The Supply and Demand of Graphic Representation: Visual Culture and Economics Textbooks (1948-1969)

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Yann Giraud

Center for the History of Political Economy
Duke University, Dept of Economics
Box 90097 / Social Science
Durham, NC 27708
yann.giraud@duke.edu

Abstract

In this paper, I analyze the changes affecting modern economics textbooks such as Samuelson's *Economics*, within the broader context of the American visual culture as inherited from the interwar period. The new tools and Medias depicting and disseminating social information to a mass audience were heavily used as means of education during wartime. When economic departments all over the US were confronted with an increasing flow of students, teachers emphasized the necessity of relying more extensively on visual aids. *Economics*, which was particularly concerned with the problem of addressing non-professional audiences, used visual representation but as a tool of communication and persuasion and in so doing changed the place of visualization in economic education. I argue that the rise of visual representation in US economics textbooks involved a change in the role of visual language itself, which ceased to be a mean of production of economic knowledge but a language of communication with mass audiences. This is contrasted with the way visualization has been used in British economics textbooks during the same period, as a way to develop the student's ability to think rigorously.

1. Introduction

Giving a personal account of the changes that occurred in the economic discipline during the second half of the 20th century, Robert Solow chose to begin his recollection by drawing the reader's attention to the increasing use of visual representation in economics textbook.[1] Indeed, a look at some of the most important introductory textbooks published from the early decades of the century to the beginning of the 1970s reveals how significant has been the rise of visualization in those texts. Whereas Frank Taussig's *Principles of Economics* (1931) had only 14 diagrams over more than a thousand pages and two volumes, the first edition of Lipsey and Steiner (1972) contained 325 figures for about 800 pages. It appears that the rise of visual language in such introductory textbooks really escalated during the 1950's and that its place became truly significant by the mid-1960's – with a figure every two or three pages.[2] Since then, the prominent place of visual language in economics textbook has been seen as so obvious that it is now considered a characteristic beyond investigation.[3]

By contrast, the increasing use of visual representation in recent economics has not raised the attention of historians of economics.[4] The few articles that have been

[1] See Solow (1997: 40).

[2] Whereas Samuelson's *Economics*' 1st edition (1948) contained 85 figures for 622 pages, its 6th edition (1964) had 209 figures for 838 pages and its 10th edition (1976), co-written with Peter Temin, had 305 figures for 917 pages.

[3] Though many contributions in the field of economic education have been devoted to the use of visual representation (mainly diagrams), those contributions do not offer an insight on the place of visual representation in the field. Instead, they take the importance of visualization as granted and study the accuracy of some particular visual representations for any given teaching program. See, for example, Alston & Wan (1989), Wilkins (1992) and Kugler & Andrews (1996). Yet it is noticeable that Cohn & al. (2001, 2004), who observed the relentless rise of diagrams in economics textbooks, statistically showed that "there may be circumstances when graphs may not be helpful and might even be counterproductive because they might confuse the students" (2001: 308).

[4] Though many works have been published in the field on various theories that involve the use of visual representation, like Hick's IS-LM model or Viner's cost curves, the role of visual representation in those

published on the subject have focused on late 19th century and early 20th century economics, when many canonical diagrams were invented.[5] Because they were particularly interested by the place of visual representation in the process of production of economic theory, these contributions gave little attention to the question of diffusion and to the place of the audience. Yet the latter is of great importance when we want to study the evolution of visual representation in economics textbooks. More than journal articles, textbooks are products, whose success depends not only on their scientific achievements but also on the ability of the author to convince his audience and to satisfy a demand. Textbooks stand at the crossroads of the publishing market and of the market for education. Therefore, their evolution must be placed in the larger visual and print culture.

In this article we argue that to be fully understood, the rise of visual representation in introductory economics textbooks must be put back in the context of a series of changes that have affected visual culture in the Western world from the interwar period to the early postwar years. During this period, under the joint influence of scientists, propagandists and governmental institutions, images became powerful tools of persuasion of and demonstration for the masses. Samuelson's *Economics* was one of the first economics textbook to grasp the potential of visual language for teaching the latest development of the discipline to larger cohorts of students who entered American universities following WWII. Following the unmistakable success of *Economics*, American textbooks, including the subsequent editions of Samuelson's, relied more heavily on visual representation. That was especially true when authors wanted to open the discipline to a broader audience and to emphasize its scientific character. Yet this evolution contrasted with that of British textbooks, in which visual representation, consisting mainly of diagrams, was used as finger exercises in a process of socialization within the discipline. The coexistence of these two distinct traditions shows that the rise of visual representation in economics textbooks cannot be explained

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models, how it interacts with verbal and mathematical languages and eases the production and diffusion of the theory, has barely been investigated.

