Key Influencers in Federal Government Output and their Role in Productivity

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Introduction

A public good is considered to be non-excludable and non-rivalrous because it cannot exclude individuals from use and does not reduce the availability of the good to others. National defense is an example of a public good because if one person is defended from attack in a particular area, other people in the same area are also defended. Because of its non-excludable and non-rivalrous nature, it is difficult to charge a particular group of people to pay for defense; hence, the government provides and funds this defense (Cowen, 2008, par. 1).

Along with national defense and other public goods, the United States' (U.S.) government supports many services and resources. Rex Nutting's 2011 article describes ten important things the government has offered U.S. citizens including free and universal public education, improved public health through public-sanitation measures such as water treatment and agencies such as the Food and Drug Administration, transportation networks, and communications like the U.S. postal system (Nutting, 2011, par. 2-4).

As the government is responsible for supporting and funding many goods and services, it is important to note government's responsibilities and to understand how these responsibilities are measured and quantified. This is important to note in order to determine any efficiencies or inefficiencies within government. If government efficiency can be determined in a concrete manner, then government can most likely work toward developing a more proactive and strategic means of improving productivity. The productivity of government is important for several reasons.

First, Writz (2001) hints measuring productivity within the public sector may increase efficiency. Wirtz mentions how private companies are driven by competition while government lacks this competitive incentive to drive performance. With a lack of competition and quantitative data on government productivity, there is limited accountability. Wirtz writes with limited government accountability "there will be no losses, nor any bankruptcy, just increased taxes" (Wirtz, 2001, p. 7). If the government were to be held more accountable for output, then efficiency levels may increase.

Secondly, Wirtz believes increasing productivity may help reduce taxes. He feels government increase taxes to compensate for productivity. If the government is able to quantifiably measure productivity, then efficiency may become more important. With a heightened emphasis on efficiency, the U.S. government may demand less taxes. Higher productivity can essentially allow more "bang for the buck" in regards to the value of the tax dollar. This higher value may cause taxes to decrease in the future.

Thirdly, Wirtz emphasizes the importance of increasing productivity due to the population's needs. He demonstrates this importance by stating how there will be an increase in taxes due to higher demands from a growing student, elderly, retired, and nonworking population as the baby boomers reach retirement (p. 2). Furthermore, Wirtz mentions the benefits of measuring government productivity from the standpoint of the Federal Reserve Governor Edward Gramlich. Gramlich believes a quantifiable measure will help determine the long-run path of living standards as well as determining estimates and forecasts for tax surpluses and entitlement trust funds (p. 4). Overall, Wirtz believes measuring productivity may prove to be beneficial for the government.

Additionally, Mark notes the benefits by mentioning how a quantifiable measure will "reveal the results of all past actions to improve productivity" and "provide a scorekeeping technique which managers would otherwise lack" (Mark, 1972, p. 1). Mark believes a quantifiable measure will allow managers to forecast target objects and increase efficiency due to a heightened concern for managers to meet objectives based on historical trends. Additionally, Mark observes a quantifiable measure will help the budgeting process by creating a forecast of output needs and resources, providing better information on unit costs and trends, improving goals with better analytical resources, and offering a benchmark to track performance and progress (p. 1). Mark believes a quantifiable measure will help government productivity by providing better analytics.

Furthermore, the lack of a nationwide statistic on government productivity limits government from quantifiably determining the growth or decline in output. Hayward and Kuper explain how the government needs productivity growth in order to keep up with increasing costs and how a quantifiable measure is needed in order to determine productivity growth (Hayward & Kuper, 1978, p. 4).

Finally, measuring government productivity is important because government output accounts for a significant portion of economic output, and therefore, it serves as a means of explaining economic performance. For example, the United Kingdom (UK) government is projected to be responsible for twenty percent of the UK's economic output (#7, Dunnell, 2007, p.3). Representing such a high percentage of total economic output, having a quantifiable measure may be beneficial. Dunnell also argues a measurement is be beneficial by allowing voters to see how tax money is being allocated and if the money is being allocated as a valuable service for society (p. 3).

As evident from the reasons addressed above, being able to measure and recognize government productivity and efficiency is important due to its valuable and beneficial nature. In general, measuring productivity and determining the influences for productivity will serve as a means of helping government be able to more effectively increase output for different public goods and services. Because of this importance, the aim of this paper is to attempt on a small scale 1) to recognize some of the factors that influence government productivity and 2) to investigate if there are any efficiencies or inefficiencies within different government sectors. In order to achieve this aim, the paper will set up an econometric model to explore the relationships on certain variables and past output indices created by the Bureau Labor of Statistics (BLS). The paper will progress according to the following format: I. the U.S. government's current structure and responsibilities, II. past research available on this topic, III. the structure and set up of the model, IV. the results from the study, V. the conclusion, VI. the bibliography, and VII. the appendix.

The Structure and Responsibilities of the U.S. Government

The U.S. government is separated into federal, state, and local governments. The federal government is primarily responsible for printing money, declaring war, establishing an army and navy, entering into treaties with foreign governments, regulating commerce between states and international trade, establishing post offices and issuing postage, and making laws necessary to enforce the Constitution (Fairfax County, 2014, p. 2).

