The Shifting Scully Curve: International Evidence from 1870 to 2013

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Abstract

Scully curve predictions for optimal public sector size are estimated using panel data covering 17 industrialized nations from 1870-2013. Fixed-effects regression models find that government expenditure to GDP ratios between 27-32% are growth-maximizing. Optimal size shifted over time. From 9% pre-WWI to 25% Post WWII with less precise estimates suggesting 30% during inter-war years. A flattening out of the Scully curve occurs after the mid 1970s with the exception of the Nordic countries which drive up optimal government size considerably. As well, IV estimates of the Scully relationship suggest that the Scully curve may be subject to some reverse causality.

Keywords: Scully Curve, Public Sector Size, Economic Growth

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1 Introduction

The determinants of long-term economic growth are perplexing in the wake of the post 1970s productivity slow down. Cowen (2011) maintains we have reached a technological plateau with limited prospects for growth because the low-hanging fruit has been picked. Gordon (2012, 2016) is also pessimistic arguing the progress of the last 250 years was the unique result of innovations during three industrial revolutions. However, the long-term role of government in fostering or hindering innovation and growth is rarely considered in this literature.

The analysis of the effect of government on economic growth can be divided into neoclassical, endogenous and institutional approaches.[1] Economic historians including North (1987, 1990); Rodrik (2007) and Rodrik et al. (2004) emphasize governmental institutions in economic growth such as the rule of law, and well-functioning property rights. Other institutional factors determining economic growth include economic freedom, low corruption levels, trust and well-functioning bureaucracies (Acemoglu et al., 2005; Ali, 2003; Asoni, 2008; Sturm and De Haan, 2001).[2]

Government size may be an important factor affecting economic growth because the provision of institutions and other government activities yield substantial benefits. Examples include the rule of law, assorted public goods, and internalization of negative externalities via spending, taxation or regulation. On the other hand, government activities may be costly due to deadweight losses from taxation, incentives for unproductive rent seeking behavior as well as the costs of excessive regulation.[3] These insights support the existence of an optimal government size balancing these costs and benefits.

[1] See Bergh and Henrekson (2011). Neoclassical theory relates per capita output to per capita capital stock (Solow, 1956; Swan, 1956) with government policies affecting growth through their influence on saving, capital formation and labor supply. Endogenous growth theory (Romer, 1986; Barro, 1990) emphasizes innovation and technology shocks and human capital investment with government policies that may limit innovation seen as growth reducing and investments in education and training seen as growth enhancing.

[2] The additional roles of trust and social capital are explored in Fukuyama (1995) and Knack and Keefer (1997).

[3] For a discussion, see Hillman (2009); Afonso and Furceri (2010); Facchini and Melki (2013).

The explicit relationship between government size and economic growth involves a hump-shaped curve known as the Armey Curve (Armey, 1995). Also referred to as the BARS/Scully curve (after Barro, Armey, Rahn and Scully), this inverse u-shaped relationship predicts a positive but eventually negative effect of government on economic growth. As the state develops it provides infrastructure to complement private sector growth. However, beyond a certain point, the public sector diverts resources into less productive uses such as rent seeking (Buchanan, 1980) while the higher taxes financing the expanding state distort resource allocation and reduce economic growth (Forte and Magazzino, 2010). Moreover, if one accepts the cost-disease view of the expanding public sector as in Baumol (1967, 1993), then a larger public sector also generates lower productivity and lower economic growth because of income-inelastic demand for labour intensive government output.

The Scully formulation of this relationship specifically defines the optimal economic growth maximizing size of government as the peak of the hump-shaped curve (Scully, 1989, 1991, 1994, 2000). Scully (1989) examined 115 economies, finding that nations with relatively large initial government shares grew more slowly from 1960 to 1980 than nations with smaller state sectors.[4] Scully (1991) extends this analysis using the tax to GDP ratio as an alternative measure of public sector size and finds that economic growth is maximized with government size at about 19 percent of GDP.[5]

This paper re-examines the relationship between economic growth and public sector size in a set of economically advanced countries over the period 1870 to 2013. One contribution of this analysis is to trace out Scully curves for the entirety of the twentieth century. Consistent definitions of government size and economic growth available from the Jordà-Schularick-Taylor Macro History Database make this possible for a set of 17 economies that experienced a comparable range of industrialization and economic development during the twentieth century. Fixed-effects regression models find hump-shaped and statistically sig-

[4] As well, state sector size was shown to be negatively correlated with output per-head given a fixed input ratio.

[5] Scully (1991) also examines the relationship between tax rates and economic growth, finding that economic growth is at a maximum when the tax to GDP ratio is 19.3 percent.

nificant Scully curves and predictions from these estimates suggest that public sector sizes averaging 27-32 percent of GDP were optimal for economic growth during the period of analysis.

The long-term horizon of our analysis also explores the previously-untested hypothesis that the Scully relationship has shifted over time − that is, the growth rate maximizing public sector size has changed as the size and scope of the state has evolved since 1871.[6] Scully curves are estimated for the sub-periods 1871−1912, 1925−1939, 1946−1973 and 1974−2013. These periods provide separate analysis covering the era of the first great globalization, from 1871 to 1913, the war and depression era, from 1914 to 1945, the post-war boom era, from 1946 to 1973, and the period since 1974 which marks the productivity slowdown.

We find that the optimal public sector size changed over time. Pre-WWI estimates suggest 9 percent, while less-precisely estimated inter-war period estimates suggest 30 percent. Scully curves for the post WWII suggest a return to lower levels of optimal government at 25 percent. These results suggest diminishing returns to government intervention once the initial phases of industrialization end. The Scully relationship is disrupted after the mid 1970s leading to a predicted optimal government size of 82 percent. However, these results are driven by the Nordic countries, for which the expenditure-growth relationship is exponential.

A possible reason for the diminished role of government in the second half of the twentieth century is that after industrialization, there is less direct influence on growth by government given the compositional switch in spending from goods and services to income transfers and human capital spending. This supports the conclusions of Tanzi and Schuknecht (2000)

[6]The role of the state in the 19th century was often as a minimalist or laissez faire state with government providing basic legal machinery. The role of government grew after that as a result of the influence of both Marx and Keynes. After the Great Depression, government took on a stabilization role while documents such as the Beveridge Report in the UK laid the foundations for the welfare state. The governments role peaked in the 1970s, followed by a period of deregulation and privatization in many countries. See Tanzi and Schuknecht (1997), Tanzi (2005) and Tanzi (2011).

that the benefits of government expansion in European countries in the late twentieth century have not been positive. At the same time, the predicted optimal public sector sizes for the period after 1973 while larger, generate growth rates at odds with the historical evidence suggesting a breakdown in the Scully curve after 1973. Much like Wagners Law, it may be that the Scully Curve is a product of industrialization and not as applicable in post-industrial economies.

Finally, we attempt to address concerns of reverse causality using Instrumental Variables (IV) estimation. While there is an extensive literature on the determinants of public sector size that include the effect of economic growth and GDP levels on public sector size, estimates of the Scully Curve, few studies to date have attempted to demonstrate causal effects (exceptions include Afonso and Furceri (2010), Romero-Avila and Strauch (2008) and Fölster and Henrekson (2001)), in part due to the lack of obvious instruments for government size (Bergh and Henrekson, 2011). To the best of our knowledge, our estimates are the first to deliberately consider causality within the Scully framework, which amounts to IV estimation of a quadratic relationship in government expenditure. Results suggest that OLS estimates may overstate the effect of government size on growth but suffer from considerable imprecision.

