warm, sunny weather and an absence of crime.

7. The flow of information between places may also lessen with distance, limiting migration flows.

8. Scale economies are internal economies in a firm's production at a given facility as its scale of operation increases while agglomeration economies are associated with economies that accrue to all firms in a single industry at a particular location.

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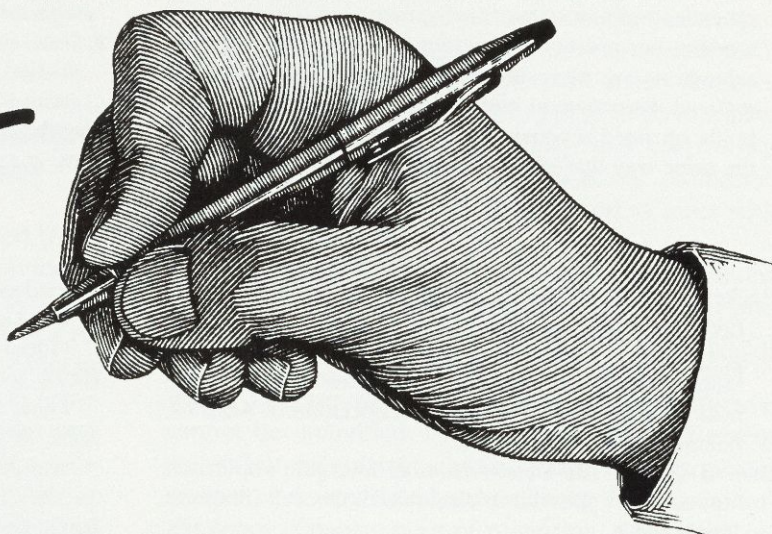
The 1990 Farm Bill

Gene D. Sullivan

Congress responded to the challenge of cutting the cost of federal farm programs by building into the 1990 Farm Act an estimated $13.6 billion cut in farm subsidies over the next five years. Most savings came from the addition of a provision to the system of target prices continued from the Food Security Act of 1985 (also known as the 1985 Farm Bill). In addition to reducing estimated costs, this feature—called the triple-base option—helps to improve the farm program's market orientation by freeing 15 percent of the acreage in subsidized crops for unsupported production of any crop (except for fruits and vegetables).

Other features of the 1990 and 1985 bills are similar. However, in the 1990 bill target prices are frozen at that year's levels after having been reduced in stages by the 1985 bill. Generally, price support levels are to be adjusted each crop marketing year based on stocks-to-use ratios.

Though it enhances market orientation, the triple-base option presents a complex set of choices to

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The author is a research officer in the regional section of the Atlanta Fed's research department.

farmers growing supported crops. Each must choose what crop to grow on the newly freed land. Their combined adjustments will influence not only their support payments received but also total production of various crops, which will in turn affect prices and the actual federal expenditure savings resulting from the new bill. These issues will be more fully considered later in this article.

This article is intended to be a summary of the background and development of the 1990 Farm Bill and the main features that distinguish it from earlier legislation. Following a discussion of the general framework of the bill, its major provisions for specific commodities are outlined. More general provisions are also discussed. In the concluding sections implications of the legislation are examined.

Controlling Government Costs

Under the previous (1985) and current legislation, income support programs for farmers have been geared to a concept of target prices that was based on direct payments to support incomes rather than

on supporting prices at levels that frequently required the government to purchase farm commodities at prices well above market clearing levels. Farmers have the option to sell their commodities at prevailing market prices or obtain a nonrecourse loan from the Commodity Credit Corporation (CCC) at a specified price per unit, usually set below the expected market price level. Direct government payments to farmers make up the difference between the target price and the higher of the CCC loan rate or the average market price during a specified period. This deficiency payment program encourages the flow of commodities into the marketplace, thereby reducing or avoiding government storage costs.

In the past the government sometimes held commodities for many years because they could not be marketed at or above their acquisition cost. Stored commodities were eventually disposed of in gifts to impoverished foreign countries or to needy groups at home, or they were sometimes bartered to countries that lacked foreign exchange but had products they could trade. The target price and deficiency payment program is intended to help avoid such losses to the government.

Government payments to farmers have themselves become an expensive item in the budget of the U.S. Department of Agriculture largely because of the wide differences between target and market prices. Payments reached a peak of $16.7 billion in 1987, compared with direct outlays to farmers totaling $1.3 billion in 1980. Increases in market prices reduced direct payments after 1987, but estimates for 1990 indicate farmers again received a relatively high level of support—about $12 billion. Without program alterations it is estimated that payments for 1991 would have moved up sharply from 1990's level, largely because of weakening market prices for wheat and feed grains as stocks are rebuilt from the shortages 1988's major drought in the Midwest and Upper Plains engendered.

