

The Cause and Benefits of GDP

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ABSTRACT

It has recently been shown that world GDP FP-Causes world life expectancy at birth, where FP denotes fractional polynomial (Bechtel, 2021). This article shows that American and Chinese GDPs FP-Cause world life expectancy *even more strongly* than world GDP does. These striking results beg the question: what FP-Causes American and Chinese GDPs? The answer is globalization, which is also shown here. Furthermore, it is demonstrated that American and Chinese GDPs also FP-Cause world literacy and employment rates. It remains to be seen if the World Bank or International Monetary Fund can show that the GDPs of the other (less affluent) 18 nations in the G20 Fp-cause their country's life expectancy, as well as their literacy and employment rates. Yearly, pre-pandemic, *within-nation* increments in these variables can then be compared with subsequent decrements to assess an endogenous viral effect on each country's well-being. These comparisons will expose inequalities across nations due to the varying wealth of nations. The results in this article are brought by Royston and Altman's (1994) generalization of polynomial regression, which *estimates both coefficients and their powers*.

Keywords:Dollar, Temporal, and Percent Indicators, FP-Causation, Ratio Scaling, R^2 Invariance with respect to Dollar, Temporal, and Percent Calibration, The KOF Index of Globalization.

INTRODUCTION

The United Nation's Secretary General Antonio Guterres has recently advocated reforms of the World Bank, the International Monetary Fund, and the UN Security Council (Aljazeera, accessed on 19 July, 2020). Guterres stresses that events have overtaken us (www.nelsonmandela.org/content/page/annual-lecture-2020):

- The corona virus has brought the world to the breaking point and exposed deep demographic inequalities.
- A new UN governance would give each nation an equal vote and no veto.
- A new social contract would create equal opportunity at all institutional levels.
- An inclusive and balanced multilateral trading system would provide sustenance and sustainability.

Guterres reiterated these issues at the United Nations 75th anniversary on September 21, 2020. Pursuing "the future we want, the United Nations we need", the UN passed a Declaration of International Collaboration advocating an egalitarian reformation of the UN as well as the entire global establishment. Ten weeks later Guterres implicitly admonished some of the G20 nations for their rejection and ignorance of the World Health Organization's information and guidance in addressing poor nation's poverty, hunger, and survival in the covid-19 pandemic: "When countries go in their own direction, the virus goes in every direction" (Aljazeera,

December 3, 2020). Pivoting to climate change, Guterres then requested governments to declare climate emergencies in their own countries: “This is a moment of truth and it is also a moment of hope” (Aljazeera, December 12, 2020).

Echoing Guterres at the World Economic Forum in Davos, Switzerland on 1/25/2021, Xi Jin Ping said: “We must build an open world economy, firmly safeguard the multilateral trade system, and refrain from making discriminating and exclusive standards, rules, and systems, as well as high walls that separate trade, investment, and technology” (<https://www.euractiv.com>).

These recent moments of truth and hope, along with the Covid19 crisis, point toward important human benefits; namely, life expectancy at birth (X), employment (E), and literacy (L). This article demonstrates that these benefits are brought by GDP (G), which is the paramount economic indicator. G is then shown to be driven by the KOF Index of Globalization (K). Variables X, E, and L have been supplied by the World Bank in Washington (<http://beta.data.worldbank.org>). Variable K has been provided by the Swiss Economic Institute in Zurich (<https://doi.org/10.1007/s11558-019-09344-2>).

Sections 2, 3, and 4 define *world* X, E, and L (<http://beta.data.worldbank.org>). Section 5 details American and Chinese Gs and Section 6 demonstrates that these Gs FP-cause *world* X, E, and L. Section 7 describes K and Section 8 then shows that K FP-causes both American and Chinese Gs. Section 9 emphasizes the advantages of dollar, yearly, and percentage indicators, like G in trillions of current US\$, X in years, and E and L in percentages, in the new era of data science. Section 10 reviews the major discoveries here; namely, American and Chinese Gs FP-cause *world* X, E, and L, and K FP-causes American and Chinese Gs.

