A Forecast of Private Philanthropy Conditional to Changes in Federal Grant Funding

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Abstract

The purpose of this paper is to identify the statistical relationship between aggregate charitable giving and federal grant funding, in order to create a reliable model for forecasting private philanthropy in this decade. The health, education, environment and human services sectors of the economy are analyzed individually to gain deeper insights into their heterogeneous mechanics. This topic is of interest to economists because private contributions to public goods are theoretically crowded out by government spending, so it would be helpful to know if this relationship holds empirically. The models used for forecasting may hint as to the true direction of the relationship between federal grants and private contributions. With current changes in federal grant funding, it is important to know if private philanthropy will change as well.

1. Introduction

Historically, the primary provider of public goods in the United States has been the government, with federal grants playing an important role in supplemental funding. The health, education, environment and human services sectors have recently experienced significant growth in funding from non-profit organizations and individual contributions. At the same time, federal grants have remained stagnant. Public goods have seen an increase in the proportion of their funding received from private donations. This paper will examine private philanthropy through a statistical lens in order to build a reliable forecast for expected growth.

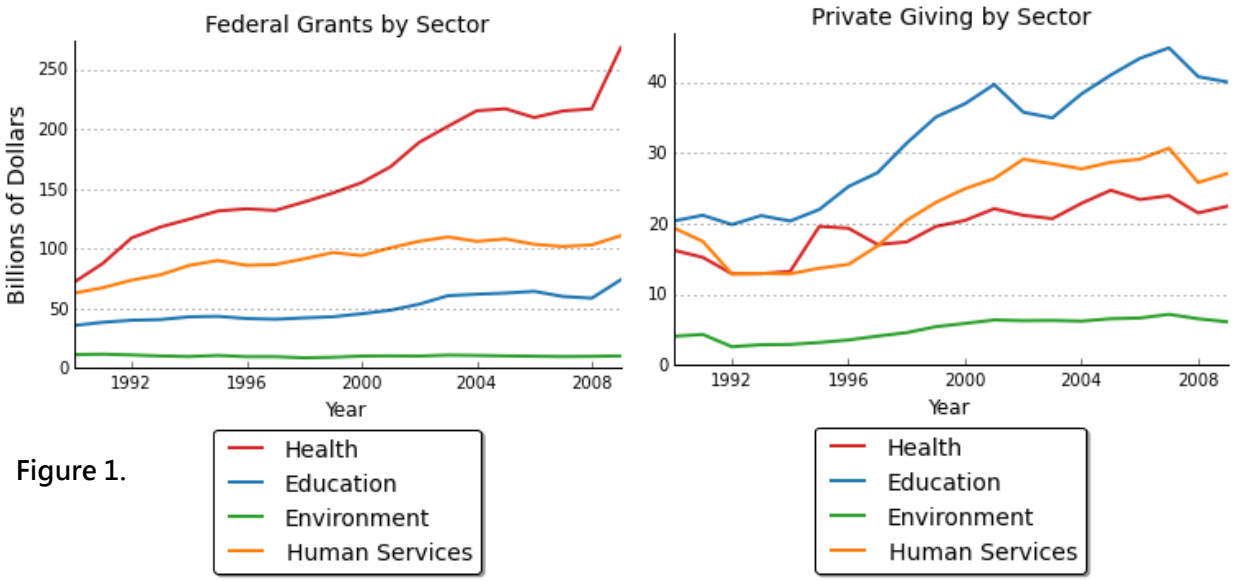


Figure 1.