Policy Pressures. Negotiations for the 1990 Farm Bill began under the specter of several unusual pressures. One was the General Agreement on Tariffs and Trade (GATT) negotiations in which then U.S. Secretary of Agriculture Clayton Yeutter had been campaigning vigorously for the removal of trade-distorting agricultural subsidies throughout the world. The success of this endeavor would have produced revolutionary changes in American farm policy because policy is heavily based on price and income support mechanisms that presumably would have been revamped or possibly eliminated. Congress decided to proceed with the 1990 Farm Bill under the assumption that total subsidy cuts were unlikely (an assumption that proved correct when the GATT negotiations subsequently broke down). Thus, the initial proposals for the 1990 legislation were rather closely modeled after the expiring 1985 Farm Bill.

An additional pressure on bill writers was the need to develop legislation in line with the budget agreement being crafted by other congressional committees. In fact, the failure of Congress to accept the budget summit agreement on October 5, 1990, left the House-Senate conference (at that time attempting to negotiate a final version of the Farm Bill from the separate bills passed by the House and Senate) without specific guidelines or goals for cutting crop subsidies. As it turned out, the estimated $13 billion cut required by the budget summit agreement remained the requirement of subsequent budget negotiators as well.

Savings Estimates. Expenditure cuts were achieved largely by reducing the amount of land on which farmers could collect subsidy payment by 15 percent. The cutbacks were made more palatable to farmers by giving them broad flexibility in crops they are permitted to grow on the nonsubsidized acreage.

It is assumed that farmers, on balance, will not change acreages and production of crops in such a way as to increase government outlays. Although production of individual crops, such as cotton and soybeans, could expand and depress market prices so that deficiency payments or CCC outlays would increase for those commodities, the corresponding reduction in grain production presumably would lift market prices and reduce deficiency payments on grain acreage. The overall effect is expected to keep net government expenditures at levels that will maintain the estimated reductions of $13.6 billion over the five-year period of the legislation.

The savings estimate is also based on assumed continued strength in domestic and foreign demand for agricultural commodities. Because target prices have been frozen, market or support price fluctuations will directly affect costs of government agricultural programs.

Provisions for Major Commodities

The new bill's major provisions for specific commodities are as follows:

Wheat. The target price for wheat is to be frozen at $4 per bushel for five years. The old legislation had allowed the minimum target price to decline each year since 1987, moving down from $4.38 to $4 per bushel in 1990. (See Chart 1, which compares target prices for the five major commodities in the first production season under the 1985 and 1990 bills.) The rate at which the CCC would lend money

Chart 1
Target Prices
1985 and 1990 Farm Bills*

Dollars per Unit

■ 1985 Bill (1986–87)
□ 1990 Bill (1991–95)
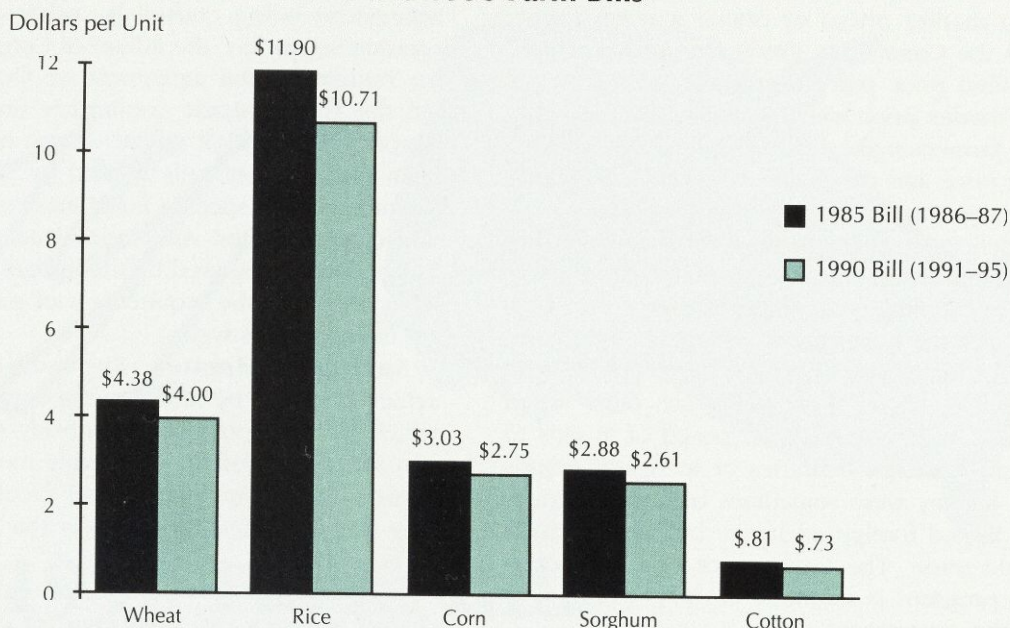
* For the first production season under each bill.
Source: U.S. Department of Agriculture, Economic Research Service, *The 1990 Farm Act and the 1990 Budget Reconciliation Act*, December 1990, 6.

