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Large swings in stock prices are sometimes associated with a redirection of household savings flows. Such changes can lead to transitory increases in M2 as investors temporarily "park" funds in depository assets while they determine the funds' ultimate destination. The authors find that, although stock price changes are statistically significant as an explanation for M2 growth, they do not account for much of M2's recent strength.

Population Aging and Fiscal Policy in Europe and the United States **10**
by Jagadeesh Gokhale and Bernd Raffelhüschen

The authors report each country's total intertemporal public liability as the sum of its explicit outstanding debt and the present value of its implicit liabilities—the excess of projected transfers and government purchases over tax revenues. They find rapid, persistent population aging in almost every European country. They also calculate that for European countries with the highest implicit liabilities, eliminating total intertemporal liabilities would require tax revenue increases exceeding 4 percent of GDP. Compared to Europe, the future challenges of population aging and fiscal problems in the United States seem far more benign.

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Effects of Movements in Equities Prices on M2 Demand

by John B. Carlson and Jeffrey C. Schwarz

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Introduction

In 1998, M2 and M3 increased 8½ percent and 11 percent, respectively. Over the past two years, these aggregates have grown at an average rate of around 7½ percent and 9 percent. But this rapid money growth has gone largely unnoticed in the financial press. It is widely understood that since 1993, the monetary aggregates have played a diminished role in the deliberation of monetary policy. At the same time, productivity increases have been surprisingly strong, especially over the past two years. This productivity "surprise" is often cited as the reason why rapid money growth has not translated into a rise in inflation.

What is less widely known is that since 1993, evidence has been building that M2 velocity is behaving more consistently with its historical experience. Though the evidence on the stability of M2 velocity is still too limited to provide a reliable basis for monetary targeting, there is good reason for concern about the risk of ignoring unusually strong money growth, especially if it persists. To determine this risk, it is constructive to assess the empirical relevance of factors identified as explanations for the unusual strength in money.

The February 1999 Humphrey–Hawkins report identifies several potential factors. First, heightened volatility in foreign financial markets has increased demand for safe and liquid assets—characteristics of several M2 components. Low long-term interest rates may also be a factor. Given the relatively flat yield curve, households give up little earnings when they hold savings in the form of short-term assets versus fixed-income securities. In addition, recent swings in stock prices may have led households to redirect savings flows. Such actions can lead to transitory increases in M2 as investors temporarily park funds in liquid assets while they determine those funds' ultimate destination. Preliminary research finds some evidence that money market mutual funds may be the liquid asset most often chosen as a "gateway" instrument.

In this article we assess the potential for such an explanation for the recent strength in M2. To do this, we extend a standard error-correction approach for M2 demand to include changes in stock prices as a transitory factor. Section I reviews previous research on the gateway factor. The framework for our analysis and the results are presented in sections II and III. We find that although stock price changes

are statistically significant as an explanatory variable, they do not account for much of the recent strength in M2. Section IV offers a summary and conclusions.

I. Money Funds as a Gateway

Dow and Elmendorf (1998) estimate the effects of changes in stock prices on the demand for money market mutual funds, a component of the M2 measure of money. Their motivation follows from the observation that households have recently increased their wealth holdings in various investment vehicles such as stock and bond mutual funds and equities. Because money funds are often a temporary "parking lot" for funds used in financial transactions, they propose that the M2 component is affected most by the rapid rise in household holdings of bond and equity funds.

More precisely, Dow and Elmendorf identify two reasons that households own money funds. First, money funds offer a unique combination of low risk, market rate of return, and liquidity, and are thus likely to be included in any balanced portfolio. As with any asset, money-fund demand depends on expected rates of return on alternative assets, including stock and bond funds. When stock prices are expected to decline, for example, one would expect portfolio holders to shift wealth away from equities to other assets, including money funds. On the other hand, when stock prices are expected to rise, one would expect households to shift holdings from other assets to equities, the effects being symmetrical.[1]

Second, households use money funds as a gateway for performing other transactions. The gateway idea stems from the ease of using money funds as a safe, relatively liquid parking lot for wealth as it is rebalanced among other financial assets.[2] Since transaction volume tends to be high when stock prices vary substantially, Dow and Elmendorf hypothesize that both positive and negative changes in stock prices have a positive effect on holdings of money funds. However, in the latter case, if price movements (for example, short-term yield changes) are an effect of transitory demand, such an effect should be symmetrical. Hence, if the effect of volatility on money-fund demand dominates, the asymmetry should be evident. Moreover, Dow and Elmendorf suggest that the gateway effect should grow, since households would hold an increasing proportion of their wealth in bond and equity funds.

To investigate this hypothesis, Dow and Elmendorf propose a simple regression model of money-fund demand. Their basic specification regresses the percent change in money funds on the percent change in stock values, the rates of return on 3-month T-bill, 30-year Treasury, and money market deposit accounts, the percent changes in nominal disposable income, and both linear and quadratic trend variables. Stock price changes are separated into two variables, one including positive changes only (zero elsewhere), the other including negative changes only (zero elsewhere). Current values and four lagged values appear for stock price changes, while current and two lagged values appear for alternative yields. The Wilshire 5000 index is used as the measure of stock market value. All data are at monthly frequency.[3] The authors also consider specifications of both retail and institution-only measures of money funds.

Dow and Elmendorf find that a 1 percent increase in the Wilshire 5000 was followed by a ⅔ percent increase in retail money funds over a five-month span. A 1 percent decrease in the Wilshire 5000 was shown to be associated with a ⅓ percent to ⅔ percent increase in retail money funds over a five-month period (figure 1).[4] Note the asymmetry in the response of money funds to positive and negative changes in stock prices. In addition, the response occurs contemporaneously and over a period of four months; there is no evidence that this effect is offset in the months following.

■ **1** Dow and Elmendorf note that past returns are not necessarily a good measure of future performance. Indeed, if past changes are seen as independent of future changes, then one-time declines in equity prices would reduce the equity share of the portfolio, thereby inducing a rebalancing toward equities and away from other assets.

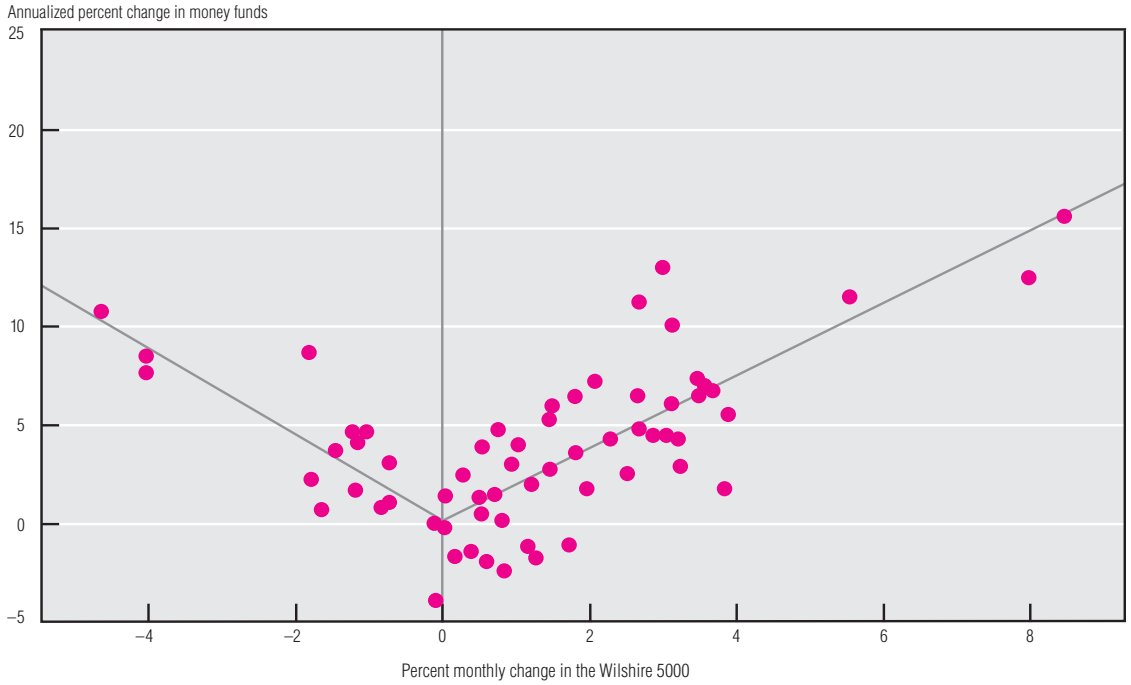
■ **2** Money market mutual funds are composed of short-term liquid securities (maturities generally less than 90 days) largely composed of Treasury bills and corporate paper.

