Economic Cycles: From Descriptive Statistics to Modelization – H.L. Moore

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Mathematical Communities in the Reconstruction after the Great War (1918–1928)

CIRM, 12–16 November 2018

Economic Cycles & H.L. Moore

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1. Historical perspective: The economic consequences of WWI in the USA

- 1917, April: The US enters the war. Five Liberty bonds for financing the War; boom in production.
- 1919: European gold stocks at 2 billion vs. 3 billion in the US; the opposite from 1914. Exports rose from 1.5 billion to 5.2 billion in 1919. After the war, the US went from debtor of the continent to creditor. t2
- 1921: **Postwar transition crisis**: corn prices decreased by 60%; 4.7 million unemployed.
- 1922: Genoa Economic and Financial Conference: *Gold exchange standard for dollar and pound sterling* replaces *gold standard*
- 1922–29: **General prosperity**. Production growth:
  - 1.5 million vehicles in circulation vs. 5.3 million in 1929. 60% of car purchases made on credit. Ford: "higher wages, lower costs, lower prices".
  - Aircraft: 50,000 travellers in 1928; 173,000 in 1929.
  - Taylor's Scientific Management and maximum productivity, Advertising.
  - But not enough output in agriculture: Rural depopulation, immigration regulation, isolationism.

Diapositive 3

t2 "Grain" est le mot générique pour catégoriser tout ce qui est céréale.
therrese; 12/11/2018

The economic consequences of WWI in Europe

- Great Britain
  - Coal miners' strikes; Oil competition; Depression in 1920–21.
  - 1920: in 3 months, unemployment increased from 1.35 to 2.2 million.
  - Foreign trade decreased (coal, cotton, naval construction). England exported from 1/3 to 1/5 of its GDP in the interwar period.
- France
  - "War casualties": 1.3 million men; 21,000 industrial buildings.
  - Reorganization of production (Renault's workforce increased from 8,000 to 35,000 workers from 1914 to 1918).
  - 1920–21 Crisis: insufficient demand, price increases, inflation: "Germany must pay".
- Germany
  - High inflation: the pound lost 20%, the franc 75%, the mark …2000% within a few months in 1920.

New economic and statistical institutions

- **New economic order, new institutions**
  - International Statistical Institute (ISI) (1885), International Labour Organization (ILO)
  - Agencies: NBER (1920)
  - Professional Societies: AEA, ASA
  - Journals: JASA, Harvard *Economics and statistics*
  - Teaching:
    - chairs and Statistics labs: Cf. Helen Walker's dissertation (1929)
    - treatises of Sechrist (1917, 21), Crum (1923), Davies (1922), Jerome (1924)
  - Rietz (1924) editor of: *Handbook of Mathematical Statistics*:
    - H.L. Rietz author of 4 of 12 chapters (frequency distributions, random sampling, probability distributions, correlation)
    - W. Persons (correlation of time series), W.L. Crom (periodogram analysis)
- **Treaties of economic statistics:** at the intersection of two traditions: administrative statistics/mathematical statistics

2. Methodoligical duality

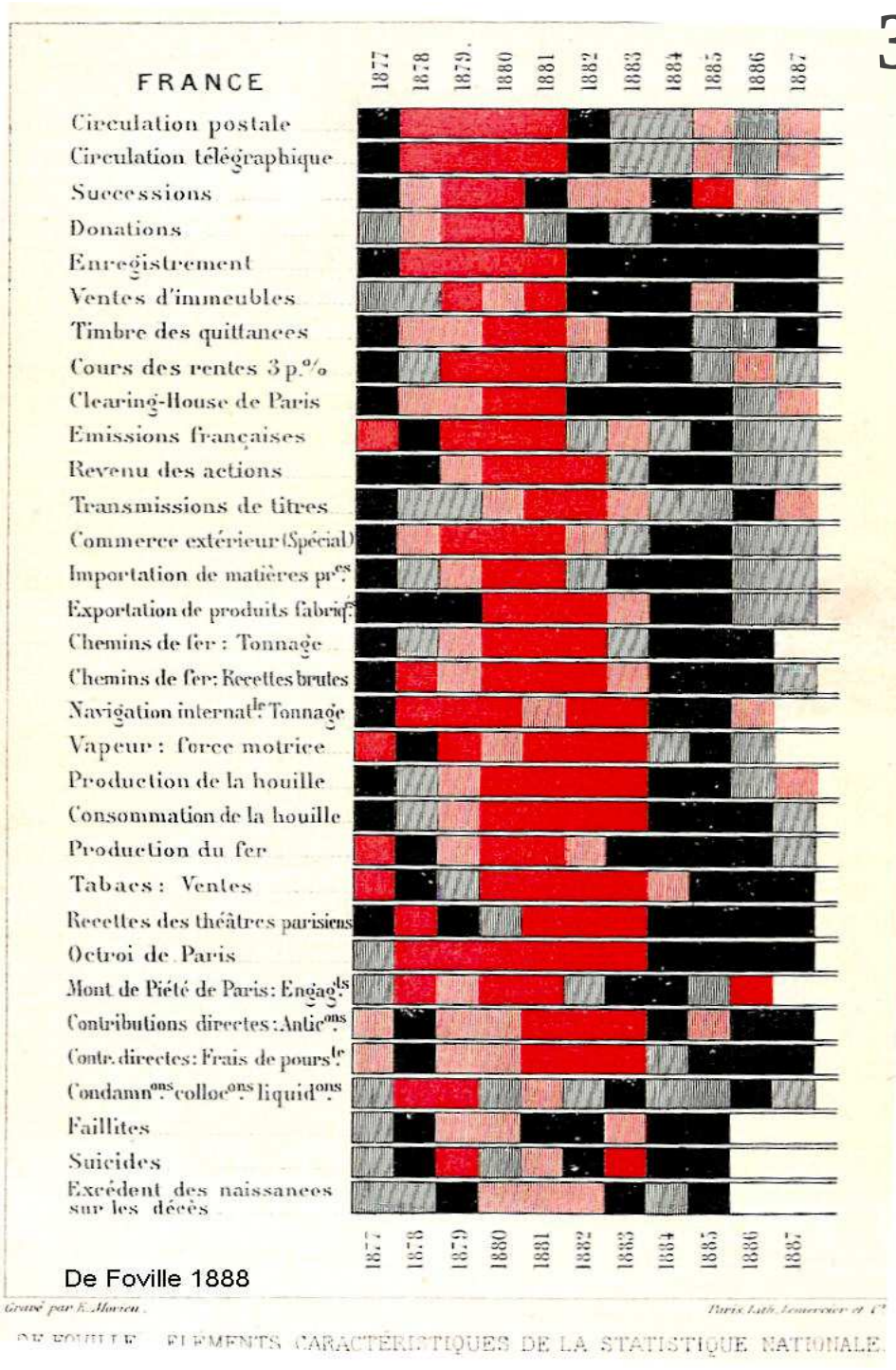
Mathematical economics (analytical formalization)	**Statistical economics (digital quantification)**
Sure knowledge (deductive) of geometry	Perceptible and probable knowledge (inductive) of events
Alembert's "mixed mathematics" Physiocrates, Canard and Bicquilley	L'*Ars Conjectandi* (Bernoulli) Political arithmetic
Cournot 1838: *Recherches sur les principes mathématiques de la théorie des richesses*	Cournot 1843: *Exposition de la théorie des chances et des probabilités*
The Marginalist Revolution (1870) Walras, Menger, Jevons	Mathematical statistics (1885): Galton Pearson
Pareto: Mathematical economics Edgeworth: *Mathematical Psychics* Bowley: *Mathematical Groundwork of Economics*	Pareto: law of income distribution Edgeworth: statistical work Bowley: *Elements of Statistics*