to farmers on wheat (the price support loan or loan rate) is set at 85 percent of a five-year moving average of market prices. Previously, the loan rate had been set in the range of from 75 to 85 percent of the five-year average. The objective of this provision is to ensure that in most years the loan rate would be far enough below the market price at some period of the year to encourage wheat to flow into the market rather than remain in storage. If stocks should build up anyway because of unusual price weakness, the Secretary of Agriculture is given the authority to reduce the loan rate as much as 20 percent, as he was also allowed to do under previous legislation.

Deficiency payments are to be calculated on a twelve-month average market price rather than the average of the first five months of the marketing year, as was the case for previous legislation. This change will probably have the effect of reducing the average deficiency payment to farmers because prices are typically lower during the first five months of the marketing season when the crop is being harvested than is the average price for the whole year, which would include prices during periods when supplies are likely to be drawn down (see Table 1).

Feed Grains. The 1990 target price for corn of $2.75 per bushel is frozen for a five-year period (see Chart 1). Like wheat, the loan rate is set at 85 percent of a five-year moving average of market prices

instead of in the range of from 75 to 85 percent of the average price. The secretary would also have the authority to reduce the support price by as much as 20 percent during a year when stocks build to high levels. Deficiency payments for corn will be calculated on a twelve-month average of market prices for the 1994 and 1995 crops, rather than a five-month market season average price. The latter average will continue to be used until 1994.

Target prices for other feed grains are set at $2.61 per bushel for grain sorghum, $2.36 per bushel for barley, and $1.45 per bushel for oats. Loan rates for these commodities are to be held in a fair and reasonable relationship with corn.

Cotton. The expiring legislation had reduced the target prices for cotton in annual increments from 81 cents per pound in 1986 to 72.9 cents in 1990. The new bill freezes the target price at that amount for five years. The loan rate for cotton will continue to be set at 85 percent of a five-year moving average of market prices. However, cotton producers will continue to have an option of repaying less than the loan amount to the CCC. A "marketing loan" concept is in use under which the producer can repay a commodity loan at the unit price earned at market. For example, if the prevailing world market price is below 80 percent of the loan rate, a loan repayment level may be set not in excess of 80 percent of the

Table 1
Commodity Price Averages*

	Corn		Cotton		Wheat		Rice	
	Marketing Year Average	Five-Month Average	Marketing Year Average	Five-Month Average	Marketing Year Average	Five-Month Average	Marketing Year Average	Five-Month Average
1985	2.23	2.41	0.57	0.56	3.08	3.00	6.53	7.74
1986	1.50	1.69	0.52	0.50	2.42	2.31	3.75	3.87
1987	1.94	1.74	0.64	0.65	2.57	2.45	7.27	5.92
1988	2.54	2.34	0.56	0.55	3.72	3.61	6.83	6.96
1989	2.33	2.27	0.63	0.63	3.72	3.77	7.30	7.25

* The "marketing year average" column shows the weighted average price for the crop sold during the marketing year defined as follows: corn, September 1 to August 31; cotton, August 1 to July 31; wheat, June 1 to May 31; rice, August 1 to July 31. The "five-month average" column shows the average price during the first five months of the commodity's marketing year.

Source: U.S. Department of Agriculture, *Agricultural Prices* Monthly and Annual Reports.

loan rate. This provision may sometimes bestow substantial financial benefits to growers in addition to the direct deficiency payments collected.

Rice. The rice program's general provisions are the same as those for cotton. The target price for rice will be $10.71 per hundredweight (cwt) for five years. As with corn, beginning in 1994 and continuing through 1995 deficiency payments for rice are to be calculated on a twelve-month average market price rather than a five-month average, which will continue in use until that time.

