

# Estimating Household Debt Service Payments

Household debt rose very rapidly during the last several years, with the ratio of debt to disposable personal income reaching an all-time high of 0.74 in 1985-IV and 1986-I (Table 1).<sup>1</sup> This high level of household debt may cause concern for at least two reasons. First, to the extent that individuals may become subject to liquidity constraints, a high level of debt may reduce future consumer expenditures, aggregate demand, and real economic activity. Second, a high level of debt may increase consumers' default rates and adversely affect the soundness of the financial system. However, liquidity constraints and default rates depend not only on the level of debt outstanding but also on the level of debt service payments.<sup>2</sup> Because data on aggregate debt service payments are not collected, this article estimates a debt service payment series from 1975-I through 1986-I.<sup>3</sup>

Aggregate debt service payments behaved quite differently from debt outstanding in recent years. Although

the estimated ratio of home mortgage plus consumer installment debt service payments to income was higher in 1986-I than in any of the previous ten years, it did not rise as rapidly over the past decade as the debt-to-income ratio. While home mortgage debt service payments increased faster over the last decade, on average, than home mortgage debt, consumer installment debt service payments increased much less than consumer installment debt.

This article also analyzes why the debt and debt service payments ratios grew at different rates by examining how changes in loan extensions, maturities, inflation, and interest rates affect each measure. Cycles in the level of loan extensions generated the cyclical pattern of both debt and debt service payments. However, while the debt-to-income ratio surpassed previous levels in 1985 and 1986-I, extensions of most types of household loans were not higher, relative to income, during the current expansion than during the 1975-79 expansion. Rather, longer maturities on consumer loans and lower inflation rates contributed substantially to the recent increase in the debt ratio.

Changes in maturities, inflation, and interest rates had different effects on debt service payments. Longer maturities on consumer loans decreased rather than increased the debt service payments ratio. In general, lower levels of inflation, if accompanied by lower nominal interest rates, affect the debt service payments ratio much less than the debt ratio. However, interest rates on consumer loans remained high in recent years, relative to inflation, contributing to the growth of debt service payments.

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<sup>1</sup>Federal Reserve Board, *Flow of Funds*

<sup>2</sup>Of course, neither the debt outstanding measure nor the debt service payments measure takes into account such factors as demographics, wealth holdings, or the distribution of debt among income groups, all of which would also affect the assessment of the consumer debt burden.

<sup>3</sup>See Goldman Sachs, *Pocket Chartroom* (November 1985), for alternative estimates of debt service payments on consumer installment debt.

### Estimating debt service payments

Data on the aggregate debt service payments due on home mortgage and consumer debt outstanding are not collected. Therefore, debt service payments of the household sector from 1975-1 through 1986-1 were estimated for home mortgages, which consist of mortgages on one to four family homes, and the components of consumer installment debt—automobile, mobile home, revolving, and "other consumer installment" credit. Debt service payments were not estimated for consumer noninstallment debt.<sup>4</sup>

The estimates of debt service payments are based on past levels of extensions, debt, and average maturities and interest rates at which loans were issued. In general, for each type of debt, the stream of debt service payments due on loans issued during a given period is calculated based on estimates of the amount of loans extended during that period, and of the average interest rates and maturities at which the loans were issued. Prepayment rates are set so that quarterly changes in debt are equal to extensions of new loans minus estimated repayments of principal. (For a detailed explanation of the methodology used, see the box.) In addition, estimates of consumer installment debt outstanding are adjusted to account for any precomputed finance charges (that is, the interest component of the debt service payments due on debt outstanding) that finance companies may include in their reported levels of debt. This adjustment has very little effect on the growth of debt outstanding over the past decade, and reduces consumer installment debt by 6 percent in 1986-1.

### Results

Chart 1 depicts the estimated ratio of required debt service payments on home mortgage and consumer installment debt to disposable personal income from 1975-1 through 1986-1, along with the estimated ratio of home mortgage and consumer installment debt to income.<sup>5</sup> In general, the estimated ratio of debt service payments to income did not increase as much during this period as the debt-to-income measure. While the debt ratio was 22 percent higher in 1986-1 than in 1975-1, the debt service payments ratio was only 8 percent higher.

Charts 2 and 3 depict the two estimated ratios by type of household debt (home mortgage versus consumer installment). Chart 2 shows that debt service payments

<sup>4</sup>Installment credit is credit scheduled to be repaid (or with the option of repayment) in two or more installments. Noninstallment credit is credit scheduled to be repaid in a lump sum rather than through periodic debt service payments. Home mortgage and consumer installment debt account for 94 percent of the home mortgage and consumer debt owed by households at the end of 1985.

<sup>5</sup>Estimated debt service payments are also presented in Table B-2 of the box.

Table 1

### Ratios of Home Mortgage and Consumer Debt Outstanding to Disposable Personal Income, 1975-86\*

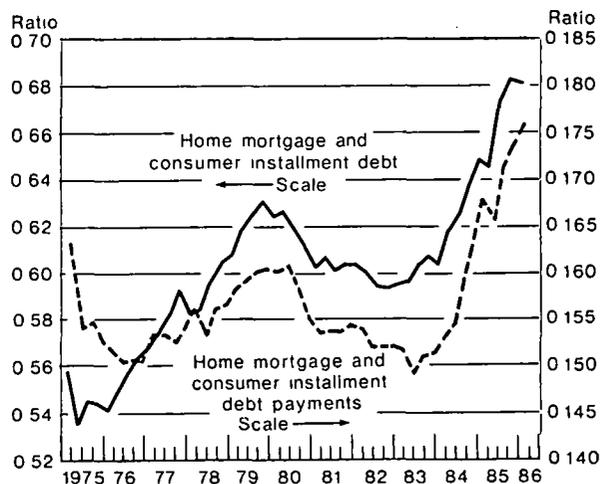
Date	Home mortgage ratio	Consumer installment ratio	Other consumer credit ratio	Total
1975	0.40	0.15	0.04	0.58
1976	0.41	0.15	0.04	0.60
1977	0.43	0.16	0.04	0.63
1978	0.45	0.17	0.04	0.66
1979	0.47	0.17	0.04	0.69
1980	0.47	0.15	0.04	0.66
1981	0.47	0.15	0.04	0.65
1982	0.46	0.14	0.04	0.64
1983	0.46	0.15	0.04	0.65
1984	0.48	0.17	0.04	0.69
1985	0.51	0.19	0.04	0.74
1986-1	0.50	0.19	0.04	0.74

\*Debt is as of the end of the year. Disposable personal income is for the fourth quarter, at a seasonally adjusted annual rate. Data for 1986 are as of the first quarter, seasonally adjusted.