3. Economic statistics

- **Chronological series, Charts and Barometers** (*Measure of the variations in the economic state of populations)*
  - **Many indices**: De Foville 1888, Von Neumann-Spallart 1887 (3 sets of economic, social and moral indicators for 5 countries)
  - **One** representative index, Juglar (1904)
  - **A few synthetic indexes**: Armand Julin (1911) & (1913); Lucien March (1922); W. Person Harvard Barometer (1919–29)
- **Relationships betweeen indexes: from correlation to covariation (March..)**
- **Decomposition and adjustment of time series in Trends-Cycles-Residuals**
  - Moving averages
  - Differentiation
  - Relative links
  - Regression analysis
  - Fourier–Shuster spectral analysis
- **Epistemological Interpretation of Barometers**
  - Heuristic
  - Semiologic
  - Causal
  - Pragmatic

Diapositive 7

t3 time series (?)
therrese; 12/11/2018



3.2. Economic Barometers

Alfred de Foville (1888)

Essay on meteorological and social economics

De Foville chose 30 indicators of economic activity (some of them are demographic)

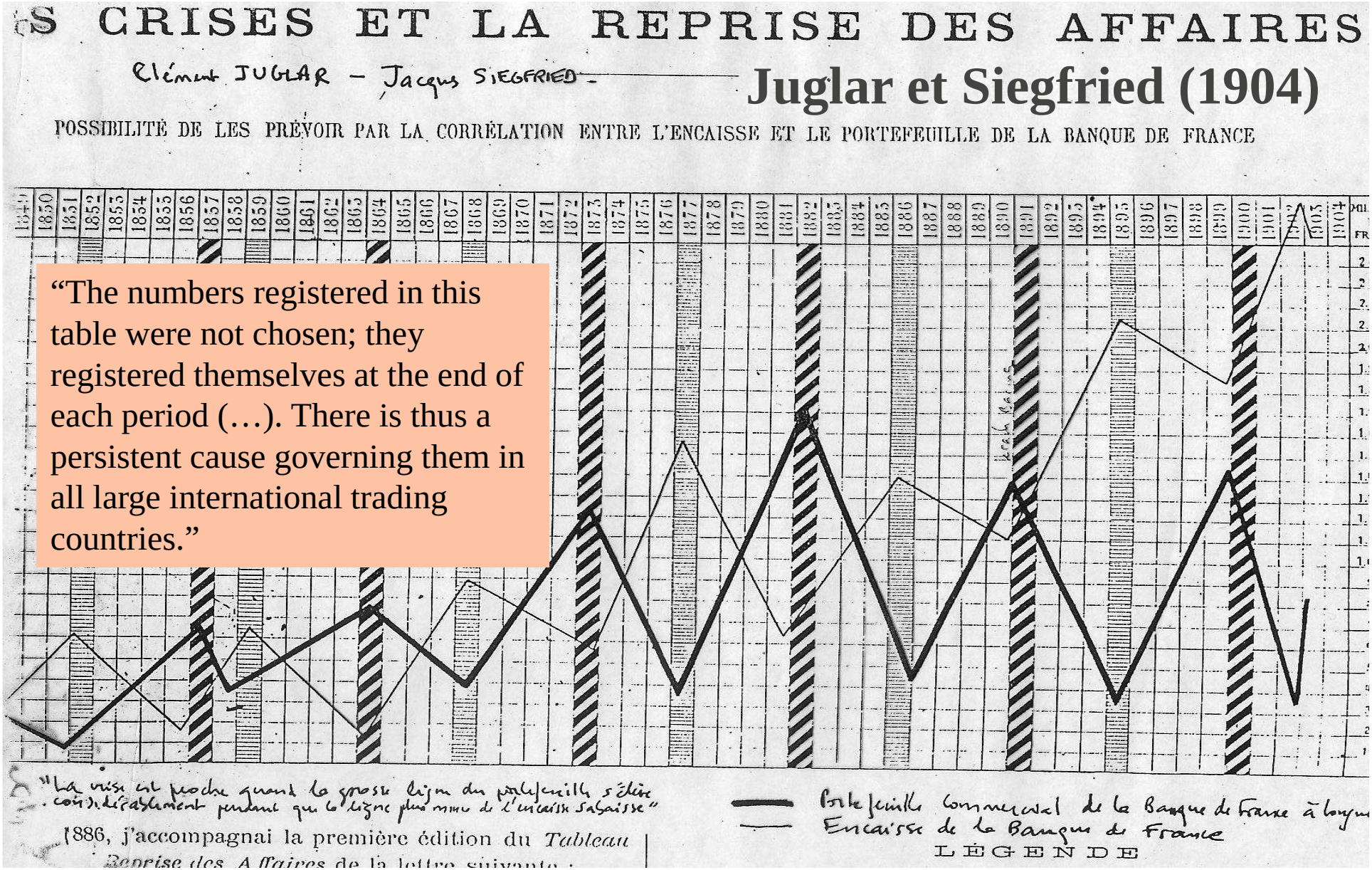
Each numerical series has its own measurement, represented by a horizontal coloured bar graph: red (good), pink, grey, black (bad).

When looking at this colored table column by column, we notice some simultaneity in the colors, demonstrating a common general phenomenon shared by all the series: *Business*. This business cycle is, in particular, characterized by a big crisis in 1884 (black zone).

But this simultaneity is not perfect: some series begin their crisis before the others: the advanced indicators become a forecasting instrument.

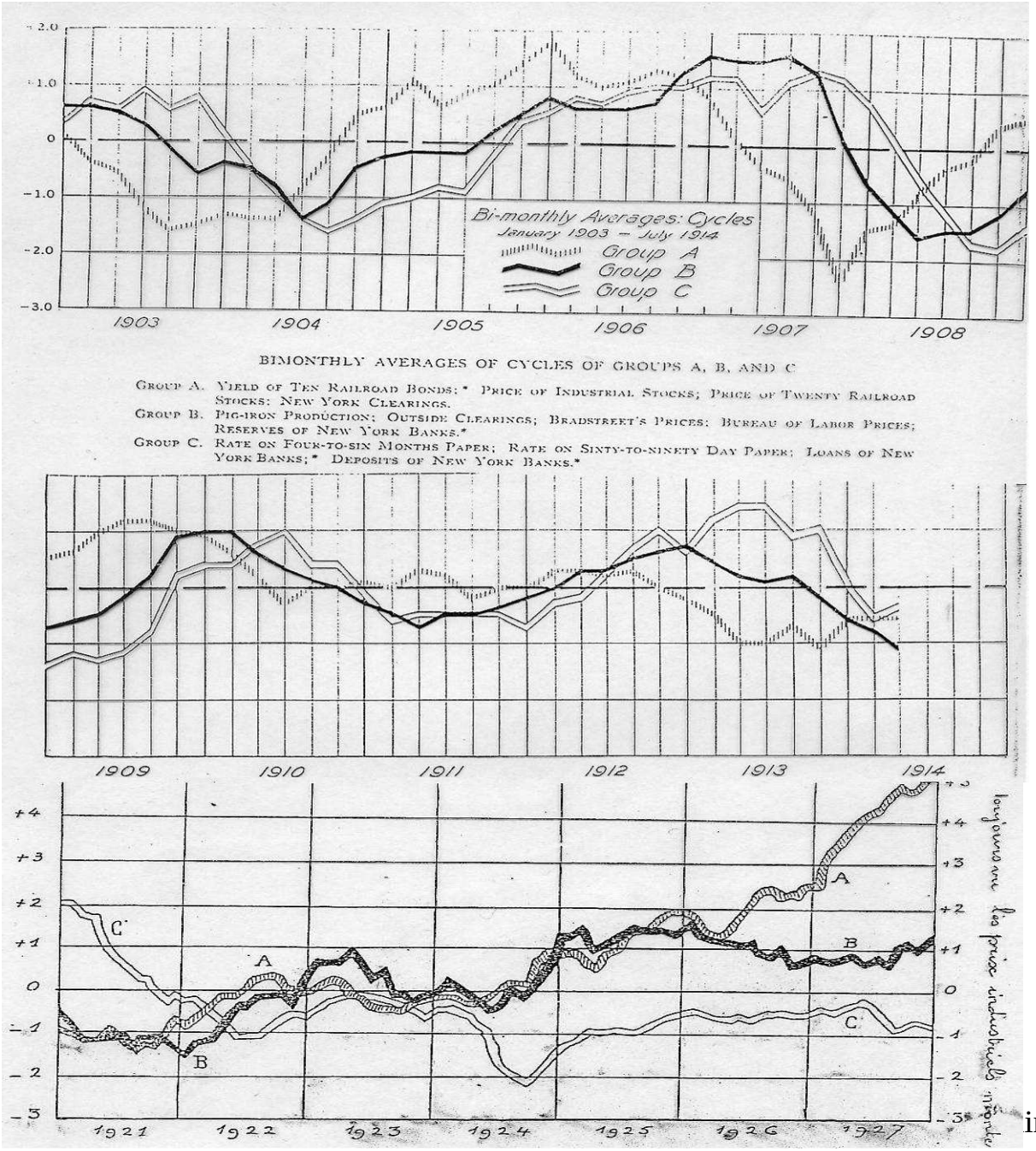
This device is analogous to a meteorological barometer that measures atmospheric pressure, making it possible to forecast the weather.
The economic barometer has two uses: to give proof of the existence of business cycles and to forecast and govern the crisis.