These findings are brought by the three data definitions and four fractional-polynomial regressions in Sections 5 and 6. It will be interesting to see if the G7 and G20 nations meeting this year will strive for similar findings regarding GDP, life Expectancy, and globalization.

LIFE EXPECTANCY AT BIRTH (X)

Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.

Source. (1) United Nations Population Division. World Population Prospects: 2019 Revision, or derived from male and female life expectancy at birth from sources such as: (2) Census reports and other statistical publications from national statistical offices, (3) Eurostat: Demographic Statistics, (4) United Nations Statistical Division. Population and Vital Statistics Reprot (various years), (5) U.S. Census Bureau: International Database, and (6) Secretariat of the Pacific Community: Statistics and Demography Programme.

Development Relevance. Mortality rates for different age groups (infants, children, and adults) and overall mortality indicators (life expectancy at birth or survival to a given age) are important indicators of health status in a country. Because data on the incidence and prevalence of diseases are frequently unavailable, mortality rates are often used to identify vulnerable populations. And they are among the indicators most frequently used to compare socioeconomic development across countries.

Limitations and Exceptions. Annual data series from United Nations Population Division's World Population Prospects are interpolated data from 5-year period data. Therefore they may not reflect real events as much as observed data.

Long Definition. Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.

Periodicity. Annual

Statistical Concept and Methodology. Life expectancy at birth used here is the average number of years a newborn is expected to live if mortality patterns at the time of its birth remain constant in the future. It reflects the overall mortality level of a population, and summarizes the mortality pattern that prevails across all age groups in a given year. It is calculated in a period life table which provides a snapshot of a population's mortality pattern at a given time. It therefore does not reflect the mortality pattern that a person actually experiences during his/her life, which can be calculated in a cohort life table. High mortality in young age groups significantly lowers the life expectancy at birth. But if a person survives his/her childhood of high mortality, he/she may live much longer. For example, in a population with a life expectancy at birth of 50, there may be few people dying at age 50. The life expectancy at birth may be low due to the high childhood mortality so that once a person survives his/her childhood, he/she may live much longer than 50 years.

WORLD EMPLOYMENT RATE (E)

Employment to population ratio is the proportion of a country's population that is employed. Employment is defined as persons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period (i.e. who worked in a job for at least one hour) or not at work due to temporary absence from a job, or to working-time arrangements. Ages 15 and older are generally considered the working-age population.

Source. International Labour Organization, ILOSTAT database. Data retrieved on June 15, 2021.

Aggregation Method. Weighted average

Development Relevance. Four targets were added to the UN Millennium Declaration at the 2005 World Summit High-Level Plenary Meeting of the 60th Session of the UN General Assembly. One was full and productive employment and decent work for all, which is seen as the main route for people to escape poverty. Employment to population ratio is a key measure to monitor whether a country is on track to achieve the Millennium Development Goal of eradicating extreme poverty and hunger by 2015. And it continues to be a priority in the Sustainable Development Goal of promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

General Comments. National estimates are also available in the WDI database. Caution should be used when comparing ILO estimates with national estimates.

Limitations and Exceptions. Data on employment by status are drawn from labor force surveys and household surveys, supplemented by official estimates and censuses for a small group of countries. The labor force survey is the most comprehensive source for internationally comparable employment, but there are still some limitations for comparing data across countries and over time even within a country. Comparability of employment ratios across countries is affected by variations in definitions of employment and population. The biggest difference results from the age range used to define labor force activity. The population base for employment ratios can also vary. Most countries use the resident, non-institutionalized population of working age living in private households, which excludes members of the armed forces and individuals residing in mental, penal, or other types of institutions. But some countries include members of the armed forces in the population base of their employment ratio while excluding them from employment data. The reference period of a census or survey is another important source of differences: in some countries data refer to people's status on the day of the census or survey or during a specific period before the inquiry date, while in others data are recorded without reference to any period. Employment ratios tend to vary during the year as seasonal workers enter and leave. This indicator also has a gender bias because women who do not consider their work employment or who are not perceived as working tend to be undercounted. This bias has different effects across countries and reflects demographic, social, legal, and cultural trends and norms.