2 Literature Review

Most estimates of the Scully Curve relationship confine themselves to the post World War Two era and often the period since 1960. This period was marked by the tail end of the post-war economic boom and the start of the productivity slowdown that begins circa the period of the first oil price shock in the 1970s. Just as there have likely been structural breaks in the rate of economic growth over time, the changing role of government and the state may have also led to structural breaks in the relationship between public sector size and economic growth.

Bergh and Henrekson (2011) maintain studies of government size and economic growth can produce conflicting results because of variation in definitions of government size and cross-country data coverage. The authors propose limiting studies to rich countries and measuring government size simply as total taxes or total expenditure relative to GDP as these restrictions provide consistent results that show a significant negative correlation.[7]

These studies have not always considered that the size of government may itself be a result of economic variables such as GDP. Studies which do consider reverse causality between economic growth and government include Christie (2012), Afonso and Furceri (2010), Afonso and Tovar-Jalles (2014), Romero-Avila and Strauch (2008) and Fölster and Henrekson (2001).

Indeed, an important literature on the determinants of government size provides two explanations as to why the public sector has grown: Wagners Law of Expanding State Activity (Wagner, 1893, 1894) and the Peacock-Wiseman Displacement Hypothesis (Peacock and Wiseman, 1967).[8] Wagners Law states that government expenditure grows faster than income in *industrializing* countries because a range of government expenditures are highly income elastic. Peacock and Wiseman argue that the rate of growth of public expenditures is driven by what taxpayers consider to be tolerable levels of taxation and that this tolerance is greater during times of national or social crisis. Thus, the public sector has grown in a step-wise fashion of abrupt jumps and long plateaus driven by crises such as war.

The empirical record on these two explanations is not clear and casts some doubt on the extent of a potential reverse causality issue. Magazzino et al. (2015) find a long-term relationship between real GDP and government expenditure with some evidence of reverse

[7] Increasing government size by 10 percentage points is associated with a 0.5 to 1 percent lower annual economic growth rate. Moreover, the authors note that several (Scandanavian) countries that seem to have high taxes and above average growth may have institutional compensating factors in the form of higher social trust levels or market friendly policies in other areas.

[8] Other explanations have involved the role of voting mechanisms and median voters and how democracies create environments where the state is expanded via redistribution (Downs, 1957; Meltzer and Richard, 1981). As well, fiscal illusion as to the marginal cost of public spending (Goetz, 1977), interest group or bureaucratic capture (Niskanen, 1971), and cost disease (Baumol, 1967, 1993; Baumol and Bowen, 1966) are other explanations.

causality using Granger causality testing. However, Florio and Colautti (2005) examine the long-term trend of public expenditures in five countries[9] and reject Wagners Law on the grounds that it disregards the role of ever increasing tax distortions. Funashima (2017) finds in favor of the Peacock Wiseman displacement effect, noting that Wagners law cannot adequately explain the long-run growth of government size.[10] Legrenzi (2004) tests for the Peacock-Wiseman displacement effect using Italian historical data and finds that the long-run equilibrium of government spending is driven entirely by domestic product and is unaffected by either the method of financing or displacement factors as captured by shifts in intercept and slope coefficients.

Our analysis is motivated by four important lessons from these studies. First, it is important to explicitly set out and adhere to consistent definitions of government size and economic growth. Second, while examining all nations is useful for comparative purposes, more formal analysis should either focus on countries with a similar level of economic development or provide separation between more and less developed countries. In any case, an attempt should be made to control for differing levels of economic development and institutional differences across countries. Third, because lower economic growth reduces resources for government and therefore leads to a smaller public sector, a negative relationship between government size and economic growth rates may be due to reverse causality. Using long-run data may therefore be important in overcoming the effects of business cycles on the results and also needs to be accompanied by a more explicit causal estimation framework. Fourth, in light of mixed evidence of Wagners law, Scully curve estimates should consider at least the possibility of reverse causality.

[9]USA, UK, France, Germany, Italy

[10]Other empirical studies of Wagners Law are quite numerous See for example, Afonso and Alves (2017), Bayrak and Esen (2014), Magazzino (2012), and Abdullah and Maamor (2009).

3 Data and Trends

The data analyzed here is from the Jord-Schularick-Taylor Macrohistory Database, a comprehensive macro-financial panel dataset of 17 countries spanning the periods 1870 to 2013 (Jord et al, 2017).[11] These countries include Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States. The data have several gaps, most notably the series for Australia begins in 1902 – later than most others. As well, government spending numbers are unavailable for some European countries through the years surrounding WWI and WWII. We present results that omit these war-time periods, and some which overlap them since the series from some countries do not have breaks.

Table 1 presents the average annual growth rate of real per capita GDP[12] for all 17 countries for all available years in the first column, as well as broken down by the four specific time periods of analysis in columns 2-5. Over the period 1871 to 2013, real per capita GDP across these 17 countries averaged an annual growth rate of 2.1 percent ranging from a high of 3.2 percent for Japan to a low of 1.5 percent for the United Kingdom. In terms of performance across sub-periods, average growth rates were highest for European countries during the post-war boom era between 1945 and 1973. Instead, the US grew fastest following the recovery from the Great Depression and Canada and Australia grew most rapidly prior to WWI during their resource sector/export booms, the period which produced the lowest growth rates for most countries in the data.

Table 2 presents the government expenditure to GDP ratios for all 17 countries for the period 1871 to 2013 and again for each sub-period used in Table 1. It should be noted that the government expenditure variable is central government expenditure which means that the

[11] Accessed October 2016. The data set and documentation are available at: http://www.macrohistory.net/data. Òscar Jordà, Moritz Schularick, and Alan M. Taylor. 2017. "Macrofinancial History and the New Business Cycle Facts." NBER Macroeconomics Annual 2016, volume 31, edited by Martin Eichenbaum and Jonathan A. Parker. Chicago: University of Chicago Press.

[12] Variable: rgdpmad, real GDP per capita in PPP terms.

public-sector size is underestimated for countries with federal forms of government: namely, the United States, Canada, Australia, Switzerland and Germany after 1949.[13]

Nevertheless, over the period 1871 to 2013, average public sector size was 17 percent ranging from a high of 24.3 percent for the United Kingdom to a low of 6.4 percent for Switzerland. Public sector size grew over time going from an average of 7.3 percent during the period from 1871 to 1913 and reaching 25.9 percent during the period 1974 to 2013.

Figure 1 plots the average annual real per capita GDP growth rates for each of the four sub-periods against the expenditure based public sector size variable. A LOWESS smoothing curve (with bandwidth of 0.8) suggests a hump-shaped Scully curve-type relationship with the maximum growth rate at 2.6 percent, corresponding to a government size of 21 percent. However, this relationship is at an aggregate level of data using averages by broad time period. Moreover, it does not control for any confounding factors that may also be determinants of economic growth. Regression models are therefore estimated to provide more reliable estimates of the Scully curve relationship using the 17 country panel data.

Prior to estimation, we address the fact that a relatively long time-series dimension raises concerns about the potential non-stationarity of variables in the data. The relationship of interest relates the growth rate of GDP, Y to the expenditure share of GDP, G. Both the expenditure share and GDP growth variables are tested for unit-roots using the Fisher meta-analysis approach to the non-parametric Phillips-Perron (PP) unit root test (Phillips and Perron, 1988), which combines separate panel-by-panel PP tests; and the Im-Pesaran-Shin, or IPS, unit-root test due to Im et al. (2003), which relaxes the assumption of prior tests that panels have the same autoregressive parameter.[14] Test results for Y are presented in Table 3 in column 1, without a trend and column 2 with a trend. The null-hypothesis that all panels of Y are non-stationary is consistently rejected at the 1% level, suggesting this series is is $I(0)$. However, the same is not true for G. The null can only be rejected with a high degree

[13] We control for being a federation as a fixed effect in regression estimates that follow.

