

# **Physicians as Health Expenditure Drivers: An Empirical Comparison of Supplier-Induced Demand in Canada and Spain**

Livio Di Matteo, Lakehead University and David Cantarero-Prieto,  
University of Cantabria

Presentation for Memorial University Seminar Series, September  
22<sup>nd</sup>, 2017.

# Summary

- We study the impact of physicians on health care expenditure and its dynamics over time in Canada and Spain for two overlapping time-spans of data availability: Canada, 1981 to 2013 and Spain, 2002 to 2013.
- Regression analysis finds physician numbers are a more statistically significant driver of real per capita provincial government health expenditures in Canada but not in Spain despite the fact that the per capita number of physicians is greater in Spain.
- Supplier induced demand therefore may more characterize the health sector in Canada but not necessarily in Spain.
- Spain appears to be achieving health outcomes that are the equivalent or better than Canada and is doing so with more physicians per capita but also while spending less per capita.
- Ultimately, these differences in outcomes and expenditures are most likely a reflection of differences in institutional structures.

# Highlights

- Canada has fewer physicians per capita than Spain but spends more on health overall.
- Basic health outcomes in Spain have improved more than Canada's
- Physicians increase Canadian and Spanish spending by nine and 0.4 percent.
- Supplier induced demand characterizes health sector in Canada but not Spain.
- Canadian physicians may have greater monopoly power than Spain.



# **Physicians and Health Expenditure Determinants**



# Key Health Expenditure Drivers

- physician numbers, population growth, population aging, income, inflation, and enrichment factors such as technological extension
- focus on physician numbers as a cost driver is traditionally linked to the argument that physicians can influence the demand for their services via supplier induced demand.

# Supplier Induced Demand

- Supplier induced demand may occur when health care providers use their superior knowledge to take advantage of the information gap between health care professionals and their patients and influence demand.
- an agency problem in that patient dependence on a physician potentially gives the physician a degree of discretionary influence in affecting demand for their billable services.
- The result of supplier-induced demand can be more spending on physician services as a result of either increased volume or a higher equilibrium fee for services.

# Uwe Reinhardt “fee test” of inducement

- evidence that fee increases follow physician supply increases is viewed as support for supplier induced demand.
- However, such a test is difficult to conduct in health care systems where fees and prices are administered or regulated.
- most of the early empirical support for the Supply Induced Demand came not from Reinhardt-type tests but from studies showing a positive correlation between physician supply and utilization rates or geographic variations in surgery rates.
- Relationship between physician numbers and total spending a proxy in public systems



# CONTEXT

# Canada & Spain

- Canada spends more per capita on health and yet in terms of basic health indicator performance, Spain has gradually overtaken Canada.
- An important health system difference between Canada and Spain is physician intensity – that is, Canada has fewer physicians per capita than Spain, despite the economic crisis and austerity policies in the European Union

# Comparing Canada & Spain

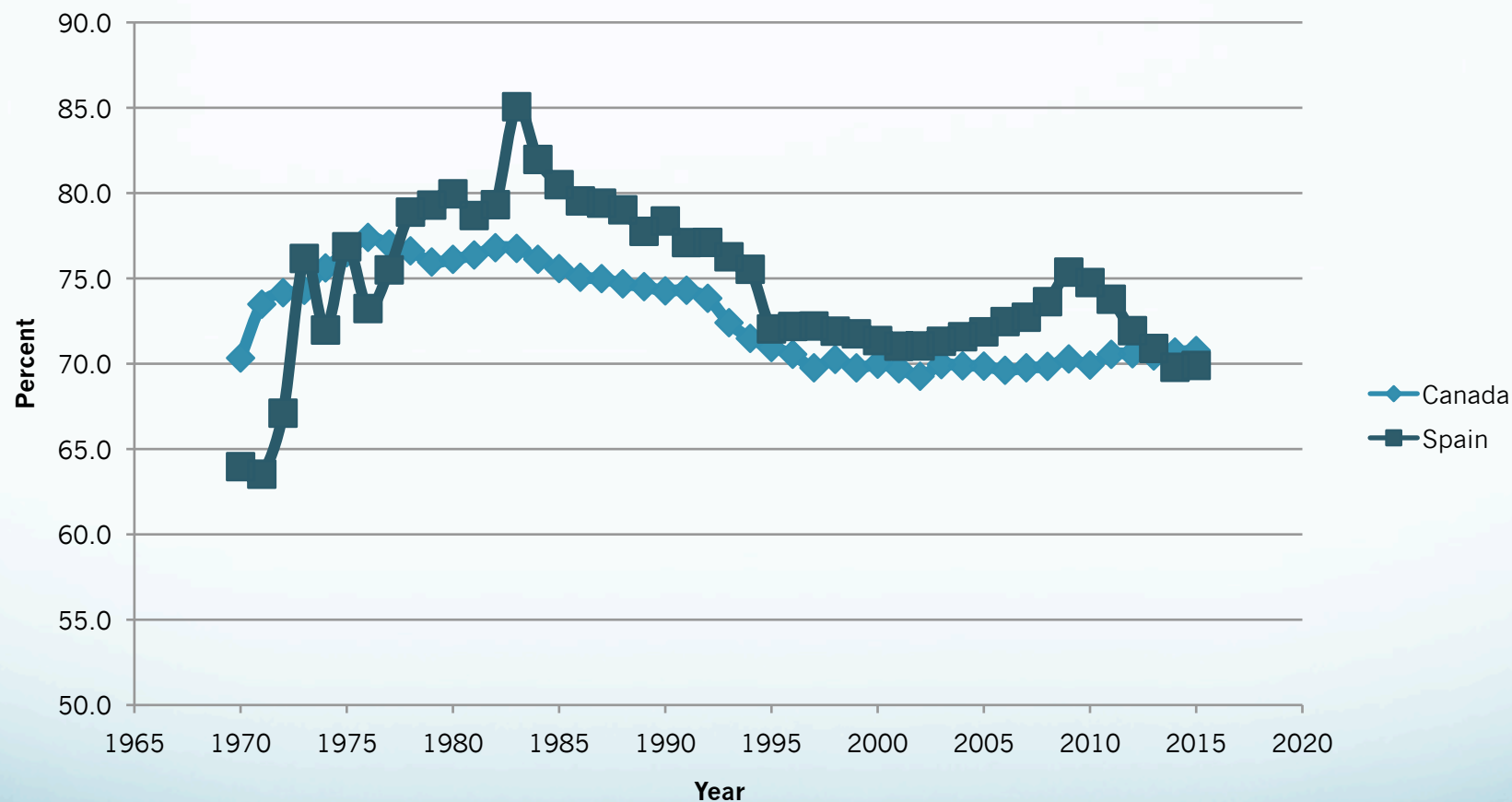
## Canada

- Decentralized provincial-territorial health care system
- 14 publically funded systems
- Fee for Service & some alternative payment programs
- No private options for physician services

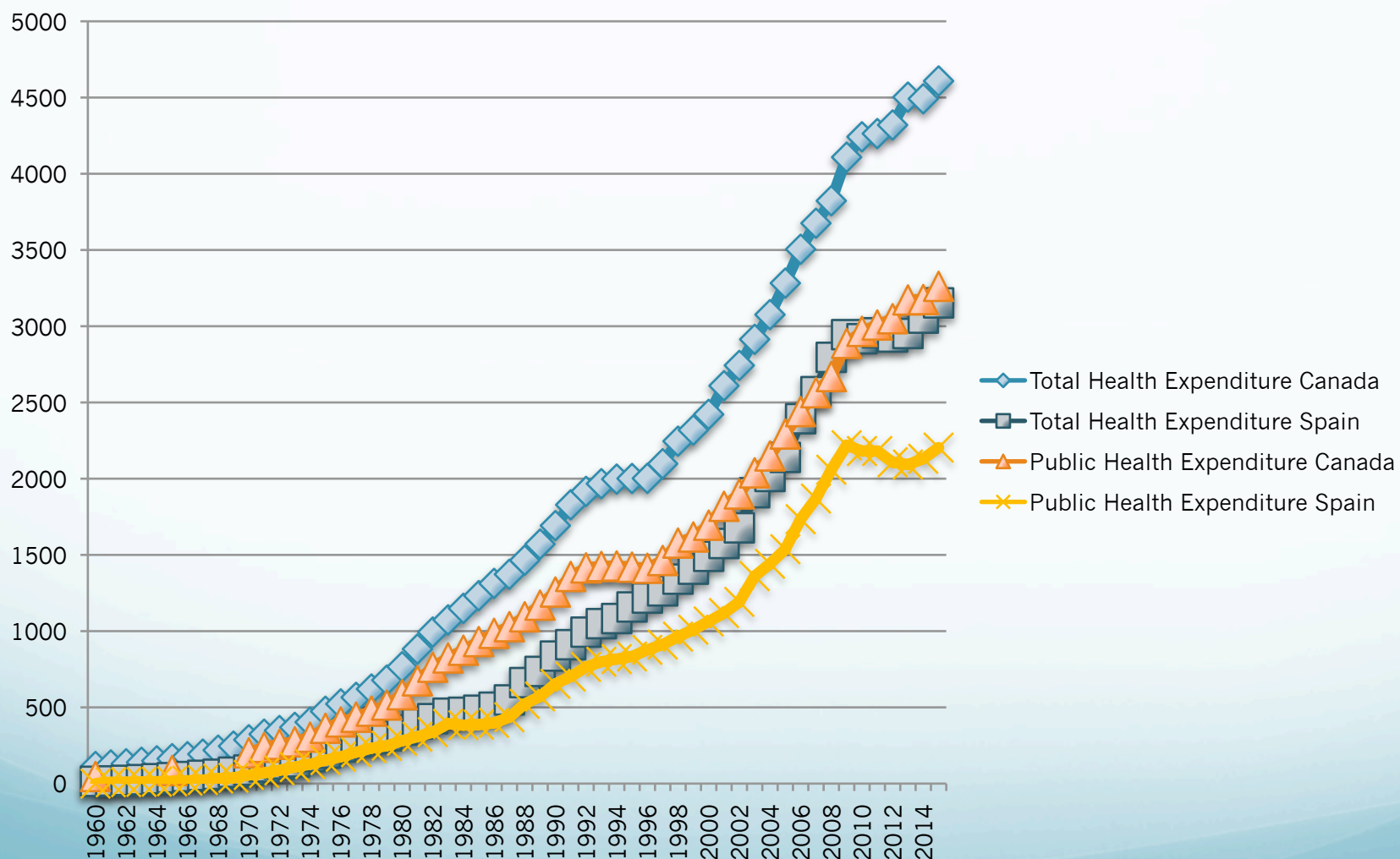
## Spain

- Regional governments organize own health systems with some federal role in harmonizing services
- 17 publically funded systems
- Physicians on salaries
- Both public and private options-private options allow for faster non-emergency care

