1 Government Debt and the Stock Market
W. Michael Cox

Higher federal budget deficits are usually presumed to reduce stock prices through their effect on interest rates. In other ways, however, government deficit financing may have a positive effect on stock prices. The corporate tax postponement implied by deficit financing benefits firms because interest rates on government debt are below those on corporate paper. Also, deficit financing benefits low-growth firms but is relatively harmful to those with high growth. The postponement of taxes to the future acts, in essence, to transfer the tax burden from currently established low-growth firms to those of higher growth. Government deficit financing thus can actually increase stock market values.

10 The Choice of Part-time Farming in Texas
Hilary H. Smith and Eric J. Weigel

Since the mid-1930s, there has been a steady erosion in the number of full-time farmers and ranchers. Analysis using econometric models and descriptive statistics reveals that for Texas, part-time farming is not likely to be a realistic alternative for many full-time agriculturalists whose operations are no longer economically viable in the 1980s. Within the state, the more urban economy and mixed agriculture of the eastern half provide more opportunities for off-farm employment, but the rural western half, with its less diversified employment base, is likely to have the greater need.

20 A New Alternative Trade-Weighted Dollar Exchange Rate Index
W. Michael Cox

This paper introduces a new exchange rate index—the X-131 Dollar Index. The new index differs primarily from those previously constructed in that it includes all U.S. trading partners. A secondary feature is that the trade weights are not tied to any particular year or group of years but are allowed to move over time to reflect current trade patterns. This index indicates a 65.5-percent appreciation in the dollar over the period from January 1980 to March 1985, similar to the appreciation shown by other indexes. In contrast to those indexes, however, this index shows only about a 6-percent depreciation since that time. Hence, relative to a full set of trading-partner currencies, the dollar indeed appreciated substantially over the pre-1985 period, but it has since depreciated only slightly.
Government Debt and the Stock Market

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Higher federal budget deficits are usually presumed to reduce stock prices. The typical argument given for this is that the issuance of government debt drives up interest rates and lowers the value of firms’ stock by reducing the capitalized value of future dividend streams. Other arguments, however, appeal to the Ricardian Equivalence Theorem, which states that the issuance of government debt in lieu of current taxes has no real effects on the economy. Under this view, interest rates are independent of the choice of government financing, and thus there is no link between government debt and the value of firms.

As an empirical issue, the question of the effect of government debt on interest rates is by no means settled. Indeed, the evidence on this issue—which is part of a larger question of whether government debt is “net wealth” or has any real effects on the economy—is widely divided. This paper makes no attempt to add to the interest rate debate. Instead, it considers two other aspects of the link between government debt and the stock market. These concern both the role played by the differential in interest rates between government debt and corporate debt and the effect that government deficits have on low-growth firms as compared to high-growth firms.

With regard to the role of the interest rate differential, a shift from current tax financing to government debt financing is shown to increase the overall value of firms on the stock market to the extent that interest rates on government debt are less than those on corporate paper. In effect, the tax postponement offered by government deficit financing amounts to a loan to the firm on which it may earn the corporate rate of return but on which interest accumulates at the lower (government) rate. Because interest rates on government debt are historically substantially less than those on corporate debt (see Figure 1), this consideration seems clearly relevant and is one whose implications should be carefully drawn out.

Another result shown is that debt financing is even more beneficial to low-growth firms and relatively harmful to high-growth firms. This result is independent of the comparison of interest rates on government debt and corporate debt and also does not rely on progressivity of the corporate income tax structure.

Also demonstrated is that government deficit financing can be good at some times for the stock market and harmful at others. In short, when the outstanding level of government debt in the economy is low, government deficit financing is likely to increase the overall value of firms on the stock market. But as the volume of government debt in the economy rises and the increased corporate borrowing cost begins to outweigh the benefit of the postponed taxes, deficit financing becomes harmful to the firm.

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Figure 1

Long-Term Interest Rates
(Annual Averages)

PERCENT

18
16
14
12
10
8
6
4
2

'54 '56 '58 '60 '62 '64 '66 '68 '70 '72 '74 '76 '78 '80 '82 '84

SOURCE: Board of Governors, Federal Reserve System.

This article presents a mathematical demonstration of these results, focusing first on the overall stock market effects and then on the individual-firm effects. Corporate interest rates are provisionally treated as independent of the level of government debt, as the article develops a simple framework in which government deficit financing increases the overall stock market index. Following an examination of the results of the model, the corporate interest rate effect is introduced, and attention is focused on the net effect on the stock market of government deficit financing.

Setting up the model: constant interest rates

The purpose of this section is to model the relationship between the stock market value of the firm and the government's budget in an environment where interest rates on corporate debt are independent of the level of government debt. Interest rates are treated as constant in order to focus attention on other aspects of the link between government debt and the stock market, as well as to enhance tractability of the mathematics. In the next section, the interest rate restrictions are relaxed, and a simple version of the model developed here is used to consolidate the effects of government deficit financing.

Because the purpose of this model is limited to studying the effect of government debt on the equity value of the firm, certain simplifying assumptions must be made.

Public sector. In the public sector, government is assumed to be infinitely lived with the power to spend and tax, as well as to issue debt. The public sector is also assumed to be linked to the corporate sector directly—and only—through the corporate income tax. All taxes are assumed to be levied on corporate earnings, with a fixed (marginal) rate structure in each period. Government spending is treated as not affecting the earnings path of firms. Essentially, this assumes that public goods and private goods are perfect substitutes in production and that output is also independent of the level of aggregate demand. Government purchases then replace (or perfectly "crowd out") private purchases of firms' output.

Of primary interest is the government's budget equation. Since corporate taxes affect the value of the firm in every period, the government's budget equation must in principle be specified in every period. This requirement may be greatly simplified, however, by isolating the budget of government for a single period and investigating its implications.
for the firm. In the model, this will be accomplished by assuming that government purchases are positive only in period 0 and equal to zero thereafter. The government’s sole choices then are (1) the level of spending in period 0 and (2) the method of financing that spending.

To finance its spending, the government is assumed to be able to tax either current (period 0) corporate earnings or issue debt. All government debt is assumed to bear no coupon, and to mature in m periods at which time the principal plus accumulated interest is financed by taxes on future (period m) corporate earnings. 6

Hence, the (real) budget constraint of the government in period 0 is

\[
t_0 = \tau_0 e_0 + \tau_m \frac{e_m}{(1 + r)^m},
\]

where

- \( t = \text{real government spending} \)
- \( \tau = \text{tax rate on corporate earnings} \)
- \( e = \text{aggregate real corporate earnings} \)
- \( m = \text{the number of periods to maturity of government debt} \)
- \( r = \text{the real interest rate on government debt} \)

In all other periods, because there are no government purchases, \( t_i = 0 \) for \( i \geq 1 \).

Equation 1 says that the government may choose, for example, to pay for current spending entirely by taxes on current corporate earnings (by setting \( \tau_m = 0 \) and \( \tau_0 = t_i/e_i \)). Alternatively, the government may defiﬁce ﬁnance all of current spending (by setting \( \tau_0 = 0 \) and \( \tau_m = 0 \)). Of course, any combination of these two that satisﬁes equation 1 is acceptable, but increasing \( \tau_m \) (and simultaneously reducing \( \tau_0 \)) is a decision to defiﬁce more of current government spending. 7

**Corporate sector: Firm A and Firm B.** In the modeling of the corporate sector here, the analysis is complicated by the need to consider different earnings paths for the ﬁrm. This complication occurs because taxes are on corporate earnings and the tax rate will vary from period 0 to period m with the government’s decision to tax or deﬁcience current spending. A decision to deﬁcience more of spending, for example, will imply a tax on earnings that is lower in period 0 and higher in period m. Hence, the government’s ﬁnancing decision will affect the capitalized value of ﬁrms’ future dividends unevenly to the extent that some ﬁrms’ earnings grow more rapidly than others.

As set out in the present model, the treatment of the corporate sector allows for different earnings paths, but it will be simpliﬁed by assuming that there are only two ﬁrms—Firm A and Firm B. The cost of capital and the rate of return on investment are assumed to be equal in each ﬁrm and across the ﬁrms. Hence, the text considers only the case of “normal” earnings growth, wherein after-tax earnings are growing at potentially different rates across the two ﬁrms because of unequal dividend payout ratios. 8

In the appendix, the analysis is extended to consider abnormal growth in one of the ﬁrm’s earnings. This is accomplished directly by permitting one of the ﬁrms to enjoy a limited number of years in which the rate of return on investment exceeds the cost of capital. Although the generalization to abnormal growth should be considered, it substantially complicates the analysis without altering any of the basic results. Hence, only the simple case of normal earnings growth is presented here.

It is useful at this point to consider one of the individual ﬁrms—for example, Firm A. Firm A pays taxes on its earnings in period 0 at the rate \( \tau_i \) and in period \( m \) at the rate \( \tau_m \). In all other periods, \( \tau = 0 \) and the ﬁrm pays no taxes. In each period, the ﬁrm pays out a ﬁxed portion of its after-tax earnings in the form of dividends and retains the rest for reinvestment. Hence, over time, the earnings path of Firm A may be written as

\[
e_{i+1}^A = [1 + g^A(1 - \tau_i)]e_i^A
\]

where

- \( e_i^A = \text{before-tax real earnings of} \) Firm A in period \( i \),
- \( r = \text{the cost of capital and the normal rate of return on investment} \),
- \( \delta^A = \text{the dividend payout ratio for Firm A} \),
- \( g^A = r(1 - \delta^A) = \text{the rate of growth in after-tax earnings of Firm A} \),

and with \( \tau_i = 0 \) in all periods except period 0 and period \( m \), and \( e_0^A \) taken as given.

Firm A’s dividend stream may be written as

\[
d_i^A = \delta^A(1 - \tau_i)e_i^A
\]

for all \( i \), where \( d_i^A \) is the dividend paid by Firm A in period \( i \), and where \( \tau_i = 0 \) in all periods except period 0 and period \( m \). The capitalized value of Firm A’s dividend stream, which is

\[
c_0^A + \frac{d_1^A}{(1 + r)} + \frac{d_2^A}{(1 + r)^2} + \frac{d_3^A}{(1 + r)^3} + \ldots
\]

may then be simply written, using equation 3, as
where $P_o^a$ is the real value of Firm A's stock in period 0.

