Causality Testing for U.S. Public Expenditure, Economic Uncertainty, and Other Indicators

Emilia Suggs

Abstract

Government policies respond to a variety of factors, often resulting in a growth in public expenditure as resources flow from the private to the public sector. A series of classic problems in public economics examines the structure of state spending. Research in the literature addresses factors such as macroeconomic conditions, periods of crisis, and political incentives. However, public opinion may contribute to changes in government expenditure proportions through mechanisms such as voting and lobbying. Significant events and conditions as well as an individual's perceptions influence public opinion, encompassing an element of economic uncertainty. This project utilizes Granger causality testing to examine causal relationships between U.S. public expenditure and factors such as periods of crisis, economic indicators, and economic uncertainty, using quarterly data from 1985-2017.

Introduction

Since the 1940s, the general trend of the U.S. public sector's share in gross domestic product has steadily increased, with several prominent peaks and troughs as is shown in Figure 1 (U.S. Bureau of Economic Analysis, 2017). A series of classic problems in public economics prompts examination of the structure of state spending. Problems of this nature elicit proposed explanations for fluctuations in the growth of the public expenditure, ultimately seeking to account for the development and evolution of the public sector. As public economics focuses on the effects of government policies, a natural framing question asks when and to what extent a state should interfere in market processes. Because these problems lead to examinations of the circumstances behind public expenditure increases, the results of such examinations substantiate the discussion regarding when it may be appropriate for the government to intervene based on historic and economic events in the country.

Beginning with the observations of Adolf Wagner and his law of increasing state spending in the late 19th century, economists from various traditions proposed theories throughout the 20th century explaining the causes of change in government expenditure (Wagner & Weber, 1977). One notable theory arose during the 1960s with a study analyzing the effects of war spending on public expenditure (Peacock & Wiseman, 1961). Using public expenditure data from the United Kingdom over a period from 1891 through 1955, Peacock and Wiseman found public expenditure increased sharply during periods of war. In wartime, the country required revenue to fund military engagements, and acquired it through raising taxes. This is known as the displacement effect because it causes funds to flow from the private to the public sector. Following wars, public expenditure remained high, indicating that the public had adjusted to the new tax rates and that government agencies were unwilling to lower tax rates. The Peacock-Wiseman hypothesis proposes that, following periods of war, tax rates and thus public expenditure remained higher than expected because the public and government had grown accustomed to high tax rates. This tendency (a strictly high rate of expenditure) produces "kinks" within the data.

Like the Peacock-Wiseman hypothesis, the ratchet effect uses the concept of the displacement effect but in a more general context (Higgs, 2012). Many social and life sciences observe the ratchet effect; however, in economics this term refers

to the irrevocability of an economic policy intended to correct an event affecting the public at large. While the Peacock-Wiseman hypothesis focuses exclusively on military spending, the ratchet effect, in its more general form, applies to a variety of crisis variables. These variables include recessions, threats to public security, natural disasters, or any catastrophic event great enough to disrupt the country. During such periods of crisis, authorities enact policies as a response, often resulting in an increase in public expenditure as the state assumes more responsibility. Like the Peacock-Wiseman hypothesis, the ratchet effect leads to predictions that authorities will encounter difficulty in rolling back newly established programs as the public grows accustomed to high levels of spending.

The displacement effect theories suggest that responses to periods of crisis significantly influence fluctuations in public expenditure. However, while crisis responses may explain significant peaks, troughs, or kinks within the data, they incompletely account for the structure of the public sector over time. In particular, the displacement effect theories examine only extreme periods of crisis, neglecting subtler changes in the economic or political atmosphere. Therefore, including relevant macroeconomic and political variables, in conjunction with the displacement effect theories, should provide a more complete account of and a more robust explanation for fluctuations in the size of the public sector.

