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JEL-codes : B23; B31; B53; C10
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Abstract

Pawel Ciompa's original and forgotten conception of econometrics is compared with Ragnar Frisch's interpretation of the term. Ciompa conceived of econometrics as being entirely descriptive, facilitating the conveyance of information in the field of accounting. In contrast, Frisch regarded it as a quantitative and empirical approach to economic theorizing. Arguments against Frisch's conception of econometrics have been brought forward among others by Ciompa's countrymen of the Austrian School. Ciompa's own conception is immune to that criticism. It is concluded that modern econometrics should be confined to the narrower descriptive character that Pawel Ciompa originally attached to the term.

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Introduction

Pawel Ciompa's conception of econometrics seems to be long forgotten, if it has ever exerted any noteworthy effect on the broader discipline of economics at all. There is no entry on Ciompa in any of the major English, French or German language encyclopedias. There is only a very short entry in the first volume of the third edition of the Polish *Wielka Encyklopedia Powszechna PWN* from 1983 (Wiśniewski 2016, p. IX). In the more recent editions of its successor, the *Wielka Encyklopedia PWN*, the entry on Pawel Ciompa has been removed.[1] It is true, his name is sometimes mentioned when it comes to the origins of the term "econometrics", but usually not more than the equivalent of a brief footnote is devoted to his work. Not even Ragnar Frisch, the originator of econometrics in the modern sense (Bjerkholt 1995), who famously defined the "new discipline" in 1926, was initially aware of Ciompa's work and his use of the same term for something rather distinct some sixteen years earlier. Frisch has admitted this in a brief note in his journal *Econometrica* (Frisch 1936).

It was professor Tomasz Lulek of the University of Cracow, who informed the editor of *Econometrica* about the fact that the term econometrics has already been used and defined by Ciompa in 1910 as the "geometrical representation of value",[2] which was considered to be closely related to the principles of accounting. Frisch's (1936, p. 95) reply to Lulek is very instructive:

> It still seems, however, that, taken in the now accepted meaning, namely, as the unification of economic theory, statistics, and mathematics, the word was first employed in the 1926 paper [(Frisch 1926b)]. Pawel Ciompa seems to emphasise too much the descriptive side of what is now called econometrics.

In the above quote, Frisch points out the fundamental difference between the two conceptions of econometrics, which is the main focus of this paper. Should we think about econometrics as being merely descriptive, as Ciompa did, or can we reasonably attach more to its meaning and scope, following Frisch and the majority of modern economists?

To answer these questions, Ciompa's vision of econometrics is presented in the next section, followed by a discussion of Frisch's conception of the term. The latter contains the roots of the modern mainstream view. Thereafter, a central point of criticism against Frisch's interpretation of econometrics from the point of view of Austrian economics is discussed and illustrated by means of a computer simulation. The need for an assumption of constancy in economics that the Austrians stress, suggests a return to a more Ciompanian view, even if one does not subscribe to Ciompa's theory in all its details. The point that is emphasized and supported here is that Ciompa thought of economic theory as being prior to, and more fundamental than, econometrics, which is based on economic theory, but does not in itself provide the means to alter it. The paper ends with some concluding remarks.

Pawel Ciompa's Conception of "Oekonometrie"

Polish economist Pawel Ciompa (1867-1913) was a professor at the Higher School of Economics in Cracow and director of accounting at the Federal State Bank of Galicia based in Lemberg. The full name of his home region was *Kingdom of Galicia and Lodomeria and the Grand Duchy of Cracow with the Duchies of Auschwitz and Zator*. It was also known as the Halychyna or Austrian Poland and was part of the dual-monarchic Austro-Hungarian Empire at that time. Hence, "ruler of Galicia and

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[1] I thank Dr. Łukasz Dominiak from Nicolaus Copernicus University in Toruń, Poland, for his assistance in this enquiry.

[2] In the German original: „die geometrische Darstellung des Wertes“ (Ciompa 1910, p. 5). We will go into much more detail in the second section of this paper.

Lodomeria” was part of the ceremonial titles of the princes of Hungary. Today the region belongs partly to Poland and partly to the Ukraine. Its former capital Lemberg is today called Lviv and part of western Ukraine, whereas Cracow lies in Southern Poland.

Ciompa published his German language book *Grundrisse einer Oekonometrie und die auf der Nationaloekonomie aufgebaute natürliche Theorie der Buchhaltung* (*Outline of econometrics and the natural theory of accounting based on economics*, from now on simply referred to as *Grundrisse*) in 1910. In the book he defended an economic, as opposed to a juridical, approach to the theory of accounting (Mattessich 2008, p. 270). In the *Grundrisse*, one finds, as far as we know, the earliest mention and definition of the term econometrics, more precisely, its German language equivalent “Oekonometrie” (also “Ökonometrie”). Ciompa describes the new term vividly:

> Just like mechanical, acoustical, dynamic, and other such phenomena in physics, and mass phenomena in geometry, also economic phenomena should be represented and displayed following a doctrine, which I envision as a sort of *economographics*. This economographics would constitute a descriptive economics; it would have to be based on economics, mathematics and geometry. The foremost task of such a doctrine would be the geometrical representation of value. This part of economographics I call *econometrics*. The practical application of econometrics to the mathematical representation of values and their changes is accounting. Conversely, econometrics is then just the theory of accounting. [emphasis added][3]

Econometrics in Ciompa’s vision, and what it adds to the more general field of economics, would therefore be strictly descriptive in nature. Its purpose is to describe and depict the changes and evolution of economic values. More specifically, he thought of it as being a collection of mathematical and graphical tools by which we could describe and depict the evolution of assets and liabilities in business accounting. He further explains the scientific status of economographics and econometrics as follows:

> Similar to trigonometry which is a subfield of geometry, econometrics would be a subfield of economographics. Accounting and econometrics would be related to each other just like mathematics and algebra. (pp. 5-6)

This latter comparison is thought-provoking. Algebra, in its broadest sense, combines elements from almost all of mathematics. It provides us with the rules of how to manipulate mathematical symbols and formulas in general, and so it enters into almost any other subfield of mathematics. It contains the basic armamentarium that any layperson interested in mathematics, and *a fortiori*, any professional mathematician, needs in order to communicate mathematical results to an audience. In

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[3] All quoted passages from the *Grundrisse* in this paper are my own translations. In the German original (Ciompa 1910, p. 5) we read:

> Wie die mechanischen, akustischen, dynamischen und dgl. Erscheinungen durch die Physik oder wie die Massenerscheinungen durch die Geometrie, so sollten auch die volkswirtschaftlichen Erscheinungen durch eine Lehre, die ich mir als eine Art Oekonomographie vorstelle, zur Darstellung gebracht werden. Diese Oekonomographie waere eine Art darstellende Nationaloekonomie, sie muesste auf der Nationaloekonomie, Mathematik und Goemetrie aufgebaut werden. Einer solchen Lehre wuerde dann vor allem die geometrische Darstellung des Wertes zufallen. Diesen Teil der Oekonomographie nenne ich Oekonometrie. Die praktische Anwendung dieser Oekonometrie auf die mathematische Darstellung der Werte und deren Veraenderungen ist dann die Buchhaltung. Umgekehrt ist dann die Oekonometrie nur die Theorie der Buchhaltung.

In the remainder of the paper, the original German quotations are only provided, when my English translations run the risk of becoming too inaccurate for a proper understanding of what Ciompa actually wrote.

this sense, algebra might be understood as containing the tools of communication for mathematical insights and knowledge. In very much the same way, it seems, Ciompa considered econometrics to be the apparatus which we should use in order to communicate and illustrate information in accounting.

In order to clarify the subject matter of business accounting, and hence of econometrics, Ciompa starts the *Grundrisse* with a brief discussion of economic value theory and the theory of goods. Although he is a bit imprecise in his exposition, we find several classical definitions and well-known classifications of economic concepts: a good is simply defined as any means, material or immaterial, that is conducive to the satisfaction of human wants. Goods are classified into economic goods that have an exchange value, free goods that have no exchange value, and services, which are defined as any outflow of human activity that has an exchange value (Ciompa 1910, pp. 1-2). Ciompa points out that only economic goods, which according to his own definitions subsume services, are relevant for business accounting.

