

# Leontief and his German period<sup>☆</sup>

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## Abstract

Wassily Leontief jun. (1905–1999) moved to Berlin in April 1925 after getting his first academic degree from the University of Leningrad. In Berlin he mainly studied with Werner Sombart and Ladislaus von Bortkiewicz who were the referees of his Ph.D. thesis “The economy as a circular flow” (1928). From spring 1927 until April 1931 Leontief was a member of the research staff at the Kiel Institute of World Economics, interrupted by the period from April 1929 to March 1930 when he was an advisor to the Chinese Ministry of Railroads. In the journal of the Kiel Institute, *Weltwirtschaftliches Archiv*, Leontief had already published his first article “Die Bilanz der russischen Volkswirtschaft. Eine methodologische Untersuchung” [The balance of the Russian economy. A methodological investigation] in 1925. In Kiel Leontief primarily worked on the statistical analysis of supply and demand curves. Leontief’s method triggered a fierce critique by Ragnar Frisch, which launched a heavy debate on “pitfalls” in the construction of supply and demand curves. The debate started in Germany but was continued in the USA where Leontief became a researcher at the National Bureau of Economic Research (NBER) in summer 1931. The Leontief–Frisch controversy culminated in the *Quarterly Journal of Economics* (1934), published by Harvard University, where Leontief made his subsequent career from 1932–1975. His later analysis of the employment consequences of technological change in the 1980s had some roots in his Kiel period.

*Keywords:* circular flow analysis, Wassily Leontief, supply and demand curves, technological unemployment.

*JEL classification:* A11, B23, B31, C67, D57, E24.

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## 1. Introduction

The paper focuses on Wassily Leontief’s life and work in Germany. The first section contains an overview of Leontief’s German biography. Thereafter three

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topics are discussed in greater detail. The first one is his Berlin Ph.D. thesis “The economy as a circular flow.” The second section covers the employment consequences of new technologies, which is a topic Leontief came to very late in his life. He devoted most attention to it in the 1980s but it clearly links to the German period, when he worked in Kiel. The third topic is the statistical analysis of supply and demand curves which had been the main focus in Leontief’s work at the Kiel Institute, but which also marks his traverse to the USA, because it was the famous “pitfalls” controversy with Ragnar Frisch. It continued after Leontief moved to the USA and became a researcher at the National Bureau of Economic Research NBER and shortly after a professor at Harvard University.

## 2. Leontief’s “German” biography

In 1994–1995 I was invited to contribute to a *Festschrift* in honor of Leontief’s 90<sup>th</sup> birthday<sup>1</sup> by Faye Duchin who was running the *Institute for Economic Analysis* at New York University which Leontief had founded after his retirement from Harvard in 1975. Duchin is one of three outstanding women economists who came out of Leontief’s group besides Anne Carter, the founding President of the International Input-Output Association (1987–1991), and Karen Polenske, and she was one of the managing editors of the journal *Structural Change and Economics Dynamics* (SCED). When I asked Faye in Summer of 1995: “When is the deadline for the submission of the paper?” she told me: “You are too late now; Wassily recently has been in Saint Petersburg and found out that in fact he was already born in 1905 and not in 1906.” However, Leontief was not born in St. Petersburg, but in Munich, i.e. his very first and short German period began with his birth. The certificate of his birth is now placed on the website of the International Input-Output Association,<sup>2</sup> and this document dates from 2005 from the city of Munich (see Appendix A). It was given to Leontief’s daughter Svetlana Alpers, after the mother Estelle née Marks (1908–2005), whom Leontief had married in 1932, had died. The document shows the 5<sup>th</sup> of August 1905 in Munich as the date and place of birth.<sup>3</sup> This is quite rational, because his father Wassily Leontief senior (1880–1966) had been a Ph.D. student at the University of Munich at that time. He had met his wife Słata (Evgenia) Becker (1881–1979), who was born in a Jewish family from Odessa, in Paris one year before, and had married her in London on March 17, 1905. The following year the father, Wassily Leontief senior, got his Ph.D. from the University of Munich. After earning his first degree in St. Petersburg, the father had already studied in Germany before and got his diploma from the High School of Commerce in Leipzig in 1901. Thereafter he studied for one year in Paris before he became a doctoral student in Munich in 1902.

<sup>1</sup> See the special theme in honor of Leontief’s 90<sup>th</sup> birthday edited by Duchin, *Structural Change and Economic Dynamics*, 6(3), August 1995.

<sup>2</sup> <https://www.iioa.org>.

<sup>3</sup> In April 2020 on the website of The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel it still reads that Leontief was born in St. Petersburg on 5 August 1906. This error is even engraved on Leontief’s tombstone in Connecticut (see Bjerkholt and Kurz, 2006, p. 332). On the history of the Leontief family, see Leontief (1987), Kaliadina and Pavlova (2006), and Kaliadina (2006).

Wassily Leontief junior was almost one year old when his father finished his Ph.D. thesis on “The cotton industry in St. Petersburg and its workers,” and shortly thereafter the family moved from Munich to St. Petersburg, where the parents registered the birth of their son a second time with the Orthodox Church, exactly one year after his birth in Munich.<sup>4</sup>

The young Wassily therefore was already 16 years old, not 15 years, when he started to study at the University of Petrograd in 1921. Directly after finishing his studies at the University of Leningrad (the city was renamed shortly after Lenin’s death in January 1924) in April 1925, with the beginning of the summer semester, Leontief moved to the University of Berlin to study there, mainly with Werner Sombart (1863–1941) and Ladislaus von Bortkiewicz (1868–1931) who later became the two referees of his Berlin Ph.D. thesis.

Leontief submitted his dissertation, which he had finished in Kiel to the University of Berlin already on December 9<sup>th</sup>, 1927<sup>5</sup> but it took about one year for the handing out of the final document, although the oral exam<sup>6</sup> had already taken place on March 1<sup>st</sup>, 1928, due to several obligations, because the Russian degree was not fully accepted and because of additional formal administrative problems which delayed the finalizing of the Ph.D. exam<sup>7</sup>.

The Ph.D. thesis was also printed as a book, but it was mainly published as an article in the journal *Archiv für Sozialwissenschaft und Sozialpolitik* (ASS), which was the only journal in economics and the social sciences in Germany, which had to stop publication after the Nazis came to power in 1933 (Hagemann, 1991). At that time the journal was edited by Emil Lederer in connection with Joseph Schumpeter and Alfred Weber, the younger brother of Max Weber. It had been a leading journal for 30 years. In 1926 the first article by Nikolai Kondratiev on long waves was published in that journal which made Kondratiev known to the Western world (Kondratieff, 1926). Schumpeter later initiated the first abridged English translation by his Ph.D. student Wolfgang Stolper (Kondratieff, 1935).

On the front page of the special offprint of his ASS article, of which Leontief had to submit 150 copies to the Philosophical Faculty of the Friedrich-Wilhelms-Universität in Berlin<sup>8</sup> as an official document of his thesis “Die Wirtschaft als Kreislauf” [The economy as a circular flow], it can be seen that the finalizing

<sup>4</sup> His mother had converted to the Orthodox faith three days before and received the name Evgenia at her baptism. The Leontief family remained faithful to the Old Believers. The reservations of the grandmother towards a Jewish daughter-in-law probably contributed to the confusion regarding Leontief’s birthdate.

<sup>5</sup> In his letter to the Dean of the Philosophical Faculty Leontief opted for Economics as the main field for the oral exam, Bortkiewicz and Sombart as the two referees, and for Philosophy and History as subsidiary subjects.