The effect on $P_o^a$ of the government's financing decision may now be determined by imposing on the value of the firm the trade-off in corporate tax rates that is required in order to finance the government spending. This is done by solving for $\tau_m$ terms of $\tau_m$ from the government's budget equation 1 and substituting the result into equation 5. By defining $A = (1 + r)/(1 + r^*)$ and simplifying, the result is

$$P_o^a = \Pi_1 + \Pi_2 + \Pi_3 + \Pi_4,$$

where

$$\Pi_1 = \frac{1 + r}{(1 + r)^\lambda},$$

$$\Pi_2 = -\frac{e_o^a}{e_o^b} \tau_o,$$

$$\Pi_3 = \tau_m e_o^m \frac{\lambda^m - 1}{(1 + r)^m},$$

$$\Pi_4 = \tau_m \frac{e_o^m}{e_o^b} \frac{e_o^a}{e_o^b} \left[ \frac{e_o^b}{e_o^m} - \frac{e_o^b}{e_o^a} \right].$$

The four parts may be interpreted as follows. The first part, $\Pi_1$, is the normal value of the firm's stock (when the cost of capital and the rate of return on investment are equal) and has the familiar feature that the dividend payout ratio does not matter for that valuation. It should be noted that for $\tau_o = \tau_m = 0$, only the $\Pi_1$ part of the right-hand side remains. Hence, this is the value of the firm without the government spending and taxing policies.

The second expression, $\Pi_2$, represents purely the effect of government spending on the value of the firm and ignores how it is financed. The government spending, $\tau_o$, reduces the value of Firm A's stock, $P_o^a$, by an amount which depends on Firm A's share of earnings relative to total earnings, $e_o^a/e_o^b$. In the case where Firm A's earnings in period 0 are large relative to Firm B's earnings, the tax will fall more heavily on Firm A. Thus, the value of Firm A's stock is more strongly reduced by the government spending.

The third term, $\Pi_3$, indicates the benefit to the firm of the timing of the government's tax. The government may either tax now (by increasing $\tau_o$ and reducing $\tau_m$) or borrow and impose the tax later. Mathematically, for $r > r^*$,

$$(1 + r)/(1 + r') = \lambda > 1,$$

so that increasing $\tau_o$ and reducing $\tau_m$ increases $\Pi_3$ and thereby increases $P_o^a$. That is, in an environment where the interest rate on government debt is less than that on corporate debt, it pays to push the tax into the future.

The explanation for this is straightforward. When the firm is able to earn a rate of return on investment which exceeds the rate it must pay on borrowed funds, it clearly benefits the firm to borrow and make the investment. Although the firm here, by assumption of normal growth, is not able to borrow from the private capital market at an advantageous rate (that is, at a cost of capital less than its rate of return on investment), the postponement of taxes in effect amounts to a loan in the amount $\tau_m e_o^a e_o^b/e_o^b$ on which the firm must pay interest at the rate $r^*$ and on which it may earn $r > r^*$. Deficit financing thus increases the value of the firm to the extent that the interest rate on government debt is less than that on corporate debt.

It is also clear from this consideration that the firm is better off the further into the future that the taxes are postponed. Since $\lambda > 1$, increasing $m$ increases $\lambda^m$, which increases $\Pi_3$, and therefore $P_o^a$. An increase in the term to maturity of government debt thus increases the value of the firm.

The fourth expression, $\Pi_4$, draws out the interfirm effects of the government deficit financing. Specifically, this term indicates the potential benefit or loss to the firm of deficit financing, resulting from the differential rates of growth of Firm A and Firm B. If Firm A's earnings grow faster than Firm B's, then $e_o^a/e_o^b$ will be less than $e_o^b/e_o^a$, and the term $e_o^m/e_o^a - e_o^m/e_o^b$ will be negative. Increasing $\tau_o$ while simultaneously reducing $\tau_m$ will then lower the value of Firm A's stock.

It is easy to show that $\Pi_4$ may be written in terms of earnings growth rates as

$$\Pi_4 = \frac{e_o^a e_o^b}{e_o^b (1 + r)^m} \left\{ (1 + g^a)^m - (1 + g^b (1 - \tau_o)) \right\} - \left( 1 + g^a \right)^m \left( 1 + g^b (1 - \tau_o) \right).$$

This expression shows that $\Pi_4$ is negative for $g^a > g^b$, so that deficit financing lowers the value of $P_o^a$. In short, deficit financing punishes those firms with relatively high growth rates.

The explanation for this result also is straightforward. If Firm A's earnings are growing faster than Firm B's, then Firm A's are growing as a portion of total earnings. Because deficit financing amounts to a postponement of taxes from the present to the future (period $m$), deficit financing will cause...
Firm A to pay a larger share of the tax burden than if the
government spending were financed by current taxes.

These discriminatory interfirm effects of government defi­
cit financing would clearly be reinforced by a corporate tax
rate structure that was progressive—i.e., taxed higher levels
of earnings at a higher tax rate. But clearly the effects do
not rely on such an assumption. It should be noted also
from equation 7 that the interfirm results are independent
of the comparison of government and corporate interest
rates. This consideration will hold regardless of the question
of the interest rate environment.

A similar set of results could now be easily derived for Firm
B. But the stock value of Firm B can be directly inferred by
simply interchanging the B's with A's in equation 6. The
stock market "index," $P_o$, is then readily calculated as the
sum of $P^a_o$ and $P^b_o$. This gives

$$P_o = \frac{1 + r}{r} e_o - t_0 + \tau_m e_m \frac{1}{(1 + r)^m} - 1$$

so that the interfirm effect disappears, but the effects over
the entire market of the government spending and deficit
policies clearly remain. An increase in government spend­ing
causes an equivalent reduction in the stock market in­dex, whereas an increase in the deficit-financed portion
of government spending (an increase in $\tau_m$) causes an increase
in the market index to the extent that the interest rate on
government debt is less than that on corporate debt.

**Analysis when government debt affects interest rates**

Up to this point, the overall stock market effects of a switch
from current taxation to deficit financing have been shown
to be strictly positive in an environment where the interest
rate on government debt is less than that on corporate debt.
That is, an increase in $\tau_m$ unambiguously raises $P_o$. From the
standpoint of the overall value of firms, this would suggest
that all of government spending should be deficit
financed. Counter to this conclusion, however, is the conventional
argument that an increase in the outstanding stock of gov­
ernment debt raises interest rates. In this section, the re­
limitation on constancy of corporate interest rates is
removed, and a simple version of the model developed
earlier is used to consolidate the effects of government defi­
cit financing. Certain simplifications are necessary, how­
ever, in order to preserve tractability while incorporating the
interest rate effect of government debt into the above

The basic features of the model may be retained, however, with only a few simplifying assumptions.

First, it is convenient to assume that the interest rate on
corporate debt is constant at the level $\bar{r}$ during the $m$ peri­
ods that the government debt is outstanding and again
constant at the level $r$ beyond period $m$. Presumably also,
$\bar{r} > r$. Second, it greatly simplifies the exposition to assume
that the dividend payout ratio for Firm A is unity, implying
that Firm B is growing faster than Firm A for $\delta^b < 1$. This as­
sumption modifies the final form of the results slightly, but
none of the key results is affected. The interest rate on
government debt is also assumed to be constant at the level
$r^*$ during periods 1 through $m$, with $r^* < \bar{r}$. In short,

$$r = \text{the corporate interest rate that prevails}
\text{in the economy in the absence of government}
debt (that is, during periods } m + 1, m + 2, m + 3, \ldots \text{ and would prevail in the}
\text{economy during periods 1 through } m \text{ were there no}
\text{outstanding government debt,}
\bar{r} = \text{the corporate interest rate that actually}
\text{prevails in the economy during periods 1 through } m,
\text{where } \bar{r} > r, \text{ and}
r^* = \text{the interest rate on government debt, where}
r^* < \bar{r}.$$

Given these simplifications, the earnings path of Firm A
may be written as

$$\text{9) } e^a_{i+1} = [1 + g^a(1 - \tau_i)]e_i^a,$$

where

$$g^a = r(1 - \delta^a), \text{ with}
\tau_i = \bar{r} \text{ for } 0 \leq i \leq m, \text{ and}
\tau_i = r \text{ for } i \geq m + 1.$$

The present discounted value of Firm A's dividends, shown
as

$$\text{10) } d^a_0 + \frac{d^a_1}{(1 + \bar{r})} + \ldots + \frac{d^a_m}{(1 + \bar{r})^m} + \frac{d^a_{m+1}}{(1 + \bar{r})^m(1 + \bar{r})} + \ldots + \frac{d^a_{m+i}}{(1 + \bar{r})^m(1 + \bar{r})^i} + \ldots,$$

may then be written, upon incorporating the government's
budget equation and simplifying, as

$$\text{11) } P^a_0 = \Phi_1 + \Phi_2 + \Phi_3 + \Phi_4 + \Phi_5.$$
where

\[ \Phi_1 = \frac{1 + r}{r} e_o^a, \]
\[ \Phi_2 = -\frac{e_o^a}{e_o^a} t_u, \]
\[ \Phi_3 = -\left[ 1 - \frac{1}{(1 + \bar{r})^m} \right] \frac{\bar{r} - r}{\bar{r}} e_o^a, \]
\[ \Phi_4 = \tau_m \frac{e_o^a \lambda - 1}{(1 + \bar{r})^m}, \]
\[ \Phi_5 = \tau_m \frac{e_m^a e_o^a}{e_o^a (1 + \bar{r})^m} \left[ \frac{e_m^a - e_o^a}{e_m^a - e_o^a} \right]^r, \]

and where \( \lambda \) now equals \((1 + \bar{r}) / (1 + r)\).

Four of these five parts—\( \Phi_1, \Phi_2, \Phi_4, \) and \( \Phi_5 \)—are familiar and correspond to the results derived earlier. The third term, \( \Phi_3 \), is new, however, and demonstrates the effect on the value of the firm of the increase in corporate interest rates caused by the issuance of government debt. This term is clearly negative for \( \bar{r} > r \), so that the stock market value of Firm A falls to the extent that the issuance of government debt raises corporate interest rates.