Next, Ciompa makes the twofold distinction of value into use value and exchange value, both of which can be either of subjective or objective nature.[4] From these distinctions he obtains the terms subjective use value that is assigned to a good in accordance with the subjective importance of the wants that it satisfies, subjective exchange value, which is assigned to a good in accordance with the importance of the wants that can be satisfied by those goods that can be obtained in exchange for it, objective use value that describes the factual or natural scientific potential of a good to satisfy wants, and objective exchange value, which is simply the market value or the price of the good as the result of the subjective evaluations of buyers and sellers. Ciompa further points out, that value is not inherent in the good, but contingent on needs, inclinations, the economic situation of the individual, and also the social environment. It is therefore subject to change, and the only way to reliably gain information about the value of a good is through exchange. It is then the objective exchange value with which accounting is primarily concerned (p. 4).

What Ciompa defines as the normal value [*Normalwert*] of a good or service corresponds to its cost of production. A rent or a profit is earned whenever the realized objective exchange value on the market exceeds the normal value. A loss is incurred whenever the realized objective exchange value is below the normal value of the good.

In order to be able to uniformly quantify and express objective exchange values, profits and losses, Ciompa has emphasized the importance of money and money prices. He simply defines money as just another good, and prices as proportions of values.[5] He writes:

[4] This classification scheme is known for example from Ciompa's fellow countryman Carl Menger (2007 [1871], pp. 121ff. and 226ff.), but at least the distinction between use and exchange value has a much longer tradition in the history of economic thought, for example over Pufendorf (1744) to the scholastic doctors of the Middle Ages, all the way back to the old Greeks (Rothbard 2006 [1995], ch. 1; Schumpeter 2006 [1954], part II, ch. 2).

[5] This is an example of an imprecision in Ciompa's exposition. It is not quite clear what he means by proportions of value. Although, he made the above-mentioned distinctions into different kinds of values, he is in the remainder of his book usually only writing about "the value" as if there was only one. These inaccuracies notwithstanding, here again, we might argue that Ciompa follows his countrymen C. Menger and E. von Böhm-Bawerk, although he is not referring to them and their work directly. Böhm-Bawerk stated that "organized exchange gives almost every good a second value" (Böhm-Bawerk 1930 [1891], p. xxxiii), which is of course the exchange value, and then emphasized the indissoluble connection between price and exchange: "The law of Price, in fact, contains the law of Exchange Value." (p. 132) Furthermore, Menger (2007 [1871], p. 257) has presented an account of the emergence of money as just another good with certain properties from the original state of barter exchange.

> This proportion of values between two goods we call price. The price, therefore, is nothing other than the expression of the value of one good in terms of the value of another; usually the price is expressed in money. The value of money is not stable, but changes, as does the value of any other good, because money itself is a good. (p. 9)

The next fundamental distinction that Ciompa makes is between wealth [*Vermögen*] and capital [*Kapital*]. Wealth is understood as the set of all economic goods that one freely disposes of (p. 9). Wealth turns into capital, if it is put to some productive use. Therefore, capital is understood as productive wealth, or as the resultant of the "combination of wealth and labor" (p. 10).[6] It is then clear that we might also think about capital as being a subset of wealth. There can be no capital without wealth, but there can be wealth without capital.[7] Wealth is, in fact, "the basis for all economic life" (pp. 9-10).

Economic life in Ciompa's vision is composed of economic actions [*wirtschaftliche Handlungen*], all of which are directed towards the use of some economic goods, or some capital, in order to consume or create new wealth and capital. Money prices provide the numerical information to compare the objective exchange value of different sets of economic goods that make up old and new wealth. Ciompa is now able to pin down the proper function of accounting and econometrics as follows:

> The task of accounting is to mathematically calculate, and econometrically illustrate the yields from wealth and capital as results of economic life. Economic life consists of processes and actions, which use up old wealth v_1 in order to create new wealth v_2. As a result, the initial wealth V_1 diminishes, and it remains a wealth of $V_2 = V_1 - v_1$, which then increases to the wealth $V_3 = V_2 + v_2$. The same holds true for the capital of this wealth; in the first instance, it simultaneously diminishes $C_2 = C_1 - c_1$; in the second instance, it simultaneously increases with the wealth: $C_3 = C_2 + c_2$.[8]

In Ciompa's view, economic life can be broken down into individual economic actions like the one schematically described in the above quotation. Ciompa's econometrics in action can be illustrated by what he called the *econometric Quadrigon*, as well as the wealth and capital accounts that emerge out of it. We take the numeric example that Ciompa uses himself: $V_1 = -C_1 = 6$, $v_1 = -c_1 = 3$, $v_2 = -c_2 = 4$, measured in money units K [*Krone*].[9] Notice that Ciompa considered capital to be a negative quantity, hence the minus sign in the equations. This is intuitively plausible, because capital is the

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[6] The careful reader realizes that at least a person's own labor according to the proposed definitions must be seen as a part of wealth, as it falls under the definition of services and therefore is an economic good.

[7] It is clear that in practice, and from a broader perspective, it might be very difficult to decide what a productive use of wealth is – an argument which has been brought forward against the *idle resources argument* for macroeconomic policy interventions during crises and recessions (Hutt 1939). However, for Ciompa's purposes, it seems, the concepts are sufficiently well defined, as we could relatively easily find out which economic goods are used, and therefore constitute capital, in any specific and well-defined economic action, for example, the production of a wooden chair.

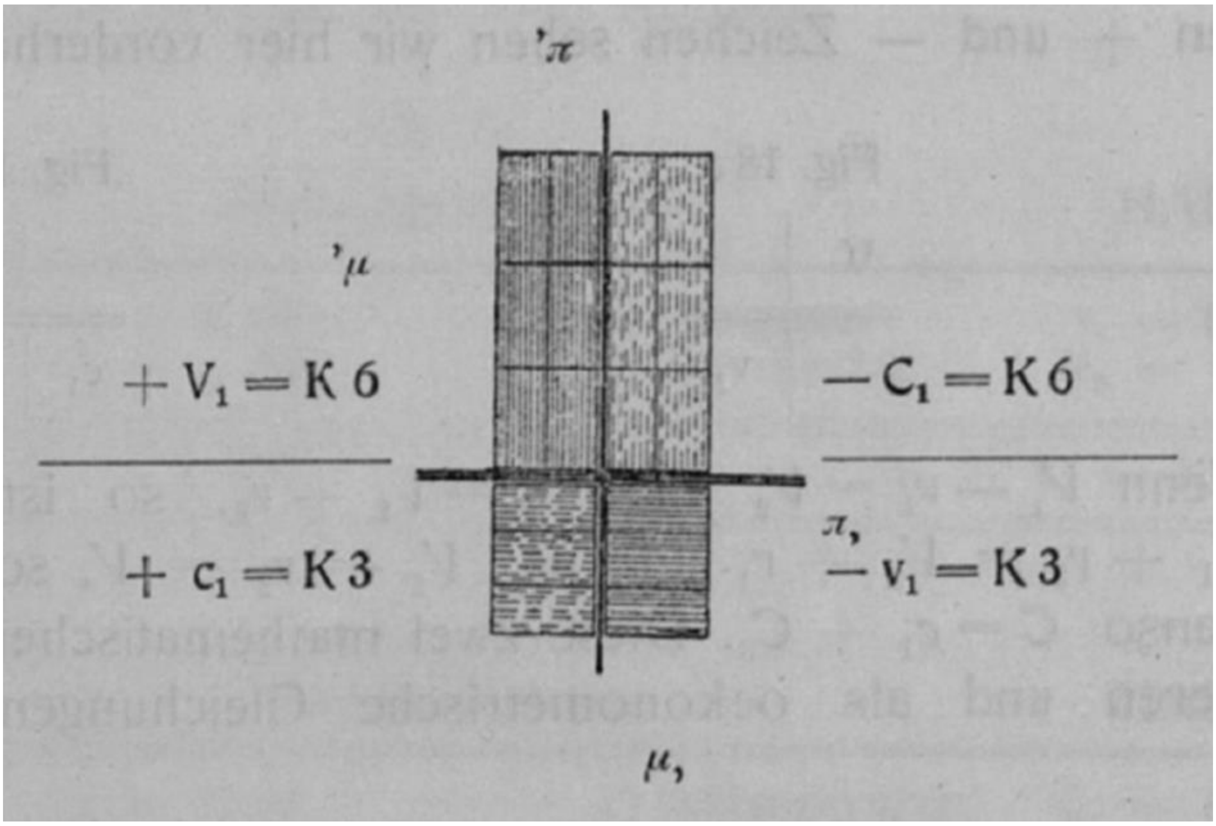
[8] In the German original, we read:

> Die Buchhaltung hat die Aufgabe, die aus dem wirtschaftlichen Leben resultierenden Erfolge des Vermögens und Kapitals mathematisch resp. ökonometrisch zu berechnen resp. darzustellen. Das wirtschaftliche Leben besteht aus Prozessen und Handlungen, welche altes Vermögen v_1 verbrauchen, um neues Vermögen v_2 zu schaffen. Dadurch nimmt das ursprüngliche Vermögen V_1 ab, es bleibt ein Vermögen $V_2 = V_1 - v_1$, welches wiederum zum Vermögen $V_3 = V_2 + v_2$ anwächst. Dasselbe geschieht mit dem Kapital dieses Vermögens; im ersten Falle nimmt es gleichzeitig ab und es verbleibt $C_2 = C_1 - c_1$, im zweiten Falle nimmt es mit dem Vermögen gleichzeitig zu: $C_3 = C_2 + c_2$. (Ciompa 1910, p. 14)

[9] The Krone became the official currency in the Austro-Hungarian Empire in 1892 when the gold standard was adopted. It replaced the Gulden, which was defined in terms of silver.

part of wealth that is put to productive use, and is thus used up in the production process. We assume an initial wealth endowment of $V_1 = K6$, which corresponds to a potential capital of $-C_1 = K6$, from which $v_1 = -c_1 = K3$ is used up in a hypothetical economic action. Figure 1 illustrates the situation so far.

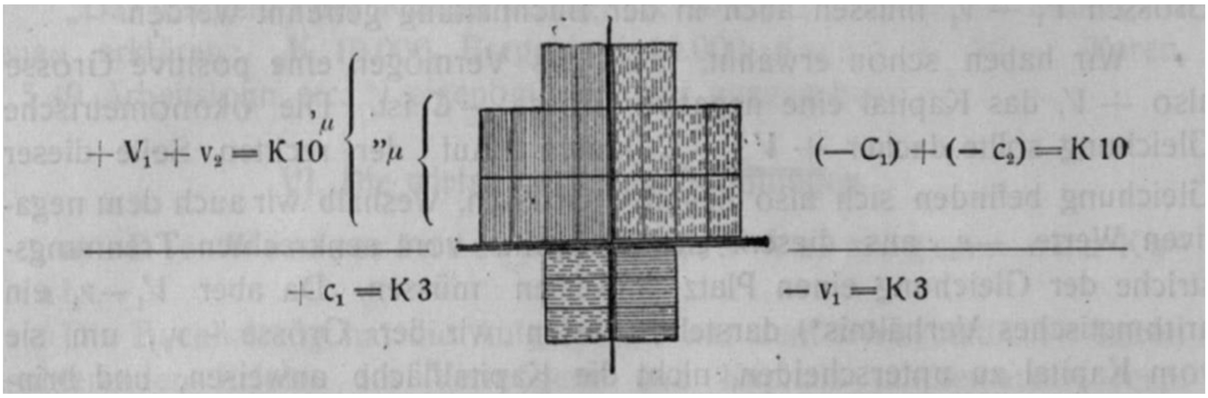
Figure 1: Ciompa's econometric Quadrigon copied from Ciompa (1910, Fig. 16b, p. 15)



Much like balance sheets in modern accounting, the econometric Quadrigon is always symmetric. Its upper left side captures the initial wealth of $V_1 = K6$, and the upper right side corresponds to the potential capital $-C_1 = K6$. Both are illustrated as six equally shaped rectangles. To emphasize again the conceptual difference between wealth and capital, different hatchings have been chosen by the author of the *Grundrisse*. In the first step of the hypothetical economic action, a part of the initial wealth, $v_1 = K3$, is used up as capital, $c_1 = -K3$, which is shown in the bottom right quadrant and the bottom left quadrant, respectively. We have thus made 270° of the full circle from upper left, over the upper right, the bottom right, to the bottom left of the Quadrigon. Each step involves a conceptual switch between wealth and capital. To complete the circle, the second part of the hypothetical economic action must be considered. We assume that the action yields new wealth of $v_2 = K4$, which corresponds to new potential capital of $-c_2 = K4$. Figure 2 shows the complete econometric Quadrigon for this case.

The upper left side in Figure 2 also contains the added wealth, or what we might call the revenue of the economic action, $v_2 = K4$. By symmetry, the new wealth corresponds to potential capital of $-c_2 = K4$, as shown on the upper right side of the Quadrigon, which is now available for further economic action.

Figure 2: Ciompa's complete econometric Quadrigon copied from Ciompa (1910, Fig. 17, p. 16)



The complete economic action, including its cost, v_1, its revenue, v_2, as well as the corresponding gain, $v_2 - v_1$, can also be documented in rather mundane wealth and capital accounts, and it certainly is subject to debate, whether this might not, after all, be the more sensible way of presenting "the yields from wealth and capital".[10] As mentioned above, wealth is considered a positive value and capital is negative. Hence, in the wealth account, we find initial wealth and revenue on the debit side [*Soll*], and the costs and net total on the credit side of the account [*Haben*]. For the capital account, we have the inverse arrangement.

Debit	**wealth account**		Credit
1.) initial wealth	$V_1 = K6$	2.) cost	$v_1 = K3$
3.) revenue	$v_2 = K4$	4.) net total	$V_2 = K7$
$V_1 + v_2 =$ K10		$v_1 + V_2 =$ K10	

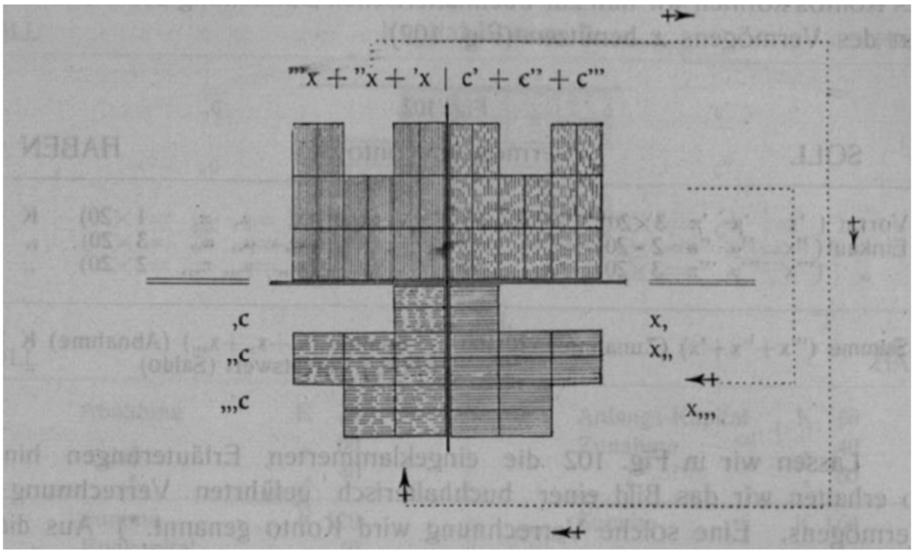
Debit	**capital account**		Credit
2.) cost	$-c_1 = K3$	1.) initial capital	$-C_1 = K6$
4.) net total	$-C_2 = K7$	3.) revenue	$-c_2 = K4$
$-c_1 - C_2 =$ K10		$-C_1 - c_2 =$ K10	

In the remainder of Part I [*Oekonometrische primäre Gleichungen und oekonometrische Verhältnisse*] and in Part II [*Oekonometrische sekundäre und tertiäre Gleichungen*] of the *Grundrisse*, Ciompa elaborates on this basic example of an economic action. He adds a couple of complications, such as variations in the per unit price of goods, or in the quantity of goods (like losses from inadequate storage) and explains how these cases enter into his econometric accounting scheme. Ciompa also presents an econometric Quadrigon that captures more than one economic action of selling and buying certain quantities of a good. The graphical representation thereby becomes increasingly complicated as illustrated in Figure 3.

[10] The two tables correspond to Fig. 21 and Fig. 22 in Ciompa (1910, p. 17).

Figure 3: Econometric Quadrigon capturing multiple economic actions copied from Ciompa (1910, Fig. 100, p. 95)

This Quadrigon captures three instances of revenue generation: $'''x = K6$; $''x = K4$; $'x = K6$, *as well as three instances of cost expenditures:* $x_{,} = K2$; $x_{,,} = K6$; $x_{,,,} = K4$. *The profit in this case corresponds to* $K4$.