Periodicity. Annual

Statistical Concept and Methodology. The employment to population ratio indicates how efficiently an economy provides jobs for people who want to work. A high ratio means that a large proportion of the population is employed. But a lower employment to population ratio can be seen as a positive sign, especially for young people, if it is caused by an increase in their education. The series is part of the ILO estimates and is harmonized to ensure comparability across countries and over time by accounting for differences in data source, scope of coverage, methodology, and other country-specific factors. The estimates are based mainly on nationally representative labor force surveys, with other sources (population censuses and nationally reported estimates) used only when no survey data are available.

WORLD LITERACY RATE (L)

The following passages are taken the World Bank's description of World Literacy Rate, which is sourced from the UNESCO Institute for Statistics:

Adult literacy rate is the percentage of people ages 15 and above who can both read and write with understanding a short simple statement about their everyday life.

Outcome. Literacy rate is an outcome indicator to evaluate educational attainment. This data can predict the quality of a future labor force and can be used in ensuring policies for life skills for men and women. It can be also used as a proxy instrument to see the effectiveness of an education system; a high literacy rate suggests the capacity of an education system to provide a large population with opportunities to acquire literacy skills. The accumulated achievement of education is fundamental for further intellectual growth and social and economic development, although it doesn't necessarily ensure the quality of education. The term literate women implies that women can seek and use information for the betterment of the health,

nutrition and education of their household members. Literate women are also empowered to play a meaningful role.

Measurement. In practice, literacy is difficult to measure. Estimating literacy rates requires census or survey measurements under controlled conditions. Many countries report the number of literate people from self-reported data. Some use educational attainment data as a proxy but apply different lengths of school attendance or levels of completion. And there is a trend among recent national and international surveys toward using a direct reading test of literacy skills. Because definitions and methods of data collection differ across countries, data should be used cautiously.

GROSS DOMESTIC PRODUCT (G)

History of GDP. In the great depression Simon Kuznetz formulated American national accounts in terms of dollars, which evaluated different commodities in a common unit. He added up various national income sources and reported his result to the United States Senate in January, 1934 (Masood, 2016, Prologue, Chapters 2 and 3). "In 1940, six years after Simon Kuznetz had presented his national income estimates to the Senate, Keynes had written down in a table the basis for what today is the formula for GDP" (Masood, 2016, p. 26). This formula adds up three macro indicators, *household expenditure*, *domestic savings*, and *government expenditure*, which constitute Keynesian GDP.

Importance of GDP. In 1999, mindful of Simon Kuznets original accounting of distinct goods like cars and cereal boxes by their dollar values, the United States Commerce Department proclaimed the GDP formula as the U.S. government's greatest invention of the 20th century (Masood, 2016, Introduction). The calibration of GDP's three indicators *in current US dollars for all nations* signals a continuing American control of the global economy. In the plethora of global indexes, GDP looms as the composite most fundamental to the global economy. GDP is so basic, longstanding, and prestigious that market traders, analysts, and policy planners track it daily on worldwide television and internet. The new empirical economics is dominated by GDP's "Making the Modern World" (Masood, 2016, Preface), it's fostering human development, and it's availability in most national accounts.

Indicators of GDP. Here we view GDP's components, *household expenditure*, *domestic savings*, and *government expenditure*, as separate time-varying indicators (<http://beta.data.worldbank.org>):

Household final consumption expenditure (current US\$): "Household final consumption expenditure (formerly private consumption) is the market value of all goods and services, including durable products (such as cars, washing machines, and home computers), purchased by households. It excludes purchases of dwellings but includes imputed rent for owner-occupied dwellings. It also includes payments and fees to governments to obtain permits and licenses. Here, household consumption expenditure includes the expenditures of nonprofit institutions serving households, even when reported separately by the country. Data are in current U.S. dollars."

Gross domestic savings (current US\$): "Gross domestic savings are calculated as GDP less final consumption expenditure (total consumption). Data are in current U.S. dollars."