<sup>6</sup> The overall result of the oral exam which was chaired by Bortkiewicz was cum laude. The examiners (in this order) were Professor Breysig in History (summa cum laude), Kähler in Philosophy (cum laude—magna cum laude), Sombart (rite) and Bortkiewicz (cum laude) in Economics. Bortkiewicz concludes the minutes with the statement that, similar to his colleague Sombart, “he has gained the impression that the positive knowledge of the candidate is not fully on a level with his perceptive capability and talent.”

<sup>7</sup> In 1924–1925 the activity of the Faculty of Social Sciences at the University of Leningrad was gradually curtailed. The prolonged period of closure contributed to the bureaucratic difficulties Leontief had to face in Berlin because his Russian diploma from 1924 was only a first degree (equivalent to B.A.). On the claims of the Faculty in 1924–1925, on the opening of a new Faculty of Economics at Leningrad State University in 1940 and the fate of this faculty in late Stalinism see Melnik (2018).

<sup>8</sup> On the initiative of Michael Burda the Economics Faculty of the Humboldt University presented an honorary renewal of his doctoral degree to Leontief on April 18th, 1995. See Burda (1995).

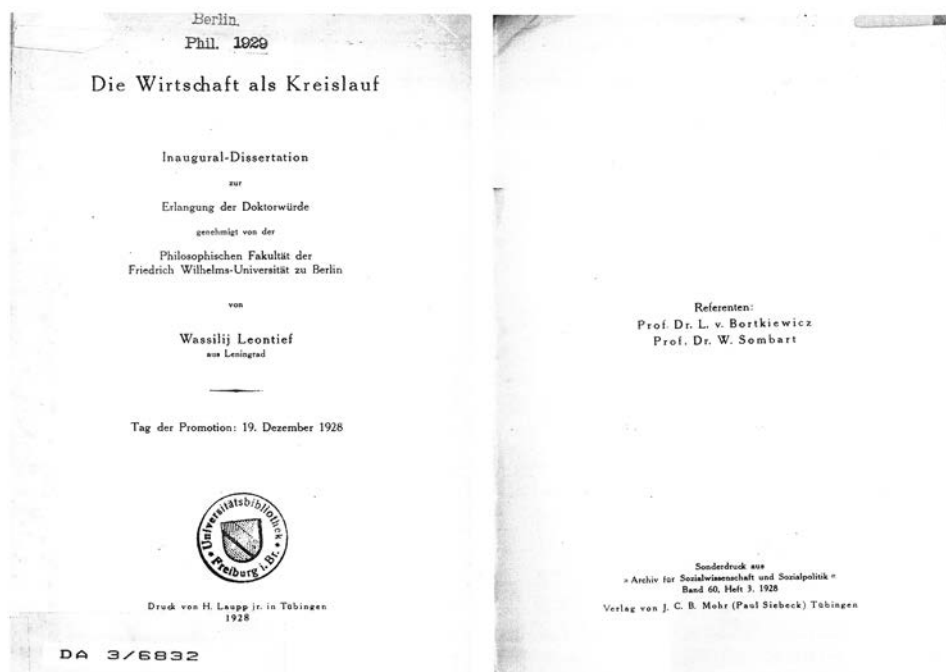


Fig. 1. Die Wirtschaft als Kreislauf (The economy as a circular flow).  
Publication of Leontief's 1928 PhD thesis.

of the Ph.D. was dated the 19<sup>th</sup> of December 1928 (Fig. 1). On the right side the names of the two referees are listed. Originally, Leontief was Sombart's Ph.D. student, but Sombart did not understand the mathematics of the dissertation well, so Bortkiewicz became the first referee who wrote the main detailed report already on January 10<sup>th</sup>, 1928, approvingly signed by Sombart two days later.

In the CV Leontief had submitted to the University of Berlin when applying for the Ph.D., he explicitly says in the first line that he was born in St. Petersburg on August 5<sup>th</sup>, 1906. There he also mentions as his main teachers in St. Petersburg Iossif Kulischer,<sup>9</sup> Sergei Platonov,<sup>10</sup> Sergei Solntsev<sup>11</sup> and Evgeny Tarle.<sup>12</sup> Kaliadina (2006) mentions a report Leontief delivered on the "Analysis of

<sup>9</sup> Iossif Michailowitch Kulischer (1878–1934) was one of the leading economic historians in Russia in the 1910s and 1920s. He had close connections with the German Historical school. See Bjerholt (2016, p. 23) for Kulischer's recommendation letter for Leontief to Sombart dated March 20<sup>th</sup>, 1925.

<sup>10</sup> Sergei Fyodorovich Platonov (1860–1933) was a leading Russian historian who led the St. Petersburg school of imperial historiography before and after the Russian Revolution. The beginning of the Stalinization of Soviet academia was marked by the "Platonov affair." In one of the first show trials Platonov was accused of taking part in a Royalist conspiracy, purged, imprisoned and exiled to Samara where he died.

<sup>11</sup> Sergei Ivanovich Solntsev (1872–1936) was among the few pre-revolutionary professors who remained active after 1917 and became influential in the history of Russian economic thought in that period. Like Kulischer he belonged to the pre-revolutionary group of economists who pursued a midway approach between Marxism and the Historical School. Solntsev had been well known to Bortkiewicz whose lectures at the University of Berlin he had attended twenty years before Leontief.

<sup>12</sup> Evgeny Viktorovich Tarle (1874–1955) was an historian who had become famous for his works on Napoleon's invasion of Russia and on the Crimean war. In the course of the Platonov affair he was arrested and exiled to Almaty. In the late 1930s he was rehabilitated and re-emerged as a kind of court historian to Stalin.

the formulas of social reproduction,” written under the guidance of Professor Solntsev. However, there can hardly be any doubt that the greatest influence was exerted by his own father who himself was teaching at St. Petersburg University since 1915.<sup>13</sup>

In 1928 Berlin University was still called Friedrich-Wilhelms-University after the former Prussian king. The University was renamed as Humboldt University in 1949. Leontief says that he started to study in Berlin in the summer semester 1925 which in Germany starts on the first of April. His main teachers in Berlin were Sombart, Bortkiewicz, and Kurt Breysig (1866–1940), an historian.

Georg Erber, from the German Institute for Economic Research (DIW) in Berlin, and a member of the editorial board of SCED, was able to get the official document of Leontief’s doctoral degree (see Appendix B) after the fall of the Berlin Wall. It was impossible for West Germans to get these documents before this. Leontief was very happy when the documents were handed over to him because he had lost them in the meantime. Almost everything is written in Latin as it was standard practice at that time including the name of the University of Berlin. It was the Ph.D. from the Philosophical faculty. In the German language area there were two different approaches. In Austria economics traditionally had been part of the law faculty, in Prussia economics had been part of the philosophical faculty.

Two issues might be interesting: the title of the Ph.D., which is the only text in German—“Die Wirtschaft als Kreislauf” [The economy as a circular flow]. The other topic is the degree he got: *cum laude*.

This is only the third grade out of four possibilities. Normally today if you would make your Ph.D. with the degree *cum laude* you cannot become a professor. It is the Latin system where the best degree is *summa cum laude*, which is excellent. The second grade would be *magna cum laude*—very good. The third is *cum laude*. And the fourth would be *rite*—which means “just passed.”

