The Shifting Scully Curve: International Evidence from 1870 to 2013

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Summary

- Scully curves 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.
- 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.
- IV estimates of the Scully relationship suggest some reverse causality.

CONTEXT

Government & Economic Growth

- Government size may be an important factor affecting economic growth because the provision of institutions and other government activities yield substantial benefits.
- Explicit relationship between government size and economic growth involves a hump-shaped curve known as the Armey/BARS/Scully Curve

SCULLY CURVE

- 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)
- 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.

Our contributions

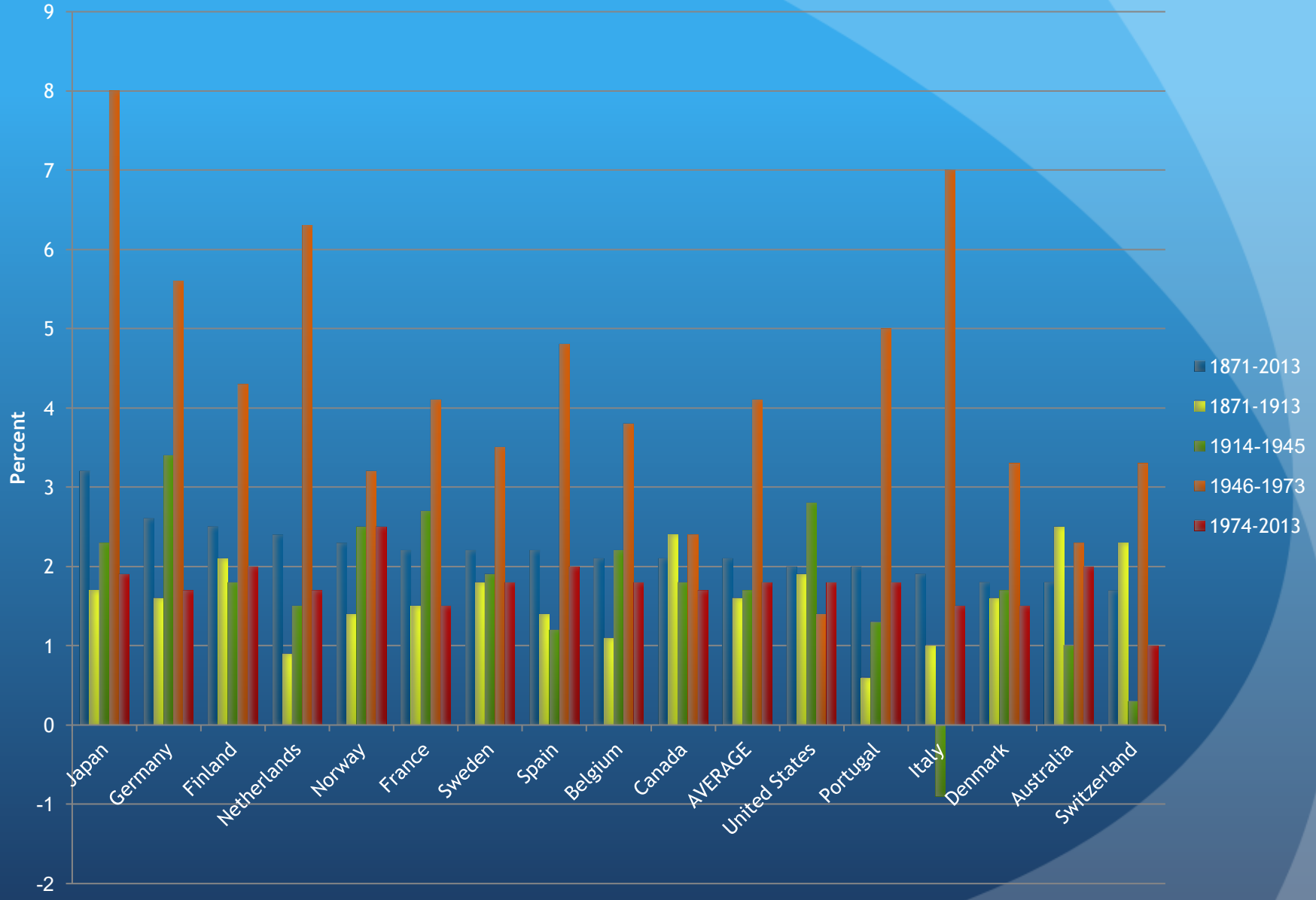
- Trace out Scully curves for the entirety of the twentieth century.
- Explores the previously-untested hypothesis that the Scully relationship has shifted over time
- We attempt to address concerns of reverse causality using Instrumental Variables (IV) estimation.