Source: Federal Reserve Board, *Flows of Funds*.

Chart 1

### Estimated Ratios of Home Mortgage and Consumer Installment Debt and Debt Service Payments to Disposable Personal Income



Debt service payments and disposable personal income are at annual rates. Ratios include home mortgages owed by households; personal trusts, and nonprofit organizations.

Sources: Federal Reserve Board, *Flow of Funds* and Federal Reserve Bank of New York staff estimates.

## Methodology for Calculating the Debt Service Payments Ratio

To estimate debt service payments for each type of consumer installment credit (excluding revolving credit), loans issued in each quarter are assumed to have an interest rate equal to the estimated average contract rate on new loans issued in that quarter, and a maturity equal to the estimated average maturity of new loans issued in that quarter. Under these assumptions, the required monthly debt service payment for loans issued in each quarter is calculated. For each type of debt, prepayment rates are set so that, at the end of each quarter beginning 1974-IV, the amount of debt outstanding implied by the debt service payments calculations equals the amount of debt outstanding as estimated by the Federal Reserve Board in *Statistical Release G 19*.

For a given type of loan, let

- $E_i$  = extensions during month  $i$ ,
- $D_i$  = debt outstanding at the end of month  $i$ ,
- $r_i$  = the interest rate on loans issued in month  $i$ ,
- $m_i$  = the maturity of loans issued in month  $i$ ,
- $M_i$  = the maximum (original) maturity on any loan outstanding in month  $i$ ,
- $X_{i,t}$  = debt service payment due in month  $t$  on loans issued in month  $i$  (assuming no prepayments),

$$= E_i \cdot r_i / [1 - (1 + r_i)^{-m_i}],$$

for  $i < t \leq i + m_i$  and  
= 0 otherwise

- $R_{i,t}$  = principal portion of debt service payment due in month  $t$  on loans issued in month  $i$  (assuming no prepayments),

$$= E_i \cdot r_i \cdot (1 + r_i)^{i-t-1} / [(1 + r_i)^{m_i} - 1],$$

for  $i < t \leq i + m_i$  and  
= 0 otherwise

- $p_t$  = prepayment rate on debt in month  $t$ ,
- $P_{i,t}$  = percent of loans issued in month  $i$  that were prepaid prior to month  $t$ ,

$$= 1 - \prod_{j=i+1}^{t-1} (1 - p_j) \quad \text{for } t > i+1 \text{ and}$$

= 0 otherwise

Then aggregate debt service payments due in month  $t$  equal

$$\sum_{i=t-M_i}^{t-1} X_{i,t} \cdot (1 - P_{i,t}),$$

while aggregate required principal payments due in month  $t$  equal

$$T_t = \sum_{i=t-M_i}^{t-1} R_{i,t} \cdot (1 - P_{i,t})$$

Prepayment rates ( $p_t$ ) are calculated as follows. Let  $d_{i,t}$  equal the estimated amount of principal remaining at the end of month  $t$  on loans issued in month  $i$ ,

$$= E_i - \sum_{j=i+1}^t R_{i,j} \cdot (1 - P_{i,j})$$

$$- \sum_{j=i+1}^t p_j \cdot [d_{i,j-1} - R_{i,j} \cdot (1 - P_{i,j})],$$

for  $t > i$ ,

$$= E_i \text{ for } t=i$$

That is, the amount of principal remaining at the end of month  $t$  on loans issued in month  $i$  equals the original amount issued minus the sum of required principal payments made through month  $t$  minus the sum of prepayments made through month  $t$ . Then, the amount of total debt outstanding as of month  $t$  equals

$$D_t^* = \sum_{i=t-M_i}^t d_{i,t}$$

Note that  $D_t^*$  is a function of the prepayment rates  $p_j$ ,  $j \leq t$ . Prior to 1975, all values of  $p_j$  are required to be equal (i.e.,  $p_j = p$ , for all  $j < 1975$ ). Then  $p$  is set so that, for  $t = \text{December } 1974$ ,  $D_t$  (actual debt) equals  $D_t^*$ . At the end of each quarter beginning 1975-1, the monthly prepayment rate during that quarter is set so that

$$D_t - D_{t-3} = \sum_{i=t-2}^t [E_i - T_i - (D_{i-1}^* - T_i) \cdot p_i],$$

where  $T_i$  and  $D_{i-1}^*$  are functions of  $p_j$ , for  $i = t-2, t$ . That is, the prepayment rate during each quarter is set so that the actual change in debt equals the estimated value of extensions during that quarter minus required principal payments minus prepayments.

Estimating debt service payments using the method described above requires data on extensions ( $E_i$ ), debt ( $D_i$ ), average (original) maturities ( $m_i$ ), and interest rates ( $r_i$ ) for each type of loan. The principal data sources for these series are listed in Table B-1. Unfortunately, data are not available for each series for all time periods. In particular, for mobile home loans, a maturity series is available only for credit on new homes at finance companies, and only through 1982-IV. Maturities on all mobile home loans are assumed to equal maturities on loans made by finance companies, and after 1982, are assumed to increase at the same rate as the maturities on new car loans (Between 1975 and 1982, average maturities on new car loans rose 21 percent, compared with 29 percent for new mobile home loans). Also, the average maturity on all mobile home loans is assumed to equal 90 percent of the average maturity on new mobile home loans, since data reported in the American

## Methodology for Calculating the Debt Service Payments Ratio (continued)

Bankers Association's *Retail Bank Credit Reports* indicates that maturities on used mobile home loans are lower than on new home loans

Data on average maturities on "other consumer installment" loans are very limited. Through 1982-IV, finance companies reported the average maturity on loans for "other consumer goods" (excluding autos, mobile homes, and recreational vehicles). This average maturity increased 44 percent between 1975 and 1982. While it corresponds to only a part of the "other consumer installment" category, this maturity series does suggest that average maturities on other consumer loans, like maturities on auto and mobile home loans, may have risen during the 1970s and early 1980s. On the basis of these data, maturities on other consumer installment loans are assumed to have increased at the same rate as used car loans (roughly 31 percent between 1975 and 1982).