This effect of deficit financing clearly provides an offset to the positive benefits derived earlier. It would be relatively easy now to mathematically model \( \bar{r} - r \) as depending on the amount of government debt issued, in order for the net effect of the government debt to be determined.\(^{13}\) All of the important results, however, may be intuitively inferred simply by comparing the components \( \Phi_3 \) and \( \Phi_4 \) of equation 11.

First, the behavior of \( \Phi_4 \) should be considered. The magnitude of this component depends directly on the interest rate differential between corporate debt and government debt. How is this interest rate differential affected by the magnitude of government debt in the economy? It seems reasonable to presume that with only a small amount of government debt in the economy, the relative scarcity of government debt would cause it to trade at a premium, depressing government yields relative to those on corporate paper. The interest rate differential \( \bar{r} - r \) would then be large. But as the outstanding volume of government paper rises, \( r \) should rise relative to \( \bar{r} \), so that \( \bar{r} - r \) falls.

In the case of \( \Phi_3 \), the magnitude of this term depends directly on the differential between \( \bar{r} \) and \( r \). With only a small amount of government debt in the economy, the corporate interest rate would not be pushed up much above the level that would prevail without government debt, so that \( \bar{r} - r \) would be small. It is also typically argued that an increase in the volume of outstanding government debt raises \( \bar{r} \), also increasing \( \bar{r} - r \).

The substitutability between government and corporate debt should also influence the degree to which an increase in outstanding government debt affects \( \bar{r} - r \) and \( \bar{r} - r^* \). If government and corporate debt are highly substitutable, an increase in the amount of outstanding government debt should raise both corporate and government interest rates. This would cause \( \bar{r} - r \) to be increased relatively strongly but \( \bar{r} - r^* \) to be relatively unaffected. In contrast, when the substitutability between the two is low, an increase in government debt should have little impact on corporate rates. An increase in the amount of outstanding government debt thus would have little impact on \( \bar{r} - r \) but would cause a relatively large narrowing in \( \bar{r} - r^* \).\(^{14}\)

With these effects in mind, it is possible to analyze the overall effect of government deficit financing on the stock market. If \( \Phi_3 \), \( \Phi_4 \), \( \Phi_5 \), and \( \Phi_6 \) are compared, it is clear that at a relatively low level of government debt, \( \bar{r} - r \) would be small, with \( \Phi_3 \) also small; and \( \bar{r} - r^* \) should be relatively large, with \( \Phi_4 \) also large. In this case, an increase in the level of government debt in the economy matched by a reduction in the level of current taxes would increase the overall stock market value of firms as the benefit of the postponed taxes exceeded the cost of the increased corporate interest rate. Beyond some level of government debt in the economy, however, the corporate interest rate effect will begin to dominate the benefit of the postponed taxes, and further issuance of debt in lieu of taxes will depress the overall value of firms in the stock market.

**Conclusion**

It is not inconsistent, then, sometimes to argue that an increase in the amount of government debt in the economy is good for the stock market, and at other times to see it as harmful. It is, however, important to understand when one would expect each of these effects. In short, (1) deficit financing is likely to increase the value of firms on the stock market when the outstanding volume of government debt is low, but (2) as the amount of government debt in the economy rises, further increases in outstanding debt are likely to yield successively smaller gains to the market index and reduce the value of firms beyond some point; and (3) government deficit financing is also more likely to yield a greater benefit to stock market values when the premium on government debt is greater (i.e., when the substitutability between public debt and private debt is lower).
Two added effects of government deficit financing that have been demonstrated and should be recalled here are that

4. deficit financing lowers the stock market value of high-growth firms relative to the market index and rewards low-growth firms, a result that is independent of the interest rate environment surrounding the firm; and, finally,

5. the positive effects of government debt issuance stem from the implicit substitution of future taxes for current taxes and not from the issuance of government debt per se; government debt issuance which represents additional government spending unambiguously lowers the value of the firm.

6. That is, because the analysis explicitly assumes that the government

7. Again, this formulation of the government budget equation does not

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1. The Ricardian Equivalence Theorem states that debt issuance on the part of government is equivalent to current taxation. According to this theorem, the issuance of government debt in lieu of current taxes causes an equal increase in the private supply of loanable funds, leaving the interest rate unaffected. For a discussion of this proposition, see, for example, Martin J. Bailey, *National Income and the Price Level: A Study in Macroeconomic Theory*, 2d ed. (New York: McGraw-Hill Book Company, 1971), 156.


3. The other ways the sectors could be related—for example, through social security or income taxes on labor—are not considered here.

4. The role of the consumer is also limited in this model. For example, changes in the stock value of firms are not permitted to feed back through private wealth into consumer spending and subsequently into the earnings path of firms.

5. The term "public goods" here is used to refer to commodities that are produced by the private sector but purchased by the government sector (such as battleships).

6. That is, because the analysis explicitly assumes that the government runs a balanced budget in the long run, all government debt is only temporarily outstanding (for m periods). Neither permanent government debt nor monetization of the deficit is considered here.

7. Again, this formulation of the government budget equation does not consider monetization of the deficit. In the context of the model presented here, monetization of the deficit should clearly benefit the firm since it amounts to a permanent reduction in the level of corporate taxation.

8. The firm is said to have normal earnings growth when the rate of return on investment and the cost of capital are equal. As typically defined and as used here, the variable $g$ represents the growth rate in after-tax earnings of the firm, where $g = r(1-\delta)$ and $\delta$ represents the ratio of dividends to earnings of the firm (the dividend payout ratio), with $0 < \delta \leq 1$. Hence, $g^*$ (the after-tax earnings growth rate for Firm A) can differ from that of $g^b$ (the rate for Firm B) because of differences in the dividend payout ratio between the two firms. For $\delta^A > \delta^B$, for example, $g^A > g^B$, so that the firm with the higher fraction of retained earnings has the higher earnings growth rate.

9. This formulation assumes that the first dividend is paid during the period in which the stock is purchased.

10. Strictly speaking, this is true for $\delta > 0$, and $\delta = 0$ is not permitted.

11. Were the corporate tax rate structure progressive and $g^A > g^B$, then deficit financing would cause Firm A to pay an even larger fraction of the tax burden for government spending. For this reason, a progressive tax structure merely reinforces the result derived here.

12. In fact, from the standpoint of the value of the firm, the government could even sell an additional amount of debt (over and above $\lambda_0$) and provide the revenue to the firm as a subsidy, which the firm would then invest to earn $r > r^*$. This formulation assumes that the first dividend is paid during the period in which the stock is purchased.

13. The results of this section may be demonstrated mathematically using a simplified version of the model given in the text. Specifically, consider the simple case where $m = 1$, and $\delta^A = \delta^B = 1$. Then the overall stock market index may be written as

$$P_0 = \frac{1 + \delta}{r} - b_0 - \frac{\delta + \gamma - \delta + \delta}{(1 + \delta)} e_0 + \frac{\delta + \gamma}{1 + \delta} - \frac{1}{1 + \gamma}.$$

Now $\delta - \frac{\delta + \gamma}{1 + \delta}$ is the market value of the amount of government debt issued at time period 0, and $\delta - \frac{\delta + \gamma}{1 + \delta}$ is the par value (call this $D$). Assume that the corporate interest rate depends positively on the par value of the amount of government debt borrowed, and in the following way

$$\frac{\delta - \frac{\delta + \gamma}{1 + \delta}}{1 + \gamma} = Q(D),$$

where $Q' \geq 0$, $Q'' \geq 0$, and $Q(0) = 0$. This says that with no government debt outstanding, the corporate interest rate $r$ is unchanged from $r$. But as the par value of government debt rises, the corporate interest rate not only increases, but it does so at an increasing rate. Similarly, assume that the differential between corporate and government interest rates falls with the par value of government debt issued, specifically,

$$\frac{\delta - \frac{\delta + \gamma}{1 + \delta}}{1 + \gamma} = Z(D),$$

where $Z' \leq 0, Z'' \leq 0, Z(0) = 0$, and $Z(D \rightarrow \infty) = 0$, so that, in general, interest rates on corporate paper are higher than those on government paper, but the differential in rates falls as the amount of government debt in the economy rises. The overall value of firms on the stock market may then be related to the amount of government debt in the economy as
\[ P_o = \frac{1 + r}{\gamma} v_o - D(D) v_o + DZ(D). \]

Taking the derivative of \( P_o \) with regard to \( D \) and equating the result to zero gives

\[ D = \frac{Q'(D) v_o - Z'(D)}{Z'(D)} \]

The value of \( D \) which satisfies this equation (say \( D^* \)) is the level of government debt which maximizes the overall value of firms on the stock market. Clearly also, because \( D^* > 0 \), the "optimal" level of government debt is positive. It also follows that \( \frac{dp_o}{dd} D > 0 \) for \( D \neq D^* \), so that an increase in the level of government debt in the economy increases the overall stock market index up to some point \( D^* \), although an increase in government debt beyond this level lowers the market index.


**Appendix**

**Valuation of the Firm's Stock under Abnormal Growth**

The appendix considers the valuation of the firm's stock under abnormal growth. For sake of tractability and for comparison with the results derived earlier, the interest rate on corporate debt is treated as independent of the level of government debt.

By definition, abnormal growth occurs when the rate of return on investment (ROI) exceeds the cost of capital to the firm \( (r) \). Now \( ROI_t = e_{t+1}/e_t \). Introduce the abnormal growth increment \( (n_t) \) for Firm A, where if \( n_t > 0, ROI_t > r \). To simplify, let \( n_t \) be constant at \( n_t = n^* \) for \( 0 \leq t \leq y - 1 \), and let \( n_t = 0 \) thereafter. That is, let Firm A enjoy \( y \) years of abnormal growth. During this time, the firm is assumed to be (optimally) reinvesting all after-tax earnings, so that \( \delta t = 0 \) for \( 0 \leq t \leq y - 1 \). After this time (for \( t \geq y \)), the growth rate of earnings falls to the normal level, \( ROI = r \). Also, for \( t \geq y \), \( \delta t \geq 0 \). For simplicity, assume that \( \delta t \) is constant at \( \delta t = \delta^* \) for \( t \geq y \).

