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A NOTE ON THE ORIGINS OF INPUT–OUTPUT ANALYSIS AND THE CONTRIBUTION OF THE EARLY SOVIET ECONOMISTS: CHAYANOV, BOGDANOV AND KRITSMAN

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Input–Output analysis plays so important a role in modern economics that its history deserves thorough study. The development of modern input–output methods is connected primarily with the work of W. Leontief, *The structure of the American Economy 1919–1929*, (1941) and *Studies in the structure of the American Economy*, (1953), which was recognised when he was awarded the Nobel prize in Economics in 1973. There is, nevertheless, great interest in the origins of the input–output approach.

It is well known that an important early contribution to input–output analysis was made in 1904 by the Russian economist V. K. Dmitriev, who proposed a system of equations for the determination of full labour costs.[1] His ideas were practically forgotten until 1959, when V. S. Nemchinov, then struggling for the recognition of input–output analysis in the USSR, rescued him from oblivion. Dmitriev's work was analysed by A. Nove and A. Zauberman and was translated into French and later into English.[2] *The New Palgrave: A Dictionary of Economics*, which appeared in 1987, includes an excellent critical review of Dmitriev's work by D. M. Nuti, in which he makes the following assertion with regard to a link between the ideas of Dmitriev and the work of the early Soviet economist Chayanov: 'the importance of Dmitriev's approach for socialist planning was already understood in the 1920s: A. V. Chayanov (1926) developed Dmitriev's scheme into an input–output table for agriculture'.[3] An article on Chayanov in the Palgrave dictionary does not mention this point.

A. V. Chayanov was certainly a gifted economist. His main achievements were in the sphere of agricultural economics and his ideas on co-operatives influenced Lenin. In 1930 Chayanov was arrested under the false pretext that he was the leader (with another famous economist, Kondratiev) of a so-called 'Labour Peasant Party', which, in fact, never existed. He was shot in 1939 and only rehabilitated in 1987. Chayanov made important contributions to mathematical economics. He formulated, and partially solved, the problem of the optimal size of agricultural enterprises, and he developed a mathematical model of the peasant household. But 'an input–output table for agriculture'? If so, the history of input–output analysis must register Chayanov's contribution. As Chayanov's works were well known in the USSR in the 1920s, it is possible to suppose that Leontief, who was then studying economics at Leningrad University, was familiar with them. Moreover, Chayanov knew Dmitriev personally.[4]

Nuti does not make clear the exact source in Chayanov's work on which he

bases his assertion. However, he used the same phrase about Chayanov's input–output table in his introduction to the English translation of Dmitriev's work.[5] In that instance Nuti made reference to M. Kaser's book *Soviet Economics*, where in regard to Chayanov the author writes: 'in his practical proposals for the immediate future, however, Chayanov was no fantasist, as may be testified by his work in developing Dmitriev's scheme of the economy into an input–output table for agriculture'.[6] Again, there is no reference to any specific Chayanov work as the source.

In a personal communication, however, Kaser has explained that his assertion was based on a passage of B. Kerblay in his introduction to the English translation of Chayanov's works. There Kerblay writes: 'he [Chayanov] postulates the existence of a central plan and administrative pyramid, with quantities for each type of agricultural production, and establishing the balance sheet of each unit by weighting the results by each production branch with these preestablished norms'.[7] In this connection Kerblay cites Chayanov's work *Ponyatie vygodnosti sotsialisticheskogo khozyaistva*, which was finished in October 1920 and published in 1921.[8]

The problem is then traced to its root. What is important to emphasise, however, is that nowhere in his work does Chayanov present an input–output table. First of all, Chayanov's balances are modified accounting balances and have nothing in common with input–output balances. This situation recalls the discussion of the early 1960s between H. Levine and N. Jasny. Jasny tried to prove that the input–output analysis was invented by V. G. Groman. But Levine correctly pointed out that the trouble with Jasny's argument was in his understanding of the definition of the input-output balance.[9] Groman's balance simply was not an input–output balance.