# Public Shares of Total Health Spending (Source: OECD Health Statistics)

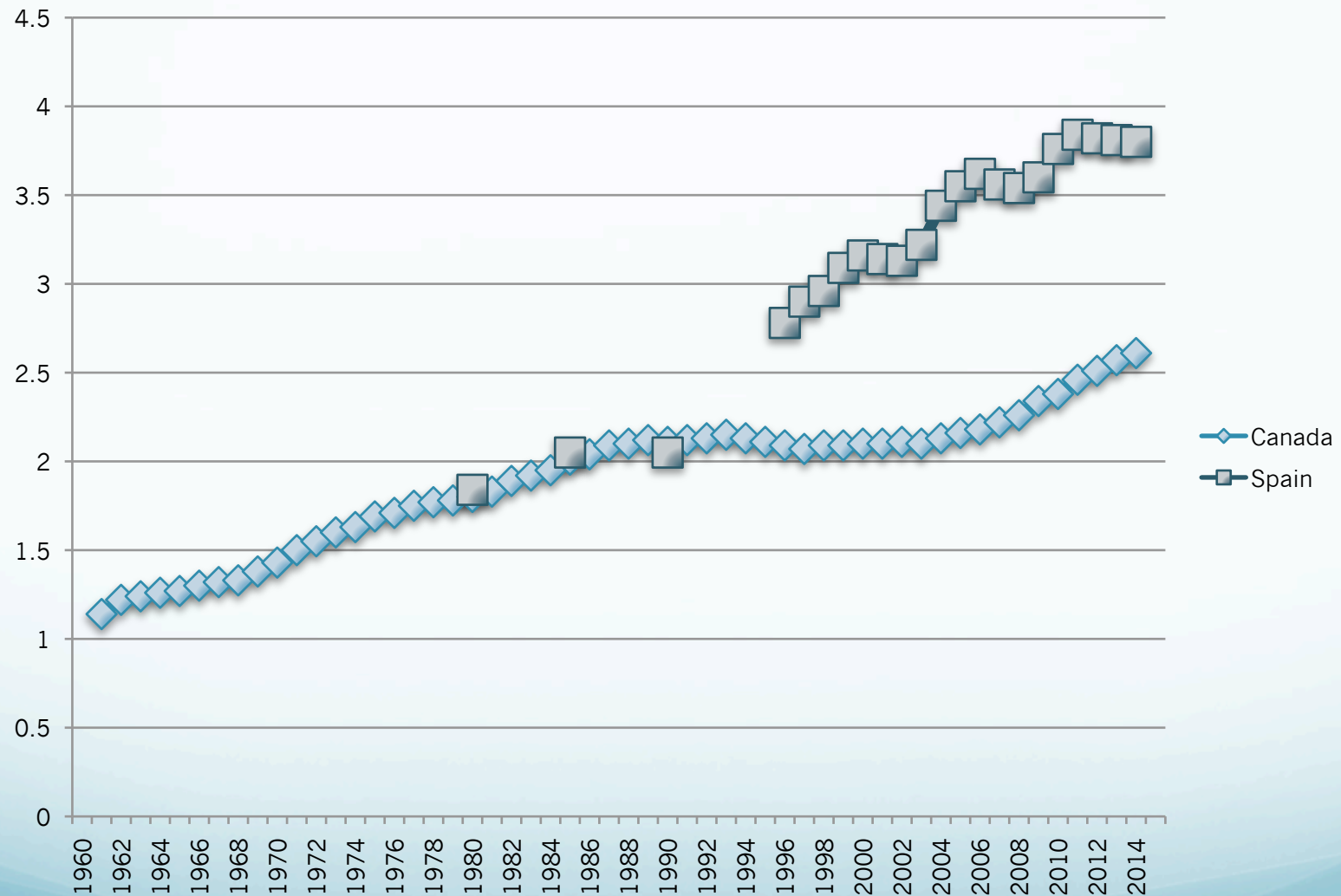


## Per Capita Health Spending in Canada & Spain, 1960-2015 (US PPP\$; OECD Health Statistics 2017)

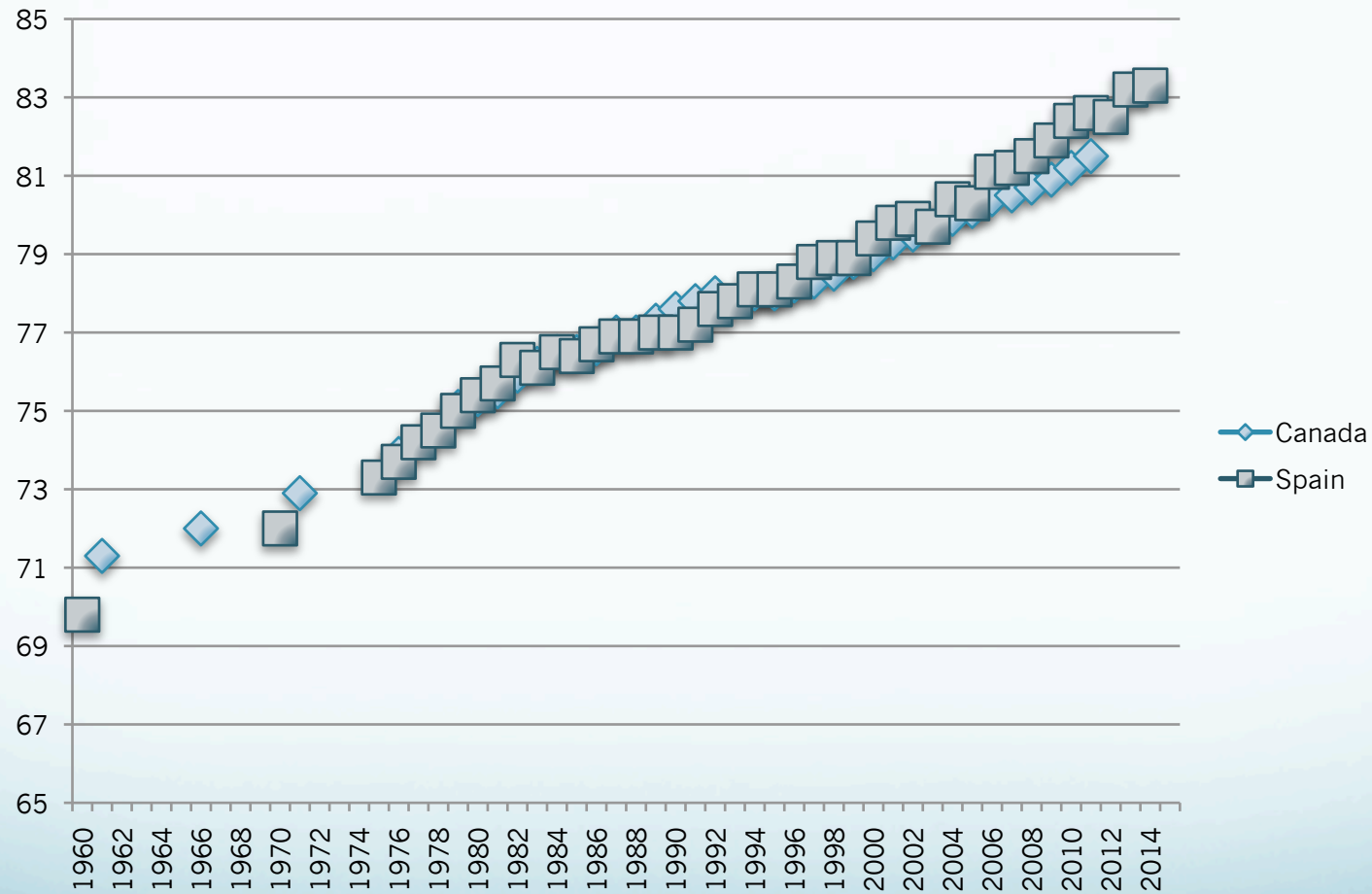




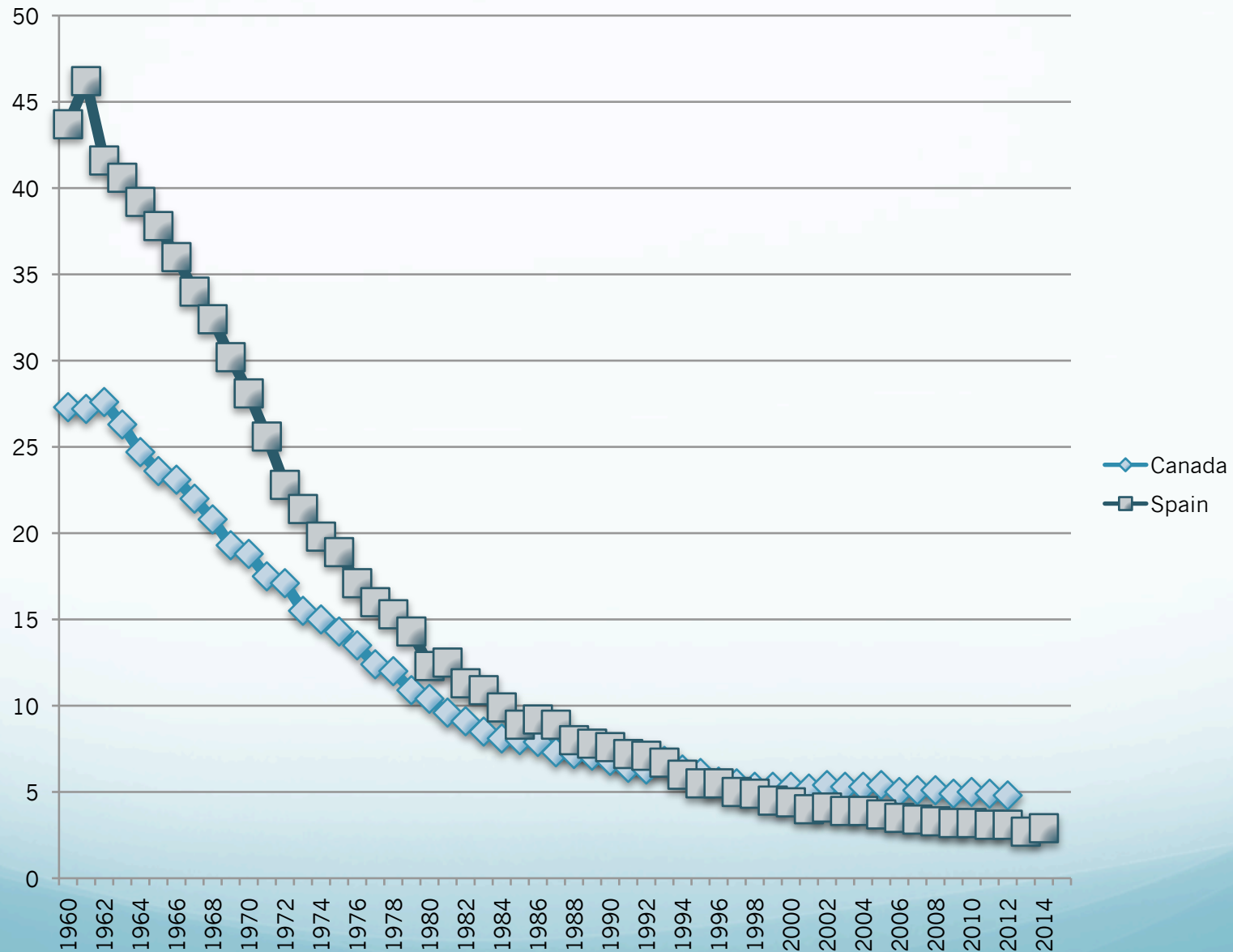
## Physicians, Density per 1,000 Population (Source: OECD Health Statistics 2017)



