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Too Much Finance, or Statistical Illusion?

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For nearly three decades, the dominant view on the role of the financial sector in economic development has been that greater financial depth facilitates faster growth. The Great Recession has shaken confidence in that view, however, because of the contributing role of high leverage and such financial innovations as collateralized subprime mortgage-backed assets and derivatives on them.[1] Important research underlying the view that financial depth fosters growth includes the seminal study by Robert King and Ross Levine (1993), who used data for 77 countries for 1960–89 relating growth to financial depth as measured by the ratio of liquid liabilities of the financial system to GDP. They estimated that, controlling for per capita income and other influences, expected growth was 1 percentage point higher for economies at the top quartile of financial depth (average ratio of 0.6) than for those at the bottom quartile (0.2).[2]

Recently, however, prominent studies at two major international financial institutions have argued that too much finance reduces growth. Apparently working independently (neither study reports the other in its references), Stephen G. Cecchetti and Enisse Kharroubi (2012) for the Bank for International Settlements (BIS) and Jean-Louis Arcand, Enrico Berkes, and Ugo Panizza (2012) for the International Monetary Fund (IMF), found that when a quadratic term is introduced into the usual regression of growth on financial depth, it has a negative coefficient. As a consequence, once financial depth exceeds an optimal level, additional financial deepening reduces rather than increases growth. Subsequent work at the IMF has proposed a Financial Development Index (Sahay et al. 2015). Finding a similar negative quadratic term relating growth to this index, the authors argue that financial development spurs growth initially at a low level on the index but causes slower growth once financial development exceeds an intermediate level on it.[3] In an environment of new doubts about finance following the Great Recession, these studies finding that there can be too much of it seem to have struck a responsive chord.

In an environment of new doubts about finance following the Great Recession, these studies finding that there can be too much of it seem to have struck a responsive chord.

This *Policy Brief* shows that these recent findings warrant considerable caution, however, because the negative quadratic term may be an artifact of spurious attribution of causality. I first show that correlation without causation could similarly lead to the conclusion that too many doctors spoil growth (for example). I then demonstrate algebraically that if the variable

1. For example, Paul Krugman has argued that an "overgrown financial sector did more harm than good" and that "we've been devoting far too large a share of our wealth, and talent, to finance." Paul Krugman, "The Market Mystique," *New York Times*, March 26, 2009, and "Don't Cry for Wall Street," *New York Times,* April 22, 2010.

2. The other influences (all in the base year) were secondary school enrollment, government consumption/GDP, inflation, and exports plus imports relative to GDP.

3. In addition, using sectoral data for 41 countries in 1996–2011, Joshua Aizenman, Yothin Jinjarak, and Donghyun Park (2015) find results that they consider mildly supportive of the nonlinear (excessive) finance hypothesis. But their quadratic term for finance is significant and negative in only 3 of 10 sectors (agriculture; public utilities; and community, social, and personal services). The quadratic term is instead significant and positive in up to 4 other sectors in the two key sets of tests (consistently for construction and for finance, insurance, and real estate). The authors do not quantify the weighted overall effects.

of interest, be it financial depth, doctors, or any other good or service that rises along with per capita income, is incorporated in a quadratic form into a regression of growth on per capita income, there will be a necessary but spurious finding that above a certain point more of the good or service in question causes growth to decline.

TOO MANY DOCTORS? TOO MUCH R&D? TOO MANY TELEPHONES?

To illustrate the likelihood of a spurious coefficient on the quadratic term, consider three indicators that one would expect to accompany, but probably not cause, growth. Using the same countries, periods, and growth data as Cecchetti and Kharroubi (2012), regression equation (1) finds that growth per capita is negatively related to the logarithm of purchasing-power-parity (ppp) per capita income, the standard "convergence" finding. It is also positively related to a linear term on physicians per 1,000 population but negatively related to the square of this "doctors" variable. Thus:

$$1)\, g = 7.3 - 0.640\, lny_0^* + 0.960\, D - 0.227D^2;\, adj\, R^2 = 0.05, n = 290$$
$$(4.3)\quad (-2.8)\qquad (+1.7)\qquad (-2.0)$$

In this equation, g is average real growth per capita over each of six five-year periods from 1980 to 2009, y_0* is ppp per capita income (2005 dollars) at the beginning of each period, and D is the average number of physicians per 1,000 population in each period (see appendix B for data description and sources). The convergence term on the first variable is negative and significant as expected. T-statistics are shown in parentheses. The linear term on physician density is positive and significant at the 10 percent level; the quadratic term is negative and significant at the 5 percent level.

