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Unlike the federal budget, which typically measures receipts and expenditures for one year at a time, generational accounts and lifetime tax rates focus on long-term intergenerational wealth redistribution. The accounts show that future generations can expect to pay, on average, more than twice as much to the government as current (1991) newborns if living generations continue to be treated as they are under current policy. Lifetime tax rates on successive generations have increased from 22 percent for Americans born in 1900 to about 34 percent for those born in 1991. Under the baseline economic assumptions presented here, future generations are slated to see that figure rise to more than *70 percent* on average.

The P-Star (P*) model forecasts inflation by exploiting the stability of M2 velocity and the tendency of the real economy to operate near its potential. While originally offered as a link between inflation and money growth, inverting the model provides a test of one of its primary assumptions: the constancy of M2's long-run velocity, or V-Star (V*). If V* has increased during the last three years, predictions of inflation from the original P* model should be inferior to predictions from a model that incorporates the new, higher V*. In fact, the deceleration of inflation through 1992:IIIQ was quite close to the original model's prediction, and simulations of the model under a variety of hypotheses regarding changes in V* provide relatively little support for a dramatic shift in that measure.

Many view the proliferation of securitization as a response to competitive or regulatory pressures. But to what extent would asset-backed lending occur in a less regulated environment? This paper addresses the extent to which models of credit intermediation have been able to formalize some of the market-based forces driving this phenomenon. The authors examine four papers that model some of the dimensions of asset-backed markets. An underlying theme is that under certain conditions, the very information costs that make financial markets important as conduits of credit can also create nonregulatory incentives for asset-backed lending as an efficient funding mode.

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Generational Accounts and Lifetime Tax Rates, 1900–1991

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Introduction

Generational accounting is a new method for determining how government deficits, taxes, transfer payments, and other expenditures affect the distribution of income and wealth among different generations. The technique is still being developed, and a number of the assumptions used to estimate the accounts are controversial.

Auerbach, Gokhale, and Kotlikoff (1991), Kotlikoff (1992), and Office of Management and Budget (1992) explain the basic concept and present some illustrative results. This article updates the baseline generational accounts reported in the 1993 federal budget and estimates the effects of several new alternative policies. It also extends the analysis for the first time to lifetime net tax rates—the taxes that a generation pays, less the Social Security and other transfer benefits that it receives, as a percentage of income over its entire lifetime.

The new analysis reveals the following:

- The lifetime net tax rates paid by Americans in the baby boom and successive generations will likely be much higher than the rates paid by those born earlier.
- The net tax rates paid by future generations will be substantially higher than those paid by the baby boom and other current generations, unless policy actions are taken now to mitigate the increase.
- The generational imbalance between newly born and future Americans could be largely eliminated either by imposing a cap on mandatory spending (excluding Social Security) from 1993 through 2004 or by instituting an appropriate surtax. Both policies would significantly raise the net taxes paid by current Americans, but the increase for the newly born would be considerably more under a surtax.

I. The Nature of Generational Accounts

The federal budget normally measures receipts and outlays for one year at a time and reports these estimates for only a few years into the future. Generational accounts, in contrast, look ahead many decades, classifying taxes paid and transfers received—such as Social Security, Medicare, and food stamps—according to the generation that pays or receives the money. For an existing

generation, taxes and transfers are estimated year by year over members' remaining lifespan. These amounts are then summarized in terms of one number, the present value of the generation's entire annual series of average future tax payments net of transfers received. For future generations, the accounts are based on the proposition that the government's bills will have to be paid either by them or by those now living. The calculations determine how much future Americans will have to pay on average to the government, above the amount they will receive in transfers, if total government spending is not reduced from its projected path and if those now living pay no more than anticipated.

Defined more precisely, generational accounts measure, as of a particular base year, the present value of the average future taxes that a member of each generation is estimated to pay minus the present value of the average future transfers that he or she is estimated to receive. This difference is called the "net payment" in the following discussion. A generation is defined as all males or females born in a given year.

Generational accounts can be used for two types of comparison. First, they allow us to compare the lifetime net payments by future generations, by the generation just born, and by different generations born in the past. Lifetime net payments by generations born in the past are based on estimates of actual taxes paid and transfer payments received through 1991, as well as on projections of taxes to be paid and transfer payments to be received in the future.

Second, generational accounts can be used to compare the effects of actual or proposed policy changes on the remaining lifetime net payments of currently living and future generations. Such comparisons can be made equally well for policies that change the totals of receipts or expenditures and for those that change the composition of the budget without affecting the deficit.

It should be noted that, as now constructed, generational accounts have a number of limitations. First, they include the taxes and transfers of all levels of government—federal, state, and local—and thus do not show the separate effect of the federal budget as a whole. However, the difference in the accounts due to a federal government policy *change* can be analyzed alone.

Second, generational accounts reflect only taxes paid and transfers received. They do not impute to particular generations the value of the government's purchases of goods and services for education, highways, national defense, and so on. Thus, the full net benefit or burden that any generation receives from government fiscal policy as a whole is not totally captured. Still, the accounts can reveal the effects of a policy change that affects only taxes and transfers. In the future, it may be feasible to impute the value of certain types of government purchases to specific generations.

Third, generational accounting does not, as yet, incorporate any policy feedback on the economy's growth and interest rates. Feedback effects can be significant, but because they generally occur slowly, their impact on the discounted values used in the accounts may be small. Moreover, there is reason to believe that they would reinforce the conclusions derived here. For example, policies that decrease current generations' net payments while increasing the burden on future generations are likely to reduce investment over time. This in turn will lower real wage growth and raise real interest rates, which on balance will harm future generations in absolute terms.

Finally, generational accounting divides people born in the same year into only two categories, males and females, with each designated a "generation." This is an important distinction, since the sexes differ significantly in such characteristics as lifetime earnings and longevity. However, the method does not reveal differences with respect to other characteristics, such as income levels or race, nor does it show the wide diversity among individuals within any particular grouping.

Thus, the results presented here should be viewed as experimental and illustrative. They are limited by the availability and quality of the data, especially for earlier years. In addition, they are necessarily based on a number of simplifying assumptions (about which reasonable people may disagree) concerning the pattern of future taxes and spending, mortality and birth rates, the interest rate used for discounting future taxes and transfers to derive present values, and so forth. The absolute amounts of the generational accounts are sensitive to all of these assumptions.

Nevertheless, like the 75-year projections issued each year by the Social Security trustees, the accounts can be illuminating when considered in light of their assumptions. Moreover, the most fundamental result—that future generations' average net payment will be relatively much larger than that of the generation just born—holds for a wide range of reasonable changes in the assumptions.

II. Remaining Net Payments by Existing Generations

Tables 1 and 2 show the generational accounts as of calendar year 1991 for every fifth generation of

TABLE 1

Generational Accounts for Males: Present Value of Taxes and Transfers as of 1991 (thousands of dollars)

		Taxes Paid				Transfers Received		
Generation's Age in 1991	Net Payment	Labor Income Taxes	Capital Income Taxes	Payroll Taxes	Excise Taxes	Social Security	Health	Welfare
0	78.9	29.2	10.1	31.8	28.2	6.1	11.0	3.3
5	99.7	37.5	12.9	41.0	33.3	7.7	13.1	4.2
10	125.0	47.8	16.5	52.3	38.7	9.2	15.7	5.4
15	157.2	61.1	21.2	67.1	44.6	10.7	19.2	6.9
20	187.1	73.5	26.5	81.3	48.3	11.8	22.2	8.4
25	204.0	80.4	33.1	89.5	49.1	14.6	24.3	9.0
30	205.5	80.4	39.9	89.8	48.5	18.0	26.4	8.6
35	198.8	77.6	46.8	87.0	47.8	22.6	29.7	8.0
40	180.1	71.0	52.3	79.9	46.9	28.5	34.1	7.3
45	145.1	59.8	55.4	67.6	44.5	35.9	39.6	6.6
50	97.2	45.8	55.3	52.0	40.7	45.2	45.4	6.0
55	38.9	30.2	52.2	34.5	36.2	57.1	51.8	5.3
60	–23.0	16.2	46.4	18.6	30.8	72.4	58.1	4.6
65	–74.0	5.7	39.0	6.6	25.6	82.3	64.6	3.9
70	–80.7	2.4	30.9	2.7	20.4	75.5	58.2	3.4
75	–75.5	1.1	23.6	1.3	15.5	63.3	50.9	2.8
80	–61.1	0.6	18.0	0.7	11.0	47.9	41.5	1.9
85	–47.2	0.2	15.0	0.3	7.6	36.4	33.1	0.9
90	–3.5	0.0	7.1	0.0	1.7	6.5	5.8	[a]
Future generations	166.5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Percentage Difference in Net Payment						
Future generations and age zero	111.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

a. $0.05 thousand or less.
SOURCE: Office of Management and Budget (1992).

males and females alive in that year. The first column, "Net Payment," is the difference between the present value of taxes that a member of each generation will pay, on average, over his or her remaining lifetime and the present value of transfers that he or she will receive. The other columns show the average present values of several different taxes and transfers. All federal, state, and local taxes and transfers are included in these calculations. Federal spending and receipts are based on the baseline calculations in the Office of Management and Budget's *Mid-Session Review of the 1993 Budget*.

The present value of future taxes to be paid by young and middle-aged generations far exceeds the present value of the future transfers they will receive. For males age 40 in 1991, for example, the present value of future taxes is $180,100 more than the present value of future transfers. The amounts are large because these generations are close to their peak taxpaying years. For newborn males, on the other hand, the present value of the net payment is much smaller, $78,900, because they will pay very little in taxes for a number of years.

Older generations, who are largely retired, will receive more Social Security, Medicare, and other future benefits than they will pay in future taxes. That is, they have negative net payments. Females have smaller net payments than males, mainly because they earn less and thus pay less income and Social Security taxes.

TABLE 2

Generational Accounts for Females: Present Value of Taxes and Transfers as of 1991 (thousands of dollars)

		Taxes Paid				Transfers Received		
Generation's Age in 1991	Net Payment	Labor Income Taxes	Capital Income Taxes	Payroll Taxes	Excise Taxes	Social Security	Health	Welfare
0	39.5	15.1	3.7	16.5	27.3	5.8	9.6	7.7
5	48.7	19.4	4.8	21.2	32.0	7.3	11.5	9.9
10	59.4	24.7	6.1	27.0	36.8	8.7	14.0	12.5
15	72.4	31.4	7.9	34.6	41.8	10.0	17.3	16.0
20	84.0	37.1	9.8	41.3	45.0	11.1	20.0	18.2
25	86.4	38.5	12.3	42.9	46.1	13.7	23.2	16.5
30	81.1	36.2	15.5	40.5	46.1	17.0	26.9	13.4
35	71.9	33.3	19.1	37.4	46.1	21.3	32.1	10.7
40	55.3	29.0	22.3	32.7	45.2	26.9	38.8	8.2
45	29.5	23.1	24.8	26.2	43.2	34.2	47.4	6.1
50	–2.2	16.7	26.1	19.0	39.5	43.5	55.4	4.6
55	–39.5	10.8	26.0	12.3	35.2	55.6	64.4	3.7
60	–80.8	5.6	24.4	6.4	30.3	71.4	73.1	3.1
65	–112.5	2.0	21.7	2.3	25.3	80.3	80.8	2.7
70	–110.6	0.8	18.0	0.9	20.6	74.2	74.4	2.4
75	–100.6	0.4	13.8	0.4	15.8	63.0	65.8	2.1
80	–83.3	0.2	9.3	0.2	11.6	49.5	53.3	1.7
85	–65.6	0.1	4.7	0.1	8.9	36.8	41.1	1.4
90	–9.8	0.0	0.5	0.0	1.6	5.6	6.0	0.2
Future generations	83.4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
		Percentage Difference in Net Payment						
Future generations and age zero	111.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

SOURCE: Office of Management and Budget (1992).

Since the figures in these tables show the *remaining* lifetime net payments of particular generations, they do not include the taxes paid or transfers received in the past. This must be kept in mind when considering the net payments of those now alive. The portion of a generation's remaining lifetime net payment depends on whether we are talking about 10-, 40-, or 65-year-olds. The fact that 40-year-old males can expect to pay more in the future than they receive, in present-value terms, while the reverse is true for 65-year-old males, does not necessarily mean that federal, state, and local governments are treating the 40-year-olds unfairly. Because 65-year-old men paid considerable taxes when younger, and these are not reflected in their remaining lifetime net payments, direct comparisons are impossible. The lifetime net payments of different generations can be compared only by using lifetime net tax rates, discussed below.

Estimates of future net payments by generation are affected by the amount of taxes, transfers, and other government expenditures assumed year by year in the baseline projection. These assumptions can differ widely. As explained in the appendix, the methods of projection generally seek to maintain current policy in some sense. However, current policy can be interpreted in several ways, especially for expenditures such as defense. Furthermore, long-term Medicare and Medicaid projections assume that, eventually, policy actions or other forces will hold spending growth to the overall rate of economic expansion (adjusted for shifts in the age and sex composition of the

TABLE 3

Percentage Difference in Net Payments between Future Generations and Age Zero

	Productivity Growth Rate		
Interest Rate	0.25	0.75	1.25
3.0	117	89	65
6.0	138	111	87
9.0	228	193	162

SOURCE: Office of Management and Budget (1992).

population), even if the growth rate is quite rapid for the next few decades.[1]

III. Net Payments by Future Generations

Future generations—those born in 1992 and later—will be required to make a 111 percent larger net payment to the government, on average, than those born in 1991. The average net payments of $166,500 by future males and $83,400 by future females are calculated assuming that the male-to-female net payment ratio is the same for future generations as for those born in 1991. The calculations also assume that all future Americans of a particular sex will make the same average net payment over their lifetimes after adjustments are made for economic growth.

A growth adjustment is needed to compensate for the fact that future generations will pay more in taxes, net of transfers received, simply because their incomes will be higher. To properly assess future generations' net payment relative to that of the newly born, it is necessary to calculate the net payment they will make above and beyond the amount due to economic growth. Generational accounts assume that all future generations will pay the same net amount apart from this growth adjustment. The net amount is the number shown in tables 1 and 2 for all future generations of the same sex.

A generational imbalance, as defined above, is calculated in such a way that the generations now alive, including the newly born, do not pay any more taxes (or receive any less transfers) than projected in the baseline. This assumption is an analytical device for determining the size of the nation's fiscal imbalance; it is not meant to suggest that future generations will in fact close the gap all by themselves. Any actual policy change is almost certain to bear in some degree on current generations as well as on those yet to be born. If such a policy change is made, the percentage difference in net payments between the newly born and future generations would be less than shown in tables 1 and 2. Policy changes of this kind are discussed below.

The size of the imbalance between future generations and the newly born is sensitive to assumptions about both the interest rate used for discounting and the growth rate of the economy. Table 3 shows the percentage differential under interest rates of 3.0, 6.0, and 9.0 percent and productivity growth rates of 0.25, 0.75, and 1.25 percent. Although the difference ranges from 65 percent to 228 percent, our basic conclusion, that future generations' net payment will be much larger than that of those just born, still holds in every case.