Oilseeds. Target prices are not provided for oilseeds because they are not included in the so-called basic program crops. The support price for soybeans has been set at $5.02 per bushel for the five-year period of 1991 through 1995, less a 2 percent loan origination fee to be deducted from the proceeds at the time the loan is granted. Producers will also be provided a marketing loan that allows CCC loans to be repaid at the smaller of the loan rate or the prevailing world market price for soybeans. Other oil seeds, including sunflower seed, canola, flax, and safflower, will have loan rates set at levels comparable to soybeans. The Secretary of Agriculture may also establish loan programs for additional oilseed crops as he deems necessary.

Dairy Products. The price support level for milk will be frozen at $10.10 per cwt of product with 3.67 percent butterfat content. This move interrupts the trend of declining support prices that had been in process since 1986, when the support price was $11.60 per cwt. Previous legislation had specified that price supports would decline periodically to reduce the incentive for surplus milk production. The CCC was required to buy manufactured milk products in sufficient volume to keep the price of milk from dropping below the legislatively specified minimum level. If surplus production levels should decline sufficiently during the life of the new legislation, price support levels might increase. To make producers share a portion of the program's cost, the new legislation requires an assessment of 5 cents per cwt of milk produced in 1991 and 11 cents per cwt for 1992 through August 31, 1995. However, a producer may apply for a refund of this assessment by certifying that his own milk production has not increased from the previous year.

To further defray program costs, the Agriculture Department may level assessments on farmers to recover the full costs of purchasing surplus dairy products in excess of 7 billion pounds a year, provided legislation has not been enacted by January 1, 1992, to limit dairy surpluses. For 1989 and 1990, net supply removal by CCC purchases is indicated to have totaled 9.0 billion and 8.5 billion pounds, respectively, suggesting that surpluses are likely to

continue to exceed the trigger point for assessments unless new dairy legislation is enacted.

Sugar. The sugar program has operated basically to restrict imports to quota levels in order to maintain domestic prices at or above the support price level. Although previous legislation allowed the support price to rise to reflect increases in the cost of production, the new bill has frozen the price-support loan for sugar at 21 cents per pound, and the legislation specifies that the programs continue to operate at no cost to the government. Duties on imported sugar have covered the government's cost of operating the program. However, imports have been shrinking over time, and domestic production has expanded to supply a larger share of total consumption. In addition, sugar substitutes and fructose (sugar from corn) have been claiming growing shares of the market.

To preserve a minimum level of imported sugar, the new legislation requires domestic marketing controls on cane and beet sugar if imports fall below 1.25 million short tons (about 18 percent of total domestic production). The growth of corn sugar marketings is also controlled by the imposition of a 200,000 ton sugar-equivalent limit on annual marketings. To ensure that sugar producers share the burden of the mandatory reductions in costs of government programs along with other major crop producers, a 1 percent fee will be assessed on sugar loans from the CCC.

General Provisions

The new legislation contains a number of other provisions that are not commodity or producer-group specific.

Payment Limitations. A limitation on the amount of payments that an individual producer can receive is carried forward from previous legislation with some changes. The maximum amount a farmer may be paid from all government programs has been cut in half, from $500,000 to $250,000. The expiring legislation's limit of $50,000 per producer on direct deficiency payments is maintained. However, payments in larger amounts may be secured from such programs as disaster relief when crops are destroyed by drought or other calamities and from marketing loan gains. Nevertheless, the total of these payments may not exceed $250,000 per farmer for the major commodities listed above. For producers of honey, wool, and mohair, the new legislation specifies a payment limit of $200,000 in 1991, decreasing to $125,000 by 1994. The stricter limits for these producers impose a way they will share in the reductions in program costs.

Food for Peace. The Food for Peace (P.L. 480) program, the chief instrument for delivering food aid abroad and helping develop markets for U.S. farm products, has been extended in the new legislation, with a few changes. The authority for grant programs, including a new government-to-government grant program, is specifically assigned to the Agency for International Development, with the Department of Agriculture retaining responsibility for concessional sales of products abroad. The 1985 act contained a provision authorizing commodity donations to support agricultural policy reform in developing countries. The new legislation restricts use of the program for foreign policy purposes and attempts to direct commodities to countries with the greatest need and market potential.

To assist the U.S. maritime industry, previous legislation specified that 80 percent of the gross tonnage of agricultural commodities exported under the P.L. 480 program must be transported on U.S.-flag commercial vessels. The new legislation allows foreign vessels to reflag as U.S. ships to qualify as carriers under the existing "cargo preference" requirements for certain ports.

Export Enhancement. Previous legislation required the Secretary of Agriculture to provide $325 million annually, or the equivalent in CCC commodities, for export assistance to counter adverse effects of a foreign country's unfair trade practices. The program involved selling export certificates to commercial exporters on a competitive bid basis. The certificates could be redeemed for CCC-owned commodities that could be exported at the prices necessary to penetrate foreign markets. The new legislation enlarges the Export Enhancement Program subsidies to not less than $500 million per year. In addition, a Marketing Promotion Program is funded at not less than $200 million per year to target markets where unfair trade practices are cited. Legislation viewed these measures as additional weapons for use against countries that continue to refuse to reduce agricultural trade impediments.

