# A St.-Louis equation to reassess the influence of macroeconomic-policy instruments

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(Working paper)

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i. ABSTRACT.

An analysis of the impact from stabilizing instruments important to macroeconomic policy on output in the US is presented. A simple approach to identify the influence of macroeconomic-policy instruments, based on the St. Louis equation, is clearly presented and examined using annual US data from 1956-2007. The conclusion from this analysis is that both monetary and fiscal policy are viable options for policymakers seeking to stabilize output across a business cycle.

ii. KEY WORDS: Business cycles, monetary policy, fiscal policy

iii. JEL CODES: E32, E63

## 1. INTRODUCTION.

Recent economic development rekindles the debate about the effectiveness of government policy to deliver "balanced" growth. Three broad, divergent interpretations of economic phenomena exist to understand how government macroeconomic policy might stabilize output. First, according to real business cycle theory, government fiscal and monetary policy will be largely ineffective; second, according to Keynesian macroeconomic theory, government expenditure as a component of aggregate demand can influence output, but monetary policy is largely ineffective; and third, according to monetarist theory, monetary policy can influence output but fiscal policy is largely ineffective. These interpretations are mutually exclusive, yet most economists do not subscribe fully to any particular interpretation, instead recognizing that each interpretation may offer insight about economic phenomena under different conditions. Similarly, most policymakers do not subscribe to any one interpretation, instead choosing piecemeal from different interpretations as political needs dictate.

A simple test is presented to evaluate the viability of stabilizing instruments important to monetary and fiscal policy. The method used is an update of the St. Louis equation[1]. The structure is as follows: this introduction followed by a brief discussion of the model and data, a presentation of the results, a summary of conclusions, a list of references, and an appendix listing the data used and describing their sources and transformations.

## 2. MODEL AND DATA.

The St. Louis equation as formulated by Andersen and Jordan is:

$$\Delta Y_t = \alpha + \beta(L)\Delta M_t + \gamma(L)\Delta(R_t - E_t) + \delta(L)\Delta Z_t , \qquad (1)$$

where $\Delta\mathbf{Y}$ is the change in nominal GNP, $\Delta\mathbf{M}$ is the change in a money aggregate, $\Delta\mathbf{(R-E)}$ is the change in full-employment government surplus (revenues (**R**) minus expenditures (**E**)), $\Delta\mathbf{Z}$ is the change in remaining variables that affect output, and **L** is a lag operator. The coefficients for $\Delta\mathbf{M}$ and $\Delta\mathbf{(R-E)}$

1 A series of equations were estimated, see appendix in Andersen and Jordan (1968).

were estimated by Andersen and Jordan using ordinary least squares (OLS) and quarterly data.

The measure of GNP for output used by Andersen and Jordan is a very broad measure of the US economy. If the purpose of macroeconomic policy is taken to be stabilization of fluctuations largely occurring within the business sector, then an alternative measure of output to use when estimating the effects of macroeconomic-policy instruments is value added by the business sector. Because of the current political debate about whether adjusting government revenues or outlays is more effective as stimulus, separating government outlays from revenues is meaningful. Quarterly data for the cyclically-adjusted government surplus and its components are not published by the Congressional Budget Office (CBO), so model coefficients herein will be estimated using annual data from 1956 to 2007[2].

The initial model used here to evaluate the influence of macroeconomic-policy instruments is:

$$\Delta y_t = \alpha + \beta(L)\Delta m_t + \gamma(L)\Delta r_t + \delta(L)\Delta o_t \,, \qquad (2)$$

where $\Delta\mathbf{y}$ is the first difference of the natural log of value added in the business sector ($\Delta y_t = \ln(VA_t) - \ln(VA_{t-1})$ ), $\Delta\mathbf{m}$ is the first difference of the natural log of the monetary base, $\Delta\mathbf{r}$ is the first difference of the natural log of cyclically-adjusted government revenues, and $\Delta\mathbf{o}$ is the first difference of the natural log of cyclically-adjusted government outlays, all measures seasonally adjusted and on an annual basis[3].

## 3. REGRESSION RESULTS.

OLS results* per equation (2):

2 The CBO readily makes available annual data for cyclically-adjusted government surpluses from 1956 onwards.
3 See Appendix 1b for a brief discussion of the variables, transformations, and sources.

