A Missing Stop on the Road from Warburton to Friedman – Meiselman and St. Louis

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ABSTRACT: Friedman and Meiselman (1963) typically is recognized as the original study that used a reduced-form equation to evaluate whether fiscal or monetary actions were the dominant influence on aggregate spending. It also provided the foundation for the better-known St. Louis Equation that followed. Missing from this evolution, however, are important precedents by Brunner and Balbach (1959) and Balbach (1963) that also employed a reduced form framework to offer evidence on the same fiscal versus monetary debate. Moreover, they also investigated whether the demand for money function was stable and inversely related to an interest rate, properties necessary in their reasoning before any more general model of national income determination could be developed. With this foundation, they then derived a reduced form expression for personal income from an explicit theoretical model and, in its estimation, they anticipated and addressed some of the empirical criticisms later directed at Friedman-Meiselman and the early versions of the St. Louis Equation. Taken together, the theoretical and empirical work reported in Balbach (1963) and Brunner and Balbach (1959) suggest these papers are clear antecedents of later reduced form expressions and should be recognized as such.

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Friedman and Meiselman (1963) generally is viewed as the original effort to evaluate the relative strengths of fiscal and monetary actions on aggregate activity within a single equation reduced-form framework. This paper soon received a number of critical responses from, among others, Hester (1964), Ando and Modigliani (1965), and DePrano and Mayer (1965). The criticisms of the work were both theoretical and empirical. Chief among these were that incorrect measures of fiscal actions had been used, the endogeneity of both fiscal and monetary policies had not been acknowledged, and that, by focusing on levels of the data, the estimated reduced form exhibited serially correlated errors. With these issues in mind, Andersen and Jordan (A-J (1968)) modified the Friedman-Meiselman (F-M) equation by using nominal spending rather than consumption as the equation's dependent variable and by employing several alternative measures of the money supply and federal budget deficits or spending. They also expressed the F-M equation in first differences to deal with the autocorrelation problem that might affect the results and introduced lags so that the effects of monetary and fiscal actions could be distributed over time. Even after these modifications, however, the St. Louis Equation encountered criticisms of its own. [1] Nonetheless, throughout this evolution, the results tended to be robust with respect to the assertion that the quantity of money was more closely associated with aggregate spending than were fiscal actions and, for that reason, the St. Louis Equation remained a standard model used by monetarists to examine and predict how actions by a central bank would be likely to affect aggregate activity.

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[1] Bias (2014) presents a chronology of criticisms of the Friedman-Meiselman and Andersen-Jordan equations and the authors' responses to them. This survey includes overviews of papers published as recently as 2011 that have re-visited the various controversies surrounding the F-M and A-J single equation approach to the fiscal v. monetary policy debate.

Missing from this story, however, is a set of conjectures by Clark Warburton (1945) on the relative impacts of fiscal and monetary actions on final spending that later were formalized and examined empirically by Brunner and Balbach (1959) and Balbach (1963). The latter two works not only derived a reduced form equation similar to the familiar ones named above but did so from a microtheoretic model of the supply of and demand for money. Moreover, they argued that, absent a "higher level" hypothesis that begins with the stability of a money demand function, any empirical attempt to find linkages between some measure of aggregate demand and fiscal or monetary actions would be an *ad hoc* exercise without properly grounded nulls.

Despite their more solid theoretical footings and explicit attention to money demand as a foundation for the subsequent reduced form spending equation they estimated, both Brunner and Balbach (1959) and Balbach (1963) are basically unknown in the literature. In what follows, the inspiration for this work in Warburton (1945a) is discussed and the most important features of these two overlooked papers are presented. Comparisons then are made between these early works and their better-known successors. The conclusion is that both the Friedman-Meiselman (1963) work and the subsequent versions of the St. Louis Equation have antecedents that should take their place as the original reduced form expressions that examine the relative strengths of monetary and fiscal actions.

Warburton's Conjecture

From the early 1940s through the early 1950s, Clark Warburton published numerous papers on monetary topics including the behavior of velocity, monetary rules, and the effects of money on the price level and business cycle. [2] Cargill (1979, p. 432) describes Warburton's work as reflecting "an inductive and empirical approach" that was "very similar to the methodology expressed in Friedman's (1953) discussion of positive economics." Characteristic

[2] Many of these papers are collected in Warburton (1966). The bibliography in Balbach (1963) lists thirty-one papers published by Warburton between 1935 and 1952. Bordo and Schwartz (1979), Cargill (1979, 1981), and Tavlas (2019) survey Warburton's work with special emphasis on its connections to monetarism.

of this work was a narrative explaining why certain relationships between variables should be expected accompanied by a set of data tables and plots that illustrated the behavior he had described. In several cases, for example, Warburton illustrated how turning points in money growth would anticipate subsequent changes in nominal spending and, from these presentations, concluded that money was an important determinant of economic activity. His work, however, did not include regression analysis of the type presented by others (e.g. Snyder (1934) and Angell (1936)). It also should be noted that while he and other economists had studied the association between money and aggregate activity Warburton, by the early 1940s, had not yet extended his work to the broader question of whether some measure of fiscal policy might be more strongly connected to fluctuations in aggregate activity than variations in the quantity of money. [3] On this subject Warburton was an innovator and it is this work that serves as a starting point for the fiscal v. monetary debate that evolved over the next three decades. For the discussion that follows, the presentations in Warburton (1945a and 1946b) motivate the subsequent investigations by Brunner and Balbach (1959) and Balbach (1963) which, it is argued, presented statistical evidence on this question prior to the better-known works of the 1960s and 1970s.

In "The Monetary Theory of Deficit Spending" (1945a) and "A Reply" (1946a) Warburton exhibits the "inductive and empirical approach" described by Cargill by presenting an intuitive theoretical argument that eventually connects the national income stream (value of delivered final goods) to the quantity of money and some notion of government spending. In broad outline, Warburton explains his reasoning as follows:

> "Fiscal policy as an instrument of increasing economic activity is a combination of (1) monetary policy, for any action increasing the volume of money or changing its rate of flow is a type of monetary policy, and (2) production policy, as expressed in the objects of government expenditures. Of these two aspects of fiscal policy, the monetary aspect is by far the more important with respect to the total volume of production or rate of economic activity. In fact, if fiscal policy has no effect on the volume of money or its rate of use in the purchase of products of the economy, the production policy expressed in the objects of government expenditures is a substitution of goods and services

[3] See Trescott (1982) for a survey of early empirical work on the relationship between money and nominal spending and Warburton's place in this literature.