State government powers include establishing local governments, issuing licenses, regulating intrastate commerce, conducting elections, ratifying amendments to the U.S. Constitution, providing public health and safety, and establishing a State Constitution. Together, state and federal government are accountable for establishing courts, creating and collecting taxes, building highways, borrowing money, making and enforcing laws, chartering banks and corporations, spending money for the betterment of the general welfare of residents, and transportation (Fairfax County, 2014, p. 3).

Local government is responsible for providing services such as education, police, fire, human services, public works such as construction and maintenance, urban planning and zoning, economic development, and parks and recreation. Local government powers must be granted by the state (Fairfax County, 2014 ,p. 3-4). Together the three divisions of government produce goods and services for the U.S. As the U.S. is responsible for supporting and funding many of these resources, it is important to note how these resources are measured and quantified and the influencing factors that are involved.

Literature Review: Quantitative Productivity Studies & Publications

Past Efforts to Measure Productivity

The government has attempted to quantify and measure productivity in the past. Starting in 1964 the General Accounting Office (GAO), Office of Management and Budget (OMB), Civil Service Commission, and Bureau of Labor Statistics (BLS) attempted to develop a valid productivity index to quantify government productivity. The data collected for the indexes included information on federal employees and a sample of state and local government activities, and this information was grouped into two dozen functional categories including transportation, pricing, facilities, and management. Once the data was complied, it was analyzed for productivity trends and patterns (Kull, 1978, p. 5-6). This project became part of the Division of Industry Productivity Studies and created "indexes of output per employee year, output, employee years, compensation per employee year, and unit labor costs" for "selected functional areas of government" for federal government from 1967-1994. As other areas of work were considered to be more important, the project was dismantled by Ronald Regan in the 1980's and was left as the BLS' sole responsibility (Wirtz, 2001, p. 5). Officially terminated in 1996, the only remaining facet of the project is the BLS' Industry Productivity Studies Program measure of productivity for the Postal Service (BLS, 2001, par. 1).

Bascand

Since the project's termination, there have been many publications and studies centered around finding a quantifiable measurement for government productivity. Geoff Bascand explains how measuring government output is difficult due to a lack of prices. In the market sector, prices are used to determine output. In order to maximize profits in a competitive market, producers set price, marginal cost, and marginal revenue equal to one another. Price signals the consumers' relative value for a particular good or service and the producers' value in producing an additional unit of output; therefore, price determines the marginal value of productivity. Additionally, higher productivity is usually associated with higher profits. Because price is able to signal productivity levels, it serves as a good tool for competitive market productivity measures.

In the non-market sector, such as the government, there are essentially no prices, and because there are no prices, it is difficult to quantifiably measure production levels. Bascand argues a replacement measure for price must be used to signal government productivity. He reasons the best solution is to create a replacement value for price based on estimates for the costs of production for the goods and services provided by the government. With these estimates, Bascand believes the replacement value can be used in a similar manner as price in determining productivity (2010, Bascand, p. 18).

Fisk

Fisk notes how the government lacks a quantitative productivity index at the state and local level to due measuring difficulty, and he suggests a measurement can be created in the long-run using a "building block approach" (Fisk, 1984, p. 46). Fisk proposes to create such a measurement by developing service indices and combining individual indices and groups of indices by function similar to the methods implemented under the Division of Industry Productivity Studies' productivity project (p. 47). Although Fisk's findings reflect past efforts, the results lack details on how to realistically implement such a plan.

Atkinson Review

The Atkinson Review aims to improve methods for measuring government output, productivity, and price indices related to the National Accounts. National Accounts are "records that show the social and economic activity of a country" (National Account, 2015, par. 1). The review recommends output to be measured directly rather than being considered equal to input. This method does not hold true for measuring productivity in the non-market sector because 1) measured productivity growth, calculated as the ratio of outputs to inputs, is always zero, 2) increases in real input expenditures will be mirrored as increases in output expenditures, and 3) technological improvements that reduce production costs will cause both inputs and outputs to fall; however, reduced production costs may not actually cause production to drop (Patterson, 2009, p. 39). For instance, if a company were to lay off workers to reduce production costs, productivity may drop due to an inefficient amount of labor.

With these problems, the Atkinson Review believes output should be measured independently from inputs. The recommendations suggest government non-market output should be measured in a manner similarly adopted by the national accounts (as output being measured directly) and that government output measures should be adjusted for quality by taking into account the inputs' contributions to a particular output (p. 40). With these suggestions, the Atkinson review does offer some advice on how to measure government productivity, but it fails to address the details for these methods such as how to factor in quality adjustments for output estimates.

Ab Iorweth

Another attempt to measure government productivity is offered by Ab Iorweth. Iorweth argues government should use output as the sole means of measurement by weighting each output and calculating the output's unit cost based off the weights (Iorweth, 2013, p. 96).