**Formula: y(t) = a + b1*m(t) + b2*r(t) + b3*o(t)**

| Coeff. | Estimate | Pr(>\|t\|) |
|---|---|---|
| **m(t)** | **0.35** | **0.027** |
| r(t) | 0.05 | 0.529 |
| **o(t)** | **0.23** | **0.023** |
| Intercept | 0.03 | 0.057 |

R-squared = 0.216

**Formula: y(t) = a + b1*m(t-1) + b2*r(t-1) + b3*o(t-1)**

| Coeff. | Estimate | Pr(>\|t\|) |
|---|---|---|
| **m(t-1)** | **0.41** | **0.012** |
| r(t-1) | 0.03 | 0.685 |
| **o(t-1)** | **0.22** | **0.031** |
| Intercept | 0.02 | 0.092 |

R-squared = 0.218

*** Coefficients significant at the 5% level are highlighted and bold.**

For both lags of zero and one, the coefficients corresponding to the monetary base and to government outlays are positive and significant, while the coefficient for government revenues is insignificantly different from zero. The intercept is mildly significant, indicating the likely presence of additional factors that influence output[4]. These results for the independent variables occur with or without the presence of a constant term. Based on these regression results, the term for government revenues is dropped from further analysis, leaving the following equation:

$$y_t = \alpha + \beta(L)m_t + \gamma(L)o_t \, . \qquad (3)$$

**Formula: y(t) = a + b1*m(t) + b2*o(t)**

| Coeff. | Estimate | Pr(>\|t\|) |
|---|---|---|
| **m(t)** | **0.34** | **0.029** |
| **o(t)** | **0.25** | **0.010** |
| **Intercept** | **0.03** | **0.023** |

R-squared = 0.209

**Formula: y(t) = a + b1*m(t-1) + b2*o(t-1)**

| Coeff. | Estimate | Pr(>\|t\|) |
|---|---|---|
| **m(t-1)** | **0.41** | **0.012** |
| **o(t-1)** | **0.23** | **0.017** |
| Intercept | 0.02 | 0.052 |

R-squared = 0.215

*** Coefficients significant at the 5% level are highlighted and bold.**

The regression results for equation (3) show that the coefficients corresponding to the monetary base and government outlays are positive and significant for both lags of zero and one. The coefficients for the monetary base are greater than those for government outlays. The estimate of the coefficients for the monetary base increase if the lag changes from zero to one, while those for government outlays

4 See appendix in Andersen and Jordan (1968).

decrease. For a zero lag the intercept is significant at the five-percent level, while for a lag of one the intercept is quite significant.

Including a lag of one for output as an independent variable produces the following regression results:

**Formula: y(t) = a + b1*y(t-1)**

| Coeff. | Estimate | Pr(>\|t\|) |
|---|---|---|
| **y(t-1)** | **0.31** | **0.029** |
| n/a | n/a | n/a |
| n/a | n/a | n/a |
| **Intercept** | **0.05** | **0.000** |

R-squared = 0.10

**Formula: y(t) = a + b1*y(t-1) + b2*m(t-1) + b3*o(t-1)**

| Coeff. | Estimate | Pr(>\|t\|) |
|---|---|---|
| y(t-1) | 0.13 | 0.371 |
| **m(t-1)** | **0.36** | **0.032** |
| o(t-1) | 0.20 | 0.052 |
| Intercept | 0.02 | 0.113 |

R-squared = 0.229

*** Coefficients significant at the 5% level are highlighted and bold.**

These results show that multiple R-squared improves with the addition of the monetary base and government outlays as independent variables, while at the same time the significance of lagged output greatly diminishes. The coefficient for the monetary base is significant at the five-percent level, while the coefficient for government outlays is still quite significant. The intercept term cannot be distinguished from zero at the ten-percent level with the addition of the monetary base and government outlays as independent variables.

SUMMARY OF CONCLUSIONS.

These results support the positive policy assertions of both Keynesian and monetarist economic interpretations. The monetary base and government outlays appear as plausible instruments to stabilize output through a business cycle. While the estimate of the influence from the monetary-policy instrument is greater, the timing of its greatest impact appears to be later than fiscal policy's[5]. This result suggests that utilizing the monetary base as a policy tool is more powerful than using government

5 Though the estimate is greater for the monetary base in both lags of zero and one.

expenditure, but that using monetary policy requires greater care to ensure the proper timing of its maximum effect. Specific to fiscal policy, the results of insignificance for government revenues suggest that tax policy is not an effective tool for stabilizing output, while adjusting government outlays is.

The interpretation that neither monetary nor fiscal policy are viable to stabilize output, per the real business cycle theory, is unsupported here. Inclusion of the monetary base and government outlays in regressions of output results in better model fit and reduces to insignificance the coefficient corresponding to the lag of output.

The uniqueness of this analysis is the use of value added in the business sector as the dependent variable in order to evaluate directly the influence of macroeconomic-policy instruments on stabilizing business-sector fluctuations. If the intent of policymakers is to stabilize fluctuations in output resulting from business cycles, then the use of value added in the business sector is a means to directly estimate the influence of macroeconomic-policy instruments to stabilize output. Further, much of previous analysis based on the St. Louis equation used quarterly data, while the CBO readily makes available data pertaining to cyclically-adjusted government surpluses only on an annual basis. A more inclusive dialogue about the influence of macroeconomic policy is possible when using annual data.