DATA

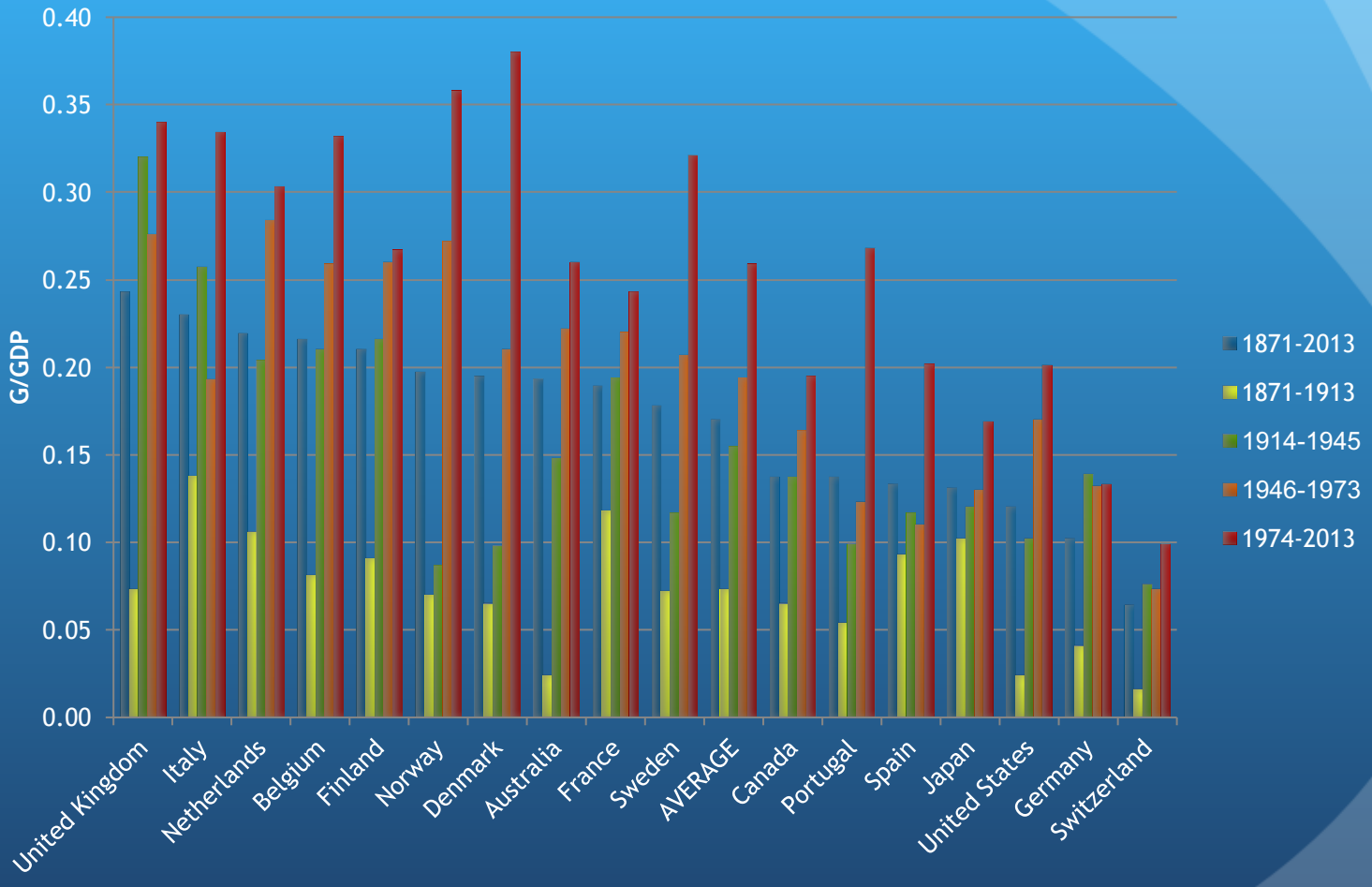
Jordà-Schularick-Taylor Macrohistory Database