Macroeconomic indicators such as consumer price, unemployment, and industrial activity indices separate elements of the economy into relevant categories. Unlike the period of crisis explanations that describe spending as a response to catastrophes, economic indicators highlight performance in certain parts of the economy, detecting changes that might not result in a recession. Fiscal authorities may target certain results, adopting proactive and flexible policies to address changes in certain sectors of the economy. Similarly, the performance of major United States industries impacts the decision-making of consumers, labor, and other producers. Activity in sectors such as the housing market affects the supply and price of housing units in a given location. In 2016, housing comprised approximately 33 percent of the average U.S. consumer's expenditures, increasing 2.6 percent from 2015 figures (Bureau of Labor Statistics, 2017). Because housing remains the largest portion of consumer expenditure, activity in the housing sector influences location

and home ownership decisions.

Another important industry for the U.S. economy is the information technology sector. Unlike in others, production and innovation in this sector influences nearly all other producers and consumers on account of the widespread use of computer technology. Both housing and information technology have experienced economic bubbles over the last few decades, making industrial performance relevant to the discussion of public sector growth. In tandem, economic indicators and industrial activity indices, rather than recessionary periods and other extreme events, account for changes in particular facets of the U.S. economy.

Public economics attempts to integrate economic and political mechanisms; optimal economic solutions may not be obtainable through political processes alone and vice versa. Therefore, the public acts in two capacities: as economic and political agents. An agent facing certain economic realities may obtain a previously infeasible state of utility through political processes, despite her actions reducing overall wellbeing. An example would be a low-income worker voting for a politician committed to instituting a minimum wage. In this case, the voting public controls, through democratic processes and to an extent, the economic decisions faced by the entire nation.

In the United States, the general public influences economic policy decisions through the election of congressional representatives. Representatives, like the general public, act as economic and political agents and follow certain assumptions regarding self-interest and rationality. Under normal circumstances, it is assumed that a strong incentive exists for political representatives to seek reelection. If representatives act in a self-interested manner and are strongly incentivized to be reelected, they must to an extent cater to the desires of the voting public. This assumes that the effects of non-voting agents such as lobbyists are minimal. If this is the case, representatives must act in a way that conforms with the political opinions of voters, indirectly allowing the general public to influence economic policy.

However, unlike economic indicators and periods of crisis, political opinion measures agents' views of events, rather than real properties of events in the world. Agents form political and economic opinions from their perception of events and

issues, and this involves their knowledge of economic and political systems, their cultural and religious views, their personal experience, and the information available. As a consequence, the public's perception of economic phenomena influences the decisions of representatives and subsequent economic policy. Through this political mechanism, where representatives act as a liaison rather than moderators of the public's views, economic policies may be enacted that do not reflect real events in the economy. Public uncertainty describes the temperament of the nation in response to economic conditions, crises, and general societal climate. The public may understate or overestimate the true values of an indicator, based on the quantity and quality of information available to them, such as the rate of unemployment or certain price levels.

Expectations of negative outcomes in the absence of near-term action can influence the political process through electoral procedures if the public makes suboptimal policy decisions based on what it believes affects it, even if conditions appear normal. In periods of great economic uncertainty, the public may grow skeptical of the effectiveness of market forces to self-correct, such as during recessions. In this case, the public can alter the size of the public sector by electing representatives who endorse the use of active economic policy as a corrective measure. This type of trend was observed during the Great Depression (1929-1941) and the Great Recession (2007-2009) and manifested in the elections of presidents Franklin D. Roosevelt and Barack H. Obama respectively. Their elections were premised on public beliefs that political mechanisms could be used effectively to redistribute economic authority from the private sector to the public sector. Because agents base decisions on their own experiences, considering the effects of uncertainty, whether justified or not, may provide an explanation for changes in the size of the public sector.

The Peacock-Wiseman hypothesis and the ratchet effect use the concept of the displacement effect to explain fluctuations in public expenditure. These types of analysis explain the presence of significant peaks and troughs in public expenditure data, but not subtle changes in continuous economic and political conditions, such as can be explained with macroeconomic indicators. In addition, public perception

may influence public expenditure through the exercise of political mechanisms. This paper addresses the following questions using statistical techniques: (1) is there significant evidence to validate the displacement effect, using periods of crisis variables? (2) Which, if any, economic factors contribute to change in government expenditure? And (3) does public economic uncertainty significantly influence government expenditure?