In the original dialogue about the St. Louis equation in the *Review*, two broad positions about the influence of monetary and fiscal policy were presented. The first position, originally presented by Andersen and Jordan, is that monetary policy alone could effectively influence output and therefore serve as a stabilizer. The second position, a response to the original position, is that both fiscal and monetary policy could influence output. The analysis and results presented here support the second position that both fiscal and monetary policy can influence output and serve to stabilize the US economy. US policymakers seem to agree because their response to declining output during the recent recession was strong monetary and fiscal action[6].

6 Recession dates of 2007Q4 to 2009Q2 per the National Bureau of Economic Research (NBER).

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APPENDIX 1a: DATA AND TRANSFORMATIONS.

| YEAR | VA_Business_Sector | MB | R | O | y | m | r | o |
|---|---|---|---|---|---|---|---|---|
| 1956 | 356.3 | 37.49 | 71 | 71 | 5.88 | 3.62 | 4.26 | 4.26 |
| 1957 | 374 | 37.78 | 78 | 77 | 5.92 | 3.63 | 4.36 | 4.34 |
| 1958 | 373.8 | 38.37 | 83 | 82 | 5.92 | 3.65 | 4.42 | 4.41 |
| 1959 | 407.7 | 39.04 | 81 | 91 | 6.01 | 3.66 | 4.39 | 4.51 |
| 1960 | 419.9 | 39.25 | 93 | 92 | 6.04 | 3.67 | 4.53 | 4.52 |
| 1961 | 431.4 | 40.05 | 100 | 97 | 6.07 | 3.69 | 4.61 | 4.57 |
| 1962 | 463.9 | 41.55 | 102 | **106.5** | 6.14 | 3.73 | 4.62 | 4.67 |
| 1963 | 488 | 43.45 | 108 | 111 | 6.19 | 3.77 | 4.68 | 4.71 |
| 1964 | 524.9 | 45.88 | 112 | 119 | 6.26 | 3.83 | 4.72 | 4.78 |
| 1965 | 570.7 | 48.46 | 114 | 119 | 6.35 | 3.88 | 4.74 | 4.78 |
| 1966 | 624.3 | 51.27 | 121 | 136 | 6.44 | 3.94 | 4.8 | 4.91 |
| 1967 | 653.6 | 53.99 | 140 | 160 | 6.48 | 3.99 | 4.94 | 5.08 |
| 1968 | 713.5 | 57.55 | 146 | 181 | 6.57 | 4.05 | 4.98 | 5.2 |
| 1969 | 769.1 | 60.73 | 178 | 187 | 6.65 | 4.11 | 5.18 | 5.23 |
| 1970 | 802.2 | 64.05 | 191 | 198 | 6.69 | 4.16 | 5.25 | 5.29 |
| 1971 | 868.3 | 69.11 | 191 | 210 | 6.77 | 4.24 | 5.25 | 5.35 |
| 1972 | 957.1 | 74.19 | 208 | 231 | 6.86 | 4.31 | 5.34 | 5.44 |
| 1973 | 1077.4 | 80.79 | 220 | 248 | 6.98 | 4.39 | 5.39 | 5.51 |
| 1974 | 1164.5 | 87.85 | 255 | 272 | 7.06 | 4.48 | 5.54 | 5.61 |
| 1975 | 1265.8 | 94 | 293 | 329 | 7.14 | 4.54 | 5.68 | 5.8 |
| 1976 | 1420.7 | 100 | 313 | 363 | 7.26 | 4.61 | 5.75 | 5.89 |
| 1977 | 1590 | 107.71 | 364 | 405 | 7.37 | 4.68 | 5.9 | 6 |
| 1978 | 1809.4 | 117.61 | 399 | 459 | 7.5 | 4.77 | 5.99 | 6.13 |
| 1979 | 2028.5 | 126.54 | 456 | 506 | 7.62 | 4.84 | 6.12 | 6.23 |
| 1980 | 2186.1 | 136.84 | 529 | 588 | 7.69 | 4.92 | 6.27 | 6.38 |
| 1981 | 2454 | 145.78 | 616 | 674 | 7.81 | 4.98 | 6.42 | 6.51 |
| 1982 | 2514.9 | 156.33 | 665 | 734 | 7.83 | 5.05 | 6.5 | 6.6 |
| 1983 | 2741.1 | 172.84 | 666 | 788 | 7.92 | 5.15 | 6.5 | 6.67 |
| 1984 | 3065.5 | 187.99 | 693 | 848 | 8.03 | 5.24 | 6.54 | 6.74 |
| 1985 | 3283.9 | 201.82 | 748 | 943 | 8.1 | 5.31 | 6.62 | 6.85 |
| 1986 | 3461.5 | 220.46 | 780 | 988 | 8.15 | 5.4 | 6.66 | 6.9 |
| 1987 | 3662 | 241.32 | 872 | 1005 | 8.21 | 5.49 | 6.77 | 6.91 |
| 1988 | 3940.2 | 258.96 | 913 | 1068 | 8.28 | 5.56 | 6.82 | 6.97 |
| 1989 | 4235.7 | 271.17 | 982 | 1147 | 8.35 | 5.6 | 6.89 | 7.04 |
| 1990 | 4453.9 | 290.48 | 1031 | 1254 | 8.4 | 5.67 | 6.94 | 7.13 |
| 1991 | 4558.6 | 318.18 | 1106 | 1316 | 8.42 | 5.76 | 7.01 | 7.18 |
| 1992 | 4829.2 | 347.96 | 1154 | 1365 | 8.48 | 5.85 | 7.05 | 7.22 |
| 1993 | 5084.1 | 386.63 | 1204 | 1396 | 8.53 | 5.96 | 7.09 | 7.24 |
| 1994 | 5425.2 | 424.05 | 1289 | 1456 | 8.6 | 6.05 | 7.16 | 7.28 |
| 1995 | 5677.8 | 447.95 | 1368 | 1517 | 8.64 | 6.1 | 7.22 | 7.32 |
| 1996 | 6030.2 | 466.35 | 1465 | 1559 | 8.7 | 6.14 | 7.29 | 7.35 |
| 1997 | 6442.8 | 493.9 | 1551 | 1602 | 8.77 | 6.2 | 7.35 | 7.38 |
| 1998 | 6810.8 | 525.18 | 1656 | 1657 | 8.83 | 6.26 | 7.41 | 7.41 |
| 1999 | 7249 | 574.18 | 1722 | 1707 | 8.89 | 6.35 | 7.45 | 7.44 |
| 2000 | 7715.5 | 607.11 | 1878 | 1796 | 8.95 | 6.41 | 7.54 | 7.49 |