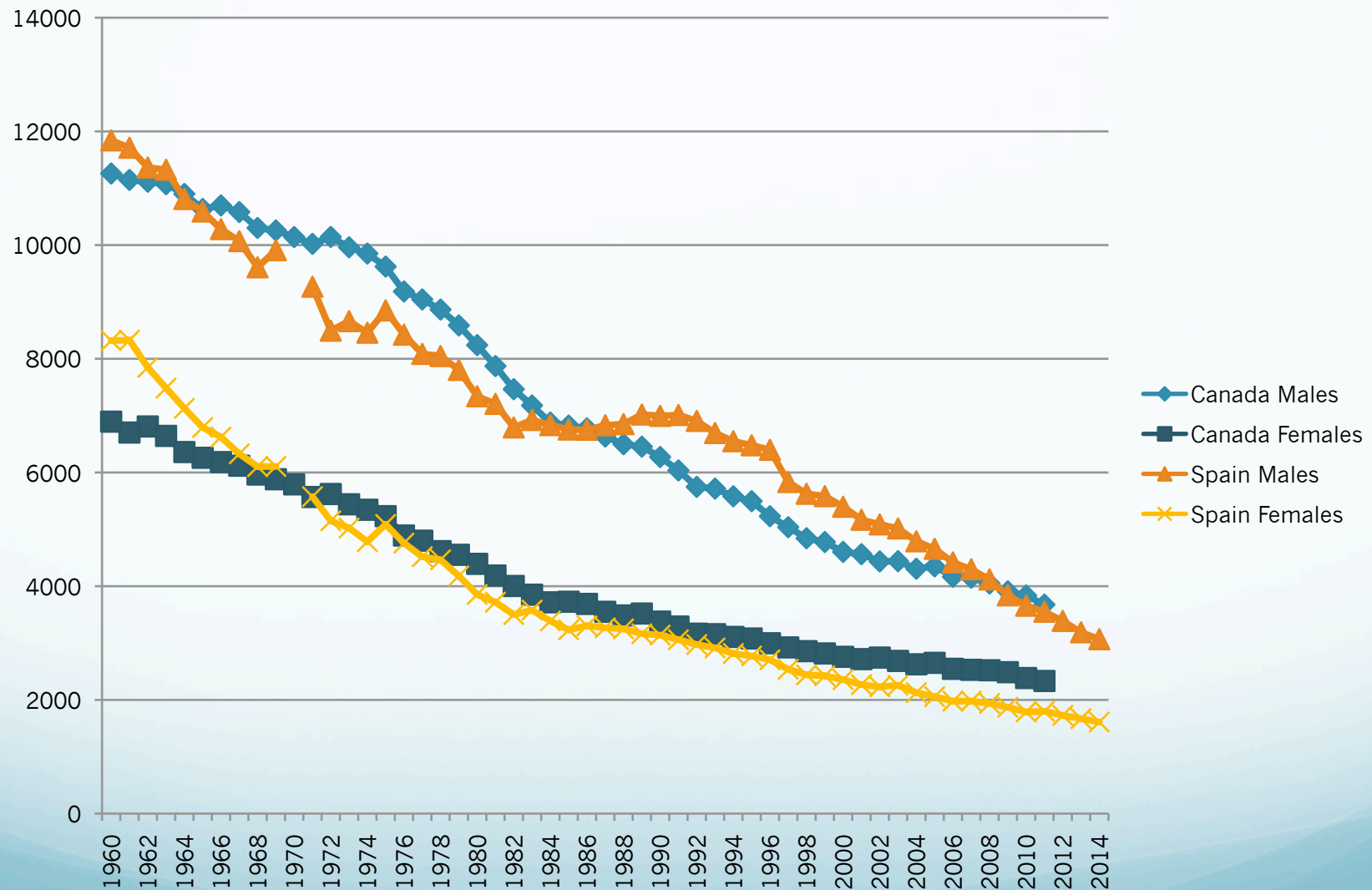
## Life Expectancy at Birth, Years, Total Population (Source: OECD Health Statistics 2017)