The World Bank's update of John Maynard Keynes final indicator, added during World War II (Keynes, 1940), is:

General government final consumption expenditure (current US\$): "General government final consumption expenditure (formerly general government consumption) includes all current government expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation. Data are in current U.S. dollars."

This dollar denomination of variables counted in different units (automobiles, cereal boxes, etc.) allows the ratio scaling of GDP up to a multiplier calibrating GDP in single, thousands, millions, billions, or trillions of current US dollars. This ratio scaling also allows daily exchange-rates to multiply one nation's currency into another's (e.g. dollars into yuan).

G AS AN FP-CAUSE OF X, E, AND L

Recalling that G denotes either American or Chinese GDP (cf. Section 1), this article shows that G FP-causes *world* X , E , and L , where FP denotes fractional polynomial (cf. Royston and Altman, 1994; Granger, 2001).

Definition 1. Vector G replicates a constant $G_t M_t$ times, where M_t denotes American or Chinese population size in year $t = 1991 \dots 2018$.

Vector G contains $\Sigma_t M_t$ values and is calibrated in singles, twenties, fifties, hundreds, thousands, millions, billions, or trillions of current US\$.

Definition 2. Vector X replicates a constant $X_t N_t$ times, where N_t is world population size in year $t = 1991 \dots 2018$.

Vector X contains $\Sigma_t N_t$ values and is calibrated in hours, days, weeks, months, or years.

Definition 3. Vector E replicates a constant $E_t N_t$ times, where N_t is world population size in year $t = 1991 \dots 2018$.

Vector E contains $\Sigma_t N_t$ values and is calibrated in percentages.

Definition 4. Vector L replicates a constant $L_t N_t$ times, where N_t is world population size in year $t = 1991 \dots 2018$.

Vector L contains $\Sigma_t N_t$ values and is calibrated in hours, days, weeks, months, or years.

Definition 5. If fractional polynomial regressions of world X , E , and L on G over $t = 1991 \dots 2018$ return $R^2s \geq .95$, then G FP-causes world X , E , and L .

The following Tobrino algorithms return importance-weighted fractional polynomial regressions in Stata syntax (StataCorp., 2011):

fracpoly regress X G [iweight = POPmillions], adjust(G:mean) degree(2) noscaling (1)
fracpoly regress E G [iweight = POPmillions], adjust(G:mean) degree(2) noscaling (2)
fracpoly regress L G [iweight = POPmillions], adjust(G:mean) degree(2) noscaling (3)
Table 1 exhibits the R^2 s for fractional polynomial regressions of X, E, and L on G over t = 1991 ... 2018.

Table 1. FP Regression R^2 s of X, E, L on G

Nation	X	E	L
USA	.9941	.9722	.9858
China	.9944	.9883	.9899

These R^2 s give strong empirical confirmation that *American and Chinese* Gs FP-cause *world* X, E, and L.

Finally, It is important to note that the above R^2 s are invariant with respect to the units in which G, X, E, and L are calibrated.

THE KOF INDEX OF GLOBALIZATION (K)

K was inspired by Visions of Governance for the 21st Century in Cambridge, MA, USA. It was introduced in 2002, published in 2006, updated and detailed in 2008, and revisited by Savina et al. (2019). The index is produced by the KOF Swiss Economic Institute at ETH Zurich, who defines globalization as the process of creating networks of connections among actors at multi-continental distances, mediated through a variety of flows including people, information and ideas, capital and goods. Globalization is conceptualized as a process that erodes national boundaries, integrates national economies, cultures, technologies and governance and produces complex relations of mutual interdependence (<http://globalization.kof.ethz.ch/>).

Table 2 lists the six sub-indicators that make up K. The Swiss Federal Institute of Technology describes the standardization of these indicators: each sub-indicator is transformed to a scale of one to one hundred, where one hundred is the maximum value for a specific indicator and one is the minimum value. Higher values denote higher globalization and lower values denote less globalization. The data are transformed according to the percentiles of the original distribution. These percentiles constitute an identity scale; i.e. a scale whose transformation is restricted to multiplication by one.