Juglar et Siegfried (1904)



This barometer by Juglar and Siegfried (1904) highlights a business cycle of roughly 7 years on the basis of two series only (issued by the Banque de France), which are incidentally in opposition: "as the purse fattens, the coffers are emptied out".

The Harvard barometer



The Harvard Barometer was elaborated at Harvard University by **Warren Persons** and published, with his complete, correlation-based methodology in the house review he created: ***Review of Economic Statistics 1919***.

It contains 3 groups of series: *A* represents the evolution of the market of stock values (Speculation); *B* that of the market of goods and services (Business); *C* the currency market (Money). The first series acts as an advanced indicator making it possible to forecast.

This barometer served as a model for lots of others in the US and Europe. A large number of Conjuncture institutes were created in the 1920s, whose main product was a barometer of this kind.

3.3. From correlation to “covariation”

- The barometer technique benefitted from important advances in statistical mathematics at the turn of the century, in particular the notions of correlation and regression “invented” by the English biometric school.
  - Francis **Galton** invented regression and correlation within the framework of his research programme on heredity and eugenics (1875–89).
  - Karl **Pearson** defined (1895–1906) the mathematical statistics, the interpretation in terms of distribution, the epistemological (contingency) framework and uses (innate/acquired).
  - G. U. **Yule** (1897) reunified the theory of regression and the theory of errors and method of least squares. He introduced (1909) their economic uses.
  - **Hooker, March, Yule** adapted the correlation tool to chronological data and established the decomposition of the time series into trends and seasonal components.
  - **Yule, Slutsky, R. Fisher** (1921–26) warned against illusory, artifactual correlations in chronological time series.

George-Udny Yule

- Inaugurated (with Bowley) the era of statistical economics, linked to the questions of the Great Depression, pauperism, and the welfare state. He was trained by Pearson but was neither a eugenist or a phenomenalist.

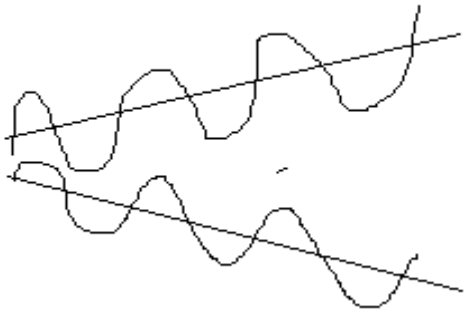
1°) *For those familiar with the theory of errors, it will be obvious that the method is nothing more thant the application to statistical research objects of the well-known method of least squares.*

2°) *As the form of the frequency distributions given by the normal law of errors is not common to statistical economics, it is important to obtain the correlation formula and its properties without using the frequency distribution.*

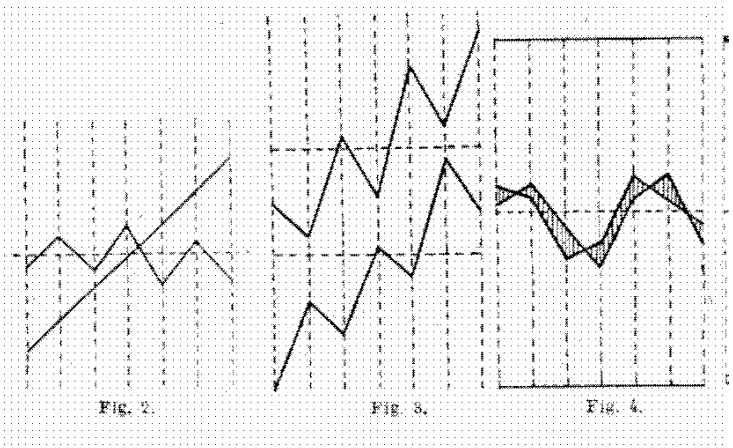
3°) Yule 1897: the straight line of least squares coincides with the straight line of regression if the latter is linear (including the normal case), and gets as close as possible to each other if not. This new approach was endorsed by Edgeworth (1902 and 1908) and Bowley (in his treaty); it remained only to prove its pertinence and efficiency in economics. Joint meeting in Paris of the IIS (12th session), SSP and SEP.
Creation by L. March of a "*committee of technical methods of statistical comparison*" (1909).

Marriage rate and wheat prices: covariation traps

- William Farr: inverse correlation (Malthusien reasoning)
- Willian Ogle (1890): direct positive link (graphic proof)
- Hooker (1891) continued by Bowley (1901) $r < 0$ before 1870 and $r > 0$ after 1870
- Hooker (1901) : necessity of separating correlation between cyclical tendancies and between trends with moving average and lags



r = 0.18 in gross value
r = 0.80 in Differnce to trend
r is <0 in trend



•Lucien March (1905): *The correlation coefficient expresses the numerical resemblance of the variations of the compared values, without any hypothesis on the distribution mode of these values.*

•March (1928): trend covariation and differential covariation.