- A comprehensive macro-financial panel dataset of 17 countries spanning the periods 1870 to 2013 (Jordà et al, 2017)
- Countries include: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and the United States

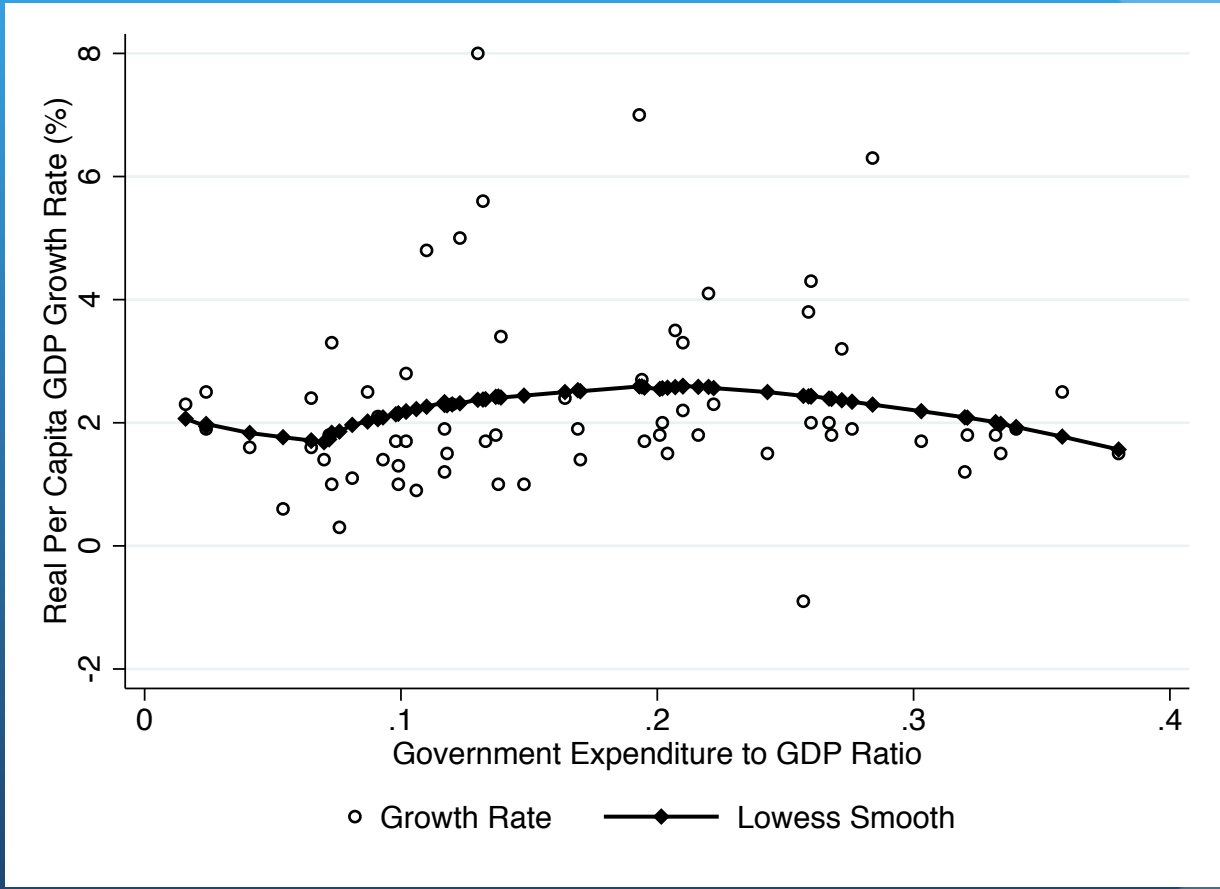
Average Annual Growth Rate of Real Per Capita GDP, 1871-2013