Table 2. Components of the K

Indicator	Sub-Indicators
Actual flows in % GDP	Trade, Foreign direct investment, stocks, Portfolio investment, Income payments to foreign nationals
Low Restrictions	Hidden import barriers, Mean tariff rate, Taxes on international trade, Capital account restrictions
Personal Contact	Telephone traffic, Transfers, Foreign population, International letters,
Information Flows	Internet users, Television, Trade in newspapers
Cultural Proximity	Number of McDonalds, Number of Ikea, Trade in books
Political Globalization	Embassies in country, Membership in international organizations,

Participation in U.N. Security Council missions, International treaties

The six sub-indicators of K in Table 2 support Xi Jin Ping's plea to the 2021 World Economic Forum in Davos, Switzerland: "We must build an open world economy, firmly safeguard the multilateral trade system, and refrain from making discriminating and exclusive standards, rules, and systems, as well as high walls that separate trade, investment, and technology" (<https://www.euractiv.com>) (cf. Section 1). This plea offers an investment-policy guide to foreign nationals, sovereign states, the United Nations, the World Bank, the International Monetary Fund, and the New Development Bank in Shanghai.

K AS AN FP-CAUSE OF G

The next Tobrina algorithm returns a importance-weighted fractional polynomial regressions of G on K for the USA and China:

`fracpoly regress G K [iweight = POPmillions], adjust(K:mean) degree(2) noscaling` (4)

The R^2 s returned by (4) for American and Chinese Gs over $t = 1991 \dots 2018$ are .9672 and .9555. These R^2 s confirm that K *FP-causes* both American and Chinese Gs. It also remains to be shown whether K *FP-causes* the GDP of each of the other 18 G20 nations over 1991-2018.

DOLLARS, YEARS, AND RATES IN DATA SCIENCE

The results brought by Stata commands (1) and (2) override the basic canon of statistical inference, that there is fundamental uncertainty in all data. Neither denying nor quantifying uncertainty, we simply ignore it. This approach to sequential populations brings compelling advantages to social and economic data science. Probabilistic inference is replaced by parameter computation and random variables give way to real variables. This suggests further "statistical thinking and new foundational frameworks" that help sort out "the many philosophical issues data science presents ..." [Davidian, 2013]. This call has been echoed by the American National Science Foundation, who has "released a revised version of the solicitation 'Critical Techniques and Technologies for Advancing Foundations and Applications of Big Data Science ... ' " (Vogelius et al., 2015). In view of trade-war, covid-19, and environmental shocks to all economies, focusing data science on GDP's predictions of other important global and national indexes is now compelling.

Pfeffermann observes that "The use of big data does not require a sampling frame, questionnaires, interviews, and all the other ingredients underlying survey samples [...] this should be the ultimate target of every country – having sufficiently accurate administrative records so that no population censuses will be needed" (Pfeffermann, 2015) (pp. 433, 455).

Horrigan also views Big Data as non-sampled data "from electronic sources whose primary purpose is something other than statistical inference. [...] this type of Big Data typically comprises the universe and, by definition, can represent (nearly) the entire population [...] (Horrigan, 2013) (pp. 25-26)." As examples of non-sampled universe files Horrigan mentions daily price indexes, point-of-sale retail databases, universe data on hospitals, and corporate data.

Similarly, Stata commands (1) – (4) here exploit the electronic files of the World Bank and the Swiss Economic Institute. Commands (1) – (4) provide the R^2 s in Sections 6 and 8, where *world*

X, E, and L are regressed on *American and Chinese* Gs. These Gs, along with X, E, L and the variables mentioned by Horrigan, are measured on ratio and identity scales, which exceed interval scales in the hierarchy of scientific measurement (Stevens, S. S.; 1946, Torgerson, W.S. 1958, Suppes, P.; Zinnes, J. L., 1963).

For almost half a century interval scales have been beset with skepticism about their incremental benefits over and above ratio and identity scales already in use (Shapiro, 1972) (p. 373). The problems associated with interval scaling, i.e. survey sampling, questionnaire interrogation, probabilistic inference, and significance testing, are absent with dollar, yearly, and percentage indicators (cf. Lyberg et al., 1997).