So he did his Ph.D. in December 1928 in Berlin but since May 1927 Leontief was already working at the Kiel Institute of World Economics, succeeding Max Schönwaldt in the department of statistical international economics and international business cycle research.<sup>14</sup> The founding director of the Kiel Institute in 1914 had been Bernhard Harms (1876–1939), who also was kicked out of office after the Nazis’ rise to power in 1933.

Adolf Löwe (since September 1939 Adolph Lowe), the director of the department for business cycles founded in April 1926,<sup>15</sup> which was the new department where theoretical work was done, hired Leontief. According to personal conversations I had with Lowe in the 1980s, he got a phone call from Sombart in Berlin,<sup>16</sup> who said “I have here a young genius from Russia, are you interested?” Lowe responded “I am always interested in geniuses.”

<sup>13</sup> For a much more detailed description of Leontief’s early years in St. Petersburg and his travels to Berlin see Bjerkholt (2016).

<sup>14</sup> See Beckmann (2000, p. 76–77). The great grandnephew of Georg Friedrich Knapp, Claus Wittich, who deserves great appreciation for clarifying Leontief’s early period and the St. Petersburg heritage, later systematically put together the documents of Leontief’s Berlin Ph.D. (Wittich, 2006).

<sup>15</sup> On the excellent research done in this department in the years 1926–1933 see also Hagemann (2020).

<sup>16</sup> Lowe had been a regular participant in Sombart’s research seminar during his Berlin years, when he was working at the Ministry of Economics and the Statistical Office before his move to Kiel.



In a letter which was sent by Leontief on February 8, 1993 he congratulated Lowe on his 100<sup>th</sup> birthday (see Appendix C). Lowe, who came back to Germany in 1983 fifty years after emigration, was living with his daughter Hannah in Wolfenbüttel at that time, and died two years later at the age of 102. Two aspects are worth noting: Leontief mentions Gerhard Colm (1897–1968) and Hans Neisser (1895–1975), two other excellent economists, who later emigrated to the USA. The other interesting point is that Leontief is referring to “Herr Geheimrat Professor Dr. Harms” who was the President of the institute in that time, and one of Leontief’s favorite activities in Kiel — namely sailing.

The photo on Fig. 2 shows the *Institute of World Economics* as it was looking during Leontief’s time until the year 1943, when many parts of the building were destroyed in the bombing of Kiel. Kiel, like Saint Petersburg, is located on the Baltic Sea, and is also the only place in Germany where the Olympic Games took place twice, but only the sailing events, in 1972, when the Olympic Games were held in Munich and in 1936, when they took place in Berlin. In 1936 the Olympic harbor with the sailing boats was located directly in front of the Kiel institute where Leontief had his working place some years before. On the right side one can see the only part of the building which survived the bombing.

In a long interview with the scientific journalist of the *New York Times* Leonard Silk (1976, p. 156), Leontief explained that in fall 1928 a group of Chinese were passing by a coffeehouse near the institute during the lunch break, and shortly afterwards the Chinese ambassador in Berlin recruited Leontief as an advisor to the Chinese Ministry of Railroads in Nanjing with a one-year contract.

Altogether, Leontief worked in Kiel from spring 1927 until April 1931, with the interruption of the year which he spent in China from April 1929 to March



Fig. 2. Building of the Kiel Institute of World Economics 1920–1943.

Source: Institut für Weltwirtschaft (1964, p. 34).

1930. Thereafter Leontief moved to New York and became a research associate of Wesley Mitchell at the National Bureau of Economic Research, which had been founded in 1920 and was located in New York until the end of World War II as long as Mitchell was the founding director and also professor at Columbia University. In 1945, the National Bureau of Economic Research was shifted from New York to Cambridge, Massachusetts, close to Harvard and MIT. Lowe had good contacts with Mitchell, because they both were working on business cycles during that time. The closest research associate of Mitchell at that time was another Russian, Simon Kuznets, who later received the Bank of Sweden Prize in Economic Sciences in Memory of Alfred Nobel in 1971, two years before Leontief.<sup>17</sup>

With the beginning of the new academic year in September 1932, Leontief moved from New York to Harvard, where he stayed until his retirement in 1975. Then he moved back to Manhattan, where he founded the Institute for Economic Analysis at New York University, where Duchin was the acting director from 1985 to 1996.

Some more details should be given on Leontief's father, Wassily senior. There exists a lot of confusion in the literature. Sometimes father and son are mixed up with each other because their publications in Germany were both signed as Wassily Leontief.<sup>18</sup> Only the first two articles by Wassily Leontief junior on "The balance of the economy of the Soviet Union" (Leontief, 1925) and "On the theory and statistics of concentration" (Leontief, 1927) are signed as Wassily Leontief junior. Thereafter it is always Wassily Leontief, but his father was continuing to publish in German journals at that time, and preferably in the *Weltwirtschaftliches Archiv*, the journal of the Kiel Institute of World Economics where his son had worked from 1927–1931.<sup>19</sup>

The original German title of the Ph.D. thesis of Leontief senior at the University of Munich is "Die Baumwollindustrie in St. Petersburg und ihre Arbeiter" [The cotton industry in St. Petersburg and its workers] (Leontief [sen.], 1906). The main referee and supervisor of the thesis was Lujo Brentano (1844–1931), who was one of the best-known German professors at that time. Among the members of the German Historical School Brentano was the strongest supporter of trade unions, which he considered to be the decisive means to solve the labor question. Brentano had also been in closer contact with Alfred Marshall over more than three decades, in particular on the social question and the labor movement. He was instrumental in publishing a German edition of Marshall's "Principles of economics," to which he wrote a preface and which was published in 1905 shortly before Leontief sen. finished his thesis. Leontief's father got better marks for his Ph.D. than his son two decades later. He got the best grade *summa cum laude* for the written thesis and *magna cum laude*, the second best grade, for his oral defense.

<sup>17</sup> Leontief's review of Kuznets' "Seasonal variations in industry and trade" (1933) is his last publication in German in the *Weltwirtschaftliches Archiv* (Leontief, 1934d).

<sup>18</sup> For example, Adam Tooze (2001, p. 201), erroneously ascribes the article of the father (Leontief [sen.], 1931) to the son.

<sup>19</sup> See, for example, his articles on the Russian economy, all signed as Wassily Leontief (Leontief [sen.], 1931, 1934), his reflections on the views of Americans and French on Soviet Russia (Leontief [sen.], 1936), or his review of Chamberlin's book on the Russian revolution (Leontief [sen.], 1937). When I was visiting the Leontief Centre in St. Petersburg in 2010, we moved to the old place on the Krestovskiy island, where the grandfather had the cotton factory, which was socialized after the October Revolution and does not exist anymore.

The family went back to St. Petersburg directly after Wassily sen. got his Ph.D. on July 17, 1906. Later, the father became private docent at the Imperial University of Jurjev (Dorpat), today's Tartu in Estonia. He started in Estonia, before in 1915 he got a professorship for labor economics in St. Petersburg. Leontief junior came back to Germany in 1925, his parents followed him two years later in 1927. The father was working in the Russian Embassy in Berlin as the representative of the Soviet Ministry of Finance from 1927 to the early 1930s.

The father got an order from Moscow to come back but he refused. So he was living with his wife in Berlin but not working in the Russian Embassy anymore. From 1930 till 1939 he was Lecturer on the Russian economy at the University of Berlin. Shortly after the outbreak of World War II, in November 1939, Leontief junior managed to bring his parents<sup>20</sup> over to the USA (via Italy), which was certainly not easy at that time.