Data on extensions of consumer installment credit after 1982 were collected only from finance companies. Therefore, data on changes in outstanding debt are used along with estimated repayments (including prepayments) of principal, to estimate extensions of each type of debt

in each quarter after 1982. The prepayment rates after 1982 are assumed to equal their average values during 1982. That is,

$$E_t^* = D_t - D_{t-1} + T_t + p_{82}^*(D_{t-1} - T_t),$$

where  $E_t^*$  equals estimated extensions of debt in month  $t$  and  $p_{82}^*$  equals the average value of  $p_t$  during 1982. While the estimated prepayment rates varied somewhat from quarter to quarter, they did not exhibit a trend over the 1970-82 period, and the averages during 1982 did not differ much from the averages during the preceding years. Predicting post-1982 prepayment rates using a more sophisticated moving-average process would not change the debt service estimates considerably.

According to the Federal Reserve Board, finance companies generally include the interest component of debt service payments owed in their reported holdings and extensions of debt. Therefore, in calculating debt service payments on loans made by finance companies, all data on extensions and debt outstanding that finance companies report to the Federal Reserve Board are assumed to include not only the principal but also the interest component of the debt service payments owed. Actual extensions by finance companies (i.e., excluding

Table B-1

### Principal Data Sources For Debt Service Payments Calculations

#### Debt outstanding

- Federal Reserve Board, *Flow of Funds* (home mortgage debt)
- Federal Reserve Board, *Statistical Release G 19* (consumer installment debt by holder and by type)

#### Extensions

- U S Department of Housing and Urban Development, "Survey of Mortgage Lending Activity," *Monthly Mortgage Loan Transactions and Commitments, 1970-79* (home mortgage originations)
- Federal Reserve Board, *Statistical Release G 19* (consumer installment extensions through 1982)
- Federal Reserve Board, *Statistical Release G 20* (consumer installment extensions at finance companies)

#### Maturities

- Federal Reserve Board, *Statistical Release E 4* (average maturities on new auto loans at commercial banks through 1982)
- Federal Reserve Board, *Statistical Releases E 4* and *G 19* (average maturities on new car and used car loans at finance companies)
- Federal Reserve Board, *Statistical Release E 10* (average maturities on mobile home loans and other consumer goods loans at finance companies through 1982)
- American Bankers Association, *Retail Bank Credit Reports* (distribution of maturities on new car loans, most common maximum maturities on other consumer loans at commercial banks)
- Federal Home Loan Bank Board, "Conventional Home Mortgage Rates" (average maturities on conventional new home and existing home mortgages)

#### Interest rates

- Federal Reserve Board, *Statistical Release G 19* (rates at commercial banks on new car, personal, and mobile home loans, and on credit card plans. Rates at finance companies on new car and used car loans)
- Federal Reserve Board, *Statistical Release E 10* (rates at finance companies on mobile home and other consumer goods loans, through 1982)
- Federal Home Loan Bank Board, "Conventional Home Mortgage Rates" (average contract interest rates on fixed-rate loans, percent of loans that have adjustable rates)

#### Prepayment rates (home mortgages)

- Helen F Peters, Scott M Pinkus, and David J Askin, "Prepayment Patterns of Conventional Mortgages: Experience from the Freddie Mac Portfolio," *Secondary Mortgage Markets* (February 1984)
- Mortgage Security Prepayment Rate Profile*, Salomon Brothers Inc., various issues
- Thomas N Herzog and Dominick C Stasulli, "Survivorship and Decrement Tables for HUD/FHA Home Mortgage Insurance Programs as of December 31, 1983," U S Department of Housing and Urban Development (March 1984)

## Methodology for Calculating the Debt Service Payments Ratio (continued)

these precomputed finance charges) are calculated based on the estimated average maturity and interest rate at which loans were issued. That is,

$$X_i^f = E_i^f / m_i,$$

where  $X_i^f$  is the monthly debt service payment on loans issued by finance companies in month  $i$ , and  $E_i^f$  equals extensions as reported by finance companies in month  $i$ . Then "actual" extensions by finance companies are calculated as

$$E_i^f = X_i^f [1 - (1 + r_i)^{-m_i}] / r_i.$$

Debt held by finance companies is adjusted as follows. Let  $Z_t$  equal the "actual" amount of debt held by finance companies, and let  $D_t^f$  equal the amount of debt as reported by finance companies. Then  $Z_t$  is estimated as  $D_t^f * k_t$ , where  $k_t$  equals the estimated ratio of principal payments remaining, in month  $t$ , on loans issued by finance companies, to remaining debt service payments. In general, these adjustments have a very small effect on the estimates of debt and debt service payments. Since not all finance companies include precomputed finance charges in their reported debt holdings, while some other holders of debt may, debt and debt service payments may be slightly understated or overstated.

The method used to calculate debt service payments on home mortgage debt is very similar to that used to calculate payments on consumer installment debt. However, for home mortgage debt, prepayment rates are varied by year of origination and by age of the loan, based on average prepayment rates for Federal Housing Administration mortgages and for loans in various mortgage security pools. That is, the prepayment rate in month  $t$  [year  $y(t)$ ] for a loan issued in year  $y(i)$  equals  $s_{y(i),y(t)} * q_t$ , where  $s_{y(i),y(t)}$  is the prepayment rate in year  $y(t)$  for mortgages issued in year  $y(i)$ , and is estimated based on aggregate mortgage prepayment rate data. The adjustment factor  $q_t$  varies by quarter and is set so that the estimate of debt outstanding implied by the debt service payment calculations equals the estimate of debt outstanding as reported in the Federal Reserve Board, *Flow of Funds*. That is, the variable  $q_t$  in the home mortgage calculations is determined in a manner analogous to that of  $p_t$  in the consumer installment calculations. The contract interest rate on adjustable rate mortgages was reset annually using the one-year Treasury bill rate.

For revolving credit, required principal payments in a given month are assumed to equal a specified fraction of the amount of debt outstanding at the end of the previous month. For revolving credit held by banks and savings institutions, required principal payments are assumed to equal .5 percent of outstanding debt. For

credit held by retailers, this fraction is assumed to equal 8 percent, while for credit held by gasoline companies, this fraction is assumed to equal 20 percent. These assumptions are based on the required minimum payment schedules of various bank, retail, and gasoline company credit cards.