The generational imbalance also depends on the policy assumption that all future generations of the same sex will have the same net payment (after adjusting for growth). But suppose that the future generations born between 1992 and 2001 pay only the same amount as those born in 1991. Because these future generations pay less than previously assumed, those born after 2001 will have a net payment that is 186 percent larger, rather than 111 percent larger, than that facing the 1991 generation. The greater the number of future generations who pay no more than current newborns, the larger will be the net payment required of generations who are born still later.

Change in the Imbalance between 1990 and 1991

The estimated 111 percent imbalance in 1991 between newborns and future generations can be compared with the estimated 79 percent imbalance in 1990 reported in the fiscal year 1993 budget. The difference primarily reflects lower baseline receipts projected for 1993–2004. Based on last year's projections, the estimated 1991 imbalance would be 81 percent. A second factor is that another generation, the one born in 1991, does not have to make the higher lifetime net payments required of future generations.

1 A pure extrapolation of recent trends, in contrast, implies that health care costs will eventually bankrupt the government.

TABLE 4

Change in Generational Accounts Due to Alternative Policies as of 1991 (thousands of dollars)

	Males		Females	
Generation's Age in 1991	Mandatory Cap	Surtax	Mandatory Cap	Surtax
0	6.4	16.1	5.4	7.5
5	7.7	19.2	6.6	8.9
10	9.1	22.4	7.9	10.4
15	10.5	25.3	9.3	11.4
20	11.1	26.1	10.4	11.6
25	11.8	25.5	11.8	11.1
30	12.6	24.0	13.5	10.4
35	14.0	21.8	15.9	9.4
40	15.9	18.8	18.7	8.2
45	18.2	15.1	22.0	6.8
50	20.7	11.2	25.6	5.3
55	23.0	7.6	29.2	4.0
60	23.2	4.9	30.3	2.8
65	20.0	3.1	27.4	1.9
70	15.6	2.0	22.7	1.2
75	11.0	1.2	16.9	0.6
80	6.6	0.7	10.2	0.2
85	2.5	0.3	3.6	a
90	0.0	0.0	0.0	0.0
Future generations	–71.3	–57.2	–33.2	–29.3
	Percentage Difference in Net Payment			
Future generations and age zero	11.7	15.1	11.7	15.1

a. $0.05 thousand or less.
SOURCES: Office of Management and Budget (1992) and authors' calculations.

IV. Illustrative Policy Changes

Table 4 compares two alternative policies aimed at rectifying the fiscal imbalance between the generation just born and future generations. Both would remove the imbalance to about the same degree, but their distributive effects among different generations vary tremendously.

The first of these policies is a cap on all mandatory spending programs except Social Security and deposit insurance. From 1993 to 2004, the savings from the cap would be calculated for each mandatory program with beneficiaries as the difference between 1) baseline spending and 2) spending limited to the growth in the number of beneficiaries plus the inflation rate (with a little additional growth allowed in the first two years for transition). Medicare and Medicaid are the largest mandatory programs, and they produce most of the total savings. For these two programs, spending would be limited to the amount determined by the cap. For all other mandatory programs (except Social Security and deposit insurance), the required savings would be spread across the board as a proportionate reduction in spending. Employing the economic assumptions used for the 1993 *Mid-Session Review* (and extended to the years after 1997), the consolidated budget is projected to be balanced under the cap in 2004.[2] Thereafter, the spending growth rates for mandatory programs would be the same as in the baseline calculations. However, because the level of mandatory spending in 2004 would be lower than under the baseline, applying these same growth rates would produce permanently lower levels of subsequent spending.

The cap on mandatory spending would largely eliminate the imbalance in net payments between future generations and those just born. Future generations would pay an average of 12 percent more, instead of 111 percent more. The net payment by future males would be $71,300 less than under the baseline, on average, and the net payment by future females would be $33,200 less.

All existing generations would face a larger net payment. In terms of age, the biggest increase would be for people who are now around 55 to 60. This is because the cap would mainly reduce transfer payments for health care, especially Medicare, which is received almost totally by the elderly. The increase in net payments would be higher for females than males at almost every age, because females live longer, and the cap would primarily reduce transfers to the elderly.

The second policy is a surtax on the federal individual income tax. From 1993 to 2004, the amount of the surtax would equal the spending reduction required by the mandatory cap. After 2004, the surtax would increase at the same rate as other taxes generally do.

The surtax would reduce the generational imbalance by almost as much as the mandatory cap. Future generations would pay 15 percent more on average than those just born, compared to 12 percent under the cap and 111 percent under the baseline. The average future male would pay $57,200 less, and the average future female would pay $29,300 less. All existing generations would pay more.

The distributional effect of the surtax would be quite different from that of the mandatory cap, however. The surtax would bear much

2 The budget would not necessarily be balanced in all later years. Generational balance over a period taken as a whole is consistent with some years of deficit, and the illustrative policies do not entirely eliminate the imbalance.

TABLE 5

Lifetime Net Tax Rates, Gross Tax Rates, and Transfer Rates (percent)

	Males			Females			Average of Males and Females		
Generation's Year of Birth	Net Tax Rates	Gross Tax Rates	Transfer Rates	Net Tax Rates	Gross Tax Rates	Transfer Rates	Net Tax Rates	Gross Tax Rates	Transfer Rates
1900	17.8	19.6	1.8	35.3	43.9	8.7	21.5	24.8	3.3
1910	21.8	24.6	2.8	35.7	49.6	13.9	24.7	29.8	5.2
1920	24.2	27.7	3.5	34.0	50.4	16.5	26.3	32.5	6.2
1930	26.4	30.5	4.1	34.4	52.8	18.5	28.1	35.3	7.2
1940	28.2	33.0	4.8	32.7	50.6	17.9	29.3	37.3	8.0
1950	30.6	36.8	6.2	30.6	46.9	16.3	30.6	39.9	9.3
1960	32.3	39.6	7.2	31.5	47.9	16.4	32.1	42.3	10.2
1970	33.6	41.7	8.1	32.5	50.3	17.8	33.2	44.5	11.3
1980	34.1	42.4	8.3	33.1	51.6	18.5	33.8	45.5	11.7
1990	33.9	42.7	8.7	32.9	52.0	19.1	33.6	45.7	12.2
1991	33.9	42.7	8.8	32.8	52.0	19.2	33.5	45.8	12.2
Future generations	71.5	n.a.	n.a.	69.3	n.a.	n.a.	71.1	n.a.	n.a.

SOURCE: Office of Management and Budget (1992).

more on the relatively young; the cap, on the relatively old. For example, a 65-year-old male would pay $3,100 more under the surtax than under the baseline, but $20,000 more under the cap; in contrast, a 20-year-old male would pay $26,100 more under the surtax but $11,100 more under the cap. This is because the surtax is paid disproportionately by younger people earning income, whereas the cap disproportionately reduces transfer payments to the elderly.

The second distributional difference is between males and females. The surtax bears more on males; the cap, on females. This is primarily due to the fact that males tend to have higher incomes and pay more income taxes, whereas females tend to live longer and receive more health care transfers.

The two policies also have different distributional effects between existing and future generations. The reduction in net payments by future generations is less under the surtax: $14,000 less for males, on average, and $4,000 less for females. This is partly because a larger imbalance remains between future generations and those just born, 15 percent compared to 12 percent. The improvement for future generations is less under the surtax because older generations do not pay as much more.

V. Historical Lifetime Tax Rates

The analysis so far has been prospective, considering only the present value of future taxes and transfers as of 1991 for existing generations and those yet to be born. A prospective analysis can compare policy changes, and it can compare the lifetime fiscal burdens on the newly born and future generations, since their entire lifetimes are yet to come. However, it cannot compare the lifetime fiscal burden of one existing generation with that of another existing generation born in a different year—or with future generations—because part of any living generation's taxes and transfers occurred in the past and thus are not taken into account.

A comparison of one existing generation with another must be based on their entire lifetime taxes and transfers. Table 5 shows the results in terms of lifetime net tax rates for different generations born since 1900 and for future generations. The lifetime net tax rate of a generation is defined as the present value of its lifetime net taxes (taxes less transfers) divided by the present value of its lifetime income. The present values are calculated as of the generation's year of birth, so that each cohort can be compared from the standpoint of when it was born. The lifetime net taxes are the

same as the generational account for a generation in the year of its birth. (As shown in table 1, the lifetime net taxes of males born in 1991 are $78,900.) Since lifetime taxes, transfers, and income have trended upward and have fluctuated to some extent, it is more appropriate to compare the relative fiscal burden on different generations in terms of lifetime net tax rates than in terms of absolute amounts.

Lifetime net tax rates are calculated from historical data on taxes, transfers, and income up to 1991 and from projections of future data as described in the previous sections. Historical data, however, are not available in the same detail as the figures for recent years underlying our projections, and in some cases they are not available at all. The appendix summarizes the methods used to construct the historical series.

Lifetime calculations also introduce a number of conceptual issues. For example, how should lifetime income be measured? Lifetime income is defined as a present value, like lifetime taxes and transfers. Therefore, the present-value calculations should include all income that increases a generation's resources: labor earnings, inherited wealth, and capital gains over and above the normal return to saving. The normal return to saving is not itself included in income, because that would be double counting. Saving and earning a normal rate of return do not increase the present value of a household's resources. Data do not exist on the share of each generation's income stemming from inherited wealth or supernormal capital gains, so labor earnings are used to represent income.[3]

The lifetime net tax rate for males in the base case exhibits a strong upward trend, rising from 17.8 percent in 1990 to about 34 percent in 1970 and succeeding years. The lifetime net tax rate for females exhibits a quite different pattern. It started much higher than for males, at 35.3 percent, declined irregularly for half a century, and rose slightly thereafter. Since 1950, the net tax rate has been about the same for both sexes.

The pattern of the female net tax rate is an artifact of women's increasing labor force participation and the method used to attribute labor earnings and taxes within a family. Labor earnings are attributed to the person who receives them; some taxes, including excises, are attributed equally to husband and wife. The lower female earnings thus contribute to a higher female tax rate, especially in the early decades of the century. At the same time, the rise in female labor force participation over time has caused their earnings to increase faster than male earnings, without directly increasing those taxes that are attributed equally to husband and wife. This has offset the general increase in taxes that contributed to the rising net tax rates observed in the series for males.

This pattern emphasizes a conceptual question in calculating the generational accounts. How should income, taxes, and transfers be attributed within a family? Excise taxes could alternatively have been attributed in proportion to labor earnings, or labor earnings could have been attributed equally between husband and wife. Table 5 displays one answer to this question by including lifetime net tax rates for males and females combined, calculated as a weighted average of the net tax rate for each sex. Note that the average net tax rises significantly over most of this century, increasing from 21.5 percent for the generation born in 1900, to 32.1 percent for the generation born in 1960, to about 33 percent for the generations born since 1970. This trend reflects the growing fiscal role of government. The average net tax rate for future generations is 71.1 percent, which is the same percentage difference relative to people newly born in 1991 as that shown in tables 1 and 2. The male and female net tax rates are virtually identical for future generations.

Table 5 also breaks down the net tax rates between gross tax rates and transfer rates. To calculate the latter, the present value of a generation's lifetime taxes (or transfers) is divided by the present value of its lifetime income. This breakdown reveals the expanded role of government transfer payments during the past century. The lifetime transfer rate for males and females taken together nearly *quadrupled* between the generations born in 1900 and those born in 1991, starting at 3.3 percent and rising each decade to a rate of 12.2 percent. The increase was more rapid, in both relative and absolute terms, for the generations born before World War II than afterward.

Because of the growth in the transfer rate, the gross tax rate has not leveled off in the past two decades to the same extent as the net tax rate. The gross tax rate for males and females combined nearly doubled between the generations born in 1900 and 1991, starting at 24.8 percent and increasing each decade to a rate of 45.8 percent. A generation's lifetime taxes pay for the government's purchases of goods and services as well as for public transfers to its own members and other generations.

■ 3 The error due to this omission is relatively small in the aggregate, given that labor income has long accounted for three-fourths of all income and that only part of the remaining income from capital should be included. However, the errors for different generations could vary, depending on trends and fluctuations in asset values and bequest behavior.

TABLE 6

Lifetime Net Tax Rates (percent)

Generation's Year of Birth	Males			Females			Average of Males and Females		
	Baseline	Mandatory Cap	Surtax	Baseline	Mandatory Cap	Surtax	Baseline	Mandatory Cap	Surtax
1900	17.8	17.8	17.8	35.3	35.3	35.3	21.5	21.5	21.5
1910	21.8	21.8	21.8	35.7	35.9	35.7	24.7	24.7	24.7
1920	24.2	24.4	24.3	34.0	34.8	34.0	26.3	26.6	26.3
1930	26.4	26.8	26.4	34.4	36.5	34.5	28.1	28.9	28.2
1940	28.2	28.9	28.5	32.7	35.2	33.2	29.3	30.4	29.7
1950	30.6	31.5	31.6	30.6	32.9	31.5	30.6	31.9	31.6
1960	32.3	33.6	34.6	31.5	34.2	33.5	32.1	33.8	34.2
1970	33.6	35.3	37.6	32.5	35.7	35.9	33.2	35.4	37.1
1980	34.1	36.5	39.9	33.1	37.0	38.2	33.8	36.6	39.3
1990	33.9	36.6	40.7	32.9	37.4	39.0	33.6	36.9	40.2
1991	33.9	36.6	40.8	32.8	37.3	39.1	33.5	36.9	40.2
Future generations	71.5	40.9	47.0	69.3	41.7	45.0	71.1	41.3	46.5

SOURCE: Office of Management and Budget (1992).

The breakdown further shows that the similarity between males and females in lifetime net tax rates masks very different gross tax and transfer rates. Each rate is much higher for females, reflecting such factors as their lower lifetime income and greater longevity (as well as the attribution assumptions for taxes and income within the family).

Table 6 shows how policy changes designed to rectify the generational imbalance would affect the lifetime net tax rates of different generations. For future generations, the cap on mandatory spending reduces the average lifetime net tax rate on males and females together from 71.1 percent to 41.3 percent, while the surtax reduces it to 46.5 percent.

For existing generations, the effect of policy changes on lifetime net tax rates increases as the generation's age declines, and for the very youngest cohort, born in 1991, the change is quite significant. Under the mandatory cap, this generation's lifetime net tax rate increases by 2.7 percentage points for males. For females, who will live longer, the increase is 4.5 percentage points. A surtax would raise the burden on the youngest group still more: an increase over the baseline of 6.9 percentage points for males and 6.3 percentage points for females. For older generations, the increase in the lifetime net tax rate is smaller, primarily because the absolute effects of the policy change are discounted over more years in order to calculate the present value as of the generation's year of birth. In the case of the surtax, the absolute effects are also smaller for older generations, because they have fewer remaining years of labor earnings.