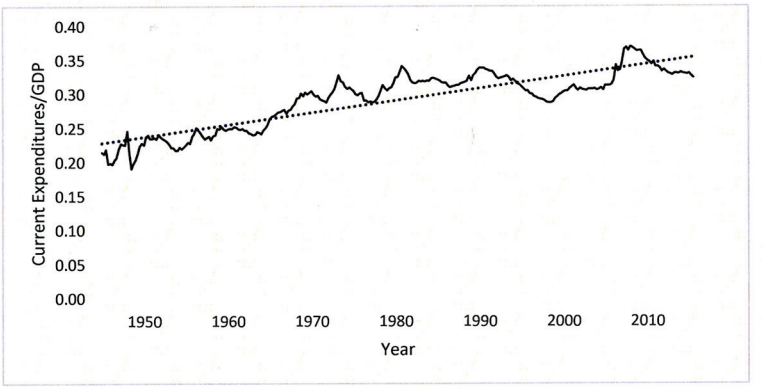

Figure 1: The gradual increase in government current expenditure as a percent of gross domestic product, 1947-2017.

Data and Methods

In our model we use causality testing to determine which factors significantly cause changes in public expenditure proportions. Granger causality is a method of causality testing using in-model forecasting. The reasoning behind Granger causality is simple and concise: assume that we have two variables, A and B. If A causes change in B, we would expect changes in A to predate changes in B. Our model encompasses three categories of variables: economic indicators, periods of crises, and public uncertainty. Using Granger causality testing, our null hypothesis (H_0) states that variable A does not cause change in variable B. Should we reject the null hypothesis, we conclude that variable A Granger causes variable B. With the exclusion of the five crisis binary variables, all data comes from the Federal Reserve Bank of St. Louis (FRED). The model uses quarterly time series data from the first quarter of 1985 through the second quarter of 2017.

The first class of variables used in our models consists of economic indicators. Economic indicators describe characteristics of the U.S. economy over time. In

our model we consider two subclasses of economic indicators: macroeconomic and industrial activity indices. Macroeconomic indicators show elements of the national economy (such as national income, price level, etc.) as they evolve over time. While macroeconomic indicators focus on the economy as a whole, industrial activity indices track the performance of key industries in the United States.

The first variable considered among the macroeconomic indicators is U.S. government current expenditure as a proportion of gross domestic product. This is of particular interest in our model, acting as our dependent variable. We include other common indicators such as the U.S. consumer price index, civilian unemployment rate, and national defense consumption to describe the state of the economy. Depending on the performance of these variables, authorities may pursue monetary or fiscal policy choices, at times resulting in an increase in public expenditure.

We consider a subclass of economic indicators describing industrial activity in the U.S., particularly industries that significantly impact the general public. We consider the activity in the technology and housing sectors as measured by the San Francisco Tech Pulse index and building permits. The San Francisco Tech Pulse index measures activity in the information technology sector using data regarding investment and consumption of IT products, employment, and trade in the San Francisco area. To measure housing market conditions, we use data from the Federal Reserve Bank of St. Louis describing new housing unit authorizations by building permits. These industrial activity measures reflect several important influences on public decision making: technical development, confidence, and affordability. We expect that the industrial activity measures negatively cause change in public expenditure; that is, as industrial activity in these sectors increases, thus improving economic conditions, authorities have less incentive to interfere in market operations. In the case of a decline in industrial activity (or in the event of an economic bubble), usually prompting a decline in economic conditions, authorities may step in to provide relief, causing expenditure to increase.