## Infant Mortality, Deaths Per 10000 Live Births (Source: OECD Health Statistics 2017)

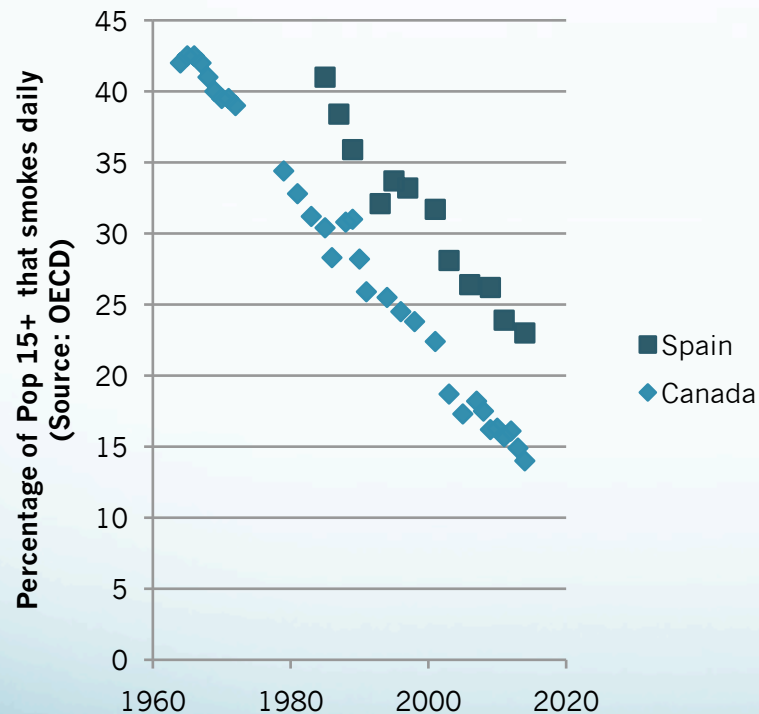


## Potential Years of Life Lost Per 100,000, All Causes, Age 0-69 (Source: OECD Health Statistics)

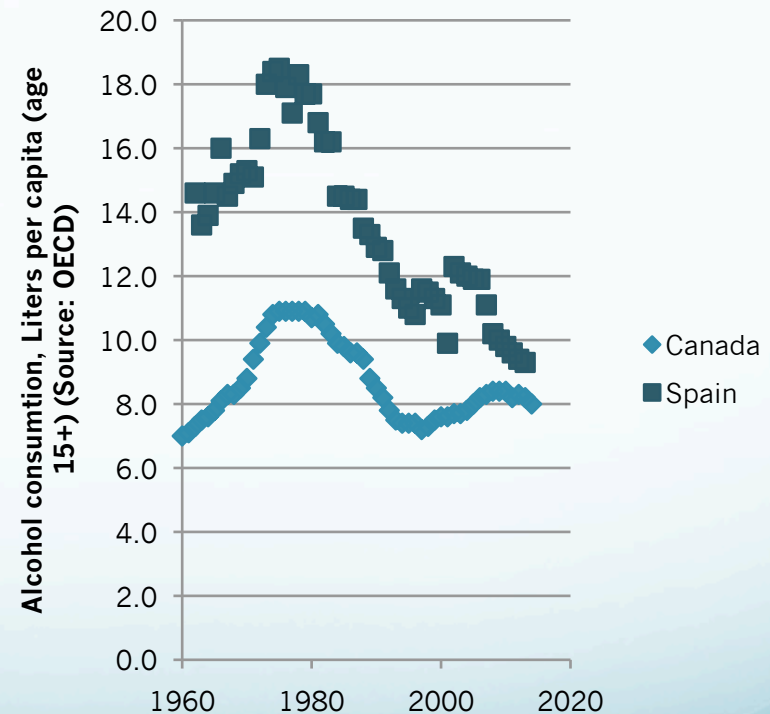


# Interestingly enough, Spain also drinks and smokes more than Canada...

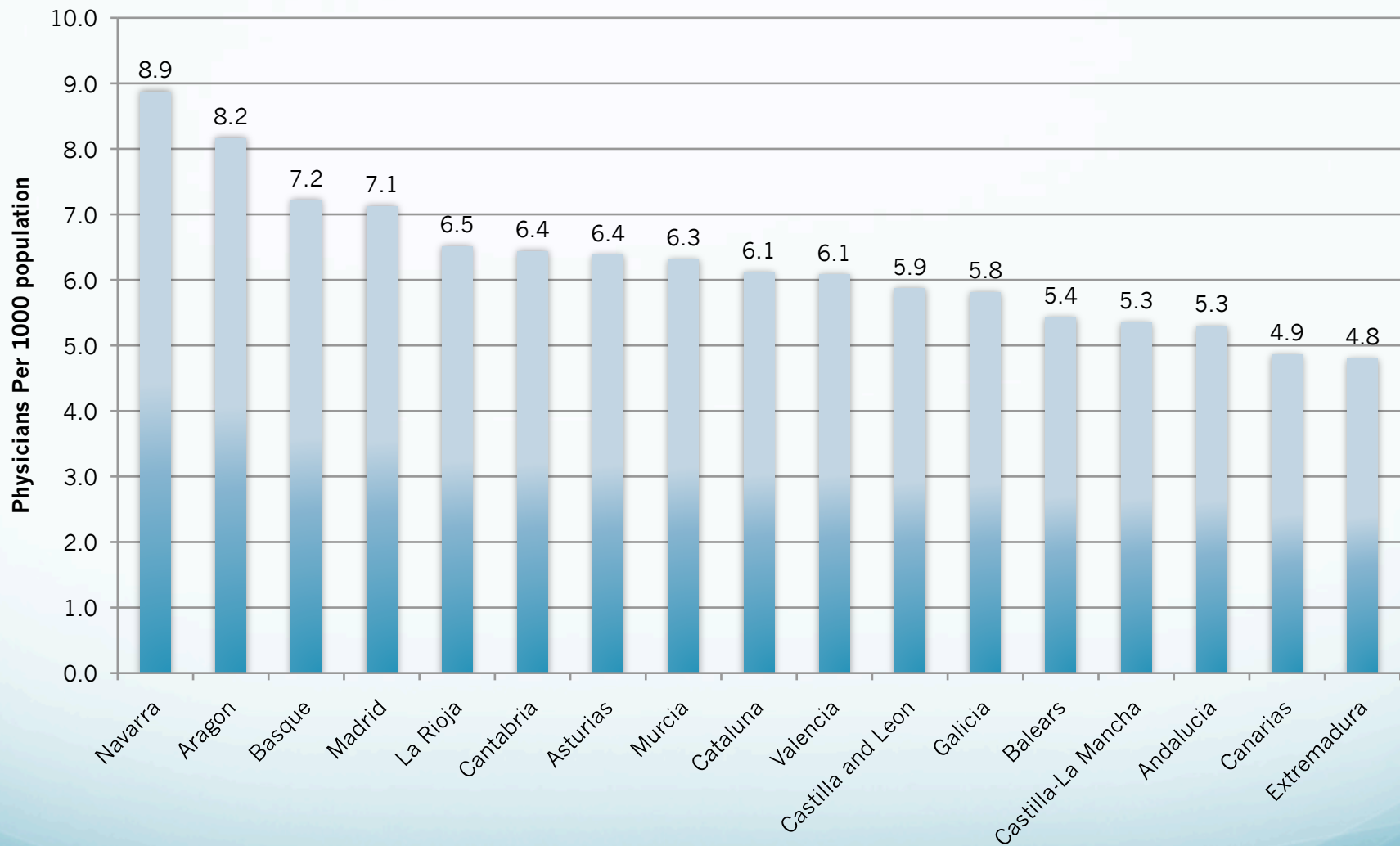
## Smoking



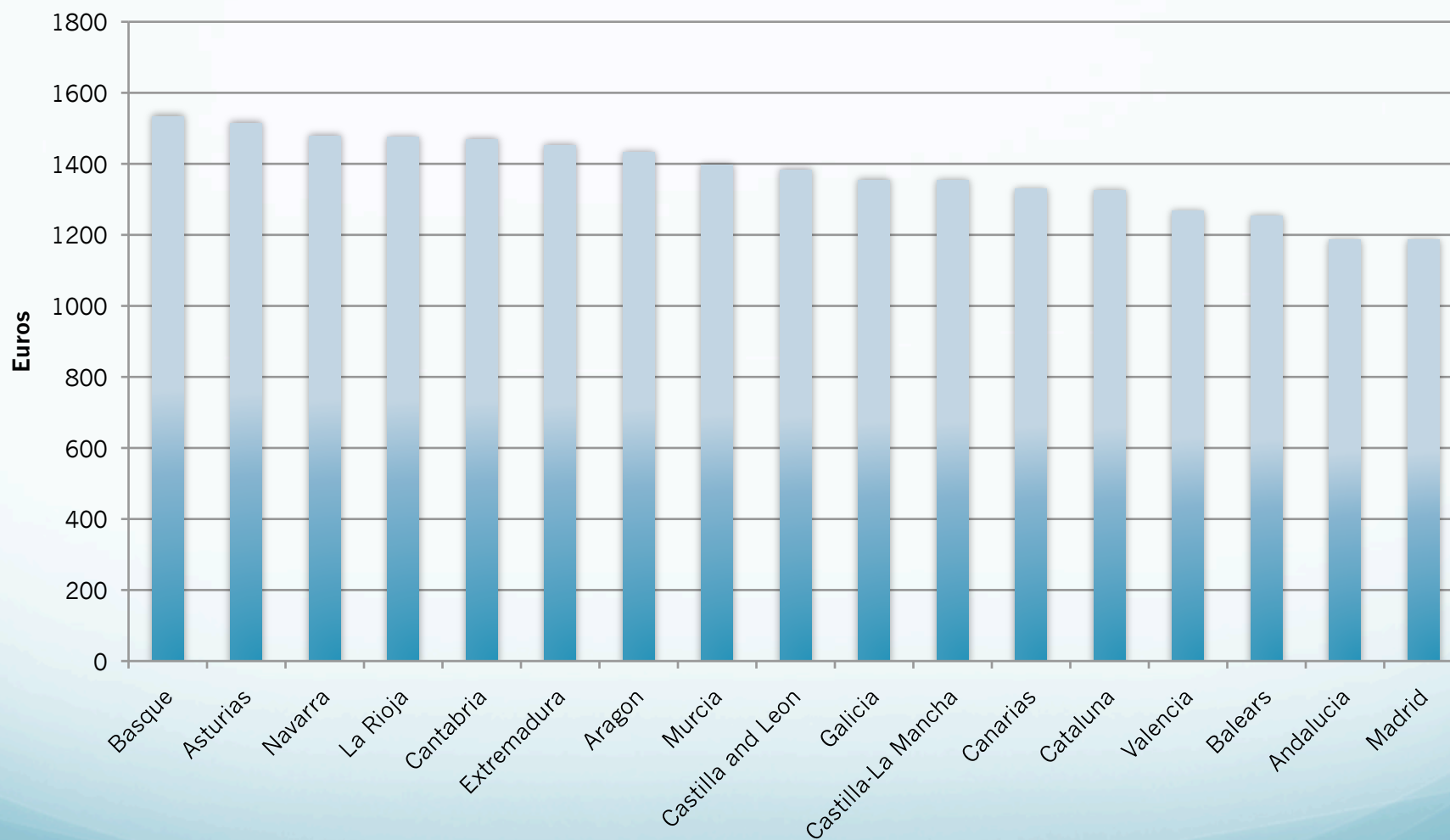
## Drinking



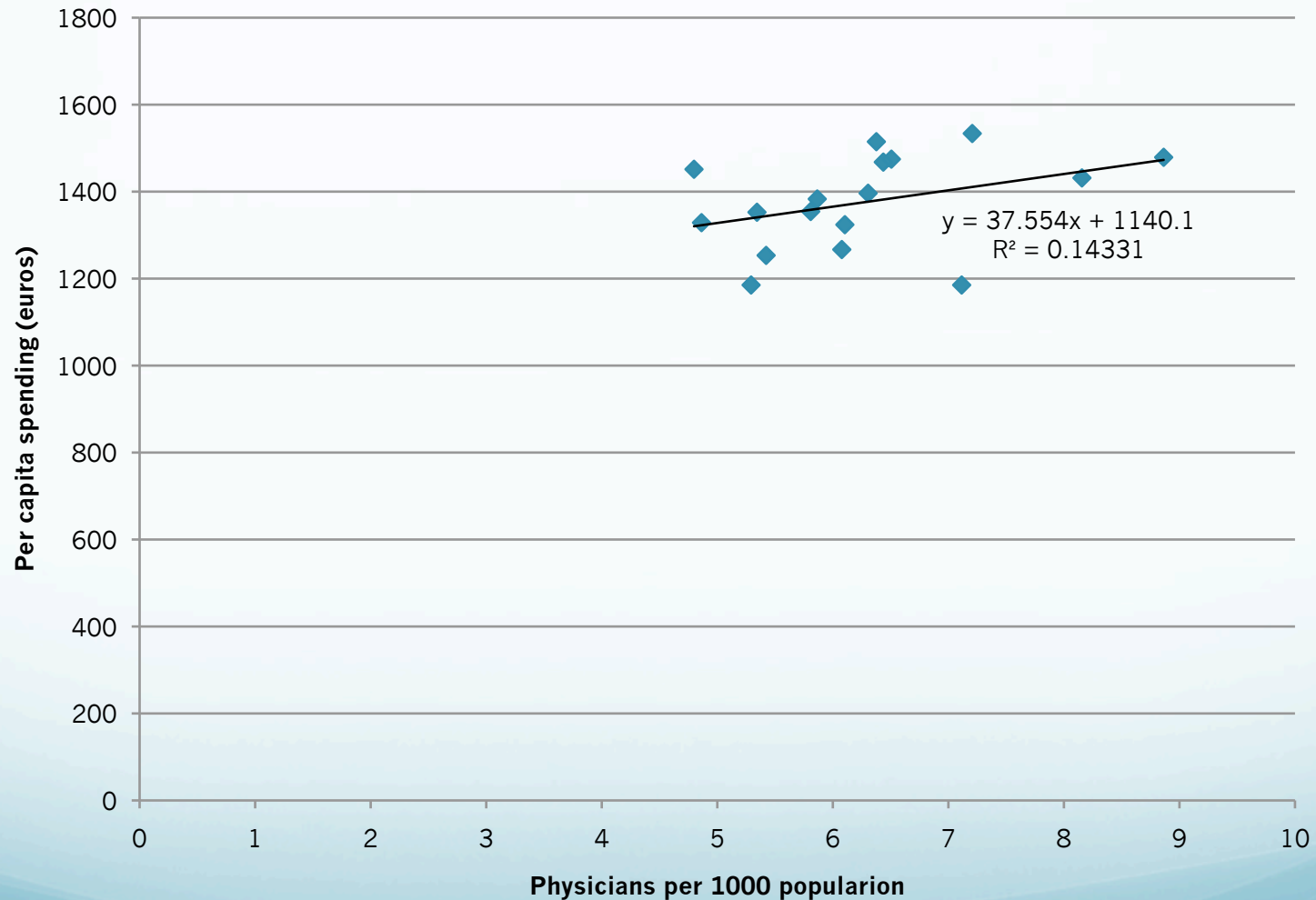
## Total Physicians per 1000 Population, Spain, Average for 2002-2013