■ **3** For the period from January 1992 to December 1998, Dow and Elmendorf focus on retail money funds, but also estimate the model using institutional money funds, money market deposit accounts (excluding the rate of return on money market deposit accounts as an independent variable in this case), and M2 less retail money funds. The model was also estimated for retail money funds using data for 1984–89.

■ **4** The range of response for retail money funds was dependent on the specification of the change in the stock index, particularly whether a month-average or month-end value was used. The larger magnitude shift in retail money funds was associated with the month-average specification.

FIGURE 1

Equity Price Changes and Money-Fund Growth[a]



a. Money-fund growth rate in the corresponding and subsequent months after subtracting the estimated effects of other factors.
NOTE: Data are month averages January 1992 to August 1997.
SOURCE: Dow and Elmendorf (1998).

FIGURE 2

M2 and M2 Less Retail Money Funds

SOURCE: Board of Governors of the Federal Reserve System.

Dow and Elmendorf find that their estimates are robust for an alternative measure of stock prices, the S&P 500 index, but not for alternative components of money measures.[5] The estimated coefficients for the demand for institution-only money funds were of similar magnitude, but were not statistically significant. Dow and Elmendorf also examined similar specifications for money market deposit accounts and M2 less money funds, yielding no statistically significant coefficients for stock price movement. Findings for the 1984–89 period for retail money funds were similarly fruitless, indicating no significant relationship between stock price changes and money funds in this period.

Dow and Elmendorf conclude that for the mid-1990s, there has been a significant asymmetric relationship between changes in stock prices and the holding of retail money market

■ **5** This conclusion should not be surprising, considering the high correlation between the two stock indexes. The correlation of the levels of the Wilshire 5000 and the S&P 500 from December 1979 to December 1998 is 0.999, and the correlation of their annualized month-to-month percent changes is 0.989.

mutual funds. They also conclude that this relationship did not exist during the latter part of the 1980s or for other measures of money, including M2 less money funds.

Although the data support Dow and Elmendorf's conclusions, it is not evident that their results extend to the M2 aggregate. M2 comprises several components that may be close substitutes for money funds. Thus, it is quite conceivable that an increase in money funds is, for example, offset by a decrease in money market deposit accounts.

Figure 2 suggests that Dow and Elmendorf's results also apply to M2. It illustrates that the non-money-fund component of M2 increased at an average rate of around 5 percent per year, as opposed to 6.5 percent for M2. The growth in the non-money-fund component is much more in line with historical experience. Thus, if money-fund strength derives from stock market price fluctuations, as hypothesized by Dow and Elmendorf, one would expect M2 growth to be strong given the recent large changes in stock prices. Further, if the recent swing in stock market prices is to explain the surge in M2 last year, then the change in stock market prices should enter significantly into specifications of M2 demand. Interestingly, Dow and Elmendorf do not examine this specification.

II. The Error-Correction Framework

To investigate the effect of stock prices on M2, we propose an error-correction specification based on a framework first proposed by Moore et al. (1990). This approach clearly distinguishes the long-run and short-run effects of the determinants of money demand. As in Moore et al., long-run money demand (often referred to as equilibrium money demand) is specified as

$$(1) \quad m_t = \alpha + y_t + \beta s_t + e_t,$$

where m_t = log (*M2*), y_t = log (*nominal GDP*), and s = log (*opportunity cost*).[6] The term e_t represents the deviation of money from its long-run equilibrium value (derived from money balance to equilibrium levels). The unitary coefficient on nominal GDP implies that velocity varies directly with opportunity cost.[7]

The second aspect of the error-correction framework is a dynamic specification that describes the convergence process of M2 to its equilibrium. More precisely, this process specifies money growth as a function of the deviation of money from its long-run growth rate:

$$(2) \quad \Delta m_t = a + be_{t-1} + \sum_{i=1}^{u} c_i \Delta m_{t-i} + \sum_{i=0}^{v} d_i \Delta s_{t-i} + \sum_{i=0}^{w} f_i \Delta y_{t-i} + \sum_{i=1}^{q} \sum_{j=0}^{n} g_{ij} \Delta x_{i,t-j} + \varepsilon_t .$$

Changes in lagged values of log (*M2*) and current and lagged values of log (*opportunity cost*) and the scale variable (in our case, nominal GDP) also determine the adjustment to equilibrium—that is, the short-run path.

The general form allows for other variables, x_{ij}, to be included as transitory contributors (in log values) to the adjustment process, even though they may not affect the equilibrium value of money balances. These additional variables can be anything that may affect the rate of adjustment to equilibrium, such as personal consumption expenditures or movements in financial markets. The hypothesis proposed by Dow and Elmendorf suggests that stock price changes affect money balances in a transitory manner and, hence, are appropriately specified as log changes in equation (2), not as determinants of equilibrium demand. When the coefficient on the error-correction term is negative, convergence to equilibrium is assured.

When the long-run equilibrium equation, equation (1), is substituted into the short-run convergence equation, equation (2), the result is

$$(3) \quad \Delta m_t = a - b\alpha - b\beta s_{t-1} + b(m_{t-i} - y_{t-1}) + \sum_{i=1}^{u} c_i \Delta m_{t-i} + \sum_{i=0}^{v} d_i \Delta s_{t-i} + \sum_{i=1}^{w} f_i \Delta y_{t-i} + \sum_{i=1}^{q} \sum_{j=0}^{n} g_{ij} \Delta x_{i,t-j} + \varepsilon_t .$$

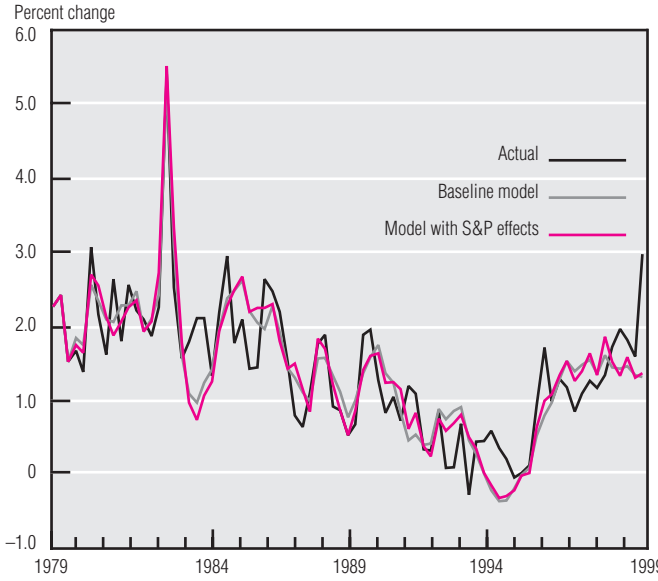
We estimate a version of equation (3).

■ **6** Some economists argue that the appropriate scale variable in the long-run money demand function is wealth. For example, Sekine (1998) finds significant wealth effects in the demand for broad money in Japan. We examine the potential for wealth effects using alternative stock price measures as scale variables and find no significant effect.

■ **7** Tests for the restriction that income elasticity equals one reveal that the restriction is supported by the data. For further results, see Carlson et al. (1999).

FIGURE 3

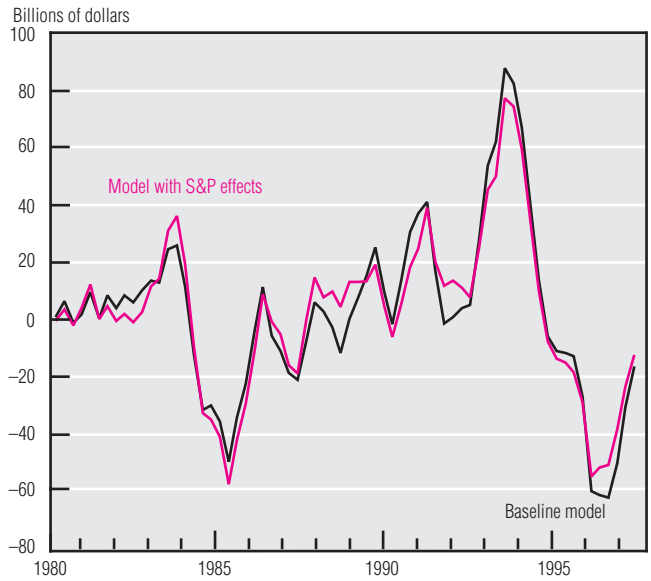
Effect of Stock Prices on M2 Demand, Actual versus Predicted



SOURCES: Board of Governors of the Federal Reserve System; and Federal Reserve Bank of Cleveland.

FIGURE 4

Estimation Errors (Predicted minus Actual)



SOURCE: Federal Reserve Bank of Cleveland.