The earnings stream of the firm may then be written as

\[ e_t = (1 + n^*)^{y-m}(1 + r)^{y-m-1}[1 + r (1 - \tau_o)]e_0 \]

\[ e_{t+1} = (1 + n^*)^{y-m}(1 + r)^{y-m-1}[1 + r (1 - \tau_m)]e_m \]

\[ e_{t+2} = (1 + n^*)^{y-m}(1 + r)^{y-m-1}[1 + r (1 - \tau_m)]e_m \]

\[ = \ldots \]

\[ e_y = (1 + n^*)^{y-m}(1 + r)^{y-m-1} \]

\[ [1 + r (1 - \tau_m)]e_m \]

\[ e_{y+1} = (1 + n^*)^{y-m}(1 + r)^{y-m-1}[1 + r (1 - \tau_m)] \]

\[ [1 + r (1 - \delta^*)]e_m \]

\[ e_{y+2} = (1 + n^*)^{y-m}(1 + r)^{y-m-1}[1 + r (1 - \tau_m)] \]

\[ [1 + r (1 - \delta^*)]^2 e_m \]

\[ \ldots \]

\[ \ldots \]

\[ \ldots \]

The discounted value of the firm's dividend stream (the value of the firm's stock) may then be written as

\[ p_o^* = \delta^*(1 + n^*)^{y-1}(1 + r)^{y-1-m-1} \]

\[ (1 + r)^{y-1} \]

\[ [1 + r (1 - \tau_m)]e_m \]
Note that this expression is the same, up to the addition of \(1 + m\), as the expression obtained under normal growth. Hence, the conclusions of that analysis apply as well here, with some only minor modifications. First, note that for the third term the relevant comparison is now \(m^*\) to 1, rather than simply \(m^*\). The presence of abnormal growth (that is, \(n^* > 0\)) increases the potential benefit to the firm of the interest rate differential between corporate and government debt, and thus the value to the firm of deficit financing is increased. Finally, the term

\[
\frac{f_0^m}{1 + r_m^m - (1 + r_m^m)\left(1 - (1 - m^*)\right) - (1 + r_m^m)^m} - \frac{f_0^m}{1 + r_m^m - (1 + r_m^m)\left(1 - (1 - m^*)\right) - (1 + r_m^m)^m}
\]

that may be rewritten as

\[
\frac{f_0^m}{1 + r_m^m - (1 + r_m^m)\left(1 - (1 - m^*)\right) - (1 + r_m^m)^m} + \frac{\delta^m(1 + r_m^m - (1 - m^*))}{1 + r_m^m - (1 - m^*)} - \frac{\delta^m(1 + r_m^m - (1 - m^*))}{1 + r_m^m - (1 - m^*)}
\]

which follows from the fact that for \(n^* > 0\), deficit financing \((m^*) > 0\) lowers the value of Firm A's stock. Hence, government deficits penalize high-growth firms and reward low-growth firms, even in the presence of abnormal growth.
The Choice of Part-time Farming in Texas

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Agriculture, perhaps best known for its cyclical periods of prosperity alternating with times of low prices, has been in a continuous state of transition since at least the turn of the century. With the increasing efficiency of low-cost producers, there has been an exodus of people from farming and a corresponding increase in the size of farms. A salient characteristic of this ongoing structural change has been the growing incidence of off-farm employment of farm family members.1

Broadly speaking, the migration of farmers from agriculture and the trend toward increasing off-farm employment of farmers constitute a labor supply phenomenon. This article looks at the theoretical issue of farmer labor supply to the off-farm market. Some descriptive evidence is marshaled on the pressures on farmers to enter the off-farm labor market. Nine regions in Texas are examined using descriptive statistics and econometric models. These regions are also examined for characteristics of the demand side of the labor market.

The article shows that the Southern High Plains region in West Texas is experiencing the greatest pressure on farmers to seek off-farm employment. Texas agriculture is heavily concentrated in areas, such as the Southern High Plains, that are far from major employment centers, which reduces the possibilities of off-farm employment. Econometric estimates show that crop agriculture is less suited for the farm operators to engage in off-farm employment. Crop farmers are also that segment of agriculture most afflicted with high levels of financial stress. Moreover, the scale of crop operations in the distressed areas of the state, especially in the Southern High Plains, tends to be quite large, further depressing the probability of operators engaging in off-farm work. Given these factors, individuals attempting to downsize their farm operations and take on outside employment will have to be prepared for a demanding job search. For policymakers, off-farm employment does not appear to be a mass alternative for dealing with farm financial stress in Texas.

Modeling the part-time farming choice

Some farmers participate in the off-farm labor market, while others work full-time on the farm. Under what conditions would a farmer choose to work off the farm? The essential framework for most models of the off-farm employment

The authors extend special thanks to John K. Hill for substantive comments and suggestions.
The decision of a farmer or rancher has its roots in the labor economics literature.²

The labor-leisure trade-off model underlies most of these studies of off-farm employment.³ In a simple formulation, the model used here posits that a farmer's utility is dependent on income (including nonlabor income) and leisure. Labor income can be derived from farm work only or from some combination of off-farm and on-farm work. The farmer's time allocation problem is to divide his or her time among work on the farm, work off the farm, and leisure or nonwork activities.

Off-farm work is assumed to be available for a fixed wage but for any amount of hours the farmer chooses to work. The farmer chooses the amount of farm work by equating the marginal net returns from farm work with the off-farm wage. The allocation of the remaining time between off-farm work and nonwork activities depends on the individual's income-nonwork time preferences.

A simplified version of the farmer's choice problem is shown in Figure 1.⁴ The farmer's net returns from agriculture are represented by the curve $R$. The net returns curve is concave to the origin because of decreasing marginal returns to the agricultural production process. In this model the farmer is indifferent between farm work and off-farm work. Up to $L_1$ hours of labor, the marginal net returns from farming exceed the off-farm wage ($w$). The farmer would then work exclusively on the farm. Past $L_1$ hours, however, off-farm work is more remunerative. Additions to income beyond $Y_1$ are most efficiently provided by working off the farm.

The amount of off-farm work the farmer will engage in depends on his relative preference for income and nonwork time. The trade-offs between income and nonwork time that the farmer is willing to make are described by his or her indifference map, of which the indifference curve $U_0$ is a single member. $U_0$ is tangent to the wage line at point $B$, indicating that the marginal rate of substitution (MRS) between income and nonwork time is equal to the off-farm wage. Thus, at points $B$ and $A$ the tangency of $U_0$, wage line $w$, and net returns curve $R$ indicate that the marginal evaluation of nonwork time in terms of income forgone, the off-farm wage, and the marginal net returns from farming are all equal. The farmer works $L_1$ hours at farming and

---

Figure 1  
The Choice of Off-Farm Employment

---
Farmer, responding to these higher on-farm returns, will expand the amount of hours worked off the farm if the net returns curve falls from $R_3$ to $R_2$ (some factors that would cause such a fall are declines in commodity prices, increases in input costs, and reductions in farm capital stock), the farmer will have to reconsider his or her labor choices. With no restriction on the amount of off-farm work hours available to the farmer, the relative preference for work and income embodied in the indifference map would determine the off-farm hours worked. For instance, if the farmer wished to work the same number of off-farm work hours as before, he or she would farm for $l_2$ hours at point $C$ and work off the farm for $(l_1 - l_2)$ hours, but the total work time would be less than before ($l_1$ versus $l_2$) at point $D$.

Alternatively, if the farmer increased his or her off-farm work hours to $(l_0 - l_1)$, the farmer would be working at both jobs for a total of $l_0$ hours at point $E$, the same total hours as before the downward shift of the net-returns-to-farming curve. The differences between points $B$ and $E$ are that the farmer is earning less income at point $E$ and, although total work hours are the same, the farmer is working more hours off the farm than before. A farmer with stronger preferences for income over nonwork time might choose a point such as $F$, which would lessen the farmer's original nonwork time in return for more income.

A little more realistically, the farmer may not be able to expand the amount of hours worked off the farm if the net returns curve falls from $R_3$ to $R_2$. If all of agriculture were in a downturn, for instance, the likely sources of off-farm jobs, at least in more rural areas, might be experiencing declining revenues as well. Such a scenario is depicted by net returns curve $R^*$, with off-farm employment hours restricted to a maximum of $(l_0 - l_1)$. Comparing the income opportunities along the wage line with the restricted off-farm work hours curve $R^*$ shows that the greater the farmer's preference for income over nonwork time, the greater his or her welfare reduction because of the work restriction. For example, a farmer working $l_0$ hours would earn less income at point $G$ than in the unrestricted case at point $E$.

While the income-nonmarket time trade-off and off-farm work hours restriction guide the farmer's labor decision, the size of the farming operation also plays a role. The three revenue curves in the figure can be used to illustrate the effect of farm size on the off-farm labor decision. If the net revenue curves are considered to reflect different amounts of capital used in the farming operation, then the marginal returns to farming rise as the capital employed increases from $R_1$ to $R_3$. If the off-farm wage remains fixed, then the farmer, responding to these higher on-farm returns, will engage in more farm work. Correspondingly, the higher income generated from farm work will lead to a desire for more nonmarket time if, as is customarily assumed, nonmarket time is a normal good. Given a time constraint, off-farm work hours will necessarily be squeezed. Operators of larger agricultural operations will work less off the farm.

In principle, the off-farm labor supply function can be derived from the tangency conditions that characterize an optimal solution in Figure 1. The marginal returns-to-farming function is

$$r = P Q'(L, K, H),$$

where

- $P =$ output price
- $Q'(L, K, H) =$ marginal product of labor in farming
- $L =$ time spent working on the farm
- $K =$ farmer's capital stock
- $H =$ human capital (such as experience, education, and farming skills).

A simplified off-farm wage function may be

$$w = g(M, H),$$

where $M$ equals labor market characteristics.

The marginal rate of substitution between income $Y$ and nonwork time $l_n$ could be

$$MRS = h(l_n, Y),$$

where

- $l_n =$ total time $- (l_1 + l_{of})$
- $l_{of} =$ time spent working off the farm
- $Y = Y_n + P Q(l, K, H) + w l_{of}$
- $Y_n =$ nonlabor income
- $Q(l, K, H) =$ farm production function
- $w =$ off-farm wage.

The equilibrium conditions, as represented by points $A$ and $B$ in Figure 1, are

$$r = w = MRS,$$

where $(r = w)$ determines the work hours on the farm and $(w = MRS)$ determines off-farm work hours.