Peacock and Wiseman proposed that government expenditure increases following periods of war as the public grows accustomed to new tax rates as a means of maintaining sufficient aggregate demand. Similar to the ratchet effect, the Peacock-Wiseman hypothesis describes the inability of the public sector to roll back

policies responding to an external shock, particularly war. Following the intuition of the Peacock-Wiseman hypothesis, periods of crisis include significant catastrophes, such as war, recession, and natural disasters. In our model we use five variables to account for significant distressing events in the United States. The first set of variables includes significant war periods after 1985, specifically, the Gulf War (1990-1991), the Iraq War (2003-2011), and Operation Enduring Freedom (2001-2014). In addition to the war variables, we include binary variables describing recession and election periods in the United States.

Public uncertainty describes the temperament of the nation in response to economic conditions, crises, and general societal climate. Unlike the crisis and indicator variables, which describe real properties of such events, public uncertainty is the response to such shocks. The public may understate or overestimate the true values of an indicator, such as the rate of unemployment or inflation. These expectations can build into the political process through electoral procedures as the public makes policy decisions based on what the public believes affects it, even if conditions appear normal. We use data from the Economic Policy Uncertainty (EPU) index as a measure of public uncertainty. The EPU index tracks the frequency of key economic and political words in major U.S. newspaper headlines. Some of these words include "congress," "uncertainty," "economy," and "Federal Reserve," as well as common variants of such words (Baker, Bloom, & Davis, 2012). We expect that, in periods of high uncertainty, these words would occur more frequently, reflecting the rise of public uncertainty. Because the EPU index uses major newspapers, that reflect public interest in these topics, the index may be assumed to capture the public perception of the economic climate of the United States.

Descriptive Statistics

Variable	Description	Min	Max	Mean	Std. Dev
GOVEXP	Government Current Expenditures/GDP	0.28839	0.37078	0.323147	0.28839
EPU	Economic Policy Uncertainty	43.72	225.23	101.3428	43.72
FDEFX	National Defense Consumption Expenditures and Gross Investment	310.912	851.464	534.8385	310.912
CPIAUCSL	Consumer Price Index for All Urban Consumers	106.267	245.15	177.4305	106.267
TECH	San Francisco Tech Pulse	19.80543	117.1653	61.25505	19.80543
UNRATE	Civilian Unemployment Rate	3.9	9.9	6.034351	3.9
PERMIT	New Private Housing Units Authorized by Building Permits	539	2228	1352.282	539
IRAQ	Duration of Iraq War	0	1	0.274809	0
ELECT	Periods of U.S. Presidential Election	0	1	0.152672	0
RECC	Periods of U.S. Recessions	0	1	0.083969	0
GULF	Duration of Gulf War	0	1	0.022901	0
OEF	Duration of War on Terrorism – Operation Enduring Freedom (OEF)	0	1	0.40458	0

Table 1. Granger Causality Results (H0: A does not cause B)