[5] See for example Maas & Morgan (2002), De Marchi (2003), Morgan (2004) and Cook (2005).

by the evolution of economic theory alone, but also by the various contexts surrounding its diffusion and the various audiences that are addressed.

In section 2, we explain the rise of visual representation in postwar economics textbooks as the result of changes affecting both demand and supply of pictures in western societies, i.e. visual and print culture in Europe and in the US, as well as the evolution of the academic world. We show how the various innovations that have been developed in visual communication during the interwar period have been applied to higher education in the early postwar period, when the increasing number of students in US universities revealed the necessity of changing teaching methods. Section 3 illustrates how these visual tools for mass communication have been incorporated into the economics textbook, focusing on the visual apparatus of *Economics* and the context of its publication. We show that unlike previous textbooks, which used diagrams as mere illustrative devices, successive editions of Samuelson's *Economics* endorsed visual language as a tool of persuasion and communication of economic theory. Section 4 draws a comparison between this evolution of the American textbook and that of the English textbook. We show that instead of using visual language as a way of broadening economic theory to a larger audience, English textbooks pursued the tradition of Marshall's diagrammatic analysis, in which the study of diagrams constitutes the early stages of mathematical economic theorizing. Section 5 offers concluding remarks.

2. The invention and diffusion of a visual mass education in the early postwar period

From the mid-1920s to the early postwar period, American society witnessed a rise of the visual character of work, leisure and education. Scientists, teachers, publishers and propagandists altogether encouraged the use of visual language as the main vehicle to spread information and opinions to a larger audience. Among those innovations was the photographical project initiated by the Historical Section of the Farm Security Administration (FSA). An emanation of the Resettlement Administration of 1935, the FSA was a governmental agency whose main goal was to promote programs remedying

rural poverty. It was headed by Rexford Guy Tugwell, formerly an economics and political science professor at Columbia University. According to Cara Finnegan (2003: 35), "Tugwell had become increasingly convinced of the power of visual images to frame issues and influence audiences" during his years at Columbia when he coauthored the economics textbook *American Economic Life and the Means of Its Improvement* (1925). The book contained an abundant iconography, including maps, network schemas, statistical charts and a series of pictures by photographer Lewis Hine.[6] The visual part of the book had been prepared by Tugwell's graduate student Roy Emerson Stryker. The latter had borrowed these materials from daily news and magazines like the *New York Times* and *The Survey*, and from other sources published by the US departments of labor and agriculture. Consequently, Tugwell hired his former assistant to supervise the Historical Section. Stryker's job at the FSA consisted in gathering and using charts, graphs and other kinds of visual aids related to the programs of the administration. He hired a group of photographers, whose mission was to travel around the US and to collect pictures related to farm activities. With the likes of Dorothea Lange, Walker Evans and Arthur Rothstein, they gathered more than 250,000 pictures.

Without Medias to diffuse them to a broader audience, these pictures would have been useless to Roosevelt's administration. The interwar period witnessed the expansion of newsmagazines like *US Camera*, *Look* and *Life*. Their development was made possible by a greater productivity of the rotary press, which enabled publishers to include more visual materials in their books and magazines. One of the most important outputs for government propaganda was *Survey Graphic*, a liberal sociological magazine promoting "the graphic representation of social facts" (Finnegan 2003:63). The whole concept of this magazine, founded in 1921 by Paul Kellogg, rested on the idea that the diffusion of liberal ideas should be based on the scientific process of

[6] The presence of such a diversified visualization was not unusual in a textbook devoted to the description of the US economy. The book's main competitor, L.C. Marshall and L.S. Lyon's *Our Economic Organization* also contained photographs, maps and schemas. Yet what was rather unusual was the extent of the visualization contained in Tugwell's book and its integration in the text as means of argument.

collecting and analyzing social facts.[7] Visualization was seen as the most appropriate way to convey this analysis to a larger audience. The journal often ordered the FSA photographs to illustrate their articles and the FSA occasionally asked the magazine to include special reports. *Survey Graphic* also began to incorporate a new scientific technique of graphic representation of social facts called "Isotype" (international system of typographical education). This technique had been invented by the economist and sociologist Otto Neurath, in collaboration with the German painter Gerd Arntz, in the late 1920s. For Neurath, visual language was more than an illustrative device and its use reflected his whole conception of the economic system and of economic theorizing.[8] This graphical method consisted of wide tableaux made of standardized pictographic symbols representing quantities. One of the assets of visual language against an arithmetical representation of statistical data was that it contained no monetary quantities and no mention of value and costs; another one was its universal character.[9]