These conditions can be used to express the farmer off-farm labor supply in terms of the exogenous variables in the model:

$$l_{of} = f(P, H, M, K, Y_n).$$

The signs under the variables indicate the direction of the expected influence of the variables. High agricultural com-
modity prices will boost the returns to farming and provide an incentive for more farm work. Off-farm work will be reduced if nonwork time remains the same. Human capital has indeterminate effects on the off-farm employment decision. Human capital skills may increase farm productivity but may make the farmer more attractive to off-farm employers. If there is a shortage of labor in the off-farm labor market, employment opportunities and higher wage offers should result. The influence of farm size has already been explained. Large amounts of nonlabor income diminish the incentive to trade nonmarket time for income, thus reducing the off-farm labor supply.6

**Estimating the probability of off-farm employment**

Ideally, the farmer's selection of farm work and of off-farm work hours, together with the wage rates for each, would be simultaneously estimated in a multi-equation framework. But no direct wage data are available for on-farm or off-farm work by farmers from the 1980 Census, which is the data source for this article. Further, no separation is made in Census data for hours worked on the farm versus hours worked off the farm. Thus, the multi-equation approach is precluded. It seems unlikely, however, that variables found to be significant in a single-equation model would lose their explanatory power in a simultaneous equations model. Individual questions can be studied in partial-equilibrium frameworks.

Given the model and the data, the question is narrowed to the likelihood of a farmer being employed off the farm. Because the issue addressed in this article is the probability of off-farm employment, rather than the quantity of employment either sought or obtained, a qualitative dependent-variable approach is suitable. Probit analysis can provide estimates of the strength of the influence of various factors on the probability of off-farm employment. Probit models are generally single-equation models, so the demand and supply effects are aggregated into a single reduced form.

The variables to be included in the reduced-form equation were suggested in the preceding section: output prices, human capital variables, labor market characteristics, nonlabor income, and capital stock. A production-technology binary variable can be included, which would differentiate between crop and livestock farms. All prices are assumed to be the same for all farmers, so the price effect would be picked up by the regression intercept.

The employers' demand for part-time work by farmers is conditioned by job qualifications held by farmers. Specifically, education and experience are the most measurable and also must proxy for the less quantifiable aspects of job qualifications. Labor market conditions and any region-specific factors not fully captured by other variables in the model are proxied by regional dummy variables.6 Another supply-side variable is the nonlabor income of the farm family. Finally, capital stock, or the size of the farm opera-
tion, is proxied by the sum of all family members’ agricultural income.

Data sources and restrictions. The data used in this study were obtained from the Public-Use Microdata Sample from the 1980 Census of Population and Housing. Our sample for the state of Texas was restricted to householders citing farming or ranching as their primary occupation. Among individuals engaged in agriculture part-time are those whose primary employment is off the farm and who do not consider themselves farmers. Most farms in this category are very small, have negative cash flow, and are generally considered hobby farms or rural residences (airline pilots running a few cows is an oft-cited Texas example). As such, they are excluded from this analysis.

As mentioned above, the technique used in estimating the probability of participation in off-farm employment is probit analysis. The technique of probit analysis involves the use of dummy dependent variables. This study uses a choice variable with a value of 0 if the household head had no wage income or nonfarm self-employment income in 1979 and with a value of 1 if the farmer worked off the farm for a wage or operated a nonfarm business. Our sample of Texas farmers and ranchers included 3,262 individuals (in Census Occupation Code 473, comprising farmers, except horticultural), 2,614 of which reported no off-farm wage or management income.

Table 1 shows the means of the regression variables by region and for Texas, while the map shows the geographical division of the state. There are some pronounced regional variations. Farmers are younger and better educated in the High Plains and receive more agricultural income. Compared with the rest of the state, the proportion of livestock farmers in the High Plains is smaller. Farmers in the central part of the state are older and less educated, receive less farm income, and receive more nonlabor income than average. South Texas is close to the state averages in most categories but does have the largest nonlabor income of any region. The percentage of farmers with off-farm income
is fairly uniform across the state except in the Southern High Plains, where it is relatively low.

One question about the data is whether the results of the empirical work, which are based on 1979 data, are relevant today. The position in this article is that the sorts of variables used—age, education, family characteristics, and the like—change slowly over time. It is likely, therefore, that 1979 data are fully adequate for the purposes of this study.

Results and interpretation. Two versions of the model were estimated—one with the proxy for capital stock, or farm size, and another version without it. This approach was followed because of concerns for the endogeneity of levels of production and off-farm work. For entrants into farming, the production level decision is clearly endogenous: the level of production and the choice of working off the farm would be resolved simultaneously. Even for established farmers, capital stock can change in the short run (for example, about one-third of all agricultural land is rented), so within any one year a farmer or rancher could make production adjustments.

The econometric questions concern the direction and magnitude of bias introduced when an endogenous variable is included as if it were exogenous or by omitted-variable bias if that variable is excluded. An endogenous explanatory variable in a single-equation model produces a biased estimate of the coefficient on the endogenous variable and will likely have some effects on other coefficient estimates. Excluding a relevant variable biases all the coefficients to the degree that the omitted variable is correlated with the included explanatory variables. On balance, econometric theory leans in the direction that more accurate estimates are produced by including the proxy variable.8

Table 2 shows the final estimated coefficients, t statistics, derivatives, and the average probability of a Texas farmer or rancher engaging in off-farm employment. The figures in the derivatives columns show the effect of a one-unit change in an explanatory variable on the probability of participation in off-farm work. These partial derivatives have been computed at the means for each variable, using the entire sample.

Overall, inclusion of the possibly endogenous capital stock proxy had salutary effects on the regression model. The magnitude of the chi-square statistic increased, indicating that all the estimated coefficients are now more likely to be jointly different from zero. Other than the dummy variables, all the coefficients increased in size and significance. Most affected was the coefficient on nonlabor income, which doubled and became statistically significant.8 Discussion of the results, therefore, will concentrate on the model that includes the proxy for agricultural production.

The size of farm operation as proxied by total farm family income, while statistically significant, is biased. The size or direction of the bias is not known. The derivative of the estimated coefficient shows that for every $10,000 increase in agricultural income, the probability of off-farm employment falls about 3 percentage points.

The farmer's educational level is positive and significant. The derivative shows that every additional year of schooling would raise the probability of off-farm employment by a percentage point. Farm family nonlabor income is significant, and the negative sign is as anticipated. The influence of nonlabor income is such that a $10,000 increase in family nonlabor income would cause the probability of off-farm employment to decline 1.6 percentage points. The coefficients on the farmer's age and the square of his or her age both are significant and have the expected signs. The derivative of age implies that for an additional year of experience, the probability of employment increases 2.8 percentage points.

The regional dummy variables were chosen to represent approximations of aggregations of Texas agricultural crop reporting regions. The equation was estimated using eight dummies, with Central Texas as the standard of comparison. The Southern High Plains variable has a large negative coefficient. The derivative implies that residing in the Southern High Plains will reduce the probability of off-farm employment over 7 percentage points compared with Central Texas. The variable is probably picking up the weakly developed labor market for part-time farmers.

To see how the Southern High Plains may have the least hospitable market for part-time farm work, two perspectives on off-farm employment of farmers are shown in Table 3. The first column indicates that the concentration of full-time farmers (among those describing their primary occupation as farming in the 1980 Census) varies only moderately across the state. The perspective among agricultural bankers, shown in the second column, is quite different. Although the Census data are from 1979 and the survey of bankers is from 1986, the Census data can be used to make comparisons with the newer bankers' survey data because of the gradual nature of change in agriculture.

Analysis of survey responses of the bankers shows that the percentage of their agricultural loan customers who farm full-time varies widely from region to region and varies differently from the Census data. For example, in the Southern High Plains, 88.2 percent of the farmers are full-time according to the Census data, while 97.4 percent of agricultural loan customers at banks in that region are full-time. This contrasts markedly with East Texas. There, the Census data have 78.3 percent of farmers as full-time, but...
Table 2
PROBIT ESTIMATES OF FARMER PARTICIPATION IN OFF-FARM EMPLOYMENT

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
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<td>Derivative</td>
<td>Coefficient</td>
<td>Derivative</td>
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<td>(-7.02)</td>
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<td></td>
<td>(4.21)</td>
<td>(4.54)</td>
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<tr>
<td>Age squared</td>
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<td>-0.0005</td>
<td></td>
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<tr>
<td></td>
<td>(-4.65)</td>
<td>(-5.04)</td>
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<tr>
<td>Years of schooling</td>
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<td>0.00961</td>
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<td>0.01051</td>
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<tr>
<td></td>
<td>(4.25)</td>
<td>(4.66)</td>
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<tr>
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<tr>
<td></td>
<td>(3.03)</td>
<td>(2.87)</td>
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<td></td>
<td>(0.37)</td>
<td>(0.35)</td>
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<tr>
<td>Trans-Pecos and Edwards Plateau</td>
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<td>-0.02488</td>
<td>-0.0844</td>
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<td></td>
<td>(-0.44)</td>
<td>(-0.06)</td>
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</table>

Probability of participation  0.1913  0.1874
-2 X likelihood ratio         89.86   135.26
Degrees of freedom            13      14

NOTE: Figures in parentheses are t statistics.
survey bankers reported only 23.5 percent of their agricultural borrowers in the full-time category.  

Evidently, most of the farming in the Southern High Plains is by people who consider themselves farmers, while in East Texas, many are farming on the side, with their main occupation off the farm. Any region with large numbers of agricultural loan customers who are part-time farmers would have an economy more accommodating to additional part-time jobseekers than a region that has little experience with such farmers.  

The type of farm enterprise is important in determining whether farm operators will be able to take advantage of off-farm employment opportunities. The livestock variable is positive and significant, indicating that livestock operations are more conducive to off-farm employment than are cropping enterprises. Crop farmers face heavy demands on their time during periods of planting and harvesting, which may prevent them from engaging in regular year-round off-farm employment. However, crop farmers often have substantial amounts of free time during the winter months.  

Livestock farmers do not experience as heavy seasonal demands on their time, but the nature of livestock operations is such that constant year-round attention is required. In that sense, livestock producers may be more suited to steady year-round part-time work off the farm. Table 1 shows the wide variation in concentration of livestock enterprises in Texas. Again, the Southern High Plains region, with its dearth of livestock farms (other than feedlots, which are not considered farms), is particularly ill-suited to part-time off-farm employment.  