The turning point at which additional doctors per capita begin to have a negative influence on growth is at 2.12 physicians per 1,000 population. This density of doctors tends to be reached at per capita income of about $12,000.[4] In the final period observed (2005-09), Italy, Norway, and Switzerland had the highest density of doctors, at 3.9 physicians per 1,000 population. If one takes equation (1) literally, the consequence is that per capita growth in these economies is –0.81 percentage point lower than it would have been if instead they had adhered to the optimal density of 2.1 per 1,000 population.[5]

The corresponding exercise for telephones is shown in equation (2). This time, besides the logarithm of per capita income, the equation includes a quadratic form of fixed-line telephone subscriptions per 100 population (variable T). The coefficients are all highly significant, and as expected the quadratic term on telephones is negative. Too many fixed-line telephones reduce growth.

$$2)\, g = 19.799 - 2.279\, lny_0^* + 0.208\, T - 0.00196\, T^2;\, adj\, R^2 = 0.15, n = 290$$
$$(7.8)\qquad (-6.9)\qquad (5.4)\qquad (-4.2)$$

This time the turning point beyond which additional telephone lines begin to reduce the growth rate is at 53 telephone lines per 100 population.[6] On average that telephone density is associated with a per capita income of $41,500.[7] Switzerland is slightly below this income level but substantially above optimal telephone lines (at 66), whereas the United States is at a slightly higher per capita income and lower but still above-optimal fixed telephone line density (55). By implication, the risk to growth from too many phone lines is still more remote for most countries than the risk from too many doctors.

Finally, the same test using R&D technicians (100s per million population) yields the results shown in equation (3).

$$3)\, g = 20.07 - 2.039\, lny_0^* + 0.164\, RND - 0.0020\, RND^2;\, adj\, R^2 = 0.18, n = 132$$
$$(5.7)\qquad (-4.9)\qquad (3.9)\qquad (-3.9)$$

4. A simple regression of doctors per 1,000 population on the logarithm of ppp per capita income yields: D = –5.37 (–13.2) + 0.796 (18.3) *ln y**; adj. R^2 = 0.54. (T-statistics in parentheses.)

5. That is: taking the derivative of equation (1) with respect to D gives dg/dD = 0.9604 – 0.4538D. The final term shows that increasing physician density from 2.12 to 3.9 per 1,000 population changes the per capita growth rate by (–0.4538) x (3.9 – 2.12) = –0.81.

6. Again using the derivative with respect to T, which turns negative above this level.

7. From a regression yielding: T = –134.37 (-25.1) + 17.616 (30.7) *ln y**.

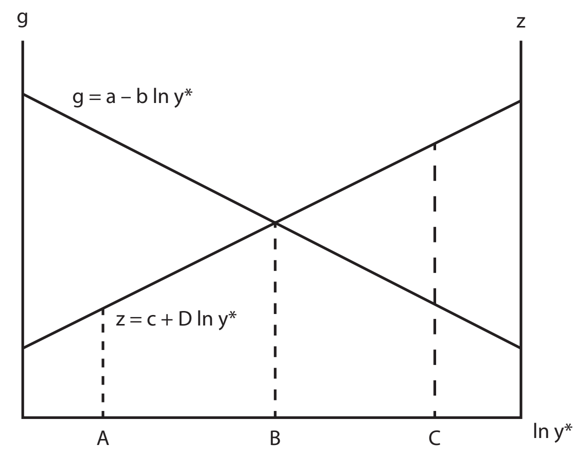
Once again the coefficients are all significant and have the expected signs. The influence of additional R&D technicians on growth turns negative at 4.1 per 1,000 population.[8] This level tends to be associated with ppp per capita income of $43,000.[9] Finland and Japan substantially exceed the optimal level of R&D technicians (at 7.5 and 5.5 per 1,000 population, respectively), although the United States is slightly below it (at 3.8).