The burden that remains on the older generations is greater under the mandatory cap than under the surtax, as previously explained, because Medicare benefits are relatively high and income taxes relatively low during their remaining years. Since females live longer than males, the increase in their lifetime net tax rate under the mandatory cap is greater than for males at every age. On the other hand, because males have higher labor earnings, the surtax generally hits them harder than it does females.

Appendix—Construction of the Generational Accounts

Present-Value Constraint

Generational accounting is based on the present-value budget constraint of the government sector. In simple terms, this constraint says that the government must ultimately pay for its purchases of goods and services either with resources it obtains from current and future generations or with its current assets (net of debt). If current

generations pay less in taxes (net of transfers received) to finance government purchases, future generations will have to pay more. For example, suppose that, through borrowing, payments for the government's bills were repeatedly shifted to future generations by each successive current generation. Then this debt would grow, with interest. Eventually, the interest would exceed the lifetime income of future generations, resulting in default.

More precisely, the government's present-value constraint means that, at any point in time, the present value of the government's future purchases of goods and services cannot exceed the sum of three items: 1) the present value of future taxes to be paid (net of transfers received) by existing generations (that is, the sum of their generational accounts multiplied by the number of people in each generation), 2) the present value of taxes to be paid (net of transfers received) by future generations, and 3) the value of government assets that yield income, less the government debt. Generational accounting estimates the present value of the government's purchases of goods and services plus amounts 1 and 3. Amount 2, the present value of taxes to be paid by all future generations (net of transfers received), is calculated as the present value of future government purchases minus amounts 1 and 3.

The generational accounts for future generations are derived from the aggregate amount 2. For all but one of the policy experiments discussed here, different net payments (after adjusting for economic growth) are not estimated for different future generations. Rather, the aggregate present-value net payment by future generations is divided on an even basis among all future generations so that the average net payment by the members of each keeps pace with the economy's productivity growth. Thus, as shown in tables 1 and 2, one single (growth-adjusted) average figure stands as the generational account for all future generations of a given sex. Because the generational account is calculated indirectly from the above aggregates, it can be shown only as a single number and cannot be divided among specific taxes and transfers.

Underlying Calculations

Calculating the generational accounts is a three-step process. The first step entails projecting each currently living generation's average taxes and transfers for each future year in which at least some of its members will be alive. The second step converts these projected values into an actuarial present value, using assumptions for the discount rate and the probability that the generation's members will be alive in each of the future years. The sum of these present values, with transfers subtracted from taxes, is the generational account, or net payment, for existing generations shown in the first column of tables 1 and 2. The third step estimates the other terms of the present-value constraint (explained in the previous section) so as to derive the average net payment by future generations. The calculations are based on projections to the year 2200.

Projection of taxes and transfers. The projection of average future taxes and transfers begins with the national totals of all federal, state, and local taxes and transfers as reported in the National Income and Product Accounts (NIPAs) for calendar year 1991. (All years in this article are calendar years unless otherwise stated.) Employee retirement and veterans' benefits paid by the government are considered a form of employee compensation and are classified as the purchase of a service rather than as a transfer payment.

The base-year NIPA totals are distributed to all existing generations, as defined by age and sex, based on the corresponding distributions in cross-section survey data. These surveys include the Survey of Income and Program Participation and the Current Population Survey, both by the Bureau of the Census, and the Survey of Consumer Expenditures by the Bureau of Labor Statistics. Those taxes that are not directly paid by individuals and so do not appear in these surveys, such as the corporate income tax, are allocated. Because generational accounting attributes taxes and transfers to individuals, household taxes and transfers are attributed to household members. No special imputations are made to children, but the cross-section surveys impute some consumption to them; thus, the taxes on that consumption are attributed to children. The attribution rules affect the values of the baseline accounts, but are not likely to alter the generational implications of policy changes.

The distribution of average future taxes and transfers by age and sex is assumed to equal the base-year average amounts after adjustments for growth and projected policy. In the case of federal taxes and transfers for 1993–2004, the amounts correspond to the current service estimates of taxes and transfers in the *Mid-Session Review of the 1993 Budget* (July 1992), extended beyond 1997 and updated for the actual fiscal year 1992 results. In the case of state and local taxes and transfers for 1993–2004, the amounts are based on the GDP assumptions in the *Mid-Session Review* as well as on the assumption that the ratios of

state and local tax and transfer aggregates to GDP remain constant at 1991 levels. After 2004, the average taxes and transfers by age and sex are assumed, with two exceptions, to increase at the assumed rate of productivity growth. Productivity (both labor and multifactor) is assumed to increase by 0.75 percent a year, which is close to the average annual rate of multifactor productivity growth since 1970.

Social Security and health care transfers are the two exceptions. Projected Social Security transfers and payroll tax receipts after 2004 are based on special calculations made by the Social Security Administration assuming a productivity growth rate of 0.75 percent. Projected Medicare and Medicaid transfers from 2005 through 2030 are calculated from the growth rates in the Health Care Financing Administration's middle-scenario estimates published in 1991.[4] After 2030, health care transfers are assumed to stabilize as a percentage of GDP apart from the effect of changes in the composition of the population by age and sex. Medicare receipts are assumed to grow at 0.75 percent a year.

Assumptions for present value. The appropriate discount rate for calculating the present value of future amounts depends on whether these amounts are known with certainty. Future government receipts and expenditures are risky, which suggests that they should be discounted by a rate higher than the real rate of interest on government securities. On the other hand, government receipts and expenditures appear to be less volatile than the real return on capital, which suggests that they should be discounted by a rate lower than that. The baseline calculations assume a 6 percent real discount rate, which is intermediate between the roughly 2 percent average real return available in recent years on short-term Treasury securities and the roughly 10 percent real return available on capital.

The present values of future average taxes and transfers are also discounted for mortality probabilities in order to derive actuarial present values. The demographic probabilities through 2066 are those embedded in the Social Security trustees' intermediate projection in 1992 (alternative II) of the population by age and sex. The fertility, mortality, and immigration probabilities in 2066 were used for later years. Immigration is treated as equivalent to a change in mortality.

Other projections. Federal purchases of goods and services through 2004, like federal taxes and transfers, are from the latest *Mid-Session Review* extended beyond 1997 and updated for the actual fiscal year 1992 results. State and local purchases through 2004 are kept at the same ratio to GDP as in 1991. Federal, state, and local purchases after 2004 are divided between 1) those made on behalf of specific age groups—the young, middle-aged, and elderly—such as educational expenditures, and 2) those that are more nearly pure public goods, such as defense and public safety. Purchases per person in each of the three age groups, and purchases of public goods per capita, all increase at the assumed rate of productivity growth.

The economic value of the government assets that yield income, less the government debt, is estimated to be the cumulative amount of the NIPA deficit since 1900 converted to constant dollars by the GDP deflator.

The average growth-adjusted net payment to be made by future generations is determined using the aggregate present value of the net payment (as derived through the present-value budget constraint), the assumed productivity growth, and the projected size of future generations. The size of future generations is estimated using the Social Security alternative II projection through 2066 and the demographic assumptions for 2066 for later years.

Historical lifetime net tax rates. Lifetime net tax rates for generations born between 1900 and 1991 are calculated by dividing the generational account of each generation at birth by its human wealth—the present value at birth of its future labor earnings. Calculating a generation's human wealth requires knowing its average labor earnings in each future year. The average labor earnings received by particular generations in particular years are determined by distributing aggregate labor income by age and sex using cross-section distributions of labor income found in cross-section survey data. The lifetime generational accounts for generations born between 1900 and 1991 are based on actual taxes and transfers between 1900 and 1991 and on projected taxes and transfers in the years thereafter.

Aggregate labor earnings, taxes, and transfers were obtained from the NIPAs for 1929 and later years. Pre-1929 aggregate labor earnings are from *Historical Statistics of the United States, Colonial Times to 1970.* Pre-1929 taxes and transfers are from the 1982 Census of Governments, *Historical Statistics on Government Finances and Employment.* Various cross-section surveys are used to distribute aggregate labor earnings, taxes, and transfers by age and sex. Cross-section surveys prior to the early 1960s were not available for this study, so surveys from years after 1960 are used for earlier years. The Current Population Surveys are used for labor earnings and taxes on labor earnings in 1964 and later years, and the 1964 survey is used for earlier years.

4 This scenario is discussed in Sonnefeld et al. (1991).

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Has the Long-Run Velocity of M2 Shifted? Evidence from the P* Model

by Jeffrey J. Hallman and Richard G. Anderson

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Introduction

Since early 1990, M2 has grown more slowly than suggested by its historical relationships with both income and opportunity cost, the latter measured relative to short-term market interest rates. During the first part of this period (1990–91), although historical relationships with its opportunity cost suggested a significant decrease, M2 velocity remained quite close to its long-run average value of about 1.65. During 1992, M2 velocity increased sharply while its opportunity cost apparently decreased further.

This behavior suggests that the long-run velocity of M2, or V-Star (V*), may have risen, perhaps as a result of changes in the money supply process, such as the stricter regulatory environment facing depository institutions. If V* has indeed increased, then the P-Star (P*) model, which assumes no change in M2's long-run velocity, should have persistently underpredicted inflation over the last three years. We find, however, that the model has quite accurately predicted the deceleration of inflation since 1990.

The paper also presents an extensive analysis, based on simulation of the P* model under a variety of alternative hypotheses regarding possible shifts in long-run velocity, that provides little support for the view that V* has changed. Our findings reinforce other recent research concluding that the pickup in M2's velocity may be largely explained by increases in an alternative opportunity cost measure based on long-term market rates.[1] If correct, these results suggest that sluggish M2 growth over the last three years contributed to both the slow pace of economic activity and the significant progress toward price stability. In addition, they suggest the potential for a rebound of M2 growth during 1993 as long-term rates fall and M2 velocity growth decelerates.

I. The P* Model[2]

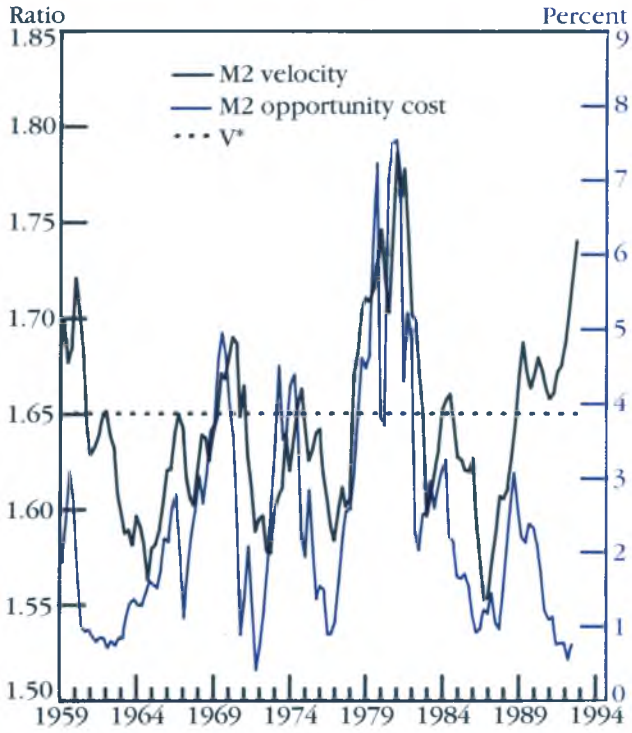
The P* model links the behavior of the price level to the growth of M2 by imposing two hypotheses on the equation of exchange, $MV = PQ$: (i) real output Q_t fluctuates around potential real output Q_t^* over long periods, and (ii)

1 See Feinman and Porter (1992).

2 See Hallman, Porter, and Small (1991).

FIGURE 1

M2 Velocity and Opportunity Cost



SOURCE: Authors' calculations.

velocity V_t has an equilibrium level V*, independent of time, that it tracks in the long run.[3] With these assumptions, P_t^* is defined as the long-run equilibrium price level that could be supported by the current level of the money stock (M_t) if current output (Q_t) settled down to this period's level of potential output (Q_t^*):

$$(1) \qquad P_t^* = \frac{M_t V^*}{Q_t^*}.$$

Our assumptions regarding V_t and Q_t imply that if money remains fixed at M_t, then P_t will fluctuate around P_t^*.

For policymakers, P_t^* provides an index in each period t of the cumulative long-run impact of money on the price level. The difference between the current price level and P_t^* can provide a leading indicator of future acceleration or deceleration of inflation as $P_t \rightarrow P_t^*$. Hallman, Porter, and Small (1991) show that the P* model can be derived as the reduced form of a special case of the expectations-augmented Phillips curve. In this case, changes in the inflation rate follow a simple autoregressive process augmented by the lagged price gap, $p_t - p_t^*$:

$$(2) \qquad \Delta\pi_t = \alpha(p_{t-1} - p_{t-1}^*) + \sum_{1}^{4} \beta_i \Delta\pi_{t-i} + \varepsilon_t,$$

where lower-case letters denote natural logs, π_t is the inflation rate, and $\Delta\pi_t$ is the quarterly change in the inflation rate. The *existence* of P_t^* depends critically on the validity of assumptions (i) and (ii). The assumption that real output fluctuates around a growing level of potential output is not controversial; indeed, measures of potential output are often constructed so as to ensure the validity of this assumption. The velocity assumption is more open to dispute.[4]

The constant velocity assumption of the P* model is motivated, in part, by the tendency of M2's velocity since 1955 to fluctuate around 1.65, trending neither up nor down (see figure 1). Velocity at times has remained above its long-run average for several years, and recent increases do not appear particularly unusual in this respect. The assumption is likewise motivated by the close historical correspondence between M2's velocity and its opportunity cost that prevailed through 1989, also shown in figure 1.[5] During this period, sustained deviations of velocity from its long-run average tended to be accompanied by comparable deviations of opportunity cost from its long-run average.[6] The tendency for M2 opportunity cost to return to its long-run average provided an economic rationale for M2 velocity to do the same. Empirical models

■ 3 Equivalent alternative assumptions are (i) M2 velocity is a stationary stochastic process, or (ii) all shocks to the level of M2 velocity are transitory. In a nonstochastic model, P will converge to P*. For a statement of the modern quantity theory, see Dewald (1988). For antecedents to P*, see Humphrey (1989).

■ 4 See, for example, Kuttner (1990) and Pecchenino and Rasche (1990). As Pecchenino and Rasche note, the inflation dynamics in Kuttner's paper are incorrect because he confuses Q and Q* in the P* model.

■ 5 The opportunity cost shown equals the difference between the three-month Treasury bill rate (on an annualized coupon-equivalent basis) and a share-weighted average of the own rates paid on the components of M2. See Moore, Porter, and Small (1991). Note that their series begins in 1959.