## Real Per Capita Regional Government Total Health Expenditures (euros), Spain, Average 2002-2013

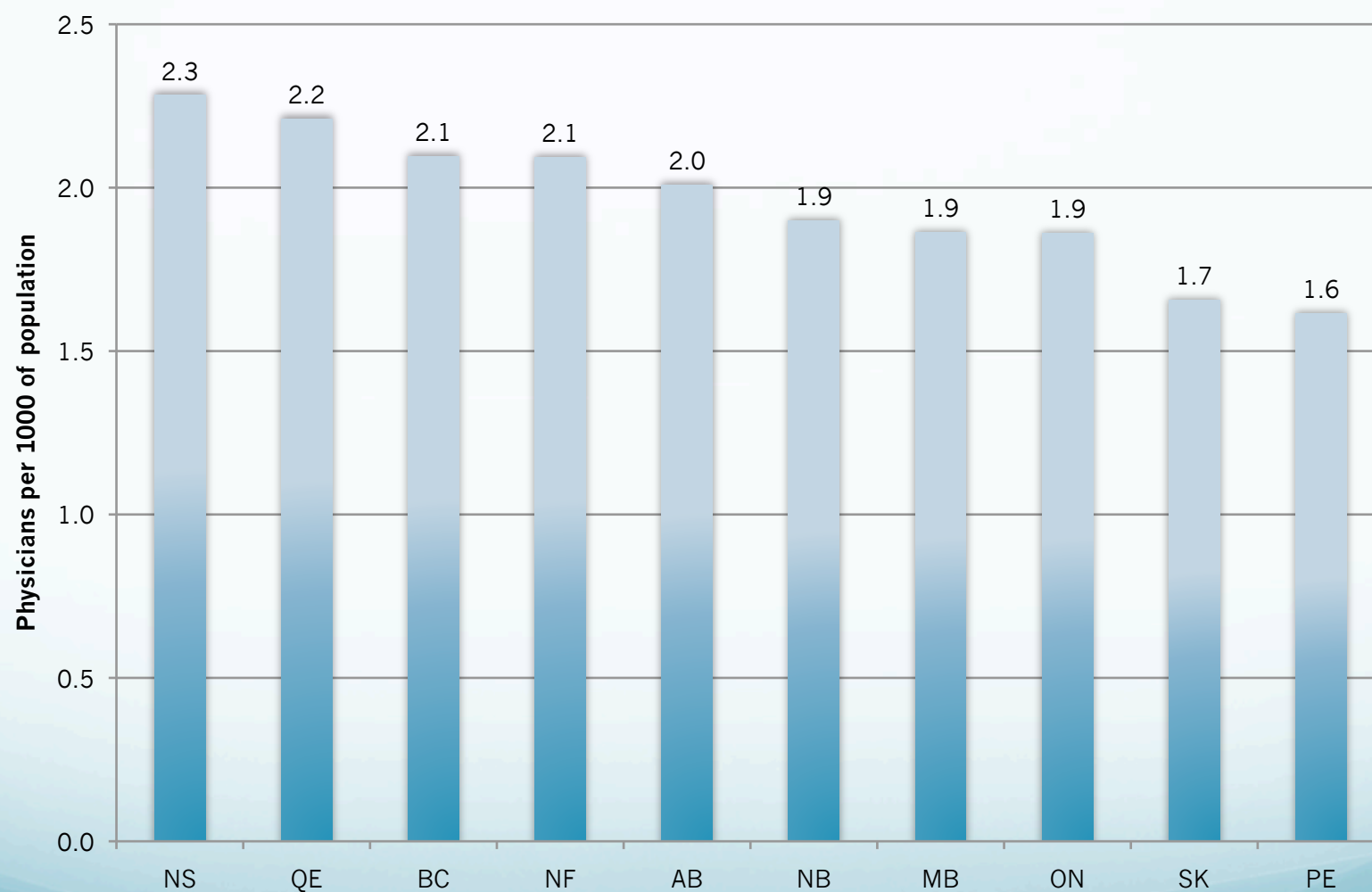


## Average Per Capita Regional Government Health Expenditures Versus Physicians per 1,000, Spain 2002-2013

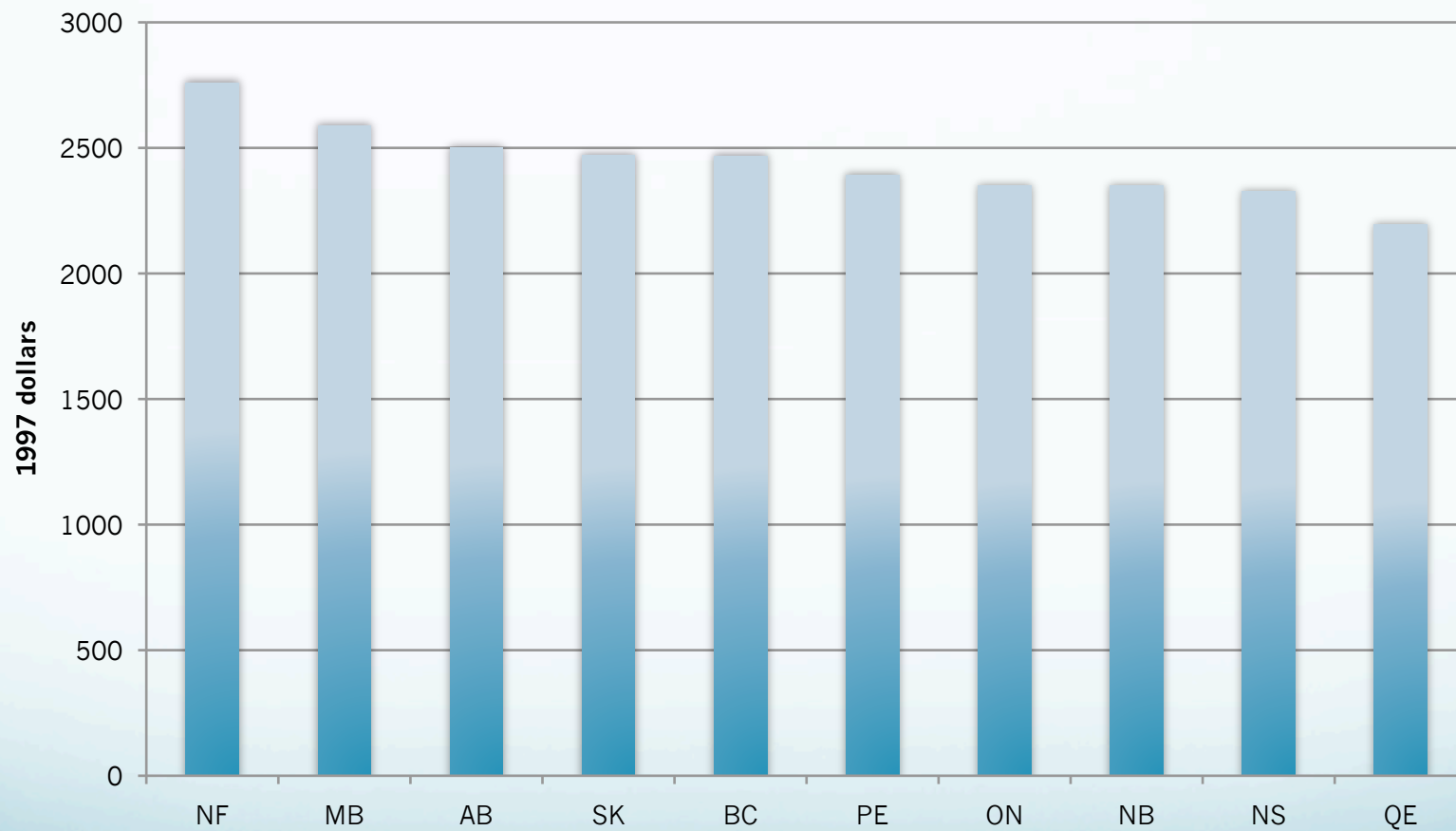




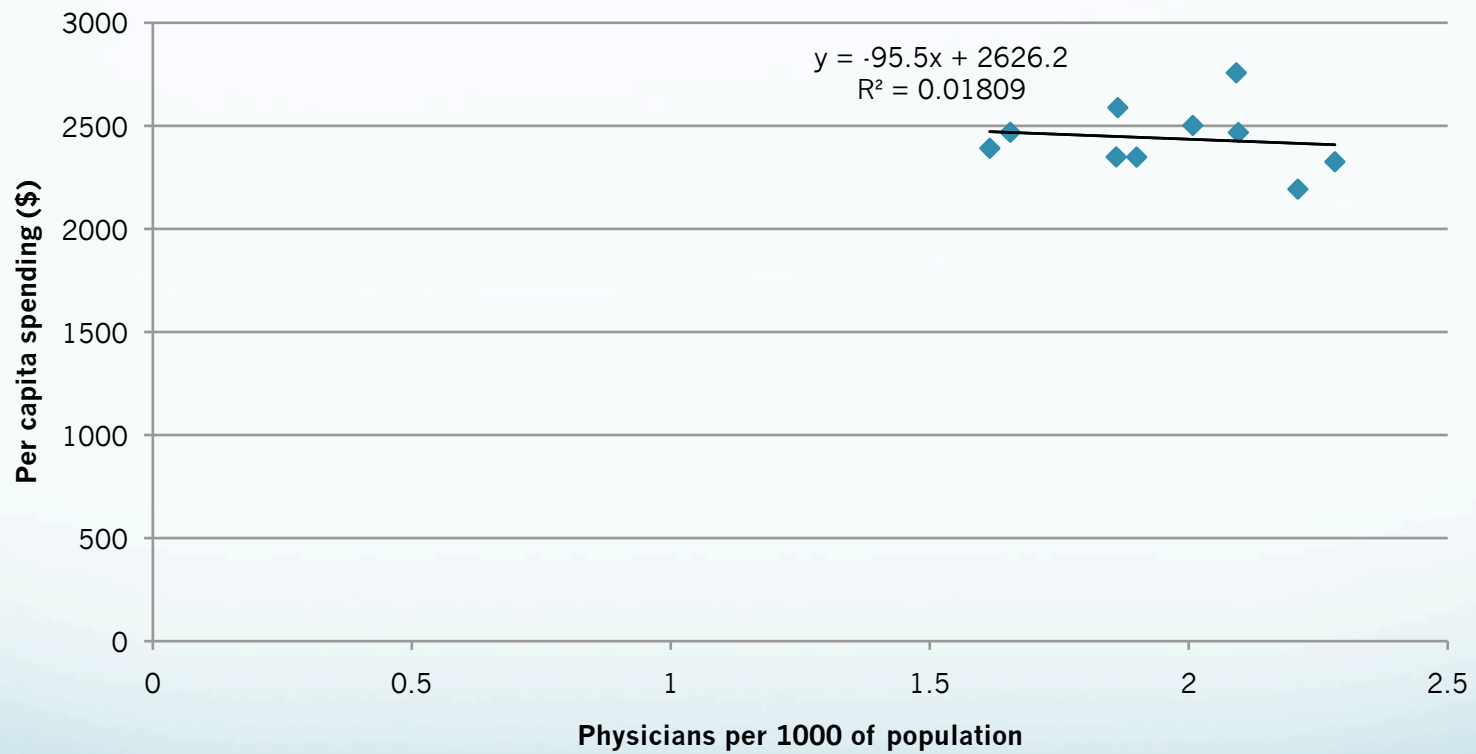
## Total Physicians Per 1000 Population, Average 2002 to 2013, Canada