Leontief junior was an outstanding example of a larger group of Russian economists, most of them Mensheviks and well trained in mathematics and statistics, who emigrated from the Soviet Union and came over to Germany in the years of the Weimar Republic. There were many others, for example Boris Brutzkus, an agricultural economist. Several of them later became well known internationally.<sup>21</sup> The most important one is Jacob Marschak (1898–1977), who was the very first one who came to Germany in January 1919, exactly on the day when Rosa Luxemburg and Karl Liebknecht were murdered in Berlin. Another important one was Vladimir Voitinsky (Woytinsky) (1885–1960). In 1918–1919, he was imprisoned in the Peter and Paul Fortress for three months. He was a former leading economic socialist but he was more a Menshevik than a Bolshevik. Voitinsky became chief advisor of the German trade unions on economic issues in the Weimar Republic. And like all the others he had to emigrate a second time in 1933 after the Nazis' rise to power.<sup>22</sup> There were two centers of gravitation in Germany for all the emigré Russian Menshevik economists. One was Berlin, the other place was Heidelberg. The key figure in Berlin who attracted the younger Russian mathematical economists was Bortkiewicz, himself born in St. Petersburg. Heidelberg had a long liberal tradition particularly in economics and the social sciences where Max Weber was once a towering figure, and it is located a little bit north of Baden-Baden, which was a fashionable place for many Russians in the 19<sup>th</sup> century (and has become again after 1990). Dostoevsky, for example, made his observations in the casino in Baden-Baden.

Marschak got his Ph.D. and his habilitation from the University of Heidelberg. But he also worked about two years at the Kiel Institute from 1928–1930, where he was directing the section on trade statistics. For more than a year Leontief was his colleague there. Leontief's very first paper in economics on "The balance of the Russian economy" was published in German in the *Weltwirtschaftliches Archiv*, which still exists today and is the economic journal of the Kiel Institute. The Kiel Institute gave a prestigious prize in economics, the Bernhard Harms

<sup>20</sup> See Estelle Leontief's detailed memoir (Leontief, 1987) on her parents-in-law.

<sup>21</sup> Others were Naum Jasny, Nathan Leites, Mark Mitnitzky, Paul A. Baran, who did his Ph.D. with Lederer in Berlin in 1932, and later became famous in the 1968 student movement with his book "Monopoly capital," co-authored with Paul Sweezy (Baran and Sweezy, 1966).

<sup>22</sup> See also his fascinating autobiography: Woytinsky (1961).



prize, to Leontief in 1970.<sup>23</sup> I was a student at that time at the University and could follow the lecture which was given by Leontief in a very good German with a strong Russian accent. Major colleagues of Leontief in Kiel were Lowe, Colm and Neisser. Colm, who chaired the department from 1930–1933, became the chief architect of the German currency reform in June 1948 and was the first to receive the bi-annual Harms Prize in 1964 (succeeded by Roy Harrod in 1966). All these economists were forced to emigrate after the Nazis' rise to power. This included also some others, of whom two worked on topics with a strong connection to Leontief. One is Fritz (later Frank) Burchardt (1902–1958) who emigrated to the UK in 1935, where in 1949 he became director of the Oxford Institute of Statistics founded by Marschak in 1935. Two of Burchardt's works, namely "The schemes of the stationary circular flow in Böhm-Bawerk and Marx" (Burchardt, 1931–1932), and "Quesnay's *Tableau Économique* as a foundation for business-cycle theory" (Burchardt, 1933), have a certain connection with Leontief's work. Burchardt's ground-breaking comparison of the two most important methods of modelling the production system and his innovative synthesis of the Austrian or vertical approach and the interindustry or horizontal approach has given inspiration to Ragnar Nurkse's essay "The schematic representation of production" (Nurkse, 1935) as well as to Leontief's essay "The significance of Marxian economics for present-day economic theory" in which Leontief (1938) discusses the relative merits of Marx and Böhm-Bawerk's contributions to linear analysis.<sup>24</sup>

The Ph.D. thesis by Alfred Kähler (1900–1981), "The theory of labour displacement by machinery," basically the machinery problem as it was called by Ricardo, covers a topic, on which Leontief worked in the 1980s. Kähler had already an advanced embryo of a static input-output model in his Ph.D. thesis.

### 3. The economy as a circular flow

Leontief's first article is on the balance of the economy of the Soviet Union soon after a committee of twenty economists under the direction of Pavel Popov, the chairman of the Soviet Statistical Administration, had published their preliminary results for 1923/24. It was written immediately after his arrival as a student in Berlin and published in the same year in the German original, and shortly afterwards also in Russian. In 1964 an English translation, "The balance of the economy of the USSR," was published in a larger project which originally had been initiated by another famous economist of Russian origin, Evsey Domar, who was professor at the MIT since 1958. It is included in a collection of essays on the *Foundations of Soviet Strategy for Economic Growth* edited by Nicolas Spulber (1964). Many of the articles by Grigory Feldman, Popov (who

<sup>23</sup> Leontief's Harms lecture "Structural Approach to the Analysis of International Economic Interdependences" was held on June 10, 1970 in the Kiel castle and published with the Laudatio by Herbert Giersch, director of the Kiel Institute from 1969–1989 (Leontief, 1971). Giersch is also the "unknown" German (no. 15) standing next to Leontief on the photo of the August 1948 seminar in Salzburg where he became a close friend of Robert and Barbara Solow (see Foley, 1998, p. 123).

<sup>24</sup> Burchardt's influence on Leontief was also noted by David Clark (1984, pp. 424–425) who would have been more outspoken if he knew of Burchardt's habilitation thesis which was already accepted by Goethe University in Frankfurt. However, due to the Nazis' rise to power the habilitation process was not finalized.

was dismissed by Stalin soon after the final “Balance of the national economy” was published in 1926),<sup>25</sup> and other important Russian works of the 1920s were translated into English here for the first time.

In this very first paper by Leontief, which is published in his country of birth, Germany, two points are important. First, his emphasis that a country which favors a planned economy has a high need for detailed statistical information. The second point is that already on the very first page of his very first article he made explicit reference to Quesnay’s *Tableau Économique*.

Leontief finalized his Berlin Ph.D. thesis when he was working as a research associate in Kiel. In 1991, an abridged English translation of his Berlin Ph.D. thesis of “The Economy as a circular flow,” was published in *Structural Change and Economic Dynamics*. Paul Samuelson wrote an introduction on the importance of that work. In his assessment he refers to the famous composer Richard Wagner and his *Ring*, commenting that Leontief’s Ph.D. thesis “sounds the first note of the overture to his *Ring* of Input-Output” (Samuelson, 1991, p. 177).<sup>26</sup>

The content of Leontief’s Ph.D. thesis fitted very well into the research program of the Kiel group. This work matched with the major research interest of the Kiel group to construct a theoretical model of cyclical growth, with the basic working hypothesis that a satisfactory explanation of industrial fluctuations must fit into the general framework of an economic theory of the circular flow as it was developed by Quesnay and Marx.

Leontief, who was still alive at that time, was aggrieved that the publishing house Elsevier, known as the “Journal Industrial Complex,” which is very capitalist, did not give much money for the translation. For financial reasons a short reduction in the translation had to be made. The first 10 pages were cut down to 2. That was not a great problem or loss, because the introductory part was basically written to please his supervisor Sombart, a descendant of the German historical school. The more interesting stuff starts thereafter. But four points should be emphasized which show that there is no full anticipation of his later work. For example, in contrast to a statement in his 1925 article, the dissertation contains nothing of manageable empirical measurement. You will not find matrices. The thesis is primarily taxonomic and “topological.” Furthermore, there is no reference to either Quesnay or Marx.