■ 6 M2's velocity and its opportunity cost have moved in opposite directions before. In 1960, velocity rose while opportunity cost fell; in 1983, velocity fell while opportunity cost rose. The duration of the most recent divergence appears unusual, however. Note that the vertical distance between the lines in the figure is not meaningful.

of M2's opportunity cost developed by Federal Reserve Board staff during the 1980s seemed to confirm this long-run behavior.[7] During the past three years, however, M2's velocity and opportunity cost have diverged sharply, with the former increasing as the latter has decreased. This divergence raises the question of whether equilibrium velocity has indeed changed.[8]

II. Using the P* Model to Identify Changes in V*

While the P* model was originally offered as a link between inflation and money growth, its inverse provides a test of one of its primary assumptions: the constancy of long-run M2 velocity.[9] If the long-run velocity of M2 has in fact increased during the last three years, predictions of inflation from the original P* model (which assumes that long-run velocity has not changed) should be inferior to predictions from a model that incorporates the "true" change in V*. This simple insight immediately suggests a testing strategy for evaluating alternative hypotheses regarding putative shifts in V*: Construct the various P_t^* time series corresponding to alternative velocity assumptions; use a battery of goodness-of-fit and forecast accuracy tests to compare the relative forecasting performance of the model under the alternative assumptions; and accept the velocity assumption(s) most consistent with the data or, in other words, the one that yields the best model forecasting performance.[10] Suppose, for example, we learn that V* increased 6 percent in mid-1989, to 1.75 from 1.65, and has remained at that value. Using equation (1), we can construct an alternative time series of P_t^* values that will also have shifted up by 6 percent, consistent with the higher velocity. Use of this new, more accurate measure of the equilibrium price level should improve the accuracy of inflation forecasts from the P* model.

Although the divergence of velocity and opportunity cost shown in figure 1 suggests that V* may have increased, the curves tell us little about the precise form of the change. In our analysis, we consider five alternative hypotheses concerning V* during 1989–92:

- It remained at its 1955–89 average value of 1.65.
- It increased 6 percent in 1989:IIIQ. This quarter was chosen based on the presence of two high-visibility events that marked the end of a decade of regulatory forbearance for undercapitalized depository institutions: passage of the Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) and the first resolutions of insolvent thrifts by the Resolution Trust Corporation. The depository sector, facing a stricter regulatory environment and the need to improve its capital ratios, might be expected to grow more slowly or even to contract as a result.
- It shifted upward by 2¼ percent each year in 1990 and 1991 and by 2½ percent in 1992. These are approximately the size of the forecast errors from the Federal Reserve Board staff's model of M2 demand based on income and M2's opportunity cost relative to short-term market rates.[11]
- It began increasing at a 1½ percent annual rate in 1990:IQ.
- It began *decreasing* at a ½ percent annual rate in 1990:IQ. This scenario is included for two reasons. First, it directly challenges the widely held conjecture that structural changes affecting depository intermediation during the past three years must have increased M2's long-run velocity. Second, it admits the possibility that the decrease in the inflation rate since 1989 has occurred largely as might have been expected (and perhaps even a bit more rapidly than expected), given the slow growth of M2 and the significant output gap.

■ 7 See, for example, Moore, Porter, and Small (1991). These models typically assumed the existence of a long-run fixed spread between the offering rate on a particular type of deposit and a short-term risk-free market rate (for example, the three-month Treasury bill). A similar assumption was made for money market mutual fund yields. The size of the equilibrium spread presumably depended on both demand and supply factors, including regulatory (capital) requirements facing the intermediary, deposit insurance premiums, and the liquidity of the deposit.

■ 8 It also raises the possibility that M2's opportunity cost was incorrectly measured. Recent research by other Board staff suggests that this may have been the case. A new opportunity cost measure that includes a long-term Treasury rate and a rate on consumer loans appears to track M2 velocity during 1984–92. These models are highly preliminary, however, and do not feature the long-run error-correction behavior of previous Board staff models. See Feinman and Porter (1992).

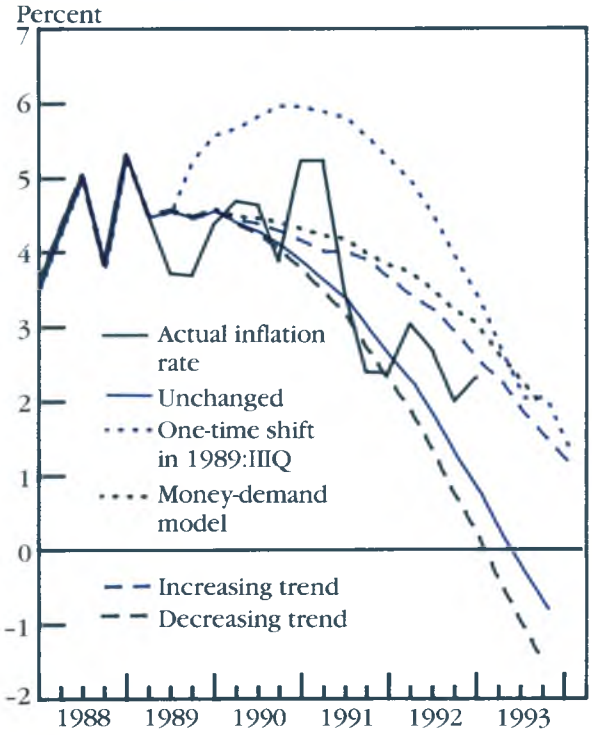
■ 9 The antecedents discussed by Humphrey (1989) also view P*-type models primarily as models of the inflation rate. A constant (or very slowly changing) velocity of money is assumed almost without mention. This is reminiscent of Irving Fisher's quantity theory model. See Laidler (1985), chapter 5.

■ 10 This is somewhat more complicated than stated, since the tests are non-nested. Below, we generate the empirical sampling distribution for each individual statistic.

■ 11 See Feinman and Porter (1992), figure 1.

FIGURE 2

Simulated Inflation Rates from Alternative V* Hypotheses



NOTE: First simulated value under all five hypotheses is 1989:IIIQ.
SOURCE: Authors' calculations.

Each of the V_t^* hypotheses suggests a corresponding P_t^* series, constructed according to equation (1) using the hypothesized V_t^*. Under the null hypothesis that V* has not changed from its 1955–89 level, the inflation-rate path for each P_t^* series is given by equation (2). Actual data are used through 1992:IVQ.[12]

Under the five alternative V* assumptions, dynamic simulation of the P* model, shown in equation (2), yields the five inflation-rate paths shown in figure 2. Each simulation begins in 1989:IIIQ and is nonstochastic; that is, all of the ε_t error terms in equation (2) are set equal to zero over the simulation period. During the past three years, the actual inflation rate generally has been between the rates suggested by the unchanged or declining V* scenarios and those suggested by a trend increase in V*. On balance, the inflation rate appears to have most closely followed the path given by the constant V* hypothesis, at least through 1992:IIIQ. Inflation in 1992:IVQ, however, was higher than forecast by the P* model with V* unchanged.

The nonstochastic simulations shown in figure 2, though suggestive of an unchanged long-run M2 velocity, are not capable of answering our question about a shift in equilibrium velocity. In particular, the simulations assume that no stochastic factors influence the evolution of the inflation rate ($\varepsilon_t = 0$ for all t), including possible random fluctuations in M2 velocity, when M2 velocity in fact has a relatively high variance. From a statistical viewpoint, the data shown in figure 2 represent only one "draw" from the universe of ways velocity and inflation might have evolved under each alternative hypothesis regarding V*. An adequate test must incorporate the inherent randomness and variability of economic variables. Furthermore, comparing the performance of several models (or, in our case, the same model using alternative estimates of P_t^*) solely on observed, actual data leaves unanswered a number of interesting questions, such as:

- Suppose, in fact, that inflation accelerates in 1993. How long might it take before incoming data reveal a change in V*? At what point, if any, will the statistical evidence compel us to reject the hypothesis that the long-run velocity of M2 has not changed?
- Which hypothesis regarding M2 velocity is believed by financial market participants? Are further decreases in long-term market interest rates waiting for clearer signals regarding future M2 velocity?

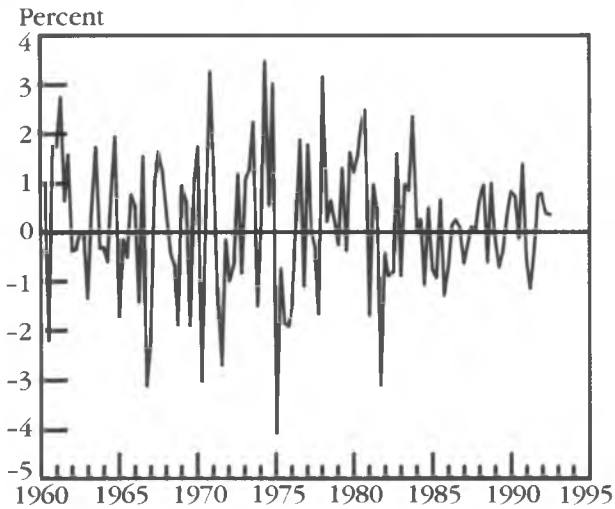
We conducted a simulation study to investigate these issues as well as the overall acceptability of the V* hypotheses.[13] Our simulation design generates, for each of the five V* hypotheses, 1,000 simulated paths for P_t from 1989:IIIQ through 1994:IVQ. Each path is the result of a stochastic simulation of the P* model under the appropriate velocity hypothesis. The stochastic innovations ε_t for the simulations are drawn from a normal distribution scaled to have a mean of zero and a standard deviation of about two-thirds of 1 percent at an annual rate. This corresponds to the smaller post-1986 variance of the residuals from the P* model when estimated over 1960:IIIQ–1992:IIIQ, as shown in figure 3. (A formal statistical test strongly rejects equality of the variance of the residuals before and after 1986.) Although the reason for this smaller variance is not apparent, it may be due to less variance in the expected inflation rate after 1986. Our simulations assume that the future

■ **12** After 1992:IVQ, M2 and Q_t^* are assumed to grow at annual rates of 4.5 percent and 2.5 percent, respectively.

■ **13** The simulation methodology also allows us to address some issues of interest mainly to econometricians, such as assessing how well various statistics perform in detecting the kinds of changes in which we are interested.

FIGURE 3

P* Model Residuals



SOURCE: Authors' calculations.

variance of the random innovations will resemble the smaller post-1986 period.

When the precise specification of alternative hypotheses in a testing situation is uncertain, as it is for hypotheses regarding changes in V*, the choice of an appropriate test statistic is difficult. Some hypotheses suggest tests for omitted dummy variables (such as a discrete shift in the level or a nascent time trend), while others suggest the use of more general tests based on forecast errors. Along each simulated path P_t^*, we computed the values of 12 test statistics, including tests for omitted variables as well as tests for general misspecification based on one-step-ahead forecast errors. Our statistics fall into four categories:

- *Lagrange multiplier (LM) tests* for an omitted variable in equation (1). *Lmshift* tests for a post-1989:IIQ shift dummy variable, *lmtrend* for a time trend beginning in 1990:IQ, and *lmboth* for both the shift and trend.
- *Chow tests* for a change in the forecast error variance, relative to the variance of the disturbance ε_t in the simulations, perhaps due to a change in V*. *Ch4*, *ch8*, and *ch12* are based on the last four, eight, and twelve forecast errors, respectively.
- *Random walk tests* for autocorrelation in the forecast errors due to misspecification of the model, including a structural change. *Rw4*, *rw8*, and *rw12* are based on the last four, eight, and twelve forecast errors, respectively.
- *Binomial tests* for an unusually high number of positive forecast errors, due to the assumed V* being too small. *Bn4*, *bn8*, and *bn12* are based on the last four, eight, and twelve forecast errors, respectively.

The statistics are discussed further in the appendix. For each of the 1,000 replications, we calculated and stored the values of the statistics for each quarter from 1990:IQ through 1994:IVQ.

For any particular quarter within our simulation period, the degree of support for a V* hypothesis may be inferred by comparing the values of the statistics in that quarter to the simulated distributions of possible outcomes. The simulated distributions indicate the range of values of the statistics that could result from random, unobserved influences.[14] If the value of a statistic falls outside the central area of the corresponding simulated distribution, we tend to reject that particular hypothesis.

Our results for 1992:IVQ are shown in table 1 and figure 4. Values of the test statistics calculated from data for 1992:IVQ, the most recent quarter for which we have preliminary gross domestic product (GDP) data, are shown in column 2 of the table. Columns 3-7 display a count of the number of model replications (out of 1,000) wherein a test statistic took on a value less than that shown in the second column. The third column, for example, summarizes our simulations under the hypothesis that V* has not changed from its historical average value of 1.65. Each entry in the column shows the number of replications for which the value of the statistic named in the first column was less than or equal to the 1992:IVQ value, shown in the second column.

Consider, for example, the interpretation of the *lmshift* statistic for 1992:IVQ as summarized by the first row of table 1. The value of this statistic calculated from 1992:IVQ data is 0.026. The third column indicates that the *lmshift* statistic was less than 0.026 in 266 of the 1,000 replications of the unchanged V* scenario. According to this hypothesis, then, 0.026 appears to be neither unusually large nor small. In contrast, the entry in the fourth column tells us that observing an *lmshift* statistic value as small as 0.026 would be highly unusual if V* had in fact increased by a one-time 6 percent shift in 1989:IIIQ. A value that

14 In other words, the distributions shown are the empirical sampling distributions of the statistics.

TABLE 1

Observed Values of Test Statistics in 1992:IVQ and Cumulative Frequency of Occurrence of those Values in Simulation

Test Statistics and 1992:IVQ Values		Number of Replications wherein Value of Statistic Is Less than in 1992:IVQ				
		V* Hypothesis				
Statistic (1)	Value (2)	H1 No Change (3)	H2 One-Time Shift (4)	H3 Money-Demand-Model Shift (5)	H4 1½ Percent Trend (6)	H5 −½ Percent Trend (7)
LM tests						
lmshift	0.026	266	0	42	135	240
lmtrend	0.233	719	8	78	263	636
lmboth	0.377	573	1	62	229	537
Chow tests						
ch4	4.10	626	278	227	429	576
ch8	12.9	879	351	530	752	866
ch12	15.0	753	84	388	611	727
Random walk tests						
rw4	3.86	960	595	494	752	926
rw8	0.475	536	9	42	184	460
rw12	1.16	727	4	166	377	664
Binomial tests[a]						
bn4	4	947:1,000	612:1,000	541:1,000	719:1,000	979:1,000
bn8	5	648: 869	18: 136	63: 274	170: 473	778: 940
bn12	8	816: 932	16: 95	254: 497	431: 699	895: 974

a. The two values correspond to the value of the statistic being, respectively, either strictly less than, or less than or equal to, the value in column 2.
NOTE: Each entry is the number of replications out of 1,000 trials.
SOURCE: Authors' calculations.

low never occurred in 1,000 replications of the "6 percent shift" scenario.