Variable A	Category	Variable B	pval	LRM	pvLRM	Result
EPU	3	GOVEXP	0.0041	1.00E-04	0.0191	A does cause B
CPIAUCSL	1	GOVEXP	0.1863	-0.0015	0.2049	A does not cause B
TECH	1	GOVEXP	0.0218	-4.00E-04	0.0247	A does cause B
UNRATE	1	GOVEXP	0.0021	0.0057	0.0178	A does cause B
PERMIT	1	GOVEXP	4.00E-04	0	0.0044	A does cause B
FDEFX	1	GOVEXP	0.0527	0	0.3744	A does not cause B
IRAQ	2	GOVEXP	0.3597	-0.0039	NA	A does not cause B
ELECT	2	GOVEXP	0.0615	0.0015	NA	A does not cause B
RECC	2	GOVEXP	2.00E-04	0.0053	0.0463	A does cause B
GULF	2	GOVEXP	0.2621	-0.002	NA	A does not cause B
OEF	2	GOVEXP	0.6059	-0.0021	NA	A does not cause B
GOVEXP	1	EPU	0.6933	721.0019	0.2685	A does not cause B
CPIAUCSL	1	EPU	0.0358	4.2028	0.0334	A does cause B
TECH	1	EPU	0.0296	-0.6617	0.113	A does cause B
UNRATE	1	EPU	0.0366	1.6668	0.4121	A does cause B
PERMIT	1	EPU	0.1888	-0.0323	0.0967	A does not cause B
FDEFX	1	EPU	0.2341	0.0027	0.3856	A does not cause B
IRAQ	2	EPU	0.5334	-7.1718	NA	A does not cause B
ELECT	2	EPU	0.1649	13.7147	NA	A does not cause B
RECC	2	EPU	0.6474	2.2933	0.3725	A does not cause B
GULF	2	EPU	0.8916	4.9668	NA	A does not cause B
OEF	2	EPU	0.3682	-9.9897	NA	A does not cause B
GOVEXP	1	CPIAUCSL	1.00E-04	-1.2789	0.4917	A does cause B
EPU	3	CPIAUCSL	0.0949	-0.0066	0.2231	A does not cause B
TECH	1	CPIAUCSL	0.0671	0.0657	0.0929	A does not cause B
UNRATE	1	CPIAUCSL	0.1178	-0.3941	0.2614	A does not cause B
PERMIT	1	CPIAUCSL	0.155	-0.0011	0.2725	A does not cause B
FDEFX	1	CPIAUCSL	0.4657	-4.00E-04	0.2648	A does not cause B
IRAQ	2	CPIAUCSL	0.6346	0.3374	NA	A does not cause B
ELECT	2	CPIAUCSL	0.2288	-0.2681	NA	A does not cause B
RECC	2	CPIAUCSL	0.4342	-0.2466	0.3731	A does not cause B
GULF	2	CPIAUCSL	1	-0.1818	NA	A does not cause B
OEF	2	CPIAUCSL	0.433	-0.5627	NA	A does not cause B
GOVEXP	1	TECH	0.3898	-372.918	0.0598	A does not cause B
EPU	3	TECH	0.8126	0.0063	0.4353	A does not cause B
CPIAUCSL	1	TECH	0.0061	-2.5102	0.0042	A does cause B
UNRATE	1	TECH	0.4746	-2.2833	0.1538	A does not cause B
PERMIT	1	TECH	0.9334	-0.0015	0.4311	A does not cause B
FDEFX	1	TECH	0.4898	-0.0021	0.2185	A does not cause B
IRAQ	2	TECH	0.2115	4.7038	NA	A does not cause B
ELECT	2	TECH	0.2767	-5.5508	NA	A does not cause B
RECC	2	TECH	0.2334	-1.9818	0.1662	A does not cause B
GULF	2	TECH	1	0.4058	NA	A does not cause B
OEF	2	TECH	0.1577	-5.2401	NA	A does not cause B
GOVEXP	1	UNRATE	0.1771	49.7294	0.0887	A does not cause B
EPU	3	UNRATE	0.0039	0.0147	1.00E-04	A does cause B
CPIAUCSL	1	UNRATE	0.0016	0.1337	0.2119	A does cause B
TECH	1	UNRATE	2.00E-04	-0.0611	0.0096	A does cause B