> ordered by government for goods and services which would be ordered by individuals. Except for a possible effect upon efficiency, the net effect of fiscal policy upon the total volume of economic activity or production is due solely to its monetary aspect.
>
> The effectiveness of fiscal policy as an instrument for increasing economic activity or enlarging the income stream, in order that a condition approaching full use of resources or full employment may be achieved, therefore depends directly upon the effectiveness of fiscal policy as a technique for the exercise of monetary policy." (1966, p. 236)

After more discussion of how fiscal policy will affect borrowing and spending and a summary of his reasoning under four articulated tenets of how fiscal policy is transmitted in the economy, Warburton states his conclusion as:

> "That is, we have again arrived at the conclusion that it is the monetary expansion accompanying deficit spending or a change in the rate of use of money accompanying its transfer from individuals to government, rather than deficit spending itself, which is of significance in the relation of government financial operations to the size of the income stream." (1966, p. 245).

In terms of evidence on these propositions, Warburton relies on a chart, reproduced in Figure 1, displaying the data he reports in the text of his paper (1966, pp. 250 - 251). The top panel of the figure plots what he calls "the size of the income stream – value of delivered final products" and a measure of money. The two series, as shown, appear to move together. [4] Although Warburton reported no statistics, a simple correlation coefficient for them is 0.80. The two bottom panels of the figure show alternative measures of fiscal actions. The first, shown in the middle panel, is "Income Producing Expenditures that Offset Savings." The second, shown in the figure's bottom panel, is defined as "excess of expenditures excluding debt retirement over revenue" and is referred to in Warburton's table as "Excess of Cash Outgo." The years between 1922 and 1933 do not appear in the bottom panel because Warburton notes that they are less than zero. Whereas money and aggregate expenditures appear to move together in the top panel, the data in the two middle panels, in Warburton's

[4] The top panel of the figure, although based on a different sample period, is similar to one presented by Angell (1936, p. 145) that illustrated a long run relationship between money and nominal income. Angell's discussion of the data, however, noted that it was not possible to conclude from these data a direction of causation between the two variables. Further analysis based on an expanded set of data led Angell (1937) to change his opinion to one where money was the causal force and that much of the downturn in economic activity between 1928 – 1933 could have been avoided if the money supply had been stabilized.

eyes, do not appear to be associated with the income stream. From this Warburton draws the conclusion:

> "These data indicate that the facts support the foregoing conclusions, namely, that changes in the size of the income stream are much more closely related to changes in the volume of money, adjusted for the trend in the volume of money held as a store of value, than to the amount of government deficit spending or to such spending plus business spending for capital purposes." (1966, pp. 252)

Warburton's narrative and the data shown in Figure 1 are all that is brought to bear on this early inquiry to the fiscal versus monetary policy debate. The conclusion about the effects of fiscal activity on final expenditures, however, is mistaken: The correlation between the expenditures on final goods shown in the top panel and the proxy for deficit spending shown in the middle panel is 0.77, a value in both magnitude and significance indistinguishable from that associated with money. [5]

Finally, in regard to his main conjecture – that it is the creation of money from fiscal actions that ultimately affects aggregate income -- it should be the case that tests of causality would reveal fiscal actions as the cause of changes in money. Here, the results reject his conjecture. Whether using the measure plotted in the figure's middle panel or two alternative measures of deficit spending reported in Warburton's table, causality tests between money and these alternative fiscal variables in each case show no significant causation between them. In rejecting Warburton's conjecture about fiscal actions causing movements in money, the causality tests also appear to indicate that the value of final products delivered causes movements in the money supply rather than the reverse. Thus, while the top panel in Figure 1 does show money and spending to move together, the association appears to be the product of the reverse-causation criticism later directed to the results reported by F-M and A-J.

[5] Warburton reports another measure of deficit spending in his table and calls it "income producing expenditures of all governments." Notably, its correlation with the measure of deficit spending shown in the figure's middle panel is 0.05. This lack of association across alternative measures of deficit spending illustrates the possibility that estimated relationships between final spending and fiscal action could be sensitive to measurement, a criticism later directed at F-M and A-J.

Formalizing Warburton

The material presented in Brunner and Balbach (1959) and Balbach (1963) overlap to a considerable degree and, for that reason, the discussion below will focus primarily on the latter paper. The overlap occurs because Balbach (1963) is a PhD dissertation supervised by Brunner while Brunner and Balbach (1959) can be seen as the presentation of some preliminary work from that thesis. Although the results from the earlier paper will be discussed briefly, the dissertation presents a fully formed theoretical model from which the reduced form equation for aggregate spending is derived.

The first parts of the paper and thesis are presentations of what can be regarded as an enunciation of principles drawn from the philosophy of science. For example, the purpose of the thesis is described as an effort to:

> "…indicate methodological problems existing in the writings of economists of that time…..and to evaluate the implications of the hypotheses, as corrected, as a basis for monetary policy and as a test of hypotheses in other branches of economics.
>
> The plan is (1) to evaluate Warburton's assertions as restated in more rigorous form, (2) to show that these assertions can be derived for a higher level hypothesis, and (3) to analyse the implications of this hypothesis (if true) with respect to monetary policy as they are suggested by Warburton." (Balbach (1963), p. 6).

Balbach (1963, p. 23) notes his dissertation is not intended to be a critique of Warburton and explains that he chose Warburton's work as an example because

> "The difference between Warburton's assertions and those of many of his contemporaries lies in the fact that he at least made an attempt to test the validity of his assertions by assigning semantic rules to his variables and comparing his predictions with observable events. This attempt in itself was of the utmost importance since it raised meaningful questions and problems for further investigation."