## Real Per Capita Provincial Government Health Expenditures, Canada, Average 2002-2013



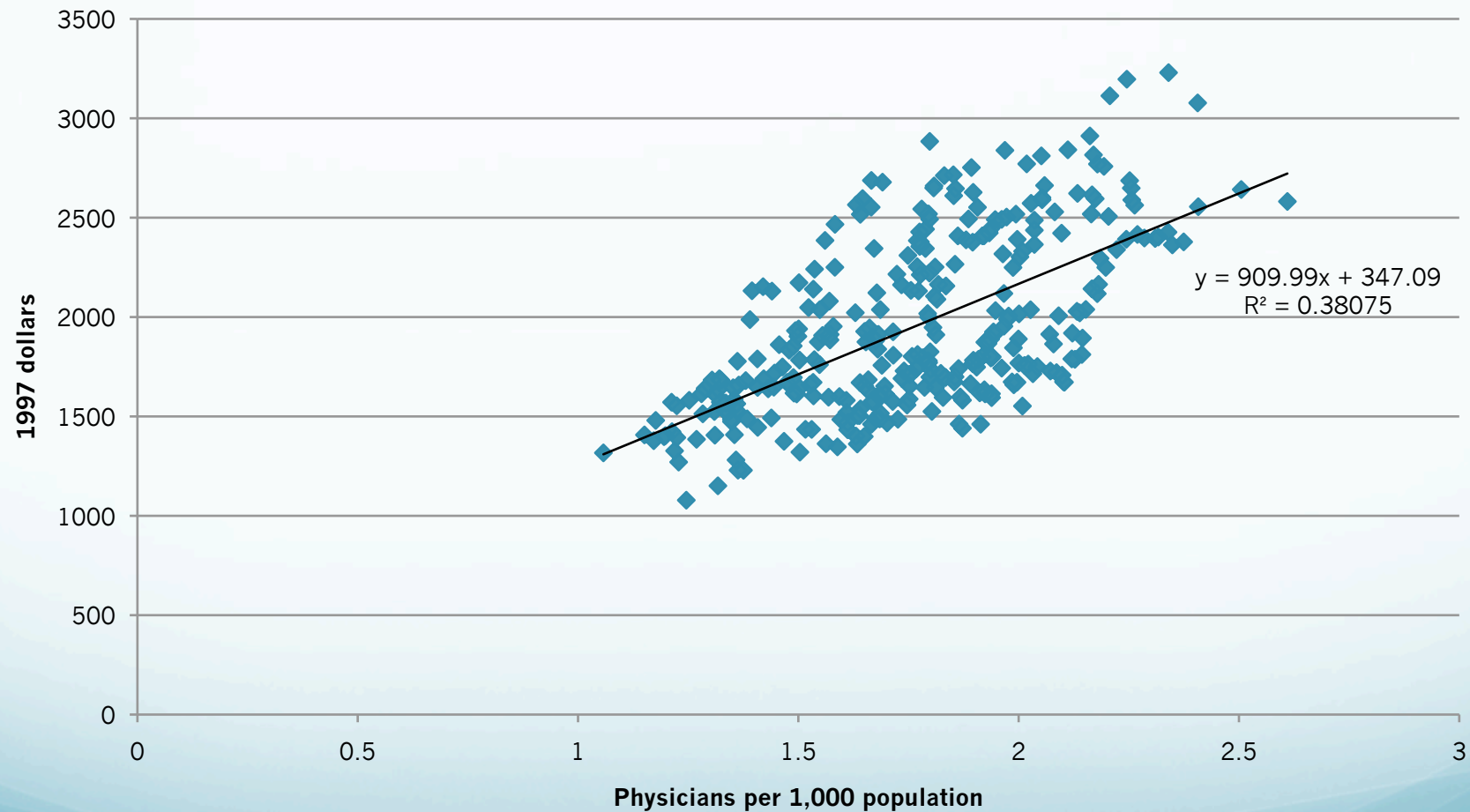
## Average Per Capita Provincial Government Health Expenditures Versus Physicians per 1,000, Canada 2002-2013



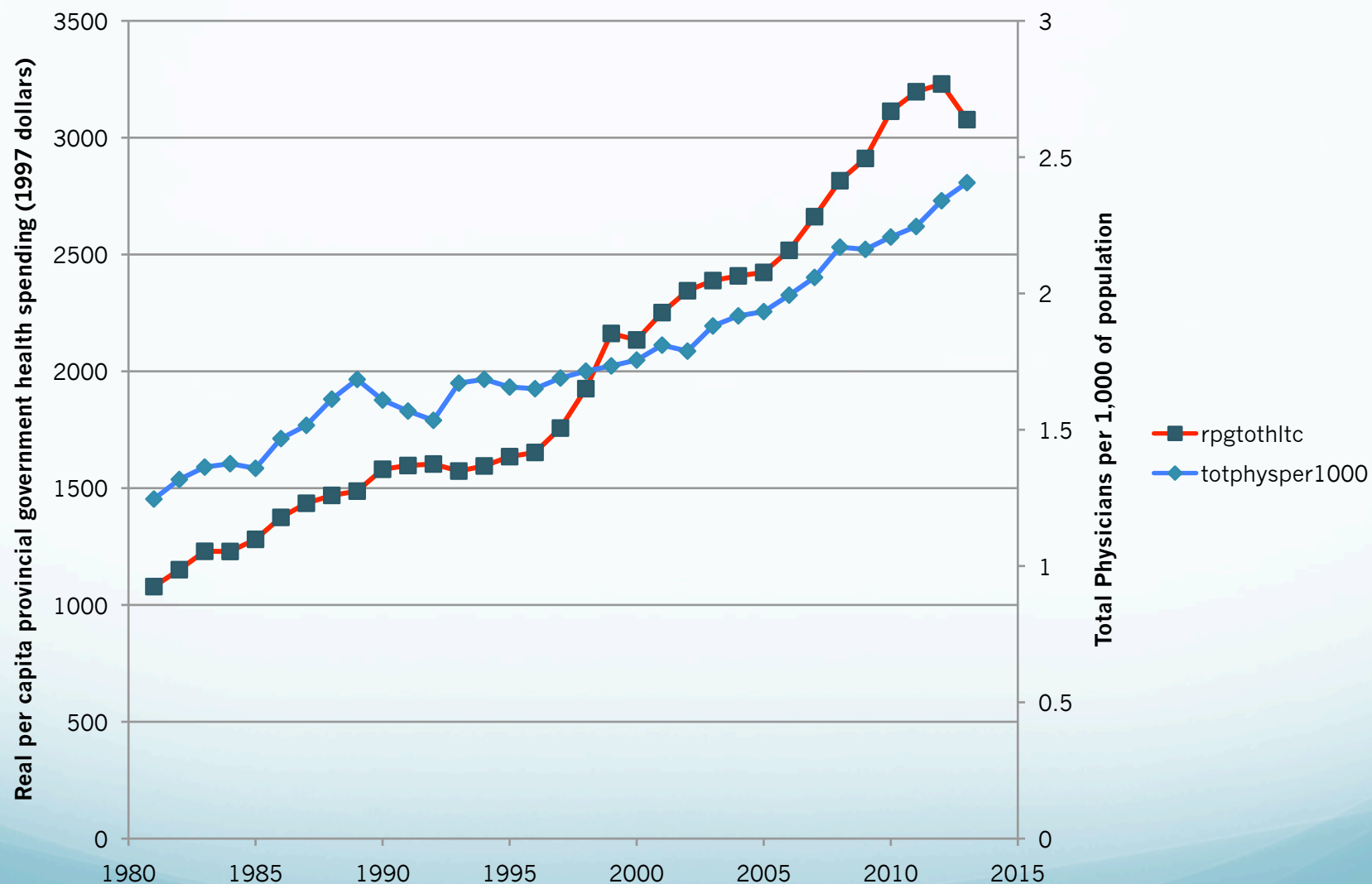
# Discussion

- Regional averages crude way of looking at physician-spending relationship
- Time spans are also an issue
- More detailed look at data by province/region helpful

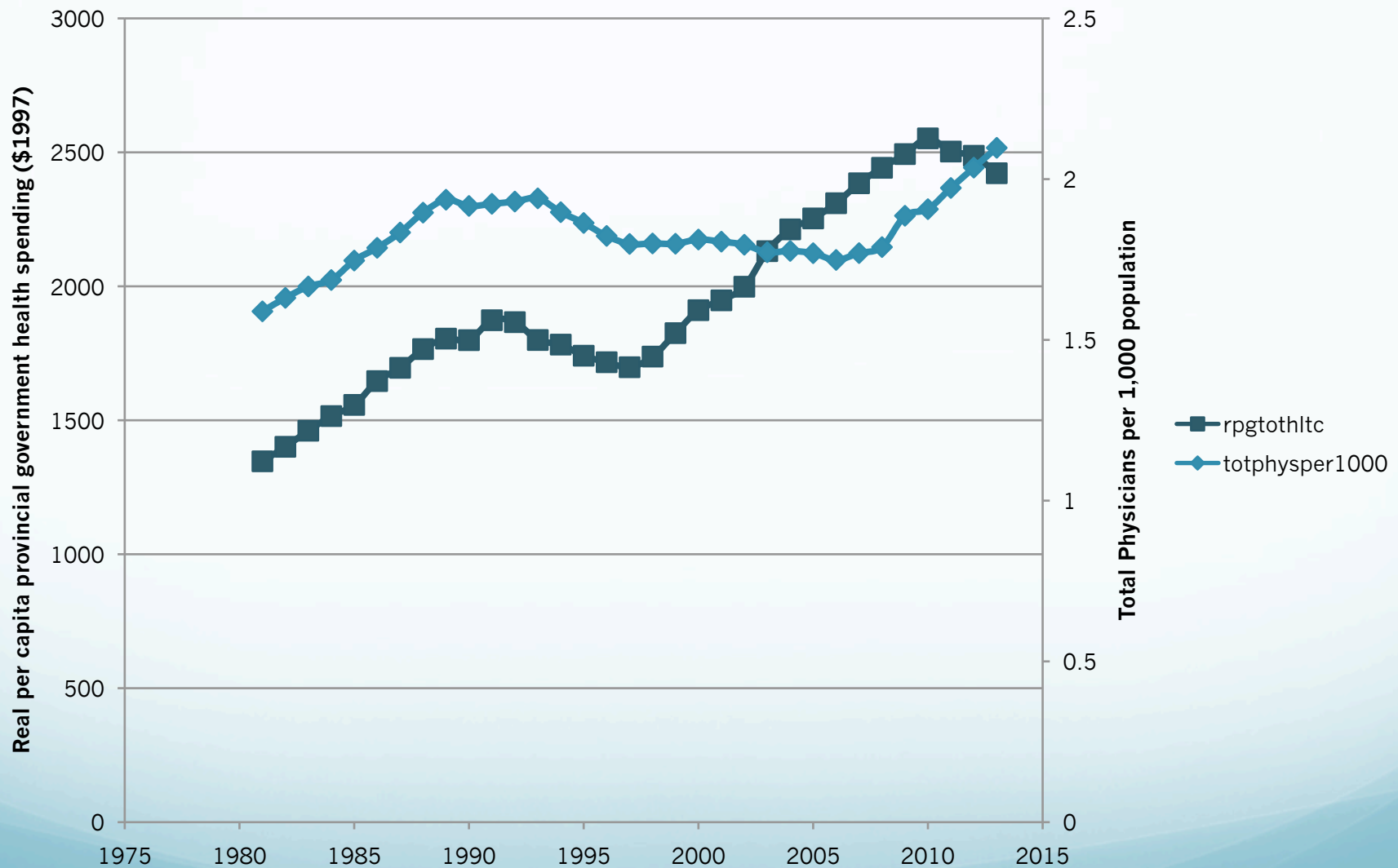
# Real Per Capita Provincial Government Health Spending Versus Physicians per 1000 Population, Province Level Annual Data, Canada, 1981-2013