**Comparison with other studies.** In comparing these results with previous study estimates, only age, education, and household nonlabor income are directly comparable. Table 4 shows the results from two other studies, one using 1971 data on farmers in Illinois and the other using 1980 data on Saskatchewan farmers. The estimates in this article seem to be roughly similar to other efforts but smaller in magnitude. This can be partially explained by comparing the data used to make the estimates.  

The bottom panel of Table 4 shows the means for the three variables. Note that Texas farmers are older than Illinois farmers and have more nonlabor income. The income data are in nominal dollars, which signifies that with the considerable inflation of the 1970s, 1979 Texas off-farm income data would appear unduly large in comparison with the 1971 Illinois data. If the relationship between the explanatory variables and the choice of off-farm work is the same for all farmers, then the larger values of the variables for Texas farmers would make the estimated coefficients smaller. But the means of the variables would also be larger, which would somewhat offset the smaller coefficients' downward influence on the size of the estimated derivatives.  

**Farmers and regional labor markets**  

The success of farmers seeking off-farm employment is a function not only of the supply characteristics that have been discussed so far but also of the structure of the labor market in which the farmer seeks work and the number of farmers seeking work in that market.  

The first two columns in Table 5 show the dependence of the regional economies on agriculture and energy, the two Texas sectors that are not prospering in 1986. On the basis of averages for 1969-82, the Plains regions are much more dependent on agriculture than are other regions in Texas. The Southern High Plains and Rolling Plains also have heavier concentrations of income from energy than do other areas of the state. The third column shows that in the Plains regions, farmers make up a greater percentage of employed individuals—almost four times the state average.  

The next two columns contain 1986 data on the pressure on farmers to seek off-farm employment. The Southern High Plains and East Texas stand out as the areas well above the state average of farmers having to sell real assets to meet debt obligations. Bankers reported that Southern High Plains farmers had the largest percentage of farm loans with some kind of repayment problem. Farmers in the Rolling
Table 4
COMPARISON OF PRESENT REGRESSION RESULTS WITH OTHER ESTIMATES

<table>
<thead>
<tr>
<th>Study</th>
<th>VALUE OF VARIABLE DERIVATIVES</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age</td>
<td>Years of schooling</td>
<td>Nonlabor income</td>
</tr>
<tr>
<td>Van Kooten-Arthur¹</td>
<td>0.027</td>
<td>0.025</td>
<td>0.000</td>
</tr>
<tr>
<td>Sumner²</td>
<td>0.036</td>
<td>0.014</td>
<td>-0.023</td>
</tr>
<tr>
<td>Present study</td>
<td>0.028</td>
<td>0.011</td>
<td>-0.002</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study</th>
<th>MEANS OF SELECTED VARIABLES</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Age</td>
<td>Years of schooling</td>
<td>Nonlabor income</td>
</tr>
<tr>
<td></td>
<td>Whole sample</td>
<td>Off-farm workers</td>
<td>Whole sample</td>
</tr>
<tr>
<td>Sumner</td>
<td>49.6</td>
<td>46.8</td>
<td>11.3</td>
</tr>
<tr>
<td>Present study</td>
<td>53.5</td>
<td>51.1</td>
<td>11.3</td>
</tr>
</tbody>
</table>

3. Van Kooten and Arthur did not include a table of variable means. NOTE: Whole sample includes farmers with and without off-farm income. Off-farm workers include only farmers with employment off the farm.

Table 5
FARMERS AND INDICATORS OF REGIONAL LABOR MARKETS

<table>
<thead>
<tr>
<th>Region</th>
<th>Regional dependence on agriculture and energy</th>
<th>Farmers and measures of farm financial stress</th>
<th>Survey bankers' evaluation of opportunities for part-time employment for farmers¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Averages, 1969-82</td>
<td>Farmers as percent of all occupations</td>
<td>Percent of bankers responding</td>
</tr>
<tr>
<td></td>
<td>(Percent)</td>
<td>(Percent)</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Farm income</td>
<td>Energy income</td>
<td>Forced to sell real assets</td>
</tr>
<tr>
<td>Northern High Plains</td>
<td>17.7</td>
<td>6.0</td>
<td>4.2</td>
</tr>
<tr>
<td>Southern High Plains</td>
<td>10.6</td>
<td>8.9</td>
<td>4.0</td>
</tr>
<tr>
<td>Rolling Plains</td>
<td>8.5</td>
<td>9.1</td>
<td>3.9</td>
</tr>
<tr>
<td>North Central Texas</td>
<td>8.8</td>
<td>2.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Central Texas</td>
<td>2.8</td>
<td>1.2</td>
<td>1.6</td>
</tr>
<tr>
<td>East Texas</td>
<td>3.4</td>
<td>4.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Trans-Pecos and Edwards Plateau</td>
<td>3.3</td>
<td>7.5</td>
<td>1.9</td>
</tr>
<tr>
<td>South Texas</td>
<td>3.5</td>
<td>4.1</td>
<td>.7</td>
</tr>
<tr>
<td>Coastal Prairie</td>
<td>6.8</td>
<td>7.1</td>
<td>.4</td>
</tr>
<tr>
<td>TEXAS</td>
<td>2.6</td>
<td>5.2</td>
<td>1.1</td>
</tr>
</tbody>
</table>

2. Percentages may not add to 100.0 because of rounding.

U.S. Department of Commerce.
Federal Reserve Bank of Dallas.
Plains and in the Coastal Prairie were also experiencing loan repayment problems well above the state average.

The last three columns of Table 5 show survey bankers' estimation of the local labor market's receptiveness to part-time work by farmers. A majority of bankers in the state rated part-time employment opportunities for farmers as "poor." But the Southern High Plains and South Texas are far worse off than the state average.

The data in the table reinforce the significant coefficient regression result for the dummy variable for the Southern High Plains. That region is relatively dependent on agriculture and energy, it has more farm financial stress, and its off-farm labor market is rated the weakest by bankers. But the table data also show that farmers in most parts of Texas face problems in finding a job in the local economy.


4. The model here is a version of one developed by Sumner, "Off-Farm Labor Supply."


6. Labor demand variables, such as the regional unemployment rate and agricultural income as a proportion of total income in a Census county group, were included in unreported regressions. In separate regressions, neither variable proved to be significant, with or without inclusion of the regional binary variables.

7. Restricting the sample here to bona fide farmers introduces sample selection bias. But there is no bias in using this subgroup of farmers as long as the inferences drawn from the empirical work refer only to them. Further, it is believed that to include hobby farmers and individuals with rural residences would severely reduce the value of the empirical results for policy analysis. For one perspective on this question of small farms, see U.S. Department of Agriculture, Economic Research Service, *Minifarms: Farm Business or Rural Residence?* by Nora L. Brooks, Agricultural Information Bulletin no. 480 (Washington, D.C.: Government Printing Office, revised February 1985).

8. Econometric theory is hardly clear-cut on this point and says little on the special case of nonlinear estimation, but studies have shown that in the general linear case, including a proxy variable, even a poor one, is usually better than omitting it. There are, however, qualifications and exceptions. For discussions of this issue, see "The Dilemma of Proxy Variables," in George G. Judge, William E. Griffiths, R. Carter Hill, and Tsourng-Chao Lee, *The Theory and Practice of Econometrics* (New York: John Wiley & Sons, 1980), 516-18; and "Proxy Variables," in G. S. Meddula, *Econometrics* (New York: McGraw-Hill Book Company, 1977), 158-62.

9. With ordinary least squares, the omitted-variable bias in the remaining variable coefficients depends on the sign of the omitted-variable coefficient and the correlation between the omitted variable and the included ones. Using that criterion, with a negative simple correlation between agricultural income and nonlabor income and with a negative coefficient on agricultural income, one would have expected a positive bias and the coefficient on nonlabor income to get less negative. The opposite occurred.

10. Some percentage of full-time and part-time farmers are debt-free. To the degree that the percentages of debt-free farmers differ among regions, the bankers' survey results would be biased. However, the magnitude of such bias is likely to be quite small.
This paper reports the construction of a new exchange rate index—the X-131 Dollar Index. The new index differs from existing indexes in two major ways—by the method used to construct trade weights, and by the selection of currencies against which to measure the dollar. With regard to the first of these, moving trade weights are employed rather than weights which are tied to trading patterns of a specific year or group of years. Second, and more importantly, this new dollar index contains all 131 U.S. trading partners. This is in contrast to existing popular indexes, which contain only 10 to 22 countries. By including all U.S. trading partners and by allowing trade weights to be determined solely by actual current trade patterns, this index provides an alternative effective measure of the dollar's value to which the others may be contrasted.

The following section details construction of the index, which we will call the X-131 Dollar Index, and reviews the contrasting features of four existing exchange rate indexes. As Table 1 shows, there is general agreement among these existing indexes that the dollar experienced a major run-up over the five years prior to early 1985 and that it has depreciated substantially since that time. According to the Federal Reserve Board's trade-weighted value of the dollar—probably the most widely cited of existing indexes—the value of the dollar rose roughly 62 percent over the period from January 1980 to February 1985, but it has depreciated 34 percent since that peak. Likewise, the other dollar indexes show a range of 41.6-percent to 56.8-percent appreciation in the dollar prior to early 1985, with 17.5-percent to 28.3-percent depreciation since that time.

Findings for the index reported here, which are notably different, can be summarized as follows. First, in line with the existing indexes, the X-131 Index shows a 65.5-percent appreciation in the dollar over the period from January 1980 to March 1985. In contrast to those indexes, however, calculations using the X-131 Index reveal that only about a 6-percent depreciation has occurred since that time. These results thus indicate that, relative to a full set of trading-partner currencies, the dollar indeed appreciated substantially over the pre-1985 period, but it has depreciated only slightly since then and remains near its peak.

The source of this difference in depreciation clearly pertains to the assignment of trade weights—specifically, the number and choice of currencies against which the dollar is measured. By measuring the dollar only against currencies of the countries of the Organization for Economic Cooperation and Development (OECD)—specifically by focusing on Europe and Japan—the existing indexes have

The basic content of this paper was presented to the Board of Directors of the Federal Reserve Bank of Dallas in July 1986. This work here differs from the presentation in that the preliminary exchange rate data have been revised and the base period for the dollar index changed from 1970 to the first quarter of 1973.
essentially included only those currencies against which the dollar has depreciated after March 1985, and they have excluded those against which the dollar continues to appreciate. The currencies excluded are mainly those of the Western Hemisphere countries, as well as those of the Pacific Newly Industrialized Countries (referred to here as PACNIC), and all others, which together accounted for over 37 percent of U.S. trade in 1985.