Table B-2

### Estimated Home Mortgage and Consumer Installment Debt Service Payments

In billions of dollars

Quarter	Home mortgage	Consumer installment	Total
1975-I	12.3	31.8	44.1
1975-II	12.6	31.5	44.1
1975-III	12.9	31.7	44.6
1975-IV	13.2	32.0	45.2
1976-I	13.6	32.5	46.1
1976-II	14.0	32.5	46.5
1976-III	14.3	33.1	47.5
1976-IV	14.8	33.8	48.6
1977-I	15.3	35.2	50.5
1977-II	15.8	36.2	52.0
1977-III	16.4	37.1	53.5
1977-IV	17.0	38.2	55.3
1978-I	17.5	40.0	57.5
1978-II	17.8	40.9	58.7
1978-III	18.5	42.8	61.3
1978-IV	19.4	44.1	63.4
1979-I	20.2	45.8	66.0
1979-II	21.1	46.6	67.7
1979-III	22.0	48.1	70.1
1979-IV	23.0	49.0	72.0
1980-I	23.9	50.3	74.2
1980-II	24.8	50.4	75.1
1980-III	25.6	50.8	76.4
1980-IV	26.5	51.4	77.9
1981-I	27.4	51.7	79.1
1981-II	28.2	52.2	80.4
1981-III	29.2	53.7	82.8
1981-IV	30.0	54.2	84.2
1982-I	30.8	54.2	85.0
1982-II	31.5	53.5	85.0
1982-III	32.2	54.4	86.5
1982-IV	32.6	55.4	88.0
1983-I	33.2	55.6	88.1
1983-II	33.8	55.2	89.1
1983-III	34.7	57.3	92.0
1983-IV	35.9	59.6	95.4
1984-I	37.2	62.5	99.7
1984-II	38.6	63.3	101.9
1984-III	40.0	67.1	107.1
1984-IV	41.3	69.7	110.9
1985-I	42.4	73.1	115.5
1985-II	43.3	74.2	117.5
1985-III	43.9	77.2	121.1
1985-IV	44.8	80.1	124.9
1986-I	45.6	83.4	129.0

on home mortgages increased steadily over the past decade, and grew faster, on average, than home mortgage debt outstanding, particularly during the 1980-82 period. Chart 3 illustrates that consumer installment debt increased much more sharply, on average, than debt service payments. While the consumer installment debt ratio was 24 percent higher in 1986-1 than in 1975-1, the debt service payments ratio was 4 percent lower. The debt ratio was 11 percent higher in 1985 than in 1979 (its peak during the previous business cycle), while the debt service payments ratio was 3 percent higher in 1986-1 than at its previous peak.

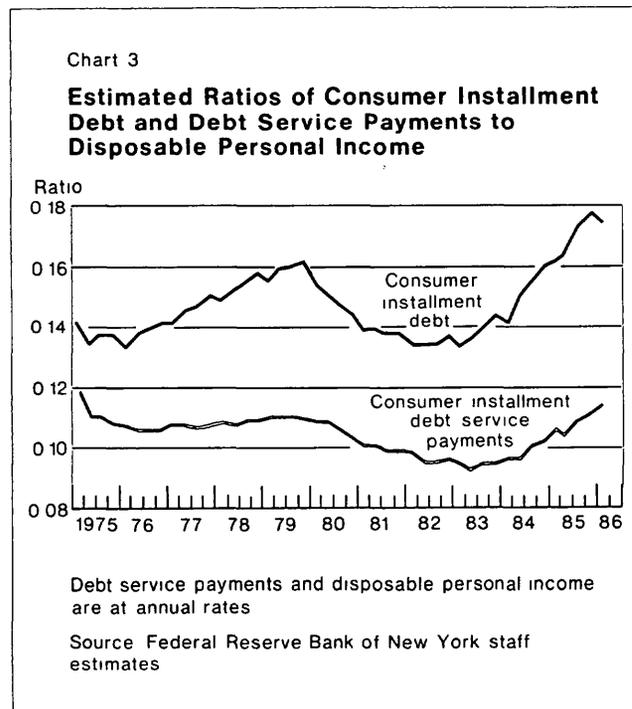
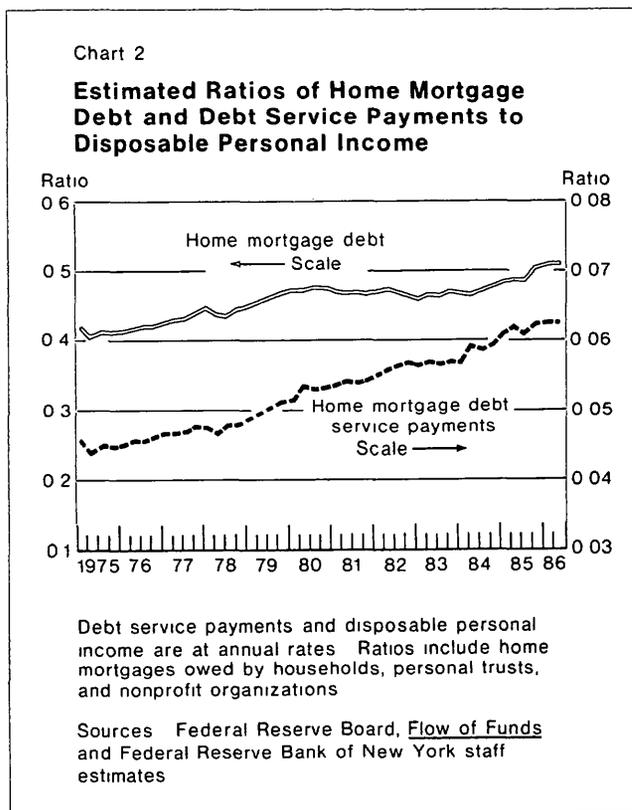
**Factors that affect debt and debt service payments**  
 Changes in a variety of factors—amounts of loans issued, maturities of new loans, interest rates, and inflation—caused the debt service payment and debt ratios to grow at different rates over the past decade. Understanding how these various factors affect debt and debt service payments, both in the short and long run, will aid in the assessment of consumers' current debt burden as well as in projecting how quickly debt and debt service payments are likely to grow in the future.<sup>6</sup> To illustrate the effects of these factors, examples are presented based on the "typical" loan, where the required monthly debt service payment is constant (in nominal terms) over the loan maturity.<sup>7</sup> That is, the principal portion of the monthly debt service payment increases over time as the interest portion decreases.