According to Leontief, economic concepts should be observable and measurable. Otherwise they would be meaningless and become potentially misleading. He considers the circular flow as fundamental and objective fact of economic life. Therefore it should be placed at the center of economic analysis. The concept of the circular flow is considered as a tool to identify important interconnections and causal relationships existing in the economy. For the construction of an economic system comprising the interconnections between economic processes, a careful and thorough inquiry of the technological aspects is a necessary precondition. In Leontief’s approach “[t]he two basic concepts are cost and returns. *Cost items* (inputs) are those elements whose consumption in production causes the generation

<sup>25</sup> For greater details see Spulber and Dadkhah (1975).

<sup>26</sup> Samuelson also regretted that Leontief and Piero Sraffa never cited the other’s work. “The tub of genius stands on its own bottom” (Samuelson, 1991, p. 177). For a more detailed analysis of the interaction between Leontief and Sraffa see Parys (2016).

of corresponding *return items* (output)” (Leontief, 1928/1991, p. 181). Leontief elaborates in his dissertation a two-sectoral static input-output system with constant technical coefficients to give a clear picture of the production, distribution and consumption side of the economy. The adjustment problems resulting from new combinations or changes in technical coefficients are indicated. He assumes constant returns to scale.<sup>27</sup>

Leontief insisted that before the beginning of the English translation of his thesis a short passage of the statement by the referee—Bortkiewicz, should be included. The original documents from the University of Berlin include this letter by Bortkiewicz, which he had sent to the Dean of the Faculty already on the 11<sup>th</sup> of January 1928 together with his report on the thesis. Bortkiewicz was the one who was basically responsible for Leontief only getting *cum laude* for his thesis. So he states:

Although I find much that is objectionable in it, this dissertation is without any doubt acceptable. In developing his—in my opinion very doubtful—theoretical constructs the candidate received no guidance whatsoever from his academic teachers. He arrived at his present position quite independently, one might say, despite them. It is very likely that he will maintain this scientific point of view also in the future.

#### 4. Technical progress and unemployment

Technical progress and unemployment was the key topic of Leontief in the 1980s with the main study being “The future impact of automation on workers” (Leontief and Duchin, 1986), growing out of research done in the Institute for Economic Analysis in New York. In this work, predictions for the US economy about the employment consequences, particularly of industrial robots, until 2000 were made. The main novelty in this study, which comprises 89 sectors and 53 different occupations, consisted in the treatment of investment demand, making use of some version of the capital stock adjustment principle. The endogenization of private investment demand is a decisive advantage of this study which thus takes into consideration the machinery production argument associated with the diffusion of new technologies. It is also interesting for input-output specialists, because a special dynamic input-output model had been developed for this project (Duchin and Szyld, 1985). Similar work on the consequences of new technologies on employment was done in Germany in the late 1980s and early 1990s. However, there are two major differences. You cannot treat Germany, which is a very open economy, in the way they did in the US model, as a closed economy. The second modification consists of the fact that the elaborated model also allowed for shrinking sectors, and this is quite difficult to handle mathematically with negative growth rates of some sectors of the economy. Leontief in those years wrote many articles, for example his major article “The distribution of work and income” in the *Scientific American* (Leontief, 1982), in which he argued against drastic general wage

<sup>27</sup> For a more detailed analysis and integration of Leontief’s dissertation and his subsequent early work on input-output analysis in the USA see Kurz and Salvadori (2000).

cuts as well as against the erection of Luddite barriers as palliative remedies against technological unemployment<sup>28</sup>. In the following year he was emphasizing the fact that “the specter of technological unemployment [...] is here again. But there are good reasons to believe that this time it will not retreat” (Leontief, 1983, p. 405).

Concerning the employment consequences of new technologies, there is a strong parallel to the work which was done by the Kiel group, when Leontief worked there. The analysis of cyclical growth and the relationship between capital accumulation, technical progress and employment was a key research topic in the department. Neisser, who was Vice Chairman from March 1930 to April 1933, in a famous paper (Neisser, 1932) not only made a seminal contribution to general equilibrium theory but also inspected Wicksell’s critique of Ricardo’s analysis of the machinery problem. In his essay, Neisser developed Ricardo’s argument that the demand for labor will continue to increase with an increase of capital only. In a subsequent paper, published a decade later in *The American Economic Review*, Neisser (1942, p. 70) stated clearly: “It never has been doubted by any theorist of rank that accumulation of capital in the form of fixed equipment raises the demand for labor.” Overcoming the bottleneck of capital formation is a necessary, but not a sufficient condition for a successful reabsorption of workers who have been displaced by the introduction of new machinery into the production process.<sup>29</sup> In his essay, Neisser (1942, p. 70) also coined the metaphor of “the capitalistic process as a race between displacement of labor through technological progress and reabsorption of labor through accumulation” whose outcome “is impossible to predict [...] on purely theoretical grounds.” His conclusion is clear. There is no adjustment mechanism which would guarantee a successful compensation process or even the maintenance of full employment over time when dynamic forces such as technological change are at work. The outcome of the race is open and it may differ with changing times and between various countries.

Leontief himself did not work on the employment consequences of technical progress in his time at the Kiel Institute. An important work in that context is the Ph.D. thesis by Kähler “Die Theorie der Arbeiterfreisetzung durch die Maschine” [The theory of labor displacement by machinery], which was published as a book in 1933 (Kähler, 1933) but the thesis was already accepted in 1932.<sup>30</sup> Kähler did not refer to Leontief’s dissertation “The Economy as a Circular Flow” but he drew on Burchardt’s essays on the schemes of the stationary circular flow in Böhm-Bawerk and Marx (Burchardt, 1931–1932). Burchardt, however, had not discussed the machinery problem more intensively.

Kähler was not a member of the research team; he was an external Ph.D. student of Lowe. So, it is not very clear how well Kähler and Leontief knew each other. But in Kähler’s work you can find an input-output model. What Kähler used in his dissertation to estimate the employment consequences of new technologies

<sup>28</sup> See Leontief (1982/1986, pp. 369–370).

<sup>29</sup> For a more detailed assessment of Neisser’s contributions to the analysis of the problem of technological unemployment, see Hagemann (2008, pp. 356–360).

<sup>30</sup> Kähler emigrated in 1934 to the USA where he became Professor at the University in Exile of the New School for Social Research in New York and continued to publish on technological unemployment (Kähler, 1935).

**Table 1**

Kähler's total circulation scheme.

Inputs	Flows and Slucks in the production of										Total flow
	Coal & iron		Machines		Buildings		Agriculture		Labour		
	Flow	Stock	Flow	Stock	Flow	Stock	Flow	Stock	Flow	Stock	
Coal & Iron	90.8	6	156.4	26	41.5	30	65.2	16	100	30	454
Machines	45.4	225	39.1	195	41.5	203	65.2	240	200	200	391
Buildings	45.4	360	39.1	390	0	0	130.4	800	200	2000	415
Agriculture	45.4	5	0	0	41.5	30	65.2	70	500	10	652
Labour	227.0	25	156.4	30	290.5	210	326.0	250			1000
Total production	454.0	621	391.0	641	415.0	475	652.0	1376	1000	2240	

Total stock of productive capital = 3113; Total wages = 1000; Productive capital: Total wages = 3.11

Source: Gehrke (2003, p. 145).

within his “total circulation scheme” in today’s language we would call a static closed input-output model. Table 1 shows Kähler’s initial input-output scheme for an economy in a stationary equilibrium (zero profits, no investment) before the introduction of technical progress.