In short, Balbach viewed his thesis as a general examination of research methodology that used a few of Warburton's papers to illustrate his argument. In more basic terms, the fundamental criticism of Warburton is that his conclusions are *ad hoc* assertions based on

intuitive reasoning or observed associations in the data rather than being based on a coherent model from which formal null hypotheses can be drawn. [6]

After this discussion of scientific principles, Balbach eventually explains how Warburton's narrative and presentations of data might be interpreted:

> "It seems that Warburton is primarily concerned with showing that the demand for cash balances can be measured and is independent of the supply of money, and that money supply is a determinant of national income and/or the price level, implying the effectiveness of monetary policy within the institutional framework of the U.S. economy. A fully implemented hypothesis about the demand for money combined with one about money supply and with an appropriate income model would accomplish the desired results."
>
> The money demand hypothesis is a higher level hypothesis than those put forth by Warburton which, with appropriate modifications, could be derived from it." (Balbach (1963), p. 25).

In acknowledging the usefulness of Warburton's earlier findings while also emphasizing the need for a higher level theory to motivate sharper hypotheses and empirical tests, Balbach (1963) presages similar views expressed by Brunner himself, with Allan Meltzer, in their "Friedman's Monetary Theory" (1972, p. 838):

> "A prevalent view among economists is that hypotheses involving empirical regularities must be "supported" by a higher-level theory from which the lower-level proposition can be derived. We do not share this view; in fact, we dissent strongly and so does the modern literature of the philosophy of science. However, if theories generate useful empirical conjectures -- such as the empirical work on the demand for money and the relation of money to income (Andersen and Jordan (1968); Keran (1969)) -- the expected gain from more discriminating tests derived from more fully developed hypotheses increases." [7]

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[6] In subsequent correspondence with both Balbach and Brunner, Warburton made no substantive points on the work. In correspondence (February 14, 1964) with Brunner, however, he did object to the idea that Balbach did not base his study on a full treatment of his other papers or provide an opportunity to review the dissertation prior to its completion. In response, Brunner (March 25, 1964) noted that "I fail entirely to understand why you feel that Mr. Balbach or the thesis committee, lacked 'ordinary courtesy' for the reason you indicated. Once your work is in the public domain, anybody may address himself to it." This correspondence can be found in the Special Collections Library at George Mason University. We thank Brittney Falter for her help in obtaining this correspondence.

[7] Hoover (2018, p. 10) explains Brunner's views on the importance of a higher level hypothesis in this manner:

From this critique Balbach (p. 28) begins with a discussion of the demand for money and its derivation from the optimizing behavior of individuals and firms. As the higher level hypothesis, finding empirical evidence against it (e.g., a positive interest elasticity) would not justify its use in making any subsequent derivations that linked money to aggregate income. With the foregoing in mind Balbach states that the essence of Warburton's discussion is based on three premises. The first is:

(1) $P_n/P_0 = (M^s_n/M^s_0)/(M^n_n/M^n_0)$

where P_n/P_0 is a price index, M^s_n/M^s_0 is an index of the "supply" of money, and M^n_n/M^n_0 is an index of the "need" for money. In Warburton's discussion (1945b, p. 155), the public has a certain "need" for money. This expression then states that the relative change in the level of prices is equal to the relative change in the money supply divided by the relative change in the "need" for money.

Warburton's second proposition is about the behavior of velocity, which is expressed by Balbach as:

> "One element in his effort to achieve unification in science is his recognition of a hierarchy of theories (Brunner 1969, p. 506). A simple empirical generalization (e.g., "for all economies, inflation is correlated with the growth rate of the money stock") is an elementary theoretical claim. It goes beyond observation, but is testable. An observation of an economy in which such a correlation was not found would refute (but not necessarily reject) it. Still, such an empirical generalization is analytically shallow. A higher level theory of the economy (e.g., the IS/LM model or Brunner and Meltzer's (1976) own three-asset extension of that model or the dynamic stochastic general-equilibrium (DSGE) model) from which such elementary empirical generalizations could be derived provides us with a richer cognitive articulation and with a greater analytic capacity, which are helpful, for example, in guiding policy and understanding its limitations."

From this perspective, empirical investigations of the type performed by Warburton and Friedman-Meiselman report some useful information but are "analytically shallow" in the absence of a higher level theory that would permit the findings to offer a "richer articulation of them." This distinction seems to be the motivating influence for Balbach's thesis.

(2) $V_t = (1 - 0.015)V_{t-1}$

This represents Warburton's conclusion (1946b, p. 488), based on observation of the data, that velocity declined at a rate of 1.5 percent per year over a "normal period" of 1923-1928. Noting that this conclusion is based on just six observations, Balbach estimates a regression of velocity on a time trend over a sample spanning 1923 – 1941 using data in Warburton (1946b). He reports the results as (standard error in parentheses):

(2a) $V_2 = 2.042 - 0.2574*\text{trend}$
(0.06)

which leads Balbach (p. 16) to conclude that "the outcome of this test does not imply even that the postulated relationship is any better than pure chance."

The last of Warburton's three conjectures (1945a, p. 81) is interpreted by Balbach as:

(3) $\Delta Y = k_1\Delta M + k_2\Delta G + k_3\Delta I$

where changes in income are a function of changes in money, government expenditures, and investment. For money to dominate deficit spending as the primary influence on aggregate income, estimation of an equation of this form would show $k_1 > (k_2 + k_3)$. Note here that, unlike F-M or A-J, this equation shows two possible channels of influence from fiscal actions rather than measures of autonomous expenditures, deficit spending, or government receipts alone.

The Demand for Money

With the demand for money taken as the higher-level hypothesis from which sub-hypotheses can be derived, Balbach (p. 55) specifies a money demand function as:

(4) $M_2 = F(r_3, P_1, E_2)$

where M_2 is the conventional M_2 monetary aggregate composed of M_1 plus savings and small time deposits, r_3 is the bank rate on loans to businesses, P_1 is the wholesale price index, and E_2

is an estimate of permanent income. [8] Sub-scripts are attached to the equation's variables because the author experimented with a number of alternative measures. These included two measures of money, three concepts of the interest rate, two measures of income, and two measures of the economy's equity. [9] Balbach estimated 24 regressions that represent all possible combinations of the equation's four variables and another sixteen regressions that add two different measures of the price level to the equation. These were estimated on a sample of quarterly data spanning 1939.1 through 1957.4 and then a "best" equation was identified as the one with the lowest error variance for out-of-sample forecast values over 1958.1 through 1960.4.