Part III [*Bewertung des Kapitalvermögens in der Bilanz*] covers the balancing of accounts and some criticism of accounting rules and practices in Austro-Hungary and Germany at that time.[11] Ciompa emphasizes again, that accounting and econometrics must be based on economic theory, and in particular, on the economic theory of value (p. 134).

As pointed out in the introduction of the paper, the purpose here is neither to describe nor to defend Ciompa's work in detail. There are many shortcomings and inaccuracies in his exposition. However, without evaluating his framework in its specificities, the important point that merits emphasis is that his conceptions of econometrics and economographics are entirely descriptive. They are attempts to build upon economic theory, without transforming it. As such they stand in sharp contrast to the modern conception of econometrics, which is discussed in the next section.

Ragnar Frisch and the Modern Conception of Econometrics

The celebrated originator of the modern conception of econometrics is Norwegian economist Ragnar Frisch (1895-1973), who was the first recipient of the Nobel Memorial Prize in economics together with Dutchman Jan Tinbergen in 1969. Needless to say, we know much more about the life and work of Ragnar Frisch than we know of Pawel Ciompa.[12]

Frisch was born in Oslo, as the only child in a family, whose ancestors were mining specialists from Freiberg, Saxony. They had been recruited to work in silver mines near Kongsberg during the regency of King Christian IV of Denmark-Norway (1588-1648). His grandfather founded a jewelry firm in 1856,

[11] Ciompa notes that "the truth and clarity of our balances is sinking further into a muddy subsoil. Today, it takes considerable effort to rescue the theory of accounting from the clutter that surrounds it" (p. 136). He argues that differences in accounting rules for different types of businesses (privileges for corporations) and different types of equity, such as operational capital [*Betriebsgegenstände*] and goods for sale [*Veräusserungsgegenstände*] are unjustifiable on economic grounds. Everything should be based on universal principles.

[12] For biographical information on Frisch, see for example Bjerkholt and Dupont (2010, section 1), Bjerkholt (1995) and Frisch (1970c).

which was taken over by his father. Frisch himself was expected to continue the family tradition in gold and silver manufacturing and started an apprenticeship in a larger goldsmith firm in Oslo. Supported by his mother, who felt that the profession would not be satisfactory for her son in the long run, Frisch took up a study program in economics at the University of Oslo at the same time. He chose economics because it was "the shortest and easiest study" (Frisch 1970c). It took him only two years.

After having finished his undergraduate studies in economics in 1919 and his apprenticeship in 1920, he left Norway to visit France, Germany, Italy, Great Britain, and the United States in order "to study economics and mathematics in earnest" (Frisch 1970c). The academic community in France must have had the greatest impact on his intellectual development. He wrote: "During my stay of nearly three years in France, I got so familiar with the conditions there that ever since, when I get to visit France, I somehow feel that I have 'come home again'" (Frisch 1970c). He earned his PhD in mathematical statistics from the University of Oslo in 1926 (Frisch 1926a), the same year in which he published his first academic paper in the field of economics – a paper that "would deserve a place in the history of economics, even for no other reason than the opening sentences" (Bjerkholt 1995, p. xiii). In the first lines of this French language essay, published in a Norwegian periodical under the title "*Sur un problème d'économie pure*",[13] Frisch famously defined the allegedly new discipline of "*économétrie*":

> Intermediate between mathematics, statistics, and political economy, we find a new discipline, which, for lack of a better name, may be called *econometrics*.
>
> It is the aim of econometrics to subject abstract laws of theoretical political economy or 'pure' economics to experimental and numerical verification, and thus to turn pure economics, as far as possible, into a science in the strict sense of the word. [emphasis in the original][14]

Thus, in stark contrast to Ciompa, Frisch did not only attempt to add a new layer to the existing body of economic theory, but sought much more than that. He called for a genuine transformation of economics into a "science in the strict sense." The guiding ideal for his scientific vision of econometrics is to be found in the natural sciences, and in particular in physics and astronomy.[15] In

[13] An English translation of the article has been published in Chipman (1971, pp. 386-423) under the title "On a Problem in Pure Economics". Having no access to the volume, direct quotations provided in the article are my own. The French original is provided only for passages that are of particular importance. All quotations come from the republication of the original French article in *Metroeconomica* in 1957.
[14] In the French original we read:

> Intermédiaire entre les mathématiques, la statistique et l'économie politique, nous trouvons une discipline nouvelle que l'on peut, faute de mieux, désigner sous le nom de *l'économétrie*. L'économétrie se pose le but de soumettre les lois abstraites de l'économie politique théorique ou l'économie 'pure' à une vérification expérimentale et numériques, et ainsi de constituer, autant que cela est possible, l'économie pure en une science dans le sens restreint de ce mot. (Frisch 1957 [1926b], p. 79)

[15] After Irving Fisher had arranged a visiting professorship from his personal funds, Frisch came to Yale University in the early 1930s. In one of his lectures, he praised astronomy as being one of the most scientific fields, as "astronomical observations are filled into the theoretical structure […] Economic theory has not as yet reached the stage where its fundamental notions are derived from the technique of observations" (Frisch 1930, ch. 1.1, as cited in Bjerkholt and Dupont 2010, p. 57). It would be false, however, to reduce Frisch's ideal conception of econometrics to empiricism and little else, although, this is exactly what this particular statement suggests. In his lectures there are several other references to Newtonian physics and Einstein's theory of general relativity.

order to push this transformation further, Frisch has built upon, and was inspired by, the ideas of several renowned economists, among which are Léon Walras (1834-1910), William Sranley Jevons (1835-1882), Alfred Marshall (1842-1924), Vilfredo Pareto (1848-1923), Knut Wicksell (1851-1926), Irving Fisher (1867-1947), and Joseph Schumpeter (1883-1950).[16] All of these economists were, to a greater or lesser extent, and if only occasionally, driven by the attempt to formalize and quantify elements of economic theory, such as the concept of utility.[17] Frisch himself considered the quantification of utility a primary objective of econometrics:

> The econometric study that we present is an attempt to realize Jevon's dream [the author refers to the paragraph *Numerical Determination of the Laws of Utility* in the fourth edition of Jevons (1965 [1911], p. 146)]: measure the variations of the marginal utility of economic goods. We consider in particular the variation of the marginal utility of money. (Frisch 1957 [1926], p. 79)

In his Nobel Memorial lecture, delivered after 44 years of an outstanding academic career as Norway's leading economist, professor and director of the Institute of Economics at the University of Oslo, cofounder of the *Econometric Society* and editor of its journal *Econometrica*, he refers again to Jevon's dream of being "able to quantify at least some of the laws and regularities of economics", and claims that, "since the break-through of econometrics – this is not a dream anymore but a reality" (Frisch 1970a, p. 12). What then did the break-through look like? How did the dream become true?

Frisch believed that the quantification of economic concepts and theory was a necessary condition for the application of most natural scientific methods to economics. These methods require observability and measurability, ideally on cardinal scales. Methods of experimental and numerical verification (or falsification) could not simply be applied to classical economic theory, as the underlying core concepts possess no independent existence in the observable external world, and its conclusions only take the form of qualitative or even counterfactual laws.[18]

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[16] According to Bjerkholt (1995), Frisch's two great mentors were Marshall and Wicksell (he refers to Frisch 1950,1952). Apparently, their books were the only really worn-out ones in his personal library. Frisch credits Marshall for having combined the Walras-Jevons-Menger subjective notion of value with the cost of production viewpoint (Frisch 1970a, p. 16). He specifically refers to Menger as the head of the Austrian economists, but misspells his first name as Karl instead of Carl. Karl Menger (1902-1985), son of Carl Menger, was a mathematician and probably more to Frisch's liking. Obviously, Frisch was more drawn towards the formal mathematical presentation in Walras (1874) and Jevons (1965 [1871]), rather than the entirely verbal presentation in Menger (2007 [1871]). For an interesting de-homogenization of these three thinkers, see Jaffé (1976). Frisch studied a French translation of Fisher's dissertation thesis *Mathematical Investigations in the Theory of Value and Prices* during his time in Paris (Bjerkholt and Dupont 2010, p.28, fn. 10). Fisher himself refers to Jevons' *Theory of Political Economy* as one of two books that had the biggest influence on him (Fisher 1892, p. 3). Although, Walras and his successor at the University of Lausanne, Pareto, both made important contributions to the mathematical formalization of economic theory in general, and value theory in particular, it is important to note that Pareto rejected a cardinal interpretation of value and utility, but thought of them as being ordinal, and, in fact, based his famous welfare economics on ordinal utility (Aspers 2001). In this respect, Frisch departed from Pareto.