Those new tools were far from neutral in representing social facts. In Neurath's pictograms, the poor and the unemployed were represented with dangling arms, displaying a sad appearance. When it was published in *Survey Graphic*, Lange's famous picture "The Migrant Mother" was consciously darkened to increase its emotional impact.[10] The choice of caption wording was often meant to enhance the demonstrative power of the picture. However, those representations lost most of their ideological content, as they became part of the American visual culture. Images were not mere illustrative artifacts anymore; they had become powerful tools of demonstration devoted to a large audience. As such, they could be used as pedagogical devices, a role that was

[7] Actually, *Survey Graphic* was an emanation of the *Survey*, which Stryker had used as a source of visual representations in preparing *American Economic Life*. From 1921 to 1932, it was a supplement of *The Survey* and it became a separate publication in 1933.

[8] On Neurath's visual project in Red Vienna, see Leonard (1999), on Isotype see Lupton (1986).

[9] As Ellen Lupton (1986: 50) observes : "To the theorists of constructivism, de Stijl and the Bauhaus, geometry held the promise of synthesizing art and technology, and offered a visual "language" that would exist independently of particular cultures … Constructivist graphics often paired geometric and photographic imagery, both of which were considered universal and objective".

[10] See Finnegan (2003: 99).

increased in American Society during wartime, as Roger Burlingame observed (1959: 407):

> During the war visual education was widely used in quick training programs. At that time when the requirement of speed was paramount, the people in command of training projects seized upon any device that could help quicken the instruction. Factory workers were taught by films how to use lathers or millers; men in the Army medical corps were shown films on first-aid procedures; soldiers were taught everything from machine-gun assembly to venereal prophylaxis by motion picture.

US Army technical and field manuals were full of visual content: there were pictures and schemas of firearms, munitions, vehicles, telescopes and gun-aiming devices. There were also complex organizational flowcharts and some maps representing operation centers or the state of German forces. Maps particularly required good skills in visualization, with various pictograms representing various kinds of mines and their schemes of arrangement on a given field (cf. figure 1 below). The rising demand for technical manuals was a highly profitable trade for some publishers, and one of the most prolific in this respect was McGraw Hill. Founded in 1909, following the merge of two companies that had been created in the mid-19th century, McGraw Hill partly owed its expansion to governmental orders during WWI. In 1917, the US Army Educational Commission ordered 150,000 technical manuals to be sent to France in 10 days.[11] McGraw Hill was chosen by US government because it had become the leader in engineering textbook, providing widely illustrated materials for teaching. During WWII, the company's paper orders were considered as special priority by US government. This allowed for economies of scale and for another lucky period of expansion after ten years of depression encountered by the company.

[11] According to Burlingame (1959: 306), "this was the largest single order for technical books ever placed with any publisher".

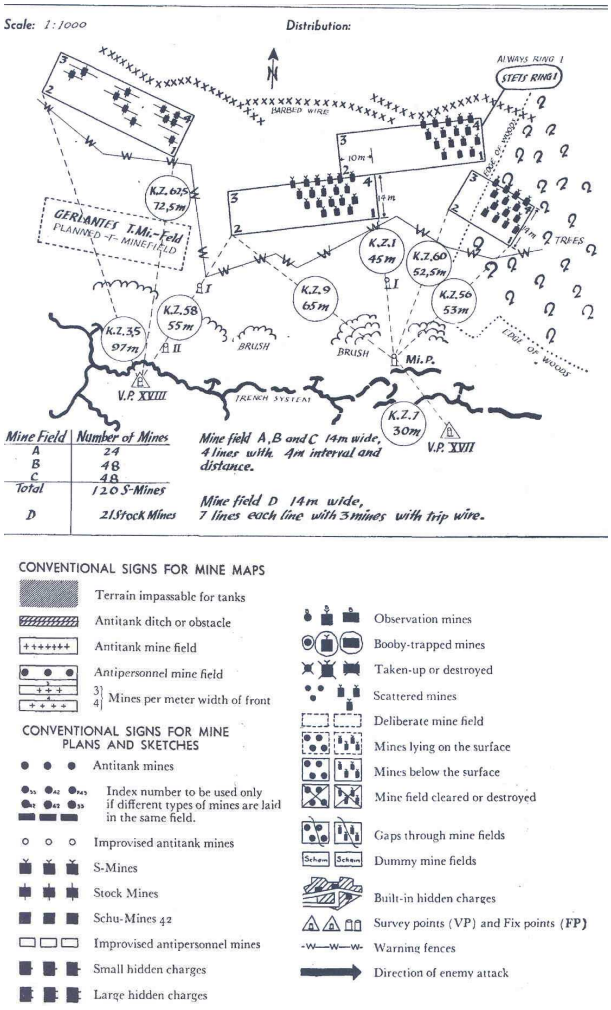

Figure 1. German mine field with caption
WWII Technical Manual TM-E-30-451 (1945: IV-40-4)