The resulting money demand equation (with standard errors in parentheses) was: [10]

$$(5)\quad \log M_2 = -2.41 - 0.39 \log r_3 + 1.07 \log (E_2/P_1) + 1.03 \log P_1'$$
$$\qquad\qquad\qquad\qquad (0.02) \qquad (0.02) \qquad\qquad (0.03)$$

The author notes that, as the "higher level" hypothesis upon which subsequent derivations will depend, this equation must exhibit stability as well as signs on coefficients that comport with theory. In Balbach's judgment these conditions are satisfied because the demand curve is negatively related to the interest rate and positively related to the price level and all measures of wealth employed. The estimate attached to the price level, in this equation and in the fifteen other equations reported, is not significantly different from one. In terms of stability, Balbach notes that the estimated interest elasticities of demand range from -0.28 to -0.68 and do not show a tendency to decline as the interest rate decreases, a result that is inconsistent with the notion of a liquidity trap. Finally, Balbach notes that his finding of a significant relationship

[8] Considerable discussion in the text, much of which resembles that in Friedman (1956a), is devoted to the theory that leads to a money demand equation of this form.

[9] Appendix B of Balbach (1963) discusses these alternatives in greater detail and shows the source of each measure. Table 1 of this Appendix provides the data for all series used in the empirical work.

[10] Although not stated in Balbach (1963), the notation suggests use of logs to the base ten rather than natural logs.

between the quantity of money demanded and an interest rate is in contrast to Friedman's (1959) argument that the demand for money depends on permanent income alone.

With evidence in support of the higher-level hypothesis in place, Balbach (1963) lays the foundation for the reduced form spending equation with a model composed of six equations. His point is that (p. 61):

> "In short, Warburton is attempting to show that monetary policy is more effective than fiscal, but due to the incomplete implementation of this assertion no conclusions were reached. It can, however, be derived from and be consistent with the money demand hypothesis. The assertion as stated resembles the reduced form of many national income models. In view of the derivation of the money demand function H_2, investment cannot be exogenous but other variables can. The simplest national income model that conforms with the preceding interpretation of (3) [Warburton's reduced form for aggregate spending as shown in (3) above] and is consistent with H_2 [the money demand hypothesis] is the following: [11]

Balbach then presents his model as follows (using the same enumeration in his text):

(6) $Y_3 = d_0 + d_1Y_1$ where Y_3 is personal income and Y_1 is Gross National Product

(7) $Y_1 = C + I_1 + G_1$ where C is consumption, I_1 is Gross Private Domestic Investment and G_1 is government purchases of goods and services

(8) $C = a_0 + a_1E_2 + a_2r_3 + a_3M_2$ where E_2 is an estimate of permanent income, r_3 the interest rate on bank loans to businesses, and M_2 is the M_2 measure of the money supply

(9) $I_1 = b_0 + b_1E_2 + b_2r_3 + b_3M_2$

(10) $r_3 = c_0 + c_1E_2 + c_2M_2$

(11) $E_2 = 0.4Y_3 + E_2^*$

Balbach (pp. 61-62) summarizes the model as follows:

> "Equation (10) is the solution of the monetary subset of the model, using a money demand function in which wealth is stated in nominal terms; equation (11) is simply a separation of the past permanent income component from the current component. Y_3, personal income, was chosen instead of Y_1, gross national product, as the income to be

[11] This H_2 hypothesis is as follows. Assuming all of society's individual money demand curves can be aggregated, the demand for money can be expressed as: $Md = F(P, r_i, W, U)$ where Md is the total amount of money demanded, P is the price of all non-money assets, r_i is the intertemporal rate of substitution, W is the total wealth of society, and U represents society's preferences.

predicted in order to eliminate the implicit correlation arising from the use of Y_1 and G_1, since G_1 is part of Y_1 by definition."

After solving the model to find an expression for nominal income, Balbach (1963) estimates a reduced form equation and reports the results as (standard errors in parentheses):

(12) $Y_3 = 5.39 + 0.39M_2 - 0.43E_2^* + 0.75G_1$ $\quad r = 0.5131$

(0.29) (0.10) (0.09)

He notes that, in this form, the equation shows the quantity of money does not share a significant relationship with personal income. Balbach also notes, however, that this form of the equation exhibits serial correlation that could affect the relatively large standard error associated with M_2 and, perhaps as well, the magnitudes of coefficients associated with permanent income and government spending.

To deal with the serial correlation he re-estimates equation (12) after expressing the variables as rates of change. This modification produces:

(13) $\Delta\log Y_3 = 0.006 + 0.62\Delta\log M_2 - 0.38\Delta\log E_2^* + 0.13\Delta\log G_1$ $\quad r = 0.6901$

(0.12) (0.11) (0.13)

Here, before moving on to the specific results, it is worth noting that Balbach identified a problem with serial correlation and addressed it by estimating his equation in growth rates. Friedman and Meiselman (1963) did not acknowledge the same issue, however, and its existence was one of the criticisms initially directed at their results. And while the original 1968 version of the St. Louis equation was estimated in first differences to address the serial correlation problem, Benjamin Friedman (1977) noted this revised specification was associated with heteroskedasticity in the errors. It was not until Carlson (1978) that the St. Louis Equation was expressed in rates of change and this specification eliminated both the serial correlation and heteroskedasticity problems found in earlier work. In light of this evolution of the subsequent models in response to assorted criticisms, it is noteworthy that Balbach (1963) identified and adjusted for problems in the equation's error term not fully reconciled by others for another fifteen years.