III. Results

We estimate two specifications, one based on a streamlined version of Moore et al., the other including transitory variables to estimate the asymmetrical effect of changes in stock market values on M2 demand. The basic regression is

$$
\begin{aligned}
(4)\quad \Delta m_t = & -\underset{(-7.08)}{0.077} - \underset{(-7.32)}{0.009}\, s_{t-1} - \underset{(-7.82)}{0.184}\,(m_{t-1} - y_{t-1}) \\
& + \underset{(9.49)}{0.511}\,\Delta m_{t-1} - \underset{(-4.21)}{0.006}\,\Delta s_t \\
& + \underset{(4.16)}{0.252}\,\Delta c_t + \underset{(7.33)}{0.032}\, d831_t - \underset{(-7.77)}{0.028}\, dum_t \\
& - \underset{(-7.06)}{0.0001}\, t2_t + \varepsilon_t .
\end{aligned}
$$

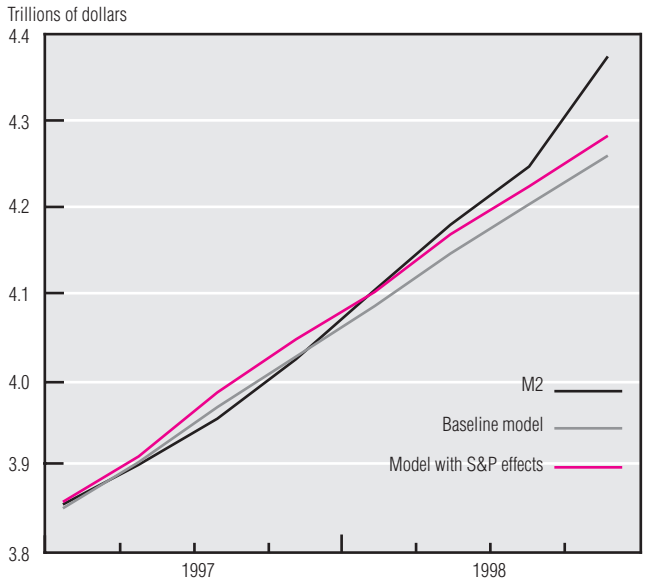
Adjusted R^2 = 0.78; estimation period = 1964:IQ to 1996:IVQ; t-statistics in parentheses (123 degrees of freedom) where s = log (*opportunity cost*), m = log (*M2*), y = log (*nominal GDP*), c = log (*personal consumption expenditures*), $d831$ is a qualitative variable that is equal to one in 1983:IQ and zero elsewhere,[8] *dum* is a dummy variable that introduces a linear shift from 1990:IQ to 1994:IQ,[9] and $t2$ is a modified

■ **8** Following Moore et al., we include this variable to account for a one-time shift in demand due to the deregulation of banking that took effect in 1983:IQ.

■ **9** This trend-shift variable is discussed in Carlson et al. (1999) to account for the unexplained shift in M2 velocity in the early 1990s. It was initially based on the observation of a persistent cumulative error in the standard model forecast in the early 1990s. By the end of 1993, the error had stabilized, suggesting that M2 velocity had stabilized around a higher level. This shift accords with findings of Whitesell (1997) and Orphanides and Porter (1998). Using annual data, Whitesell employs a procedure that allows him to identify both the timing and the magnitude of the velocity shift. Whitesell estimates that a sharp upward shift in long-run M2 velocity essentially begins in 1990 and is largely completed by 1994. Orphanides and Porter use a regression-tree approach to estimate structural changes in the M2 velocity opportunity-cost relationship. They conclude that the equilibrium of M2 velocity experienced an upward shift over a short period in the 1990s. Our shift variable is also similar to the interaction term that Mehra (1997) includes in his regression, *D*. His variable equals the spread between the 10-year Treasury and the own rate on M2 from 1989:IQ to 1996:IVQ and equals zero otherwise. Thus, his variable mimics a broken linear trend in 1980:IQ. The data are too limited in duration to discriminate between these approaches.

FIGURE 5

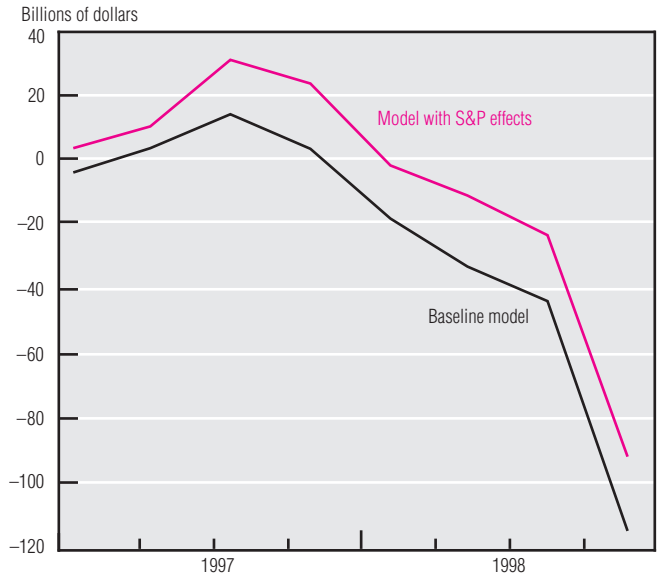
M2 Forecasts



a. Projections are based on actual post-sample values of GDP, personal consumption expenditures, and opportunity cost.
SOURCES: Board of Governors of the Federal Reserve System; and Federal Reserve Bank of Cleveland.

FIGURE 6

Out-of-Sample Estimation Errors



SOURCE: Federal Reserve Bank of Cleveland.

time trend which levels off at 1990:IQ.[10] All parameter estimates are significant at the 1 percent level or better. This regression will be referred to as the baseline.

The second regression, which will be referred to as including "S&P effects," is given by

$$
\begin{aligned}
(5)\quad \Delta m_t = & -\underset{(-7.05)}{0.074} - \underset{(-7.31)}{0.009 s_{t-1}} - \underset{(-7.63)}{0.176}\,(m_{t-1} - y_{t-1}) \\
& + \underset{(9.97)}{0.521}\,\Delta m_{t-1} - \underset{(-3.90)}{0.005}\,\Delta s_t \\
& + \underset{(4.35)}{0.255}\,\Delta c_t + \underset{(7.21)}{0.031}\,d831_t - \underset{(-7.31)}{0.026}\,dum_t \\
& - \underset{(-7.05)}{0.0001}\,t2_t + \underset{(3.02)}{0.027}\,stk_pos_t \\
& - \underset{(-3.02)}{0.027}\,stk_neg_t + \varepsilon_t .
\end{aligned}
$$

Adjusted R^2 = 0.79; estimation period = 1964:IQ to 1996:IVQ; *t*-statistics in parentheses (121 degrees of freedom), where *stk_pos* and *stk_neg* are the positive and negative proportional changes in the S&P 500.[11] As in the baseline model, all parameter estimates are significant at the 1 percent level or better. A restriction that the coefficients on the change in stock-market variables must sum to zero was imposed. This restriction was introduced only after estimating the model with no restrictions, which showed that the two coefficients were of the expected signs and of similar magnitudes.[12] An F-test reveals that the restriction is supported by the data.[13] The restriction results in a slight increase in adjusted R^2 (from 0.78 to 0.79) and an improved forecast.

10 Moore et al. include a time trend to account for a modest upward drift in M2 velocity. When M2 was redefined in 1997, the drift was amplified (see Collins and Whitesell [1997]). We find, however, no evidence of an upward drift in the period since 1993.

11 The value of the S&P 500 at time *t* is defined as the average of the first month of the current quarter, *t*, and the last month of the previous quarter, *t*–1.

12 The coefficients for *stk_pos* and *stk_neg* without restriction were –0.024 and 0.037, respectively; the former was significant at the 5 percent level and the latter at the 1 percent level. All other variables in the unrestricted model were significant at the 1 percent level.

13 An F-test against the null hypothesis that the restriction is accurate—that is, the sum of the two coefficients is indeed zero—had a p-value of 0.464, indicating that the restriction is statistically valid.

Although the effect of stock prices on M2 demand is statistically significant, the improvement over the baseline model is only marginal. The addition of S&P movement terms increases the proportion of in-sample variation explained by slightly greater than 1 percent. This minor improvement is only slightly apparent in figure 3, which shows the in-sample predictions of the two models when estimation began in 1980:IQ.

Figure 4 illustrates the in-sample projection errors for the two regressions. The sum of the absolute value of errors for the model with S&P effects was about 97 percent of the sum for the baseline model (with the projections starting the estimation at 1980:IQ). Interestingly, the baseline model explains much of the M2 money growth for 1993–98; only after 1997 does the model go off track.

Figure 5 shows the out-of-sample forecasts of both regressions. Both models predict a similar path for M2, which is expected to exceed $4.6 billion by the end of 2000. The errors for the out-of-sample forecasts are shown in figure 6. The baseline model underperforms the model with S&P effects in 1998, while both models underpredict the level of M2. The out-of-sample sum of the absolute value of estimation errors for the S&P effects model was only 83 percent of the baseline model.