Phillip Lee

Phillip Lee complied a comprehensive conclusion of the "'best' method for measuring non-market output" based off of international publications including the Atkinson Review and the Organization for Economic Co-operation and Development (OECD) Handbook ((Lee, 2008, p. 6). First, Lee's findings show measuring output on a detailed level is important to create accurate productivity measurements. For example, Lee explains in healthcare, the "best unit of output quantity" include all the parts of treatment provided to a person with a specific diagnosis while in education, the best measurement would be the number of pupil-hours in pre-primary, primary, and secondary education and the number of full-time equivalent tertiary students (p. 6). Similar to the Atkinson Review, Lee notes how output distinctions can be problematic as differentiating quantity may skew data due to an emphasis on quality. Secondly, Lee notes that weights should be given to each output quantity based on the total production cost involved with the good or service. Finally, Lee acknowledges there is not currently consensus on how to incorporate differences in the output's quality nor is there agreement on the importance quality plays in output (p. 6). While Lee's study is comprehensive, it still leaves much ambiguity in regards to determining how to measure non-market output productivity.

Difficulties associated with Quantitative Productivity Measurements

With the termination of the Division of Industry Productivity Studies project, the government lacks a means of quantifiably measuring government productivity. This lack of measurement for government productivity has extensive repercussions. The U.S. government is one of the largest working institutions devoid of a productivity measure. This lack of measuring device for government productivity causes analysts and policymakers to be unaccountable for productivity gains or losses in government workers. As government workers represent one out of every six employees, this lack of accountability can be problematic by under or overestimating production (Mark, 1972, p. 1).

Many have offered suggestions and recommendations regarding how to create such a measurement because many have realized how crucial a quantitative measure is for government productivity analysis. Although many suggestions are offered, the suggestions fail to concretely measure and implement a plan due to several difficulties. Bascand notes difficulties including the challenges of determining what to cover in regards to inputs and outputs, measuring quality change in government services, and establishing relative value of government services (Bascand, 2010, p. 18). Iorweth discusses how creating a quantitative measure is difficult due to the challenge of identifying the important and valuable facets of government services. Iorweth reasons only valuable elements, such as social security, tax collection, customs, prison service, etc, should be measured for productivity analysis (Iorweth, 2013, p. 98-99). Fisk mentions how creating such a measurement can be problematic because of problems associate with defining and measuring service outputs, operational activities, and organization outputs. Creating a measurement is daunting because of the magnitude of services that only have a limited amount of supporting data. Additionally, Fisk mentions how most government services also have privately owned counterparts which can cause confusion and problems in output measures (Fisk, 1984, p. 48). Overall, there are many barriers and difficulties associated with creating such a vast and complex measurement. Because of the difficulties of creating such a measurement, it may be important to first look at the influencing factors in government productivity as a first step to creating such a measurement.

Structure and Style of the Econometric Model

The variables

In order to achieve the aim of 1) recognizing some of the factors that influence government productivity and 2) investigating if there are any efficiencies or inefficiencies within different government sectors, several models will be used within this paper. These differing models are all based loosely on the following general model. An explanation of the variables within the model is listed below in Table 1 (Please see the appendix for specifications).

$$OUT = \beta_o + POP\beta_1 + NUML\beta_2 - INFL\beta_3 + EMP\beta_4 + NUMVH\beta_5$$

Table 1: Variable Definitions and Specifications

Variable	Definition
Dependent	
Y	Output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for total Federal Government, fiscal years 1967-1994
Y.T	Output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for the Federal Government's transportation and traffic management, fiscal years 1967-1994
Y.E	Output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for the Federal Government's education and training, fiscal years 1967-1994
Independent	
POP	The average annual percentage change in national population as measured by the U.S. Census Bureau's historical national population estimates in the ith year
NUML	The number of laws passed by Congress in the ith year
INFL	The historical average annual percentage U.S. inflation rate in the ith year
EMP	The total number of Federal personnel (in thousands) in the ith year
NUMVH	The total number of recorded votes in the House in the ith year

Before proceeding with the model, a further explanation for each of these variables will be provided. First, I will start with the dependent variables. As previously mentioned, BLS created "indexes of output per employee year, output, employee years, compensation per employee year, and unit labor costs" for "selected functional areas of government" from 1967-1994 (Wirtz, 2001, p. 5). Holding all independent variables constant, the model will use the BLS measured output indices for 1) total Federal Government, 2) total transportation and traffic management, and 3) total education and training as an attempt to discover if there are any efficiencies or inefficiencies within different sectors of the Federal government. Additionally, these dependent variables will be used as a means for determining the robustness of the model.

Next, an explanation of the independent variables will be provided. To begin with, POP is the average annual percentage change in national population as measured by the U.S. Census Bureau's historical national population estimates per year. As the population grows, the number of government services and goods produced should increase proportionally; thus, if there is population growth, there *should* be an increase in government output, and consequently, an increase in Y. This variable is included in the model because government output is essentially a function of supply and demand. If society needs more goods and services, the government will need to react accordingly and supply these goods and services; consequently, if the population increases, then government output should also increase.

Secondly, the independent variable NUML represents the number of laws passed by Congress per year. NUML *may or may not* lead to an increase in government productivity; hence, this is a variable of interest. It is important to note how "each Congress starts a few days into January and finishes a few days into January two calendar years later" (Gov Track, 2014, par. 5). Because of this lag in time, the estimates for the number of laws enacted *per year* may be biased causing a degree on error within the model.

In regards to the signage for NUML, according to Daniel Newhauser, the 113th Congress has been labeled as being the second "least productive" Congress in history by enacting only two hundred and ninety-seven new laws (Newhauser, 2014, par. 1-3). Although Congress has recently enacted fewer laws, does this mean Congress is being less productive? Do more laws lead to more productivity within the government? With these pressing questions, the sign on this variable is ambiguous. This variable is included in the model to address the pressing questions mentioned above and to determine if Congress' laws *do* impact government output.