Variable A	Category	Variable B	pval	LRM	pvLRM	Result
PERMIT	1	UNRATE	0	-0.0036	5.00E-04	A does cause B
FDEFX	1	UNRATE	0.1268	-1.00E-04	0.3543	A does not cause B
IRAQ	2	UNRATE	0.9362	-0.0449	NA	A does not cause B
ELECT	2	UNRATE	0.0631	0.0633	NA	A does not cause B
RECC	2	UNRATE	5.00E-04	0.619	0.0041	A does cause B
GULF	2	UNRATE	0.6674	-0.5919	NA	A does not cause B
OEF	2	UNRATE	0.2106	-0.7684	NA	A does not cause B
GOVEXP	1	PERMIT	0.4872	-1864.08	0.3802	A does not cause B
EPU	3	PERMIT	0.8446	-0.3453	0.3052	A does not cause B
CPIAUCSL	1	PERMIT	0.0038	-44.6788	0.0082	A does cause B
TECH	1	PERMIT	0.8307	-2.0989	0.2983	A does not cause B
UNRATE	1	PERMIT	0.7175	18.2455	0.3547	A does not cause B
FDEFX	1	PERMIT	0.4582	-0.0111	0.4131	A does not cause B
IRAQ	2	PERMIT	0.7944	22.715	NA	A does not cause B
ELECT	2	PERMIT	0.7666	-24.496	0.3613	A does not cause B
RECC	2	PERMIT	0.7329	-14.55	0.4018	A does not cause B
GULF	2	PERMIT	0.9461	127.3999	NA	A does not cause B
OEF	2	PERMIT	0.4708	-62.6002	NA	A does not cause B
GOVEXP	1	FDEFX	0.0729	114341.7	0.2439	A does not cause B
EPU	3	FDEFX	0.9377	-3.3235	0.4164	A does not cause B
CPIAUCSL	1	FDEFX	0.0113	586.7302	0.0403	A does not cause B
TECH	1	FDEFX	0.3765	-6.4518	0.4623	A does not cause B
UNRATE	1	FDEFX	0.7405	236.3967	0.393	A does not cause B
PERMIT	1	FDEFX	0.8554	-1.6315	0.3224	A does not cause B
IRAQ	2	FDEFX	0.4956	-958.853	NA	A does not cause B
ELECT	2	FDEFX	0.9082	570.3735	NA	A does not cause B
RECC	2	FDEFX	0.9603	33.416	0.4855	A does not cause B
GULF	2	FDEFX	0.2752	-1977.99	NA	A does not cause B
OEF	2	FDEFX	0.6106	775.2853	NA	A does not cause B
GOVEXP	1	IRAQ	0.8998	10.7224	0.152	A does not cause B
EPU	3	IRAQ	0.0263	0.0014	0.1923	A does cause B
CPIAUCSL	1	IRAQ	0.9047	0.0049	0.2654	A does not cause B
TECH	1	IRAQ	0.7025	-0.001	0.3851	A does not cause B
UNRATE	1	IRAQ	0.2928	0.0546	0.1354	A does not cause B
PERMIT	1	IRAQ	0.7995	-1.00E-04	0.3431	A does not cause B
FDEFX	1	IRAQ	0.0515	-1.00E-04	0.1074	A does cause B
ELECT	2	IRAQ	1	0	NA	A does not cause B
RECC	2	IRAQ	1	0	0.5	A does not cause B
GULF	2	IRAQ	1	0	NA	A does not cause B
OEF	2	IRAQ	1	0	NA	A does not cause B
GOVEXP	1	ELECT	0.8077	16.6595	0.2854	A does not cause B
EPU	3	ELECT	0.9314	0.0013	0.3276	A does not cause B
CPIAUCSL	1	ELECT	0.487	0.0113	0.4202	A does not cause B
TECH	1	ELECT	0.9682	-0.0033	0.4117	A does not cause B
UNRATE	1	ELECT	0.7622	0.1295	0.2295	A does not cause B
PERMIT	1	ELECT	0.3442	-7.00E-04	0.179	A does not cause B
FDEFX	1	ELECT	0.9835	0	0.4999	A does not cause B
IRAQ	2	ELECT	1	0	NA	A does not cause B
RECC	2	ELECT	0.9852	0.0031	0.4875	A does not cause B
GULF	2	ELECT	0.0119	0.6794	NA	A does cause B