In discussing the results from equation (13) Balbach notes that the coefficient associated with money growth (0.62) is larger than the sum of the coefficients associated with the equation's other two variables, showing that money's effects on personal income are greater than the effects of fiscal actions. This result supports Warburton's original notion but now is the product of a formal model and statistical testing. Second, he notes the unexpected negative sign associated with permanent income, E_2^*. He offers an extended explanation for how this might occur by examining the interplay of the parameter values in the six-equation model detailed earlier. [12] He ultimately offers two explanations for the result. The first is that the response of individuals to the *level* of permanent income might be different from their response to *changes* in permanent income. Second, he notes two different ways that permanent income affects current income: its positive effect on consumption and investment versus its negative effect on interest rates. His conclusion is that a negative coefficient for E_2^* implies that, via interest rates, the magnitude of this variable's effects on consumption and investment is large. Finally, causality tests conducted with Balbach's data reveal that the reverse causation issue discovered for Warburton's data is not present. They also indicate, however, the lack of a significant causal relationship between money and aggregate income. These tests do show, however, that personal income appears to cause changes in government purchases of goods and services.

One issue equation (13) does not address is the possibility of lagged responses that were examined in an Appendix to F-M and would become standard in all variants of the St. Louis Equation. It is doubtful that the author did not see the possibility of lagged adjustment of changes in personal spending to past changes in the monetary and fiscal measures. Instead, it is more likely that the available computing technology did not permit the estimation of a model with lags or, if possible, that such an exercise was prohibitively expensive. On this score it is worth noting that the first estimates of the St. Louis Equation were produced using the computers of the McDonnell-Douglas aircraft corporation in St. Louis and, even with this

[12] These derivations are presented over two pages of the dissertation and, for this reason, only are summarized here.

technology, the estimation took a considerable amount of time to complete. And while it is true that Fisher (1925) computed what he claimed was the first distribution of a statistical lag, his simple correlations were between just two variables, not a regression containing multiple explanatory variables. Finally, it also should be noted that the Almon lag technique employed by the St. Louis Equation was not published until 1965. The absence of lags in equation (13) certainly provides a contrast with later work but it is one that can be understood.

In sum, Balbach derived a reduced form equation for personal income from a model that had a money demand equation as its foundation. That money demand function revealed a negative and significant association with an interest rate and the estimated reduced form equation showed that money exerted a stronger influence on nominal income than did fiscal actions. The reduced form also was estimated in growth rates rather than levels and this choice side-stepped a criticism directed at the results of F-M and, later, the first version of the St. Louis equation. Finally, by estimating the reduced form with alternative measures of fiscal actions, Balbach's results minimized the criticism that they were dependent on a particular measure, a criticism later directed at both F-M and A-J.

The Brunner – Balbach Results

As noted earlier, Brunner and Balbach (1959) can be seen as a preliminary discussion of theory and results that were developed more fully in Balbach (1963). Approximately four of the paper's seven pages are devoted to the same discussion of hierarchies of hypotheses and an associated issue of how models can be classified as "non-monetary," "amonetary," and "monetary." Of these, the first class of models does not contain a variable for the money supply or an interest rate and, in so doing, excludes the possibility that a monetary variable could influence aggregate spending or the price level. An "amonetary" model is described as a non-monetary model augmented by a money demand function where money or an interest rate is taken to be an exogenous variable. Finally, "monetary" models are defined as those where economic aggregates – typically income or the price level – require a money demand function and a monetary variable for their determination. To put their work in context, the authors

explain that, of nineteen models described in Tinbergen (1954), only three could be described as being "monetary" but even these three are flawed in their eyes as being incomplete or producing counter-intuitive results. Given their perception of the state of macro models as of the 1950s, the motivation for their paper is to present what they regard as a complete and coherent monetary model according to their definitions and then use it to produce some empirical evidence on the model's implications. [13]

Going further into detail about the characteristics of a monetary model, they review conditions for "M-relevance" set forward in Friedman (1956, p. 15) and Brunner (1958). The result of this discussion is that, in the most elementary terms, a model can be deemed as M-relevant if the demand for money by individuals and banks is downward sloping with respect to an interest rate. And, for that reason, the authors first investigate, via partial correlation coefficients and regression analysis, whether the demand for money satisfies this condition. Because the results for M_2 are little different from those for M_1 they report only the latter. Use of M_1, three different measures of aggregate demand, and five different interest rates produces thirty partial correlation coefficients, with each calculated for three different samples of quarterly data spanning 1939 – 1957. In most of the cases, the quantity of money demanded is correlated positively with the chosen measure of aggregate demand and negatively with the chosen rate of interest.

The authors then estimate twenty different regressions for the money demand function that combine M_1 with five measures of aggregate demand and four measures of an interest rate. The results in their Table 4 (p. 84) indicate that, in each case, the coefficients attached to the measure of aggregate demand and the interest rate are significant and of the expected signs. Notable here is that these results are contemporaneous with Friedman (1959) but offer strikingly different implications about the significance of an interest rate in a demand for

[13] The authors illustrate in their footnote 4 how a quantity-theoretic model can be developed to solve for the same endogenous variables that appear in a Keynesian framework. The set of six equations there differ from the six equations used by Balbach (1963) but they still include a money demand function as one component of the model.

money function. The primary empirical difference between the two studies is the authors' use of quarterly data against the cycle average data employed by Friedman. More substantively, the authors derive a model where an interest rate plays a role and then test the model's implications directly rather than eliminate the interest rate from empirical testing *a priori* – as in Friedman (1959) -- because plots of its behavior over time with respect to velocity are counter to what one would expect. In any case, because each of the money demand equations exhibits a negative slope with respect to an interest rate, they view the key characteristic of a monetary model to have been confirmed and, on this basis, proceed to the estimation of a reduced form equation for aggregate demand.

Instead of repeating the more detailed expressions that lead to this point, their empirical investigation into the relative influences of monetary and fiscal actions on aggregate spending is summarized in two equations. These are:

(14) $A_t = b_0 + b_1M_t + b_2H_t$

and

(15) $M_t = I_0 + I_1r_t + I_2a_t$

where A_t in equation (14) and a_t in equation (15) represent aggregate demand, M represents the money stock, r is an interest rate, and H represents "some combination of government account variables." In their empirical investigation, Equation (14) is estimated with varying combinations of measures for aggregate demand, money, and a fiscal variable. Equation (15) is a money demand function that relates the quantity of money demanded to an interest rate and a measure of aggregate demand. With these general concepts in mind they use six different measures of aggregate demand, three measures of money, seven measures of government accounts, and six variations of an interest rate to estimate different empirical versions of the equations above. Notably different from the later derivations and estimations in Balbach (1963), this first pass at estimating the reduced-form equation was done on levels of the data.