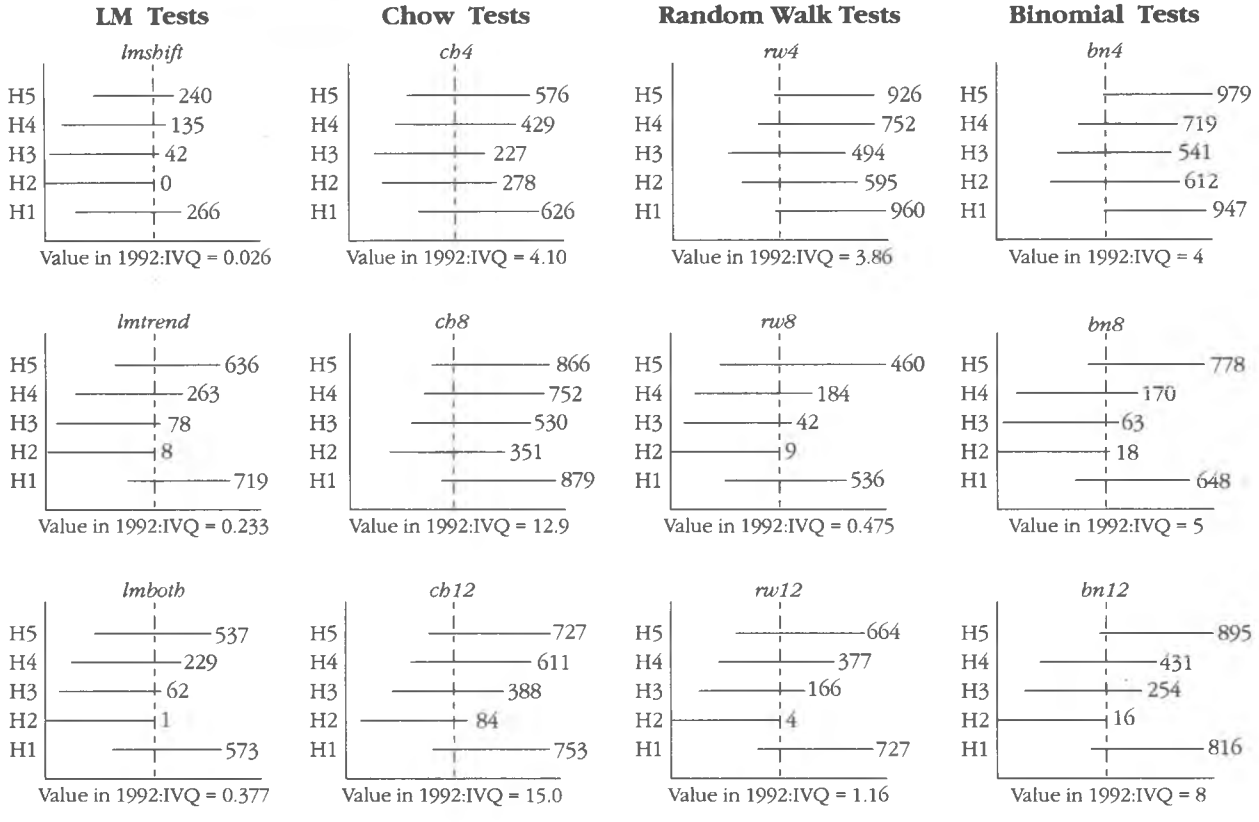
Table 1's test statistics and simulation outcomes are summarized in figure 4, with each panel corresponding to one of the 12 statistics. Each horizontal line segment in each panel represents the 1,000 replications of the P* model under one of the five alternative V* hypotheses, denoted H1–H5. A hypothesis regarding V* is judged more or less acceptable (in other words, consistent with the data) as the horizontal line segments for that hypothesis tend to be centered around the vertical dotted lines denoting the values of the statistics calculated from 1992:IVQ data. Overall, the hypotheses that V* has not changed (H1) or has been decreasing slowly (H5) appear to be highly consistent with the data, with the 1992:IVQ value falling near the midpoint of the distribution of simulated values for a number of the statistics. The hypothesis of a one-time shift in 1989:IIIQ (H2) is soundly rejected. The hypothesis that M2 velocity shifted as suggested by the Federal Reserve Board staff's money-demand model (H3) appears less consistent with the data than the hypothesis of a steady upward trend (H4), which seems fairly plausible. Neither of the trending V* hypotheses (H3 and H4) appear to be as consistent with the data as the unchanged and falling hypotheses (H1 and H5), however.

Market participants' inflation expectations appear to reflect acceptance of a significant increasing trend in M2 velocity, despite the deceleration of inflation over the past three years.[15] The January Blue Chip consensus forecast, for example, calls for the GDP implicit price deflator

■ **15** Chairman Greenspan's latest Humphrey–Hawkins report to the Congress in February of this year appears to endorse this view, as does the FOMC's reduction of its 1993 M2 target growth ranges. To avoid such bias, we use a Blue Chip forecast published before these were announced.

FIGURE 4

Summary of Simulation Experiments for 1992:IVQ



NOTE: Each horizontal line represents 1,000 replications of the P* model under either H1, H2, H3, H4, or H5. Shown after each line is the number of replications wherein the value of the statistic is less than in 1992:IVQ.
SOURCE: Table 1. H1–H5 correspond to columns 3–7 in the table.

to increase at about a 2.7 percent rate during the first half of 1993, versus its 2.1 percent pace in the second half of 1992. The inconsistency between the paths of the price level implied by the Blue Chip forecast and the P* model with an unchanged V* is evident in table 2. Values of our test statistics calculated from projected values of P_t for 1993:IIQ that are based on this forecast are shown in column 2.[16] The entries in column 3 show that many of our statistics will reject the constant V* hypothesis if inflation follows the Blue Chip forecast. The complete set of test results is displayed in figure 5. Ignoring the Chow tests and the *bn4* statistic, the trending V* hypotheses H3 and H4 appear fully consistent with the Blue Chip forecast.[17]

Initially, it may appear somewhat surprising that the statistical support for the constancy of V* is so sharply changed by inclusion of the two additional quarters from the Blue Chip consensus forecast. The reason for this sensitivity is that the consensus inflation forecast is very different from the forecast suggested by the P* model with an unchanged V*. P_t^* is currently more than 8 percent below P_t, so the P* inflation model — equation (2) — forecasts that inflation will continue to decelerate over the next several quarters from its 2.1 percent pace in 1992:IIH. The consensus forecast, by contrast, predicts an acceleration during the first half of 1993. The message of table 2 is that such an acceleration is highly unlikely unless equilibrium velocity has been trending up for some time and has escaped

16 See *Blue Chip Economic Indicators*, Sedona, Arizona, January 10, 1993, p. 5.

17 Neither the Chow tests nor the *bn4* test has much power against the hypothesis being tested, as is evident from examination of table 3.

TABLE 2

Projected Values of Test Statistics in 1993:IIQ and Cumulative Frequency of Occurrence of those Values in Simulation

Test Statistics and 1993:IIQ Values		Number of Replications wherein Value of Statistic Is Less than Projected 1993:IIQ Value				
		V* Hypothesis				
Statistic (1)	Value (2)	H1 No Change (3)	H2 One-Time Shift (4)	H3 Money-Demand-Model Shift (5)	H4 1½ Percent Trend (6)	H5 −½ Percent Trend (7)
LM tests						
lmshift	0.318	791	2	124	368	693
lmtrend	1.40	992	198	318	750	969
lmboth	1.81	982	69	387	774	962
Chow tests						
ch4	10.8	979	885	716	888	971
ch8	17.3	970	731	659	867	964
ch12	22.8	966	514	701	866	954
Random walk tests						
rw4	8.91	1,000	961	817	951	993
rw8	3.54	955	273	184	519	898
rw12	3.63	960	47	199	544	903
Binomial tests[a]						
bn4	4	943:1,000	711:1,000	472:1,000	668:1,000	980:1,000
bn8	6	879: 965	224: 540	149: 439	340: 687	959: 992
bn12	8	824: 952	34: 125	97: 294	279: 550	931: 985

a. The two values correspond to the value of the statistic being, respectively, either strictly less than, or less than or equal to, the value in column 2.
NOTE: Each entry is the number of replications out of 1,000 trials.
SOURCE: Authors' calculations.

detection by our tests for 1992:IVQ.[18] Such an acceleration of inflation would provide significant evidence against the constancy of V*.

III. Evaluating Alternative, Less Specific Hypotheses

At this point, a true believer in higher equilibrium velocity will object that, while our approach mostly rejects the specific shifted and upward-trending V* hypotheses outlined above, this does not conclusively prove that V* has not changed. Simulations with slower growth trends in V* or ones that started later than 1990:IQ, for example, might not be rejected.

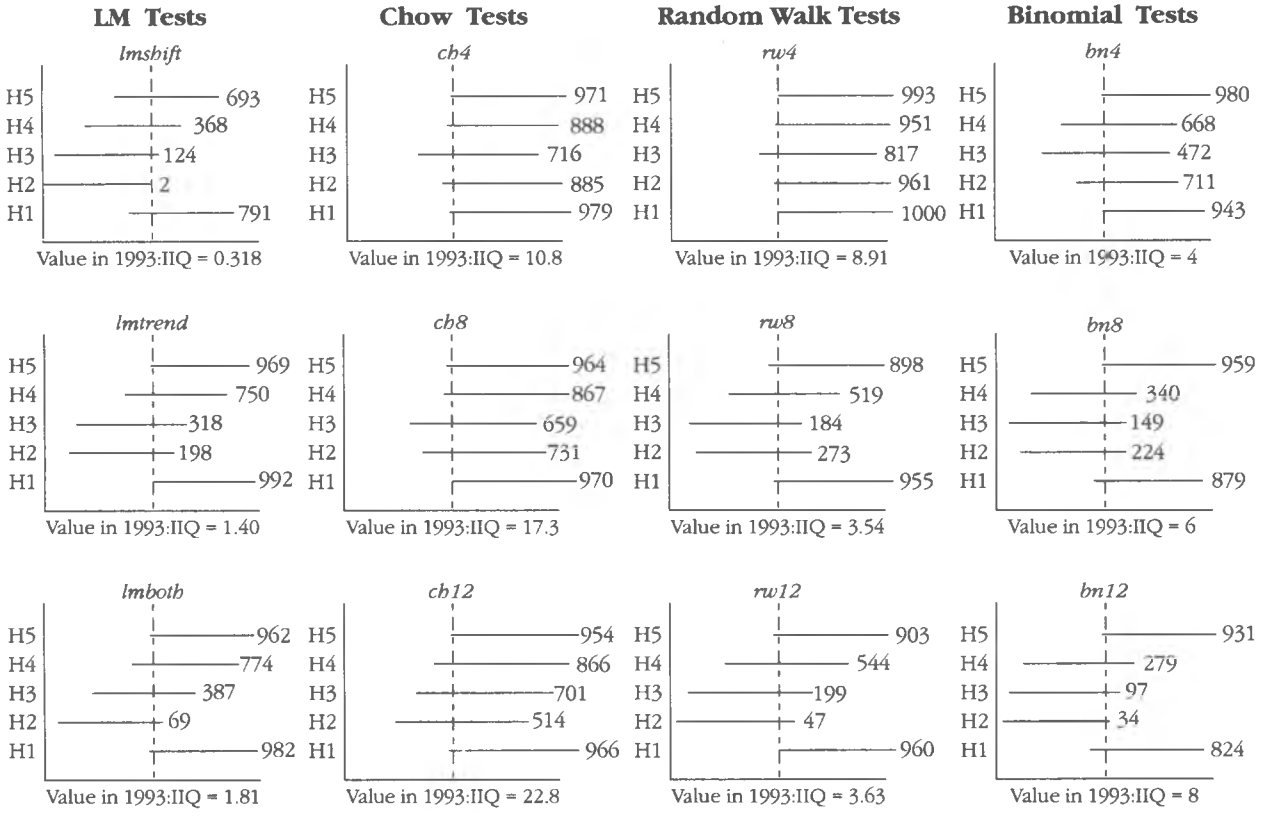
The objection has merit. Our experiments consider only a few specific alternative hypotheses. To evaluate rigorously, using our stochastic simulation method, the evidence for or against a less specific hypothesis—such as "V* shifted sometime in the late 1980s or early 1990s"—would require repeating our experiments using alternative models with shifts beginning in 1989:IVQ, and again with shifts beginning in 1990:IQ, and so on. The number of required simulations increases even further if we allow for a number of trend growth rates, rather than the 1.5 percent annual V* growth used here.

We can, however, address the issue indirectly. Our test statistics should be valuable in detecting

18 Alternatively, it may be that the variance of the innovations has increased. One way to see how inference about the constancy of V* depends on the assumed variance of the innovation process is to note that, if the Blue Chip forecast is correct, the P* model's 1993:IQ forecast of 1.2 percent will miss by about 1.6 percent. Since we have assumed an innovation standard error of 0.6 percent, this is about a two-and-one-half-standard-deviation miss, which is unusual. If the innovation standard deviation were instead (say) 1.6 percent, the forecast error would be only about one standard deviation, which is not so odd.

FIGURE 5

Summary of Simulation Experiments for 1993:IIQ



NOTE: Each horizontal line represents 1,000 replications of the P* model under either H1, H2, H3, H4, or H5. Shown after each line is the number of replications wherein the value of the statistic is less than in 1993:IIQ.
SOURCE: Table 2. H1–H5 correspond to columns 3–7 in the table.

shifts in V* that begin in other time periods or that follow time paths with somewhat different shapes than those considered above. According to table 3, when V* is subjected to a one-time upward shift of 6 percent, within six quarters the best of our test statistics (using the 5 percent critical values shown in the appendix) reject the (false) hypothesis of an unchanged V* in more than half the replications. When V* is subjected to the less dramatic change of increasing at a 1½ percent annual rate, all of our statistics have difficulty detecting this new trend growth until at least three years have passed, as shown in table 4. In part, this slow speed of detection is due to the high underlying variance of V_t.

IV. Conclusion

All models used for policy analysis require periodic revalidation of their underlying assumptions. Of particular concern in the P* model is the assumed constancy of the long-run velocity of M2. Unfortunately, the long-run velocity of M2 is no more amenable to direct observation than other "long-run" variables in economic models. Two of our findings suggest that it has not changed, however. First, the deceleration of inflation over the past three years (at least through 1992:IIIQ) closely resembles the predictions of the P* model based on an unchanged long-run M2 velocity. Second, stochastic simulation of the P* model under five alternative hypotheses regarding putative shifts in V* provides little evidence against the constant V* hypothesis, strong evidence against the hypothesis of a one-time shift following the FIRREA legislation, and somewhat weaker evidence against the hypothesis of an upward trend during the past three years.