INFL represents the historical average annual percentage U.S. inflation rate per year. As inflation increases, the value of the U.S. dollar in relation to other currencies decreases. With a depreciation in U.S. currency, other currencies will appreciate. Under inflation, it will cost the U.S. more money to buy exports. Essentially, it will cost the government more money to buy certain inputs to produce its output; therefore, if inflation increases, then government output (Y) may decrease as a result. This variable is included in the model to serve as an indicator of how the economy is performing. Theoretically, if the U.S. economy's performance is high, then its output should also be high.

Fourthly, EMP represents the total number of federal personnel per year. As the number of federal employees increases, output should also increase; however, this output will only increase up to a certain point. The law of diminishing marginal productivity states " while increasing one input and keeping other inputs at the same level may initially increase output, further increases in that input will have a limited effect...on output" (Gray, 1914, p. 473). Because of the law of diminishing marginal productivity, increasing EMP will increase Y but only up to a certain point. This variable is included in order to determine if government is utilizing an efficient number of employees.

Finally, NUMH represents the number of recorded votes in the House per year. Unlike the number of laws passed by Congress, this variable is able to incorporate both the yea's and nay's included in the decision making process. If there are more votes, then there *may* be more government output due to care with which the decisions are made. This variable is included in the model as an attempt to account for the quality of laws being enacted versus the quantity.

Overall, these five variables are used in the model. Please note, several other variables, such as total government expenditures, taxes, and GDP, were incorporated into other regressions but were omitted from this explanation due to multicollinearity and irrelevancy issues. The full excel file is available for further details in regards to these variables.

The Model

The model is comprised of the three dependent and five independent variables that have been described above. In total, twelve regressions were recorded. Four regressions were run for each dependent variable. The four regressions for each dependent variable consists of the same five independent variables. These independent variables are given varying forms in order to account for specification. Please see Table's 2-4 in the appendix for the regression results. Each of these regressions will be discussed further.

First, regressions # 1, 5, and 9 take a linear form. This linear form is used as a foundation to gauge and judge the results from the other regression forms.

Secondly, regressions #2, 6, and 10 take on multiple forms. For these regressions, the variables NUML and NUMVH are lagged one year and POP and INFL are logged. NUML and NUMVH are lagged because they represent legislation. If legislation is passed in a certain year, it most likely will not be impactful in that *same* year. Instead, the impact of the legislation may be felt in *future* years. For instance as noted above, Congress partakes in two-year sessions to enact laws (Gov Track, 2014, par. 5). Because of this time period, it may be important to lag NUML. Overall, because of the time frame of the impacts of NUML and NUMVH, these variables may be better observed as lagged variables. In addition to NUML and NUMV being lagged, POP and INFL are logged. These variables are logged due to being percentages.

Thirdly, regressions #3, 7, and 11 are very similar to the #2, 6, and 10 with a minor adjustment. For these regressions, NUML and NUMVH are lagged and POP and INFL are logged similar to before. Additionally, these regressions square EMP so that EMP will take on a polynomial form. As noted above, the law of diminishing marginal productivity will reduce efficiency if there are too many employees. Because of this, the EMP variable may not necessarily take a linear form but an exponential form; therefore, in order to account for this, the variable has been squared.

Fourthly, regressions #4, 8, and 12 log POP and INFL keeping all other variables in the linear form. As previously addressed, POP and INFL should be logged because they are percentages. Overall, these four different regression forms are incorporated into the model to add robustness and account for specification errors.

General Concerns with the Model

Due to the nature of the subject matter and data, there are some general concerns with this model. Some concerns regarding the model include: the data, omitted and irrelevant variables, multicollinearity, and serial correlation. Each of these general concerns will be addressed in further detail.

First, the data may cause some concern due to its nature. The dependent variables represent output indices for labor productivity for fiscal years 1967-1994 as calculated by BLS; however, these indices are only provided for twenty-eight years; thus, there are only twenty-eight observations for the regressions. In order to account for many general concerns that arise in regression analysis, it is important to increase the sample size; however, additional years cannot simply be added into the regression due to the data's limited nature.

Secondly, omitted and irrelevant variables may be a concern. Because government output is daunting and complex to measure and quantify, there are several variables that can help explain the dependent variable; therefore, there may be an omitted variable present in the model. Additionally, irrelevant variables may be a concern. NUML is the only statistically insignificant variable across regression forms and dependent variables; however, because this variable is a variable of importance, it is crucial to include this variable within the model.

Additionally, multicollinearity is a general concern to address. Multicollinearity occurs when there is a high correlation between independent variables. In previous versions of this model, total government expenditures per year and the average tax rate per year were used as independent variables; however, these variables were heavily correlated to one another, and consequently, they were dropped from the overall model (and consequently are not included in the results). Furthermore, these variables were dropped due to potentially being too dominant and closely related to the dependent variable. For the current model, please see Table 6 for the regressions' correlation matrix and Table 7 for the VIF tests on multicollinearity. Except for the correlation between NUMVH(-1) and LN.INFL, all variables have a correlation below 0.500, and thus, there is not a big concern for multicollinearity. NUMVH(-1) and LN.INFL have a correlation of 0.650 statistically significant at the 0.01 level. Although there is some concern for multicollinearity here, all VIF results are below 2; therefore, within there is not a big concern for multicollinearity within the model.