[17] Schumpeter may be seen as an exception. Although he did engage in empirical work, for example, in his *Business Cycles* (Schumpeter 1939), he was not actively involved in the mathematization of economic theory. He did, however, enthusiastically support the efforts of his mathematically inclined colleagues. Schumpeter, together with Frisch and Fisher, was a founding member of the *Econometric Society* in 1930 and its president from 1940 to 1941.

[18] On a recent and systematic reinterpretation of economic laws as essentially being of counterfactual nature, see Hülsmann (2003).

The first task, therefore, is to redefine economic concepts in terms of variables and indicators that are at least in principle observable and measurable, which allows the derivation of quantitative economic relationships. Frisch, in the spirit of neoclassical economics, based this redefinition on a mathematical axiomatization of human behavior. This approach has become so widespread that all undergraduate students of economics today learn certain versions of it in their microeconomic classes under the headings of *rational behavior*, *utility maximization* and *homo oeconomicus*. This axiomatization comprises, for example, the well-known assumptions of *determination*, *additivity* and *transitivity* of preferences.[19] Utility or value is not described as an abstract psychic phenomenon, but rather as a well-defined mathematical function of a vector of quantities of consumer goods. Utility is given a quantitative-empirical grounding in the material world.

Hence, utility is just understood as a mapping from multidimensional bundles of consumer goods, which are observable as they have some form of physical existence, to some cardinal scale of measurement. The critical aspect, of course, is the determination of that mapping. In Frisch's view, the fact that the mapping is merely assumed into existence should not cause too much concern. He was convinced that it was determinable, in principle, through choice questions [*expériences par interrogation*] posed to the respective individuals (Bjerkholt and Dupont 2010, pp. 39-45; Frisch 1957 [1926b], p. 81, 2013 [1933], Lecture 1).[20] He undoubtedly recognized that there were conceptual problems with the idea of inferring cardinal utility measurements from (hypothetical) interview data, and that, in fact, only ordinal rankings could, in principle, be determined. However, the auxiliary assumption of cardinality was often justified "with an appeal to 'everyday experience'" (Bjerkholt and Dupont 2010, p. 39).

These assumptions, which are extended in similar ways to the production sphere of the economic system, allow for a deductive mathematical derivation of a model framework that contains abstract quantitative relationships between economic variables. The second step, then, consists in the proper application of statistical-empirical methods in order to bring these abstract quantitative relationships into a concrete form, through the estimation of coefficients based on observed data. This is what Frisch refers to as the combination of the *theoretical-quantitative* (mathematical model framework) and the *empirical-quantitative* (statistical estimation methods) in his editorial comment to the first issue of *Econometrica* (Frisch 1933, p. 1). Elsewhere, he describes the general approach as follows:

> The attempt at quantification in econometrics comprises two aspects of equal importance. First, we have the axiomatic aspect, i.e. an abstract approach which consists in establishing as far as possible logical and quantitative definitions and to construct from the definitions a quantitative theory of economic relations. Then we have the statistical aspect, here we use empirical data.
>
> We try to fill the boxes of abstract quantitative relationships with real numerical data. We try hard to show how the theoretical laws manifest themselves at present in this or that industry or for this or that consumption category, etc. The true unification of these quantitative elements is the foundation for econometrics. (Frisch 2013 [1933], Lecture 1)

[19] For a complete list of the axioms outlined in Frisch's Poincaré lectures (Frisch 2013 [1933], Lecture 1), see Bjerkholt and Dupont (2010, p. 42, Table 2).

[20] Similarly, he would later explain in his Nobel Memorial lecture that expert economists could derive a preference function for policy optimization from interrogating the politicians in charge, which is a conclusion that he reached "not only on theoretical grounds but also because of […] practical experience" (Frisch 1970a, p. 23).

Thus, in his response to Professor Lulek, Frisch (1936, p. 95) defines econometrics as the "unification of economic theory, statistics, and mathematics". At the heart of this unification are the underlying axioms and assumptions that comprise the mathematical model framework. These assumptions can be altered to the discretion of the econometrician, the only ultimate restriction being the laws of formal logic. It is of course indispensable, to ask on which grounds one set of underlying assumptions can be declared superior to another set of assumptions. According to Frisch (2013 [1933], Lecture 1) it is "by the subsequent agreement of the consequences of the axioms with reality that we can judge the plausibility of them." This view anticipates the instrumentalist methodology of Friedman (2008 [1953]), which has become the most influential methodological view in 20th century economic thought (Hausman 2008, p. 33).

It is clear, that econometrics in this modern sense is of a completely different caliber than Ciompa's econometrics. Whereas the latter, strictly speaking, does not attempt to contribute any new theoretical knowledge to the existing body of economics, but merely tries to illustrate and convey information based on it, the former concept of econometrics tries to change the method of economic reasoning, and therefore the whole nature of the discipline. Ciompa's econometrics is merely a matter of style and pedagogy and must be judged accordingly. Yet, the transformation of economics, which Frisch's econometrics has strived for, and has to a large extent successfully brought about, opens itself to all kinds of fundamental criticisms, and must in fact be defended and justified on methodological and epistemological grounds. In the next section a closer look at Frisch's justification as well as a critique of his econometrics from the perspective of Austrian economics are given.

Frisch's Epistemological Views and the Case for a Purely Descriptive Econometrics

In justifying the theoretical and empirical quantification of economics, Frisch makes an important claim: "As long as economic theory still works on a purely qualitative basis without attempting to measure the numerical importance of the various factors, practically any 'conclusion' can be drawn and defended" (Frisch 1970a, p. 17). This statement suggests that the instrumentalist-econometric approach to economic analysis as advocated by Frisch and his numerous intellectual followers sets effective and objective restrictions on the alleged arbitrariness of economic analysis in the traditional and qualitative sense. However, a closer look at Frisch's epistemological views reveals that the foundations for his econometric analysis are not really as rock-solid as he would let us believe.

The essence of his views on the theory of knowledge, which he dubbed a *Philosophy of Chaos*, can be found in the last of his Poincaré lectures from 1933 (Frisch 2013 [1933], Lecture 8) and his Nobel Memorial lecture from 1970 (Frisch 1970a, section 2). On both occasions, Frisch elaborated on a very simple example.

Imagine two variables x_1 and x_2. Whenever a set of arbitrary and chaotic observations in the (x_1, x_2)-coordinate system is given, it is possible to apply a linear transformation to the set of observations from the (x_1, x_2)-coordinate system into a (y_1, y_2)-coordinate system, so that the absolute value of the correlation coefficient between the observations of y_1 and y_2 is as close to 1 as we wish. The transformed variables y_1 and y_2 are defined as:[21]

$$y_1 = a_{11}x_1 + a_{21}x_2 \text{ and } y_2 = a_{12}x_1 + a_{22}x_2.$$

The coefficients a_{11}, a_{12}, a_{21}, a_{22} are constants. They are the elements of the linear transformation matrix:

[21] Frisch includes intercepts in the equations, but this is not relevant at all.

$$T = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}.$$

Let (x_{1j}, x_{2j}) denote the j-th pair of observation of variables x_1 and x_2. Given n pairs of observation, the transformation can be written in matrix algebra as:

$$\begin{pmatrix} x_{11} & x_{21} \\ \vdots & \vdots \\ x_{1n} & x_{2n} \end{pmatrix} \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} = \begin{pmatrix} y_{11} & y_{21} \\ \vdots & \vdots \\ y_{1n} & y_{2n} \end{pmatrix}.$$

Now, as the transformation matrix is chosen to be arbitrarily close to a case of singularity, that is, a case in which the rank of the matrix is equal to 1, the absolute value of the correlation coefficient between the transformed variables can be pushed arbitrarily close to 1, regardless of the initial random set. This is a trivial mathematical insight. Let us consider some concrete numerical examples.