| YEAR | VA_Business_Sector | MB | R | O | y | m | r | o |
|---|---|---|---|---|---|---|---|---|
| 2000 | 7715.5 | 607.11 | 1878 | 1796 | 8.95 | 6.41 | 7.54 | 7.49 |
| 2001 | 7913.6 | 641.09 | 1904 | 1864 | 8.98 | 6.46 | 7.55 | 7.53 |
| 2002 | 8132.8 | 697.08 | 1863 | 1993 | 9 | 6.55 | 7.53 | 7.6 |
| 2003 | 8502.8 | 740.94 | 1843 | 2141 | 9.05 | 6.61 | 7.52 | 7.67 |
| 2004 | 9084.6 | 776.76 | 1921 | 2281 | 9.11 | 6.66 | 7.56 | 7.73 |
| 2005 | 9695.5 | 806.62 | 2175 | 2472 | 9.18 | 6.69 | 7.68 | 7.81 |
| 2006 | 10284.1 | 835.04 | 2417 | 2659 | 9.24 | 6.73 | 7.79 | 7.89 |
| 2007 | 10771.4 | 850.53 | 2601 | 2732 | 9.28 | 6.75 | 7.86 | 7.91 |

APPENDIX 1b: DATA SOURCES AND (ONE) IMPUTATION.

1. VA_Business_Sector: Value added (billions of nominal dollars at annual rate) by the business sector from Line #2 of the National Income and Product Accounts (NIPA) Table 1.3.5. Gross Value Added by Sector.
2. MB: (Adjusted) monetary base in billions of nominal dollars (aggregated through averaging) from the Federal Reserve (series= AMBSL).
3. R*: Revenues of the federal government in billions of nominal dollars at an annual rate, cyclically adjusted by the Congressional Budget Office (CBO).
4. O:* Outlays of the federal government in billions of nominal dollars at an annual rate, cyclically adjusted by the Congressional Budget Office (CBO).
5. The natural log transformations **y**, **m**, **r**, and **o** are the natural logarithms of VA_Business_Sector, MB, R, and O, respectively.

* For the years 1956-61, the data used are the annual estimates published in 1999 by the CBO. For 1962-2007, the data used were published in 2009. Cyclically-adjusted outlays for the year 1962 which are used here are an average of the estimates for 1962 published by the CBO in 1999 and 2009. The two estimates of cyclically-adjusted outlays for 1962 were 107 and 106, respectively.