DEMONSTRATING THE BIAS TOWARD NEGATIVE QUADRATIC EFFECTS

To recapitulate, unless one firmly believes that too many doctors, telephones, and/or R&D technicians reduce growth, one should be suspicious of cross-country regressions showing that too much finance does so. It is possible to go further and show formally that if there is a negative relationship between growth and per capita income (as one expects from convergence) but a positive relationship between another indicator variable and per capita income (for example, doctors per capita, or financial depth), then including a quadratic form of that other variable as an explanatory variable in a growth regression will almost certainly force a negative coefficient on the quadratic term of that variable. Appendix A sets forth a proof of this proposition.

This inherent quadratic coefficient bias can be seen more intuitively, however, in figure 1. The natural logarithm of ppp per capita income is on the horizontal axis. The primary relationship of growth to per capita income is shown by the downward-sloping convergence line, *g*. Some other variable related positively to per capita income, such as financial depth or doctors per capita, is shown on the upward sloping line *z*, against an appropriate scale on the right-hand vertical axis. Suppose the units for this other variable are chosen such that at income level B, where the two lines intersect, the value of the variable *z* will be the same as the growth rate *g*. Then if a regression of *g* on $ln\ y^*$ is augmented by including terms *z* and z^2, a positive contribution from those two terms will tend to be needed in the zone AB, but a negative contribution will be needed in the zone BC where the *g* line lies below the *z* line. The only way for the contribution to shift from positive to negative will be for the coefficient on *z* to be positive and the coefficient on z^2 to be negative.

Figure 1 Growth (left axis) **and financial depth or other variable positively related to per capita income** (right axis)



TOO MUCH "TOO MUCH FINANCE" TO BELIEVE?

Some of the recent "too much finance" studies arrive at estimates that indicate implausibly large negative effects for high-income countries. Thus, when the 1960–2010 equation estimated by Arcand, Berkes, and Panizza (2012) is applied to Japan, it turns out that Japan could achieve annual growth 1.6 percentage points higher if it would only reduce its ratio of private credit to GDP from 178 to 90 percent.[10] A more recent paper by several IMF staff members devises a new Financial Development Index (Sahay et al. 2015). The study then finds that at Japan's financial development (0.85) annual growth is 3 percentage points lower than it would be if the index were lower at the optimal level of 0.5 (p. 16). These estimates, especially by the IMF researchers, are too large to be credible. The latter would imply boosting annual labor productivity growth from a typical 1.7 percent per year to a remarkable 4.7 percent per year.[11] The estimates of Cecchetti and Kharroubi (2012) are less implausible in this regard. They apply private credit from banks, which stands at 105 percent of GDP for Japan (World Bank 2015). Their optimal financial depth ratio is 94 percent. In their estimated equation, the excess finance of Japan causes a reduction in the growth rate of only 0.02 percent.[12]

It seems highly likely that the reason for the much smaller impact is that Cecchetti and Kharroubi (2012) estimate their equations for only 50 countries, whereas both the Arcand, Berkes, and Panizza (2012) and Sahay et al. (2015) studies estimate equations for about 130 countries. A central proposition

8. The derivative of growth in equation (3) is 0.164 –0.004 RND, which turns zero at 40.65 hundred technicians per million population, or (rounding) 4.1 technicians per 1,000 population.

9. From the simple regression: RND = –143.11 (–12.0) +17.225 (14.0) $ln\ y^*$.

10. Applying their equation (4), p. 34.

11. Japan's labor force is shrinking at 0.5 percent per year and its expected average growth is about 1.2 percent (Cline 2014).