4. Henry Ludwell Moore (1869–1958)

- Born in Maryland, 15 children
- 1892–96: B.A. John Hopkins University: Lectures on the application of Mathematics to Political Economy
- 1894–95: Univ of Vienna (Menger)
- 1896: Ph.D. on von Thünen's theory of natural wages (dir. John Bates Clark)
- 1897: Marriage
- 1897–02: Smith College: Prof of Pol. Eco.
- 1902–06: Adjunct Prof of Pol. Eco. at Columbia
- Trips to Europe: 1903 Walras; 1908 Pareto; 1912 Bortkiewicz
- 1906–29: Prof of Pol. Eco. at Columbia. Reduction in teaching load
- 1929–58: Retired due to nervous breakdown

H.L.Moore: Publications

- 1895: Von Thunen's Theory of Natural Wages, *QJE IX* *doctrinal history*
- 1905: AA Cournot, *QJE XIX; Revue de métaphysique et de morale*
- 1908: *The Statistical complement of Pure Economics*, *QJE XXIII*
- **1911: *Law of Wages: An Essay in Statistical Economics***
  - Reviews by Taussig, Edgeworth, Persons, Brown, Schumpeter, Stigler
- **1914: *Economic Cycles: Their Laws and Causes***
  - Reviews by Wright, Lehfeldt, Persons, Magee, Yule, Fanno, Stigler
- 1917: *Forecasting the Yield and Price of Cotton*
  - Reviews by Yule, Persons
- **1923: *Generating Economic Cycles***
  - Reviews by Hayek, Wright, Ingraham
- 1929: *Synthetic Economics*, Macmillan
  - Reviews by Wright, Ezekiel

5. Laws of Wages 1911 (1)

- **Introduction**:
  - The pure theory has **3 objectives**: definitions, analysis, general views. It needs mathematical expression with a system of simultaneous equations (Walras)
  - There are **good conditions for empirical investigation**: early Statistical material became abundant. Calculation of mass phenomena had progressed from Laplace to Gauss to Galton, Pearson, Edgeworth. Assistance of mechanical devices for performing compilation; calculus is available (machine arithm., electric accounting machines)
- **Ch1 : Statistical Laws**
  - Science was concerned with **Hypotheses** while pretending to discover **Laws**.
  - Statistical laws are characterized by 1. Simplicity 2. Excellence of Fit with facts
  - Statistical laws are founded in individual observations and representative facts. They are **laws of mass phenomena, limited to a particular time and place**, which we cannot expand beyond the limits of observations, and whose results reinforce the weight *of a priori* demonstration.
  - Statistical economics proposes these twofold objects: 1. to bring to the **test** the hypotheses and theorems of pure economics with representative facts 2. to supply data in the form of **general facts and empirical laws**, for the elaboration of dynamic economy. Empirical laws differ from inductive verification of theory.

Laws of Wages (2)

- **Chap 2 Wages as a mean of subsistance and standard of Life**
  - **Objective:** to test Turgot theory of "mean of subsistence" and Ricardo theory of "standard of life"
  - **Data** : Cross series Salaries and working hours in France (Office du Travail) for 87 departments, 1893–97. Wages for skilled (2) and unskilled (3) *Food expenditure* = relative cost of fixed means of subsistence (4) *individual housing fees per isolated worker* = standard of living
  - Regression on 2-4 (r = 0.306) and 2-5 (r= 0.667) . Turgot is rejected; Ricardo is right, with elimination of prices by partial correlation.
- **Chap. 3 Wages and productivity of labor**
  - **Theory of marginal productivity**: (1) in a particular industry, the fluctuation in the rate of general wages varies directly with the fluctuation in the value of the product (2) relative share of the value of product and amount of machine power per laborer are proportional (3) trend of laborer share of the product is determined by the ratio in which capital and labor are combined in production
  - **Data**: Simiand's (1907) dissertation: *The Wages of Coal Miners in France*. Sociological approach to antagonism laborer–employer.
  - **Method**: **Proxy**: Marginal productivity is replaced by fluctuations in daily product per laborer Adjustment with method of moments on time series of the form $y = AB^x$ and Correlation of relative deviation of trend
  - Repeated for the problem 2 (relationship wages–machine power) and 3 (relative share of the product and power machine per laborer) by comparison of two coal mines.
  - **Conclusion**: These general propositions (theory of marginal productivity) are the adequate description of the economic laws of wages.

Laws of Wages (3)

- **Chap. 4: Wages and ability**
  - **Marshall**: “We may regard competition as tending to make time earning proportionate to the efficiency of the worker”, **efficiency** is defined by “general sagacity and energy (…) physical, mental and moral”.
  - **Quetelet and Galton:** Hypothesis of normality for the distribution of ability => Galton 1902 law of differential distribution of two prices. Two errors : a function of normal variable is not normal; The same distribution is not an evidence of link
  - **G. Sorel**: “Capitalism resolves the question of equality of laborers by taking into account natural or acquired inequalities that manifest as inequalities at work”.
  - Hypothesis: **Wages are distributed among laborers proportionally to their differential ability**
  - **Data :** a) wage in France in the department of Seine (OT 1893), 13,804 workers b) wages in Massachusetts 1905
  - Method: 2 groups treated separately (skilled and unskilled), adjustment of an asymmetrical law.
- We don’t comment on Chapter 5 (wages and strikes) and 6 (wages and concentration of industry)

Law of Wages (4)

- **Chapter 7: Conclusion**: Relation of our results to actual practice (expertise)
  - "**Legislation** must be based upon **experience**", and experience must be interpreted by the statistical method. (Baconian legislation of Newmarch and Jevons). So "**Economics becomes an almost entirely experimental science**".
  - This theory of productivity is compatible with the interests of the laborers and with socialism (in a collectivist state: Barone 1908)
  - In accord with **Sorel** (introduction to modern economics), he thinks that economists have reasoned too much over the "laborer of average capacity": Emancipation tentative of the average.
  - "With a definite technical and social organization of industry, **the laborer tends to get what he produces**". Increased efficiency, increased wages. If not, there is justified strikes. But "without increased efficiency, no amount of strikes will result in a permanent increase in wages".
  - **Two propositions for a good economic policy**: "it is desirable 1) to have the national dividend of wealth at a maximum; 2) producers should receive shares that are proportionate to their contribution to the total product."

Reception of *Laws of Wages*

- **Lucien March** (JSSP 1912): **"one of the best examples of what the application of statistics to research or to the verification of economic laws can yield**". He congratulated Moore for using "documents (from public administration) that had never been assembled in such a determined spirit".
- **Harry Brown** (AER 1912): "*the book is a stimulating piece of statistical work*" **Taussig, Schumpeter, Yule, Aftalion** positively reviewed the book.
- **Alfred Marshall** to Moore (June 5, 1912): "I will be frank. Your book proceeds on lines which I deliberately decided not to follow many years ago for two reasons:
  - 1. No economic chain of events seems likely to be associated with any one cause so predominantly that a study can be made by mathematics […] The "ceteris paribus" clause seems to me impracticable.
  - 2. Nearly half of the whole operative economic causes have refused as yet to be tabulated statistically.
- In his review in EJ, **Edgeworth** was first laudatory then critical on **"**the attempting to show that the wages of individuals varied in proportion to their ability (he may with equal success prove "that tallness depends on ability". He concludes, "Not only has he employed a steam engine to crack a nut, but the nut is blind."
- In a private letter from Edgeworth to Marshall (16 January 1912): "Moore is a nightmare for me…The use of economic statistical talk in pairs of the extreme free traders and extreme protectionists in the USA set the corn growing".