These results suggest little reason for policymakers to abandon the P* model when seeking to understand the future adjustment of inflation to money growth. Comparison of the P* model's inflation forecasts to the Blue Chip consensus fore-

TABLE 3

Number of Rejections of Hypothesis "V* Has Not Changed" When V* in Fact Increased 6 Percent in 1989:IIIQ

	LM Tests			Chow Tests			Random Walk Tests			Binomial Tests		
	lmshift	*lmtrend*	*lmboth*	*ch4*	*ch8*	*ch12*	*rw4*	*rw8*	*rw12*	*bn4*	*bn8*	*bn12*
1990												
IQ	299	198	245	252	252	252	207	405	68	0	0	0
IIQ	421	341	347	327	327	327	421	521	472	0	0	0
IIIQ	549	459	491	420	419	419	641	431	657	0	305	305
IVQ	673	591	587	411	452	452	659	765	789	0	264	264
1991												
IQ	735	626	646	359	484	484	609	686	848	0	229	229
IIQ	796	720	733	358	580	580	596	806	855	0	615	615
IIIQ	867	786	796	366	625	609	639	920	826	0	740	545
IVQ	908	812	856	386	590	640	595	886	933	0	727	489
1992												
IQ	917	862	888	380	575	677	598	893	897	0	712	754
IIQ	953	894	907	346	551	713	546	892	952	0	675	695
IIIQ	964	907	932	281	481	709	481	875	978	0	627	765
IVQ	975	939	953	244	488	656	444	868	978	0	583	726
1993												
IQ	981	934	965	206	447	619	354	819	967	0	527	694
IIQ	991	960	969	181	376	561	314	759	967	0	460	875
IIIQ	991	957	979	154	303	515	225	678	949	0	404	836
IVQ	994	966	980	139	281	475	194	616	935	0	353	493
1994												
IQ	995	977	989	125	231	424	180	535	918	185	293	433
IIQ	995	977	991	112	193	379	161	439	834	0	240	370
IIIQ	998	979	993	101	155	305	155	365	765	0	207	311
IVQ	998	988	994	106	161	258	134	320	692	0	171	529

SOURCE: Authors' calculations.

cast suggests that market participants already believe that V* has shifted. In so doing, they apparently are discounting evidence that the steep slope of the yield curve has induced portfolio substitution away from M2 (particularly small time deposits) and toward assets such as bond mutual funds.

Our results also suggest a word of caution. The high variance of V_t means that attempts to distinguish changes in V* from short-run movements in V_t are subject to a high degree of uncertainty. Our tests almost surely would have identified by now a large, discrete shift in V* that occurred other than very recently. However, they might not yet have detected an emerging slow growth trend or a more rapid trend that started later than 1990:IQ. To the extent that inflation responds with a long and variable lag to changes in money growth, this uncertainty reinforces the need for caution and vigilance in the conduct of monetary policy. If M2's long-run equilibrium velocity has in fact shifted or is trending up, continuing slow money growth may yield less progress toward price stability than expected. The stickiness and (later) halting decline of long-term interest rates during the recovery likely reflects, in part, views by financial market participants that V* has increased and that price stability is not yet the rule of the land.

TABLE 4

Number of Rejections of Hypothesis "V* Has Not Changed" When V* in Fact Began Growing at a 1½ Percent Rate in 1990:IQ

	LM Tests			Chow Tests			Random Walk Tests			Binomial Tests		
	lmshift	*lmtrend*	*lmboth*	*ch4*	*ch8*	*ch12*	*rw4*	*rw8*	*rw12*	*bn4*	*bn8*	*bn12*
1990												
IQ	50	50	50	50	50	50	50	50	50	0	0	0
IIQ	52	53	50	53	53	53	52	53	54	0	0	0
IIIQ	54	52	58	52	56	56	49	38	57	0	39	39
IVQ	53	64	60	51	57	57	64	66	79	0	26	26
1991												
IQ	52	65	60	50	58	58	53	46	99	0	15	15
IIQ	61	80	75	61	70	70	78	63	78	0	62	62
IIIQ	69	120	88	67	76	73	115	94	62	0	80	47
IVQ	84	128	104	87	80	84	128	87	120	0	96	39
1992												
IQ	94	182	129	85	95	91	176	141	83	0	122	99
IIQ	135	238	159	102	110	108	188	213	149	0	143	79
IIIQ	181	297	203	118	109	101	223	277	203	0	174	90
IVQ	216	383	263	147	141	118	266	360	249	0	224	120
1993												
IQ	244	431	311	148	156	133	280	405	344	0	271	158
IIQ	317	576	386	182	180	168	343	512	503	0	313	450
IIIQ	378	646	474	210	215	201	334	565	579	0	356	530
IVQ	440	745	557	230	274	244	380	641	675	0	384	290
1994												
IQ	520	823	683	223	302	282	437	700	780	374	417	339
IIQ	569	886	771	256	317	337	478	740	814	0	458	406
IIIQ	645	925	820	266	344	358	454	774	874	0	481	460
IVQ	677	966	867	281	396	400	473	787	927	0	506	757

SOURCE: Authors' calculations.

Appendix—The Test Statistics

The 12 statistics calculated during the simulations for each quarter include tests for omitted variables and for properties of forecast errors.[19] The first three statistics are LM tests for omitted variables in equation (1): *lmshift* tests for a post-1989:IIQ shift dummy, *lmtrend* for a time trend beginning in 1990:IQ, and *lmboth* for both simultaneously. An appropriate test for a 1989:IIIQ shift in equilibrium velocity can be formulated as a test for an omitted variable, where the omitted variable itself is a dummy variable that equals zero until 1989:IIQ and one thereafter. To see this, notice that the variable p^* in equation (1) is defined as $p^* = m2 + v^* - q^*$, where lowercase letters indicate natural logs. A shift or trend in v^* translates directly into an equivalent shift or trend in p^*. If a 6 percent increase in equilibrium velocity causes us to understate p^* by 0.06, this can be handled in equation (1) by adding a constant term equal to -0.06 times α, the coefficient on $p - p^*$. The rationale for the *lmtrend* test is identical.

19 To obtain forecast errors for the tests that need them, we estimate the P* model (using the constant V* version of P_t^*) for each quarter of the simulation period using the simulated P_t series running up through the previous quarter. A single-step forecast error for the quarter is computed and saved, the process is repeated for the next quarter, and so on.

TABLE A-1

95th Percentile of Empirical Sampling Distribution of 12 Test Statistics under Null Hypothesis that V* Is Unchanged from Its Long-Run Value

	LM Tests			Chow Tests			Random Walk Tests			Binomial Tests		
	lmshift	*lmtrend*	*lmboth*	*ch4*	*ch8*	*ch12*	*rw4*	*rw8*	*rw12*	*bn4*	*bn8*	*bn12*
1990												
IQ	0.83	0.89	1.31	8.05	12.72	15.02	3.12	2.25	1.28	3	6	6
IIQ	0.87	0.87	1.38	9.42	13.78	14.86	4.01	2.23	1.34	4	6	7
IIIQ	0.86	0.85	1.29	9.82	13.88	15.73	3.94	2.76	1.93	4	5	7
IVQ	0.86	0.81	1.34	9.99	14.38	17.70	3.72	3.10	2.16	4	6	8
1991												
IQ	0.89	0.93	1.45	10.39	14.64	19.31	4.26	3.65	2.68	4	6	9
IIQ	0.94	0.89	1.42	10.00	15.31	19.67	4.21	4.12	2.90	4	6	8
IIIQ	0.92	0.85	1.41	9.97	15.53	19.95	3.78	3.74	3.08	4	6	8
IVQ	0.94	0.88	1.38	9.64	15.98	19.98	3.82	4.33	3.60	4	6	9
1992												
IQ	0.98	0.84	1.39	9.52	15.85	19.70	3.56	4.13	4.03	4	6	8
IIQ	0.90	0.83	1.44	9.48	15.56	20.63	3.79	3.74	3.89	4	6	9
IIIQ	0.89	0.84	1.42	9.64	16.23	21.27	3.70	3.60	3.80	4	6	9
IVQ	0.87	0.76	1.33	9.25	15.52	21.64	3.40	3.31	3.75	4	6	9
1993												
IQ	0.90	0.82	1.37	9.30	15.21	21.51	3.62	3.55	3.72	4	6	9
IIQ	0.82	0.72	1.38	9.11	15.51	21.49	3.27	3.26	3.26	4	6	8
IIIQ	0.81	0.77	1.36	9.37	15.66	21.51	3.79	3.17	3.30	4	6	8
IVQ	0.80	0.72	1.31	9.29	14.81	21.01	3.72	3.10	3.17	4	6	9
1994												
IQ	0.76	0.67	1.25	9.73	14.87	20.82	3.36	2.96	2.87	3	6	9
IIQ	0.78	0.68	1.23	9.10	14.93	20.49	3.27	2.91	3.15	4	6	9
IIIQ	0.76	0.67	1.27	9.01	15.17	20.65	3.44	2.91	2.98	4	6	9
IVQ	0.78	0.63	1.26	9.31	14.82	20.59	3.65	3.05	2.75	4	6	8

SOURCE: Authors' calculations.

Chow forecast tests have long been used to determine parameter constancy and are, in fact, tests of the constancy of variances. The idea is that if the process generating the data changes at time t but the model used by the forecaster does not, the forecast error variance will increase. The utility of the test is limited by its implicit assumption that the variance of the true disturbances is constant. Our three Chow statistics — *ch4*, *ch8*, and *ch12* — are calculated as the sum of the latest four, eight, or twelve squared forecast errors, respectively, divided by the variance of the simulation innovations.

The *rw* statistics are our own invention, motivated by the idea that a persistent misspecification of the P* model, such as would result from a shift or trend in V*, will lead to positive autocorrelation in the forecast errors. The variance of the sum of K consecutive forecast errors will then be much larger than just K times the innovation variance. The *rw4* statistic is the square of the sum of the four most recent forecast errors, divided by four times the innovation variance; *rw8* and *rw12* are analogous. An *rw* statistic can be written as the sum of a Chow statistic plus a term that measures autocorrelation in the forecast errors. Thus, we expect the *rw* test to be more powerful than the corresponding Chow test when the alternative hypothesis involves positive forecast error autocorrelation.

The binomial statistics (*bn4*, *bn8*, and *bn12*) are simple counts of the number of positive forecast errors made over the corresponding intervals. A correctly specified model should, on average, give about the same number of positive and negative forecast errors. The estimated coefficient in equation (2) is negative, so if V* and P* are understated, we would expect to see an inordinately high number of positive forecast errors.

Table A–1 shows the 95th percentile of the 12 statistics' sampling distributions, based on 1,000 replications, under the null hypothesis that V* has not changed from its 1955–89 value. The number 0.87 in the 1992:IVQ row and *lmshift* column, for example, indicates that the *lmshift* statistic for 1992:IVQ was less than or equal to 0.87 in 950 of the 1,000 replications of the constant V* model.

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Examining the Microfoundations of Market Incentives for Asset-Backed Lending

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Introduction

The past two decades have witnessed a virtual revolution in financial intermediation. One innovation is securitization: the packaging of loans into pools that are funded by marketable securities. At the same time, the selling of individual loans has itself grown tremendously over this period. While individual loans are primarily sold to other depository institutions, securitization involves the sales of securities to nonbank investors as well. Both loan sales and securitized loan pools are broadly identified as *asset-backed lending*.

A financial asset is a claim to future cash flows as stipulated by the issuer. What distinguishes asset-backed lending is that the securities involved are backed by specific financial assets and then sold. Alternatively, these financial assets might have been pooled and funded by issuing general claims on the firm. Instead, when a loan is either securitized or sold individually, it is funded separately rather than with the other assets on the balance sheet of the loan originator.[1] Hence, loan sales and securitization, from the perspective of the seller of the asset-backed securities, are a means of *off-balance-sheet finance*.

The proliferation of asset-backed lending has been commonly viewed as a response to competitive and regulatory pressures, which have prompted institutions to participate in credit markets in ways that are not directly reflected on their balance sheets. In particular, capital requirements are cited as reducing the profitability of funding certain investments on-balance-sheet with deposit liabilities. However, nonbank firms that are not subject to the regulations associated with the federal safety net are also engaging in asset-backed financing. This indicates that there are important nonregulatory incentives for loan sales and securitization.

Asset-backed lending has become an important mode of funding for particular types of credit. Though depository institutions are the primary originators of home mortgages, more than 40 percent of these claims are ultimately financed through the government-sponsored secondary mortgage market. In the past several years, however, asset securitization has spread beyond government-sponsored sales of mortgage-backed

■ 1 Although securitized loan pools are funded separately, they are frequently sold with some type of recourse, which means that they are partially backed by the general claims of the firm that originated the loan.

securities to include private pools that are backed by increasingly diverse types of loans, from credit-card receivables to Third World debt. Currently, more than 15 percent of consumer installment credit is funded through securitization.[2]

The evolution of financial market innovations in tandem with changing banking regulations makes it difficult to assess what is driving the trends in asset-backed markets. Because we wish to evaluate why asset-backed lending occurs in the absence of regulations, we examine how successful economists have been in applying formal models to this phenomenon. Although off-balance-sheet funding can arise for either market-based or regulatory-based reasons, we focus on four papers that attempt to model asset-backed lending in the absence of government-sponsored insurance and regulations.

We first outline the general nature of intermediation and describe asset-backed markets in this context. Information costs have long been viewed as a rationale for financial intermediation. The literature on asset-backed lending has picked up on this theme to argue that loan sales and securitization are also best understood as a means of minimizing information costs. Therefore, in order to understand some of the models that have attempted to formalize asset-backed lending, we first discuss several models of financial contracting under imperfect information, which have been useful in characterizing the roles that financial intermediaries play in channeling credit.[3] Finally, we analyze how existing government policies may affect the incentives for firms, primarily banks and thrifts, to engage in these activities.

I. An Overview of Intermediation

In a decentralized economy with significant information and transaction costs, the financial sector affects how resources are channeled from lenders to borrowers. As financial conduits, intermediaries pool lenders' resources to fund a portfolio of claims on many, often diverse, borrowers. In doing so, intermediaries are said to conduct *indirect finance,* allowing them to issue indirect claims with cash flows that differ in varying degrees from those of the borrowers. Thus, intermediaries perform *asset transformation* in making their investment and funding choices.

To the extent that information is costly to obtain, financial contracts and institutions also can reduce the information costs associated with channeling resources to the most productive investment opportunities. Thus, intermediation yields more attractive portfolio choices for investors while facilitating a more efficient flow of credit to borrowers.

Intermediation and Asset Transformation

Three of the types of asset transformation produced by intermediaries are 1) denomination transformation, 2) credit risk transformation, and 3) maturity transformation. How effectively these methods can mitigate information costs is an important part of our subsequent analysis.

Denomination transformation allows intermediaries to lend to borrowers with large credit needs by issuing smaller-denomination claims to many savers. For example, mutual funds that invest in government bonds and Treasury bills pool the funds of a group of small investors to fund a portfolio of relatively similar claims. Denomination transformation also allows small savers to diversify by enabling them to hold a wider variety of investments.