Results for the aggregate demand equation, taking the form of (14) above, are presented in their table 3 (p. 84) for fifteen different versions of the model over a sample of quarterly data that spans 1939.1 through 1957.4, the same sample used in Balbach (1963). They report that the measure of money is significant and positive in all fifteen regressions but that, in seven of the fifteen, the coefficient associated with their measure of fiscal actions is not significant and, in two cases, takes a negative sign as well. In all but one case the coefficient associated with money is significantly larger than that of the fiscal variable. In this last case the coefficient values for the monetary and fiscal variables are almost identical numerically. Overall, on the basis of this evidence, Brunner and Balbach conclude that money exerts a stronger influence on aggregate demand than does fiscal policy.

That these results appear to be robust across alternative measures of the equation's fiscal variable is important to note relative to criticisms of the F-M study that followed.[14] By choosing measures of fiscal actions based on what theory suggested and then testing the robustness of their model by showing that the results were not dependent on the choice of particular measures for its variables, Brunner and Balbach (1959), as in Balbach (1963), sidestepped, or at least minimized, the criticism that their results were sensitive to measurement. This characteristic is another by which this work can be seen as a more thorough investigation of the subject than the later and better-known studies. With this overview in mind, the discussion proceeds to the well-known paper by Friedman and Meiselman (1963).

Friedman-Meiselman (1963)

Taking the official chronology at face value, the publication of Friedman and Meiselman's (1963) "The Relative Stability of Money Velocity and the Investment Multiplier in the United States, 1897 – 1958," this paper was published after Brunner and Balbach (1959) and coincident with Balbach (1963). This, however, would be misleading and, as such, raises

[14] These include Hester (1964), DePrano and Mayer (1965) and Ando and Modigliani (1965). Friedman and Meiselman (1964, 1965) respond to criticisms raised in these papers.

questions of whether these works evolved in tandem or whether one takes historical precedence over the others. On this score, Nelson (2020, pp. 90 - 91) quotes Meiselman as saying that work on the F-M project began "around 1954" but soon lapsed. Nelson also reports that a twenty-one page preliminary draft, under a different title, was presented on October 27, 1959 to Chicago's Workshop on Money and Banking and that Friedman (1956c) also had presented evidence from some "preliminary" tables in a 1956 lecture at Wabash College. Thus, while Friedman presented evidence from some preliminary tables in 1956 and F-M had preliminary results to report by late 1959, the Brunner and Balbach paper (1959) was already in print. Moreover, because so much of the 1959 paper includes discussion and results similar to those presented in Balbach (1963), it would appear that Balbach's thesis was well underway by the time the F-M preliminary results were distributed for the Chicago seminar. [15]

In their discussion of hypotheses Brunner and Balbach (1959) note that Friedman (1956b, p. 15) established his own conditions for a model that was "M-relevant." His conditions, like those expressed in Brunner (1958), involve stable money demand and supply functions that are independent of each other as well as another that maintains the endogenous variables of the system are causally dependent upon a subset of the system that contains the money demand function. [16] The reason for expressing these conditions, according to Brunner and Balbach (1959, p. 81), is that they represent "Friedman's attempt to find an explication for the notion that 'money matters' independent of the traditional juxtaposition, 'quantity theory' vs. 'Keynesian theory.'"

With this in mind, it would seem natural that Friedman and Meiselman would base their empirical work on these principles and work from a framework that included an explicit

[15] Friedman's correspondence with Brunner, archived in Friedman's papers at the Hoover Institution, reveals no communication on these papers.

[16] This is a non-technical expression of Friedman's statements. The reader is referred to Friedman's (1956b) full statement or a stronger set of conditions for M-relevance discussed in Brunner (1958).

statement about the demand for money and its role as a "higher level hypothesis." This is not the case, however. Instead, an assumption behind their model is the existence of a stable money demand function that is associated with permanent income alone. In part, this assumption can be attributed to the results in Friedman (1959) where, similar to Warburton, visual inspection of co-movements in the data led him to conclude that the interest rate was not an important influence on velocity. As discussed with respect to Figure 1, however, statistical tests can lead to conclusions opposite of what plots of data might indicate. For example, Brunner (1961) reported the results of estimating three money demand functions, similar to those in Brunner and Balbach (1959), with each showing a significantly negative coefficient on the interest rate variable. He also cites the 1959 paper at the end of his discussion. Selden (1956) and Latane' (1960) also had published recent studies of money demand that reported a significant role for an interest rate. Thus, while F-M do not report any new evidence on the demand for money, a key assumption of their work was not supported by evidence available at that time. [17]

The assumption that an interest rate was not an important determinant of the demand for money implied, in the context of the IS-LM model, a vertical LM curve such that constant money growth would not create a role for either real shocks or fiscal actions to affect nominal income. Had F-M first estimated a money demand equation and found that the interest rate was an important variable in the function, as did Brunner and Balbach (1959), Balbach (1963), and many subsequent papers, the acknowledged influence of interest rates on velocity would

[17] Johnson (1962, p. 357), after noting the absence of an interest rate in Friedman's (1959) study of the demand for money, describes a subsequent problem with interpreting the results in the then forthcoming Friedman and Meiselman paper:

> "These results pose an important theoretical problem since they imply that a change in the quantity of money that has no wealth-effect will nevertheless have an effect on consumption even though it has no effect on interest rates. The difficulty of understanding how this can be prompted the dissatisfaction of Keynes, Wicksell, and other income-expenditure theorists with the quantity theory and provides the hard core of contemporary resistance to it. Friedman and Meiselman's explanation of their results may therefore initiate a new and possibly fruitful debate on how money influences activity."

have forced F-M to consider how nominal income might be influenced by variables other than the money supply. But, with a specific characteristic of a money demand function assumed, F-M became an exercise based on a consumption function rather than the demand for money.