1914 *Economic Cycles, their laws and causes*

- Moore's announced programme in the book is to connect weather and the crops, then the yield and its price (law of demand), and finally crop prices with general prices and industrial activity.
- **Chapter II** Moore studies cycles of rainfall with the method of spectral analysis
  - Fourier's theorem: All periodic functions can be decomposed into a sum of trigonometric functions:
  - $f(t)=A0 + A1 \cos kt + A2 \cos 2kt + A3 \cos 3kt + ...$

    $+ B1 \sin kt + B2 \cos 2kt + B3 \cos 3kt + ...$
- Coefficients A and B estimated by the mean square method;
- 1910 Economists (Moore, Persons, Crum in Rietz 1924, Beveridge) use Arthur Schuster's method (1898, 1906) to establish the periodogram of a series
- Rainfall in the Ohio Valley is adjusted by a periodic function with two periods: 8 and 33 years (Figure 6, below). Confirmed with rainfall in Illinois (Midwest)

1914 *Economic Cycles, their laws and causes (2)*

- **Chapter III Rainfall and the crops** (most important crops in Illinois: corn, oat, hay, wheat and potatoes)
  - Observations in Regression series on time → trend → secular trend eliminated by difference.
  - Critical period of growth: "ascertaining, for each crop the combination of months within planting and harvesting, whose rainfall gives the highest correlation with the ultimate yield per acre for the crop"
  - **Cycles in the yield and cycle of rainfall are compared** with the two periodograms (see Figure 12). The degree of fit of the two curves is measured by one special ratio K
  - For example with hay, periods 33 and 8, r = 0.620 between yield and rainfall of July and August. Fit of compound cycle to the data K=1.54
  - Results: this compound cycle fits the yield data nearly as well as it fits the rainfall data.
  - Moore computes a weighted synthetic index of the crop, which is correlated with the rainfall.
  - He concludes that "the cyclical movement in the weather conditions represented by rainfall is the fundamental, persistent cause of the cycles of the crops".

Rainfall and crops in the Ohio Valley

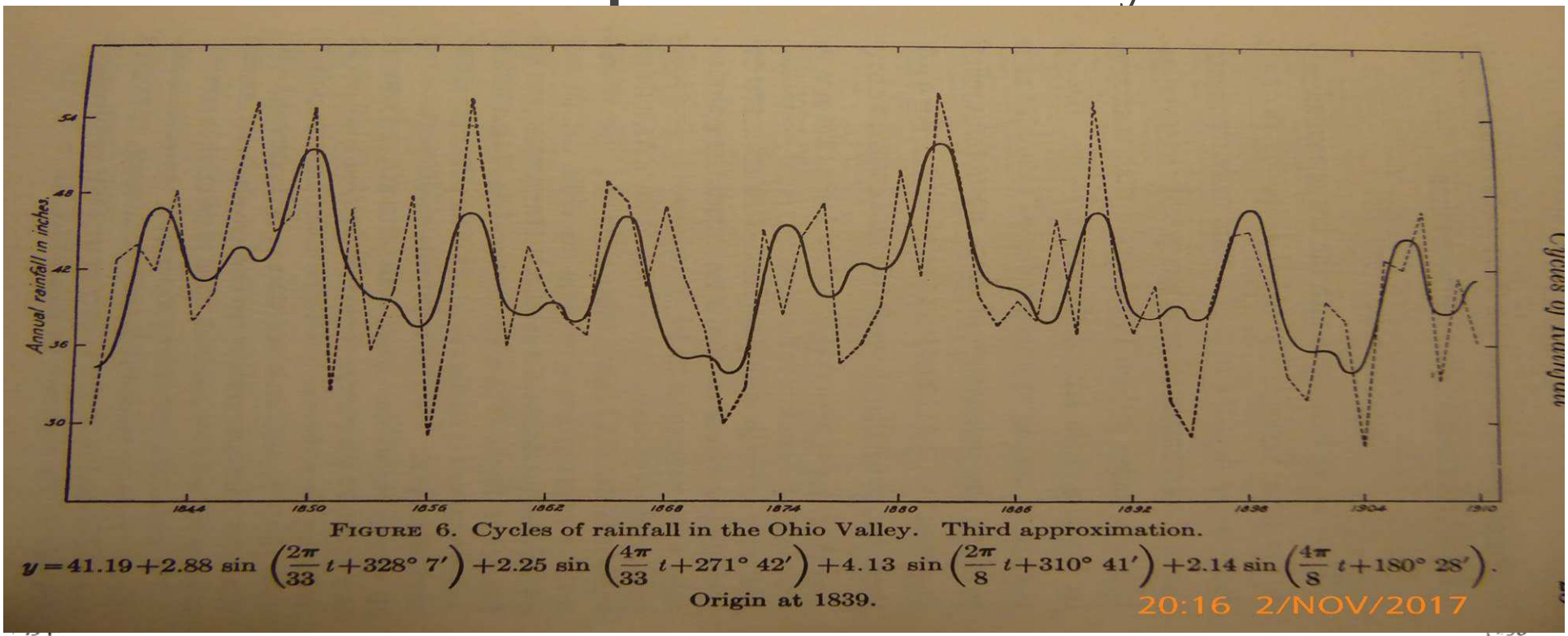


FIGURE 6. Cycles of rainfall in the Ohio Valley. Third approximation.

$$y = 41.19 + 2.88 \sin\left(\frac{2\pi}{33}t + 328^\circ\ 7'\right) + 2.25 \sin\left(\frac{4\pi}{33}t + 271^\circ\ 42'\right) + 4.13 \sin\left(\frac{2\pi}{8}t + 310^\circ\ 41'\right) + 2.14 \sin\left(\frac{4\pi}{8}t + 180^\circ\ 28'\right).$$

Origin at 1839.

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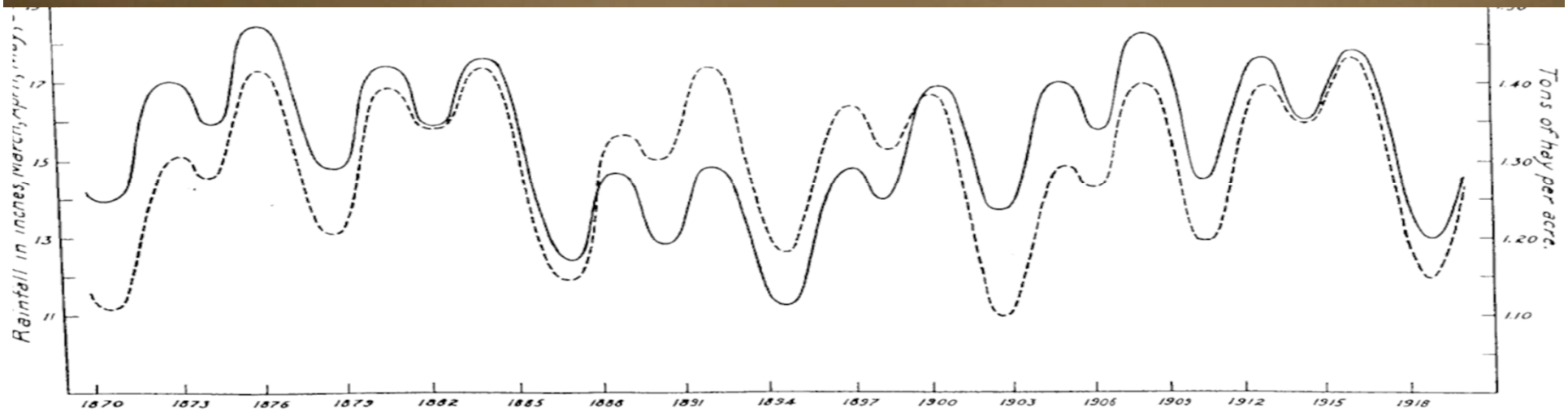

Cycles in the yield per acre of hay and in the rainfall of its critical period of growth.