Credit risk transformation pools the resources of many lenders to fund several projects. This allows intermediaries to diversify the risks of the assets in their portfolios, and thus to issue indirect claims to investors with a more predictable return than the individual assets being funded. This is the main role of stock or bond mutual funds, although most intermediaries engage in credit risk diversification.

Finally, intermediaries also perform maturity transformation by issuing indirect claims that offer a pattern of promised cash flows different from those promised by borrowers. Banks and thrifts are noted for the degree of maturity transformation in their portfolios. They fund medium- and long-term projects by issuing short-term liquid deposits that serve as close substitutes for legal tender.[4] Contractual savings institutions, such as insurance companies and pension funds,

■ 2 See *Federal Reserve Bulletin,* Domestic Financial Statistics, Table 1.55, Consumer Installment Credit, March 1993.

■ 3 Two important papers surveying this literature are Gertler (1988) and Bhattacharya and Thakor (1991).

■ 4 McCulloch (1981) emphasizes that this degree of maturity transformation is actually "misintermediation" that reflects the regulatory incentives for banks to assume credit risks as well as the risk associated with mismatching the durations of their assets and liabilities.

produce a very different sort of cash flow transformation. They fund portfolios of assets by selling contracts promising cash flows that are contingent on specific events, such as property loss, death, or retirement.

Much of the intermediation associated with these types of asset transformation channels funds to borrowers who place debt or equity directly in credit markets. A distinguishing characteristic of some intermediaries is that they specialize in lending to borrowers who would find it prohibitively costly to obtain funds through direct market placements because of the relative costs associated with screening, monitoring, and servicing their claims. Depository institutions and finance companies, for example, profit by developing a comparative advantage in lending to small or information-intensive borrowers. Thus, some intermediaries are *special* in the sense that they provide lenders with new investment opportunities—that is, they are asset originators.

An Overview of Asset-Backed Markets

In contrast to funding a portfolio of assets by the issue of unsecured claims, asset-backed lending is an alternative funding mode by which an asset or set of assets is sold by its originator. We use the term asset-backed lending to refer to both securitization and individual loan sales.

A loan sale is usually made by a bank to another bank, and involves no asset pooling in and of itself.[5] However, the process of making loans marketable, by increasing the access of other lenders to investment opportunities, can improve the allocation of credit. Loan sales involve transactions between two (or more) financial institutions, whereas securitization generally involves the sale of claims (against the securitized asset portfolio) to individual investors who hold these in their portfolios for investment purposes. Consequently, securitized claims are priced like other capital-market instruments, but loan sales are priced based on bilateral (multilateral) negotiations.

Alternatively, nonmortgage securitization usually takes the form of a bank or nonbank firm funding a pool of similar assets by forming a subsidiary that markets claims to the pool to nonbank investors. These pools are generally originated by large firms. From the perspective of the pool originator, however, nonmortgage securitization is basically a means of separating the financing of certain assets from that of its general portfolio.

Finally, securitization of mortgages takes place in the secondary market in order to fund pools of insured mortgages. These pools include claims from many, often geographically diverse, mortgage originators. This form of securitization simultaneously creates a pool of similar loans (mortgages) purchased from loan originators in different localities. Hence, a unique characteristic of mortgage-backed securities is that they are collateralized by loans from various financial firms.

Loan Sales versus Securitization

A major difference between loan sales and securitization is that loan sales usually provide no recourse for the party buying the loan. Most view this as the result of regulators' treatment of loan sales in their assessment of capital adequacy requirements for depository institutions. Banks and thrifts are not required to hold capital against loans sold, except for those sold with recourse, which are treated as if they are on-balance-sheet items in determining capital adequacy. Thus, given the incentives to maximize leverage, these institutions tend to sell loans without recourse to truly "get them off the regulatory books."

Securitization, on the other hand, is generally associated with the provision of some form of credit enhancement that increases the marketability of the asset-backed securities. One common form of enhancement for securitized assets is backing by a bank-issued standby letter of credit (SLC). For a stipulated fee, banks issue SLCs, which are promises to insure the purchasing party up to a prespecified amount for losses incurred on the securitized loans. Before a loan pool is funded, both the loans and the bank issuing the SLC are rated. Because the rating of the pool is affected by the rating of the bank issuing the guarantee, the extent to which this method of credit enhancement is used is limited. Moreover, to avoid regulated capital assessments, a bank securitizing a pool of loans usually does not issue the credit-enhancing SLC. Thus, the originator of the pool is generally not also its guarantor.

An increasingly popular enhancement, the cash-collateral-account method, has the pool

■ 5 For a comprehensive overview of the loan sales market, see Gorton and Haubrich (1990).

originator covering potential losses with cash placed in an escrow account. Another method to enhance loan quality is to overcollateralize the loan pool. That is, extra loans are included in the pool so that the value of the loans exceeds the value of the securities issued to fund it.

Why Fund Off-Balance-Sheet?

Given the attributes of asset pooling, it is natural to question the benefit of funding a loan or pool of loans off-balance-sheet. The answer, of course, is that this method is more efficient—less expensive—than on-balance-sheet funding. As we have asserted, asset-backed lending is commonly viewed as a response to both regulatory costs and market incentives.

In its early years, regulations were clearly an important factor motivating securitization via the secondary mortgage market.[6] Regulated branching restrictions in tandem with information costs caused banks and thrifts to operate in relatively localized markets. The government-sponsored secondary mortgage markets allowed these institutions to hold portfolios from many different parts of the country. These regulatory restrictions are less important today. This suggests that information costs are becoming the more relevant determinant of interregional lending.

A fundamental role of intermediation is to produce the information involved in channeling credit in the most cost-effective way. In particular, lenders do not always have good information about the risk and return of borrowers' investment opportunities. Intermediaries specialize in producing this information, as well as in structuring and servicing contracts. Therefore, in order to understand why off-balance-sheet funding may be more efficient, it is useful to examine the roles of both financial contracts and intermediation in mitigating information costs.

Here, the primary focus is on market incentives—specifically due to information costs—as a motive for asset-backed lending. In the following section, we discuss several models of financial contracting and intermediation. We then proceed to examine why asset originators might choose asset-backed lending as an alternative to on-balance-sheet funding.

II. Financial Structure in Response to Information Costs

Even in a world where there is complete information about available investment opportunities, credit intermediation can occur if individuals without wealth have more profitable projects than do those with greater financial resources. However, while intermediation can help in diversifying the portfolios of the individuals supplying financial resources, the nature of the claim on these investment projects is uncertain. In particular, as Modigliani and Miller (1958) state, it is not clear why a project should be funded via a *debt contract,* which stipulates a predetermined promised cash flow and default (should that cash flow not be met), versus an *equity contract,* which promises only to pay a cash flow that is contingent on the project's return—precluding the event of default. Modigliani and Miller show that in a world without taxes, transaction costs, and information costs, entrepreneurs would be indifferent between funding projects with debt or equity.

Debt versus Equity Contracts

Information costs thus play an important role in explaining the structure of the contracts between borrowers and lenders that we observe in reality. One model of financial contracting under imperfect information is presented in Townsend (1979). He demonstrates that when it is costly for lenders to monitor the performance of a borrower's project, debt contracts allow lenders to minimize monitoring costs.[7] In his model, borrowers can observe the proceeds of their investment opportunities, while lenders can do so only by paying a fee. In this setting, an equity-type contract stipulating a payoff that always depends on the project's realization implies that investors will always have to expend resources to monitor the project's outcome.

Alternatively, debt contracts minimize these monitoring costs by specifying a contractual interest payment to lenders. Borrowers pay this prespecified amount except when default is declared. In that situation, lenders receive the realized value of the project (or firm), which they must ascertain

■ 6 See Pavel (1986) for a comprehensive description of the historical evolution of this market.

■ 7 This suggests that debt would be preferred to equity. One reason equity might be preferred is if bondholders cannot observe the riskiness of the investments undertaken by the firm's management. In that situation, the investments undertaken will be too risky, which transfers wealth from bondholders to equityholders.

by incurring monitoring costs. Here, debt contracts minimize monitoring costs because lenders must monitor investment outcomes only in the event of borrowers' default.[8]

Information Costs and Credit Risk Transformation

One function of financial intermediation, as mentioned earlier, is to pool assets in order to reduce portfolio risks, thus enabling investors with limited wealth to hold a diversified portfolio. Another, indirect advantage of diversification is that it helps to minimize information costs by decreasing the need for investors to monitor privately observed portfolio risks.

Diamond (1984) examines how asset diversification by banks mitigates the need for depositors to monitor the performance of bank investments. He describes a world in which information about realized project returns is costly. If many lenders are needed to fund one borrower, an intermediary could group these lenders to fund the project. However, because the project's return is costly to observe, each lender would in general have to monitor the intermediary's investment.

Diamond demonstrates that by diversifying across many projects, an intermediary can decrease the variability of the return on its portfolio, and thus the need for lenders to monitor the performance of the portfolio. Depositors in essence loan funds to the bank in exchange for debt contracts. A reduction in portfolio risks lowers expected monitoring costs by reducing the probability that the firm will default on its liabilities by not paying depositors their stipulated return. In the extreme case, complete diversification of asset returns eliminates portfolio risk and thus the need for depositors to monitor the bank. Hence, Diamond describes how asset pooling allows the monitoring function to be *delegated* to intermediaries.[9]

III. Asset-Backed Lending as a Funding Mode

Diamond's analysis illustrates an interesting point, but in more realistic settings, firms may be limited in how much they can benefit from asset pooling. This restriction is useful to consider in examining why loan sales and securitization may be efficient ways of funding certain investments. Asset-backed lending in its most general sense is the sale of an asset by its originator, which separates the financing of the asset from that of the originator's portfolio.

Imperfect information about the portfolio choices of intermediaries can help to explain market-based incentives for asset-backed lending. The first two papers we discuss below cite the inability of localized or specialized banks to diversify portfolio returns as a rationale for financial firms to engage in both loan sales and securitization. The models developed in these papers formalize this rationale, motivating asset-backed lending as a means for local borrowers to tap into nonlocal sources of funds. The second two models of asset-backed lending emphasize the differences in the information available to intermediaries versus the individuals who hold their debt prior to investment choices. These models formalize asset-backed lending as a means of collateralizing, thus enabling investors to obtain financing terms that better reflect the underlying quality of the projects being funded.

Portfolio Risks and Capital Constraints

While perfect diversification removes the need to monitor imperfectly observed portfolio risks, imperfect diversification creates the need for a more complicated financial structure. For example, when banks cannot perfectly diversify risks, the amount of their equity capital assumes greater importance. Without sufficient equity capital, banks may be unable to attract funding in order to finance risky investments. By buffering potential portfolio losses, equity capital serves as an alternative means of mitigating the need for lenders to monitor an intermediary: It cushions portfolio losses and thus protects depositors.

Bernanke and Gertler (1987) and Samolyk (1989a,b) show that when depositors' costs of monitoring an institution are prohibitive, intermediaries may face market-imposed capital constraints on the risks associated with their portfolio choices. Capital inadequacy arises when a bank is

8 This result is predicated on the assumption of deterministic auditing. That is, auditing occurs with a probability of either one or zero. Mookherjee and Png (1989) show that, in general, random auditing will be optimal. That is, even when bankruptcy occurs, the probability of being audited is less than one.

9 Ramakrishnan and Thakor (1984) show that financial intermediaries will also arise with ex ante monitoring costs. Diamond's paper assumes ex post monitoring costs.

unable to attract funds to finance profitable investments because it has inadequate capital to absorb possible portfolio losses.

The key to this result is that it is assumed to be extremely costly for depositors to monitor the outcome of a bank's portfolio. Depositors recognize that banks have the incentive to report large losses on their risky assets, in effect claiming that they are unable to meet depositors' claims. Hence, banks will not be able to attract depositors unless they have sufficient capital to cover potential portfolio losses on risky investments.[10]

Limits to the Benefits of On-Balance-Sheet Intermediation

Capital constraints can arise because banks are both unable and unwilling to diversify their portfolios adequately. Government policies have affected the incentives for intermediaries—especially banks and thrifts—to manage portfolio risks prudently. Portfolio and branching restrictions have limited the ability of banks and thrifts to diversify credit risks as well as the risks associated with maturity transformation. Regulatory limits on the types of depository lending, such as the "Qualified Thrift Lender Test," also constrain portfolio diversification.[11] Finally, the provision of federally sponsored deposit insurance creates moral hazard problems in both the management of credit risks and the interest-rate risks associated with maturity transformation. These policies reduce the potential for depositors (and regulators) to delegate the monitoring function.

Given the partial deregulation of the banking industry, these restrictions are probably not as important an impediment to diversification as they once were. Ironically, a major factor limiting intermediaries from diversifying and hence minimizing information costs is the very costs of identifying, monitoring, and funding borrowers that make financial contracts and intermediation important. These costs may cause intermediaries to specialize in lending to certain types of borrowers (industry versus consumers) or to borrowers in certain regions.

Asset-Backed Lending as a Response to Localized Capital Constraints

Carlstrom and Samolyk (1993) present a model in which capital constraints motivate one rationale for off-balance-sheet lending. Their model predicts that loan sales occur as a response to differences in project returns across regions that arise when some regions are capital constrained and others are not. Similar to the model used by Samolyk (1989b), banks operate in distinct, informationally segmented regions or markets. Bankers within a particular region have a comparative advantage in supplying loans there because they have better information about credit conditions or would-be borrowers. However, the inability of banks to diversify localized portfolios perfectly can cause some regions to be capital constrained.[12]

The authors demonstrate that in the absence of asset-backed lending, a region with a relatively large set of profitable—albeit risky—investment opportunities and limited bank capital can be constrained. That is, the region will be unable to attract sufficient deposits to fund all of its profitable investment opportunities. A constrained bank must channel resources instead into safer but less profitable investments.

Binding capital constraints cause interregional differences in returns on projects. These, in turn, create the incentive for banks in constrained markets to originate and sell unfunded profitable investments to banks in unconstrained regions. Unconstrained banks, though adequately capitalized, would not lend to constrained banks via deposit liabilities because these liabilities are claims on the constrained banks' entire portfolios, which nonlocal firms have no comparative advantage in monitoring. Alternatively, unconstrained bankers will purchase individual projects from these banks. They recognize that banks are constrained because of excess profitable investment opportunities in their region. Thus, binding capital constraints give rise to asset-backed lending by allowing a bank to separate the funding of certain projects from the performance of its portfolio.

■ **10** In this discussion, depositors should be understood as either uninsured depositors or banking regulators.

■ **11** The Qualified Thrift Lender Test refers to the regulation that requires thrifts to hold a certain fraction of their portfolio in the form of home mortgages.

■ **12** Capital constraints arise because of short-term variations in lending opportunities that do not create the incentive for a structural reallocation of bank equity capital.