Conservation. Growing environmental concerns are largely responsible for a number of new and revised stipulations of the conservation section of the new legislation. Previous legislation provided penalties intended to discourage the expansion of agricultural production on land defined as highly erodible or as wetlands, which are important wildlife habitats. The new legislation enlarges previous programs by creating an Agricultural Resources Conservation Program to protect these fragile lands as well as land that in cultivation may contribute to water pollution. The new program includes three separate components: the existing Conservation Reserve Program, which assists owners and operators in conserving

and improving soil and water resources on highly erodible land; a new Wetlands Reserve Program; and a new Water Quality Incentives Program.

The Conservation Reserve Program specifies that by 1995 not more than 45 million or less than 40 million acres of environmentally sensitive lands are to be enrolled in the program. The new Wetlands Reserve Program authorizes the subsidized enrollment of up to one million acres of wetlands into easements of thirty years or longer, with priority given to wetlands that enhance wildlife habitat. Landowners may participate in this program on a voluntary basis. The new Water Quality Incentives Program would pay farmers up to $3,500 a year to carry out government-approved plans to reduce water pollution, and more if wildlife habitat is also improved. The program specifies an enrollment goal of 10 million acres.

Credit. During the latter half of the 1980s the Farmers Home Administration experienced severe problems with loan delinquencies and defaults. For a period of time the agency was prevented from disposing of this property, and the foreclosed property inventory ballooned. That development motivated the authors of the 1990 agricultural legislation to include stipulations to address the Farmers Home Administration's property inventory problems. The new legislation calls for disposing of the land within one year. Leasers of property acquired by the Farmers Home Administration before January 6, 1988, would have the right of first refusal on the sale of that property. Purchase preference would also be given to beginning farmers and ranchers.

Write-downs of both loan principal and interest have been used to bring a borrower current on his indebtedness to the Farmers Home Administration. The new legislation limits borrowers to a single write-down for loans made after January 6, 1988. It also places on individual borrowers a lifetime cap of $300,000 in principal and interest, a stipulation that grew out of losses to some unusually large farming operations during the late 1970s and early 1980s.

Rural Development. In conjunction with the liquidations and consolidations of farming operations during the period of unusual financial stress on the farm sector during the 1980s, the economies of rural communities shrank and, in some cases, virtually disappeared. This development has motivated afflicted regions to secure government assistance to preserve and develop rural economies.

The new law contains provisions to create a Rural Development Administration within the Agriculture Department. One of its specified functions is to establish in as many as five pilot states panels of state officials who will rank state and local applications for Farmers Home Administration funding through that agency's loans for community development.

Implications of the Farm Bill

The major change in the 1990 Farm Bill is the triple-base option, which calls for the division of a farmer's acreage base into three categories. As already noted, that provision reduces the acreages of program crops on which farmers can receive deficiency payments by 15 percent, but it allows farmers the freedom to plant the crop of their choice (except fruits and vegetables) on those acres. It also permits farmers to remove voluntarily an additional 10 percent of the base acreage program crop production under the same stipulations. Farmers may still be required to remove (idle) some acreage from all crop production to qualify for program benefits according to the annually announced Acreage Reduction Program based on stocks-to-use ratios of the specific crop in question. The portion of the crop base left is the permitted acreage on which the program crop is grown. Each permitted acre of the crop is eligible for income deficiency payments as previously described.

The major unknown impact of the new legislation concerns what farmers will actually do with the 15 percent of their acreage base the new legislation has freed. Farmers can be expected to make individual decisions based on the productivity of their land (expected yields) in various crops and the expected price once a particular commodity has been produced. Farmers who select options different from the majority of their counterparts will probably make the most rewarding choices. For example, if most corn farmers choose to switch their triple-base acreage to soybeans, a substantially larger harvest might well push down the price of soybeans while reduced production of corn might drive its price up so that farmers who continue to produce corn on their freed acreage could end up receiving a higher income than those who switch. In that case, deficiency payments to corn producers would shrink because of the rise in market prices. In the South, reduced winter wheat and rice production in favor of increased soybean and cotton output could have the same result. That is, those who stay with the base program crop might receive higher returns after all. Obviously, such potential rewards for second-guessing competitors make it unusually difficult to forecast what most farmers will do in 1991 and subsequent years. In addition, the USDA has not released detailed rules and regulations governing all of the specific commodity programs. These stipulations could also influence farmers' decisions in the coming crop year.