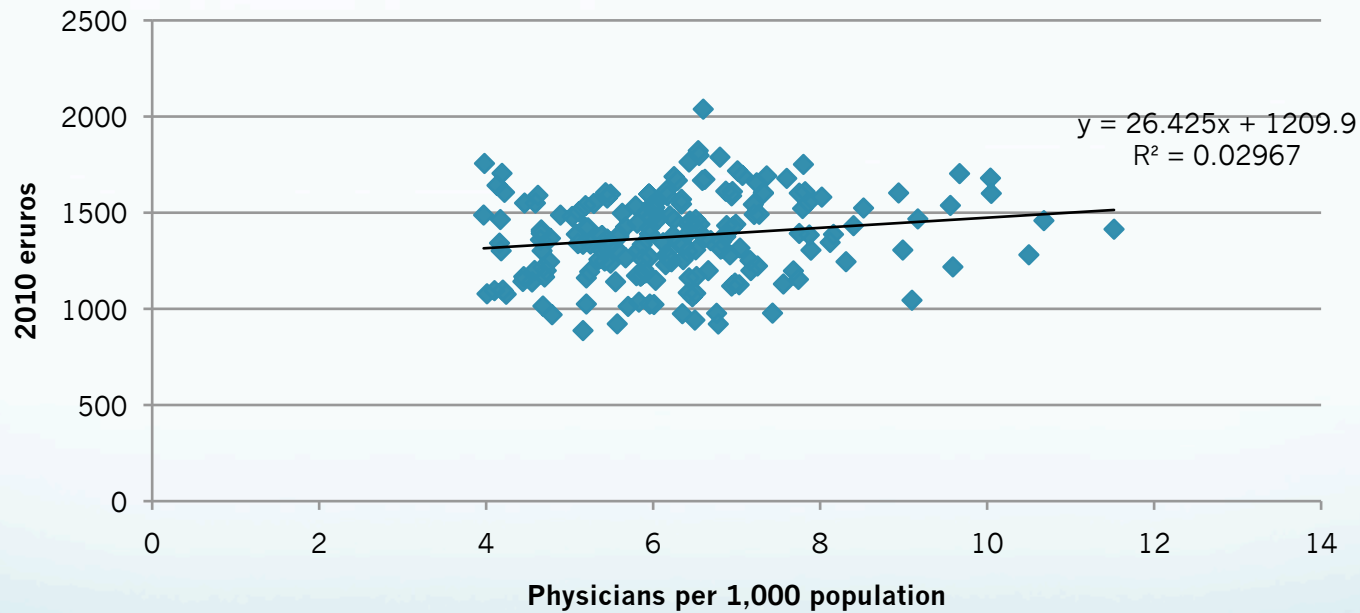
## Physicians and Health Spending: Newfoundland & Labrador, 1981-2013



## Physicians and Health Spending: Ontario, 1981-2013

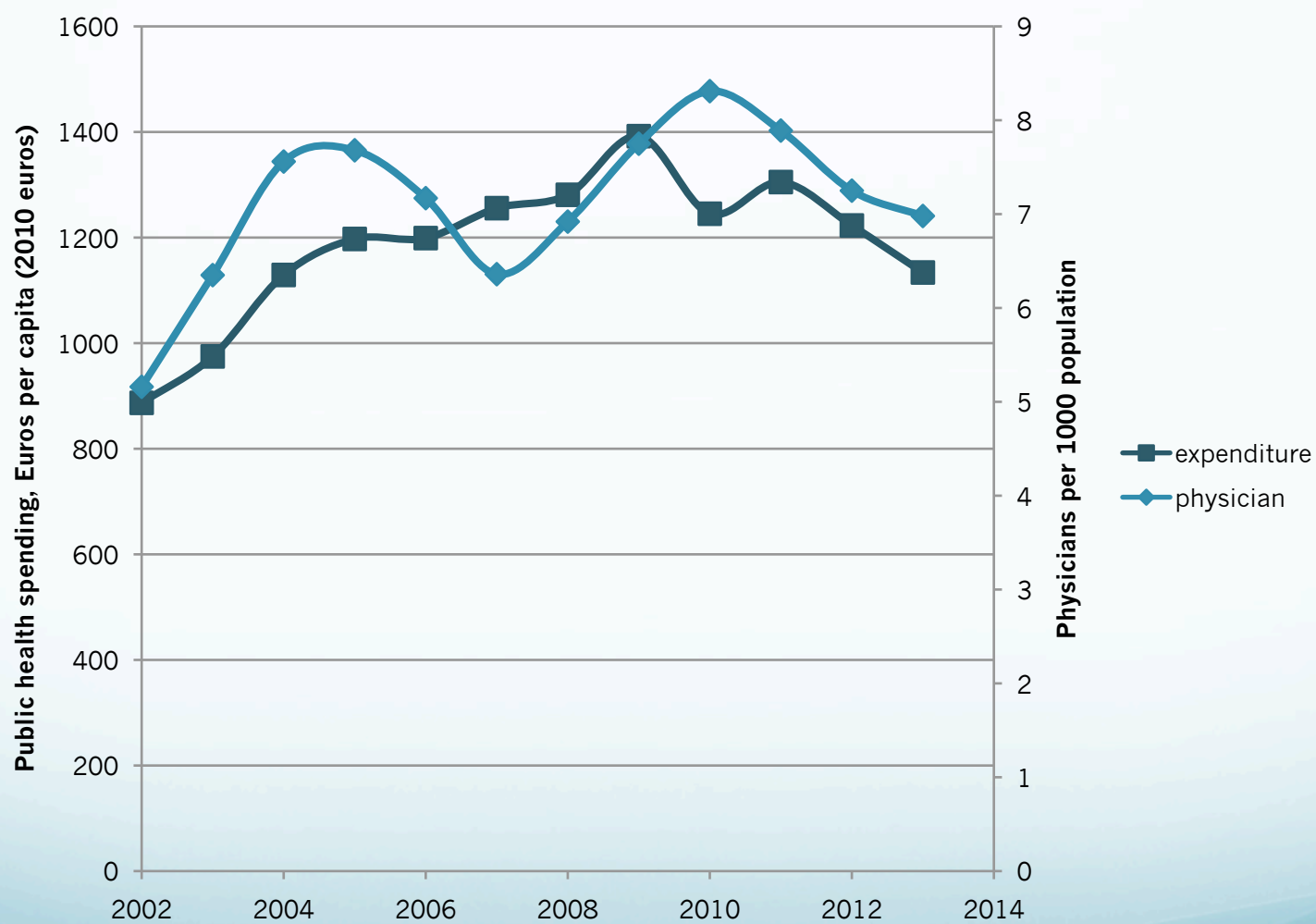


# Real Per Capita Government Health Spending Versus Physicians per 1000 Population, Regional Level Annual Data, Spain, 2002 to 2013

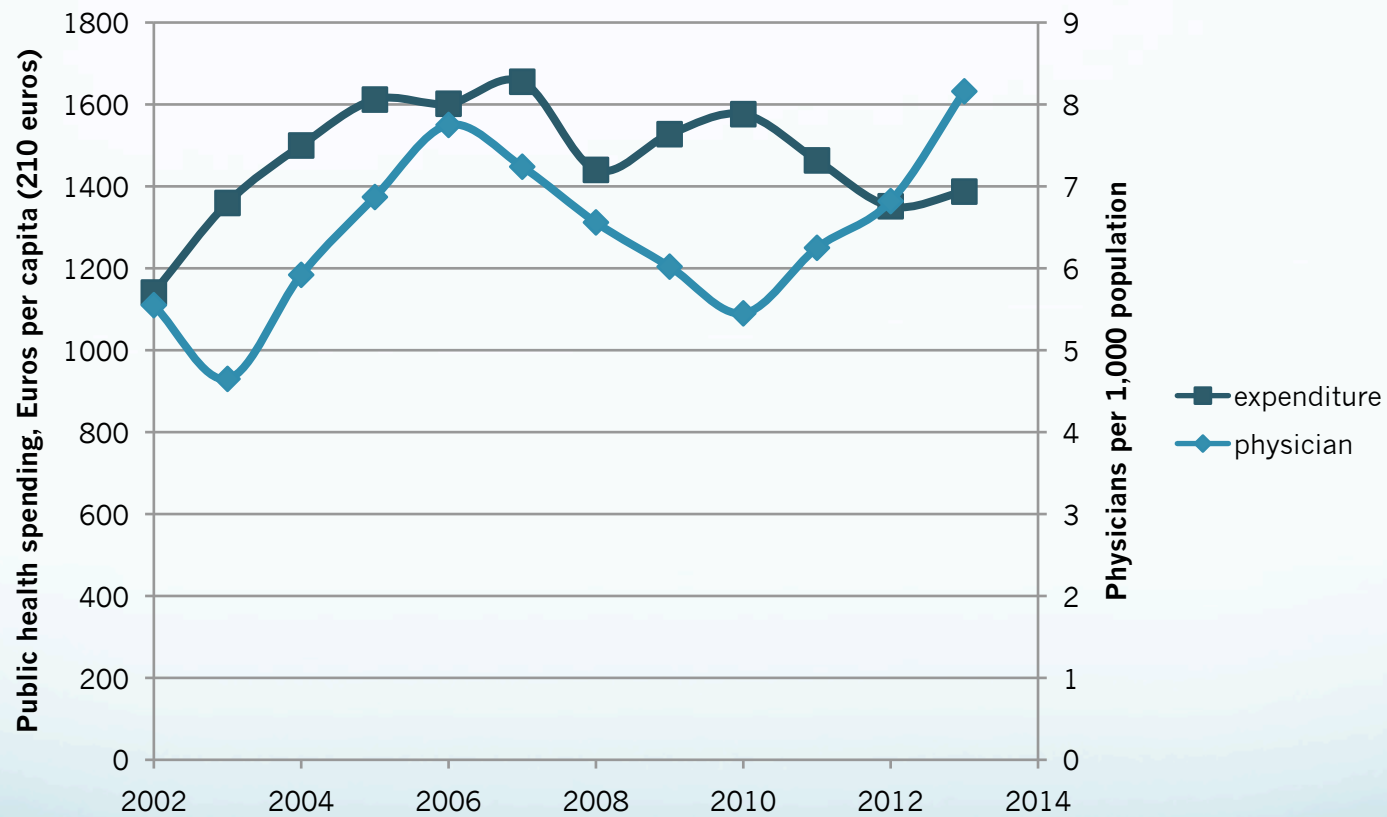




## Physicians and Health Spending: Madrid, 2002-2013



## Physicians and Health Spending: Cantabria, 2002-2013





# **Data and Methodology**

# Data

- Data is available for 17 Spanish regions 2002 to 2013 and for 10 Canadian provinces for the period 1981 to 2013
- Used to run separate pooled time series cross-section regressions that include the number of physicians per 1,000 of population as an independent variable and determinant of health spending.
- Due to the nature and availability of the data collected, identically specified regressions were not possible but the role of physicians as an independent variable is the key commonality.