We also test whether the effect of stock prices is greater in the 1990s. Recall that Dow and Elmendorf found no significant asymmetrical effect of stock market movements on the demand for retail money funds in the latter part of the 1980s. We tested specifically whether there was a significant increase in the effect of stock market fluctuations on the demand for M2 in the 1992–97 period, the period for which Dow and Elmendorf found a significant effect for retail money funds. The regressions used to test this hypothesis were based on equations (4) and (5), with the addition of the interaction between both *stk_pos* and *stk_neg* and a dummy variable, *dum92*.[14] *Dum92* took the value of one from 1992:IQ through 1997:IVQ, the period of estimation used by Dow and Elmendorf, and zero elsewhere. The interaction terms were insignificant when added to both models.[15] Thus, unlike Dow and Elmendorf, we find that the gateway effect has not increased in recent years, but it is present in the data over the whole sample.

In the case of the baseline model, where the impact of movements in the stock market was considered only in the mid-1990s, there is no significant effect for M2. This is contrary to the findings of Dow and Elmendorf for retail money funds: the effect of the stock market fluctuations was significant only in the mid-1990s in their models. In the S&P effects model, the insignificance of the interaction terms leads us to conclude that there is no change in the effect of stock market fluctuations on the demand for M2 in the mid-1990s.

IV. Summary and Conclusions

Along at least one dimension, our results extend Dow and Elmendorf's hypothesis. We find that stock prices affect the demand for M2, not just its money-fund component. Thus, it appears that M2 serves as a gateway for redirecting funds in household portfolios. Although our statistical results are strong, the effect is not materially important for explaining recent fluctuations in M2, as it accounts for less than 13 percent of the out-of-sample errors in 1998.

Further, we find that the effect of stock prices on M2 is evident over the whole sample period, not just in the 1990s. In contrast, Dow and Elmendorf do not find statistically significant effects on money funds prior to 1990. This suggests that among M2 components, money funds are increasingly the instrument used as a gateway. Apparently, this purpose was served by alternative M2 components in earlier years.

We should note that our regressions are based on quarterly data, while Dow and Elmendorf examine a monthly specification. Their estimates, however, reveal that the effects of stock prices occur over a period of approximately four months, suggesting that the use of lower-frequency data sacrifices little empirically.

■ **14** Given the number of parameters we estimate, there were too few data points to break the sample in 1990.

■ **15** The models were estimated both from 1964:IQ to 1996:IVQ (our estimation period) and 1964:IQ to 1997:IVQ (to include all of Dow and Elmendorf's estimation period). The models were estimated both with and without a restriction that the coefficients on the interaction terms sum to zero. In each case, an F-test of the restrictions showed that the null hypothesis of coefficients which sum to zero could not be rejected, so only results for the restricted models are included. In all cases, the other coefficients estimated remained significant at the 1 percent level or better. The estimated coefficients follow (the format is as follows: positive coefficient [p-value] / negative coefficient [p-value]). Baseline model (restricted): through 1996:IVQ, 0.064 (0.060) / –0.064 (0.060); through 1997:IVQ, 0.023 (0.211) / –0.023 (0.211). Model with S&P effects (restricted): through 1996:IVQ, 0.041 (0.156) / –0.041 (0.156); through 1997:IVQ, –0.001 (0.482) / 0.001 (0.482).

Finally, if recent swings in stock prices do not account for much of the unexplained M2 growth, then what does? Volatility in foreign financial markets has subsided substantially, yet there is little evidence that M2 growth is being reversed. Further, recent strength in reported measures of output has led to an upward drift in long-term interest rates, which should unwind any yield-curve effect.

We emphasize that our baseline model has held up reasonably well since 1993. Except for the surge in the second half of 1998, M2 fluctuations have largely been explained by standard determinants of money demand. Notwithstanding the velocity shift in the early 1990s, M2 behavior has been much more in line with its historical experience, suggesting that underlying growth in nominal GDP is stronger than might be expected. Recent surprises in the strength of M2 have been matched with surprises in the strength of economic activity. Up to this point, however, rapid productivity growth has been a saving grace.

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Population Aging and Fiscal Policy in Europe and the United States

by Jagadeesh Gokhale and Bernd Raffelhüschen

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Introduction

Establishing sound and sustainable public finances is a top priority among policymakers in all Western countries. In Europe, the Maastricht Treaty's criteria for acceptance into the European Monetary Union (EMU) include substantial fiscal consolidation with respect to both public-sector budget deficits and the stock of outstanding public debt. Except under special circumstances, a prospective member country's budget deficit must be less than 3 percent of its GDP and its public debt less than 60 percent by 1997.[1]

To retain membership in the EMU, countries must conform to similarly tight constraints.[2] However, even for nonretirement spending—public-capital investments, welfare, and unemployment benefits—staying within the Maastricht fiscal limits is an uphill task for many member nations. Germany, for example, whose public debt is already at the limit, cannot borrow significant additional sums from capital markets to finance the ongoing process of unifying its Eastern and Western economies. Furthermore, pressures to exceed the limits will intensify as a ballooning number of retirees demand delivery of the generous retirement benefits promised under current pension laws. These issues motivate us to analyze the size of the true liabilities, explicit and implicit, faced by member nations and the total fiscal adjustment that may be necessary for establishing long-term fiscal sustainability.

U.S. policymakers face long-term fiscal problems that are similar to Europe's but less severe. High debt, accumulated in the 1980s and early 1990s, has increased service costs. Although prospective budget surpluses could help reduce the size of outstanding debt, political support for additional government consumption seems to be growing.

1 The former criterion was considered to be "hard"—that is, required of all countries—while the latter was considered "soft"—not essential if all other fiscal and monetary criteria were met.

2 Under the Stability and Growth Pact of the Maastricht Treaty, if a country is judged to have violated the deficit criterion in the absence of exceptional circumstances (such as a recession or a natural disaster), a four-month maximum is allowed for corrective action. Sanctions are imposed in several steps. Ultimately, in addition to certain nonpecuniary sanctions, the country may be required to make a non-interest-bearing deposit with the European Central Bank of up to 0.5 percent of its GDP each year that its deficit violates the limit. This deposit is forfeited if the country fails to conform to the deficit limit within two years. For more details, see http://europa.eu.int/euro/quest/normal/frame.htm?language_nb=5.

Despite improved budget projections, the long-term fiscal challenge in the United States remains sizable. Long-term projections based on intermediate economic and demographic assumptions indicate large revenue shortfalls for Social Security and Medicare. However, from the perspective of these programs' finances, the assumptions may prove too optimistic: The productivity growth underlying these projections seems higher than warranted by U.S. experience during recent decades, and the assumed future improvements in longevity occur more slowly than the nation's past experience suggests.[3]

In this paper, we make a transatlantic comparison of the total size of *intertemporal public liabilities* (IPLs)—the sum of the explicit and implicit liabilities embedded in the fiscal policies of several European countries and the United States. The driving force behind implicit demands on future public budgets is the demographic transition underway in Europe and the United States. Almost all developed countries have one phenomenon in common: a significant "double aging" of the population. Because of the baby boom (and the subsequent baby bust during the postwar period) and because of steadily improving longevity, these countries' populations will not only contain a greater proportion of elderly people in the future, but also a higher fraction of *older elderly* individuals. That is, aging of the population as a whole will be accompanied by aging of the elderly population itself.

Traditional fiscal indicators based on cash-flow accounting fail to address aging phenomena because the future liabilities of pay-as-you-go retirement and health care systems are absent from current fiscal flows. Hence, cash-flow deficits and the size of outstanding debt are unreliable indicators of fiscal sustainability; moreover, the debt and deficit criteria for fiscal "harmonization," such as those of the Maastricht Treaty, may prove insufficient and shortsighted.[4] This paper uses the machinery of generational accounting developed by Auerbach, Gokhale, and Kotlikoff (1991, 1992) to calculate and compare the composition of U.S. and European IPLs with regard to explicit and implicit liabilities.

Our analysis is restricted to the United States, Norway and 12 member states of the European Union—Austria, Belgium, Denmark, Finland, France, Germany, Italy, Ireland, the Netherlands, Spain, Sweden, and the United Kingdom.[5] Our findings suggest that the present fiscal policies of all these countries except Ireland have positive IPLs and hence are unsustainable over the long term. Only Ireland has a slight negative IPL, indicating a small stock of assets and, therefore, the potential to reduce taxes or increase transfers or other public expenditures in the future. Finland and Sweden have the highest IPLs, with IPL/GDP ratios exceeding 200 percent. In Austria, the United Kingdom, Spain, Germany, and Italy, the ratio ranges from 100 percent to 200 percent. Our calculations show somewhat smaller, but nonetheless high, IPLs for the United States, France, the Netherlands, and Denmark, countries whose IPL/GDP ratio lies between 70 percent and 100 percent. Finally, Norway and Belgium have very small ratios (only 10 percent and 19 percent, respectively).