[14] PP tests use 4 lags as selected by the Schwert criterion. IPS tests use bandwidths selected using the Bayesian Information Criterion.

of certainty in column 3, suggesting that this series are trend-stationary. Thus our regression analysis will include time-trends to ensure the dependent and independent variable of interest are integrated of the same order.[15]

4 Regression Model and Estimates

Estimates of the relationship between public sector size and GDP growth are based on the specification (1) below.

$$Y_{jt} = \gamma_1 G_{jt-1} + \gamma_2 G_{jt-1}^2 + \boldsymbol{X}'_{jt-1}\boldsymbol{\beta} + \delta_j + T_t + \epsilon_{jt} \tag{1}$$

The dependent variable, Y, is the growth rate of real per-capita ppp-adjusted GDP in country j in year t. The independent variable of interest, G, is the central government expenditure share of GDP. All independent variables enter the regression lagged one period to reflect the fact that the dependent variable Y is constructed as $(GDP_t - GDP_{t-1})/GDP_{t-1}$ and to account for the possibility that government expenditure as well as other covariates could plausibly affect the change in GDP with a lagged effect over time.[16]

A quadratic polynomial in government expenditure will allow the regression to pick-up the Scully relationship in the data, that is suggested by Figure 1.[17] The vector $\boldsymbol{X}$ contains a list of other covariates relevant to GDP growth, including the debt-to-GDP ratio, the export-share of GDP, and nominal short-term interest rates. Linear time trends T are also included. Country-specific fixed effects δ are included to account for time-invariant differences across countries. These terms may be especially important in capturing differences in the levels of

[15] Results were also computed using HP de-trended series for G, with smoothing parameter is set to 6.25 according to the Ravn-Uhlig rule-of-thumb. The Scully relationship also appears to be present, however, we present results are using the trend-controls instead to preserve the interpretation of the coefficients that is necessary to plot the Scully curve. These results are available from the authors upon request.

[16] A robustness exercise using no lags and two-period lags produced similar estimates, although slightly less significant. These results are available in Appendix Tables A.2 and A.3.

[17] Alternative estimates of equation (1) suggest that a quadratic relationship fits the data best. Higher-order polynomials terms in G were found to be insignificant.

government at which spending is financed and persistent differences in the wealth of particular nations. We also present specifications without the fixed-effects that instead include a binary indicator for whether or not the country is a federation in the covariate vector.

Table 4 presents estimates of equation (1) for the full series 1871-2013 with HAC standard errors, which are robust to arbitrary heteroscedasticity and autocorrelation.[18] Estimates across columns 1-4 differ in terms of covariates: column 1 is the least restrictive specification, and columns 2-4 are progressively more restrictive. A comparison of columns 1 and 2 illustrates the potential importance of country fixed-effects, which lead to estimates that predict a taller quadratic shape with respect to government expenditure. Among the covariates, the debt-to-GDP ratio and short-term interest rates are consistently associated with lower levels of real per capita GDP growth. The export share of GDP and WW1 years are also associated with lower economic growth whereas the WW2 coefficient is insignificant, likely due to missing expenditure data for many European countries.[19] As a robustness check, Appendix Table A.4 presents GLS estimates with standard errors corrected for panel-specific heteroscedasticity and AR(1) autocorrelation. These estimates may be slightly more efficient under the assumption that serial dependence is limited to a single period.

Using the regression, Scully curves are generated using the regression predictions for GDP growth calculated as $\hat{\gamma}_1 G + \hat{\gamma}_2 G^2$. Figure 2 presents four predicted Scully curves that correspond to estimates in each column of Table 4. The optimal levels of government expenditure predicted by all three fixed-effects specifications are very similar, ranging from 30-32 percent. The maximum real per capita GDP growth rates associated with this range between 3 and 4 percent.

Given the values in Table 1 these estimates suggest that only the Netherlands and Sweden have achieved an optimal public sector size, although government spending in Italy, Belgium and the UK is within 2 percentage points of this range. By contrast, the results suggest that

[18]HAC standard errors generated using the Bartlett kernel with smoothing parameter set to 22 according to the Newey and West (1994) selection method.

[19]See Appendix Table A.1 for a summary of missing values.

economic growth in Canada, Spain, Switzerland and the US might be expected to increase somewhat if a larger proportion of these nations' wealth were devoted to government expenditure, presumably for use on infrastructure, education and other productivity-enhancing ventures.

4.1 Scully curves over time

Whether or not the Scully curve has remained stable since the late 19th century is an open question. We subsequently split the sample into four periods: 1871−1912, 1925−1939, 1946−1973 and 1974−2013. The first two series breaks coincide with World Wars I and II, while the third break in the 1970s coincides with the oil price shock of the early 1970s and the subsequent ensuing period of productivity slowdown and stagflation and the recovery from that era in the 1990s. The second break is volatile period even when omitting WWI and its aftermath covering the boom of the 1920s and the Great Depression.

Table 5 presents estimates for each of the four periods corresponding to column 3 from Table 4. This is the most restrictive specification when the series do not overlap with the WWI and WWII periods. A growth-expenditure relationship is visible in all four periods, although the quadratic term is statistically insignificant post 1974 and both terms are insignificant for the inter-war period when using the conservative HAC standard errors. Large point estimates suggest that statistical insignificance is likely the result of the smaller sample size during this period.

Predicted Scully curves from Table 5 estimates are plotted in Figure 3. These estimates suggest that the Scully curve is indeed a dynamic and evolving relationship. Around the turn of the twentieth century when government involvement in the economy was more laissez-faire, optimal government expenditure to GDP ratios were likely very low − in the neighborhood of 9 percent of GDP and associated with a growth rate just under 3 percent. In the data, higher growth rates during this period of analysis were recorded among non-European countries, which tended to have smaller public sectors. Thus, fixed-effects regressions may be particularly important in providing reliable estimates.

By contrast, during the inter-war period the relationship is barely quadratic and the predicted optimal spending level was 30 percent of GDP with an associated peak growth rate of just over 8 percent. However, the interwar period is marked by adjustment to the Great War as well as the boom of the 1920s and the Great Depression and an increase in military spending in the run-up to WWII making it a volatile period for data in general. It is also a very short span of data compared to the other three sub-periods and the results for this period cannot be considered very robust.

Following WWII, the optimal government size shrinks to about 25 percent of GDP but it is substantially higher than the $1871-1912$ period and the growth rate associated with this optimal public sector size is just over 7 percent. This suggests that the optimal size of government needed to maximize economic growth did grow in the post WWII era and the expanded role of government did yield positive impacts on growth. In fact, this era produced substantially higher average growth rates for the European countries and Japan.

After 1973, predicted optimal expenditure grows to 82 percent of GDP but the associated peak economic growth rate is now just over 10 percent, but this relationship is only weakly quadratic. Given that this estimated relationship is well outside actual historical performance and is not very significant, it suggests a large shift in the relationship between government spending and economic growth. This time period overlaps the era of the oil shock and productivity decline as well as more recent rapid skill-biased technological change, when the increasing supply of human capital may have been of primary importance to economic growth.[20] By the 1970s, all the countries in the data set were effectively industrialized and the role of government in affecting economic growth and activity via investment in transportation and communications infrastructure was less important.

This result also suggests that the economic growth benefits of government expenditure

[20] Acemoglu (1998, 2002) argues that technical change was skill biased in the past century, with the most rapid changes taking place since the early 1980s.

on health and education which one might argue is investment in skills and human capital and that marked the 1945 to 1973 may have also reached diminishing returns in the post 1973 period. Indeed, Table 1 shows that the post 1973 period is characterized by the highest values for government expenditure shares across all countries except Germany while actual growth rates are low.