**Table 1: Regression Variables, Canada & Spain**

**a) Canada**

*Dependent Variables*

Real per capita provincial government total health expenditures in 1997 dollars deflated using the Government current expenditure implicit Price Index. Source: Canadian Institute for Health Information, NHEX.

*Independent Variables*

Number of family physicians per 1000 population.  
Number of specialist physicians per 1000 population.  
Number of total physicians per 1000 population.

Real per capita gross domestic product in 2007 dollars. Deflated using the GDP Deflator, 2007=100.

Real per capita federal cash transfer revenues. In 1997 dollars, deflated using the Government Current Expenditure Implicit Price Index.

Proportion of population aged 0 to 24  
Proportion of population aged 25 to 44  
Proportion of population aged 45 to 64  
Proportion of population aged 65 to 74  
Proportion of population aged 75 or greater.

1 if Newfoundland & Labrador, 0 otherwise.  
1 if Prince Edward Island, 0 otherwise  
1 if Nova Scotia, 0 otherwise.  
1 if New Brunswick, 0 otherwise.  
1 if Quebec, 0 otherwise.  
1 if Ontario, 0 otherwise.  
1 if Manitoba, 0 otherwise.  
1 if Saskatchewan, 0 otherwise.  
1 if Alberta, 0 otherwise.  
1 if British Columbia, 0 otherwise.

Canada Health and Social Transfer. 1 if combined Canada Health and Social Transfer in effect (1996-2004), 0 otherwise.

Year (defined as a time indicator variable running from 1 to 33)

## **b) Spain**

### *Dependent Variables*

Real per capita provincial government total health expenditures in Euros deflated. Source: BBVA Foundation and Ivie (Instituto Valenciano de Investigaciones Económicas) (2015).

### *Independent Variables*

Number of total physicians per 1000 population. Source: Spanish Institute of Statistics

Real per capita gross domestic product in 2010 euros. Source: Spanish Institute of Statistics

Proportion of population aged 65 or greater.

1 if Andalucía, 0 otherwise.

1 if Aragón, 0 otherwise

1 if Asturias, 0 otherwise.

1 if Balears Islands, 0 otherwise.

1 if Canarias, 0 otherwise.

1 if Cantabria, 0 otherwise.

1 if Castilla and Leon, 0 otherwise.

1 if Castilla-La Mancha, 0 otherwise.

1 if Cataluña, 0 otherwise.

1 if Region of Valencia, 0 otherwise.

1 if Extremadura, 0 otherwise

1 if Galicia, 0 otherwise.

1 if Madrid, 0 otherwise

1 if Murcia, 0 otherwise.

1 if Navarra, 0 otherwise

1 if Basque Country, 0 otherwise.

1 if La Rioja, 0 otherwise

Year (defined as a time indicator variable)

# Model

- A pooled time-series cross-section regression model is estimated for provincial/regional government health expenditure category. Is preferable to single province/region estimates because pooling allows for a larger sample and more degrees of freedom. The regression takes the form:
- (1)  $H_{it} = f(z_{1it}, z_{2it}, \dots, z_{nit})$
- where  $H_{it}$  is real per capita government health expenditures of the i-th province/region at period t, and  $z_1$  to  $z_n$  represent a vector of social, demographic, economic and policy variables of the i-th province/region at time t which are

# Estimation Notes

- Generalized Least Squares (GLS) estimates for linear and log-linear specifications.
- The GLS estimates assumed heteroscedastic panels with a common AR(1) correlation for all panels
- Estimates were done with STATA 14 and testing was done on the data.
- Levin-Lin-Chu and Fisher Type unit root tests for panel data



# Canada: Results

Dependent Variable

Real Per Capita Provincial government Health Expenditure (dollars)

	Linear		Log Linear	
	Coefficient	z	Coefficient	z
Total Physicians per 1,000	184.9290	1.95	0.0917	1.95
Real Per Capita GDP	0.0055	1.90	0.0000	1.85
Real Per Capita Federal Transfers	0.0373	1.89	0.0000	2.00
Proportion Aged 25 to 44	960.3219	1.19	1.4419	3.72
Proportion Aged 45 to 64	5846.9590	5.50	3.3338	6.52
Proportion Aged 65 to 74	-1724.9020	-0.77	-0.7091	-0.65
Proportion Aged 75 and Over	-10393.6000	-2.93	-2.8237	-1.61
Newfoundland & Labrador	-6.6213	-0.09	-0.0215	-0.65
Prince Edward Island	145.8127	1.59	0.0583	1.30
Nova Scotia	-58.7220	-0.85	-0.0475	-1.34
New Brunswick	27.3663	0.40	0.0032	0.09
Quebec	-157.8583	-3.14	-0.0787	-3.11
Manitoba	295.1607	4.63	0.1409	4.51
Saskatchewan	362.6875	4.56	0.1839	4.62
Alberta	-22.5956	-0.22	0.0108	0.21
British Columbia	163.6879	3.60	0.0750	3.30
Canada Health & Social Transfer	-74.5984	-3.62	-0.0374	-3.62
Time Trend	24.3710	5.58	0.0100	4.72
Constant	-2.7035	-0.01	6.0988	31.93
Observations	330		330	
Wald chi <sup>2</sup>	1494.01		1636.38	

# Spain: Results

Dependent Variable

Real Per Capita provincial government total Health Expenditures (euros)

	Linear Coefficient	z	Log Linear Coefficient	z
Total Physicians per 1,000	5.8252	0.67	0.0041	0.67
Real Per Capita GDP	0.0754	12.51	0.0001	13.53
Proportion Aged 65 and Over	-33.4548	-0.51	-0.0293	-0.62
Andalucia	1052.4000	10.95	0.8249	11.58
Aragon	748.9717	4.76	0.5930	5.22
Asturias	1231.8380	5.86	0.9623	6.36
Balears	520.3124	6.57	0.4082	6.72
Canarias	958.5836	9.91	0.7522	10.63
Cantabria	1060.5210	7.86	0.8345	8.53
Castilla and Leon	1033.2250	4.70	0.8188	5.16
Castilla-La Mancha	1172.7530	8.25	0.9189	8.90
Cataluna	423.5702	5.49	0.3387	5.99
Valencia	886.3002	9.11	0.6997	9.63
Extremadura	1529.6180	9.47	1.1971	10.23
Galicia	1145.3200	5.63	0.9087	6.17
Murcia	1108.5420	11.44	0.8640	12.37
Navarra	491.7964	5.25	0.3864	5.75
Basque	511.7945	4.42	0.3935	4.75
La Rioja	779.7010	5.76	0.6040	6.52
Time Trend	35.7308	12.84	0.0289	14.36
Constant	-72866.5500	-13.01	-52.7149	-13.01
Observations	204		204	
Wald chi <sup>2</sup>	366.32		426.47	



# **Discussion of Results**

# Physicians, Income & Time

- Results for Canada and Spain show that physicians per 1,000 population, real per capita GDP and time trend were positive drivers of real per capita government health expenditures.
- After controlling for confounding factors, each year saw an increase of approximately 24 dollars in real per capita spending for Canada and 36 Euros for Spain – average annual increases of 1.0 and 2.9 percent respectively.

# Aging & Regional Effects

- proportion of population aged 65 years and over was not a positive driver of health spending once confounding factors were controlled for supporting the case for a more complicated impact of aging on health care spending
- province/regional variables for both countries show some statistically significant regional variation in spending with more pronounced variations in Spain.

# Regional Differences

- For Canada, compared to Ontario (the omitted province), real per capita spending is 8 percent less in Quebec but 14, 18 and 8 percent more in Manitoba, Saskatchewan and British Columbia respectively.
- For Spain, compared to Madrid (the omitted region), real per capita spending is significantly higher in all the other regions ranging from only 34 percent higher in Cataluna to 120 percent more in Extremadura.

# Physician Impact

- total physicians per 1,000 were only statistically most significant (at the 5 percent level) for Canada and not significant for Spain.
- Adding a physician per 1,000 of population increased real per capita provincial government health spending in Canada by \$185 while for Spain it would increase spending by 6 euros (and the result was not significant).
- Given the availability of a breakdown into GPs and Specialists for Canada, the model was also run for Canada using these two variables rather than total physicians and it was found that it was Specialists per 1,000 that was positive and statistically significant.

# Measuring Physician Contribution

- physician numbers in Canada are a more significant contributor to spending even considering the additional age distribution and federal transfer variables included for the Canadian regression.
- Adding one physician per 1,000 of population would increase average real per capita government health spending in Canada by approximately 9 percent and in Spain by 0.4 percent.





# CONCLUSION

# Public Health Spending: Canada Spends More

- Canada spends more per capita on health than Spain while basic health outcome indicators show the performance of Spain's health care system has improved more than Canada's.
- Although the two countries follow a National Health System approach to health care funding, an important difference between Canada and Spain is the difference in physician intensity – Canada has fewer physicians per capita than Spain.

# Regression Analysis

- Physician numbers are a more statistically significant driver of real per capita provincial government health expenditures in Canada but not in Spain despite the fact that the per capita number of physicians is greater in Spain.
- Adding a physician per 1,000 of population increased real per capita provincial government health spending in Canada by \$185 while for Spain it would increase spending by 6 Euros (and the result was not significant).

# Physicians and Health Spending

- Supplier induced demand seems to characterize the health sector in Canada but not necessarily in Spain.
- Key difference between Canada and Spain when it comes to physician compensation is that in Spain – unlike Canada - individuals can consult private specialists at their own expense in order to complement public health insurance.
- There may be greater monopoly power for Canadian physicians allowing them to influence demand for their services – and ultimately expenditures –more so than the Spanish system.

# Policy Implication: Spending and Health

- When it comes to health outcomes, more spending does not necessarily translate into greater health outcomes.
- With respect to public health care spending, in 2015 Canada spent approximately 48 percent more than Spain and yet by 2012 life expectancy at birth in Spain was 1.3 percent higher and infant mortality 35 percent lower in Spain.

# Policy Implication: Physicians and Spending

- Physicians may be a driver of spending via supplier-induced demand but this result is not automatic.
- In the Canadian case, having fewer physicians per capita and without the ability for patients to access physicians outside the public system means they may have a greater degree of “market” power than in Spain resulting in supplier-induced demand.
- In Spain, there are more physicians per capita but there is the option of consulting them in a supplemental fashion privately outside the public system and little evidence of supplier-induced demand.



Thank you