The same is true for Chayanov's norms. He did not explicitly formulate the idea of input–output coefficients. His norms were quite different, and were proposed as success indicators. Under his approach, 'the only possible way to judge the relative benefits of branch activities of the industrial productive unit is to compare their actual results with a marginal social norm of productivity, established by the centre. . . For example, if for production of 100 pails of milk we spend 40 working days, while the norm is 44, then the success in milk production will be measured with the index 1.1, assuming 1.0 as the norm. . . In this case the norm of the Centre plays the same role as the rate of the prices in the capitalist market'.[10] He shows that for the whole agricultural enterprise a total index, comprising indexes for each product, can be calculated. Thus, Chayanov's norms are not connected with those fundamental to input–output analysis.

This leads us to the conclusion that Nuti's attribution of a role to Chayanov in the development of input–output analysis is unfounded. Moreover, the author of this note has searched the Soviet economic literature of the 1920s carefully and has found no evidence of Dmitriev's influence on planning concepts.

In 1921, however, an important and apparently independent contribution to the input–output concept really was made by A. A. Bogdanov. Bogdanov is mostly known for his *Tektologiya*, in which the foundations of general systems theory were laid.[11] As far as we are aware, the only Western author who has studied Bogdanov's approach to planning is T. B. Remington.[12]

In January 1921 Bogdanov made a report to a conference on Scientific Organisation of Labour and Production Processes, in which he proposed a system of planning.[13] The core of his approach was the idea of chain links between the branches of the economy. The existence of such links, including feedbacks, determines certain proportions in the economy. The possible expansion of production of some product will, for example, depend on the most scarce input factor. This rule Bogdanov named 'the law of the minimum'.

The starting point of Bogdanov's planning procedure was the calculation of final requirements of the population. To meet them, consumer goods must be produced and this means the use of producer goods. Their production, in turn, demands other producer goods. Thus, the elaboration of the plan is an iterative procedure. Bogdanov does not use the term 'technological' or 'input–output' coefficients, but he says that for the output of a product, calculated inputs of certain other products are needed. This was an important contribution to the elaboration of the ideas underlying input–output analysis.

This approach was also expanded by L. M. Kritsman, who published several articles on the methodology of planning in the newspaper *Ekonomicheskaya zhizn'*. Later they were issued as a book.[14] Kritsman developed further Bogdanov's iterative process, adjusting it to the economy with three groups of products: those produced in the state sector, those purchased in the private sector and those purchased from abroad. Kritsman formulated the task of planning as follows: 'to determine the sizes of the economic branches such that they will be able to develop without disturbances, producing the maximum possible under existing resources'.[15] Kritsman already used the terminology input coefficients' (*koeffitsienty raskhodovaniya*) and underlined that their reliability determines the relevance of planning. Later, in 1922, he proposed to use in planning some sort of chess-board table.[16]

Remington has analysed the impact of Kritsman's as well as Bogdanov's ideas on Soviet planning. Although he did not explicitly connect their approach to the development of input–output analysis, he understood that the iterative procedure proposed by Bogdanov and Kritsman 'is the "missing link" between the hazy visions of a national economic table of Quesnay or Marx and the innovative efforts by Groman, Bazarov and other Gosplan leaders in the 1920s to devise a "balance" method of planning'.[17]

Remington believes that 'it was Kritsman who first put forward the principles of iterative balancing and material budgets as a method for the construction of a general economic plan'.[18] Kritsman first published an article on this point in *Ekonomicheskaya zhizn'* on 20 February 1921, and Remington refers to Bogdanov's later presentation of these ideas to the trade union club, in April 1921.[19] But in fact Bogdanov's presentation was a shortened version of his paper to the All-Russia Conference on Scientific Organisation of Labour and Production Processes in January 1921, mentioned above.[13] Although Kritsman's name was not on the list of participants of this conference, a comparison of the texts in terms of general approach and terminology used strongly suggests the conclusion that Kritsman was acquainted with Bogdanov's ideas. Thus the priority would appear to belong to Bogdanov.