1.1 Government spending

The United States has been experiencing a contraction in the size of the federal government. Current fiscal policy has reduced federal funding to States and organizations. In 2013, spending cuts known as sequestration reduced planned spending by over $80 billion and the stopgap federal funding bill further reduced federal expenditures. With a growing heterogeneous population, it is questionable if a federal government governed by majority

Fig.1. All variables are in billions of constant FY 2009 dollars. The data used to generate the figure is collected from the White House Office of Management and Budget available at https://www.whitehouse.gov/omb and the *Statistical Abstract of the United* States provided by the United States Census Bureau available at http://www.census.gov/compendia/statab.

decision can provide the diverse number of public goods demanded by its constituents. Citizens find themselves demanding more but receiving less. With a growing non-profit industry, that is providing more of the public goods historically provided by the government, it is reasonable to question if the federal government is relinquishing some of its responsibility to the private sector. Economist should be concerned if private provision will fill the place of curtailed federal funding.

1.2 Contributions to charity

In the past decade, the United States has seen substantial growth in private philanthropy. It is possible that individuals find themselves underprovided for of certain public goods and through philanthropic contributions to non-profit organizations have found a way to increase the supply. Young suggests that individuals have preferences for the level and type of public goods and that if citizens are dissatisfied will find means of provision through a voluntary collective basis. However, due to the nature of public goods, voluntary private giving is highly subject to the "free riding" phenomena. Public goods are non-excludable and non-rivalrous; theory suggests that rational agents will choose not to contribute because it is difficult to enforce payment and impossible to prevent their consumption. Despite what theory suggests, in the United States charitable giving is prevalent. Over 90% of employed adults give a portion of their income to charitable causes, and the proportion of GDP generated from nonprofit organizations has increased.

2. Literature Review

Theoretically it is suspected that there is either a supplementary or complementary relationship between government provision of public goods and private philanthropic provision of those same goods; such as for education, health, the environment or human services.

In the supplementary model, government and nonprofits fulfill the same demand, which implies an inverse relationship between private and government funding of the same public good (Young 2006). In the complementary view, nonprofits are partners of the government in financing and distributing public goods (Young).

Garrett and Rhine explore how charitable contributions to different sectors of the economy, primarily to education, respond to changes in government expenditures. This paper extends their research by measuring the statistical relationship between federal grants and charitable giving, and then predicts future growth of each, in total and in four sectors of the economy.

3. Data analysis

3.1 The Data

The sample period used for analysis is from 1990 to 2009, with 2010 through 2014 functioning as a pseudo out of sample forecast only for federal grants, due to unavailability of private giving data. All variables are in billions of constant fiscal year 2009 dollars. The federal grant funding data is collected from the White House Office of Management and Budget and private philanthropy data is collected from the United States Census Bureau provided by the Giving USA Foundation. The health, education, environment and human services variables include all federal grants or private donations allocated to each sector. From examining the time-plots of federal grant funding and charitable giving, it is clear there is a persistent trend in the data. Therefore, percentage changes in variables are used in analysis.

3.2 Unit root tests for stationarity

After transforming the data, stationarity tests are applied to test if each transformed variable is stationary. To test for a unit root in each of the variables, augmented Dickey Fuller

tests are used to test the null hypothesis of non-stationarity. The ADF tests reject the null hypothesis for each sector of federal grant funding and for the majority of sectors for private giving as well. For a robustness check, DF-GLS tests and Phillips-Perron tests are also implemented to test for unit roots. These tests conclude that the remaining variables are stationary.

3.3 Model Selection

Theory suggests that there is simultaneous causality between private contributions and government spending. Therefore, there is a potential identification problem; if there is two-way causality then neither variable is exogenous and single equation OLS estimation would be invalid. A proposed solution to the problem is to treat all variables equally through a vector autoregressive procedure (Silvia 2014). A reduced form VAR will be used for forecasting. The lag order for the model is determined by the lag that produces the minimum SBIC and RMSE. A VAR (1) was selected for the totals and education, a VAR (2) for environment and human services, and VAR (4) for the health sector.

3.4 Tests for Granger causality

The Granger causality test is an effective way to test for a relationship between variables based on their predictive power. Theory suggests a causal relationship between government spending and charitable giving, however it is important to economists to know if the relationship is supported empirically.