At the end of WWII, partly as the consequence of Roosevelt's Servicemen's Readjustment Act of 1944, American universities and colleges witnessed the arrival of an increasing number of students. The GI Bill of Rights offered grants for young soldiers wishing to pursue higher education, covering part of their registration fees and providing financial assistance for those of them who would encounter a period of unemployment after their studies. Between 1939 and 1950, the number of bachelor degrees delivered by American universities, schools and colleges doubled. Economics departments were no exception, and this had an impact on how the subject had to be taught. According to Howard Bowen's report on Graduate Education (1953), there was

only a minority of economic students who wanted to become teachers or researchers. 38 per cent of registered students wanted to work in the business area but only half of them thought that economic theory would play a role in their future profession. 13 per cent claimed they pursued economic studies because of the existence of grants and 33 per cent registered for mere intellectual curiosity. In other terms, economic teaching was not devoted to specialists anymore. At the end of the 1940s decade, the American Economic Association had ordered a report on 'the Teaching of Undergraduate Economics' which was published in 1950 under the supervision of Horace Taylor. An entire section was devoted to the use of visual aids in undergraduate economic education. It was based on a survey addressed to 153 economic departments during the year 1947-48. According to this study, economic teachers endorsed visual aids as pedagogical devices. Most cited visual aids were statistical diagrams and circular flow diagrams, but also mentioned film strips, movies, photographs and pictorial statistics. Yet teachers admitted they devoted only 5 per cent of their time using visuals, because of the lack of available materials. At the end of the report, the authors advocated a centralized production of visual aids.[12]

By the late 1940s, despite an increasing demand for visual materials and the existence of new visual methods to teach a larger audience, visual representation in introductory economic textbooks was reduced to a strict minimum. One of Harvard's endorsed textbooks, Frederic Garver and Alvin Hansen's *Principles of Economics* (1928) contained only 75 diagrams over 726 pages, of which only 21 were statistical diagrams – the most demanded diagrams by economic teachers according to the 1950 report. Summer Slichter's voluminous *Modern Economic Society* (1931), one of the other recommended textbooks at Harvard, contained only 15 diagrams — among which 2 statistical ones — and only a few numerical tables. Even Kenneth Boulding's *Economic Analysis* (1941), with its 164 figures for some 800 pages, fell short of statistical diagrams.[13] In fact, the only introductory textbook writer expressing the

[12] See Taylor (1950: 187-201).

[13] On the other hand, Boulding's book could hardly be considered an introductory textbook: it was a technical book devoted to the specialist, which could have been recommended for a graduate student. It is indeed recommended by Bowen's AEA report on graduate education (1953).

necessity of using visual materials was Irving Fisher, who wrote in the preface of his *Elementary Principles of Economics* (1937 [1912]: *xii*): "the 'difficulties' in the elementary use of curves are largely imaginary. Every beginner in economics may be assumed to be familiar with latitude and longitude on a map, and perhaps also with the temperature charts in the daily paper. It is a very easy step from these to curves of supply and demand, provided they be used with sufficient frequency and with sufficient system to take lodgment in the student's memory". He was also the only one to associate the necessity of using visual language in economics textbooks and its rise in some other domains of American culture. Yet, *Economics* by Fairchild, Furniss and Bucks (1940), which was built on Fisher's textbook, used even less diagrams than its predecessor, leaving aside the hydraulic apparatus Fisher had invented to represent economic equilibrium. Not only visual aids were scarce in most economics textbooks published before and even after WWII, but they were often drowned in the body of text, displayed with no caption and reduced to a ridiculously small size. These were merely illustrations of the verbal arguments and did not participate to the core of the demonstrations. In other terms, there was room on the US economics textbook market for books which would seize the opportunities given by the rise of visual education in other domains and meet the demand that had been expressed by economic teachers.