Although the two equations presented below ultimately are combined so that fiscal and monetary effects on aggregate income or consumption can be investigated together, their starting relationships are one drawn from the Quantity Theory

(16) $Y = a + V'M$

and one based on the expenditure-income theory

(17) $Y = \alpha + K'A$

where Y represents aggregate income, V' is the marginal income velocity of money, M is a measure of the money supply, K' is the marginal multiplier, and A is autonomous expenditures. In these forms, F-M pose the question as whether velocity or the multiplier is more stable over time. Because of potential statistical problems created by correlations between aggregate income and autonomous expenditures, one component of income, F-M made the decision to use consumption rather than income in the main body of their empirical work.[18] Thus, equations (16) and (17) above are modified so that aggregate consumption (C) replaces aggregate income as the dependent variable. This expression can be written as:

(18) $C = \alpha + VM + KA$

Friedman and Meiselman present a considerable amount of statistical evidence, using both annual and quarterly data, on whether money or autonomous expenditures exerts a stronger influence on consumption or aggregate income and, in spirit, use an "inductive and empirical approach" similar to the one Cargill (1979) attributes to Warburton.[19] Indeed, if one

[18] Recall that Balbach (1963) recognized the same problem and chose to use personal income rather than GNP as the dependent variable.

[19] Cargill (1979) notes that Friedman and Schwartz (1963, p. xxii) acknowledge Warburton's contributions by saying: "We owe an especially heavy debt to Clark Warburton. His detailed

were to identify what might be the most important difference between Warburton and Friedman-Meiselman it is that the former relied on visual associations between series in a figure while the latter added regression analysis to this. The bulk of results presented by F-M are based on levels of annual data. They also present results for the case where income, rather than consumption, is the dependent variable. The last section of their paper looks briefly at the relationships above in terms of first differences and also uses quarterly data to investigate whether lags of money or autonomous expenditures affect consumption or income. Because this paper deals with a thread that runs from Warburton through to the St. Louis equation, only these results are discussed below.

As described above, the F-M work differs from Brunner and Balbach (1959) and Balbach (1963) in several important ways. First, rather than estimate a money demand function as a first step to examine whether an interest rate exerts a significant influence on the demand for real balances, they assume an interest rate has no role to play. Second, F-M focuses primarily on relationships between levels of variables rather than first differences or rates of change to draw their conclusions about the relative importance of monetary and fiscal actions on either consumption or income; this choice subjected their work to econometric criticisms not applicable to work by Brunner and Balbach (1959) or Balbach (1963) that preceded it or to the St. Louis equation that followed it. [20] Finally, although F-M presented some correlation coefficients in an Appendix to illustrate the associations between alternative measures of their variables, DePrano and Mayer's most forceful criticism was that F-M chose

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and valuable comments on several drafts have importantly affected the final version. In addition, time and again, as we came to some conclusion that seemed to us novel and original, we found that he had been there before." F-M also acknowledge (p. 169, footnote 1) that Warburton was one of the few economists to examine the empirical evidence for money's influence on economic activity in the years after the Keynesian revolution. Chow (1970) conjectures that Friedman (1952) "probably marked the beginning of Friedman's effort to use the quantity theory to explain price (and income) changes in preference to the income-expenditure theory" and that, as such, it anticipated the later work with Meiselman.

[20] In response to comments made by Hester (1964), F-M (1964) reported new results based on first-differenced data and the main conclusion of the original paper, that money was more closely correlated with spending than was their fiscal measure, remained.

their preferred measures on an *ex ante* examination of correlation coefficients rather than theory. Overall, the earlier works by Brunner and Balbach, and by Balbach based their empirical work on more solid theoretical and statistical foundations and in so doing produced results on the fiscal v. monetary question that were both more robust to choice of empirical measures and less subject to econometric criticisms directed at F-M.

St. Louis Equation (1968)

The Andersen-Jordan (A-J) equation (1968) used intuition to connect fiscal and monetary actions to an aggregate measure of income or spending and, in this sense, it was constructed in much the same manner as the expressions presented by Warburton and by Friedman and Meiselman. Although any number of criticisms were directed at the results produced by evolving expressions for the St. Louis equation -- choice of proxies for the variables, questions about the endogeneity of variables, serial correlation or heteroskedasticity in the error term, etc. -- Brunner and Balbach (1959) and Balbach (1963) would emphasize a more fundamental criticism: That the results of any hypothesis test would be suspect because it would not have been derived from what they termed a "higher level hypothesis" which, in their case, involved a money demand function from which associations between money and aggregate spending could be derived.

If the St. Louis Equation is seen as a natural extension of F-M, its central role in the discussion of whether fiscal or monetary actions are the more dominant force on spending, its success might be attributed to empirical choices that addressed many of the criticisms directed at the earlier work. [21] The use of quarterly data and the Almon (1965) lag technique addressed the issue of lagged effects of policy actions dealt with only in passing by F-M. By expressing the equation in first differences, A-J avoided the question of whether serial correlation exerted a significant impact on their results. Carlson (1978) eventually made the last substantial

[21] McCallum (1986, footnote 4) mentions Brunner and Balbach (1959) as an "interesting predecessor of the A-J equation and conjectures that it "probably influence[d] the latter."

modification of the A-J equation by expressing it in growth rates to deal with a pattern of heteroscedasticity that had been identified in the equation's error term.

Even with modifications to the basic F-M equation, the St. Louis Equation still faced considerable criticism.[22] As enumerated by Batten and Thornton (1986), the equation was said to have excluded important exogenous variables, suffered from simultaneous equations bias associated with the use of a reduced form equation estimated by ordinary least squares, and as was the case with F-M, used the wrong variables to represent the relevant fiscal and monetary policy actions. Batten and Thornton addressed each of these issues by performing a variety of statistical tests on the data from the original A-J (1968) paper and concluded that none of the criticisms affected the primary conclusion that the quantity of money was a more important influence on aggregate spending. [23] In addition, they performed tests of Granger causality to investigate the common assertion that the equation's results were due to reverse causation running from income to money and found, instead, causation running from money to income. Coming full circle, the tests supported Warburton's conjecture that variations in money were a causal determinant of income.