Kähler’s multisectoral model comprises nine sectors but two are linearly dependent, so in fact it is an 8-sector model.<sup>31</sup> Kähler’s attempt to cover the employment effects of new technologies by means of a sequence of static input-output tables in a transition process from an old to a new technique is an important advancement in the direction of dynamic input-output models developed in the 1980s to calculate the impact of the rise of microelectronics and industrial robots on overall employment. Leontief, however, never referred to Kähler’s work which in the view of Lowe (1959, p. 64) contains “the first attempt at input-output analysis, applied not only to stationary equilibrium but also to the intersectoral shifts required for capital formation.”

As Tooze (2001) has pointed out in his groundbreaking study on the development of national accounts in Germany, official estimates of national income by the Statistical Office and by the newly founded Berlin Institute for Research on Business Cycles, both chaired by Ernst Wagemann, began in summer 1925. This was exactly at the time when Leontief published his article on the balance of the Russian economy. Whereas in the Weimar period advances in national accounting were induced by the analysis and calculation of reparation payments, in the Nazi period advances in economic planning were mainly induced by the preparation and supervision of war production. As Tooze has elaborated, Leontief’s early attempts at input-output analysis had a considerable influence on the construction of input-output tables by German statisticians for a rudimentary system of central planning.

## 5. Statistical Supply and Demand Analysis

The main work which Leontief had done in those years when he was employed at the Kiel Institute, consists of the statistical analysis of supply and demand. In those years in the late 1920s it had become fashionable to do statistical supply

<sup>31</sup> For greater details on Kähler see Gehrke (2000, 2003).



and demand analysis. Henry Schultz (1893–1938) from Chicago was an economist who, in the wake of his teacher Henry Ludwell Moore, mainly pioneered that work (Schultz, 1925a, 1925b, 1928).<sup>32</sup> Schultz was born into a Polish-Jewish family in the former Russian empire in a place which today belongs to Belarus. Schultz was also responsible for circulation of an early translation of Slutsky's famous article on random shocks (Slutsky, 1927), which became enormously important for modern equilibrium business-cycle theory.

At Kiel, Leontief got his position in the department for business cycle research where he did not work very much on business cycles. Nor did he work very much on traffic either which was the area where his predecessor had specialized, but maybe this was the reason Leontief had been hired by the Chinese.<sup>33</sup> Leontief became responsible for the newly established section "Market analysis and elasticity studies."

So, basically, Leontief was primarily engaged in the derivation of statistical supply and demand curves which led to two major papers (Leontief, 1929, 1932), of which it was the first one that played the decisive role in the "pitfalls" controversy. Leontief's proposal for a solution to the problem that the relevant data to estimate a supply function were different from the relevant data needed to estimate a demand function caused a fierce critique by Frisch (1933), which launched a heated debate on the proper method of deriving statistical supply and demand curves. This started when Leontief was still in Germany and continued after he had arrived at Harvard. The *Leontief-Frisch controversy* was so vehement that the editors of the *Quarterly Journal of Economics* called Marschak, who himself had written his Heidelberg habilitation thesis on the "Elasticity of demand" (Marschak, 1931)<sup>34</sup> during his Kiel years from 1928–1930, as a referee and mediator. (Leontief (1931) was a reviewer of Marschak's book.)

Frisch's first work on pitfalls in the statistical construction of supply and demand curves was still published in Germany, but in English. Frisch attacked Leontief because he did not accept the premise of Leontief's method, namely the independence of the schedules of both functions. You then find a continuation of the debate across the Atlantic in the *Quarterly Journal of Economics* in 1934. Marschak's contribution concluded the debate.

This controversy deals with complex and tricky issues of econometrics. It would require a full long seminar by specialists which would probably end in a controversy. The main issue was whether you could deal with supply and demand independently or not. Leontief proposed a solution to the problem that the data needed to estimate a demand function (consumption) were different from the relevant data to estimate a supply function (production). He assumed that demand and supply relations were linear in the logarithms, with constant

<sup>32</sup> In his application to sugar, Schultz's work could benefit from the fact that he focused on a commodity that entered strongly into international trade.

<sup>33</sup> The institute had been founded as *Institut für Seeverkehr und Weltwirtschaft* [Institute for Sea Traffic and the World Economy] at the University of Kiel, to which it was associated as an independent entity.

<sup>34</sup> In his preface, written in October 1930, Marschak thanks Lederer, Schumpeter, Colm, Leontief, Löwe and Neisser for numerous suggestions made throughout the process of writing the book. Marschak also translated Umberto Ricci's paper on the classification of demand curves on the basis of the elasticity concept from Italian into German (Ricci, 1931).

slopes (elasticities) over time, and were subject to random shifts that were independent as between demand and supply relations. His method (Leontief, 1929, p. 29) was to divide the time series into two periods and perform regressions in each of the two periods, and then solve the resulting equations jointly to obtain two elasticity estimates, one of which would be interpreted as a demand elasticity, and the other as a supply elasticity. Later in the period of 1943–1948 important work was done at the Cowles Commission in Chicago when Marschak was the director there. In those years at the Cowles Commission the simultaneous equations approach in econometrics became the trademark due to the work of Frisch’s student Trygve Haavelmo (1943, 1944), for which he later received the Nobel Prize.

A few more publications listed here are important in that debate, in particular, the last publication by Leontief in German on delayed adjustment of supply and partial equilibrium being published in 1934 in the Vienna-based *Zeitschrift für Nationalökonomie*, in which he analyzes the cobweb dynamics of non-linear supply and demand curves (Leontief, 1934a).

Schultz had been the first critic of Leontief’s method to determine the elasticities of supply and demand.<sup>35</sup> In his final summary of several shortcomings of Leontief’s method Schultz (1930, pp. 96–97, 1938, pp. 94–95) concludes “that Leontief’s method is an extremely arbitrary method, and that the results obtained by it are apt to be arithmetical accidents.” Nevertheless, “[s]tudents of the subject will, however, always be grateful to Leontief for his bold and painstaking attempt to deduce the true static, Cournot-Marshall demand and supply curve from statistics.”

The best modern text on these issues is John Chipman’s contribution to the memorial symposium for Frisch (Chipman, 1998, pp. 78–84). Chipman has also a much higher opinion of Leontief’s contribution and he tries to find a balance between Leontief and Frisch given the rule of different approaches to estimate supply and demand curves. Chipman in greater detail summarizes Frisch’s critique:

Frisch carried out an exhaustive classification of cases, culminating in a table ([Frisch, 1933], p. 30). His general conclusion was *that there were only three cases in which Leontief’s method would give correct results under his assumption of uncorrelated shifts*: (1) The two elasticities are known to be equal in magnitude, but of opposite signs; but in that case an ordinary regression would give the elasticities. (2) There is a pronounced Cournot effect on the demand side in one data set, and a pronounced Cournot effect on the supply side in the other; but in that case, too, straightforward regression would give the correct result. (3) Both the “relative violence” and the correlation have significantly different values in the two data sets. Only in the third case would Leontief’s method do better than straight

<sup>35</sup> See Schultz (1930, pp. 84–97) and slightly modified Schultz (1938, pp. 83–95). For a survey on different methods to obtain elasticities of demand see also his contribution to the first volume of *Econometrica* (Schultz, 1933). Elizabeth Waterman Gilboy (1931) soon compared the methods of Leontief and Schultz to describe “demand” curves. Although preferring Leontief’s method in theory, she considered it useless in practice because the hypothesis of independence in the supply and demand shifts was improbable to be realized on the original data.

regression. But, he reasoned, for Leontief's method to have any *raison d'être*, it would have to give good results in other cases. (Chipman, 1998, pp. 80–81; emphasis added).