3. How visual mass communication was incorporated into the economics textbook

Published in 1948, Samuelson's *Economics: an Introductory Analysis* was a very different textbook.[14] Though it contained no more diagrams than Garver and Hansen's textbook of 1928, it endorsed visual representation as a language of demonstration and persuasion, not as a merely illustrative device. The specificity of *Economics* can be explained by its context of publication. Samuelson published *Economics* as a professor at MIT, a school he had joined in 1940, soon after he had finished his PhD thesis

[14] Though Elzinga (1992) and Skousen (1997) offer some interesting facts about the publication of *Economics*, it must be noted that they are intended as critical essays of its content – concerning especially policy recommendations. As a consequence, Samuelson (1997) and Samuelson & al. (1999) adopt an apologetic tone.

dissertation at Harvard. MIT was mainly oriented toward engineering and applied sciences. The inclusion of economics courses was made necessary by the significance of economic in some parts of engineering. Yet MIT economics department was not particularly renowned in the early 1940s, and there was no doctoral program before Samuelson's arrival. At this time, the school was increasingly involved in military programs, with the creation in 1940 of the Radiation Laboratory – hereafter referred to as 'Rad Lab' – by the National Defense Research Committee.[15] According to Philip Mirowski (2002: 225), Samuelson was hired by the Rad Lab in 1944 and was working on some calculations related to the testing of MK-56, a gun-aiming device for heavy guns and naval vessels. Even if his work was mainly statistical and rather isolated from the military domain, it is no exaggeration to suggest that he was much more involved in the engineering and applied sciences culture than most of his fellow economists and as a result knew better about the profusion of visual aids in US army technical manuals. During this period, Samuelson was, in his own words, "temporarily out of economics" (Samuelson 1950: 358).

After WWII, technical institutes witnessed an increasing number of students to a larger extent than traditional universities.[16] The fact that Samuelson taught at MIT, where economics was only a minor subject, influenced the way he had to articulate his course. After all, his students only needed basic economic knowledge as part of their curriculum. Ralph Freeman, who headed the economics department, asked Samuelson to write a textbook for future engineers. Samuelson wrote a manuscript that was mimeographed and distributed to students. According to Elzinga (1992: 862),

[15] It is noticeable that the National Defense Research Committee was headed by MIT former vice-president Vannevar Bush. For more information on the Rad Lab, and more generally on the relations existing between and MIT and the military administration during the Cold War period, see Leslie (1993).

[16] According to Burlingame (1959: 398): "When the war was over, quantities of men who had been exposed to various programs of training filled the technical institutes to overflowing and posed an urgent need for more. These schools were a natural for veterans who were unable to get into colleges and universities or whose formal education had been so interrupted that they no longer felt they could give the time to long courses. The GI Bill of Rights, however, provided ample funds for the two-year technical institute curriculum. The result was that these schools multiplied almost overnight".

Samuelson chose McGraw-Hill among several offers because he was acquainted with the company local salesman and because the company had published Schumpeter's *Business Cycles* in 1939. In fact, this choice was particularly judicious in regard to the book's expected audience. Though McGraw-Hill had already forayed into economics, with the purchase of *Business Week* in 1929, *Economics* constituted a breakthrough for the company, which would eventually become leader on the economics textbook market.[17] For Samuelson, choosing McGraw-Hill as a publisher allowed for a more luxurious cover and binding than other competitors on the market.[18] On the cover and the edge of the first edition was printed in relief and in two colors one of its most famous visual representations, known as the "Keynesian cross". [19]

[17] During its first year of commercialization, Samuelson's book sold 43,000 copies, 48,000 in 1949 and 31,000 in 1950. Yet the sales figures really took off after the third edition was published, the peak having been reached with the 7th edition, which sold 180,000 copies only in 1967. Incidentally, the first book to top these figures was Campbell McConnell's *Economics*, which sold more than 200,000 copies in 1969 and was also published by the McGraw-Hill Company.

[18] *Economics* 4th edition was selected among the fifty best textbooks published in the year 1957-1958 by the American Institute of Graphic Arts.

[19] It is debatable whether the figure known as the 'Keynesian cross' is the 45 degree diagram, representing the intersection of income and aggregated demand, or the diagram representing the intersection of savings and investment that is reproduced on the book cover. Yet the term Keynesian cross has been used to depict alternatively the one and the other. See Elzinga (1992),