Calculation of the X-131 Dollar Index

There are various ways to construct an exchange rate index. In addition to the new index constructed here, Table 2 details the construction of four popular dollar indexes—one prepared by the Board of Governors, Federal Reserve System; one by the International Monetary Fund (IMF); one by Morgan Guaranty Trust Company of New York; and one by the Department of the Treasury. As that table shows, several features distinguish an exchange rate index. One of these pertains to the use of bilateral versus multilateral weights. For example, Morgan Guaranty and the Treasury use bilateral weights, whereas the Board and the IMF use multilateral weights. Another relatively minor issue concerns the treatment of exports and imports in constructing trade weights (that is, whether one should use export weights, import weights, or some combination of the two). Also, there is the choice of a geometric or arithmetic averaging technique, although the preponderance of indexes have adopted the geometric procedure.

Potentially more important, however, is that the indexes differ according to the year(s) over which the trade weights are calculated. In the Board’s index, for example, the weights are constructed for trade patterns of the 1972-76 period, whereas Morgan Guaranty uses those for 1980. On this point, it is worth noting that actual trade weights vary significantly (albeit slowly) over time. Over the period from 1970 to 1985, U.S. trade with Japan, for example, has ranged from a low of 10.6 percent to a high of 16.5 percent of total U.S. trade; Canada, from 16.6 percent to 26.5 percent; and Europe, from 23.7 percent to 31.7 percent.

Of primary importance is the choice of currencies against which to measure the dollar. On first inspection, the existing indexes appear to vary widely in this regard. The Board’s index, for example, contains only 10 countries, whereas that of the Treasury contains 22. On closer inspection, however, there is clearly a consistent pattern of “nesting” in the countries used. The Board’s index contains the G-10 countries plus Switzerland, to which Morgan Guaranty adds five countries (Australia, Austria, Denmark, Norway, and Spain). The Fund adds two more (Finland and Ireland). Finally, the Treasury adds Greece, Iceland, New Zealand, Portugal, and Turkey to arrive at all 22 OECD countries.

Primary motivation for the construction of exchange rate indexes has been the need “to provide a measure of changes in the dollar’s general foreign exchange value broader than a measure provided by any single exchange rate change.” In the selection of currencies against which to measure the dollar, however, the choice has been guided, at least in part, by the desire to judge the dollar relative to other major traded currencies rather than simply by trade in goods. The Swiss franc, for example, is in every major exchange rate index, although Switzerland is the United States’ twentieth largest trading partner; and notably excluded is the Mexican peso, despite Mexico’s being our third largest trading partner. Also notably excluded are the PACNIC group—Taiwan, Korea, Hong Kong, China, Singapore, Indonesia, Malaysia, and Thailand—whose combined trade share has grown from under 6 percent in 1970 to 14 percent in 1985. Thus, the indexes generally “do not purport to represent a guide to measuring the impact of exchange rate changes on U.S. international transactions.”

The X-131 Dollar Index has been developed to provide a contrast to existing exchange rate indexes and to assess the benefits of constructing a broader exchange rate index. The key distinguishing feature of this new index is that it contains all 131 U.S. trading partners. Including all U.S. trading partners shifts the focus more toward issues of international competitiveness. A somewhat secondary feature is that the trade weights are allowed to move over

---

Table 1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Board of Governors, Federal Reserve System</td>
<td>61.7</td>
<td>33.6</td>
</tr>
<tr>
<td>International Monetary Fund (MERM)</td>
<td>49.7</td>
<td>28.3</td>
</tr>
<tr>
<td>Department of the Treasury</td>
<td>58.8</td>
<td>17.5</td>
</tr>
<tr>
<td>Morgan Guaranty Trust Company of New York</td>
<td>41.6</td>
<td>25.7</td>
</tr>
</tbody>
</table>

1. Index peak occurs in February 1985.
2. Index peak occurs in February 1985; depreciation is to April 1986.
<table>
<thead>
<tr>
<th>Index</th>
<th>Averaging procedure</th>
<th>Base period</th>
<th>Trade weights</th>
<th>Number of countries</th>
<th>Country names¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board of Governors, Federal Reserve System</td>
<td>Geometric</td>
<td>March 1973</td>
<td>Multilateral, export plus import</td>
<td>10</td>
<td>Germany, Japan, Canada, France, United Kingdom, Italy, Netherlands, Belgium, Sweden, Switzerland</td>
</tr>
<tr>
<td>Morgan Guaranty Trust Company of New York</td>
<td>Geometric</td>
<td>1980-82</td>
<td>Bilateral, export plus import</td>
<td>15</td>
<td>Canada, Japan, Germany, United Kingdom, France, Italy, Belgium, Netherlands, Switzerland, Austria, Sweden, Spain, Denmark, Norway, Australia</td>
</tr>
<tr>
<td>International Monetary Fund (MERM)</td>
<td>Geometric</td>
<td>1980</td>
<td>Multilateral, derived from MERM¹</td>
<td>17</td>
<td>Japan, Canada, Germany, France, Italy, United Kingdom, Australia, Netherlands, Sweden, Belgium, Spain, Switzerland, Denmark, Norway, Austria, Finland, Ireland</td>
</tr>
<tr>
<td>Department of the Treasury</td>
<td>Geometric</td>
<td>May 1970</td>
<td>Bilateral, export-import averages</td>
<td>22</td>
<td>Japan, Canada, Germany, France, Italy, United Kingdom, Australia, Netherlands, Sweden, Belgium, Spain, Switzerland, Denmark, Norway, Austria, Finland, Ireland, Turkey, Iceland, Portugal, Greece, and New Zealand</td>
</tr>
<tr>
<td>X-131</td>
<td>Geometric</td>
<td>Q1:1973</td>
<td>Bilateral, export plus import moving annually</td>
<td>131</td>
<td>All U.S. trading partners¹</td>
</tr>
</tbody>
</table>

1. Trade weights are derived from a detailed elasticity-estimating procedure using the Multilateral Exchange Rate Model as developed in the IMF’s Research Department.
2. In descending trade-weight order. Ordering is not available for Treasury; ordering changes for X-131; however, for sake of comparison, as calculated by the methodology here, the United States’ top 20 trading partners in 1985, in descending order, were as follows: Canada, Japan, Mexico, Germany, United Kingdom, Taiwan, Korea, France, Italy, Hong Kong, Netherlands, Brazil, Venezuela, Australia, Belgium-Luxembourg, China, Singapore, Saudi Arabia, Sweden, and Switzerland.
3. Excluding the Soviet Union (see footnote 15).
<table>
<thead>
<tr>
<th>Year</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>114.714</td>
<td>117.448</td>
<td>118.170</td>
<td>119.889</td>
<td>122.827</td>
<td>125.166</td>
<td>127.519</td>
<td>129.547</td>
<td>127.737</td>
<td>127.518</td>
<td>126.336</td>
<td>126.733</td>
</tr>
<tr>
<td>1983</td>
<td>149.685</td>
<td>152.014</td>
<td>154.091</td>
<td>156.497</td>
<td>157.095</td>
<td>159.909</td>
<td>161.586</td>
<td>164.431</td>
<td>165.633</td>
<td>168.050</td>
<td>170.390</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>204.304</td>
<td>201.034</td>
<td>199.971</td>
<td>199.943</td>
<td>198.026</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>

**SOURCES OF PRIMARY DATA:** Bank of America, Financial Times (London), International Monetary Fund.

The calculations, the dollar reached a high in March 1985, climbing by 65.5 percent from January 1980. This is consistent with the Board’s index and other existing indexes, which show a range of appreciation in the dollar from 41.6 percent to 61.7 percent over this period. In contrast to the other indexes, however, which show a 17.5-percent to 33.6-percent depreciation in the dollar since the peak, the new X-131 Index shows only a 6.3-percent depreciation. The implication is that the dollar has not, in fact, fallen sig-

![Figure 1](image-url)
Table 4

<table>
<thead>
<tr>
<th>Country or group</th>
<th>1985 weight</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>0.207</td>
<td>+17.3</td>
</tr>
<tr>
<td>Japan</td>
<td>0.168</td>
<td>+8.3</td>
</tr>
<tr>
<td>Europe</td>
<td>0.252</td>
<td>+83.2</td>
</tr>
<tr>
<td>PACNIC</td>
<td>0.140</td>
<td>+30.0</td>
</tr>
<tr>
<td>Western Hemisphere</td>
<td>0.137</td>
<td>+195.7</td>
</tr>
<tr>
<td>Other</td>
<td>0.096</td>
<td>+88.5</td>
</tr>
</tbody>
</table>

SOURCES OF PRIMARY DATA: Bank of America, International Monetary Fund.

Table 5
DEPRECIATION OF THE DOLLAR: MARCH 1985-MAY 1986

<table>
<thead>
<tr>
<th>Country or group</th>
<th>1985 weight</th>
<th>Percent change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>0.207</td>
<td>0.0</td>
</tr>
<tr>
<td>Japan</td>
<td>0.168</td>
<td>-43.8</td>
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<tr>
<td>Europe</td>
<td>0.252</td>
<td>-32.6</td>
</tr>
<tr>
<td>PACNIC</td>
<td>0.140</td>
<td>+1.1</td>
</tr>
<tr>
<td>Western Hemisphere</td>
<td>0.137</td>
<td>+64.0</td>
</tr>
<tr>
<td>Other</td>
<td>0.096</td>
<td>+15.6</td>
</tr>
</tbody>
</table>

SOURCES OF PRIMARY DATA: Bank of America, Financial Times (London), International Monetary Fund.

significantly on a purely trading-partner basis, but it remains near its peak, and at a level approximately 60 percent above that in 1980.

Assessing the depreciation in the dollar

In order to determine the sources of disparity between the depreciation figures calculated here and those calculated by the other indexes, it is helpful to measure the dollar against the currencies of specific countries or groups of countries. Table 4 shows the appreciation in the dollar relative to the currencies of Europe, Canada, Japan, the PACNIC, the Western Hemisphere (excluding Canada), and of all other countries over the period from January 1980 to February/March 1985. The central message here is that during this period the dollar appreciated relative to every major trading partner or group.