12. Applying their equation (1), p. 7.

of this *Policy Brief* is that the supposed negative quadratic term on finance is picking up the influence of lower growth at higher per capita income. In other words, the specification of the per capita income term itself is inadequate to capture convergence fully and leaves some false attribution of convergence to financial depth.[13] It is far more likely that the single per capita income variable (log of income per capita) will be overburdened and less capable of complete explanation of convergence when a large number of much smaller and poorer economies are included in the set of countries examined.[14]

CONCLUSION

The recent studies' finding that "too much finance" reduces growth should be viewed with considerable caution. The reason is that there is an inherent bias toward a negative quadratic term in a regression that incorporates financial depth, or any other variable that tends to rise with per capita income, along with the usual convergence variable (logarithm of per capita income) in explaining growth. That the results may well be unreliable is demonstrated here by finding a statistically significant negative quadratic term in equations that "explain" growth by spurious influences: doctors per capita, R&D technicians per capita, and fixed telephone lines per capita. In some situations, finance can become excessive; the crises of Iceland and Ireland come to mind. But it is highly premature to adopt as a new stylized fact the recent studies' supposed thresholds beyond which more finance reduces growth.

13. This possibility is amplified in the tests of Aizenman, Jinjarak, and Park (2015), who do not include the standard convergence variable (logarithm of per capita income) in their tests.

14. The poorest country in the Cecchetti-Kharroubi dataset is India, with ppp income per capita at $5,456 in 2013 (IMF 2015). Surprisingly, neither Arcand, Berkes, and Panizza (2012) nor Sahay et al. (2015) identify the countries they include in their tests, but with 130 countries many must be far poorer than India.

REFERENCES

Aizenman, Joshua, Yothin Jinjarak, and Donghyun Park. 2015 (forthcoming). Financial Development and Output Growth in Developing Asia and Latin America: A Comparative Sectoral Analysis. In *From Stress to Growth: Strengthening Asia's Financial Systems in a Post-Crisis World*, eds. Marcus Noland and Donghyun Park. Washington and Manila: Peterson Institute for International Economics and Asian Development Bank.

Arcand, Jean-Louis, Enrico Berkes, and Ugo Panizza. 2012. *Too Much Finance?* IMF Working Paper 12/161. Washington: International Monetary Fund (June).

Cecchetti, Stephen G., and Enisse Kharroubi. 2012. *Reassessing the Impact of Finance on Growth*. BIS Working Paper 381. Basel: Bank for International Settlements (July).

Cline, William R. 2014. *Sustainability of Public Debt in the United States and Japan.* Working Paper 14-9. Washington: Peterson Institute for International Economics (October).

Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer. 2015. Penn World Table 8.1. Available at www.rug.nl/research/ggdc/data/pwt/pwt-8.1.

IMF (International Monetary Fund). 2015. *World Economic Outlook Database April 2015.* Washington.

King, Robert G., and Ross Levine. 1993. Finance and Growth: Schumpeter Might Be Right. *Quarterly Journal of Economics* 108, no. 3 (August): 717–37.

Sahay, Ratna, Martin Čihák, Papa N'Diaye, Adolfo Barajas, Ran Bi, Diana Ayala, Yuan Gao, Annette Kyobe, Lam Nguyen, Christian Saborowski, Katsiaryna Svirydzenka, and Seyed Reza Yousefi. 2015. *Rethinking Financial Deepening: Stability and Growth in Emerging Markets.* IMF Staff Discussion Note 15/08. Washington: International Monetary Fund (May).

World Bank. 2015. *World DataBank: World Development Indicators.* Washington. Available at http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source= world-development-indicators.

APPENDIX A SPURIOUS NEGATIVE QUADRATIC INFLUENCE IN ESTIMATION BASED ON RELATED LINEAR EQUATIONS

Suppose the basic relationship of the dependent variable of interest, *y*, to the exogenous variable, *x*, is negative and linear, such that:

$$A1) y = \alpha - \beta x$$

Suppose that a parallel variable of interest, z, instead has a positive linear relationship to the exogenous variable, such that:

$$A2) z = \gamma + \delta x$$

Suppose that in a statistical test the variable *y* is regressed not only on *x* but also on a quadratic form of the parallel variable *z*, in an estimating equation as follows:

$$A3) \hat{y} = \lambda + \eta x + \pi z + \theta z^2$$

Substituting from equation (A2), we can write:

$$A4) \hat{y} = \lambda + \eta x + \pi[\gamma + \delta x] + \theta[\gamma + \delta x]^2$$

Suppose that in some sense the statistical estimation captures only half of the direct influence of *x*, such that the parameter η is estimated to have a value of $\eta = -0.5\beta$.