Region-specific effects may be responsible for some of these results. The fixed-effects estimation strategy employed in this paper nets-out many country-specific factors that may be important in understanding the evolution of the Scully curves over time. For example, damage to infrastructure in Europe during the world wars was extensive. As a result, there is reason to believe that the optimal levels of government spending differed across countries. Furthermore, differences in historical economic development, institutions and economic policy may affect both the conduct the efficacy of government spending across countries. The cross-country evidence presented thus far could, for example, mask competing relationships across broad country or regional groupings such as northern and southern Europe for example.

For this reason, we repeat the analysis after dividing the sample into four country groupings that traditionally can be grouped together because of similarities in economic development or social and economic policies during the twentieth century. These groupings are: Anglophone Nations (Australia, Canada, the United Kingdom and the United States)[21], Nordic Nations (Denmark, Finland, Norway and Sweden), Western European Nations (Belgium, France, Germany Switzerland and the Netherlands) and Southern Europe (Italy, Portugal and Spain). Japan does not fit neatly into any of these groupings but based on their historical economic development, which borrowed many policies from the UK and Germany, we include them with the western-European countries.[22]

Results are presented for these three groups in Appendix Tables A.5-A.8. With the ex-

[21] Sometimes termed the Anglosphere, The Anglosphere is rooted in the British Empire and generally refers to English speaking common-law based countries.

[22] Alternative estimates including Japan with Anglophone nations produced very similar results.

ception of the Nordic Nations, all of the country groupings demonstrate evidence of a Scully curve relationship. Although none of the coefficients are statistically significant at the 10% level, large negative coefficients suggest low optimal levels of spending in all three groupings. Interestingly, the Nordic Nations alone generate the inverted-U shaped curve during the inter-war era. A careful examination of column 4 across these 4 tables also suggests that, only for the Nordic nations is there not a Scully relationship in the post WW2 period. Anglophone and Western European Nations appear to be driving the results for the post-WW2 period, although the quadratic term for the latter group is not statistically significant.

The very different results for the most recent period, 1974-2013 seem driven by the Nordic countries, which the literature has found to have both high government size and growth (Bergh and Henrekson, 2011), suggesting that some social or economic features of these countries are able to accommodate greater government activity without the growth reducing features. Country-specific factors driving these results may not be captured by fixed-effects if they are time-varying. Given the difference in coefficients across the columns in Table A.6, this appears to be the case. Appendix Table A.9 confirms this intuition, presenting the main results excluding Nordic countries.

4.2 Reverse Causality

Estimates of the coefficients γ_1 and γ_2 are unlikely to suffer from reverse causality. In spite of concerns rasied by Wagners law, government budgets are tabled prior to the actual expenditure. The passage of time should therefore guarantee that lagged government size affects real GDP growth and not the other way around. Nevertheless, we cannot completely rule out the presence of third factors residing in the error term that correlate with both. In this section we examine whether the Scully curve is robust to estimation that attempts to accounts for reverse causality.

Following Afonso and Furceri (2010), we proceed with an identification strategy that provides exogenous variation in government expenditure from changes in country size. Increased populations would naturally lead to additional government expenditure since larger governments needed to serve larger populations have been documented as less-efficient than their smaller counterparts (Afonso et al., 2005). For this reason a population size instrument should not be weak.

A measure of country size should also be valid because population measures should not directly affect our PPP-adjusted measure of real GDP growth. However, there is some scope for violation of the exclusion restriction in cases where population is affected by national wealth, for example through decreases in the birth rate. To avoid this complication, we do not use population directly as an instrument but instead generate a counterfactual population instrument, Z_{jt}, from the interaction between the time-series for world average population growth and initial cross-sectional population in the first period of the panel for each country. The resulting variable can be interpreted as the predicted population which would have occurred had population grown from initial conditions at the world rate across all countries. The instrument can be considered part of a linear model predicting population:

$$Z_{jt} = \pi_1 \bar{P}_t + \pi_2 P_{j,t=1} + \pi_3 \left(\bar{P}_t \cdot P_{j,t=1} \right) \tag{2}$$

The use of year and country fixed effects will subsume the first and second terms in this expression. The instrument is plausibly exogenous because actual own-country population growth is not part of the counterfactual model generating our predicted population measure.

An added complication is that the potentially endogenous relationship described by equation (1) is non-linear in G. Although government spending is a single potentially endogenous factor, both terms for G and G^2 may require instruments. We follow Wooldridge (2010) and generate these in a two-step process. First, we estimate a reduced-form model relating government spending to our instrumental variable Z. We also include country and year fixed-effects (δ_j and λ_t, respectively) in this stage as additional exogenous variables.

$$G_{jt} = a_0 + a_1 Z_{jt} + \delta_j + \lambda_t + \epsilon_{a,jt} \tag{3}$$

Second, fitted values from this reduced-form regression, here denoted are collected and used in place as instruments in the Two-Stage Least Squares (TSLS) model given by equations

4-6 below.

$$G_{jt} = b_0 + b_1\hat{g}_{jt} + b_2\hat{g}_{jt}^2 + \epsilon_{b,jt} \tag{4}$$

$$G_{jt}^2 = c_0 + c_1\hat{g}_{jt} + c_2\hat{g}_{jt}^2 + \epsilon_{c,jt} \tag{5}$$

$$Y_{jt} = \phi_1\hat{G}_{jt-1} + \phi_2\hat{G}_{jt-1}^2 + \boldsymbol{X}'_{jt-1}\boldsymbol{\theta} + \delta_j + \lambda_t + \epsilon_{jt} \tag{6}$$

Estimates of equations (3)-(6) are presented in Table 6 for the most restrictive set of control variables. Year dummies are included in the model to account for business cycles, as suggested by Bergh and Henrekson (2011). In Column 1, OLS estimates of the reduced form equation (2) from the Wooldridge procedure are presented. These estimates can be used to assess the strength of the relationship between our proposed instruments Z and the potentially endogenous G in place of the traditional first-stage, which is less informative given the procedure above. The coefficient a_1 is statistically significant at the 1% level with a large t-statistic of 12.39. This result suggest that the instrument is not a weak predictor of government expenditure.

In columns 2 and 3 of Table 6 the traditional first-stage regressions are reported, reflecting equations (3) and (4) above. Robust multivariate F-tests for exclusion of $\hat{g}$ and $\hat{g}^2$ in both first-stage equations yield F-statistics exceeding the "rule of thumb" value of 10, which commonly used to evaluate whether each instrument is providing significant variation. Because our first stage estimates do not have the usual interpretation, we refer the reader to our discussion of reduced form equation (3) estimates above.

TSLS Estimates of the parameters ϕ_1 and ϕ_2 are presented in column 4. The signs of the estimated coefficients suggest that any causal effect of government expenditure on economic growth isolated by a population shock is quadratic in shape. Moreover, real GDP growth peaks at 2.3 percent but at a government expenditure to GDP ratio of nearly 50 percent. The quadratic shape in our results may also help to explain why previous causal estimates suggested a negative effect of government size on growth. Estimates in the literature exploiting plausibly exogenous variation in government size, including Afonso and Furceri (2010), Romero-Avila and Strauch (2008) and Fölster and Henrekson (2001), assume linearity in government expenditure.

Both the linear and quadratic terms are smaller than the OLS estimates, and statistically insignificant. One interpretation of smaller IV estimates is that accounting for Wagners law produces produce a weaker, but still quadratic relationship of low significance between growth and government size.[23] Under this interpretation, we cannot rule out the possibility that the Scully curve is not causal. A second interpretation is that population shocks are ultimately a relatively small contributor to the observed Scully relationship. Under this interpretation we cannot rule out the possibility of a quadratic relationship.