1914 *Economic Cycles, their laws and causes (3)*

- **Chapter 4: The Law of Demand**
  - **Theory of demand** (Cournot, Marshall): "**There is one general law of demand**: the amount demand increases with a fall in prices and diminishes with a rise in price".
  - **Statistical method**: to derive the dynamic of demand, we must take into account directly all the factors of change with the method of multiple correlation. From a scatter diagram of quantities and prices (on vertical axis) in relative change and adjust the data with least square by a linear, then cubic, function. He calculates *r* and elasticities.
  - **Results** are that the concrete and dynamical laws of demand are decreasing for corn, hay, oats and potatoes, but increasing for pig iron (see below)

1914 Law of Demand for corn

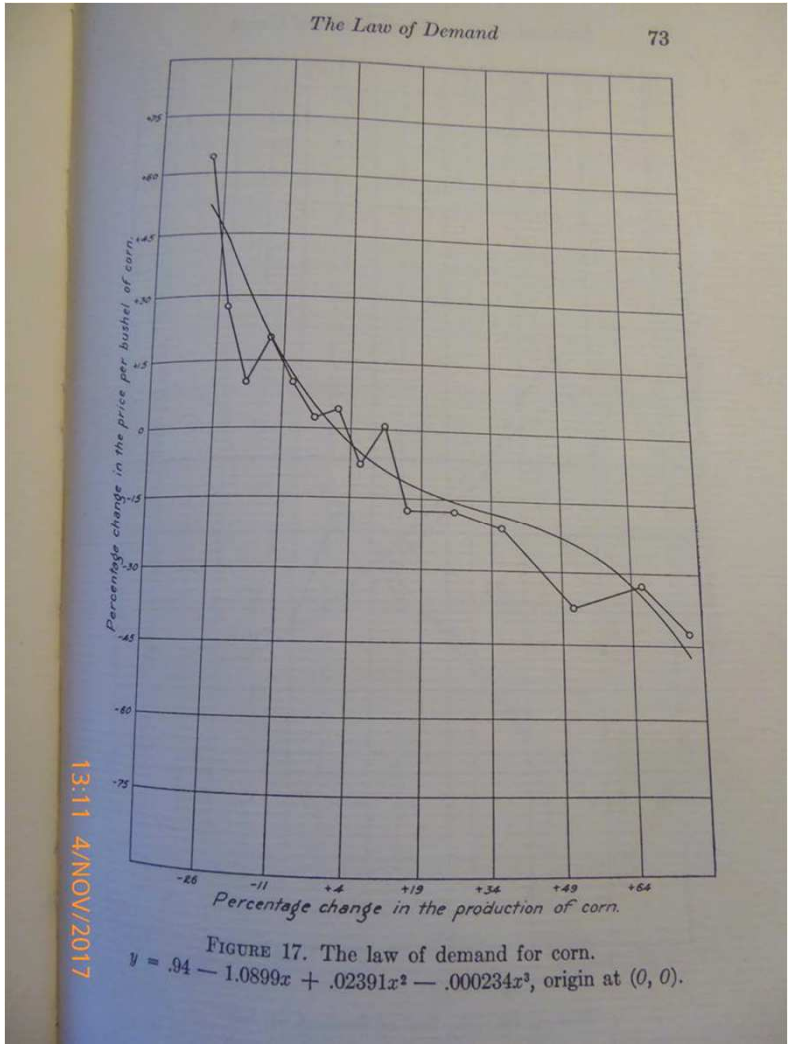

FIGURE 17. The law of demand for corn.
$y = .94 - 1.0899x + .02391x^2 - .000234x^3$, origin at $(0, 0)$.

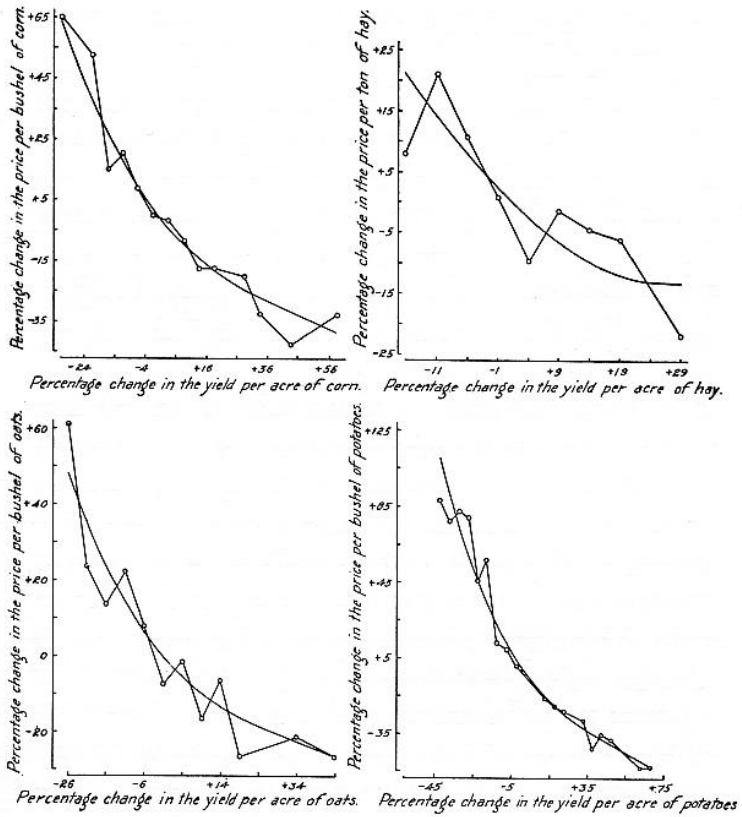

FIGURE 21. The relation between the price and the yield per acre of the several crops.

When the origin is at $(0, 0)$, the equations are

For corn, $y = .17 - 1.2989x + .01892x^2 - .000137x^3$.
For hay, $y = 1.17 - 1.0215x + .01549x^2 + .00009x^3$.
For oats, $y = -1.49 - 1.1346x + .02324x^2 - .000238x^3$.
For potatoes, $y = .49 - 1.4863x + .01993x^2 - .000141x^3$.

1914 Economic cycles (conclusion)

- **Chapter V: The mechanism of cycles**
  - **What relationship to industry**?
  - **Pig iron** is an unusually good barometer of trade. First, Moore compared (in trends then in cycles) yield per acre of crops with production of pig iron with an optimized lag of two years (r = 0.718, Figure 23). Second, he studied the demand for iron (percentage change in prices and in production) (positive slope, r = 0.537)
  - Moore said that, "**This dogma of uniformity is an idol of the static state – of the method of ceteris paribus** (all other thing being equal)", and the notion of elasticity of demand, a ratio of relative change in demand to the relative change in price, for a point in time, is also a static concept.
  - **Mechanism**: With this positive slope, "The falling yield in the crops would lead to a diminution of the volume of trade, a decline in the **demand for producers' goods**, a fall in the prices of producers' goods, a decrease in employment, a fall in the demand curves for crops, with the final result of **a fall in general prices**".
  - At the end, Moore had to verify this by studying the covariation between cycles of yield per acre and the **cycle of general prices** (indices of Falkner and of the Bureau of Labor; See Figure 27) with a 4-year lag. General prices fell with the yield per acre of crops, which is congruent with positively oriented demand.
  - **General conclusion**: The law of the cycles of rainfall is the law of the cycles of the crop and the law of economic cycles.

Pig iron: an increasing law of demand?