The breakdown of the appreciation in the dollar by country or group is shown in Figure 2. Of the 65.5-percent appreciation in the dollar over the 1980-85 period, 21.0 percentage points were attributable to appreciation against the mark and other European currencies; 14.4 points against the yen; 4.2 points against the PACNIC currencies; 3.6 points against the Canadian dollar; 26.8 points relative to the currencies of the Western Hemisphere countries (excluding Canada); and 8.5 points relative to other countries' currencies. If the depreciation in the dollar (see Table 5) since March 1985 is examined, a different story emerges.

Whereas the dollar has depreciated against the currencies of Japan and Europe, it has continued to appreciate against those of the PACNIC, the Western Hemisphere, and other countries. The greatest depreciation in the dollar is against the yen and against European currencies, with the greatest appreciation still against the currencies of the Western Hemisphere. When multiplied by respective trade weights (see Figure 3), the figures show that Europe has contributed 8.2 percentage points to the depreciation in the dollar since March 1985, and Japan has contributed 7.4 points. This has, in part, been offset, however, by appreciation in the dollar relative to the PACNIC, the Western Hemisphere, and other currencies, and essentially no movement relative to the Canadian dollar.

As Table 6 shows, most existing indexes essentially do not weight the currencies of the Western Hemisphere countries (excluding Canada) or the PACNIC; they overweight the European currencies according to 1985 actual trade shares, and they omit or underweight the other countries' currencies.20 By including the currencies of the Western Hemisphere countries (a 1985 trade weight of 14 percent), the PACNIC (a weight of 14 percent), and others (9 percent)—and by the consequent adjustment of the trade weights of Europe, Japan, and Canada to reflect actual trade patterns—the X-131 Index would have the potential to diverge from the other indexes. The fact that the other indexes track the X-131 Index closely over the 1980-85 period follows from a more uniform appreciation of the dollar during this period relative to every major trading partner (those included as well as those excluded in the other indexes). Since early 1985, however, because the dollar has simultaneously depreciated against Europe and Japan and ap-
Figure 2
Trade-Weighted Appreciation of the Dollar: January 1980–March 1985

PERCENT

<table>
<thead>
<tr>
<th>Region</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>21.0</td>
</tr>
<tr>
<td>Japan</td>
<td>1.4</td>
</tr>
<tr>
<td>Pacific</td>
<td>4.2</td>
</tr>
<tr>
<td>Canada</td>
<td>3.6</td>
</tr>
<tr>
<td>Western Hemisphere</td>
<td>26.8</td>
</tr>
<tr>
<td>Other</td>
<td>8.5</td>
</tr>
<tr>
<td>Total</td>
<td>65.5</td>
</tr>
</tbody>
</table>

SOURCES OF PRIMARY DATA: Bank of America, International Monetary Fund.

Figure 3
Trade-Weighted Depreciation of the Dollar: March 1985–May 1986

PERCENT

<table>
<thead>
<tr>
<th>Region</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>-8.2</td>
</tr>
<tr>
<td>Japan</td>
<td>-7.4</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.2</td>
</tr>
<tr>
<td>Canada</td>
<td>0.0</td>
</tr>
<tr>
<td>Western Hemisphere</td>
<td>8.8</td>
</tr>
<tr>
<td>Other</td>
<td>1.5</td>
</tr>
<tr>
<td>Total</td>
<td>-6.3</td>
</tr>
</tbody>
</table>

SOURCES OF PRIMARY DATA: Bank of America, Financial Times (London), International Monetary Fund.
preciated against the rest of the world, the indexes have diverged.

Conclusions and projections

The new alternative trade-weighted dollar exchange rate index reported here differs from existing indexes in that it contains all 131 U.S. trading partners. A moving-trade-weight approach is also adopted. The basic finding of the study is that, measured on a full trading-partner basis, the dollar has depreciated roughly only 6 percent since early 1985. This figure is in marked contrast to those of existing indexes, which indicate a depreciation in the dollar from 17.5 percent to 33.6 percent over this period. Additional research is needed in order to fully assess the applicability of the X-131 Index in determining international trade flows. In this regard, it is widely held that international trade flows should depend upon the real exchange rate—that is, the rate of exchange of one country’s goods for those of others—at least over the long term.21 The five indexes reported here are, of course, purely nominal in that they measure only the rate of exchange of U.S. currency for foreign currency. Hence, further research is needed in order to construct a comparable new real index, and to examine the ability of both the new X-131 Index and the other indexes to explain international trade flows.22


2. All reported percentage appreciation or depreciation figures for all indexes are calculated on a logarithmic basis. That is, the percentage difference between the exchange rate (€) in time period t and that in time period t + 1 is calculated as ln(€t+1/€t).

3. One exception here is the Canadian dollar, which is included in the existing indexes and against which the U.S. dollar has not depreciated.

4. Recently, Merrill Lynch has developed an exchange rate index which may be contrasted to the existing indexes as well as to the new X-131 Index reported here. Merrill Lynch's index contains 25 of the United States' top trading partners as calculated on both an import-trade and an export-trade basis for 1985. The Merrill Lynch index thus includes Mexico, Taiwan, Korea, Hong Kong, and several other countries not contained in most existing indexes but contained in the X-131 Index. In contrast to the other indexes but in line with the X-131 Index, Merrill Lynch finds that the dollar has depreciated only 2.1 percent (using export-trade weights) to 7.7 percent (using import trade weights) since...
The United States is, of course, excepted from the

while the use of moving trade weights is desirable in the above context, this procedure could introduce some simultaneity bias if the index were used to estimate the impact of dollar exchange rate movements on trade flows.

The United States is, of course, excepted from the C-10 group considered here.

Again, the United States is specifically omitted from the OECD countries discussed here.

The quotation is taken from the notes to Table IFS-4, in "Weighted Average of Exchange Rate Changes for the Dollar," Treasury Bulletin (Spring Issue, 2d Quarter, Fiscal 1966): 43.

The rankings for Switzerland and for Mexico are on the basis of export-plus-import trade weights for 1985, as calculated in the text.

See footnote 11, supra.

With the exception of that for Taiwan, all export-plus-import data are taken from the Direction of Trade Statistics, and exchange rate data come from International Financial Statistics, both published by the International Monetary Fund. Data on Taiwan originated from the Bank of America. Finally, several recent exchange rate statistics were obtained from the Financial Times (London).

Trade with the Soviet Union accounts for approximately 0.9 percent of U.S. exports plus imports in 1985. The ruble/dollar exchange rate, however, has not been included in the index because the exchange of the ruble is generally not at free market rates. Remaining trade weights have been adjusted to reflect this exclusion.

As an illustration, the X-131 Index has not excluded those countries from whom the U.S. imports primarily oil-related products. (The argument typically given is that these countries should be excluded since oil is primarily a dollar-denominated commodity.) Mexico and Venezuela, for example, are omitted in some indexes on this basis.

The primary motivation for adopting the moving-trade-weight approach (rather than using a fixed-base-year approach) was to reduce the overestimation or underestimation of exchange rate movements associated with long periods of data. In order to assess the degree to which the moving-trade-weight approach affected the results, the X-131 Index also was calculated for three other weighting schemes—one using 1972-76 weights, one using 1985 weights, and one in which the weights were estimated using a three-year moving average process. Using 1972-76 weights, the dollar is calculated to have appreciated 66.0 percent over the period from January 1980 to March 1985 and depreciated 6.3 percent since that time. Using 1985 weights, the results are, similarly, 65.3-percent appreciation and 6.3-percent depreciation. Finally, the three-year moving average method shows 64.4-percent appreciation and 4.6-percent depreciation. Hence, the central results of the study here are preserved.

Because of the incomplete nature of trade data, in the calculation of the current-year figures for the index, prior-year trade weights were used. (That is, during 1986, 1985 trade weights were used.) The 1986 numbers should then be viewed as preliminary, although little change is anticipated.

For the sake of visual comparison, the Board's index has been multiplied throughout by the constant 1.2804, so that the indexes have a common starting value for January 1980.

Because details of the trade weights used by the Treasury were unavailable, they have not been included in the calculations shown in Table 6.

In this regard, it could be argued that one of the virtues of the Board's index is that it contains a selection of countries whose inflation histories are similar to that of the United States; thus, at least over a short period, the Board's index could also be used as a measure of the real exchange rate. This argument also applies, though to a lesser degree, to the other existing indexes reported here.

The author is currently in the process of constructing a new real alternative trade-weighted index and is empirically examining the explanatory power of both the X-131 Index and a variety of other exchange rate indexes.
Appendix

Construction of the X-131 Quarterly Index

The primary motivation for the calculation of quarterly statistics is that the monthly exchange rate data are not available for all 131 countries prior to 1976, whereas quarterly data are available much earlier.

The calculation of the quarterly series parallels that of the monthly statistics reported in the text, except that the individual exchange rate statistics used in calculating the index are quarterly averages.

Table A reports the X-131 Quarterly Index over the period from Q1:1970 to Q1:1986.

<table>
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<tr>
<th>Year</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
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<tr>
<td>1970</td>
<td>107.205</td>
<td>107.845</td>
<td>106.999</td>
<td>107.062</td>
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<tr>
<td>1971</td>
<td>107.103</td>
<td>106.991</td>
<td>106.243</td>
<td>104.230</td>
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<tr>
<td>1972</td>
<td>102.179</td>
<td>101.692</td>
<td>102.071</td>
<td>102.520</td>
</tr>
<tr>
<td>1973</td>
<td>100.000</td>
<td>96.928</td>
<td>95.262</td>
<td>97.203</td>
</tr>
<tr>
<td>1974</td>
<td>99.907</td>
<td>97.995</td>
<td>100.007</td>
<td>100.422</td>
</tr>
<tr>
<td>1975</td>
<td>99.172</td>
<td>99.842</td>
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<tr>
<td>1976</td>
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<td>105.521</td>
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<tr>
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<td>1982</td>
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<tr>
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<td>1986</td>
<td>201.910</td>
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</table>

SOURCES OF PRIMARY DATA: Bank of America
International Monetary Fund.