The VAR (1) model selected by minimum SBIC yields inconclusive results at the aggregate level. However, a VAR (4) model suggests there is two-way causality between total federal grant funding and private donations. In both the health and education sectors, the Granger causality test concludes there is two-way causality, but it appears that federal funding may crowd

out contributions to health while it crowds in contributions to education. The causality test in the environment sector is sensitive to the lag order, and may suggest either a one-way or two-way complementary relationship. The Granger causality test in the human services sector concludes there is one-way causality from federal grants to private giving.

4. Forecasting methodology

4.1. Vector Autoregression

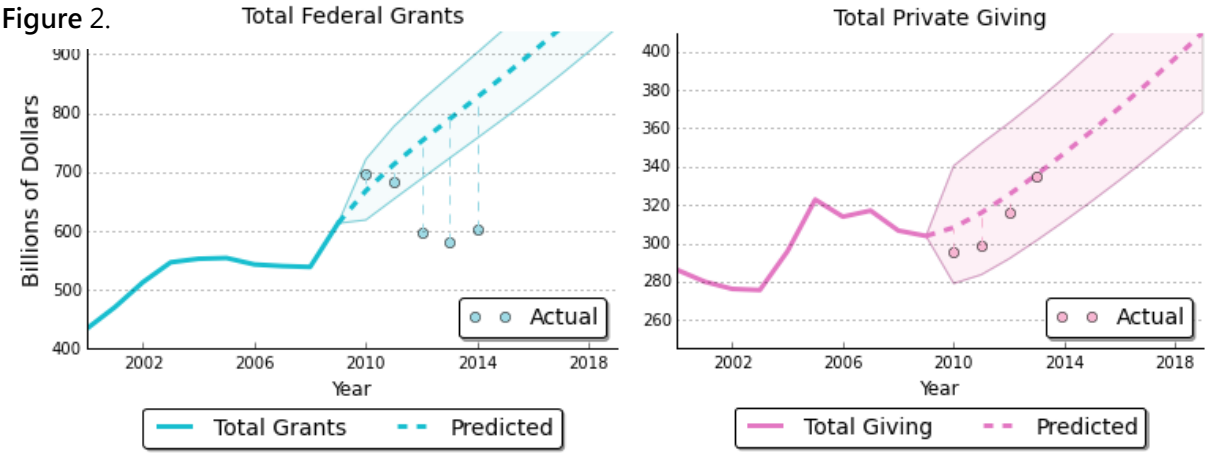
The overarching aim of the paper is to empirically test the statistical relationship between federal grants and private contributions. Forecasts are then built with a vector auto-regressive model to predict private philanthropy for the coming 5 years to help economists gauge the size of private contributions to the health, education, environment, and human services sectors.

A simple AR(1) model will be used as a benchmark for model selection based on pseudo out-of-sample forecast errors. Since government expenditures and outlays have been estimated for the coming years, it is possible to generate more accurate forecasting models using these variables as independent predictors.

The benefits of the VAR model are its ease of implementation and few identifying assumptions. Flaws of this technique are the potential for omitted variables and the unknown structural form “for dynamic responses”. However, VAR models are very popular because they capture complex patterns that are present in the data.

5. Results

Figure 2.



5.1 The relationship between government spending and charitable giving

Total federal grants are estimated to grow at a declining rate that approaches 4% growth annually. In contrast, total private giving is estimated to grow at an increasing rate from approximately 1% to 3.33% by 2019. The model fails to predict changes in federal grant funding in 2012, 2013 and 2014 most likely due to structural changes in federal policy. However, the model accurately predicts total private giving, which does not alter trend in response to changes in federal grant funding. This may indicate that total private giving is not statistically related to total federal grants or that at the aggregate level the data does not reveal the true, complex and dynamic relationship.