*Effects of an increase in loan extensions*

An increase in monthly consumer borrowing will lead, in the long run, to proportionate increases in aggregate debt service payments and debt outstanding, assuming that interest rates and maturities remain constant. However, in the short run, debt will increase much more quickly than debt service payments. For example, assume that in each month prior to some month  $m_0$ , \$100 of new loans is issued at a 36-month maturity and

<sup>6</sup>The attribution of changes in debt and debt service payments to the factors listed above does not take into account the effect that one factor, such as interest rates, may have on another factor, such as loan extensions. Nevertheless, this exercise is useful in explaining why debt and debt service payments grow at different rates over time. Explaining how inflation and interest rates affect borrowing patterns is a subject for future research.

<sup>7</sup>Most consumer loans are issued at a fixed interest rate for a given maturity and require a debt service payment that is constant over time. The main exceptions are revolving credit, with required debt service payments that may decline over time, and adjustable rate loans, with debt service payments that may vary over the life of the loan in response to changes in interest rates. Most of the examples presented below illustrating the relation between debt service payments and debt outstanding generalize to cases where the interest rate varies over the life of the loan.



an interest rate of 0.5 percent per month, with no prepayments. Then prior to month  $m_0$ , the rate of amortization implied by the loan terms will generate an aggregate debt level of \$1904, and aggregate debt service payments of \$109.50 per month. Now suppose that beginning in month  $m_0$ , the amount of new loans issued doubles to \$200 per month. In the long run (i.e., after 36 months have elapsed), both debt and debt service payments will double as well. However, in the short run, for example after only six months have elapsed, debt service payments will have increased less than 17 percent, while debt outstanding will have increased over 33 percent (Table 2). That is, the ratio of the remaining principal on loans issued in the past six months to total debt is, in general, greater than the ratio of debt service payments on loans issued in the past six months to total debt service payments. Because much of the original principal on the "older" loans has already been repaid, those loans account for a relatively small portion of debt outstanding. The debt service payment on the "older" loans, however, remains constant over the maturity of the loan. Therefore, recently issued loans account for a larger proportion of debt than of debt service payments, causing changes in the rate of borrowing to affect debt more quickly than debt service payments.

Chart 4 presents the ratios of estimated extensions of home mortgages and consumer installment loans to income from 1975-1 to 1986-1.<sup>6</sup> Extensions rose, relative to income, during the 1975-79 expansion, declined during the 1980-82 downturn, and then increased again. The cycles in extensions account for the cycles in debt and debt service payments. However, with the exception of revolving credit, the estimated ratios of extensions to income have not been higher, on average, in the current expansion than in the 1975-79 expansion. While Chart 4 depicts gross rather than net extensions, it nevertheless suggests that a trend in the rate of borrowing does not, at least by itself, explain why the debt ratio is currently at an all-time high.

Table 2 also demonstrates that if the amount individuals borrow each period increases, debt outstanding (as well as debt service payments) will increase at a decreasing rate over time. Thus, for example, even if borrowing were to continue at the relatively high level of the past year, the growth in the consumer installment

<sup>6</sup>Data on extensions of consumer installment loans were collected after 1982 only from finance companies. Except for revolving credit, extensions of loans were estimated after 1982 based on changes in debt outstanding, estimated required principal payments, and estimated prepayments (box). Extensions of revolving debt were not estimated after 1982.

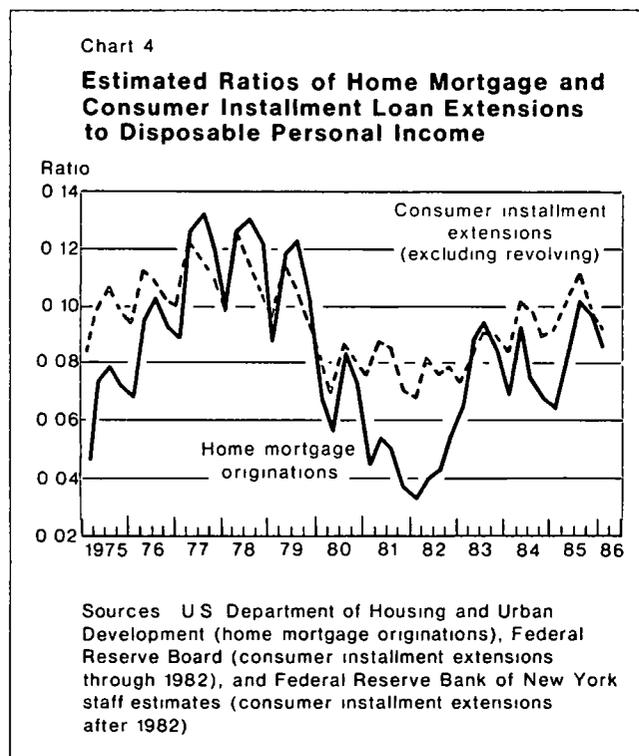


Table 2

**The Effects of Changes in Amount of New Loans and Maturity on Aggregate Debt and Debt Service Payments**

In percent

Between month 0 and month	Increase in loans issued*		Increase in maturity†	
	Change in debt outstanding	Change in debt service payments	Change in debt outstanding	Change in debt service payments
Six	33.9	16.7	0.8	-3.7
Twelve	57.7	33.3	2.9	-7.6
Eighteen	76.3	50.0	6.4	-11.4
Twenty-four	89.7	66.7	11.4	-15.2
Thirty	97.6	83.3	17.8	-19.0
Thirty-six	100.0	100.0	25.7	-22.8
Forty-two	100.0	100.0	31.9	-10.0
Forty-eight	100.0	100.0	33.7	2.9

\*Prior to month 0, \$100 of new loans is issued in each month, at a maturity of 36 months and an interest rate of 0.5 percent per month. Beginning in month 0, \$200 of new loans is issued per month. No loans are prepaid.