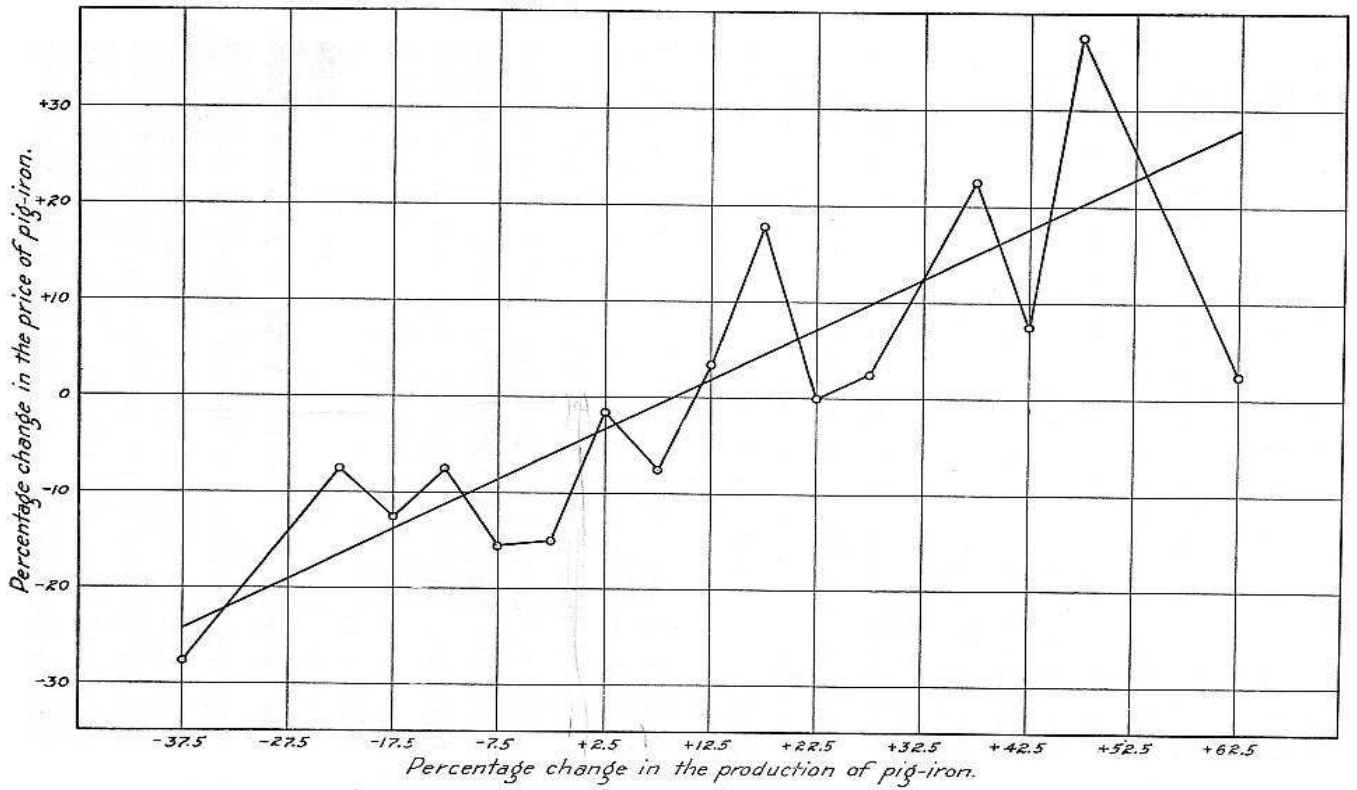

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FIGURE 24. The law of demand for pig-iron. Equation to straight line, $y = .5211x - 4.58$, origin at $(0,0)$.

In the case of an industrial good (iron), the same analysis method leads to a growing curve. His colleagues called it a supply curve. Moore maintained that it was a dynamic demand curve, different from theoriticians' static demand, valid with other things being equal (*ceteris paribus*).