5.3 Forecast evaluation

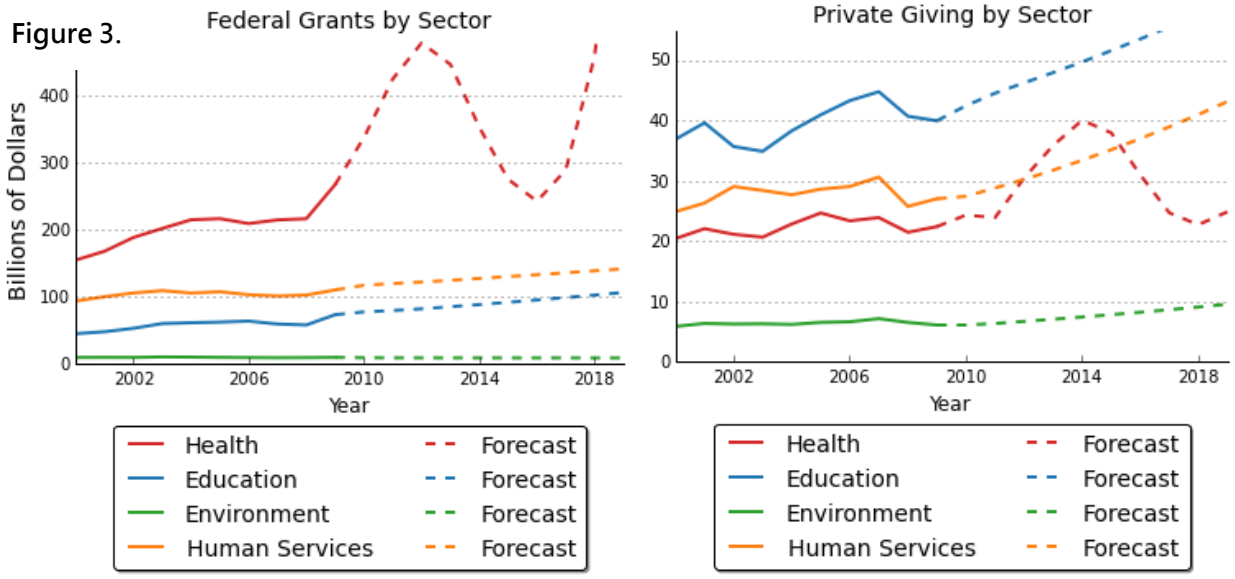
The predicted forecasts of total federal grants are evaluated against actual realized values that were reported by the White House Office of Management and Budget. Out of sample forecasts were generated using data of actual realized values from 2010 to 2014. For total private giving and federal grant funding, the VAR (1) model produced the lowest out of sample RMSFE. The models selected for each sector produced the lowest RMSFE of predicted federal grants.

Fig. 2. All variables are in billions of constant FY 2009 dollars. The data used to generate the figure is collected from the White House Office of Management and Budget available at https://www.whitehouse.gov/omb and the *Statistical Abstract of the United* States provided by the United States Census Bureau available at http://www.census.gov/compendia/statab.

Overall, the forecasts tended to overestimate both total giving and total federal grants. The estimates understated grants for the environment, while vastly overstated grants in the health, education and human services sectors. Due to the importance of adequate provision of public goods, it is reasonable to prepare for significantly less funding then the forecasts estimate.

5.3 Model predictions by sector.

Figure 3.



Selected by minimum forecast error, a VAR (4) model was used for estimation of the growth in grant funding and giving in the health sector. This model predicts that federal grant funding will peak in 2012 and then start declining, beginning a cyclical pattern. In response, private health giving will peak in 2014 and then decline as federal grants begin to grow again.

A VAR (1) model was used for forecasting grants and giving in the education sector. The VAR (4) model was suggested by selection criterion, but produced inaccurate and unbelievable out of sample forecasts. The VAR (1) model had accurate in sample and out of sample predictions, so it was selected as the better model. The VAR (1) model predicts a steady increase

Fig. 3. All variables are in billions of constant FY 2009 dollars. The data used to generate the figure is collected from the White House Office of Management and Budget available at https://www.whitehouse.gov/omb and the *Statistical Abstract of the United* States provided by the United States Census Bureau available at http://www.census.gov/compendia/statab.

in private giving to the education sector that will reach over $50 billion a year by the end of 2015.