Ultimately, the timing of government budgets suggest that the OLS estimates should not suffer significantly from reverse causality and these IV estimates are identified using predicted variation in population size, which is only one possible reason for government size to change. Instruments which isolate exogenous variation in government size from other sources might be expected to generate more significant estimates. However, as noted in a recent review of the literature (Bergh and Henrekson, 2011), it is difficult to find good instruments for government size.

5 Conclusion

This paper extends the state of knowledge about the empirical link between public sector size and economic growth, known as the Scully curve. Using the Jordà-Schularick-Taylor Macrohistory Database we provide estimates of optimal growth maximizing central government size for the entirety of the twentieth century, more specifically over the period 1870 to 2013. Owing to the importance of economic growth for the long-run wealth of nations, evidence of this nature has significant merit. Furthermore, this analysis covers a period of industrialization that may hold important lessons for similar development of less-developed

[23]TSLS estimates without a quadratic term, as presented in the literature to date, did not outperform the quadratic estimates, yielding statistically insignificant but positive coefficients.

countries in the century to come, including some post-Soviet nations and perhaps nations on the African continent still currently developing their political and economic institutions.

Predictions from fixed-effects regression models estimated over the entire time-period of the data set suggest that the optimal public sector size with respect to economic growth ranged from 27-32 percent of GDP. These estimates provide reliable evidence because the analysis is confined to a set of 17 economies that experienced a comparable range of industrialization and economic development and because our empirical strategy further accounts for country-specific heterogeneity.

In keeping with the changing role of government over time that saw government evolve from laissez-faire in the 19th century to interventionist Keynesian welfare states after WWII, optimal public sector size appears to also have changed over time. Shifting Scully curves accompany changes in the size and scope of the state since 1871. Estimates show that the growth-maximizing size of government oscillated from 9 percent during the period $1871-1912$, to 30 percent from $1925-1939$. Following WW2, from $1946-1973$ it fell to 25 percent. Given the lower reliability for the 1925 to 1939 estimates, these results show that the growth maximizing size of government did expand with the onset of the Keynesian era.

However, while the predicted size of optimal government and associated economic growth for the post 1973 period is even larger, the results are not very significant. They are also at odds with the historical evidence, suggesting a breakdown in the Scully Curve as economies have moved beyond industrialization. Furthermore, notwithstanding the interwar period, while the optimal size of government for maximizing economic growth has grown over time, the less significant relationship since the mid 1970s suggests a weakening of the link between government size and growth with perhaps the exception of the Nordic countries.

This post 1973 era was marked by a retreat from the Keynesian paradigm as well as greater privatization, deregulation and some reduction in the role of government. These results suggest diminishing returns to government intervention once the initial phases of industrialization end. The Scully Curve relationship is disrupted after the mid 1970s generating a high optimal predicted government size but with the results driven by the Nordic countries. Much like Wagners Law, it may be that the Scully Curve is a feature of industrialization and not as applicable to post-industrial economies.

This also suggests that diminishing returns to economic growth from government intervention in the economy may be a feature of the post 1973 era for some countries but not necessarily all. More importantly, these documented shifts in the Scully curve may mean that the role of government in the economy is not a constant anchored on blocks of granite but must be flexible and evolve with the shifting structure and needs of the economy rather than be taken as some type of immutable relationship.

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Table 1: Average Annual Growth Rate of Real Per Capita GDP

	All Years	**Period-specific**			
	1871-2013	**1871-1913**	**1914-1945**	**1946-1973**	**1974-2013**
United States	2.0	1.9	2.8	1.4	1.8
United Kingdom	1.5	1.0	1.2	1.9	1.9
Belgium	2.1	1.1	2.2	3.8	1.8
Denmark	1.8	1.6	1.7	3.3	1.5
France	2.2	1.5	2.7	4.1	1.5
Germany	2.6	1.6	3.4	5.6	1.7
Italy	1.9	1.0	-0.9	7.0	1.5
Netherlands	2.4	0.9	1.5	6.3	1.7
Norway	2.3	1.4	2.5	3.2	2.5
Sweden	2.2	1.8	1.9	3.5	1.8
Switzerland	1.7	2.3	0.3	3.3	1.0
Canada	2.1	2.4	1.8	2.4	1.7
Japan	3.2	1.7	2.3	8.0	1.9
Finland	2.5	2.1	1.8	4.3	2.0
Portugal	2.0	0.6	1.3	5.0	1.8
Spain	2.2	1.4	1.2	4.8	2.0
Australia	1.8	2.5	1.0	2.3	2.0
AVERAGE	2.1	1.6	1.7	4.1	1.8

Source: Jordà-Schularick-Taylor Macrohistory Database. R eal GDP Growth based on one-year change, per-capita and ppp adjusted. Average growth rates for the full available series in column 1. Columns 2-5 provide growth rates that to correspond to specific time-periods of analysis.

Table 2: Average Government Expenditure to GDP Ratio

	All Years	**Period-specific**			
	1871-2013	**1871-1913**	**1914-1945**	**1946-1973**	**1974-2013**
United States	0.120	0.024	0.102	0.170	0.201
United Kingdom	0.243	0.073	0.320	0.276	0.340
Belgium	0.216	0.081	0.210	0.259	0.332
Denmark	0.195	0.065	0.098	0.210	0.380
France	0.189	0.118	0.194	0.220	0.243
Germany	0.102	0.041	0.139	0.132	0.133
Italy	0.230	0.138	0.257	0.193	0.334
Netherlands	0.219	0.106	0.204	0.284	0.303
Norway	0.197	0.070	0.087	0.272	0.358
Sweden	0.178	0.072	0.117	0.207	0.321
Switzerland	0.064	0.016	0.076	0.073	0.099
Canada	0.137	0.065	0.137	0.164	0.195
Japan	0.131	0.102	0.120	0.130	0.169
Finland	0.210	0.091	0.216	0.260	0.267
Portugal	0.137	0.054	0.099	0.123	0.268
Spain	0.133	0.093	0.117	0.110	0.202
Australia	0.193	0.024	0.148	0.222	0.260
AVERAGE	0.170	0.073	0.155	0.194	0.259

Source: Jordà-Schularick-Taylor Macrohistory Database. Average growth rates for the full available series in column 1. Columns 2-5 provide growth rates that to correspond to specific time-periods of analysis. Missing values occur for various countries at the start of the panel and during the world wars. Details are provided in Appendix Table A.1.

Table 3: Panel unit-root tests for series 1870-2013

	Y		***G***	
Test	**No Trend**	**Trend**	**No Trend**	**Trend**
Fisher PP (Z)	-32.351***	-72.696***	-1.612*	-7.043***
IPS (w_{t-bar})	-39.416***	-40.026***	-0.212	-4.038***

Source: Jordà-Schularick-Taylor Macrohistory Database. Fisher Philips-Perron (PP) test combines p-values from panel-specific PP tests using the inverse normal distribution. Real GDP Growth based on one-year change, per-capita and ppp adjusted.

Table 4: Expenditure share of GDP and Real GDP Growth, 1871-2013

	(1)	(2)	(3)	(4)
	Real GDP Growth	**Real GDP Growth**	**Real GDP Growth**	**Real GDP Growth**
$\frac{EXPEND}{GDP}$	19.309*** (4.610)	23.99*** (5.365)	22.604*** (5.396)	23.031*** (5.279)
$\left(\frac{EXPEND}{GDP}\right)^2$	-35.617*** (7.918)	-39.321*** (8.741)	-37.803*** (8.770)	-35.561*** (8.711)
$\frac{DEBT}{GDP}$	-1.454*** (0.290)	-2.012*** (0.448)	-1.907*** (0.442)	-1.997*** (0.445)
$\frac{EXPORT}{GDP}$	-1.551*** (0.549)		-1.208 (0.759)	-1.371* (0.781)
$STIR$	-0.126*** (0.034)	-0.168*** (0.037)	-0.162*** (0.037)	-0.183*** (0.038)
$WW1$				-1.732* (0.892)
$WW2$				-1.207 (1.052)
Fixed Effects	NO	YES	YES	YES
N	2064	2070	2064	2064

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time-trend.