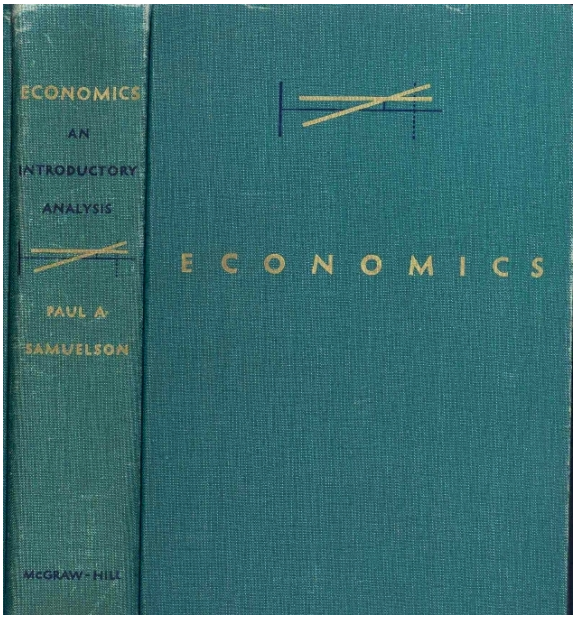

Figure 2. *Economics* 1st Edition cover and binding edge

Whereas previous textbooks' authors seemed to ignore the persuasive power of visual representation, Samuelson paid special attention to the way the figures interacted with the various elements of the text and of the epitext, so that they fully participated to the economic demonstrations provided by the book. In particular, this is shown in the way he introduces the visual representations that have been associated to Keynes's theory: the 45 degree diagram that showed the intersection of income and aggregated demand and the circular flow diagram, a network schema showing how investment determines savings. One of the most interesting features of those two (and other) representations in the book was the accompanying captions. In previously published textbooks, captions were often inexistent, and when they existed, they did not explain how the representation worked. When Samuelson introduced the 45 degree diagram, showing the intersection between aggregated demand and income, he added a caption reading: "How consumption and Investment Determine Income". Yet, the 45 degree diagram does not describe a process but its result. The only thing in this diagram that "demonstrated" the determination of income was its existence on the paper sheet, in the same way a FSA photograph could constitute a demonstration. The process itself was described in the circular flow diagram, a network schema that represented a hydraulic

circuit. The caption for this schema was "How Investment Determines Income". Interestingly, that schema, which had been used as a pure descriptive device in previous textbooks (for example, Bye 1931) was used as an analytical tool by Samuelson.

Among the other figures that Samuelson used as tools of demonstration was the Lorenz Curve. Usually, a Lorenz Curve is a convenient way to represent income inequalities in a given society or country, its intent is descriptive, yet the presence of a line of equal distribution may give the figure a prescriptive flavor, in the sense that it shows all the situations that are closer to the line as "better" than those that are further.[20] Samuelson used the curve on three occasions, twice for descriptive purposes, and then to show the pros and cons of a progressive tax (see figure 3 below). He argued that the tax had a "favorable" impact on equalities and an "unfavorable" impact on investment. This figure showed Samuelson's role as a social reformer, using scientific representation to make the reader react to political questions. This attitude toward visualization was in line with Neurath's project in Red Vienna, which showed visually the advantage of government intervention.

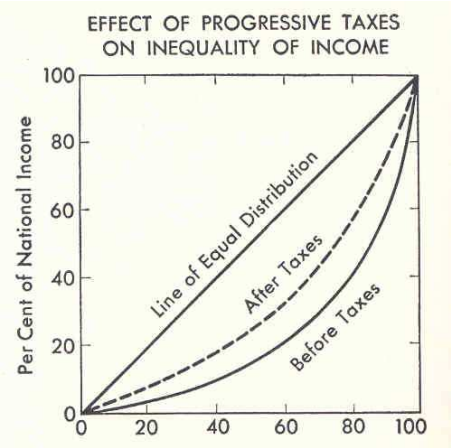

Figure 3. Samuelson's use of the Lorenz Curve (1948: 174)

[20] The 'positive' and 'normative' aspects of the Lorenz Curve, as well as the passage from one to the other in the History of economic thought, have been detailed by Derobert & Thériot (2003).

The Lorenz curve is one of many examples of how empirical and theoretical materials were intertwined in the book. *Economics* contained 36 statistical diagrams, more than any other previously published economics textbook, which were often related to the analytical diagrams used elsewhere in the book. For example, on page 202, Samuelson introduced a statistical chart representing the consumption of various kinds of goods – food, clothing, housing, automobile, etc. – at different income levels. The figure both illustrated the Engel's law that consumption of necessary goods would slow down with higher income, and Keynes's psychological law that total consumption would slow down with higher income. Indeed, a few pages later, Samuelson constructed step by step the curve representing consumption in Keynesian theory. Showing how facts and theories were related, those figures demonstrated how economic theory could solve real life problems.[21]