Indications thus far are that acreage shifts may be relatively small for the nation as a whole. The

American Farm Bureau has projected that total cotton and wheat acreages are unlikely to change much as a result of the 1990 Farm Bill, and relatively minimal changes are projected for corn and soybeans.[1] Annual corn acreage may decline by an average 800,000 acres, and annual soybean acreage will probably increase by an average 1.2 million acres over the five-year life of the program. As a result, the level of soybean production could rise by 30 million bushels (1.5 percent) and the amount of corn output diminish by 90 million bushels (1 percent) during that time. The reduced output should raise the five-year average corn price by 4 cents per bushel (1.8 percent) from what it would have been under previous legislation. Increased soybean output is expected to lower the five-year average soybean price by 31 cents per bushel (5.1 percent) from the baseline forecast. The bill should have little impact on cotton and wheat prices.

The 15 percent reduction in acreage eligible for government payments will cut producers' program crop returns. Farmers who produce other more marketable crops on acres no longer eligible for deficiency payments could recoup at least some of that loss. However, if market prices of crops decline, the government's deficiency payments would have to increase to maintain income levels on program base acres. For example, if corn production does not decline as anticipated, prices could fall from the approximately $2.25 per bushel level at year's end 1990 to the projected loan rate of $1.90 per bushel, necessitating increased payments on program acreage. In addition, CCC outlays could grow as farmers repay certain commodity loans at market prices that have dropped rather than at the higher loan rate. If, as expected, a significant amount of triple-base acreage is shifted to soybean production so that prices drop, soybean producers would be the ones most likely to exercise the marketing loan option, but the price would have to decline by more than the 31 cents per bushel projected by the Farm Bureau to drop the year-end 1990 price of about $5.60 per bushel below the $5.02 per bushel loan rate.

The likelihood that deficiency payments will increase over the next five-year period is somewhat reduced by the program's movement to the twelve-month-marketing-year average as the base for calculating payments. Table 1 shows that for corn in the 1985-89 period, the marketing-year average price was higher than the five-month average in three out of the five years. For wheat, the marketing-year average was higher in four out of five years (the exception occurred in 1989, when the five-month average was slightly higher).

Corn and wheat account for the major share of the government's deficiency payment expenditures.

If price relationships during the next five years remain approximately the same as during the last five-year period, using the marketing-year average base could cut deficiency payments an additional 1.5 to 2.5 percent. Because the target price is frozen for the term of the new legislation, however, a plunge in commodity prices would require that deficiency payments increase substantially, regardless of the market price series used. The new program has been designed to keep American grains competitive in world markets, though, so total demand for grains is expected to remain strong enough to prevent major price declines. The American Farm Bureau projects modest increases in corn and wheat prices during the five years of the program.

Whether government costs rise or not, farmers in some regions fear damage from potential major acreage shifts. For example, southeastern soybean farmers worry that midwestern corn growers might plant soybeans instead of corn on their nonsubsidized acreage because the soybean crop may promise greater marketplace returns in their region. If prices fall because of extra soybean production, southeasterners would fail to cover their relatively high production costs. For these farmers, few profitable alternatives are available for a good portion of the poor land now devoted to soybeans. Southeastern farm spokesmen point out that the region's farm failures might well increase in the wake of the new legislation.

Conclusion

The 1990 Farm Bill has the overriding objective of cutting the government's costs for agricultural programs, costs that had grown large and threatened to grow much larger if allowed to continue on their course. The chief cost-cutting measure is the triple-base feature, which in effect reduces the acreage on which eligible crop producers can collect income deficiency payments. Such farmers now have a third category of land in addition to the acreage on which they receive subsidy payments and the acreage the government can require them to idle as a condition of receiving these payments. On land in this third category, farmers can plant whatever crop offers the greatest return in the marketplace (except fruits and vegetables) and still preserve the acreage history for the basic crop.

If market prices for the crops grown on triple-base acreage remain high or increase, farmers' incomes may not decline much as a result of the program change. However, market prices could sag under the weight of additional production and possi-

bly softening demand abroad as world production of crops increases.

A reduction in market prices and support prices would lead to increased government expenditures to maintain incomes of farmers, which would reduce the estimated savings projected for the new legislation. On the other hand, if demand should prove stronger than expected, government support costs could decline and a greater budget savings than the $13.6 billion projected would be realized.

If farm incomes drop sharply under the new program, Congress will come under intensifying pressure to raise subsidies again. On the other hand, the likelihood of continuing excessive budget deficits will almost certainly stiffen resistance to enlarging spending programs.