Asset-Backed Lending as a Means of Delegating Nonlocal Monitoring

Carlstrom and Samolyk's model shows how capital constraints in informationally segmented banking markets can cause banks to sell loans, facilitating a more efficient allocation of resources. These capital constraints are one example in which capital markets may not be as efficient as suggested by textbooks. Loan sales may arise to help correct the associated regional imbalances.

Another potential problem with intermediation is that information costs may cause credit to be rationed for some borrowers. Credit rationing exists when someone is unable to obtain credit even though he or she is (ex ante) identical to a borrower who does obtain financing. When information is costless, economic theory predicts that credit rationing will not arise because loan rates will increase until the quantity of loans supplied equals the quantity of loans demanded.

Williamson (1986) demonstrates that it may be efficient for intermediaries that face monitoring costs to ration credit. As in Diamond, he characterizes banks as issuing claims to a large number of lenders and lending to a large number of borrowers. Because of ex post project monitoring costs, banks issue debt contracts to many ex ante identical borrowers, monitor projects only in the event of default, and pay a noncontingent return to depositors.

Unlike Diamond, who assumes that banks can fund any number of investments at a given cost of funds, Williamson analyzes an economy in which banks face an increasing marginal cost of funds: They must charge higher loan rates to offer returns that will attract the funds of investors with better alternatives. Higher loan rates, however, lead to greater monitoring costs because higher interest charges raise the probability that borrowers will default on their loans. Although lenders get all of a project's proceeds in the event of default, the increase in expected monitoring costs may actually decrease the expected return of a loan. In this setting, intermediaries may be unwilling to charge higher loan rates in order to fund more projects and instead choose to ration credit.

In a related paper, Boyd and Smith (1989) extend this analysis to show another way in which asset-backed lending may improve the performance of informationally segmented credit markets. As in Carlstrom and Samolyk, differences in interregional returns on projects lead to a type of asset-backed lending.

Boyd and Smith consider a variation of the contracting model described by Williamson (1987).[13] In their model, identical borrowers, whose projects require costly ex post state verification, contract individually with lenders to supply funds. To observe the ex post returns on borrowers' investments, lenders must incur monitoring costs, but such costs are assumed to be larger for lenders in other markets. Thus, like Carlstrom and Samolyk's model, there is a comparative advantage to funding projects within one's own region. Boyd and Smith consider two banking regions that differ in the local ratios of potential lenders to borrowers, creating a scenario in which a Williamson-type credit rationing occurs in only one of the regions.

Securitization allows lenders in unrationed markets to fund projects in rationed markets: An intermediary pools and monitors the loans of local borrowers, funding them by issuing claims to other markets. Like Diamond's model of intermediation, diversification by this intermediary allows the ultimate investors, lenders in the unrationed market, to delegate the monitoring to the intermediary in the market where the loans are being originated.

Lenders do not find it profitable to fund projects in other markets directly because of the large intermarket monitoring costs. However, asset pooling, which completely diversifies away the risk of the pool, eliminates the need for investors to incur the large intermarket costs of monitoring the underlying assets. All monitoring takes place locally by the coalition at the lower intramarket monitoring cost. Similar to Carlstrom and Samolyk's model, loan sales occur in order to equalize expected project returns across markets. Credit rationing, however, may still occur in markets where assets are being securitized.

How Well Do These Models Describe Off-Balance-Sheet Financing?

In Boyd and Smith's model, securitized loan pools are originated by a coalition of individual borrowers within one locality, but are funded by lenders in another. Most mortgage securitization takes place via an interregional intermediary, which pools loans from loan originators in many

■ 13 Williamson (1987) shows that credit rationing can occur in a model with debt contracts, where individual borrowers contract with individual lenders. This paper is similar to his earlier one (Williamson [1986]), except that there are no financial intermediaries.

localities. To the extent that interregional diversification is conventionally viewed as an important rationale for mortgage securitization, the Boyd–Smith model is limited in the extent to which it can be interpreted as a model of the secondary mortgage market.

Instead of being a model of regional mortgage securitization, their analysis is a better description of most nonmortgage securitization. They do not, however, depict an intermediary that funds a share of its projects off-balance-sheet through a subsidiary. Rather, each individual borrower (not a "bank") funds his entire project along with other borrowers.

Carlstrom and Samolyk depict loan sales and not securitization. However, they model one important aspect of nonmortgage asset-backed lending in the sense that banks fund parts of their portfolio on- and off-balance-sheet.

These models help explain some of the benefits of both loan sales and securitization. For two reasons, however, the models are limited in describing some dimensions of asset-backed markets. First, both the Carlstrom–Samolyk and Boyd–Smith models rely on regionally segmented banking markets to drive their results—an increasingly less likely scenario given the consolidation of the depository industry and the increase in nonbank intermediation. Second, as discussed earlier, securitized assets are usually backed by some type of credit enhancements or provide some sort of recourse for the purchasing party that helps make them marketable. Neither of these papers explains why credit enhancements might be an important part of the securitization process. The next two papers discuss the importance of credit enhancements in making risky bank assets attractive to nonbank investors.

Asset-Backed Lending as a Means of Signaling Credit Quality

Greenbaum and Thakor (1987) present a model in which the choice of on- versus off-balance-sheet funding (which they refer to as the deposit funding mode [DFM] and securitized funding mode [SFM], respectively) is a sorting mechanism whereby borrowers choose one or the other based on the quality of their project. If a borrower selects the SFM, he must also choose the degree to which the bank will provide recourse in the event of default. The degree to which a loan is collateralized signals the quality of the asset to nonbank investors. This eliminates the need for them to screen the borrower.

The model consists of borrowers with projects that differ in quality. Borrowers must choose between one of two funding modes. If a project is funded on-balance-sheet, a bank's entire stock of equity capital effectively collateralizes the project. The bank screens the borrower to ascertain the quality of his project, while depositors screen the bank. This redundancy is necessary because banks are unable to convey the outcome of their screening directly to depositors. Under the DFM, the value of the bank's collateralization and both of these screening costs are priced into the borrower's risk-adjusted loan rate.

Alternatively, under the SFM, a bank offers to fund the project off-balance-sheet by providing a credit enhancement in the form of bank collateralization. A borrower pays for the amount collateralized with an up-front fee. Banks screen borrowers and then announce a fee schedule associated with a borrower's choice of collateralization. As with insurance, lower-risk projects are charged less for any given level of coverage (collateralization). A borrower's choice of coverage is public information and thus can signal a project's quality, eliminating the need for the purchasing party also to screen the asset.

For higher-quality projects, the fee associated with the borrower's choice of bank collateralization is offset by the reduction in depositors' screening costs. For poorer-quality projects, however, the fee necessary to purchase collateralization is greater, outweighing the benefits from the elimination of screening by nonbank investors. Thus, poorer-quality borrowers forgo the fee and choose the DFM with full collateralization, although depositors' screening costs will be priced into their loan rates.

An important implication of this framework is that higher-quality assets will tend to be securitized, while lower-quality assets will tend to be held on-balance-sheet. The intuition is as follows: Higher-quality borrowers receive a lower interest cost than lower-quality borrowers under either funding mode. However, because the choice of collateralization under the SFM produces information about project quality and eliminates the need for asset-backed investors to screen the underlying assets, higher-quality borrowers can take advantage of low credit enhancement rates to obtain a better term of finance. Moreover, their cost of funding is lower despite the increased risk associated with less-than-full bank collateralization from the investors' perspective.

The Greenbaum–Thakor framework represents an important step in characterizing the

trends in securitization, especially to the extent that asset-backed lending separates the collateralization and monitoring of the underlying claims from their funding. Similar to the Boyd–Smith model, this model depicts asset-backed lending as a means of eliminating the need for investors to monitor the performance of the underlying asset(s). Here the reduction in monitoring costs occurs, however, because a borrower's choice to fund via a collateralized loan sale signals project quality and eliminates investors' need to screen. Alternatively, in Boyd and Smith, the diversification associated with borrowers' pooling of claims facilitates delegated monitoring.

Asset-Backed Lending as a Means of Securing Credit Quality

James (1988) presents a model that characterizes a different rationale for asset-backed lending. Specifically, he emphasizes that loan sales with recourse are a means of obtaining lower funding costs by separating the cash flows on a particular claim from those to the unsecured claimants funding a bank's balance sheet. He argues that loan sales with recourse are equivalent to a firm issuing secured debt. Because banks are prohibited from issuing secured claims, loan sales with recourse are likely to occur for the same reasons that firms issue secured debt.

Firms issue secured debt in part to mitigate an underinvestment problem that may occur with fixed-rate bond contracts. If firms with outstanding debt are constrained to raise funds by issuing additional unsecured claims, they may forgo financing certain new profitable projects—in particular, projects that would reduce the overall risk of the firm's portfolio. This occurs because banks cannot reprice existing unsecured claims to reflect accurately changes in the risk of their portfolio due to new asset acquisitions. Thus, if a firm chooses to issue unsecured claims to finance a project that reduces portfolio risk, existing bondholders receive a wealth transfer from stockholders as the risk-adjusted value of their claims increases.

James refers to the underinvestment problem that motivates the use of secured debt as the *collateralization hypothesis*. The key to this problem is that banks are locked into a fixed cost of funds on their liabilities. With secured debt, the existing bondholders do not have access to the newly acquired assets should the firm declare bankruptcy. Since regulations restrict banks and thrifts from issuing secured debt, loan sales with recourse—by separating the funding of new projects from that of a firm's existing investments—can mitigate a potential underinvestment problem.

Banks cannot issue secured debt, so the extent to which they fund their portfolios by issuing term liabilities such as certificates of deposit (CDs) may motivate them to finance certain assets off-balance-sheet with some form of recourse. Still, James' model may be limited as an explanation for asset-backed lending by banks and thrifts, because the bulk of their liabilities are short-term deposits. Such liabilities have a return that can be readjusted to reflect the risk of a bank's portfolio after new assets are acquired. Thus, any wealth transfers from bank equityholders to depositors (in an unregulated environment) could be mitigated by readjusting short-term deposit rates.

Regulatory Factors and Asset-Backed Lending

In reality, the fact that banks are insured, and that the FDIC (not insured depositors) must consider the risk of a bank's portfolio, complicates this analysis. As the residual claimant of a bank's assets, the FDIC, not insured depositors, bears the credit risk of these assets. If capital requirements and deposit insurance premiums were correctly priced (and effectively repriced) to reflect a bank's risk, the incentives for banks to engage in asset-backed lending would be reduced. To the extent, however, that the FDIC does not price the provision of insurance to reflect a bank's risk accurately, James' model motivates asset-backed lending. The interpretation here is that safer assets will be funded off-balance-sheet to maximize the value of FDIC insurance to bank equityholders.

The models in both James and Greenbaum and Thakor explain why firms would provide credit enhancements for their off-balance-sheet funding. In reality, these enhancements are generally issued by a third party—to some degree because of regulations. This is especially true for bank loan sales, as loans sold with recourse are viewed as on-balance-sheet assets in the assessments of capital requirements. In spite of these limitations, however, these frameworks are useful in characterizing a widely accepted rationale for the proliferation of nonmortgage securitization: to separate the securitized assets from the general portfolios of financial intermediaries.

The proliferation of asset-backed lending is merely one way that the financial scene is changing. As evidenced by nonbank activities in this market, securitization is both the result of technological innovations in information production and an artifact of banking regulations. In this paper, we have focused primarily on models that formalize market-based reasons for asset-backed lending. However, the existence of government regulations, in tandem with the provision of the federal safety net, is widely viewed as a significant factor impacting both the volume of securitization and the types of loans securitized.

IV. Regulatory Incentives for Securitization

Regulatory models of asset-backed lending generally focus on how regulations impact a bank's choice of funding. For example, Benveniste and Berger (1987) argue that credit enhancements for asset-backed securities allow banks to maximize the value of deposit insurance by issuing claims that are senior to those of the FDIC. Although their argument is similar to that posited by James, he argues that this adverse tendency is offset by the likelihood that loan sales backed by SLCs mitigate the underinvestment problem.

The incentive to shift risk to the FDIC is also limited by the marketplace. The creditworthiness of both the loans being securitized and the issuer of credit enhancements affects the rating of a pool. Thus, banks that issue SLCs are generally lower-risk institutions.

Other regulatory incentives for banks to engage in asset-backed lending are the regulatory taxes associated with on-balance-sheet funding. For example, capital requirements—the minimum legal fraction of an investment that must be held as equity capital—are popularly viewed as the primary regulatory incentive for banks and thrifts to sell assets. These requirements are designed to protect the FDIC and uninsured depositors in the case of bank failure.

Regulation-based models, however, emphasize that if capital requirements on a particular class of loans are greater than merited by the inherent risk of the claims, banks will have an incentive to either sell or securitize the loan.[14] That is, there will be an incentive to move a loan from on-balance-sheet, where it is subject to capital requirements, to off-balance-sheet, where it is not. This will be the case when the cost of the regulated equity buffer exceeds the cost of marketing the claims.

Two other regulatory taxes that have been cited as potential inducements for asset-backed lending are fractional reserve requirements and flat-rate FDIC insurance premiums on deposit liabilities. These assessments are viewed as raising the cost of deposit funding, thus encouraging depository institutions to fund loans off-balance-sheet. Yet, securitization has continued to expand in spite of decreases in the reserve requirements set by the Board of Governors of the Federal Reserve System. In addition, to the extent that deposit insurance is subsidized, flat-rate deposit insurance premiums are unlikely to be a major factor in the growth of securitization. For example, if the premiums charged to insure the deposits funding relatively risky loans allow an institution to obtain funds more cheaply than from other sources, then even though there are other costs associated with deposit funding, this may be a relatively cheap source of finance. Because deposit insurance premiums are currently not risk based, they may still have the undesirable effect of causing banks to securitize their safest and most liquid loans.

V. Conclusion

Although market-based reasons are an important factor driving off-balance-sheet lending, this type of lending may still impact the risk of lending that is funded on banks' balance sheets. For example, Greenbaum and Thakor's model predicts that the safest assets will be securitized while the risky assets will be held on-balance-sheet. Regulations provide similar incentives for securitizing the safest assets. Because these factors can clearly impact the exposure of the FDIC, policymakers are understandably concerned about the rapid growth of this practice.

In its role as an insurer, the government aims to maintain the solvency of the insurance fund by regulating deposit insurance premiums and capital requirements. But it is precisely these assessments that can affect the risks undertaken by depository institutions, as regulatory costs create an incentive for banks to shrink their balance sheets by securitizing loans.

However, the trend toward asset-backed lending should not be viewed as either a boon for nonbank competitors or the bane of the FDIC. Depository institutions can earn fee income for participating in various dimensions of the securitization process. Moreover, with prudent regulatory supervision of banks' off-balance-

14 See Pennacchi (1988).

sheet activities, asset-backed lending can mitigate the rising costs of the federal safety net as it reduces the share of credit funded on the books of depository institutions. Thus, securitization is better viewed as an important innovation in the financial sector—one that allows new suppliers of credit to enter the market and existing ones to intermediate credit more efficiently.

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