This study confirms the claim, made by advocates of generational accounting, that explicit debt is a poor indicator of long-term fiscal sustainability. Among EMU members, those with the highest implicit liabilities report the lowest (but nonetheless positive) explicit debt. However, countries with the smallest (or negative) implicit liabilities have rather high explicit debt levels in 1995, the base year of the calculations. The explanation for the apparent negative correlation between explicit and implicit liabilities may be that by 1995, the future EMU countries with the highest explicit debt/GDP ratios had already begun implementing fiscal reforms to become eligible for participation in the EMU.

Section I of this paper briefly describes the method adopted for estimating IPLs. Section II reports and discusses trends in dependency ratios for the elderly and the oldest-old populations in Europe and the United States. Section III

3 Some believe that the high productivity growth witnessed in recent years is likely to be sustained; in our opinion, however, it does not as yet provide adequate reason to revise upward the long-term productivity growth rate assumed in making Social Security revenue projections.

4 Note that limits on the debt and on cash-flow deficits are sufficient for maintaining a sustainable policy. However, whether such limits, in and of themselves, are sufficient precommitment devices to move to a sustainable policy remains an empirical question—one that only the passage of time will help resolve.

5 The studies were undertaken by a team of experts at the request of the European Commission's Directorate General XXI (Task Force on Statutory Contributions) and collected in European Commission (1999). See Keuschnigg et al. for Austria, Dellis and Lüth for Belgium, Jensen and Raffelhüschen for Denmark, Feist et al. for Finland, Crettez et al. for France, Bonin et al. for Germany, McCarthy and Bonin for Ireland, Franco and Sartor for Italy, Bovenberg and ter-Rele for the Netherlands, Berenguer et al. for Spain, Lundvik et al. for Sweden, and Cardarelli and Sefton for the United Kingdom. For Norway, see Norwegian Ministry of Finance (1999). These studies are available upon request. Results for the United States are based on Gokhale et al. (1999).

reports IPLs for 13 European countries and the United States, decomposes them into explicit and implicit liabilities and, for each country, calculates the size of the immediate and permanent hike in all taxes that would reduce IPLs to zero. This section also presents country-specific IPLs, calculated under the assumption of a constant population structure to examine how population aging affects the size of implicit liabilities. Section IV summarizes the results and concludes the paper.

I. Intertemporal Public Liabilities and their Measurement

Intertemporal Public Liabilities

The point of departure for our calculations is the government's intertemporal budget constraint, which states that the government's future net taxes must be just sufficient to service or retire its net explicit debt. It can be expressed as

$$(1) \quad \sum_{s=t}^{\infty} T_s R^{-(s-t)} - B_t = 0.$$

Here, B_t stands for the public sector's net explicit debt in the base year, t; T_s represents *actual* net taxes collected in future years indexed by s; and $R = 1 + r$ represents a discount factor where the assumed interest rate is r. The term *net taxes* is shorthand for unified primary budget surpluses. It refers to aggregate public-sector taxes less expenditures on non-interest transfers and purchases of goods and services. Actual future net taxes depend on future changes in fiscal policy. Hence, actual future net taxes will generally differ from those that would be collected if the current set of fiscal policies were maintained indefinitely. We denote the latter by T^*_s. Equation (1) need not hold when T^*_s is substituted for T_s. If it does not hold, standard convention is to consider current fiscal policy as being unsustainable: If the present value of net taxes, T^*_s ,exceeds B_t, fiscal policy would need to be changed to avoid a wasteful accumulation of resources within the government.[6] Alternatively, if the present value of net taxes falls short of B_t, fiscal policy would have to be altered to avoid government debt default.

We report the size of the IPL embedded in each country's existing fiscal policy.[7] This measure is defined by rewriting equation (1) as

$$(2) \quad IPL_t = B_t - \sum_{s=t}^{\infty} T^*_s R^{-(s-t)}.$$

As equation (2) shows, the value of the IPL reflects both explicit and implicit government liabilities, the latter being caused, for example, by generous pay-as-you-go retirement programs at a time of rapid population aging. The size of the IPL also indicates how much policy adjustment is needed to restore fiscal sustainability: If the value is positive, the government's total expenditure commitments (including interest payments on its explicit debt) exceed prospective revenues under status quo conditions, and net taxes must be increased in the future. If negative, the IPL indicates how far taxes should be reduced.

Measurement

B_t is easily measured as the government's financial indebtedness minus its tangible and financial assets.[8] Measuring the second term on the right-hand side of equation (2) is more difficult because it requires projections of future government taxes and expenditures under current policy. Reliable projections of taxes, transfers, and government purchases of goods and services are available for only a few of the countries analyzed here. Fortunately, generational accounts have been estimated for most European countries and for the United States. The machinery of generational accounting offers a relatively straightforward way to project future government revenues and expenditures under prevailing fiscal policies.[9]

For countries where projections of aggregate taxes, transfers, and government spending on goods and services are not available or are unreliable, we use a standard procedure to project these aggregates. For each country, relative profiles of taxes and transfers by age

■ **6** Note that the first term in equation (1) represents the present value of the stream of net taxes through the indefinite future.

■ **7** In the literature, this indicator is also called the "generational balance gap" or "true debt." See Raffelhüschen (1999a) for a broader discussion.

■ **8** The calculation does not include intra-agency debt—that is, liabilities of the government held in other government accounts.

■ **9** For a brief description of generational accounting, see Auerbach et al. (1991, 1992, 1994). The method employed in this paper follows the standards developed in the European Commission's project, *Generational Accounting in Europe* (see Raffelhüschen [1999a, 1999b]).

and sex are available for the base year (1995). These profiles are obtained from micro-data surveys, one for each tax and transfer category in each country.[10] The available tax profiles cover all forms of statutory payments to the government; transfer profiles reflect both in-cash and in-kind benefits.[11] The relative-profile values for government purchases of goods and services are assumed to equal one for each age and sex because these outlays are for providing public goods.[12] The profiles for a given country constitute a detailed representation of its fiscal policy during the base year; they reflect the age- and sex-specific distribution of taxes, transfers, and purchases of goods and services across the population.

For each country, aggregate taxes, transfers, and government purchases in the base year (at all levels of government—federal, state, and local) are distributed among individuals alive in that year according to the applicable age–sex relative profiles. This procedure yields per capita taxes, transfers, and government purchases for the base year. For future years, profiles of per capita taxes, transfers, and government purchases are obtained by applying an assumed long-run growth factor of 1.5 percent annually to the base year's per capita profiles. Thus, let $h^{*x}_{a,i,s}$ represent the ith type of tax per capita for a person of sex x aged a in year t. Then, the ith per capita tax in year $s>t$ is calculated as

$$(3) \qquad h^{*x}_{a,i,s} = h^{*x}_{a,i,s}\,(1+g)^{s-t}.$$

The same growth factor is used for every country included in this study, with appropriate modifications to future per capita values in cases where recent changes in fiscal policy imply future changes in the distribution of taxes or transfers by age and sex. Next, for each country, two profiles of per capita taxes—net of transfers and net of government purchases of goods and services—are computed (one for each sex) for each future year as

$$(4) \qquad \eta^{*x}_{a,s} = \sum_i h^{*x}_{a,i,s}.$$

Finally, aggregate taxes net of transfers and net of purchases of goods and services for future years are computed as

$$(5) \qquad T^{*}_{s} = \sum_x \sum_{a=0}^{D} \eta^{*x}_{a,s} P^{x}_{a,s}.$$

In equation (5), $P^{x}_{a,s}$ stands for the number of individuals of sex x aged a in year s. The calculations use country-specific population projections, based on assumptions for mortality, fertility, and immigration consistent with those of official medium-term estimates of future demographic trends.[13]

For countries where reliable long-term projections are not available, we use the method described above to obtain future aggregate taxes, transfers, and government spending. For others, such as the United States, where official government agencies provide reliable medium- and long-term projections, we use the method described above to extend the projections beyond the last year available. The projections are extended sufficiently far out that adding more years does not appreciably alter the second term on the right side of equation (2).

II. A Cross-Country Comparison of Demographic Trends

Figure 1 shows the elderly dependency ratio for the United States and the European countries considered here. (In all four of our figures, the countries are listed in ascending order according to their IPLs in 1995.) This is the ratio of the over-60 population to that aged 20 to 59.[14] The ratio for 1995 is based on actual population data, whereas the ratios for 2015, 2035, and 2055 are based on the previously mentioned population projections for the various countries. Among the European countries, Sweden, Italy, and Belgium have the highest elderly dependency ratios in 1995. Over the next 15 years, all countries' elderly dependency ratios are pro-

■ **10** See the works cited in footnote 5.