Furthermore, serial correlation is also a concern for the model. Serial correlation occurs when there are repeating patterns due to the level of a variable effecting its future level and is often found in time series regressions. Serial correlation can be corrected by properly specifying the equation and adjusting the model technique by using generalized least squared (GLS) or auto regressive (AR) technique. The Durbin Watson statistics are included in the regression results if one would like to dive into a more detailed analysis of the serial correlation. Within the scope of this paper and for this model, four different specifications of the regression are included in order to account for serial correlation; however, a GLS and AR test could be run to further help account for this correlation concern.

Overall, there are many general concerns potentially impacting the model. Taking these concerns into consideration, the model is designed on a small scale to attempt to 1) recognize some of the factors that influence government productivity and 2) investigate if there are any efficiencies within different government sectors. The next section will address these two aims through the results of the model.

The Results

The results for total Federal Government output will first be explained followed by a discussion on the overall general results for 1) transportation and traffic management and 2) education and training. Please note, Tables 2-4 show regression results and Table 5 shows descriptive statistics for all regressions.

Total Federal Government Output (Y)

Total Federal Government output (Y) comprises regressions #1-4. Conclusively, these regressions have surprising negative signs for EMP, NUMVH, and POP with each of these variables being statistically significant under #1 and #4 regression forms. Furthermore, EMP is statistically significant at the 1% level and POP is statistically significant at the 5% level across all four different regression forms. All other variables (NUML and INFL) take on their expected signs. Please note the signage is consistent across all three outputs (Y, Y.T, and Y.E).

When looking at regressions #1-4, #1 and #4 are the most statistically significant. Under these form, EMP is statistically significant at the 1% level and NUMV, POP, INFL are statistically significant at the 5% level. It is important to note NUML is *not* statistically significant across all regression forms.

With #1 and #4 forms being the most statistically significant, regression #4 has the most predictive power with an adjusted R^2 0.727.This adjusted R^2 shows 72.7 percent of the variation in output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for total Federal Government, fiscal years 1967-1994 in the ith year is caused by variations in NUML, EMP, NUMVH, POP, and INFL.

As #4 has high statistical significance and adjusted R^2 out of regressions #1-4, I will focus on the results for this form; however, all results are available for regressions #1-4 in Table 2 of the appendix. Regression #4 has the following results for the five independent variables:

1) As the total number of laws passed by Congress increase by one, the output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for total Federal Government, fiscal years 1967-1994 in the ith year increases by 0.004 all else constant.

2) As the total number of Federal Government employees increase by one, the output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for total Federal Government, fiscal years 1967-1994 in the ith year decreases by 0.016 all else constant.

3) As the number of votes in the House increase by one, the output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for total Federal Government, fiscal years 1967-1994 in the ith year decrease by 0.028 all else constant.

4) As the log of the average annual percentage change in national population as measured by the U.S. Census Bureau's historical national population estimate in the ith year increases, the output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for total Federal Government, fiscal years 1967-1994 in the ith year decreases by 30.750 all else constant.

5) As the log of the historical average annual percentage U.S. inflation rate in the ith year increases, the output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for total Federal Government, fiscal years 1967-1994 in the ith year decreases by 6.881.

Transportation & Traffic Management Federal Government Output(Y.T)

Transportation and traffic management comprises regressions #5-8. According to the results, regression #5 and #8 (which take on the same forms as #1 and #4) are the most statistically significant with EMP being statistically significant at the 1% level, NUMV at the 5% level, and POP at the 10% level. Regression #5 has the most predictive power with an adjusted R^2 0.719 with regression #8 falling close behind with an adjusted R^2 0.714. Please see regression data in Table 3 for full results.

Education & Training Federal Government Output (Y.E)

Education and training comprises regressions #9-12. According to the results, the regressions are not statistically significant. The only variable with significance in regressions #9-12 is POP at the 10% level. Furthermore, the predictive power for these regressions is also very low. Regression #10 has the highest adjusted R^2; however, the adjusted R^2 is only 0.205. Overall, these regressions show low statistical significance and predictive power for education and training. Please see regression data in Table 4 for full results.

Conclusion

In general, measuring productivity and determining the influences for productivity will serve as a means of helping government be able to more effectively increase output for different goods and services. Because of this, the aim of this paper is to 1) recognize some of the factors that influence government productivity and 2) investigate if there are any efficiencies within different government sectors.

In regards to the factors that influence government productivity, EMP, NUMVH, POP, and INFL appear to negatively impact government output while NUML does not appear to have a statistical significant impact. These results suggest an increase in employment and voting may potentially fail to increase output; therefore, it may be advantageous to monitor these variables in order to help improve productivity. Furthermore, NUML's statistical insignificance may also suggest something about government productivity. For example, there has been much attention on the number of laws passed by Congress and how Congress has recently been less "productive" due to passing fewer laws (Newhauser, 2014, par. 1-3). Because the results show the number of laws passed as being insignificant in relation to government's productivity, this focus on Congress passing more laws perhaps should not be an area of concern. Instead, government may want to focus on other areas that play a stronger and more influential role on productivity such as employment.