Frisch did not accept the premise of Leontief's method, namely the hypothesis of independence in the supply and demand shifts and insisted on the importance of studying how the shifts of demand and supply curves are correlated. But with regard to the character of Frisch two points should be emphasized: although he was engaged in this bitter controversy with Leontief he later supported Leontief to become President of the Econometric Society in 1954. Furthermore, as early as 1970, Frisch suggested Leontief for the Nobel Prize in economics for his contributions to Input-Output analysis. In 1969 the Bank of Sweden Prize in Economic Sciences in memory of Alfred Nobel was given the first time to Frisch and Jan Tinbergen together. According to the practice of the Nobel Prize Committee in Stockholm, former Nobel Prize winners have a strong say in making recommendations. In 1973 Frisch was successful and Leontief received the Prize "for the development of the input-output method and for its application to important economic problems."

Just to give a flavor of the "pitfalls controversy": Leontief (1934b, p. 357) wrote: "Professor Frisch is tilting at windmills." At the same time Frisch (1934, p. 755) ended his discussion with the following statement: "One cannot help feeling that the prestige of economics as a science must suffer when papers containing such mistakes and oversights as Dr. Leontief's last paper appear in a journal of high international standing."

So, one may understand why the editors of the journal summoned Marschak as an expert mediator to settle this conflict after Leontief's "final word" (Leontief, 1934c). The arbiter had previously discussed Leontief's method in his own study (Marschak, 1931, pp. 23–28). The mediator demonstrated his qualities as an expert in the comparison of the different methods used by Frisch and Leontief (and his mathematical collaborator Robert Schmidt<sup>36</sup>). Marschak (1934, p. 760) concluded that Frisch "succeeded in giving to this [Leontief's] method an elementary mathematical exposition which is considerably simpler and at the same time more general." In his exposition Marschak specified five assumptions necessary for the application of Leontief's method:

- (1) elasticities of the demand and supply curve to be constant all along the curves, and
- (2) constant over time;
- (3) demand shifts are noncorrelated with supply shifts;
- (4) the price-quantity-correlations must be significantly different in both materials, and
- (5) the same must hold for the relative violences.

"Even granting Assumption I, R. Frisch denies that the four other assumptions are likely to hold good simultaneously except by a 'miracle'" (Marschak, 1934, p. 761), whereas for Leontief they are a "mathematical necessity." Marschak elaborates the assumption of constant elasticities over time as the "vulnerable

<sup>36</sup> Schmidt himself published a subsequent article on the conciseness of the elasticity coefficients (Schmidt, 1930).

point in Leontief's method" (Marschak, 1934, p. 763). The Leontief–Frisch controversy also revealed differences in economic reasoning. Whereas Leontief was more concerned with invariance and autonomy, Frisch worried more about correlations and spurious results.

Mary Morgan, who discusses Leontief's method in her comprehensive history of the development of econometric ideas in demand analysis,<sup>37</sup> comes to the conclusion that "Leontief's paper marked an ingenious and challenging attempt to estimate a two-equation demand and supply model simultaneously" (Morgan, 1990, p. 180).

One other very interesting later commentator on the econometric issues is Edward Leamer, who very much regretted that the modern development in econometrics had widely overlooked Leontief's contribution. Leamer (1981, p. 321–22) concluded as follows:

The method [...] rests on the unlikely assumption that the slopes  $\beta$  and  $\theta$  are constant over time but the variances are not. Still, Leontief did have the hyperbola properly defined, which is only one short step from the results in this paper. It is therefore surprising that Leontief's contribution has been so completely ignored by the post-1940 econometrics literature. The fault seems to me to lie with excessive attention to asymptotic properties of estimators and insufficient interest in the shapes of likelihood functions.

## 6. Concluding remarks

Let me conclude with a quotation from a letter which was written by Schumpeter to the Dean of Harvard University when in 1935 the issue of Leontief's prolongation as an assistant professor came up. Schumpeter himself had moved from the University of Bonn in Germany to become a Professor at Harvard University in September 1932. Schumpeter had been a co-founder of the Econometric Society and was a close personal friend of Frisch. So Schumpeter knew the Leontief–Frisch controversy very well. According to Samuelson, "[i]t must have been the newly-arrived-in-Cambridge Schumpeter who plucked Leontief from a brief National Bureau stint to Harvard [...] a brilliant investment decision even if not 100 percent cogent" (Samuelson, 2004, p. 4).<sup>38</sup>

In the American university system at that time in the 1930s, just like today, normally you get a first contract as an assistant professor for three years, which then has to be renewed for a second three-year period. When Leontief was in the 3<sup>rd</sup> year of his first period as an assistant professor, Schumpeter wrote that letter to support the prolongation of the contract, which was endangered.

But, when 23, he followed this up by a paper on the simultaneous derivation of logarithmically linear demand and supply functions, which won international attention. (Dr. R. Schmidt, the Kiel mathematician, helped with the mathematics. Perhaps you know him.) Everybody read, discussed, criti-

<sup>37</sup> See Part II of Morgan (1990).

<sup>38</sup> For a detailed analysis of the intense relationship between Schumpeter and Leontief in the decisive years 1929–35 and Schumpeter's role as a promoter of Leontief's professional career see Bjerkholt (2016).

cized, admired or damned it—young Leontief was, in this field, in the centre of discussion. Much may be said for and against the method itself, but no doubt is possible about the question relevant here, viz. the supreme force and brilliance of the author as displayed by it. No similar case, of similar success of so young a man, is known to me either from experience or from the history of my science.” (Joseph A. Schumpeter, letter of November 10, 1935 to George Birkhoff asking for the promotion of Leontief for a second term as Ass. Professor at Harvard—Schumpeter, 2000, p. 281)

Schumpeter here refers to the very first 1929 article by Leontief, which provoked the fierce critique by Frisch. The first statement is wrong since Leontief was 24 not 23, when he wrote this article on the simultaneous derivation of logarithmically linear demand and supply functions.

Schumpeter wrote also a letter with similar content to John Maynard Keynes to ask him to support the prolongation of Leontief’s contract. As is well known today, Schumpeter was successful: Leontief’s contract was renewed. But now we have left Germany permanently and are fully in the USA where Leontief’s work became increasingly preoccupied with input-output analysis.