Now suppose that the statistical regression mimics the remaining half of the influence of *x* by incorporating the final two terms of equation (A4)—the contribution of the quadratic form of parallel variable *z*. In order for the marginal influence of *x* to have its full true value of $-\beta$ on the estimated dependent variable, the contribution of the marginal influence of the parallel variable will have to equal the missing amount. On this basis, it will have to be the case that:

$$A5) \frac{d\{\pi[\gamma + \delta x]\}}{dx} + \frac{d\{\theta[\gamma + \delta x]^2\}}{dx} = -0.5\beta$$

Differentiating,

$$A6) \pi\delta + 2\theta[\gamma + \delta x][\delta] = -0.5\beta$$

Rearranging,

$$A7) \theta = \frac{-0.5\beta - \pi\delta}{2[\gamma + \delta x]\delta}$$

We know that the parameters β and δ are positive. Suppose that the exogenous variable *x* is such that it is also always positive (for example, the logarithm of per capita income). Suppose further that the parallel variable *z* is such that it is always positive even as the exogenous variable *x* approaches zero, such that γ is positive. Then the right-hand side of equation (A7) is strictly negative. As a consequence, the parameter θ on the quadratic term of the parallel variable, or z^2, is strictly negative.

In this system, then, when a regression of a variable bearing a negative linear relationship to an exogenous variable is conducted in an equation including not only that exogenous variable but also a quadratic formulation of a parallel variable that itself is a positive linear function of the exogenous variable, the result will be to estimate a positive linear coefficient and a negative quadratic coefficient on that parallel variable.[15]

The fundamental problem is that although the estimating equation (A3) is treated statistically as if the variable *z* were independent of variable *x*, equation (A2) requires that they are not independent. Correspondingly, any inference of a causal influence of *z* on *y* specified as strictly marginal (i.e., interpreted as the change in *y* resulting from a change in *z when there is no change in x*) will be spurious.

15. Note further that because one element in the right-hand side of equation (A7), *x*, is a variable rather than a parameter, by implication it would require varying valuation of θ to make the equation hold generally, although θ would always be negative. A reasonable assumption would be that the value of θ obtained in the statistical estimation would be that resulting from application of *x* at its average or median.

APPENDIX B DATA DESCRIPTION[16]

A standard specification of the growth regression used in the "too much finance" literature is adopted for this *Policy Brief*: The per capita real growth rate is related to the indicator variable such that $g = a + lny^*_0 + bX - cX^2$, where g is per capita real growth, lny^*_0 is initial ppp per capita income, and X is the indicator variable substituted in place of the financial depth indicator.

The same countries[17] and growth indicators used in Cecchetti and Kharroubi (2012) are also used in this *Policy Brief*. The cross-country growth data thus refer to per capita real growth that is constructed by using the *real GDP at constant 2005 national prices (2005 dollars)* and *population* variables available in the Penn World Table version 8.1 hosted on the University of Groningen's website. Similarly, initial ppp per capita income refers to the *expenditure-side real GDP at chained PPPs (2005 dollars)* variable in the Penn World Table database.

The three variables that are substituted for a financial depth indicator as the variable of interest in the three separate panel regressions reported in this *Policy Brief* are *physicians (per 1,000 people)*, *researchers in R&D (100s per million people)*, and *fixed telephone subscriptions (per 100 people)*. Data for these three indicators are from the World Bank World Development Indicators. As in Cecchetti and Kharroubi (2012), the regression equations for physicians and telephone subscriptions were estimated over six nonoverlapping five-year periods from 1980 to 2009, with *g*, the five-year average per capita real growth, regressed on the five-year average of the respective indicator variable. For the regression relating per capita real growth to the share of R&D technicians in the population, due to missing data on R&D technicians, the time period examined is 1995–2009 and 44 countries comprise the dataset (with no data available for Bangladesh, Chile, Egypt, Morocco, Nigeria, and Vietnam).

16. Prepared by Abir Varma.

17. The dataset is constructed from a sample of 50 countries: Argentina, Australia, Austria, Bangladesh, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Morocco, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Philippines, Poland, Portugal, Russia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States, Venezuela, and Vietnam.