Subsequent editions of the book contained more visuals with enhanced demonstrative character. The sixth edition, published in 1964, had 197 diagrams, which means than their quantity more than doubled over the course of fifteen years. On the other hand, there were only 200 more pages in the 6th edition, which means than figures were just more frequent than in the 1st edition.[22] The use of visual representation was broadened to more subjects in economic theory, like the theory of foreign trade, the theory of growth and the theory of imperfect competition. Actually, there were not many new diagrams but rather a multiplication of preexisting ones. In the 1st edition, there were three Lorenz Curves and five Keynesian Cross, whereas, in the 6th edition there were five and ten of them, respectively. In the 1st edition, supply and demand schedules were used sporadically, whereas in the 6th edition their use was systematic in

[21] This intention was clearly stated by Samuelson in the preface (p. *vi*): "The Committee for Economic Development is a middle-of-the-road business group that initiates fundamental research in economic policy … Every intelligent citizen should be able to read critically the important reports of this group, ranging as they do from international trade to postwar reconversion. But to present-day economic texts, built on foundations laid-down at about the time of World War I, with chapter on monopolistic competition and national income appended – even the best of them – help in the above task?"

[22] Moreover, the 6th edition offered multicolored diagrams, which was a quite unusual feature of economics textbooks in the mid-60s.

various fields such as agricultural and labor economics. The multiplication of quite similar diagrams in the 6th edition of *Economics* made them look more dynamic and animated than in the first edition, which increased their demonstrative power. There was also a behaviorist flavor in the book's teaching approach: the reader was expected to react to images more than words. The student was brought to the subject by the use of repeated procedures; step by step, he was taught how to apply diagrams to various economic situations. Thus, the understanding of visual representations in the book did not require much former training.[23]

One of the obvious changes in the 6th edition concerned captions. Though the use of caption was already unusual in the 1st edition, the 6th edition offered three different levels related to captions. There were two titles for every figure, the first one describing the content of the figure as a whole – on figure 4 below, it is "The Paradox of Thrift" – and the second one explaining the economic significance of the curve – on figure 4 below, it is "An attempt to save more could result in less actual saving and investment". At last, located on the edge a figure, a few lines of text explained how the curves work and how they intersect. With these multiple levels in the caption the relation existing between words and diagrams was turned upside down: the essential of what was taught was included in the visual representation and the text had now become illustrative and subsidiary.

[23] It is noticeable than in the mid-1960s, behavioral education was quite fashionable, following the publication of B.F. Skinner's *Verbal Behavior*.

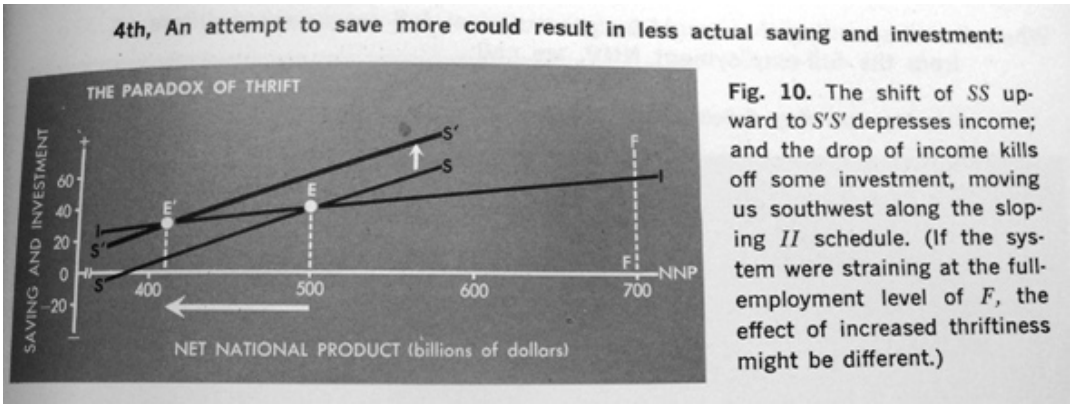

Figure 4. Samuelson's use of captions in *Economics* 6th edition (1964: 239)

This displacement of visual language from subsidiarity to centrality in shaping an argument is what allowed for the use of visual representation as a way to diffuse economic theory to a broader audience, especially the younger ones. In the year 1962-63, the AEA was involved in the creation of a TV broadcast, "College of the Air", which was intended to arouse people's interest for economic questions. This is the reason why the AEA ordered several reports on the diffusion of economic theory toward a broader audience. In 1961, Samuelson, then president of the association, appointed Paul Olson as the chairman of a sub-committee that had in charge the study of high school economics textbooks. Olson published a report in 1963, reaching the conclusion that those textbooks were particularly poor in regard to the expectations of the economics profession. Olson noted (1963: *xii*): "[T]he economic analysis contained in social studies textbooks is distressing in its absence and unfortunate when attempted. It may be hoped that the ample room for improvement which clearly exists will in due course be filled, and the economic quality of the social studies courses in the high schools correspondingly improved".