Table 5: Expenditure share of GDP and Real GDP Growth during various time periods

	(1)	(2)	(3)	(4)
	Real GDP Growth 1871-1912	**Real GDP Growth 1925-1939**	**Real GDP Growth 1945-1973**	**Real GDP Growth 1974-2013**
$\frac{EXPEND}{GDP}$	56.59*	55.346	58.248*	25.699*
	(33.167)	(52.694)	(34.248)	(15.248)
$\left(\frac{EXPEND}{GDP}\right)^2$	-299.617**	-91.094	-115.82***	-15.738
	(143.010)	(122.036)	(43.940)	(21.452)
$\frac{DEBT}{GDP}$	1.414	5.799*	-0.749	-0.386***
	(1.055)	(3.405)	(1.147)	(0.429)
$\frac{EXPORT}{GDP}$	0.442	9.225	-26.491***	2.722
	(0.897)	(10.811)	(9.736)	(2.210)
$STIR$	-0.392**	-0.539	-0.243	-0.195***
	(0.156)	(0.366)	(0.175)	(0.039)
Fixed Effects	YES	YES	YES	YES
N	504	238	432	677

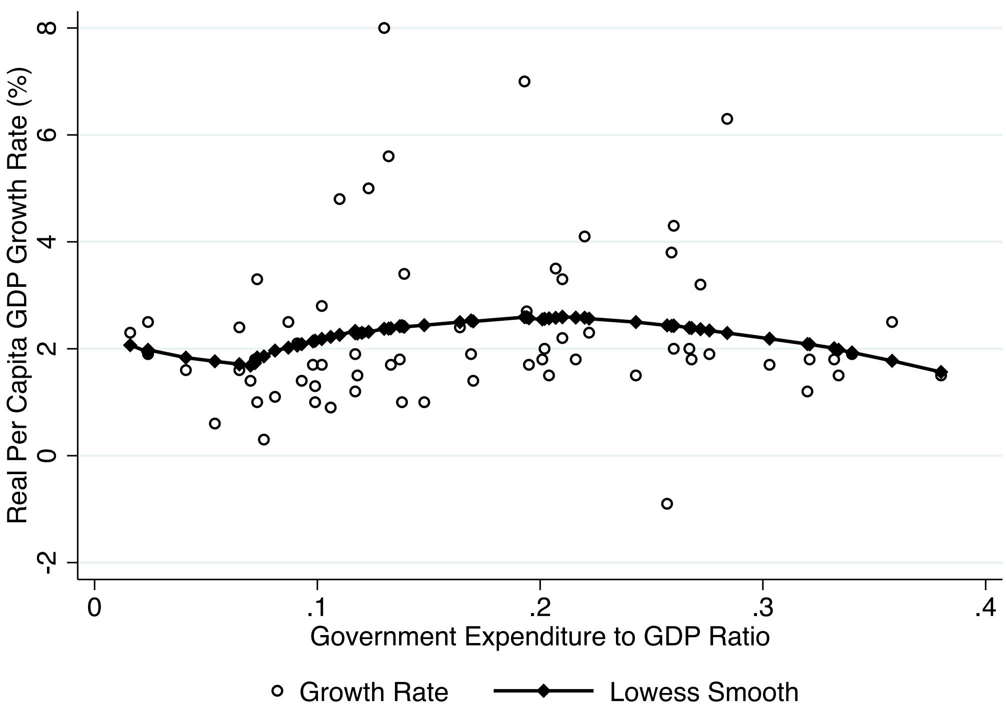
Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time-trend.

Table 6: IV Estimates of Expenditure share of GDP and Real GDP Growth, 1871-2013

	(1)	(2)	(3)	(4)
	Reduced Form	*First Stages*		*Second Stage*
	$\frac{EXPEND}{GDP}$	$\frac{EXPEND}{GDP}$	$\left(\frac{EXPEND}{GDP}\right)^2$	R. GDP Grwth
$\left(\bar{P}_t \cdot P_{j,t=1}\right)$	-0.816***			
	(0.066)			
$\hat{g}$ (red. form)		-0.104	-0.245**	
		(0.200)	(0.232)	
$\hat{g}^2$(red. form)		2.654***	1.883***	
		(0.332)	(0.232)	
$\frac{EXPEND}{GDP}$				9.193
				(21.213)
$\left(\frac{EXPEND}{GDP}\right)^2$				-9.186
				(31.637)
$\frac{DEBT}{GDP}$		0.072***	0.032***	-1.743
		(0.010)	(0.005)	(0.665)
$\frac{EXPORT}{GDP}$		-0.028	-0.015	1.445**
		(0.027)	(0.016)	(0.672)
$STIR$		0.006***	0.002***	-0.157**
		(0.001)	(0.000)	(0.071)
Year Dummies	YES	YES	YES	YES
Fixed Effects	YES	YES	YES	YES
N	2319	2053	2053	2053
F	43.09			
F_{IV}		36.97	40.58	

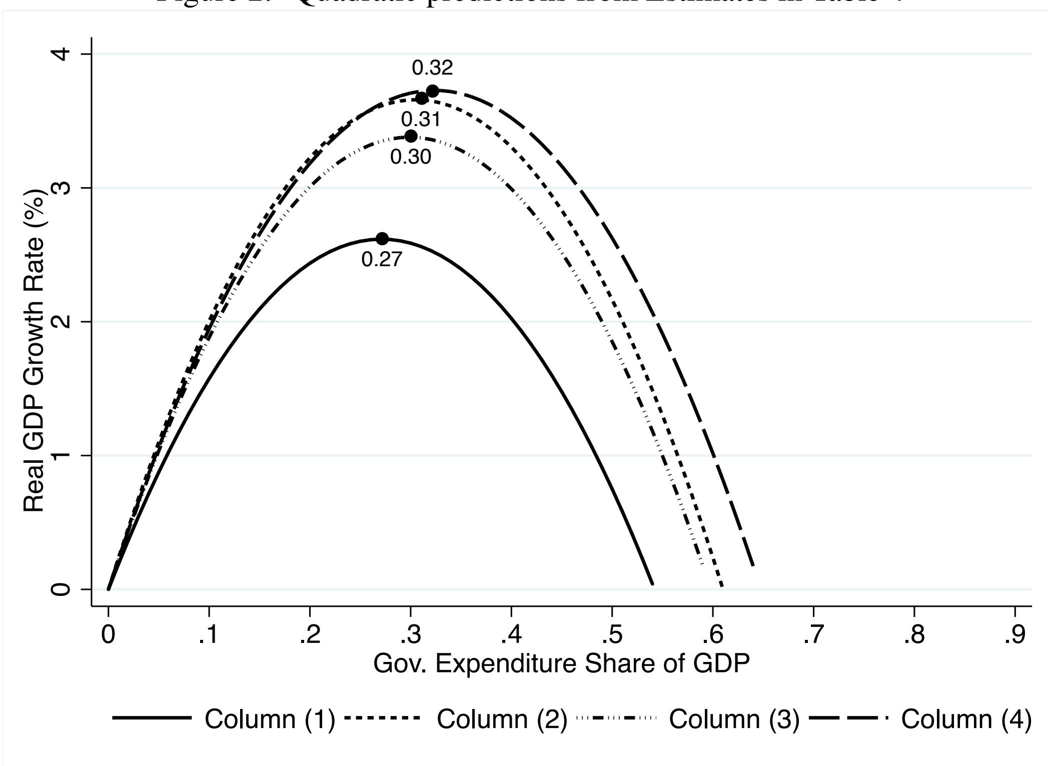
Source: Jordà-Schularick-Taylor Macrohistory Database. Reduced form are estimates of equation (3). Instrument coefficient $\left(\bar{P}_t \cdot P_{j,t=1}\right)$ is per 100,000s population. Fitted values from reduced form $\hat{g}, \hat{g}^2$ used as instruments in TSLS estimation. For details see Wooldridge (2010). First-stage equations in columns 2 and 3. Real GDP Growth is one-year change in per-capita ppp adjusted GDP. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroskedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. $F_I V$ is the F-test for excluded instruments only in first-stage.