■ **11** All available information was used to derive age–sex profiles for the various types of taxes and transfers. Whenever information was insufficient to distinguish payments by age or sex, we distributed the base-year aggregate amount equally by age or sex.

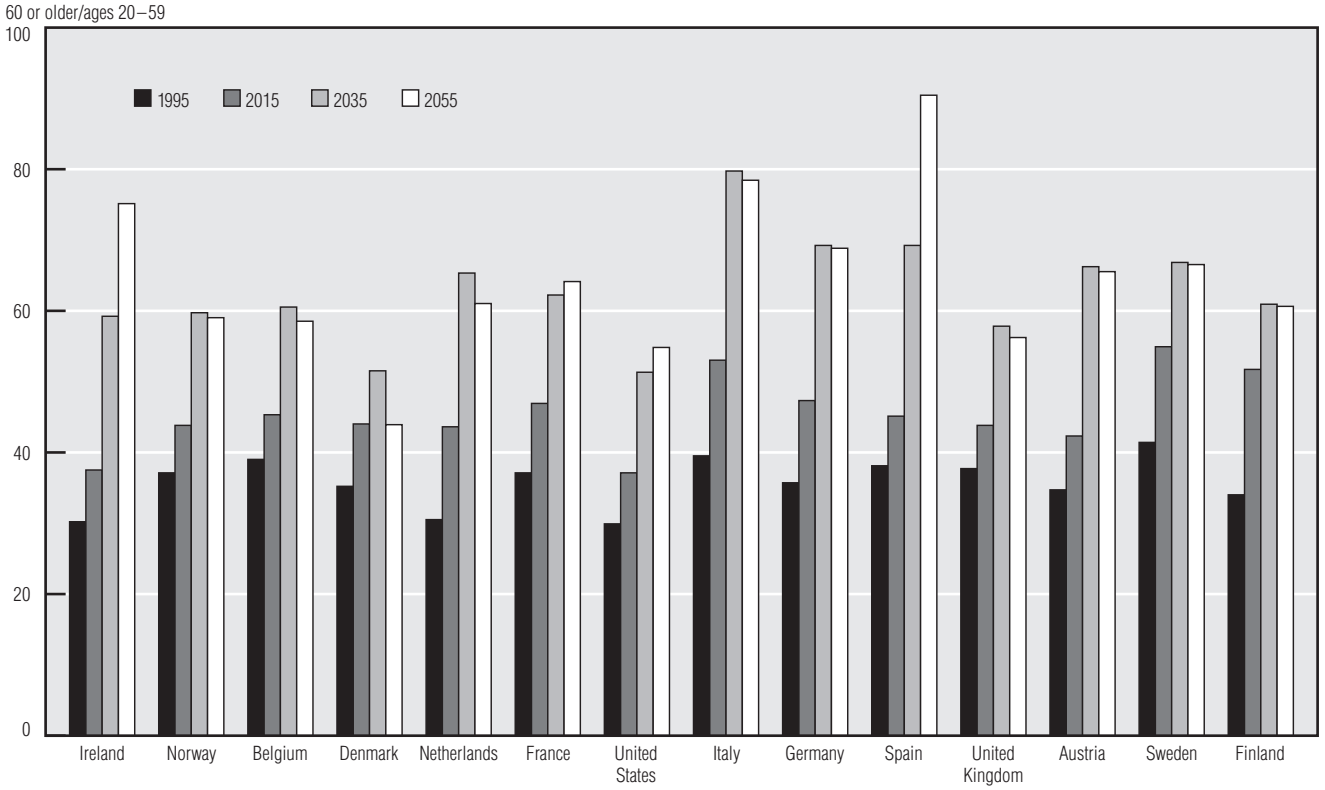
■ **12** For some countries, such as the United States, government purchases of goods and services are distributed according to a few age–sex categories. However, the portion of government spending that represents purchases of pure public goods (such as defense) is distributed uniformly across the living population.

■ **13** For country-specific data sources, see the references listed in footnote 5.

■ **14** The cutoff age was set at 60 because this is the effective retirement age in public pension systems for most of the countries considered here.

FIGURE 1

Elderly Dependency Ratio in Europe and the United States, 1995



SOURCES: Country studies in European Commission (1999); U.S. data are based on Gokhale et al. (1999).

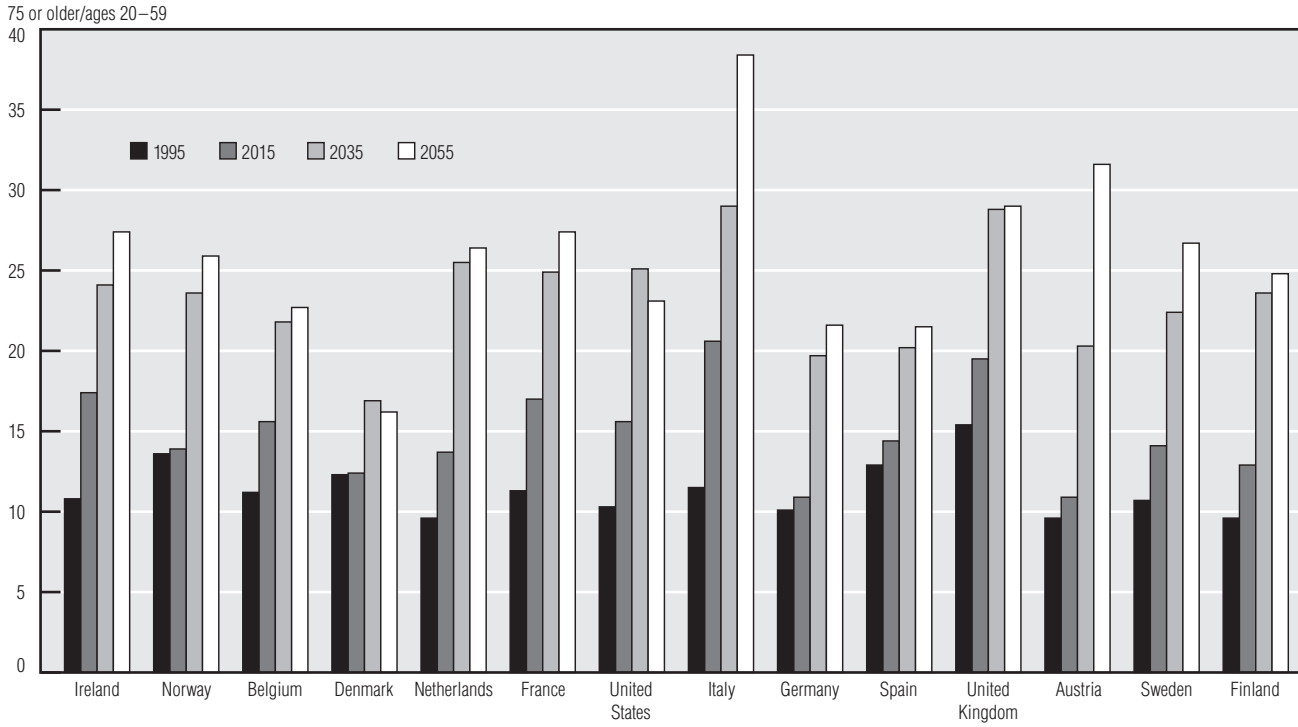
jected to increase significantly. Finland's ratio will increase the most, but Sweden and Italy are again prominent as countries that will experience the steepest increase in the size of the elderly relative to the working-age population. By 2015, more than a third of the people living in these three countries will be 60 or older. By contrast, the elderly dependency ratio in the United States will be a modest 37 percent.

Population aging in Europe will continue well beyond the first two decades of the next century. In Italy, four out of every nine persons will be 60 or older by 2035! In Sweden, Austria, and Germany, two out of every five persons will be elderly by our criterion. In comparison, the U.S. population will be much younger, with only one of every three persons falling into the elderly category. Except in Ireland and Spain, where elderly dependency ratios will continue to rise after 2035, the process of population aging will cease after about five decades.

Population aging has two dimensions: Not only will there be more elderly individuals in the future; in addition, healthier lifestyles and medical advances will create an expanding population of the oldest old. Figure 2 shows dependency ratios for the oldest old—the ratio of people aged 75 or more to those aged 20–59—for the years 1995, 2015, 2035, and 2055. This ratio is at or just over 10 percent for most of the countries considered here (the United Kingdom, at 15, is an exception). By 2035, this ratio is expected to roughly double for 10 of our 13 European countries. It more than triples for Italy: By 2055, roughly two of every five Italians will be 75 or older. In the United States, this ratio is expected to increase through 2035, but then fall back slightly by 2055. Overall, the elderly dependency ratio will almost double in another three decades and the ratio for the oldest old will nearly triple by the middle of the next century.