The fractional polynomial regressions in (1) and (2) evade the host of long-standing, and now acute, issues daunting micro-data collection and analysis. First, sampled micro data are beset by the unresolved competition between randomization-based and model-based regression (Chaudhuri and Stenger, 2005; Opsomer, 2009). Second, both types of regression face problems of measurement error (Bound, Brown, and Mathiowetz, 2001), sampling error (Thompson, 1997, Lohr, 2010, and Brick and Montaquila, 2009), unit nonresponse (Frankovic, Panagopoulos, and Shapiro, 2009), missing data (Little and Rubin, 2002), and variance estimation (Demnati and Rao, 2004, Prášková and Sen, 2009). Unit nonresponse alone threatens the entire survey industry due to public unwillingness to answer mail, telephone, internet, or face-to-face questions. The host of problems associated with survey measurement and process quality were discussed and illustrated over two decades ago (Lyberg et al., 1997). Today Bradburn laments that “[...] the challenges confronting the survey researcher are dominated by the difficulty in locating sample persons and getting them to respond at all.” (Bradburn, 2016) (p. 94).

CONCLUSION

IMF's Chief Economist Gita Gopinath, warned of a drop in global economic outlook in 2020 (CNBC, 24 June, 2020). On this same day she predicted that worldwide GDP will shrink 4.9% in 2020 (Aljazeera, 24 June, 2020). In the second quarter US and German GDP then fell 10%, the largest quarterly drop for these two nations since WWII. At an annualized rate, the American Economy contracted by one third of its value in 2020 due to Covid19 (CNBC and Aljazeera, 30 July, 2020).

This American G contraction has reversed in 2021 due to the liberal monetary policy of President Biden, Treasury Secretary Yellen, and Federal Reserve Chairmen Powell (CNBC, May, 2021). The long-term ratio of American G to world G is .2909 (https://ycharts.com/indicators/us_gdp_as_a_percentage_of_world_gdp). This ratio supports the American R²s in Table 1, which demonstrate that *American* G Fp-causes *world* X, E, and L.

The other major findings of this article are that *Chinese* G also FP-Causes *world* X, E, and L and that K FP-Causes both American and Chinese Gs. It remains to be seen if the World Bank or International Monetary Fund can also show that the GDPs of other nations Fp-cause their country's life expectancy, literacy and employment rates. Yearly, pre-pandemic, *within-nation* increments in these variables can then be compared with subsequent decrements to assess an endogenous viral effect on each country's well being. These comparisons will expose inequalities across nations due to the varying wealth of nations.

ACKNOWLEDGMENTS

This article is dedicated to the memory of the author's best critic, Maria Cohn Bechtel. The author thanks Dr. Bethany Bechtel for the book *The Great Invention: The Story of GDP and the Making and Unmaking of the Modern World* (Masood, 2016). We have also benefited from Dr. Bechtel's insistence on monitoring a population's economic indicators over time, coupled with a gradual approach to loosening entrenched economic approaches to data analysis. This paper sequels a recent article in the *Open Journal of Social Sciences* (Bechtel, 2021).

CONFLICTS OF INTEREST

The author declares no conflicts of interest.