A VAR (2) model was used for estimation of changes in environmental grants and giving because it produces the lowest out of sample forecast errors. The model indicates that the change in environmental giving will begin to increase drastically after 2010 and will reach a constant growth of more than 5% annually. The model generates a poor out of sample RMSE for the prediction of federal grants. The model predicts that private contributions for environmental causes will increase over 50% and surpass federal grants to this sector by 2019.

Due to large forecast errors with the VAR (4) model, a VAR (2) model was selected for forecasting in the human services sector because it produced a smaller RMSFE. Private giving to human services is forecasted to increase to a rate of growth of 5% a year while increases in federal grants to human services are forecasted to decline to approximately 2% growth annually.

6. Conclusion

As the world becomes increasingly diverse, people in the United States may find that the federal government cannot provide the numerous public goods demanded by society. Already, private provision is increasing in the health, education, environment and human services sectors. Public policy should be aimed to stimulate private philanthropy to ensure adequate funding for public goods. Sectors that were beyond the scope of this paper, but deserve further research, include federal grants and private giving for regional development, international aid, the arts, culture and humanities. An analysis of private contributions in relation to government funded grants to organizations at the micro-level is suggested. This paper provided a statistical analysis of the relationship between federal grants and private philanthropy in the United States. A forecast was then built to estimate the growth of private giving conditional to federal grant

funding in four sectors. An often overlooked segment of the economy, private philanthropy is forecasted to grow significantly in the second decade of the 21st century.

References

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Silvia, J. E., Iqbal, A., Bullard, S., Watt, S., & Swankoski, K. (2014). *Economic and business forecasting.*

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Appendix A

Table A1
Descriptive statistics.

	Level		*Percent Change*	
	Mean	Std. Deviation	Mean	Std. Deviation
Grants				
Total Federal Grants	441.54	102.77	0.043	0.042
Health Grants	162.82	51.79	0.069	0.071
Education Grants	50.09	10.97	0.038	0.066
Environment Grants	10.33	0.73	-0.006	0.060
Human Services Grants	93.37	14.25	0.030	0.045
Giving				
Total Private Giving	245.21	59.79	0.032	0.053
Health Giving	19.36	3.72	0.017	0.118
Education Giving	31.97	8.86	0.036	0.073
Environment Giving	5.12	1.51	0.021	0.145
Human Services Giving	22.10	6.47	0.018	0.115
Observations	20	20	19	19

Data source: Federal grant data is collected from the White House Office of Management and Budget and private philanthropy data is collected from the United States Census Bureau provided by the Giving USA Foundation.
Notes: The sample period is from 1990 to 2009. All variables are in billions of constant FY 2009 dollars.

Table A2

Unit root tests for stationarity.

	ADF test			DF-GLS test			Phillips-Perron test		
Lag	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
Grants									
Total Grants	-2.37	-2.88*	-3.15**	-2.16	-3.05*	-3.18**	-2.10	-2.14	-2.03
Health	-3.13**	-2.35	-2.22	-1.37	-1.95	-2.15	-2.27	-2.28	-2.22
Education	-2.93*	-1.72	-3.13**	-3.23*	-2.06	-4.31***	-2.35	-2.08	-1.96
Environment	-2.91*	-2.73*	-2.07	-3.25*	-2.98*	-2.15	-4.47***	-4.47***	-4.48***
Human Services	-2.81*	-2.29	-2.38	-3.37*	-3.02*	-2.16	-2.96*	-2.91*	-2.84*
Giving									
Total Private	-2.28	-1.92	-2.05	-2.52	-2.22	-2.31	-2.59	-2.56	-2.52
Health	-4.17***	-4.35***	-4.43***	-3.63**	-3.85***	-3.01*	-3.89***	-3.90***	-4.10***
Education	-2.19	-1.83	-2.98*	-2.64	-2.48	-3.65**	-3.01**	-3.03**	-3.04**
Environment	-4.65***	-1.24	-0.56	-1.18	-0.99	-0.71	-4.09***	-4.11***	-4.12***
Human Services	-3.30**	-2.15	-1.31	-1.07	-1.18	-1.06	-2.72*	-2.73*	-2.72*