FIGURE 2

Oldest-Old Dependency Ratio in Europe and the United States, 1995



SOURCES: Country studies in European Commission (1999); U.S. data are based on Gokhale et al. (1999).

III. Findings

Explicit, Implicit, and Total Intertemporal Public Liabilities

Figure 3 shows the composition of the IPLs of specific countries, sorted in ascending order by their total IPL as of 1995. The figure also shows the magnitudes of explicit liabilities (the public sector's net outstanding debt in 1995) and implicit liabilities calculated according to the method described earlier. Only Ireland has a negative IPL. Despite its significant population aging and high level of explicit debt, Ireland's 1995 fiscal policies generated a surplus of future net taxes relative to non-interest expenditures. The projected surpluses are more than sufficient to repay its explicit debt, indicating the potential for somewhat lower taxes, higher transfers, or greater government purchases in the future.[15] Norway's rich petroleum reserves are valued at an amount that is almost double the country's GDP. The government controls an overwhelming share of this wealth, either directly or indirectly (through taxation). Norway's implicit liabilities slightly exceed its explicit assets, producing a small positive IPL.

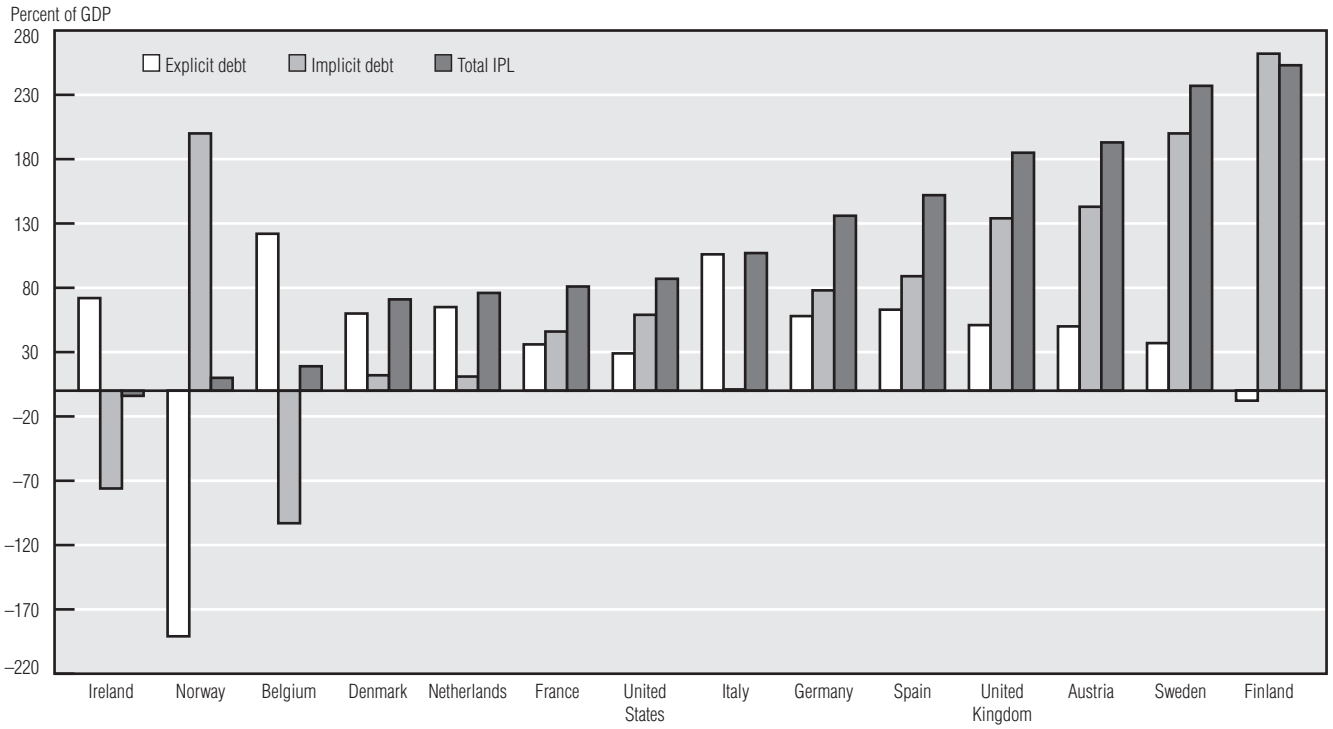
Belgium also has a low positive IPL, but for the opposite reason: Its high explicit debt slightly exceeds its negative implicit liabilities. Knowing that the Maastricht Treaty's debt/GDP criterion of 60 percent by 1997 was out of reach, the Belgian government sought to reduce the annual deficit to well below the 3 percent threshold, mainly by increasing tax revenues. Denmark, the Netherlands, France, and the United States have moderate IPL levels—less than 100 percent of GDP.

The correlation coefficient between the explicit and implicit liabilities of the 14 countries shown in figure 3 is –0.63. Had all these coun-

■ **15** Part of the explanation for Ireland's implicit surpluses is that its population aging occurs much later.

FIGURE 3

Composition of Intertemporal Public Liabilities



SOURCES: Country studies in European Commission (1999); U.S. data are based on Gokhale et al. (1999).

tries' policies been fully sustainable, each would have had implicit assets exactly offsetting its explicit debt, and the cross-country correlation coefficient would have been –1.0. The explanation for the partial negative correlation between the implicit and explicit components may be that the Maastrich Treaty imposes immediate fiscal adjustment on countries with high explicit debt or deficit levels but not on those whose policies imply high implicit liabilities.

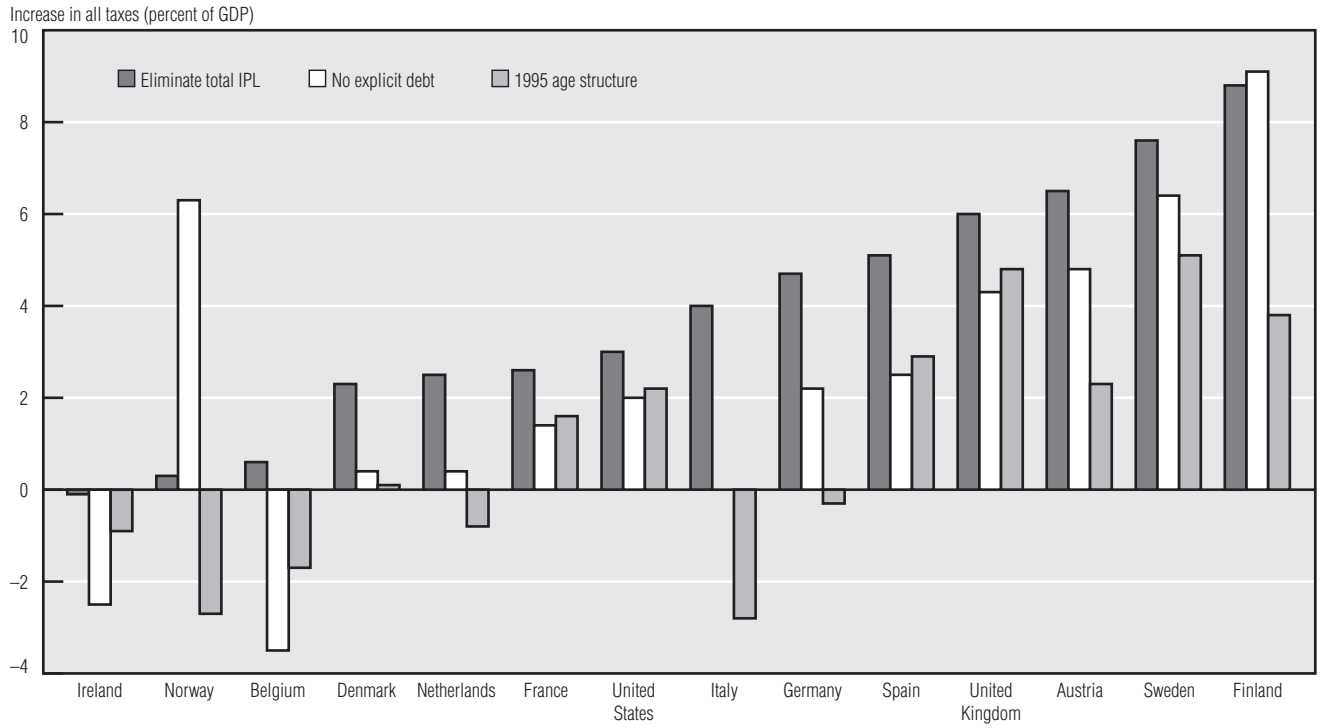
This suggests that criteria such as those of the Maastrich Treaty may allow countries with primarily implicit liabilities to postpone policy adjustments, that is, to maintain an unsustainable policy stance for some period of time. Generational accounting studies have shown that postponing adjustments to achieve fiscal sustainability generally increases the size of the required adjustments (tax increases or transfer cuts).[16] Hence, although the Maastricht criteria may ultimately force corrective action on countries with primarily implicit liabilities, postponing such action might escalate its cost to prohibitively high levels. The corollary to this, of course, is that policy choices would become more transparent and the process of adopting timely fiscal reforms would be improved were such criteria based on total IPLs, rather than on their explicit components alone. Figure 3 supports this hypothesis. It shows that countries with high IPLs, such as Sweden and Finland, had low explicit debt levels in 1995. By assessing the stance of fiscal policy only on the basis of outstanding explicit liabilities, the Maastrich Treaty may be failing to convey the appropriate degree of urgency with regard to the need for fiscal reforms in these countries.