Bogdanov's ideas also influenced N. I. Bukharin, who was the first to make a mathematical formalisation of Marx's schemes of expanded reproduction. These schemes in Bukharin's notation were the starting point for the creators of the famous TsSU balance (P. I. Popov, L. N. Litoshenko, et. al).[20] This balance contained for the first time the 'chess-board' tables. The later history of input–output analysis is well known.[21]

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[1] V. K. Dmitriev, *Ekonomicheskie ocherki*, (Moscow, 1904). English translation: V. K. Dmitriev, *Economic Essays on Value, Competition and Utility*. Ed. with an introduction by D. M. Nuti, (Cambridge, Cambridge University Press, 1974).

[2] A. Nove, A. Zauberman, 'A Resurrected Russian Economist of 1900', *Soviet Studies*, XIII no. 1 (July 1961), pp. 96–101.

[3] D. M. Nuti, 'Dmitriev, Vladimir Karpovich', *The New Palgrave: A Dictionary of Economics*. Ed. by J. Eatwell, M. Milgate, P. Newman, (Macmillan Press Limited, London, 1987). Vol. 1, p. 908.

[4] A. V. Čajanov, *Oeuvres Choisies*. Textes réunis et publiés par B. Kerblay, (S. R. Publishers Limited, Johnson Reprint Corporation, Mouton and Co., 1967). Vol. IV, p. 157, footnote.

[5] Dmitriev, *Economic Essays*. . . , p. 11.

[6] M. Kaser, *Soviet Economics*, (Weidenfeld and Nicolson, London, 1970), p. 65.

[7] *Chayanov A. V. on the Theory of Peasant Economy*. Ed. by D. Thorner, B. Kerblay, R. E. F. Smith, (Richard D. Irwin, Homewood, Illinois, 1966), pp. XLII–XLIII.

[8] Reprinted in Čajanov, *Oeuvres Choisies*. . . , vol. III, pp. 159–230.

[9] H. S. Levine, 'The Russian Economic "Balance" and Input–Output Analysis: a Reply', *Soviet Studies*, XV no. 3 (January 1964), p. 353.

[10] Čajanov, *Oeuvres Choisies*. . . , vol. III, p. 190.

[11] G. Gorelik, 'Bogdanov's Tektologia, General Systems Theory, and Cybernetics', *Cybernetics and Systems: An International Journal*, 18, (1987), pp. 157–75.

[12] T. F. Remington, 'Varga and the Foundations of Soviet Planning', *Soviet Studies*, XXXIV no. 4 (October 1982), pp. 585–600.

[13] A. A. Bogdanov, 'Organizatsionnaya nauka i khozyaistvennaya planomernost'', *Trudy Pervoi Vserossiiskoi Initsiativnoi Konferentsii po nauchnoi organizatsii truda i proizvodstva*, (Moscow, 1921), vol. 1, pp. 8–12. Reprinted in abridged form in *Ekonomika i matematicheskie metody*, XXIV, (1988), pp. 798–801. See also: A. A. Belykh, 'O kiberneticheskikh ideyakh Bogdanova' in the same issue of this journal, pp. 792–7.

[14] L. N. Kritsman, *O edinom khozyaistvennom plane*, (Moscow, 1921).

[15] *Ibid.* p. 44.

[16] L. N. Kritsman, *Novaya ekonomicheskaya politika i planovoe raspredelenie*, (Moscow, 1922), pp. 24–25.

[17] Remington, 'Varga and the Foundations. . . ', p. 591.

[18] *Ibid.* p. 599.

[19] A. A. Bogdanov, 'Organizatsionnye printsipy edinogo khozyaistvennogo plana', *Vestnik truda*, 1921, no. 4/5/6, pp. 40–45.

[20] *Balans narodnogo khozyaistva Soyuza SSR 1923/24 goda*, Trudy Tsentral'nogo Statisticheskogo Upravleniya, vol. XXIX, (Moscow, 1926).

[21] D. L. Clark, 'Planning and the Real Origins of Input–Output Analysis', *Journal of Contemporary Asia*, 14, no. 4 (1984), pp. 408–29. Also see the entry on W. Leontief in *The New Palgrave*. . . , vol. 3, pp. 164–7.