We randomly generate 100 pairs of independent observations from the standard normal distribution for x_1 and the uniform distribution between zero and one for x_2. As one would expect, the correlation between x_1 and x_2 is very close to 0 (in our simulation r=0.02) as shown in the upper left panel of Figure 4. The randomly generated $2 * 100$-matrix is then transformed in three different ways, using the following transformation matrices:

$$T_1 = \begin{pmatrix} a_{11} = 1 & a_{12} = 2 \\ a_{21} = 0 & a_{22} = 4 \end{pmatrix};\ T_2 = \begin{pmatrix} a_{11} = 1 & a_{12} = 2 \\ a_{21} = 1 & a_{22} = 4 \end{pmatrix};\ T_3 = \begin{pmatrix} a_{11} = 1 & a_{12} = 2 \\ a_{21} = 2 & a_{22} = 4 \end{pmatrix}.$$

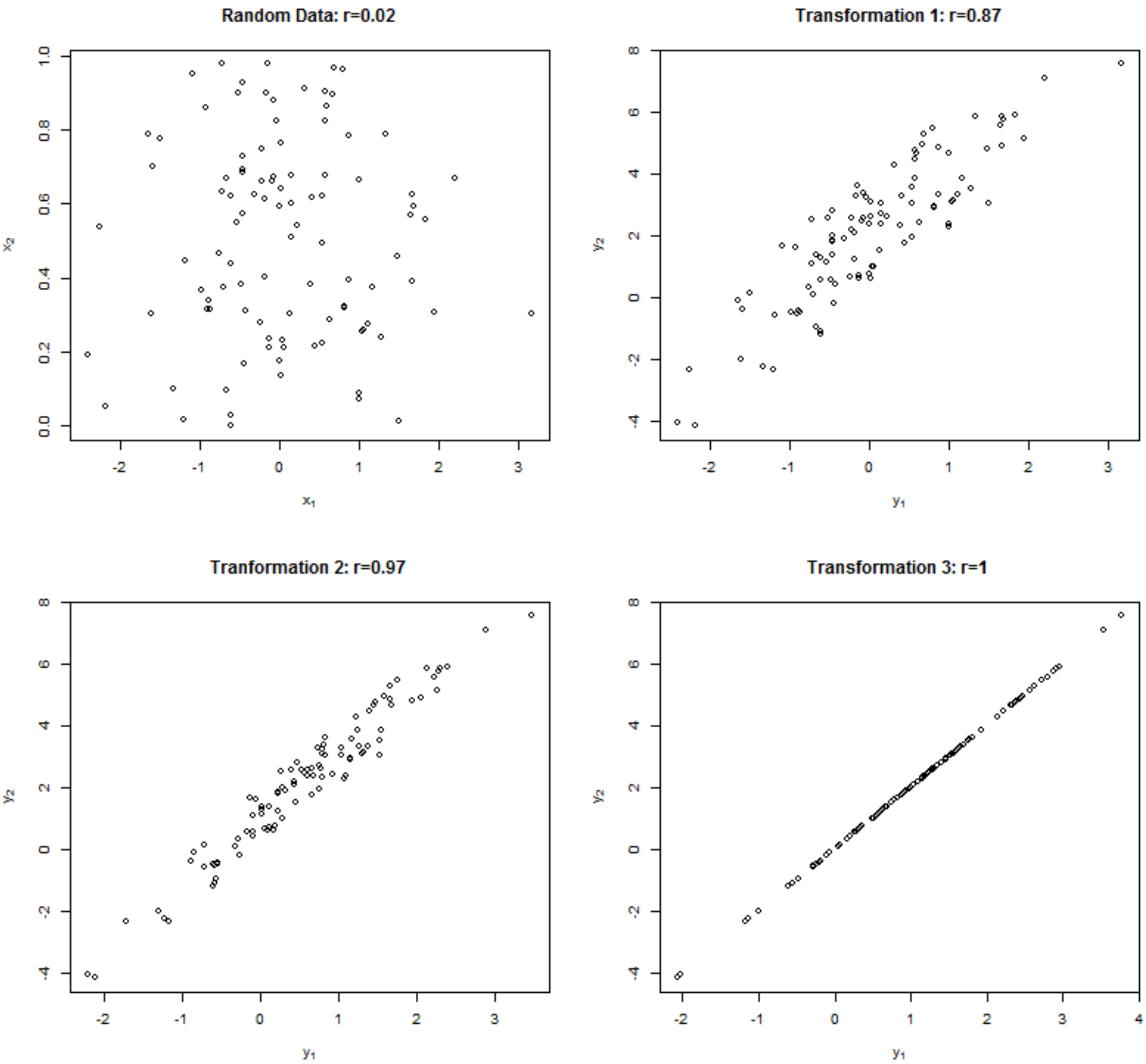
The only difference between the matrices lies in the value of coefficient a_{21}, which increases from 0 to 1 and finally to 2. The last transformation matrix is singular, since it has a rank of 1. This is the case, because the second column vector of T_3 is equal to the first column vector multiplied by 2. In other words, the two columns of the matrix (or the two rows for that matter) stand in a direct linear relationship. Using this transformation matrix leads to a situation, in which the transformed observation of y_2 is always exactly double the observation of y_1.[22] Hence, a perfect linear correlation (r=1) is generated as shown in the bottom right panel of Figure 4.

The transformations generated by T_1 and T_2 are intermediate cases. However, already the first transformation leads, from a case of no correlation (original random sample) to one in which the correlation coefficient has increased to r=0.87, which in many social scientific contexts would be considered a very strong empirical relationship. The second transformation matrix as it approaches the special case of singularity leads to an even higher correlation of 0.97.

Figure 4: Numerical examples of linear transformations of a random set of observations

Upper left: initial random sample of size $n = 100$, independently generated from the standard normal distribution for x_1 and the uniform distribution between zero and one for x_2; upper right: first transformation matrix T_1 applied to sample; bottom left: T_2 applied to sample; bottom right: T_3 (singular) applied to sample; r = Pearson's correlation coefficient.

[22] Assume the first initial random observations were $(x_{11} = 1.5, x_{21} = -0.6)$ and $(x_{12} = 0.2, x_{22} = 0.4)$. Applying T_3 leads to the following transformed observations: $(y_{11} = 1x_{11} + 2x_{21} = 1.5 - 1.2, y_{21} = 2x_{11} + 4x_{21} = 3 - 2.4)$ and hence $(y_{11} = 0.3, y_{21} = 0.6)$, and $(y_{12} = 1x_{12} + 2x_{22} = 0.2 + 0.8, y_{22} = 2x_{12} + 4x_{22} = 0.4 + 1.6)$ and hence $(y_{12} = 1, y_{22} = 2)$. In general, $y_{2i} = 2x_{1i} + 4x_{2i} = 2(x_{1i} + 2x_{2i}) = 2y_{1i}$ holds, and hence, no matter what the initial random data, the transformation leads to a straight line in the (y_1, y_2)-plane with slope 2. It should also be obvious that, simply by choosing a different singular transformation matrix, we enjoy full freedom of changing the slope. If we had $T_3 = \begin{pmatrix} 1 & -3 \\ 2 & -6 \end{pmatrix}$ instead, the slope would be -3.



Now, what are the conclusions that Ragnar Frisch draws from this trivial mathematical insight? At first, he declares:

> It is clear that if the Jacobian [the transformation matrix] […] is singular, something important happens. In this case the distribution of y_1 and y_2 in a (y_1, y_2) diagram is at most one-dimensional, and this happens regardless of what the individual observations x_1 and x_2 are - even if the distribution in the (x_1, x_2) diagram is a completely chaotic distribution. […]
>
> […] the essence of the situation is that even if the observations x_1 and x_2 are spread all over the (x_1, x_2) diagram in any way whatsoever, for instance in a purely chaotic way, the corresponding values of y_1 and y_2 will lie on a straight line in the (y_1, y_2) diagram when the transformation matrix is of rank 1. If the slope of this straight line is finite and different from zero, it is very tempting to interpret y_1 as the "cause" of y_2 or vice versa. This "cause", however, is not a manifestation of something intrinsic in the distribution of x_1 and x_2, but is only a human figment, a human device, due to the special form of the transformation used. (Frisch 1970a, p. 13)

Frisch does not provide a numerical example to illustrate his point, which helps in keeping up an appearance of scientific sophistication. With an example like the above, the problem in his analogy becomes apparent. In fact, it is inadequate to talk about something like a "cause" at all in this context. While deductions from definitions can be interpreted as explanations in some cases, Frisch is not deducing an explanation, but is construing a definitional statement as a causal explanation. Sticking to our numerical example, the transformed variable y_2 will always be exactly equal to y_1 multiplied times two, by definition. The transformation is equivalent to merging the two initial random variables into one, and then defining the other as twice the merged variable. It really boils down to saying that y_1 is the cause of $2y_1$, which is, whatever y_1 may stand for, not an explanation of variable y_2 $(= 2y_1)$, but a mere definitional tautology.