Conclusions

Friedman and Meiselman (1963) built on earlier work by Warburton by calculating correlations and estimating regressions to identify any links between aggregate spending and either monetary or fiscal actions on the basis of statistical tests rather than associations suggested by plots of data. The St. Louis Equation that followed was in the spirit of F-M and differed primarily in the empirical proxies chosen for the equation's variables, its specification in first differences rather than levels of data, and the use of distributed lags for the equation's explanatory variables. Still, in both cases, the message was that the money supply was a

[22] The best known of these probably is DeLeeuw and Kalchbrenner (1969).

[23] Jordan (1986) reviews the history of the A-J equation and also reaches the conclusion that, despite the criticisms, it has stood up well to the test of time.

significant driver of aggregate spending whereas deficit spending or some other measure of fiscal actions was not.

The evolution of work from Warburton to F-M and A-J, however, has not taken note of two important papers that built a more solid theoretical foundation for the better known reduced form equations of F-M and A-J and, as well, conducted empirical analyses that were not subject to the primary criticisms leveled at their well-known successors. Beginning with the premise that a money demand function was the foundation for any subsequent derivations that would link money to aggregate activity, Brunner and Balbach (1959) and Balbach (1963) presented results that showed the demand for money was a stable function of a few variables. In particular, and in contrast to Friedman (1959), the estimated function was negatively related to an interest rate and the interest rate did not indicate any evidence of a liquidity trap. From this work on the demand for money, which allowed for an upward-sloping LM curve and, hence, a role for fiscal actions to affect aggregate spending, these earlier papers used a formal model to derive a reduced form equation similar to those of F-M and A-J. Anticipating criticisms directed at later work, Balbach (1963) estimated a reduced form relationship between personal income and measures of fiscal and monetary actions with its variables in expressed in growth rates and experimented, as well, with multiple empirical proxies for its variables. Although this work is essentially unknown, Brunner and Balbach (1959) and Balbach (1963) should take their proper place as the first and, by comparison, the more rigorous estimation of a reduced form equation that investigated propositions on the relative effects of monetary and fiscal actions on income suggested earlier by Warburton.

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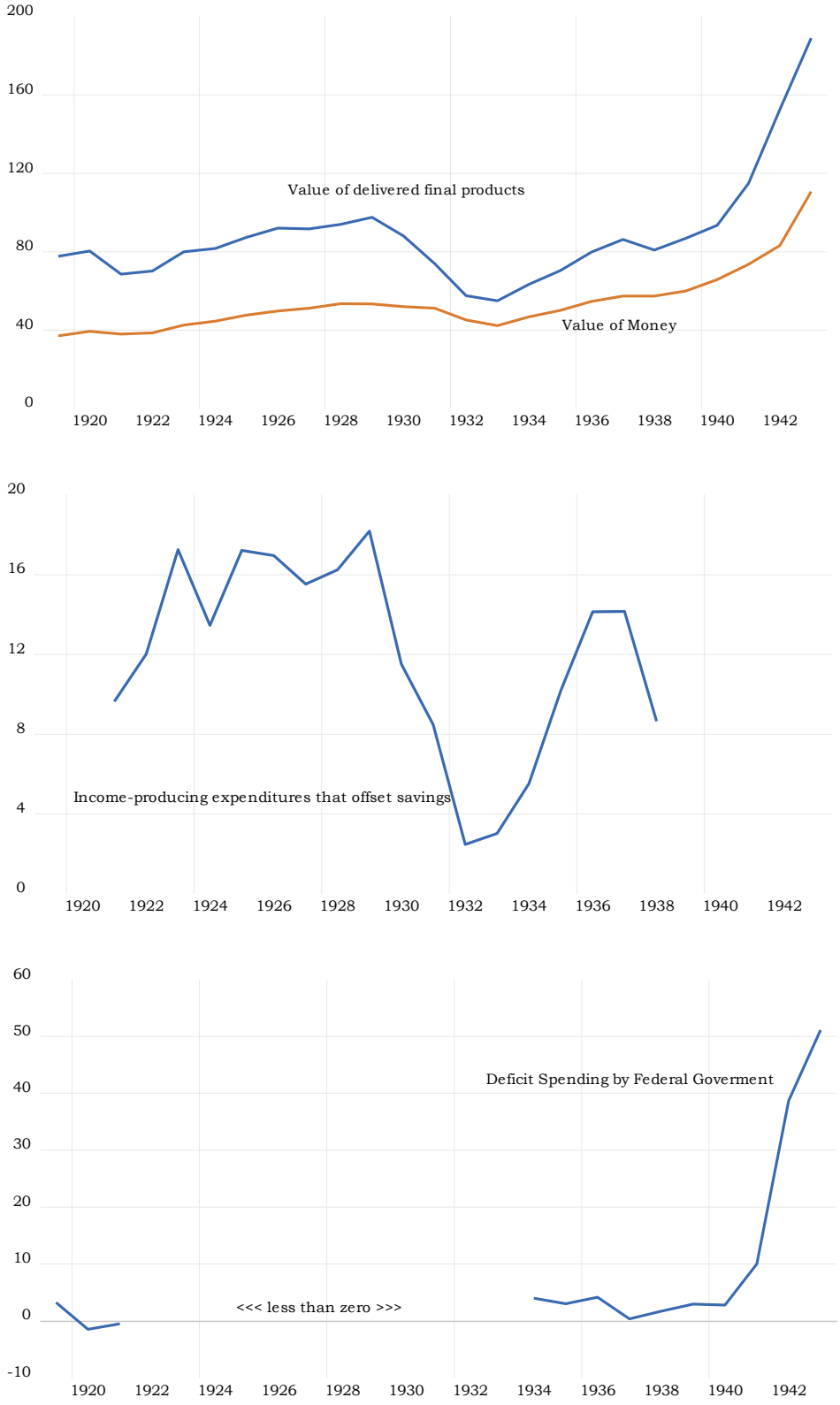
Figure 1. Reproduction of Warburton's chart 11-1



"Excess of expenditures, excluding debt retirement, over revenue"