Note

1. The American Farm Bureau Federation, *Economic Review* 7 (October 1990): 1-6.

Book Review

Manias, Panics, and Crashes:
A History of Financial Crises, revised edition.

by Charles P. Kindleberger.
New York: Basic Books, Inc., 1989.
320 pages. $21.95 (cloth). $12.95 (paper).

As the extensive set of sources cited in Charles P. Kindleberger's book attests, financial crises have claimed economists' and historians' intermittent attention for centuries. In the aftermath of well-publicized gyrations in financial markets both here and abroad in the past few years, the expansion phase of a new cycle of interest seems to be occurring. Kindleberger's book, in the revised edition reviewed here, is one of several recent systematic considerations.

The developments of the 1980s have, it seems, added evidence to support Kindleberger's view on the progress and impacts of financial crises. His argument has several basic points. Financial crises, he contends, occur at odd times. Such events may cause real harm in the economies in which they take place. In addition, financial crises more and more often have global dimensions. Kindleberger emphasizes that central banks can alleviate some of these events' costs. Furthermore, these crises' global implications and the absence of a strong international financial power call for the establishment of an international lender of last resort to maintain the stability of the world's economies.

The author, whose grasp of the subtleties of international economic relations has long been appreciated, has made the case for an international lender of last resort in many forums. In *Manias, Panics, and Crashes*, Kindleberger's basic thesis is again that the world needs a central bank, but the large number of stories he tells to illuminate this idea often serve to mask the message. His arguments are less succinct and more colorful than the straightforward recounting of them in this review might suggest. Drawing a broad descriptive outline of the process of mania, panic, and crash from the work of Hyman Minsky (1977, 1982), the American economist best known for explorations of financial fragility, Kindleberger puts meat on the bones of Minsky's stylized description with examples from a plethora of secondary sources covering financial panics from the South Sea Bubble of 1720 to the stock market crashes of 1987.

In Kindleberger's version of Minsky's model, financial fragility results mainly from high levels of debt borrowers have taken on to buy assets for short-term profit. Following Minsky, Kindleberger divides the events of a crisis into several stages. The first is a "displacement," an event that changes profit

opportunities in at least one important sector of the economy. When businesses and investors flock to these opportunities, the second phase—the boom—gets under way. The boom is typically fueled, at least in part, by expanding bank credit.

A boom often progresses into euphoria, a phase characterized primarily by investors' buying assets for short-term resale, often on the basis of overestimations of future profits. This speculation results in further credit expansion and leveraging. Euphoria draws in people who do not usually enter speculative markets; such investors also have overblown profit expectations. Kindleberger calls the stage that ensues from euphoria a mania or a bubble, implying that the phase's speculative activities are irrational and precarious.

Under Kindleberger's scenario, a crisis begins when some investors, emerging from euphoria, begin to cash in on their speculations and prices resist further increases. After a period of "financial distress," Kindleberger explains, speculators realize that prices may not always rise. Then panic selling sets in, asset prices fall, bankruptcies increase, lenders fail, credit becomes unavailable, and even projects with high projected returns find no lenders. Panic feeds itself until it burns out or is extinguished by some policy response. Ultimately, real output and welfare decline as a result of the crisis.

After delineating the model, Kindleberger embarks on a series of chapters that flesh out his outline. He draws stories from a 275-year series of financial crises. This anecdotal method, the author contends, is an appropriate technique for conveying a sense of events that are unpredictable, chaotic, and unique. Kindleberger's stories, selected and written with wit and a sense of the bizarre, are a trove of information on the varieties of financial panics' propagation, spread, and resolution through the years. They show clearly that events similar enough to fit the term "financial crises" have occurred with some frequency but have also been quite varied in all their aspects.

As with most models that concentrate on stages, Kindleberger's stylized description is somewhat unsatisfactory. He tends to fit his stories into the model's stages rather than to probe systematic relationships that might explain the dynamics that drive the economy from stage to stage. The model is presented as a one-way progression with little explicit consideration of the role of the real (or nonfinancial) economy or expectations about the real economy. For example, Kindleberger clearly considers the initial displacement stage exogenous. Booms sometimes move to euphoria; sometimes they do not. In addition, no variables in the model account for transitional phases from one stage of a financial crisis to another. Some of the explanations the model does provide, such as a discussion of the timing of financial distress, are inadequate.