More importantly, the singular transformations y_1 and y_2 have lost their relation to the initial random data. There is no way to get back from the transformed data to the original random sample, since one dimension, that is half of the complexity, has simply been erased from the picture. The singularity of T_3 implies that there exists no inverse matrix, T_3^{-1}, such that $T_3 T_3^{-1} = I$, where I denotes the $2 * 2$ identity matrix.[23] Hence, there is no matrix, which could be multiplied by the transformed data set in order to obtain the original random sample. So, if (x_1, x_2) is the underlying "ultimate reality", as Frisch likes to think about it in his metaphor, then, the singular transformation (y_1, y_2), which has generated perfect order out of chaos, seems to be rather useless as it has completely lost its connection to this reality. A conclusion drawn from the transformed data would have no real meaning.

But what if the transformation is not singular? Frisch (1970a, p. 14) explains:

> Suppose that the distribution of (x_1, x_2) is unknown and arbitrary with the only proviso that it shall not degenerate into a straight line […]. We can then indicate a nonsingular linear transformation of the variables x_1 and x_2 which produce *as strong a correlation in* (y_1, y_2) *as we please*.

This is true because we can choose a transformation matrix, which is infinitesimally close to a singular matrix, but not quite there yet. It has been illustrated in Figure 4. In such a situation the transformed data preserves all the complexity of the initial random sample and it can always be retransformed by inversion. However, the apparent structure that has been created is again only of a tautological nature. By definition, the transformed data is created out of the same elementary data x_1 and x_2. We can generalize our numerical example as follows:

$$y_1 = x_1 + (2 - \varepsilon)x_2 \text{ and } y_2 = 2(x_1 + 2x_2).$$

Obviously, as ε tends towards 0, that is, as the transformation matrix approaches singularity, y_2 approaches $2y_1$ and their correlation coefficient tends towards 1.

Even if one accepts Frisch's metaphor so far and assumes that the transformation in fact provides us with a meaningful relationship that can, in some way or another, improve our understanding of a fundamentally chaotic "ultimate reality", there remains another fundamental problem. What happens when chaos changes its mind? If the ultimate reality really is chaotic, any nonsingular transformation that has previously led to a sufficiently strong empirical relationship might explode if chaos has its way.

[23]The transformation matrices T_1 and T_2 have inverse matrices, so that it is always possible to go back to the initial data from the transformed data. For example:

$$T_1 T_1^{-1} = \begin{pmatrix} 1 & 2 \\ 0 & 4 \end{pmatrix} \begin{pmatrix} 1 & -1/2 \\ 0 & 1/4 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = I.$$

Let us illustrate the point as well as we can.[24] Assume that the transformation T_1 had been found by painstaking scientific enquiry by the most brilliant minds in Frisch's metaphorical world. Given the data shown in the upper left panel of Figure 4, the scientists have unleashed an underlying empirical relationship (r=87) by using T_1, that seems to be robust after repeated testing.[25] The point of the following example is to show, that this scientific success was possible only in so far as the underlying "ultimate reality" was ordered in some sense in the first place, and hence was not fundamentally chaotic.

Notice again, the generation of the random data in Figure 4 was based on the standard normal distribution, which has a mean of zero and a standard deviation of one, for variable x_1, and the uniform distribution between the lower bound of zero and the upper bound of one for variable x_2. In other words, the parameters, which determine the exact shape of the probability distributions, have been fixed beforehand. Now what if "real chaos" sets in and the parameters of the distributions, that is, the mean and the standard deviation of the normal distribution as well as the lower and upper bounds of the uniform distribution, become random variables themselves?

Figure 5 shows an illustrative example. The second random set also contains n=100 observations for both variables from the same families of probability distributions. After every 10th pair of observation, the configuration of the distribution parameters has randomly changed.[26] As a result, the correlation coefficient after transformation of the random set has reduced from 0.87 to a mere 0.15. The previously robust empirical relationship between y_1 and y_2 has vanished.[27]

The conclusion from this simulation exercise is that statistical induction from empirical observations requires some structure, i.e. some constants that do not change. In a "chaotic" world, where there are no such constants, we can obtain structure only by using a *singular transformation*, that is, by ignoring the true nature of the world, or the subject matter, whatever the field of scientific enquiry may be. Had the scientists in the Frischian world inductively concluded that they found a true law, a constant, structural and quantitative relationship between y_1 and y_2, and had possible social, economic, or political conclusions been drawn on the basis of that relationship, who knows where it would lead to when the *structural change* sets in? This change has been illustrated in the above

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[24] One must keep in mind that the illustration is not really chaotic. For all we know, human beings are not capable of purposefully creating chaos. It might look like chaos on the surface, but there is always an underlying deterministic structure. For the sample in the above example (Figure 4), I have used the statistical programming language R, which generates pseudo-random numbers using the Mersenne-Twister based on the Mersenne prime number $2^{19937} - 1$. This pseudo-random number generator has been developed by Matsumoto and Nishimura (1998). The same process is used for the following example (Figure 5).

[25] In fact, simulating the exact scenario from Figure 4 repetitively (1,000 times), has shown that in 96% of the cases the correlation coefficient after transformation by T_1 is larger than 0.82. It has never been lower than 0.76.

[26] For the simulation of variable x_1, the mean of the normal distribution has been randomly selected (with replacement) from the integers between -25 and +25. The standard deviation has been randomly selected (with replacement) from the integers between 1 and 10. Both parameters have been randomly changed after every 10^{th} observation. For variable x_2, the lower bound of the uniform distribution has been randomly selected (with replacement) from the integers between -25 and 25, the upper bound has then been randomly fixed between 1 to 10 integers above the lower bound (again random selection with replacement). After every 10^{th} observation the bounds have been randomly changed. After the simulation of a sample of size $n = 100$, all observations have been divided by 10, in order to bring them roughly onto the same scale as the observations in the previous simulation.

[27] Now, it is clear that in principle, the resulting correlation coefficient could also be higher than 0.87. The point is, that one can never know, when there is a "chaotic" underlying structure. Repeated simulations (1,000 times) show that more than half of the time (53.7%) the correlation coefficient is below 0.5, and in only 0.4% of the simulations, it is above 0.87.

example by switching to a different simulation mechanism in which the parameters of the probability distributions have become random variables themselves.

Figure 5: Comparison of the same transformation for different random sets

Left panel: corresponds to the upper right panel of Figure 4; right panel: the same transformation matrix, T_1, *has been applied to a different random data set, generated by the underlying probabilistic mechanism described in footnote 27.*

In his example, Frisch regards the transformations as representing the progress of the sciences in finding regularities:

> Science considers it a triumph whenever it has been able by some partial transformation here or there, to discover new and stronger regularities. If such partial transformations are piled one upon the other, science will help the biological evolution towards the survival of that kind of man that in the course of the millenniums is more successful in producing regularities. If "the ultimate reality" is chaotic, the sum total of the evolution over time - biological and scientific - would tend in the direction of producing a mammoth singular transformation which would in the end place man in a world of regularities. (Frisch 1970a, p. 15)

In his vision, Frisch sees man as being capable of creating reality himself, independent of the constraints that some underlying "ultimate reality" may have. But this seems to be a matter of semantics. One might counter with a simple stipulation, which even has a slight instrumentalist touch: all creations of man, that serve their purpose, and *a fortiori*, all creational powers of man, must be rooted in reality. It has been pointed out above that, within the boundaries of Frisch's example, any singular transformation loses its relation to the initial data set. It loses its relation to reality, so to speak. A "mammoth singular transformation", under these circumstances, seems to be a rather scary idea.

The above simulation examples are just an illustration of the critique that Austrian economists have leveled against the modern conception of econometrics that originated with Frisch (Hoppe 1983, 2006[1993], ch. 10, 2007 [1995], 2010 [1988], ch. 6; Mises 1933, 1962, 2007 [1957]). The essence of their critique is that inductive statistical methods, including falsificationist approaches, require some constancy in the way that perceived causal factors exert their effects, in very much the same way as the robustness of the empirical finding in the first simulation example, depended on the constancy of the parameters of the underlying probability distributions. For inductive statistical analysis, that is, some kind of empirical verification or falsification of meaningful quantitative hypotheses, to be possible in the first place, the constancy principle must be satisfied. This principle holds that the *same observable causes* always lead to the *same observable effect* and that *different effects* must be the result of *different causes* (Hoppe 1983, p. 11). Whether we think of "cause" merely as a "human device" as Frisch suggested, or something more fundamental, is irrelevant.