In regards to the efficiencies within different government sectors, the independent variables do have predictive power for total Federal Government output and transportation &

traffic management but lack predictive power for education & training. These results imply that the variables do not explain the output for *all* Federal Government sectors. Instead, these variables have explanatory power for only certain government sectors like traffic and transportation management. Because of this, an emphasis on a certain variable may not increase the efficiencies in government productivity across all sectors.

Overall, these results attempt on a small scale to shed light on government productivity. As research is limited in this field, there are several areas of study, such as determining a new measure of government output, that can further be explored and analyzed to help improve government productivity and efficiency levels.

References

Bascand, G. (2010). Measuring government sector productivity in New Zealand: A feasibility study. *Statistics New Zealand Tatauranga Aotearoa*, 1-194. Retrieved from EbscoHost.

Bureau of Labor Statistics (BLS). (2010). *Historical Annual U.S. Inflation Rate from 1913 to the present.* [Data file]. Retrieved from http://inflationdata.com/Inflation/Inflation_Rate/HistoricalInflation.aspx

Bureau of Labor Statistics (BLS). (2001). Productivity research and program development. *Bureau of Labor Statistics United States Department of Labor.* Retrieved from http://www.bls.gov/lpc/iprpf1.htm

Cowen, T. (2008). The concise encyclopedia of economics: Public goods. *Library of Economics and Liberty.* Retrieved from http://www.econlib.org/library/Enc/PublicGoods.html

Dunnell, K. (2007). Measuring performance in our public services. *Economic & Labour Market Review*, *1*(2), 3. Retrieved from EbscoHost.

Fairfax County. (2014). Explaining federal, state, and local responsibilities. *Fairfax County Gov.* Retrieved from http://www.fairfaxcounty.gov/dmb/federal-state-local-government-responsibilities.pdf

Fisk, D. M. (1984). Monthly labor review: Measuring productivity in state and local government. *Productivity Report,* 47-48. Retrieved from EbscoHost.

Gov Track. (2014). Statistics and historical comparison: Bills by final status. *Gov Track Civic Impulse, LLC.* Retrieved from https://www.govtrack.us/congress/bills/statistics

Gray, L. C. (1914). Rent under the assumption of exhaustibility. *The Quarterly Journal of Economics, 28,* 3. Retrieved from JSTOR.

Hayward, N., & Kuper, G. (1978). The national economy and productivity in government. *Public Administration Review*, *38*(1), 2-5. Retrieved from EbscoHost.

House Clerk's Office. (2012). *Unproductive Congress.* [Data file]. Retrieved from http://usatoday30.usatoday.com/news/washington/story/2012-08-14/unproductive-congress-not-passing-bills/57060096/1

Iorweth, A. (2013). Mastering leviathan: A review article on growing the productivity of government services. *International Productivity Monitor, 26,* 94-107. Retrieved from EbscoHost.

Kull, D. C. (1978). Productivity programs in the federal government. *Public Administration Review, 38*(1), 5-9. Retrieved from EbscoHost.

Lee, P. (2008). Measuring non market output and productivity. *Statistics New Zealand Tatauranga Aotearoa*, 1-15. Retrieved from EbscoHost.

Mark, J. A. (1972). Progress in measuring productivity in government. *Monthly Labor Review*, *95*(12), 3. Retrieved from EbscoHost.

National Account. (2015). *Cambridge Dictionaries.* Retrieved from http://dictionary.cambridge.org/us/dictionary/business-english/national-account

Newhauser, D. (2014). the 113th Congress wasn't the least productive ever. *National Journal.* Retrieved from http://www.nationaljournal.com/congress/no-the-113th-congress-wasn-t-the-least-productive-ever-20141223

Nutting, R. (2011). The 10 best things government has done for us. *Market Watch.* Retrieved from http://www.marketwatch.com/story/the-10-best-things-government-has-done-for-us-2011-09-26?page=1

Patterson, H. (2009). Progress in implementing the Atkinson review recommendations. *Economic & Labour Market Review*, *3*(8), 39-44. Retrieved from EbscoHost.

Population Estimates Program, Population Division, U. S. Census Bureau. (2000). *Historical National Population Estimates.* [Data file]. Retrieved from http://www.census.gov/popest/data/national/totals/pre-1980/tables/popclockest.txt

United States Office of Personnel Management. (n.d.). *Historical Federal Workforce Tables: Total Government Employment since 1962.* [Data file]. Retrieved from http://www.opm.gov/policy-data-oversight/data-analysis-documentation/federal-employment-reports/historical-tables/total-government-employment-since-1962/

Vital Statistics on Congress. (2013). *Resume of Congressional Activity, Congressional Record, 80th- 113th.* [Data file]. Retrieved from http://www.brookings.edu/research/reports/2013/07/vital-statistics-congress-mann-ornstein

Wirtz, R. A. (2001). Icebergs and Government Productivity. *Region (10453369)*, *15*(2), 16**.** Retrieved from EbscoHost.