Furthermore, in considering the impacts of financial crises on the rest of the economy, Kindleberger fails to apply the insights of recent macroeconomic thinking, particularly the perspectives of real business cycle and rational expectations theorists. He assumes without discussion that real costs occurring after a crisis are the result of irrational behavior during the crisis. He might well have considered the insights of economists such as Gary Gorton (1984), Charles Jacklin and Sudipto Bhattacharya (1988), and Ellis Tallman (1988), who relate behavior during banking panics to the public's expectations about real phenomena in an ensuing recession or depression. Their approach makes the crisis at least partially a function of expected future real losses rather than a cause of these losses. Such a view undermines Kindleberger's arguments for intervention in the latter stages (financial distress and panic), calling, rather, for policies designed to maintain a stable economy.

The author's failure to provide adequate explanations of his model and to consider alternative approaches ultimately detracts from the book's credibility. Despite the marvelous stories, one begins to wonder why, if this broad model of financial crises' progression is truly systematic, documentation for each phase of the process is selected from only a sample of historical crises. Is the selection criterion only that the tale fits the model? Could one support a different model with a different set of anecdotes from the same universe of crises or, as Gorton's work implies, from the same set of samples?

Kindleberger appends two observations from his own earlier work to the general descriptions of Minsky's model. These points are vital to his argument for an international lender of last resort. In the most important of these he "opens" Minsky's one-economy model by noting that history gives many examples of situations in which manias, panics, crashes, and their effects have been transmitted among national economies, becoming international in scope. Interestingly, he points out, the impacts of internationally transmitted panics have not always been the same in different countries. For example, a building boom in Germany and Austria, which the author interprets as mania, removed credit from the U.S. economy in 1871 and 1872, restraining credit to American railroad speculators and contributing to a national panic. Kindleberger also argues that international transmission of crises has expanded in recent years with the growing integration of the world's economy, but he admits that, even as long ago as the 1720 South Sea Bubble, crises had international implications.

To support his appeal for a lender of last resort the author compares panics that have been allowed to stop without intervention to those that have been arrested with intervention. Kindleberger is clearly convinced that crises in which no lender of last resort intervened have run longer and been costlier in real terms. Analyzing the historical record of the international propagation of financial crises, the author contends that the depression following a crisis has been shorter when a lender of last resort has intervened. To accept this point fully, one must be convinced by the author's argument that a government, bank, or private organization has stepped in to perform central bank functions in a majority of the crises he discusses. In international crises such an organization has, often with cooperation from similar institutions from other countries, become an international lender. Only in infrequent crises, Kindleberger avers, has there been no strong organization to intervene, and such events have resulted in greater welfare losses.

These discussions lead to the key portion of Kindleberger's book—the argument for establishing an international lender of last resort. The current global economy, he maintains, lacks a strong, active lender of last resort able to act in the international sphere: the U.S. federal deficit weakens American ability; neither Japan nor Germany are yet strong enough, and each is hampered by internal demands; the International Monetary Fund does not have sufficient resources or scope of powers. Consequently, in the face of increased threat of international crisis transmission, Kindleberger promotes the establishment of an institution capable of supplying financial resources needed to stop international panics or mitigate their results.

This conclusion prompts several questions that the author answers only briefly, if at all. Would an international central bank increase moral hazard in a world in which risk taking is often subsidized excessively? Would it not be more effective for national central banks to coordinate under pressure of crisis? What could an international central bank do to handle a potentially dangerous one-country mania that threatened to become an international panic? When faced with nations in different phases of the business cycle, how would the international central bank decide on its course of action?

Kindleberger's wide array of stories demonstrates that market economies are not, and for centuries have not been, immune to manias, panics, and crashes. His cautionary tales shake any complacency that may still exist about the stability of today's world economy; in fact, Kindleberger clearly shows that international transmission of economic crises is at least frequent and probably becoming more so. For this reason his book is worth the attention of those interested in economic policy for financial markets and the real economy. The reader could wish, however, that this book's mass of evidence provided more enlightenment on the engine operating in the chosen model and at least some consideration of the role of real shocks and expectations in alternative models.

The increasing integration of the world's economies may someday bring more coordination of national economic conditions and demonstrate that an international institution designed to respond to financial crises is vital to economic well-being. Kindleberger breaks some ground toward persuading his readers that such an outcome is desirable and inevitable, but he falls short of his ultimate goal.

B. Frank King

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*The reviewer is vice president and associate director of research at the Federal Reserve Bank of Atlanta.*

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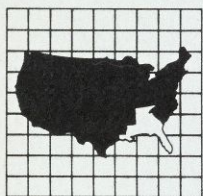
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Federal Reserve Bank of Atlanta
104 Marietta St., N.W.
Atlanta, Georgia 30303-2713

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