Now, to the extent that the constancy principle is not actually satisfied, but is simply assumed to be true, the scientist runs the risk of drawing conclusions that are not only wrong but also misleading, which is of particular importance in politically relevant fields such as economics, not so much in a field like astronomy. Formulating economic theory based on quantitative models in order to derive quantitative economic relationships, testing those relationships and thereby assuming constancy in one way or another may be regarded as a kind of approximation from the true complexity of the underlying problem. But it is of utmost importance to think about the consequences of such approximations. In order to do that, one has to reflect on the nature of the underlying problem that is approximated.

In fact, Frisch conceived of econometrics as being essentially an approximation. In a letter to F. C. Mills from 21 February 1928, he explains in a somewhat peculiar manner:

> We engage in this kind of approximation work without knowing exactly what we are trying to approximate. We engage seriously in target shooting without having any target to shoot at. The target has to be furnished by axiomatic economics. The axiomatic process of target making must necessarily be rather abstract, a fact which accounts, perhaps, for its lack of popularity in these days when it is considered quite a virtue to disregard abstract thinking in economics. It is abstract, but neither in the sense of a logic game nor in the sense of metaphysical verbiage, of which we have had some in economics, at times. Axiomatic economics will construct its quantitative notions in the same way as theoretical physics has constructed its quantitative notions. (cited in Bjerkholt and Dupont 2010, pp. 31-32)

Frisch is giving the impression that the mathematical axiomatization of economic theory[28] is a free-floating concept, detached from reality, a veritable singular transformation. Yet, it clearly serves the purpose of describing human behavior and action. By extension, this is exactly what Frischian econometrics tries to approximate. It tries to accomplish this approximation by mathematically relating some quantifiable external factors, which it conceives of as the *causes*, to some other quantifiable external factors, which are seen as the *effects* of human action. For what lies between the causes and the effects, namely the human actor, it assumes constancy, where it does not seem to be satisfied.

This is not to argue about the puzzling question of *free will* (Rothbard 2011, ch. 1). It might be true that human action from some remote point of view is in fact completely determined, taken all

[28] It is not to be confused with the axiomatization in the tradition of the Austrian school, which came to full fruition in Rothbard (2009 [1962], p. lvi), who claims:

> The present work deduces the entire corpus of economics from a few simple and apodictically true axioms: the Fundamental Axiom of action – that men employ means to achieve ends, and two subsidiary postulates: that there is a variety of human and natural resources, and that leisure is a consumers' good.

In fact, this might exactly be the kind of "metaphysical verbiage" that Frisch refers to. Action itself is an unobservable concept, and hence, useless from the point of view of Frischian econometrics. Certain consequences or aspects of actions are observable, such as the movement of the human body or the rearrangement of objects in the external world, but not action itself.

possible causal factors into account (Mises 2007 [1957], p. 1). However, it is not the case, that a certain configuration of those "causal factors" that are up to this day commonly considered in econometrics always leads to the same actions, or at least to the same observable changes in the external world – not even on average or in some other probabilistic sense. Modern econometrics is only capable of working on a rather superficial level of accuracy, given the amount and diversity of potential causal factors that could shape human action and that are completely out of reach for the econometrician and for any other scientist. On this level of accuracy and detail, substantial structural change is a well-known empirical fact.[29]

Not the verification or falsification of economic theory, that is, the generalization of empirical facts, but rather the finding of empirical facts is the proper role of econometrics. As long as modern econometricians engage in unwarranted generalizations following inductive methods of reasoning, the "cycles of empiricism and rationalism" in economics that Frisch (1930) refers to are likely to continue. Sooner or later those unwarranted generalizations may yield unsatisfactory conditions if put into practice in economic policy, which induces a renunciation from empiricism. In the same way, deranged theoretical propositions may induce a return to empiricism. Frisch himself has seen the danger of econometrics becoming more of a "playometrics" (Frisch 1970a).

The "new fusion of theory and observation" that Frisch called for could be found in purely descriptive econometrics that discovers the empirical facts and problems, which then have to be explained by economic theory. A particularly important field for econometrics would then be economic history (Mises 2007 [1957]). Many of the statistical techniques that modern econometricians have developed are completely compatible with such a more Ciompanian conception of econometrics. In particular, his broader conception of *economographics* as "descriptive economics" could be developed further into this direction.

Concluding Remarks

In the first part of this paper, Pawel Ciompa's (1910) ignored concept of a purely descriptive econometrics that is closely related to the theory of accounting has been presented. For Ciompa econometrics was a mere application of economic theory, not a way to develop it further. In sharp contrast, Ragnar Frisch's conception of econometrics, which has been discussed subsequently, calls for a reformulation of economic theory in mathematical and quantifiable terms. It calls for a genuine transformation of economic theory. One essential role of statistical analysis (the *empirical-quantitative*) within this framework is the verification or falsification of theoretical propositions (the *theoretical-quantitative*). Picking up an example from Frisch's epistemological reflections, simple computer simulations have been used to illustrate the central point of criticism that economists of the Austrian school have leveled against the modern econometric approach that originated with Frisch. Austrian economists have pointed out that the necessary condition for reliable inductive statistical analysis is the *constancy principle*. There is ample reason to question the validity of this

[29] One of the most prominent and important cases in modern macroeconomics that provide a well-known example for what has been considered a structural change, is the relationship between price inflation and unemployment. The stagflation of the 1970s has led to a rejection of the large-scale Keynesian macroeconometric models *à la* Evans and Klein (1967), Klein and Goldberger (1955) or Klein (1964) that were essentially elaborated IS-LM models augmented with a politically exploitable Phillips Curve (Webb 1999). Interestingly, Hurtado (2014) gathered empirical evidence that the modern New Classical and New Keynesian DSGE models (Galí and Gertler 2007; Galí 2008; Woodford 2003) that emerged out of the New Classical Critique (Lucas 1983 [1976]) would not have performed much better, if they had been used back in the 1970s instead of the old models. True enough, those models suffer from the same fundamental problems.

principle for the problems that econometrics typically deals with, at least on the rather superficial level of detail and accuracy that it is capable of achieving in practice.

Although the two conceptions share a common element, namely the descriptive side of statistical analysis, it is the inductive side of modern econometrics that puts them far apart. Even from Frisch's own perspective, it is clear that modern econometrics is an approximation as most other scientific enquiries. The crucial question is how far should one approximate? How much are we willing to abstract from what is considered to be real? The answer to this question may lie outside of the confines of the discipline of economics itself.

It was Joseph A. Schumpeter (2006 [1954], part I, ch. 4) in his *History of Economic Analysis*, who stressed the role and inevitability of ideology in economic analysis. According to him ideology enters economic analysis at the very start, in the "preanalytic cognitive act that supplies the raw material for the analytic efforts", which he would also refer to as the "vision" (p. 39). By the term ideology he did not necessarily refer to some quick political persuasion, but something more subtle, potentially underlying the efforts of even the most disinterested scientist. Schumpeter explains:

> Analytic work begins with material provided by our vision of things, and this vision is ideological almost by definition. It embodies the picture of things as we see them, and wherever there is any possible motive for wishing to see them in a given rather than another light, the way in which we see things can hardly be distinguished from the way in which we wish to see them. (p. 40)

It thus seems as if the question that we have dealt with at the heart of this paper is precisely one of ideology or vision. How do we look at the world, and more importantly, how do we look at human beings, their actions and interactions?

Ragnar Frisch was convinced that econometrics is in fact a set of tools for solving social and economic problems (Frisch 1944) as it provides the guidelines for economic planning. By extension, Pawel Ciompa's original vision of econometrics and economographics, as a descriptive economics, suggests that it should rather be seen as a set of tools for identifying and describing the empirical manifestations of social and economic problems, nothing more and nothing less. Solutions to these problems, if they are solvable at all, must ultimately come from reason and logic. Ideological biases may hamper disinterested reasoning, but the latter as a goal is not unattainable, and it is the only way to make conflicting positions whole.

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