V. Appendix
Table 1: Variable Definitions and Specifications

Variable	Definition
Dependent	
Y	Output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for total Federal Government, fiscal years 1967-1994
Y.T	Output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for the Federal Government's transportation and traffic management, fiscal years 1967-1994
Y.E	Output index for labor productivity showing the changes in the ratio of output to hours of labor input measured by BLS for the Federal Government's education and training, fiscal years 1967-1994
Independent	
POP	The average annual percentage change in national population as measured by the U.S. Census Bureau's historical national population estimates in the ith year
NUML	The number of laws passed by Congress in the ith year
INFL	The historical average annual percentage U.S. inflation rate in the ith year
EMP	The total number of Federal personnel (in thousands) in the ith year
NUMVH	The total number of recorded votes in the House in the ith year
Specification	
LN.POP	The log of the average annual percentage change in national population as measured by the U.S. Census Bureau's historical national population estimates in the ith year
NUML(-1)	The number of laws passed by Congress in the ith year lagged by one year
LN.INFL	The log of the historical average annual percentage U.S. inflation rate in the ith year
P.EMP	The (polynomial form) square root of the total number of Federal personnel (in thousands) in the ith year
NUMVH(-1)	The total number of recorded votes in the House in the ith year lagged by one year

Table 2: Regression Results #1-4

Y: Regression Results total Federal Government output, 1967-1994

1		2		3		4	
NUML	0.005	NUML(-1)	0.009	NUML(-1)	0.008	NUML	0.004
	(0.452)		(0.667)		(0.584)		(0.303)
EMP	-0.017***	EMP	-0.016***	P.EMP	-1.337E-6***	EMP	-0.016***
	(-6.161)		(-4.902)		(-4.752)		(-5.841)
NUMVH	-0.03**	NUMVH(-1)	-0.020	NUMVH(-1)	-0.019	NUMVH	-0.028**
	(-3.2211)		(-1.654)		(-1.526)		(-2.804)
POP	-27.887**	LN.POP	-33.204**	LN.POP	-32.22**	LN.POP	-30.750**
	(-2.279)		(-2.365)		(-2.253)		(-2.387)
INFL	-108.124**	LN.INFL	-7.327*	LN.INFL	-7.556*	LN.INFL	-6.881**
	(-2.325)		(-1.970)		(-2.004)		(-2.286)
Constant	226.231***	Constant	157.868***	Constant	112.010***	Constant	167.587***
	(11.815)		(5.958)		(5.525)		(7.871)
R^2	0.731	R^2	0.672	R^2	0.661	R^2	0.727
Adjusted R^2	0.67	Adjusted R^2	0.598	Adjusted R^2	0.584	Adjusted R^2	0.853
DW	.755	DW	0.485	DW	0.469	DW	0.760
Observations	28	Observations	28	Observations	28	Observations	28

T-stats in parentheses

***Significant at the 1% level

**Significant at the 5% level

*Significant at the 10% level

Table 3: Regression Results #3-7

Y.T: Regression Results on trans. & traffic management Federal Government output, 1967-1994

5		6		7		8	
NUML	0.000	NUML(-1)	0.004	NUML(-1)	0.002	NUML	0.000
	0.020		(0.269)		0.173		(-0.013)
EMP	-0.021***	EMP	-0.020***	P.EMP	-1.729E-6***	EMP	-0.021***
	(-7.689)		(-6.201)		(-5.972)		(-7.520)
NUMVH	-0.022**	NUMVH(-1)	-0.009	NUMVH(-1)	-0.007	NUMVH	-0.022**
	(-2.259)		(-0.733)		(-0.581)		(-2.085)
POP	-23.379*	LN.POP	-25.848*	LN.POP	-24.560	LN.POP	-23.487*
	(-1.851)		(-1.803)		(-1.668)		(-1.766)
INFL	-21.505	LN.INFL	-2.890	LN.INFL	-3.181	LN.INFL	-1.306
	(-0.448)		(-0.761)		(-0.820)		(-0.420)
Constant	242.033***	Constant	193.623***	Constant	134.468***	Constant	212.679***
	12.245		(27.064)		(6.445)		(9.672)
R^2	0.771	R^2	0.726	R^2	0.713	R^2	0.767
Adjusted R^2	0.719	Adjusted R^2	0.664	Adjusted R^2	0.648	Adjusted R^2	.0714
DW	0.679	DW	0.448	DW	0.444	DW	0.680
Observations	28	Observations	28	Observations	28	Observations	28

T-stats in parentheses

***Significant at the 1% level

**Significant at the 5% level

*Significant at the 10% level

Table 4: Regression Results #8-12

Y.E: Regression Results on Education & Training Federal Government output, 1967-1994

9		10		11		12	
NUML	0.013	NUML(-1)	0.000	NUML(-1)	0.001	NUML	0.013
	(0.836)		(-0.028)		(0.039)		(0.849)
EMP	0.005	EMP	0.004	P.EMP	3.039E-7	EMP	0.005
	(1.417)		(1.138)		(0.970)		(1.397)
NUMVH	-0.011	NUMVH(-1)	-0.023	NUMVH(-1)	-0.025*	NUMVH	-0.011
	(-0.870)		(-1.681)		(-1.777)		(-0.871)
POP	-30.101*	LN.POP	-31.965*	LN.POP	-31.844*	LN.POP	-32.061*
	(-1.894)		(-2.028)		(-2.000)		(-1.952)
INFL	36.426	LN.INFL	5.206	LN.INFL	5.394	LN.INFL	2.412
	(0.603)		(1.247)		(1.285)		(0.628)
Constant	94.228**	Constant	97.574**	Constant	111.448***	Constant	73.883**
	(3.789)		(3.280)		(4.938)		(2.721)
R^2	0.289	R^2	0.352	R^2	0.342	R^2	0.305
Adjusted R^2	0.128	Adjusted R^2	0.205	Adjusted R^2	0.193	Adjusted R^2	0.147
DW	0.623	DW	0.593	DW	.589	DW	0.637
Observations	28	Observations	28	Observations	28	Observations	28