†Prior to month 0, \$100 of new loans is issued in each month, at a maturity of 36 months and an interest rate of 0.5 percent per month. Beginning in month 0, new loans are issued at a maturity of 48 months. No loans are prepaid.

debt ratio (and eventually in the home mortgage debt ratio) would slow considerably, assuming maturities remain constant

#### *Effects of changes in maturities*

Between 1975 and 1985, the maturities on certain types of consumer loans increased substantially. For example, the average maturity on new car loans issued by finance companies increased from 38 months in 1975 to 52 months in 1985 (Table 3). This lengthening of maturities may account for much of the difference between the growth patterns of consumer installment debt and debt service payments, since in the long run a change in maturity has a much larger effect on debt than on debt service payments. An increase in maturity at first decreases aggregate scheduled repayments of principal, thereby increasing aggregate debt outstanding. While aggregate debt service payments decrease in the short run, they may be slightly higher in the long run.

To illustrate this point, consider a situation where issuances of new debt are constant over time, the interest rate is also constant at 0.5 percent per month, no prepayments occur, and the maturity at which debt is issued equals 36 months prior to month  $m_0$  and 48 months in month  $m_0$  and thereafter (Table 2). Aggregate debt service payments at first decrease, because the debt service payment on each loan issued at a maturity of 48 months is less than the payment on each loan issued at a maturity of 36 months. However, debt issued at the longer maturity remains outstanding for a longer period of time. Thirty-six months after the increase in maturity, aggregate debt service payments begin to increase, since debt issued 36 months ago is not yet paid off. Forty-eight months after the increase in maturity, aggregate debt service payments have reached their new long-run level, and are slightly higher than aggregate debt service payments in month  $m_0$ , reflecting the fact that interest is owed on a larger amount of debt. In the more general case where prepayments occur, a change in maturity may have a different effect on debt and debt service payments than in the "no prepayments" example, depending on how prepayments change. However, as in the example presented above, the effect on debt will be very different from the effect on debt service payments.

To determine how much of the divergence between the consumer debt and debt service payment series has been due to increases in the maturities of consumer loans, the debt and debt service payments ratios were reestimated, assuming that maturities did not change after 1974.<sup>9</sup> That is, household debt and debt service

<sup>9</sup>Data on maturities of mobile home and "other consumer installment" loans are limited, and a number of assumptions were made in constructing the average maturity series (box).

Table 3

#### **Average Maturities on Auto Loans Issued by Finance Companies**

In months

Year	New car loans	Used car loans
1975	38	29
1976	39	30
1977	41	31
1978	43	33
1979	44	34
1980	45	35
1981	45	36
1982	46	37
1983	46	38
1984	48	40
1985	52	41
1986*	51	43

\*January through May

Source: Federal Reserve Board; *Statistical Release G 19*

payments were estimated under the assumptions that the amounts borrowed, and interest and prepayment rates, were equal to their actual levels, but that after 1974, maturities were equal to their 1975-1 levels. If maturities had not increased, the consumer installment debt ratio would have risen only 8 percent between 1975-1 and 1986-1 rather than 24 percent (Chart 5). Furthermore, the debt service payments ratio would have increased 3 percent, instead of falling 4 percent.<sup>10</sup> Thus, increases in maturities on consumer loans account for much of the difference between changes in the consumer installment debt ratio and changes in the debt service payments ratio over the past decade.

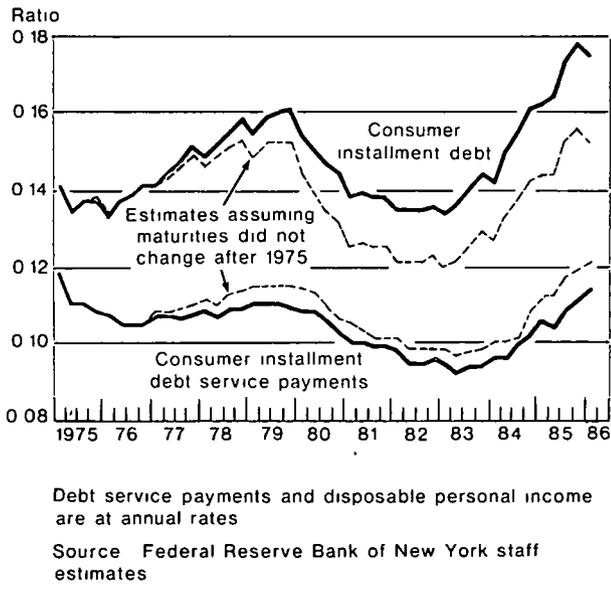
The growth in maturities also explains, to some extent, why the consumer installment debt ratio was higher in 1985 and 1986-1 than during the 1975-79 expansion, while extensions of most types of consumer loans relative to income are estimated to be lower. If maturities had not increased after 1974, the consumer installment debt ratio would have increased only 2 percent between 1979 and 1985 rather than 11 percent, while the ratio excluding revolving credit would have decreased 7 percent rather than increased 5 percent.

Changes in maturity account for virtually none of the growth in home mortgage debt or debt service payments between 1975-1 and 1986-1, partly because maturities on home mortgages did not exhibit a pronounced trend.

<sup>10</sup>By assuming that prepayment rates remain the same under the shorter maturities, the amounts prepaid decrease, since less debt is outstanding at a given time. As a result, aggregate debt service payments are slightly higher (rather than slightly lower, as in the example given above) under the shorter maturity.

Chart 5

**Estimated Ratios of Consumer Installment Debt and Debt Service Payments to Disposable Personal Income**



during this period. Furthermore, since home mortgages are issued at long maturities, any change in the maturity on new loans will affect debt outstanding very slowly.