Variable A	Category	Variable B	pval	LRM	pvLRM	Result
OEF	2	ELECT	0.4842	-0.2715	NA	A does not cause B
GOVEXP	1	RECC	0.4522	-3.0197	0.4759	A does not cause B
EPU	3	RECC	0.0108	0.0145	0.0181	A does cause B
CPIAUCSL	1	RECC	0.6546	0.0954	0.3019	A does not cause B
TECH	1	RECC	0.4131	-0.0331	0.0905	A does not cause B
UNRATE	1	RECC	0.0176	0.3551	0.1554	A does cause B
PERMIT	1	RECC	0	-0.004	0.0058	A does cause B
FDEFX	1	RECC	0.707	1.00E-04	0.4203	A does not cause B
IRAQ	2	RECC	1	0	NA	A does not cause B
ELECT	2	RECC	0.7967	-0.2556	NA	A does not cause B
GULF	2	RECC	0.0083	-1.7104	NA	A does cause B
OEF	2	RECC	1	0	NA	A does not cause B
GOVEXP	1	GULF	0.8614	-1.6995	0.4064	A does not cause B
EPU	3	GULF	0.2709	0.002	0.1451	A does not cause B
CPIAUCSL	1	GULF	0.4518	0.0379	0.1591	A does not cause B
TECH	1	GULF	0.9592	-0.0026	0.2755	A does not cause B
UNRATE	1	GULF	0.1021	0.1033	0.1789	A does not cause B
PERMIT	1	GULF	6.00E-04	-0.0014	0.0824	A does cause B
FDEFX	1	GULF	0.9866	-1.00E-04	0.1793	A does not cause B
IRAQ	2	GULF	1	0	NA	A does not cause B
ELECT	2	GULF	0.9549	-0.2022	NA	A does not cause B
RECC	2	GULF	7.00E-04	0.2727	0.167	A does cause B
OEF	2	GULF	1	0	NA	A does not cause B
GOVEXP	1	OEF	0.8682	5.0679	0.1986	A does not cause B
EPU	3	OEF	0.5746	7.00E-04	0.1137	A does not cause B
CPIAUCSL	1	OEF	0.7422	0.0117	0.2878	A does not cause B
TECH	1	OEF	0.0014	-0.0115	0.1369	A does cause B
UNRATE	1	OEF	0.0837	0.0676	0.1228	A does not cause B
PERMIT	1	OEF	0.712	-1.00E-04	0.1086	A does not cause B
FDEFX	1	OEF	0.5256	-1.00E-04	0.1002	A does not cause B
IRAQ	2	OEF	1	0	NA	A does not cause B
ELECT	2	OEF	0.2101	0.1031	NA	A does not cause B
RECC	2	OEF	1	0	0.5	A does not cause B
GULF	2	OEF	1	0	NA	A does not cause B

Notes:
Category 1: Economic Indicator
Category 2: Period of Crisis Variable
Category 3: Economic Uncertainty

Discussion

Figure 2 describes the causal relationships found within the model using Granger causality testing. Of the twelve variables used in our model, eight are correlated with at least one other variable. Four of the five crisis variables do not produce causal relationships with the other variables in the model: the Iraq and Gulf Wars, the Global War on Terrorism, and election years. This could be in part due to the length of these wars. The Iraq War and Global War on Terrorism range over eight and thirteen years respectively; whereas the Gulf War lasted less than a year. In addition, it could be argued that these wars began and ended in peculiar times, such with the enactment of NAFTA in 1994 and strong dollar policies after 2014, which may have distorted the outcome. Aside from the binary variables, national defense expenditure and inflation had no effect on change in public expenditure.

Several interesting relationships including public expenditure appear following Granger testing. Granger testing establishes five causal relationships involving public expenditure. Four variables show positive causation with public expenditure: the binary recession variable, building permits, unemployment rates, and economic policy uncertainty. Recession periods and unemployment follow the same reasoning in explaining their mutual positive causation: as economic conditions decline, often resulting in a decline in employment, we expect political authorities to pursue

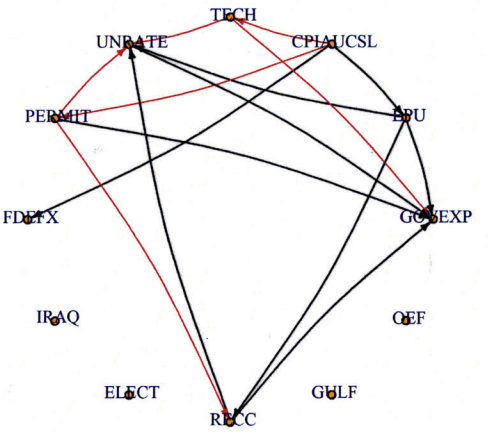

Figure 2: Flow of causation. Black arrows represent positive causation; red arrows represent negative causation.

policies to stimulate the economy, resulting in an increase in public expenditure. The relationship between economic policy uncertainty and public expenditure also makes intuitive sense: as the general public becomes uncertain about the future, it often grows skeptical of market corrections, preferring an authoritative body to oversee and speed up recovery.