T-stats in parentheses

***Significant at the 1% level

**Significant at the 5% level

*Significant at the 10% level

Table 5: Summary Statistics for Regression Results

	Observations	Mean	St. dev.	Minimum	Maximum
Regression 1,5,9					
POP	28	1.0104	0.09972	0.87	1.26
NUML	28	311.2857	103.19376	145.00	505.00
INFL	28	0.0562	0.02975	0.02	0.14
EMP	28	5284.3214	519.80723	4620.00	6639.00
NUMVH	28	560.6786	161.11465	353.00	942.00
Regression 2,6,10					
LN.POP	28	0.0057	0.09658	-0.14	0.23
NUML(-1)	28	319.7143	105.49736	145.00	505.00
LN.INFL	28	-3.0000	0.48495	-3.91	-1.97
EMP	28	5284.3214	519.80723	4620.00	6639.00
NUMVH(-1)	28	556.8214	163.71906	353.00	942.00
Regression 3,7,11					
LN.POP	28	0.0057	0.09658	-0.14	0.23
NUML(-1)	28	319.7143	105.49736	145.00	505.00
LN.INFL	28	-3.0000	0.48495	-3.91	-1.97
P.EMP	28	28184602.5400	5922224.007	21344400.00	44076321.00
NUMVH(-1)	28	556.8214	163.71906	353.00	942.00
Regression 4,8,12					
LN.POP	28	0.0057	0.09658	-0.14	0.23
NUML	28	311.2857	103.19376	145.00	505.00
IN.INFL	28	-3.0000	0.48495	-3.91	-1.97
EMP	28	5284.3214	519.80723	4620.00	6639.00
NUMVH	28	560.6786	161.11465	353.00	942.00
Dependent Variables					
Y	28	88.8214	10.85413	71.10	104.60
Y.T	28	91.7714	12.13275	61.90	110.00
Y.E	28	90.1857	8.66849	67.70	101.30

Table 6: Pearson Correlation Matrix for Regression Results

Regression 1,5,9					
	POP	NUML	INFL	EMP	NUMVH
POP	1	-0.023	-0.081	0.151	-0.039
NUML	-0.023	1	-0.046	0.212	0.036
INFL	-0.081	-0.046	1	-0.208	0.488**
EMP	0.151	0.212	-0.208	1	-0.442*
NUMVH	-0.039	0.036	0.488**	-0.442*	1
Regression 2,6,10					
	LN.POP	NUML(-1)	LN.INFL	NUMVH(-1)	EMP
LN.POP	1	0.067	-0.133	-0.064	0.151
NUML(-1)	0.067	1	-0.030	-0.025	0.325
LN.INFL	-0.133	-0.030	1	0.650**	-0.176
NUMVH(-1)	-0.064	-0.025	0.650**	1	-0.464
EMP	0.151	0.325	-0.176	-0.464*	1
Regression 3,7,11					
	LN.POP	NUML(-1)	LN.INFL	NUMVH(-1)	P.EMP
LN.POP	1	0.067	-0.133	-0.064	0.165
NUML(-1)	0.067	1	-0.030	-0.025	0.0319
LN.INFL	-0.133	-0.030	1	0.650**	-0.176
NUMVH(-1)	-0.064	-0.025	0.650**	1	-0.455
P.EMP	0.165	0.319	-0.176	-0.455*	1
Regression 4,8,12					
	LN.POP	NUML	LN.INFL	NUMVH	EMP
LN.POP	1	-0.030	-0.133	-0.025	0.151
NUML	-0.030	1	-0.067	0.036	0.212
LN.INFL	-0.133	-0.067	1	0.529**	-0.176
NUMVH	-0.025	0.036	0.529**	1	-0.442*
EMP	0.151	0.212	-0.176	-0.442*	1

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

Table 7: VIF Test for Multicollinearity

Multicollinearity test for regressions #1-12		
	R^2	VIF
Regression 1,5,9		
NUML	0.076	1.082
EMP	0.268	1.366
NUMVH	0.381	1.616
POP	0.034	1.035
INFL	0.248	1.330
Regression 2,6,10		
NUML(-1)	0.133	1.153
EMP	0.357	1.555
NUMVH(-1)	0.567	2.309
LN.POP	0.045	1.047
LN.INFL	0.46	1.852
Regression 3,7,11		
NUML(-1)	0.127	1.145
P.EMP	0.347	1.531
NUMVH(-1)	0.56	2.273
LN.POP	0.05	1.053
LN.INFL	0.458	1.845
Regression 4,8,12		
NUML	0.089	1.098
EMP	0.282	1.393
NUMVH	0.438	1.779
LN.POP	0.057	1.060
LN.INFL	0.315	1.460