Average Government Expenditure to GDP Ratio



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



Data Note

- The government expenditure variable is central government expenditure which means that the public-sector size is underestimated for countries with federal forms of government: namely, the United States, Canada, Australia, Switzerland and Germany after 1949
- We control for being a federation as a fixed effect in regression estimates that follow
- There are some gaps in the data series for a number of European countries due to war as well as some others

Model and Estimates

Model

- The dependent variable, Y_{jt} 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 – quadratic picks up Scully relationship.

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

Confounding Variables

- debt-to-GDP ratio,
- the export-share of GDP,
- and nominal short-term interest rates,
- linear time trends *T* are also included,
  (results robust to quadratic time trends)
- World Wars
- Country-specific fixed effects including federal form

Full series results 1870-2013 with HAC standard errors, which are robust to arbitrary heteroscedasticity and autocorrelation

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***	23.99***	22.604***	23.031***
	(4.610)	(5.365)	(5.396)	(5.279)
$(\frac{EXPEND}{GDP})^2$	-35.617***	-39.321***	-37.803***	-35.561***
	(7.918)	(8.741)	(8.770)	(8.711)
$\frac{DEBT}{GDP}$	-1.454***	-2.012***	-1.907***	-1.997***
	(0.290)	(0.448)	(0.442)	(0.445)
$\frac{EXPORT}{GDP}$	-1.551***		-1.208	-1.371*
	(0.549)		(0.759)	(0.781)
$STIR$	-0.126***	-0.168***	-0.162***	-0.183***
	(0.034)	(0.037)	(0.037)	(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.