Table 2 illustrates that the response of debt and debt service payments to an increase in maturity is gradual. As a result, recent increases in maturities will continue to affect the growth of consumer installment debt and debt service payments over the next few years. For example, if borrowing relative to income continues at the level of the past year through 1987-IV, and maturities remain the same, the consumer installment debt ratio will increase 4 percent between 1986-I and 1987-IV. However, if maturities had not increased after 1974, the debt ratio would increase less than 1 percent.<sup>11</sup>

**Effects of changes in inflation and nominal interest rates**

Large fluctuations in inflation and nominal interest rates over the past decade also affected debt and debt service payments differently (Table 4). An increase in inflation—holding real interest rates, maturities, and amounts borrowed (in real terms) constant, and

<sup>11</sup>For this example, interest rates on consumer loans were assumed to fall roughly 100 basis points between 1986-I and 1987-IV. Prepayment rates were assumed to remain at their average levels over the last four quarters, while income was assumed to grow roughly 6 percent per year.

assuming no prepayments—decreases the real values of both debt and debt service payments in the long run. However, if nominal interest rates rise with inflation, real debt service payments decline much less than real debt.<sup>12</sup>

To illustrate this point, suppose that prior to month  $m_0$  the inflation rate is zero, and beginning in month  $m_0$  it increases to 0.5 percent per month (Table 5). The real interest rate is set at 0.5 percent per month and the maturity at 20 years. The amount borrowed is constant in real terms and no prepayments occur. In the long run, debt will decrease 25 percent, in real terms, while the real value of aggregate debt service payments will decrease only 10 percent. If the interest rate is adjustable rather than fixed, real debt service payments will rise considerably in the short run, before declining. In either case, the change in the rate of inflation affects real debt and debt service payments quite differently.

To demonstrate how the level of inflation has affected the debt and debt service payments ratios over the past decade, the ratios were reestimated assuming that in every year after 1974, the inflation rate was 2 percent lower than its actual value. Prepayment rates, and the real values of interest rates, the amounts borrowed, and income were left unchanged.<sup>13</sup> Under this “lower inflation” scenario, the growth of the home mortgage debt ratio between 1975-I and 1986-I increases from 21 to 32 percent, but the growth of the debt service payments ratio decreases from 36 to 32 percent.<sup>14</sup> Thus, the high level of inflation experienced during the past decade slowed the growth of the debt ratio, while raising the debt service payments ratio.

A change in the long-term inflation rate affects the consumer installment ratios much less than the home mortgage ratios, because consumer loans have shorter maturities. If inflation and nominal interest rates had been 2 percent lower after 1974, the consumer installment debt ratio (excluding revolving credit) would have

<sup>12</sup>Holding the real interest rate constant, an increase in inflation will reduce the long-run level of real debt service payments by increasing the rate at which real payments on the debt are made. That is, with no inflation, the required debt service payment on a given loan is constant in real terms over the life of the loan. With inflation, the real value of an individual’s monthly debt service payment decreases over time, since the nominal value is constant. Thus, the real value of the loan is paid off more quickly in the latter case, and therefore, the long-run level of aggregate debt service payments is lower in real terms.

<sup>13</sup>Nominal interest rates on loans issued after 1974 were reduced by 2 percent. *Ex post* real interest rates on loans issued before 1975 are increased by this simulation.

<sup>14</sup>By assuming that prepayment rates remain the same under the “lower inflation” scenario, the amounts prepaid (in real terms) increase, since more debt is outstanding in real terms. Therefore, the decrease in inflation lowers the debt service payments ratio slightly, rather than increasing it slightly as in the example presented above.

Table 4

### Interest Rates on Home Mortgages and Consumer Loans, and the Rate of Growth of the Consumer Price Index (CPI), 1975-86

In percent

Year	Interest rates*				Rate of growth of the CPI//
	Home mortgages†	Auto loans at commercial banks‡	Personal loans at commercial banks§	Bank credit cards	
1975	8.8	11.4	13.1	17.2	7.0
1976	8.8	11.1	13.0	17.1	4.9
1977	8.8	10.9	13.0	16.9	6.8
1978	9.3	11.0	13.2	17.0	9.0
1979	10.5	12.0	13.9	17.0	13.2
1980	12.3	14.3	15.5	17.3	12.4
1981	14.2	16.5	18.1	17.8	8.9
1982	14.5	16.8	18.6	18.5	3.9
1983	12.2	13.9	16.7	18.8	3.8
1984	11.9	13.7	16.5	18.8	4.0
1985	11.1	12.9	15.9	18.7	3.7
1986¶	10.4	11.9	15.2	18.4	-0.2

\*Rates are annual averages of monthly data. Except for home mortgages, data are for midmonth of quarter only.

†Contract rate on fixed-rate mortgages for new homes.

‡Before 1983 the maturity for new car loans is 36 months. Beginning in 1983 it is 48 months.

§Loans with maturities of 24 months.

//From December to December. Rate for 1986 is from December to June, annualized.

¶Through the second quarter.

Table 5

### The Effects of Changes in Interest and Inflation Rates on Aggregate Debt and Debt Service Payments

In percent

Between month 0 and month	Increase in the interest rate*		Increase in the inflation rate†			
	Percent change in debt outstanding	Percent change in debt service payments	Percent change in debt outstanding		Percent change in debt service payments	
			Fixed rate loans	Adjustable rate loans	Fixed rate loans	Adjustable rate loans
Six	0.0	1.4	-2.9	-1.9	-1.6	26.1
Twelve	0.1	2.7	-5.5	-3.8	-3.0	23.7
Twenty-four	0.2	5.4	-10.1	-7.2	-5.6	19.4
Thirty-six	0.5	8.1	-14.0	-10.2	-7.9	15.4
Forty-eight	0.9	10.8	-17.1	-12.8	-9.7	11.8
Sixty	1.5	13.4	-19.7	-15.0	-11.2	8.6
One-hundred twenty	5.6	26.9	-25.8	-22.2	-14.7	-3.1
One-hundred eighty	11.0	40.3	-25.8	-24.6	-13.8	-8.8
Two-hundred forty	14.2	53.8	-25.0	-25.0	-10.4	-10.4

\*Prior to month 0, \$100 of new loans is issued in each month, at a maturity of 240 months (20 years) and an interest rate of 0.5 percent per month. Beginning in month 0, the interest rate on new loans doubles to 1 percent per month. No loans are prepaid.

†Prior to month 0, \$100 of new loans is issued in each month, at a maturity of 240 months and an interest rate of 0.5 percent per month. Beginning in month 0, the rate of inflation increases from 0 to 0.5 percent per month. The real value of new loans issued and the real interest rate on new loans remain the same. Debt outstanding and debt service payments are measured in real terms. No loans are prepaid.

Table 6.