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Appendix A

**Formule A**

1	Staat/État/Country <b>Bundesrepublik Deutschland</b>		
2	Standesamtsbehörde Service de l'état civil de München Civil Registry Office of München		
3	Auszug aus dem Geburtseintrag Nr. 2445/1905, Standesamt I München Extrait de l'acte de naissance n° Extract from birth registration no.		
4	Tag und Ort der Geburt Date et lieu de naissance Date and place of birth	Jo Mo An 05 08 1905	München
5	Name Nom/Name Leontief		
6	Vornamen Prénoms/Forenames Wassily		
7	Geschlecht Sexe/Sex M		
		8	9
		Vater Père/Father	Mutter Mère/Mother
5	Name Nom/Name Leontief	Leontief geb. Becker	
6	Vornamen Prénoms/Forenames Wassily	Slata	
10	Andere Angaben aus dem Eintrag/Autres énonciations de l'acte/Other particulars of the registration		
11	Tag der Ausstellung Date de délivrance Date of issue	Jo Mo An 04 10 2005	 Heide Jungnick Unterschrift/Signature/Signatura
			 Siegel/Scellum/Seel

SYMBOLES/ZEICHEN/SYMBOLS/SIMBOLOS/ZYMBOLIS/SIMBOLI/SYMBOLEN/SÍMBOLOS/SARETLER/SIMBOLUSYMBOLE  
 Jo: Jour/Tag/Day/Dia\* Ημερα/Giorno/Dag/Dia/Gün/Dän/Dzien  
 Mo: Mois/Monet/Month/Mesi/Mήνας/Mesa/Maand/Mbe/Ayn/Magb/Miesiac  
 An: Année/Jahr/Year/Año/ Έτος/Anno/Jaar/Ano/Yil/Godna/Rok  
 M: Masculin/Männlich/Masculine/Masculino\* App. cv/Maschile/Mannlich/Masculino/Erkek/Muško/Męska  
 F: Féminin/Weiblich/Feminine/Femenino\*Θήλυ/Feminile/Vrouwelijk/Feminino/Kadın/Zenska  
 Mar: Marriage/Eheschließung/Marriage/Matrimonio\*Τόμος/Matrimonio/Huwelijk/Casamento/Evienme/Zakljubenje braka/Matzenstvo  
 Sc: Séparation de corps/Trennung von Tisch und Bett/Legal separation/Separación personal/Χωρισμός από τραπεζής και κοιτης/  
 Separação pessoal/Scheiding van tafel en bed/Separação de pessoas e bens/Aynit/Fizicka rastava/Separacja  
 Div: Divorce/Scheidung/Divorce/Divorcio/Διζύγιον/Divorzio/Echtscheidung/Divorcio/Boşanma/Rozvod/Rozwód  
 A: Annulment/Nichtigerklärung/Annullament/Anulación\* Ακυρωσις/Annulamento/Nietigverklaring/Anulación/Pol/Ponistenje/  
 Uniovažnienie  
 D: Décès/Tod/Death/Defunción/Θάνατος/Morte/Overlijden/Óbito/Ölüm/Smrt/Zgon  
 Dm: Décès du mari/Tod des Ehemannes/Death of the husband/Defunción del marido/Θάνατος του αυζύγου/Morte del marito/Overlijden  
 van de man/Óbito do marido/Kocarin ölümü/Smrt muž/Zgon meža  
 Df: Décès de la femme/Tod der Ehefrau/Death of the wife/Defunción de la mujer/Θάνατος της αυζύγου/Morte della moglie/Overlijden  
 van de vrouw/Óbito da mulher/Karının ölümü/Smrt žene/Zgon žony

Fig. A1. Birth Certificate of Wassily Leontief jr., dated 4 October 2005, City of Munich.

Source: Handed to his daughter Svetlana Alpers.



Appendix B

QUOD FELIX FAUSTVMQVE SIT  
VNIVERSITATIS LITTERARIAE  
FRIDERICAE GVILELMAE  
BEROLINENSIS

RECTORE MAGNIFICO  
WILHELM HIS

MEDICINAE ET CHIRVRGIAE DOCTORE IN HAC VNIVERSITATE PROFESSORE PVBLICO ORDINARIO A CONSILII MEDICIS  
INTIMIS INSTITVTI PRIMI CLINICI DIRECTORE ORDINIS CRVCIS FERREAE IN SECVNDIA ET PRIMA CLASSE ORDINVM  
REGIORVM ET AQVILAE RVBRAE ET CORONAE IN TERTIA CLASSE MVLTORVMQVE ALIORVM ORDINVM EQVITE

EX DECRETO ORDINIS AMPLISSIMI PHILOSOPHORVM  
PROMOTOR LEGITIMAE CONSTITVTVS

ALBERT BRACKMANN

PHILOSOPHIAE DOCTOR IN HAC VNIVERSITATE PROFESSOR PVBLICVS ORDINARIVS SEMINARI HISTORICI DIRECTOR  
ACADEMIAE SCIENTIARVM BORVSSICAE SOCIVS ORDINARIVS SOCIETATIS LITTERARIAE GOTTINGENSIS SOCIVS  
EPISTVLARIS ORDINIS CRVCIS FERREAE IN SECVNDIA CLASSE ALIORVMQVE ORDINVM EQVES

ORDINIS PHILOSOPHORVM II. T. DECANVS

VIRO CLARISSIMO ATQVE DOCTISSIMO

WASSILY LEONTIEF

RVSSO

POSTQVAM EXAMEN PHILOSOPHIAE CVM LAVDE SVSTINVT  
ET DISSERTATIONEM LAVDABILEM CVIVS TITVLVS EST

«DIE WIRTSCHAFT ALS KREISLAUF»

AVCTORITATE ORDINIS PROBATA EDIDIT

PHILOSOPHIAE DOCTORIS  
ET ARTIVM LIBERALIVM MAGISTRI

ORNAMENTA ET HONORES

DIE XIX. M. DECEMBRIS A. MCMXXVIII

RITE CONTVLIT

COLLATAQVE PVBLICO HOC DIPLOMATE

PHILOSOPHORVM ORDINIS OBSIGNATIONE COMPROBATO  
DECLARAVIT



BEROLINENSIS  
UNIVERSITATIS LIBRARIA

Fig. B1. Official document of Leontief's Ph.D.

Source: Archive, Humboldt University Berlin.



## Appendix C



**New York University**  
*A private university in the public service*

Institute for Economic Analysis  
 269 Mercer Street, 2nd Floor  
 New York, N.Y. 10003  
 Telephone: (212) 998-7484  
 Fax: (212) 995-4165  
 Telex: 235128NYU UR

**Wassily Leontief**  
 University Professor

February 8, 1993

Dear Professor Lowe:

*I congratulate you on your 100th Birthday!*

*I never had an opportunity to congratulate someone whose life spanned an entire century and I am doing so with particular pleasure, because I had the privilege of meeting you for the first time seventy-four years ago.*

*I was a member of your seminar in Kiel. We met not in the main building of Institute but in the small club house standing on the shore of the "Kieler Fjorde"; while discussing deep theoretical problems we could watch the sails of slender yachts gliding back and forth.*

*I remember how on many occasions, while "playing hooky" --instead of sitting dutifully at my desk-- I was steering a sailing boat passed the Institute and had to drop flat on the deck in order to escape the watchful eyes of the Hern Geheimrat Professor Dr. Harms surveying the blue waters from his desk facing the front window of his splendid office located on the second floor.*

*I still cherish the discolored snapshot taken in 1927 or 1928 during one of the institute dances. It shows three rows, one above the other of laughing faces of young assistants and their girlfriends, with Gerhard Colm and Haus Neisser (sporting a naval officer's cap) on the side, and you standing in the background with a benign smile on your face.*

*Those were happy times and then came the terrible times. You lived throughout all of them keeping on a strait course, teaching and guiding generations after generations of your students and admiring colleagues.*

Sincerely,

Wassily Leontief

WL/mp  
 [8:\WL1600.06\Lowe]

**Fig. C1.** Fax letter from Leontief (New York) to Lowe (Wolfenbüttel, Germany) congratulating Lowe to his hundredth birthday on 4 March 1993.

Source: Copy given by Lowe to the author.