References

- Bechtel, G. 2021. Gross Domestic Product *FP-causes* Life Expectancy at Birth. *Open Journal of Social Sciences* 9, 325-332.
- Bradburn, N. 2016. Surveys as social interactions. *Journal of Survey Statistics and Methodology* 4, 94-109.
- Brick, J.; Montaquila, J. M. 2009. Nonresponse and weighting. In *Handbook of Statistics (Sample Surveys: Design, Methods and Applications)*; Pfeffermann, D., Rao, C. R., Eds.; Elsevier: Amsterdam, NL, Volume 29A
- Bound, J.; Brown, C.; Mathiowetz, N. 2001. Measurement error in survey data. In *Handbook of Econometrics*; Heckman, J. J., Leamer, E., Eds.; Elsevier Science: Amsterdam, NL, Volume 5.
- Chaudhuri, A.; Stenger, H. 2005. *Survey Sampling: Theory and Methods*, 2nd ed.; CRC Press: Boca Raton, FL, USA,
- Davidian, M. 2013. Aren't we data science? *Amstat News*, July, 3-5.
- Demnati, A.; Rao, J.N.K. 2004. Linearization variance estimators for survey data. *Survey Methodology* 30, 17-26.
- Frankovic, K. A.; Panagopoulos, C.; Shapiro, R. Y. 2009. Opinion and election polls. In *Handbook of Statistics (Sample Surveys: Design, Methods and Applications)*; Pfeffermann, D., Rao, C. R., Eds.; Elsevier: Amsterdam, NL, Volume 29A.
- Granger, C. W. J. 2001. *Essays in Econometrics: The Collected Papers of Clive W.J. Granger*; Cambridge University Press: Cambridge, UK.
- Horrigan, M. W. 2013. Big data: A perspective from the BLS. *Amstat News*, January, 25-27.
- Keynes, J. M. 1940. *How to Pay for the War*; Macmillan: London, UK.
- Little, R. J. A.; Rubin D. B. 2002. *Statistical Analysis with Missing Data*; Wiley and Sons: New York, NY, USA.
- Lohr, S. L. 2010. *Sampling: Design and Analysis*, 2nd ed. ; Brooks/Cole: Boston, MA, USA,
- Lyberg, L. ; Biemer, P. ; Collins, M. ; de Leeuw, E. ; Dippo, C. ; Schwarz, N. ; Trewin, D. , Eds. 1997. *Survey Measurement and Process Quality*; Wiley and Sons: New York, NY, USA.
- Masood, E. 2016. *The Great Invention: The Story of GDP and the Making and Unmaking of the Modern World*; Pegasus Books Ltd.: New York, NY, USA,
- Opsomer, J. D. 2009. Introduction to part 4: Alternative approaches to inference from survey data. In *Handbook of Statistics (Sample Surveys: Inference and Analysis)*; Pfeffermann, D., Rao, C. R., Eds.; Elsevier: Amsterdam, NL, Volume 29B.
- Pfeffermann, D. 2015. Methodological issues and challenges in the production of official Statistics, 24th Annual Morris Hansen Lecture. *Journal of Survey Statistics and Methodology* 3, 425-467.
- Prášková, Z.; Sen, P. K. 2009. Asymptotics in finite population sampling. In *Handbook of Statistics (Sample Surveys: Inference and Analysis)*; Pfeffermann, D., Rao, C. R., Eds.; Elsevier: Amsterdam, NL, Volume 29B.
- Royston, P.; Altman, D. J. 1994. Regression using fractional polynomials of continuous covariates: parsimonious parametric modeling (with discussion). *Applied Statistics* 43, 429-467.

Savina, G.; Haelg, F.; Potrafke, N.; Sturm, J-E. 2019. The KOF Globalisation Index – Revisited, *Review of International Organizations* 14(3), 543-574 (<https://doi.org/10.1007/s11558-019-09344-2>)

Shapiro, H. 1972. The index of consumer sentiment and economic forecasting: A reappraisal; In *Human Behavior in Economic Affairs*; Strumpel, B., Morgan J. N., Zahn, E., Eds.; Jossey-Bass, San Francisco, CA, USA.

StataCorp. 2011. *Stata Statistical Software, Release 12*; StataCorp LP, College Station, TX, USA.

Stevens, S. S. 1946. On the theory of scales of measurement. *Science*, 677-680.

Suppes, P.; Zinnes, J. L. 1963. Basic measurement theory; In *Handbook of Mathematical Psychology, Volume I*; Bush, R. R., Luce, R. D., Galanter, E., Eds.; John Wiley & Sons, New York, NY, USA, 1-76.

Thompson, M. E. 1997. *Theory of Sample Surveys*; Chapman and Hall; London, UK. Torgerson, W. S. 1958. *Theory and Methods of Scaling*; John Wiley & Sons, New York, NY, USA.

Vogelius, M.; Kannan, N.; Huo, X. 2015. NSF big data funding opportunity for the statistics community. *Amstat News*, April, 6.