**Interest Rates on Consumer Loans Minus  
Increases in the Consumer Price Index (CPI),  
1975-86**

In percent

Year	Interest rate minus average annual increase in CPI*		
	Auto loans†	Personal loans‡	Bank credit cards§
1975	5.3	7.1	10.9
1976	3.8	6.8	11.2
1977	1.0	4.8	10.5
1978	-1.0	0.9	7.0
1979	0.6	0.8	2.9
1980	5.8	5.2	5.8
1981	10.6	11.6	9.9
1982	13.2	14.7	14.7
1983	11.1	13.5	14.3
1984	10.3	12.8	15.2
1985	10.2	13.5	15.7
1986	8.9	12.4	16.2

\*Interest rates are as of February. CPI increase is from February to February.

†New auto loans at commercial banks. Prior to 1983, maturity on loan equals 36 months. Beginning in 1983, it equals 48 months. Increase in CPI is averaged over first three years of the loan.

‡Twenty-four month personal loans at commercial banks. Increase in CPI is averaged over the two-year loan period.

§Interest rate on credit cards at commercial banks minus increase in CPI over the first year of the loan.

increased an additional 1 percent between 1975-I and 1986-I. The corresponding debt service payments ratio would have been virtually unaffected by the change in inflation.

Fluctuations in the rate of inflation also explain why the home mortgage debt ratio is currently at an all-time high even though mortgage originations relative to income are not. Although home mortgage originations have been lower relative to income during the current expansion than during the 1975-79 expansion, the rate of inflation has been much lower as well. If, for example, inflation had been constant at 6 percent after 1975, with actual borrowing patterns left unchanged in real terms, the home mortgage debt ratio would have been 3 percent lower in 1985-IV than at its previous cyclical peak, rather than 6 percent higher.<sup>15</sup> Therefore, the high levels of borrowing during the late 1970s may have been, in part, a response to high levels of inflation, but the high inflation rates offset the impact of the borrowing on the debt ratio.

<sup>15</sup>In this simulation, the spreads between interest rates and inflation were held constant at their 1976 levels, while prepayment rates were kept at their actual values.

*Effects of changes in real interest rates*

Some of the differences between the debt service payments and debt outstanding series may be attributed to the effects of changes in real interest rates, *i.e.*, movements in nominal interest rates independent of movements in inflation or expectations of inflation. An increase in the interest rate at which debt is issued, holding the maturity, amounts borrowed, and inflation rate constant, will increase debt service payments as well as debt outstanding. Debt outstanding will increase because, at the higher interest rate, principal is paid back more slowly. That is, the higher the interest rate, the lower the first required principal payment on a given loan, and the higher the final principal payment. However, the effect of a change in interest rates on debt service payments is much larger than the effect on debt outstanding. For example, an increase in the interest rate from 0.5 to 1 percent per month—holding the maturity constant at 20 years, the amounts borrowed each period constant, and assuming no prepayments—will increase the debt service payments ratio 54 percent, and the debt outstanding ratio 14 percent, in the long run (Table 5).

Determining how real interest rates on new loans have changed over the 1975-86 period is problematic, even on an *ex post* basis, since the real interest rate on a given loan depends on when the loan is repaid. However, very rough proxies for *ex post* real interest rates on certain types of consumer loans were calculated by subtracting the average increase in the Consumer Price Index (CPI) over the approximate term of the loan from the interest rate on the loan.<sup>16</sup> The results of these calculations suggest that real interest rates on consumer loans have been rising in recent years (Table 6). These relatively high rates have contributed to the recent rise in the debt service payments ratio.

Interest rates have a much larger impact on the home mortgage debt service payments ratio than on the consumer installment debt service payments ratio. Because home mortgages have longer maturities, principal repayments make up a small part of mortgage debt service, and interest payments make up a large part. Lowering interest rates on all loans issued after 1974 by 200 basis points would reduce the home mortgage debt service payments ratio by 13 percent in 1986-I, while decreasing the consumer installment ratio by only 3 percent.

*Effect of the tax system on debt service payments*

Interest payments accounted for an estimated 45 percent of aggregate debt service payments in 1986-I, compared with 31 percent in 1975-I. This growth reflects

<sup>16</sup>The inflation rate was assumed to equal 3.2 percent (annualized) during the second half of 1986 and 4 percent during 1987.

increases in nominal interest rates as well as maturities. Because interest payments are tax deductible, the increase in debt service payments overstates the increase in households' debt burden. For example, if all households with debt itemized their deductions and faced a marginal income tax rate of 25 percent, the debt service payments ratio on a post-tax basis would have increased 3 percent between 1975-1 and 1986-1 rather than 8 percent.

The effects of changes in maturity, inflation, and interest rates are different on a post-tax basis. A lengthening of maturity increases the proportion of aggregate debt service payments that represent interest, as does an increase in inflation and nominal interest rates. Therefore, in the examples given previously, assuming no prepayments, an increase in maturity would result in a larger percentage decrease in post-tax debt service payments than in pre-tax payments in the short run, and, in the long run, would lead to a smaller percentage increase. Similarly, the percentage decrease in real debt service payments that results from an increase in inflation and nominal interest rates would be even larger on a post-tax than on a pre-tax basis, while the short-run increase in real payments on adjustable rate debt would be less.

#### **Conclusion**

Because changes in maturities, inflation, and interest rates affected debt and debt service payments differently, the household debt service payments ratio grew much less quickly than the debt ratio over the past

decade. Increases in maturities on consumer loans kept debt service payments relatively low, and at the same time increased debt outstanding. Inflation increased the divergence between the home mortgage debt and debt service payments ratios, causing debt service payments to grow faster than debt.

The debt and debt service payments ratios may change quite differently in the future as well. For example, an increase in nominal interest rates and inflation would reduce real debt but increase real debt service payments on adjustable-rate debt in the short run, assuming real borrowing remains constant. If, on the other hand, inflation remains at a low rate, and interest rates keep declining, the debt ratio will probably continue to grow much more quickly than the debt service payments ratio.

The recent rise in the debt ratio to an all-time high is not simply due to unusually high levels of new loan extensions relative to income. Rather, longer maturities and lower inflation have contributed substantially to the increase. During the 1970s, consumers may have demanded longer maturities partly to offset the impact of higher inflation and nominal interest rates, since these factors increase the rate at which debt is amortized, in real terms. In recent years, consumers may have used long maturities partly to offset the impact of high real interest rates on monthly debt service payments. In the future, if consumers choose shorter maturities in response to lower inflation and interest rates, the debt ratio may decrease as well, with the debt service payments ratio increasing slightly.

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