Italy is another country with relatively high explicit liabilities. The major pension reform it adopted in 1995 produced a sizable reduction in its implicit liabilities—an amount that was more than 70 percent of GDP. As a result, Italy's overall IPL is accounted for entirely by its outstanding debt. In terms of total IPL, the United States ranks roughly in the middle of the countries shown in figure 3. Despite a low

16 For example, see Gokhale et al. (1999).

FIGURE 4

Impact of Explicit Debt and Population Aging on Intertemporal Public Liabilities



SOURCES: Country studies in European Commission (1999); U.S. data are based on Gokhale et al. (1999).

explicit debt/GDP ratio, its IPL/GDP ratio is almost 100 percent because of relatively high implicit liabilities. Germany, Spain, the United Kingdom, and Austria have IPLs that far exceed 100 percent of GDP. Again, the countries in this group with the highest implicit liabilities show the lowest explicit ones.

A noteworthy feature of figures 1 through 3 is their implication that both types of population aging seem to contribute to increasing implicit liabilities. For example, figure 1 shows that the elderly dependency ratios of the United Kingdom, Austria, Sweden, and Finland will increase less than Spain's. Figure 2 shows that these countries will experience much greater increases in their oldest-old dependency ratios than will Spain. According to figure 3, however, implicit liabilities are larger in the four countries just mentioned than in Spain, suggesting that life-span extension may be a significant contributor to long-term fiscal shortfalls.

Tax Adjustment Necessary for Achieving Fiscal Sustainability

Figure 4 shows how much additional tax revenue (as a percent of GDP) would be required annually to eliminate each country's sustainability gap. In this calculation, all taxes are increased by a scale factor, Θ, beginning in the base year and kept in place indefinitely. Thus, living and future generations' tax liability is affected for the rest of their lifetimes. To restore fiscal sustainability, all countries except Ireland need to implement tax hikes ranging from 0.3 percent of GDP in Norway to almost 9 percent in Finland. The ranking of countries' required revenue hikes corresponds to that of their sustainability gaps. Note that sustainability could also be achieved through transfer cuts that are of similar size as a percent of GDP (not shown).[17]

■ **17** Of course, transfer cuts would affect current retirees much more than would tax hikes. The burden of the latter would fall primarily on current and future workers.

To isolate the impact of explicit liabilities, figure 4 also reports the increase in all taxes as the percent of GDP that would be needed to eliminate a country's implicit liabilities alone—that is, under the assumption of zero explicit debt. The difference between the tax hike necessary under this assumption and the hike required to eliminate the total IPL indicates the role of explicit liabilities. For all countries with positive outstanding debt, assuming zero debt reduces the required revenue increase. For Finland and Norway, which have explicit assets rather than debt, eliminating the assets implies a need for larger revenue increases. For Belgium, which has a positive IPL only because its explicit debt exceeds its implicit assets, the change in taxes required (when explicit debt is assumed to be zero) is negative. In the case of Italy, where explicit debt accounts for almost the entire IPL, eliminating the debt implies a near-zero required increase in tax revenue. For both Denmark and the Netherlands, explicit debt accounts for a significant part of total IPL, so eliminating it reduces the required tax hike substantially. For France, Germany, the United States, and Spain, explicit debt accounts for between one-third and one-half of total IPL. Hence, the required tax hikes (ignoring explicit debt) are about one-half to two-thirds as large as those required to eliminate the entire sustainability gap. Assuming zero explicit debt, the required tax hikes are almost as large as those needed to eliminate entirely the IPLs of the United Kingdom, Austria, and Sweden—countries whose explicit debt accounts for a small fraction of total IPL. As we have noted, a low explicit debt/GDP ratio does not in itself convey any information about the size of the overall sustainability gap.

The Role of Population Aging

In most of the countries considered here, population aging and the generosity of promised public pension benefits are the main factors underlying large implicit liabilities. To evaluate the impact of demographic change, we recalculate the tax increases that would be necessary if the population grew as projected while its age structure was fixed as it was in 1995. Maintaining the 1995 age structure throughout the future implies that the tax-paying population continues to be large, whereas the relative size of the benefit-receiving population does not expand over time. Hence, compared to baseline projections, tax revenues would be bigger and benefit outlays smaller if the population structure were held constant.

For countries whose population aging is projected to be rapid and persistent, maintaining the 1995 structure will reduce the implicit liability and the associated tax hike required to eliminate the total IPL. However, the impact of fixing the population structure at its 1995 level also depends on such factors as the age–sex composition of per capita taxes, benefits, and government purchases of goods and services (the tax-benefit structure). If the 1995 tax-benefit structure generates a large implicit liability, it may be transformed into an implicit asset when the population structure is fixed, even if the projected population aging is not very pronounced.

Figure 4 shows that required tax hikes (as percents of GDP) are negative for Ireland, Norway, Belgium, the Netherlands, Italy, and Germany. Among these countries, Italy has the largest difference from the baseline because population aging is projected to occur immediately and is pronounced and persistent. Given its relatively modest projections of population aging, Norway's large negative required tax change under this experiment must result from a very generous initial tax-benefit structure. Belgium's tax-benefit structure generates an implicit asset, even under baseline population aging. Fixing its age structure makes the implicit asset even larger; indeed, it is higher than Belgium's explicit debt. This accounts for the negative tax change under the current experiment. Like Italy, Germany's significant population aging occurs in the immediate future, so eliminating it transforms Germany's implicit liability into an asset that exceeds its explicit debt.

Denmark and the Netherlands provide an interesting contrast. Population aging is much less severe in Denmark than in the Netherlands. Hence, although their implicit liabilities are nearly identical, eliminating population aging generates a negative required tax change for the Netherlands, but leaves Denmark with a positive required change.

Austria and Finland are projected to experience rapid population aging. Finland's elderly dependency ratio will grow significantly in the immediate future, and the mortality rate for Austria's oldest old will drop dramatically over the next few decades (see figures 1 and 2). For both countries, maintaining the 1995 population structure delivers a significant reduction in the tax hike required to restore fiscal sustainability.

The overall sustainability gap of the United States is close to that of the median European country, but its population aging is less rapid and persistent. Hence, eliminating aging results in only a modest reduction in the required tax hike compared to that necessary to eliminate the total IPL. The reduction is of the same size as those for Ireland and France.

IV. Conclusion

This paper compares population aging and fiscal policy among 13 European countries and the United States. Competition for budgetary resources will intensify in all of these countries as the baby-boom generation grows older, lives longer, and exerts political pressure to maintain the generosity of extant public retirement and welfare systems, while younger workers resist ever-heavier tax burdens. This article reports each country's total intertemporal public liability as the sum of its explicit outstanding debt and the present value of its implicit liabilities—the excess of projected transfers and government purchases over tax revenues.

The results suggest several conclusions: First, population aging is rapid and persistent in almost every European country. Aging has two dimensions: The sizes of both the elderly and the oldest-old populations will rise significantly compared to working-age populations. The aging phenomenon is much less pronounced in the United States than in Europe.

Second, explicit outstanding debt across countries can be an extremely misleading indicator of how far "out of whack" a country's fiscal policy is. Our calculations show that for European countries with the highest implicit liabilities (Germany, Spain, the United Kingdom, Austria, Sweden, and Finland), eliminating total intertemporal liabilities requires tax revenue increases exceeding 4 percent of GDP. Some European countries, such as Italy and Belgium, have already implemented far-reaching fiscal reforms, but these are the countries with the highest explicit debt levels. The motivation for such reforms arose from the Maastricht Treaty's fiscal criteria for participating in the EMU. However, because these criteria do not impose constraints on a country's implicit liabilities, they allow countries with high implicit liabilities to postpone needed reforms. This may ultimately make the cost of conforming to the Maastricht criteria prohibitive, thus posing a threat to the EMU's effectiveness and, ultimately, to its survival. Relative to Europe's population aging and fiscal problems, future fiscal challenges for the United States seem far more benign.

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