Figure 1: Real Per Capita GDP Growth Versus Public Sector Size: 1871 to 2013



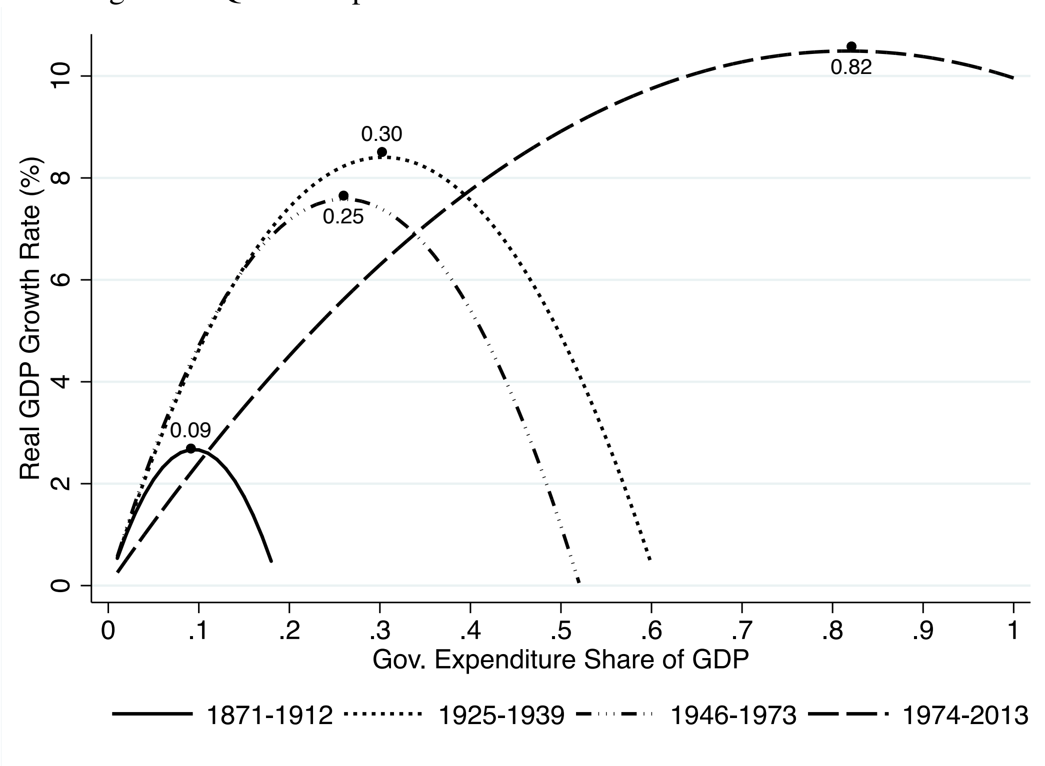
Source: Jordà-Schularick-Taylor Macrohistory Database. Data are average annual real per capita GDP growth rates in each of the four sub-periods 1871-1913 , 1914-1945, 1946-1973 and 1974-2013. Lowess smooth uses bandwidth of 0.8. Real GDP Growth based on one-year change, per-capita and ppp adjusted.

Figure 2: Quadratic predictions from Estimates in Table 4



Scully curves are predicted series: $\hat{\gamma}_1 G + \hat{\gamma}_2 G^2$ corresponding to estimates in Table 4 over four periods of time. Real GDP Growth rate is per-capita ppp adjusted. Points indicate growth-maximizing levels of government expenditure.

Figure 3: Quadratic predictions from Estimates in Table 5



Fixed.pdf

Scully curves are predicted series: $\hat{\gamma}_1 G + \hat{\gamma}_2 G^2$ corresponding to estimates in Table 5 over four periods of time. Real GDP Growth rate is per-capita ppp adjusted. Points indicate growth-maximizing levels of government expenditure.

A Appendix

Table A.1: Missing values for G by country

	Years Missing by Period		
Country	**Pre 1900**	**WWI**	**WW2**
United States			
United Kingdom			
Belgium		1913-1919	1940-1945
Denmark			1936
France		1914-1919	1939-1949
Germany	1870-1871	1914-1924	1939-1949
Italy			
Netherlands		1914-1920	1940-1945*
Norway		1940-1945	
Sweden			
Switzerland	1870		
Canada			
Japan	1870-1874		1945
Finland	1870-1881		
Portugal			
Spain		1936-1939	
Australia	1870-1901		

Source: Jordà-Schularick-Taylor Macrohistory Database.
*Netherlands series starts in 1945, however the value for this year is a stark outlier (> 1) and thus is excluded.

Table A.2: Contemporaneous Expenditure share of GDP and Real GDP Growth, 1871-2013

	(1)	(2)	(3)	(4)
	Real GDP Growth	**Real GDP Growth**	**Real GDP Growth**	**Real GDP Growth**
$\frac{EXPEND}{GDP}$	7.173	7.203	6.35	5.963
	(5.010)	(5.765)	(5.890)	(5.664)
$\left(\frac{EXPEND}{GDP}\right)^2$	-13.759	-10.247	-9.295	-5.861
	(8.522)	(8.900)	(9.089)	(9.488)
$\frac{DEBT}{GDP}$	-1.232***	-1.808***	-1.747***	-1.882***
	(0.348)	(0.505)	(0.505)	(0.506)
$\frac{EXPORT}{GDP}$	-0.763*		-0.653	-0.630
	(0.460)		(0.711)	(0.772)
$STIR$	-0.046	-0.079**	-0.075**	-0.091**
	(0.033)	(0.038)	(0.038)	(0.038)
$WW1$				-3.500***
				(1.012)
$WW2$				-0.744
				(1.417)
Fixed Effects	NO	YES	YES	YES
N	2076	2082	2076	2076

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables contemporaneous. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time-trend.

Table A.3: Twice-lagged Expenditure share of GDP and Real GDP Growth, 1871-2013

	(1)	(2)	(3)	(4)
	Real GDP Growth	**Real GDP Growth**	**Real GDP Growth**	**Real GDP Growth**
$\frac{EXPEND}{GDP}$	16.569***	20.207***	18.661***	18.353***
	(4.507)	(5.688)	(5.814)	(5.858)
$\left(\frac{EXPEND}{GDP}\right)^2$	-32.255***	-35.401***	-33.681***	-33.021***
	(7.589)	(9.218)	(9.350)	(9.252)
$\frac{DEBT}{GDP}$	-1.231***	-1.635***	-1.520***	-1.548***
	(0.291)	(0.458)	(0.454)	(0.457)
$\frac{EXPORT}{GDP}$	-1.590***		-1.565*	-1.496*
	(0.583)		(0.921)	(0.886)
$STIR$	-0.061*	-0.093**	-0.087**	-0.086**
	(0.033)	(0.037)	(0.037)	(0.039)
$WW1$				-0.881
				(0.568)
$WW2$				0.118
				(0.742)
Fixed Effects	NO	YES	YES	YES
N	2047	2053	2047	2047

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged two periods. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time-trend.