The positive causation of building permits, a measure of housing activity, on public expenditure is less intuitive than the prior variables. Using our prior reasoning, we would expect a decline in a major industry such as housing to have recessionary effects, resulting in a growth in public expenditure. Overall the effect housing activity has on public expenditure during the crises should be negative. However, the results of Granger testing do not show a negative causal relationship but a positive one. This would suggest that as housing activity increases public expenditure increases as a result. Despite this effect, housing activity maintains a negative causal relationship with the binary recession variable.

Granger causality results show that activity in the technology sector negatively causes change in public expenditure. This finding indicates that as technological growth declines, as measured by the San Francisco Tech Pulse, government expenditure rises in subsequent periods. Similar to the intuition implicit in the recession variables, we expect that a decline in the technology sector, a major U.S. industry, may trigger recessionary effects, as in the case of the information technology bubble during the late 1990s through early 2000s.

Conclusion

The Peacock-Wiseman hypothesis and the ratchet effect predict that exogenous events, such as war, natural disasters, and major crises, result in an increase in public expenditure. In our model, we test period of crisis variables along with key economic indicators and public uncertainty. Among these categories, significant variables producing change in public expenditure include unemployment, recession years, technological activity, housing activity, and economic uncertainty.

The first important finding from causality testing is the importance of economic conditions in determining public expenditure change. Recessionary effects, such as unemployment and industrial activity decline, significantly contribute to public expenditure increases. The macroeconomic variables, recession years and

unemployment rate, positively causes public expenditure. Technological activity, as measured by the San Francisco Tech Pulse, negatively causes changes in public expenditure. Housing activity produces counterintuitive results, showing a positive causation with public expenditure.

Another important result of Granger testing shows that economic uncertainty positively causes public expenditure. Prior to testing, we anticipated that economic uncertainty would cause an increase in public expenditure through the political process. As the general public perceives a decline in economic conditions, one potential countervailing response comes through democratic processes, such as voting or running for office. During such times, the public may grow skeptical of market corrections and demand more agency influence on the part of the government. In recessions, such influence often appears in the form of fiscal policy. In line with our prediction, the results suggest that uncertainty regarding current economic conditions influences policy decisions in subsequent periods.

Granger causality testing shows several intriguing relationships; however, it insufficiently covers several potential areas of research. The relationship between housing activity, recessionary periods, and public expenditure was inadequately explained by the model. Specifically, the positive causation of housing activity on public expenditure in normal times contrasts with negative causation in recession periods. We expected the relationship between housing activity and public expenditure to be similar to that of technological activity and public expenditure. Both technological and housing activity feature prominently in recent economic bubbles; however, one is linked to a negative causal relationship and the other to a positive causal relationship with public expenditure. As a result, the causes of some specific economic bubbles, while addressed but not fully elaborated, remain unclear from the Granger results alone.

Several conclusions follow from Granger causality testing. Three categories of variables were considered in our model: economic indicators, periods of crisis, and economic uncertainty. Three of the economic indicator variables produced causal relationships with public expenditure: unemployment rate, technological activity, and housing market activity. Of the five period of crisis variables, only recession years produced a significant causal relationship with any other variable in

the model. Overall, evidence for variables in line with the ratchet effect and Peacock-Wiseman hypothesis is limited from 1985 through 2017. Nevertheless, economic uncertainty, which captures public perception of such events, significantly shows positive causation with public expenditure. Combined, the variables featuring causal relationships with public expenditure share a common attribute: they reflect elements of economic activity, rather than political or military events. While the Peacock-Wiseman hypothesis does not hold through the period of our model, when it is generalized to extend to other shocks and uncertainty, change in public expenditure can be explained by key indicators, recession activity, and uncertainty.

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