Notes: All variables are in percentage changes of billions of constant FY 2009 dollars. The null hypothesis of the ADF, DF-GLS, and Phillips-Perron tests is that the process contains a unit root. The lag order is the number of lagged differences except for the Phillips-Perron test where it is the number of lagged Newey-West standard errors. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

Table A4
Granger causality Wald tests.

	Chi2	*Pr. > Chi2*	Lag
Variable Pair (x , y)			
Total Federal Grants do not granger cause Total Private Giving	0.002	0.97	(1)
Total Private Giving does not granger cause Total Federal Grants	0.79	0.38	(1)
Total Federal Grants do not granger cause Total Private Giving	17.7***	0.001	(4)
Total Private Giving does not granger cause Total Federal Grants	9.1*	0.06	(4)
Health Grants do not granger cause Health Giving	19.91***	0.001	(4)
Health Giving does not granger cause Health Grants	10.3**	0.04	(4)
Education Grants do not granger cause Education Giving	37.96***	0.000	(4)
Education Giving does not granger cause Education Grants	13.1**	0.011	(4)
Environment Grants do not granger cause Environment Giving	2.70	0.26	(2)
Environment Giving does not granger cause Environment Grants	4.40	0.11	(2)
Environment Grants do not granger cause Environment Giving	9.5**	0.050	(4)
Environment Giving does not granger cause Environment Grants	16.9***	0.002	(4)
Human Services Grants do not granger cause Human Services Giving	95.3***	0.000	(4)
Human Services Giving does not granger cause Human Services Grants	7.40	0.12	(4)

Notes: The null hypothesis of the Granger causality test is that *x* does not granger cause *y*. The lag orders used in the tests are the same for each variable and are selected by minimum SBIC. * denotes significance at the 10% level, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

Table A5
Forecasted predictions.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Grants										
Total Federal Grants	668.5 (697)	713.2 (684)	752.7 (596)	790.2 (582)	827.4 (603)	865.4	904.5	945.1	987.4	1032
Health Grants	338.4 (295)	425.9 (307)	479.6 (287)	447.4 (307)	353.7 (353)	276.2	243.3	290.1	459.9	841.1
Education Grants	78.2 (99)	80.2 (94)	82.9 (73)	85.9 (68)	89.2 (67)	92.5	96.0	99.6	103.3	107.2
Environment Grants	9.9 (16)	9.7 (16)	9.7 (14)	9.6 (13)	9.6 (12)	9.6	9.6	9.6	9.6	9.6
Human Services Grants	118.0 (129)	120.6 (130)	122.8 (116)	125.3 (115)	128.1 (116)	130.9	133.7	136.6	139.5	142.5
Giving										
Total Private Giving	308.2 (296)	315.9 (298)	325.4 (316)	335.9 (335)	347.0	358.7	370.9	383.5	396.6	410.1
Health Giving	24.4	24.0	30.5	35.9	40.1	38.0	31.1	24.7	22.8	24.9
Education Giving	42.5	44.6	46.3	48.0	49.8	51.6	53.6	55.6	57.6	59.8
Environment Giving	6.1	6.4	6.7	7.1	7.5	7.9	8.3	8.7	9.1	9.6
Human Services Giving	27.5	28.9	30.3	31.8	33.5	35.2	37.0	39.0	41.0	43.2

Notes: Forecasts are generated using a VAR(p) model for each sector selected by minimum SBIC. All variables are in billions of constant FY 2009 dollars. The numbers in parentheses are actual realized values for total giving and federal grants.