Table A.4: GLS Estimates: Expenditure share of GDP and Real GDP Growth, 1871-2013

	(1)	(2)	(3)	(4)
	Real GDP Growth	**Real GDP Growth**	**Real GDP Growth**	**Real GDP Growth**
$\frac{EXPEND}{GDP}$	28.154***	29.512***	27.648***	28.137***
	(4.626)	(4.584)	(4.621)	(4.605)
$\left(\frac{EXPEND}{GDP}\right)^2$	-42.899***	-44.806***	-42.632***	-40.053***
	(7.678)	(7.665)	(7.684)	(7.704)
$\frac{DEBT}{GDP}$	-1.336***	-1.436***	-1.321***	-1.385***
	(0.310)	(0.306)	(0.311)	(0.311)
$\frac{EXPORT}{GDP}$	-0.784		-0.768	-1.016
	(0.639)		(0.639)	(0.636)
$STIR$	-0.170***	-0.173***	-0.168***	-0.192***
	(0.033)	(0.033)	(0.033)	(0.033)
$WW1$				-1.606***
				(0.557)
$WW2$				-2.153***
				(0.500)
Country Dummies	NO	YES	YES	YES
N	2064	2070	2064	2064

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. AR(1) and heteroscedasticity-adjusted standard errors in parentheses. STIR is the nominal short-term interest rate. All specifications include linear time-trend.

Table A.5: Expenditure share and Real GDP Growth by time period, Anglophone Nations

	(1)	(2)	(3)	(4)
	Real GDP Growth 1871-1912	**Real GDP Growth 1925-1939**	**Real GDP Growth 1945-1973**	**Real GDP Growth 1974-2013**
$\frac{EXPEND}{GDP}$	92.141 (127.667)	-5.157 (73.094)	-103.131*** (32.500)	66.298* (36.883)
$\left(\frac{EXPEND}{GDP}\right)^2$	-485.269 (753.823)	123.333 (456.422)	97.498** (38.414)	-72.485 (66.154)
$\frac{DEBT}{GDP}$	17.458*** (6.729	21.869***) (4.288)	1.409 (0.971)	-3.666** (1.840)
$\frac{EXPORT}{GDP}$	-7.026 (22.839)	18.294 (18.997)	20.725 (12.972)	18.479** (8.790)
$STIR$	-0.649** (0.298)	-0.951** (0.405)	-1.157*** (0.149)	-0.421*** (0.071)
Fixed Effects	YES	YES	YES	YES
N	94	50	106	160

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time trend. Anglophone Nations include the Australia, Canada, the United Kingdom and the United States.

Table A.6: Expenditure share and Real GDP Growth by time period, Nordic Nations

	(1)	(2)	(3)	(4)
	Real GDP Growth 1871-1912	**Real GDP Growth 1925-1939**	**Real GDP Growth 1945-1973**	**Real GDP Growth 1974-2013**
$\frac{EXPEND}{GDP}$	-64.105	267.998***	18.895	-6.043
	(84.759)	(70.039)	(26.921)	(49.680)
$\left(\frac{EXPEND}{GDP}\right)^2$	180.098	-1100.000***	-56.316	28.826
	(483.640)	(292.933)	(45.394)	(67.099)
$\frac{DEBT}{GDP}$	5.437	19.756	2.881	2.274
	(4.277)	(12.068)	(3.092)	(1.564)
$\frac{EXPORT}{GDP}$	11.090	46.583***	-35.811***	13.254*
	(6.806)	(14.162)	(11.955)	(7.550)
$STIR$	-0.445	0.526	-0.224	-0.223***
	(0.274)	(0.529)	(0.342)	(0.072)
Fixed Effects	YES	YES	YES	YES
N	106	59	100	159

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time trend. Nations include the, Denmark, Finland, Norway, and Sweden.

Table A.7: Expenditure share and Real GDP Growth by time period, Western European Nations and Japan

	(1)	(2)	(3)	(4)
	Real GDP Growth 1871-1912	**Real GDP Growth 1925-1939**	**Real GDP Growth 1945-1973**	**Real GDP Growth 1974-2013**
$\frac{EXPEND}{GDP}$	54.647	61.707	105.514**	57.901**
	(34.582)	(74.204)	(53.629)	(24.344)
$\left(\frac{EXPEND}{GDP}\right)^2$	-170.359	-89.710	-150.063	-65.002*
	(176.949)	(166.447)	(89.780)	(36.936)
$\frac{DEBT}{GDP}$	-1.921	0.993	-3.315	-1.908***
	(2.557)	(3.045)	(2.563)	(0.623)
$\frac{EXPORT}{GDP}$	-0.424	7.191	-10.537	-2.917
	(1.041)	(13.876)	(11.174)	(1.942)
$STIR$	-0.188	0.304	-0.151	-0.308***
	(0.208)	(0.629)	(0.138)	(0.045)
Fixed Effects	YES	YES	YES	YES
N	216	87	142	238

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time trend. Western European Nations include Belgium, France, Germany, Switzerland and the Netherlands.

Table A.8: Expenditure share and Real GDP Growth by time period, Southern European Nations

	(1)	(2)	(3)	(4)
	Real GDP Growth 1871-1912	**Real GDP Growth 1925-1939**	**Real GDP Growth 1945-1973**	**Real GDP Growth 1974-2013**
$\frac{EXPEND}{GDP}$	10.449	-266.376	-74.178	75.747***
	(100.228)	(296.169)	(101.197)	(27.354)
$(\frac{EXPEND}{GDP})^2$	-149.866	863.564	658.822	-91.953**
	(362.403)	(721.448)	(352.120)	(43.566)
$\frac{DEBT}{GDP}$	0.793	3.766	-15.12	2.186*
	(1.501)	(6.746)	(7.872)	(1.672)
$\frac{EXPORT}{GDP}$	87.860***	51.779	-1.431	10.281
	(17.552)	(54.445)	(17.284)	(12.418)
$STIR$	-0.445	-1.124***	-0.564	-0.251***
	(0.815)	(0.382)	(0.942)	(0.076)
Fixed Effects	YES	YES	YES	YES
N	88	42	84	120

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time trend. Southern European Nations include Italy, Portugal and Spain.

Table A.9: Expenditure share and Real GDP Growth, Excluding Nordic Countries

	(1)	(2)	(3)	(4)	(5)
	Real GDP Growth 1871-2013	**Real GDP Growth 1871-1912**	**Real GDP Growth 1925-1939**	**Real GDP Growth 1945-1973**	**Real GDP Growth 1974-2013**
$\frac{EXPEND}{GDP}$	20.217***	72.354**	53.709	70.970	34.494**
	(6.265)	(34.770)	(77.030)	(50.499)	(16.688)
$\left(\frac{EXPEND}{GDP}\right)^2$	-34.750***	-351.40**	-81.116	-130.71**	-31.053
	(9.999)	(145.03)	(174.47)	(57.925)	(26.855)
$\frac{DEBT}{GDP}$	-2.046***	1.081	5.671	-0.786	-1.006*
	(0.476)	(1.108)	(3.759)	(1.425)	(0.584)
$\frac{EXPORT}{GDP}$	-0.780	0.719	6.562	-23.591**	0.944
	(0.733)	(0.933)	(12.348)	(11.208)	(2.122)
$STIR$	-0.183***	-0.440**	-0.545	-0.195	-0.189***
	(0.046)	(0.175)	(0.401)	(0.187)	(0.050)
Fixed Effects	YES	YES	YES	YES	YES
N	1575	398	179	332	518

Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West (1994) bandwidth selection used to determine long-run variance. STIR is the nominal short-term interest rate. All specifications include linear time trend. Nations include the, Denmark, Finland, Norway, and Sweden.