Reception of Economic Cycles: identification problem

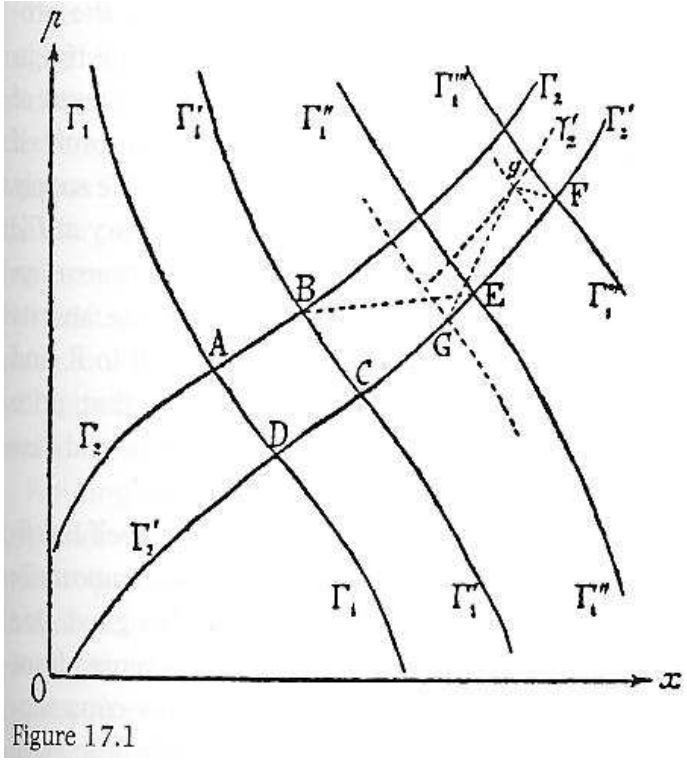


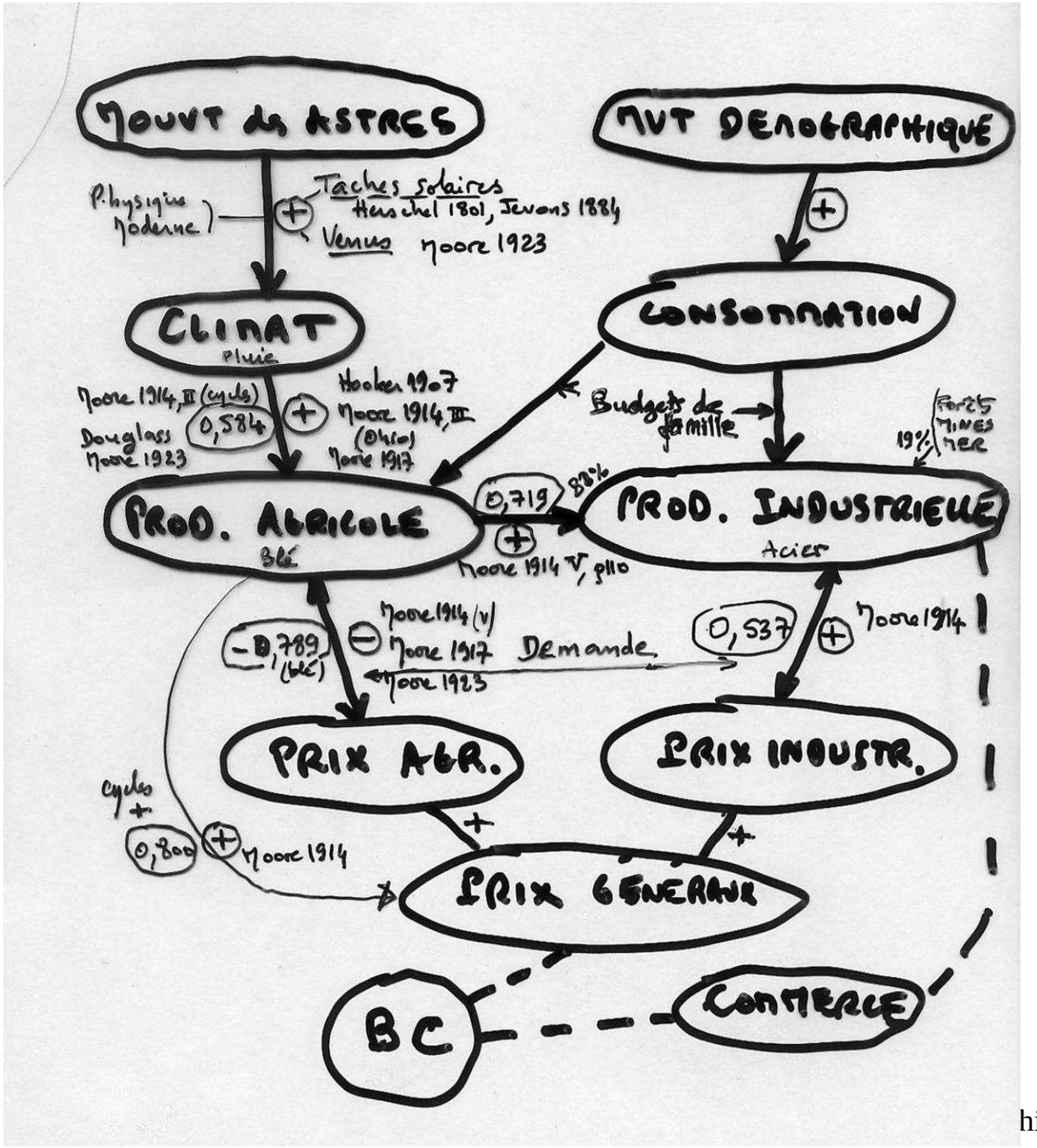
Figure 17.1

- "The reception of EC was cooler than Laws of Wages. **Persons** was the only reviewer who thoroughly appraised the book", said Stigler. **Wright** found that the 8-year cycle in rainfall was negligible. **Yule** "requested the periodogram of general business conditions instead of a long chain of indirect reasoning". But **many economists** said that the positively sloped curve of demand was in fact a supply curve, or, at best, a non-significant curve.

Marcel Lenoir, in his dissertation (1913), wrote that we cannot interpret the curve that fits the sequence of intersecting points of supply (rising) and demand (decreasing) in terms of the law of supply or the law of demand, except for the limit cases where one of the systems of curves is stable and reducible to one sole curve, for example, a demand curve if supply is fixed (corn case) or the inverse (iron case). This **identification problem** will be partially resolved by Moore 1925, Wright 1928, Tinbergen 1930, Haavelmo 1933.

1923 Generating Economic Cycles

- "The primary purpose of this Essay is to show that a known **natural cause** originates from an agricultural cycle, which in turn generates other economic cycles"
- **Chapt 4**: With the support of many weather scientists (Shiaparelli, 1890), A.E. Douglass (rings of pines), H.W. Clough (1914), F.H. Bigelow (1901), Moore establishes that **Venus is the sole planet that has an 8-year cycle of great and feeble luminosity** (period of rotation = period of revolution = 225 days), corresponding to an alignment Sun–Venus–Earth.
- **Chapt 5**: What are the physical causes of this influence? Gravitation, but also cosmic rays and the interaction with sunspot cycles (Hershel 1801, Schwabe 1838, Jevons 1865, Tomson, Perrin, Roentgen 1895, Shuster 1911, Nodon 1922).
- The periodical **interposition of Venus** on the direct line of radiation must produce disturbance in terrestrial meteorology. "The subject has been placed under **a kind of scientific taboo**. It has been regarded as the special domain of charlatans and astrologers (**Kepler**: "Sun, Moon and Planets do not exercise any influence on the general state of our atmosphere").



H.L.Moore's causal interpretation of correlations

Moore developed a causal scheme for the explanation of economic cycles and general prices, going back to Venus cycles via meteorological cycles, and demand laws. Each statistical relationship in this causal network was certified by one numerical evaluation with a correlation coefficient.

Recent reception of Moore's works

- **George Stigler** (*Econometrica* **1962**) (first Chicago School) is not sympathetic with Moore: "A **psychiatrist, I suppose would find a deep lack of self-confidence in his thirst for appreciation**: attention to citations of himself, extraordinary sensitivity to criticism. He was a proud and lonely man… devoid of a trace of humor… wholly incapable of practicing the politics of every day life".
- Stigler insidiously claimed that "Moore's statistical work was done by his wife" and judged that "**the theories he tested were vague and non-rigorous by the standards of 1910**". In spite of some methodological simplifications pointed out by Stigler (abusive proxies, feeble significations of spectral analysis and correlations), Moore's statistical work is very up to date in 1914 and 1923: "**Moore's work on cycles has left no imprint on present-day economics and he must be judged a complete failure**."
- **Mary Morgan (1990)** in her *The History of Econometric Ideas* is more favorable: "He works industriously to discover and statistically verify the causal connections of the chain of evidence in order to provide a convincing explanation of economic cycle" […] "**Economists applauded Moore's pioneering spirit while criticising his performance**" and periodic cycle analysis declined after 1925 as inadequate: spurious periodicities is to fear as spurious correlation.
- **Philip Mirowski (1990)**: Moore is not the father of econometrics, "There is much that is incongruous, queer, and artificial about this particular paternity". **Moore in vain solicited Marshall and Walras, and in fact Moore is in total rupture with the neoclassic tradition**. Only in the History according to the Cowles Commission World View, he may be intended to estimate the Marshallian demand curve. Henry Schultz is not "his sole disciple" because he doesn't adopt his critical view. Econometrics as a substitute to experimentation is misleading.

The method of unsettled correlation

- In 1921, **Yule** showed that the difference method had the annoying effect of filtering certain periods (2)
- In 1926, **Yule** denounced the "**spurious correlations**" on cross series data, and then showed that the correlation of two chronological series can be completely artefactual:
  - By no means can the successive observations be considered as a series of independent draws of the same law.
  - The serial autocorrelation of each series can artificially produce a high correlation between them.
- In 1927, **Yule** criticized the harmonic analysis, for which he had shown could originate from certain disturbances. The same year, Slutzky brought to light autocorrelations artificially caused by the average moving operator.

In 1935, the mathematician **Maurice Fréchet** led at the ISI a vigorous campaign against the abusive use of the correlation coefficient for repairing both the intensity and the linearity of a statistical link, and for whose maximization produces the optimal lag in the barometers.

Synthesis and Conclusion

- Our aim was to find **a 1920's economist who had not considered the barometers as a heuristic object of description and semiological interpretation of the *Business cycle*** (which attained its limits in 1925) and who had attempted a real breakthrough in the production and verification of a cycle theory. We found him in the person of H.L. Moore, who proposed a *Statistical Complement of Pure Economics* (near future Econometric project).
- He carried that out in using with prudence and precaution **the most advanced statistical techniques** available after 1910: harmonic analysis, correlation analysis, three-variable regression, time series decomposition, test of goodness of fit.
- Nevertheless, the reception of his work remained in part critical, because he struggled with several **unsurpassed difficulties**, even by the econometric revolution standards: rarity and unsuitability of the data, perverse effects of the decomposition methods, spurious results of correlation, identification problems… In short, some of these techniques adapted to biology or astronomy sometimes lose all their significance and their effectiveness in economics. (Concept nomads?)
- The impossibility of statistics to validate a **ceteris paribus model**, the absence of mathematical writings for statistical theory and measure (**a theoretical model**), and the absence of a probabilistic model (**model of data**), and possibilities of testing hypotheses able to explain *a posteriori* its relative failure.
- These more-or-less successful innovations were made **outside the reference of the Great War** (mentioned only one time in three books). War economics is, nonetheless, very specific (control of prices, production management when men lack certain goods, unemployment when they come home). The same is true of the postwar period (reconstruction of infrastructures, reorientation of production, fight against unemployment and inflation).

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