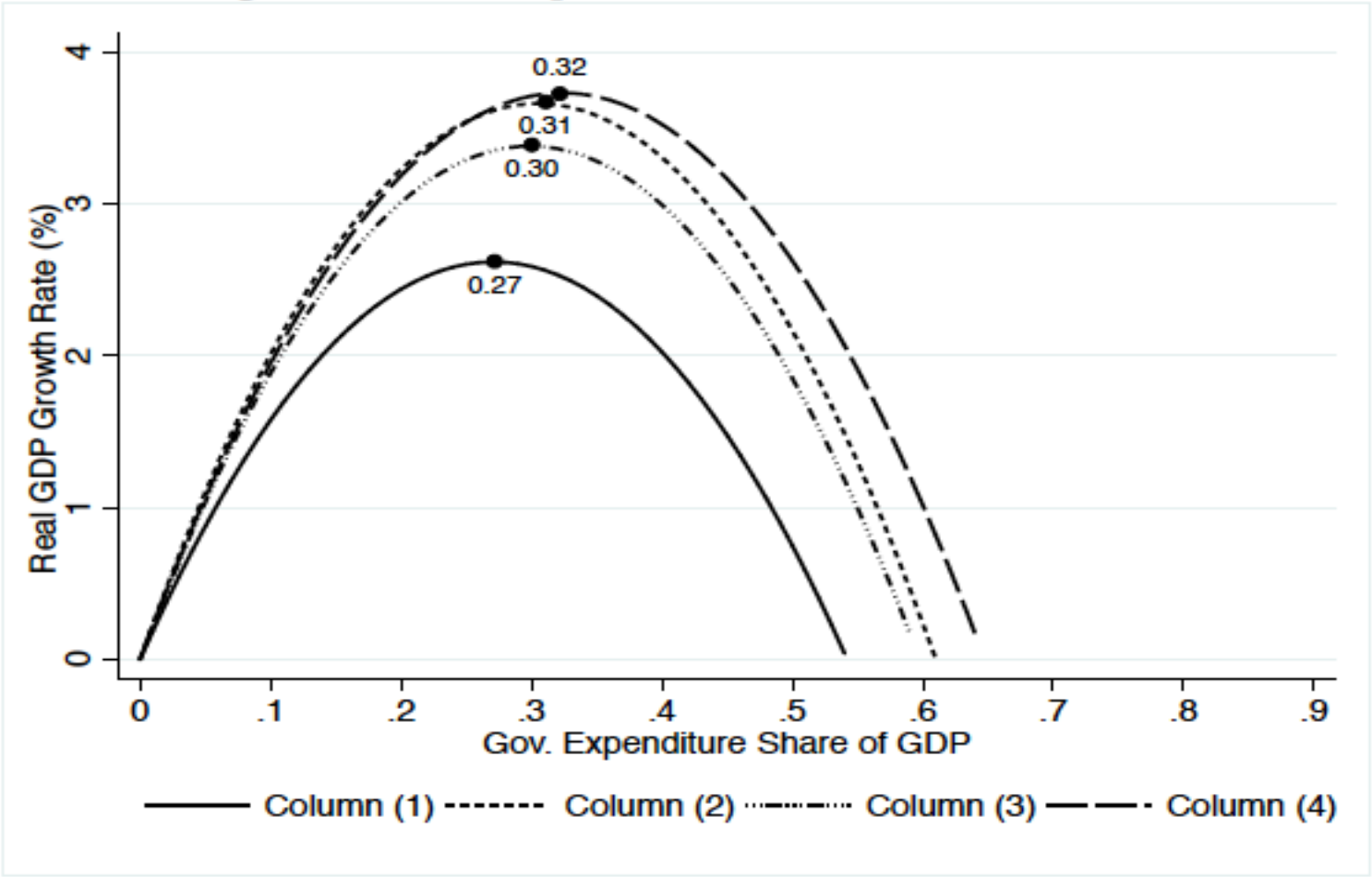
Results by time period

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

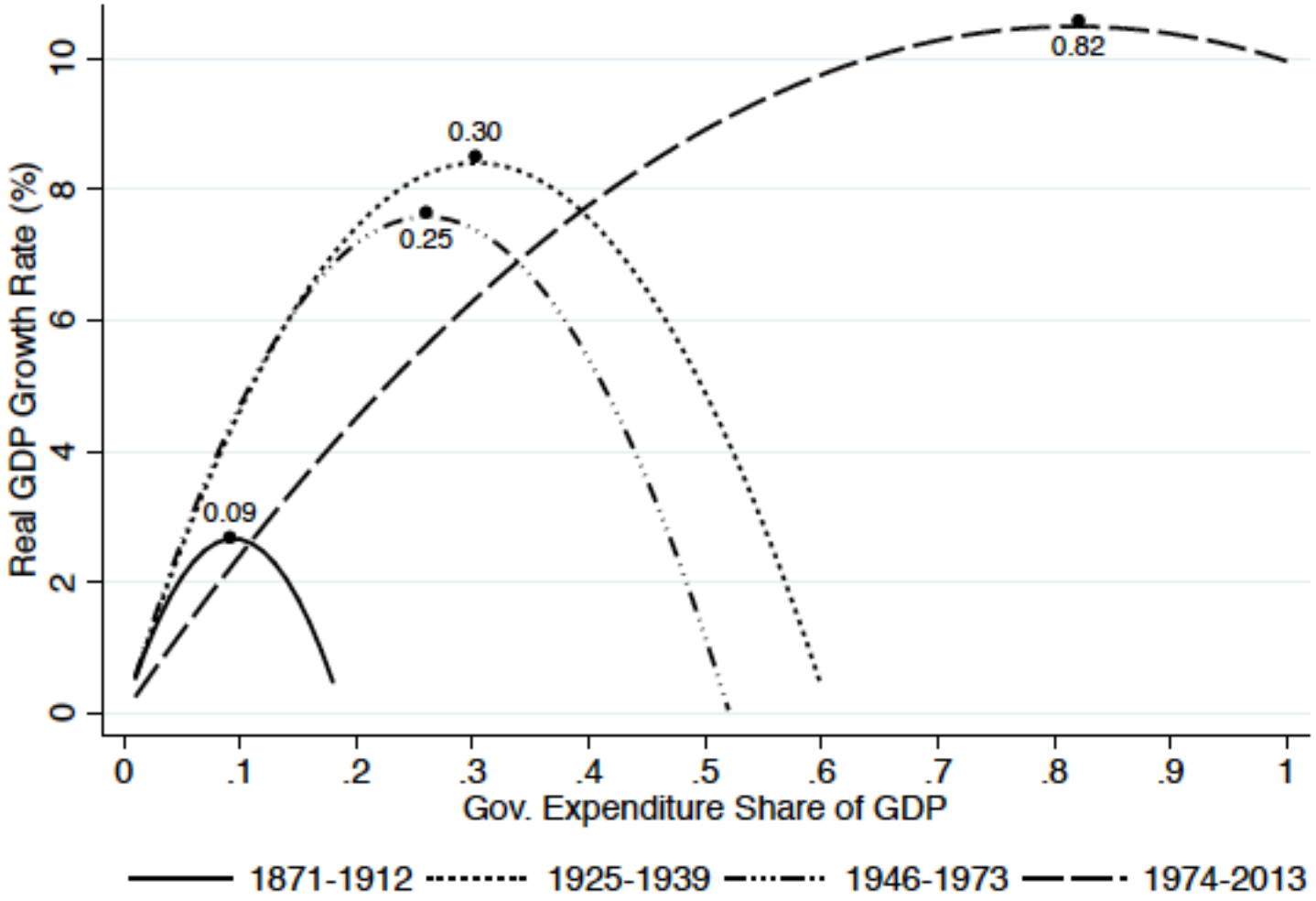
Source: Jordà-Schularick-Taylor Macrohistory Database. Real GDP Growth based on one-year change, per-capita and ppp adjusted. All independent variables lagged 1 period. HAC standard errors in parentheses robust to arbitrary heteroscedasticity and serial correlation. Bartlett kernel with Newey and West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

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



Main Results

- Predictions from OLS 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% of GDP.
- 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% during the period 1871-1912, to 30% from 1925-1939. Following WW2, from 1946-1973 it fell to 25%. Post 1973 very large estimate but results not significant.

Additional Testing

- Unit root tests were run – some evidence that G is non-stationarity - reason time trends included.
- Additional runs for region specific effects by country groupings – Anglophone, Western Europe, Southern Europe & Nordic – all generate evidence of Scully curve except Nordics.
  - Nordics may have social/economic features that combine large government size and higher economic growth
  - Nordics appear to be driving the results post 1973

IV – in case of reverse causality

- G should be exogenous since government budgets (G) chosen before before GDP is realized- plus we lag G
  - Still, Wagner's law suggests Y causes G (and G^2) ?

- Instrumental Variable based on population counts
  - Should be relevant for spending
  - Should affect Y (per-capita measure) only through G

- IV is *predicted* population: X-country in period 1 * world trend
  - Abstracts from selection (migration) across countries

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

2SLS Model

- Since G enters as a quadratic, both terms must be instrumented
- Follow Wooldridge (2010) procedure for quadratic
  1. Reduced form regression of IV on G and exog. variables

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

$\lambda_t + e_{jt}$

  2. Take fitted values $\tilde{G}$ (and make $\tilde{G}^2$) from above.
  3. Use these as "instruments" for G and G^2 in 2SLS model:

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

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

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

IV Results: Expenditure share 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	

Conclusion

A Scully Curve

- We find a Scully curve for 1871-2013 using data for 17 developed countries: optimal public sector size with respect to economic growth ranged from 27% - 32% of GDP
- 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 – optimal size of government grew from 1871 to 1973

Post 1973

- results are not very significant and are also at odds with the historical evidence suggesting a breakdown in the Scully Curve as economies have moved beyond industrialization.
- These results suggest diminishing returns to government intervention once the initial phases of industrialization end.
- Any 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.

Final Takeaway

- 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.

Questions