Leonard Silk and Philip Saunders's *The World of Economics*, published by McGraw-Hill in 1969, explicitly endorsed the report's conclusions, denouncing "the widespread economic illiteracy of the American public". The book had actually two purposes: one was to give American citizens some knowledge of their economy and the other to diffuse economic theory and its scientific aspect to a large audience. For both objectives, visual representation played a primary role. The book contained 86 diagrams

– 42 statistical ones – for about 550 pages. There were also 243 photographs disseminated in the text, as well as about 20 paintings and comic strips. In the introduction, the authors stressed the importance of visual representation in their textbook (Silk & Saunders 1969: *vi*): "We should like to call the reader's attention to our effort to make serious use of the photographs, captions, tables and diagrams as a means of teaching economics. These illustrative materials should be studied carefully; they contain important messages and have not been added just to provide visual relief from the text". Though the book was clearly simpler than Samuelson's text, it was very close in organization and layout. Diagrams, schemas and photographical essays were often intertwined to stimulate the reader and encompass both empirical and theoretical aspects of economic study. Samuelson's circular flow diagram was used by the authors, in a much more complex layout, and was supplemented with a photographic essay of four pictures, which represented people in their everyday economic activities (see figure 5 below).

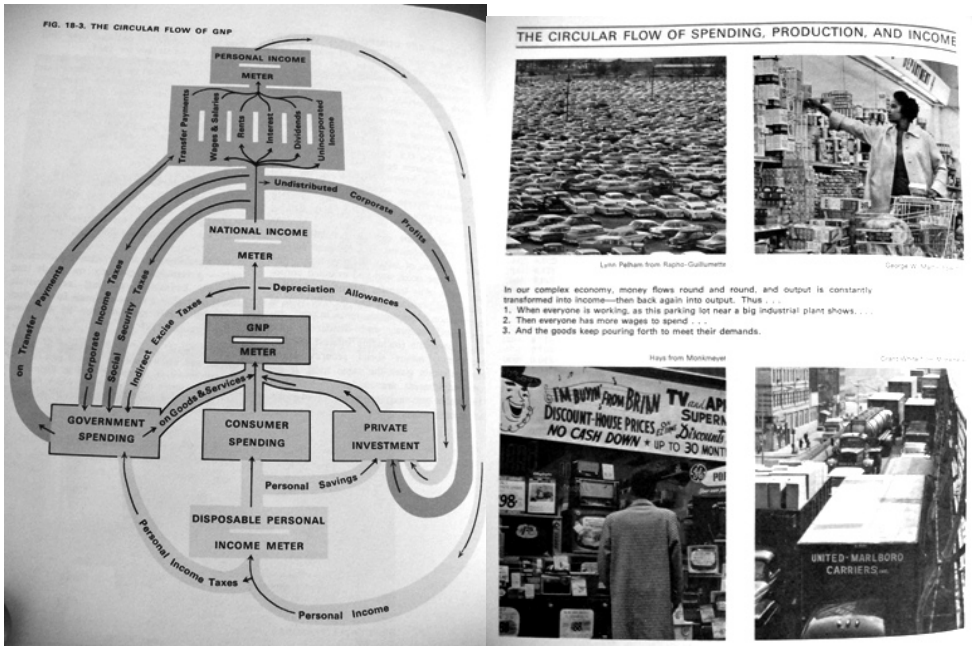

Figure 5. Circular flow represented by a network schema and by a photographic essay (Silk & Saunders 1969:220-6)

Like in Samuelson's textbook, pictures, when properly studied with their captions were self-sufficient and required no particular effort. Pictures were complementing more complicated schemas and diagrams to ease the reader's understanding. In addition, the book constantly stressed the scientific character of the discipline, with pictures of scientific devices (blackboards, laboratories, molecules). That was in line with Leonard Silk's other activities as an economic journalist who praised economic expertise and believed that social advancement depended on scientific development.[24] Silk and Saunders, though they were not renowned as accomplished theoretical economists, shared with Samuelson the same vision of economic science as a vehicle for a general progress for American society, based on a rigorously scientific approach.[25] In this process, the education of citizens was of a crucial importance and visual representation encompassed, more than a mere collection of tools, their vision as social reformers.

4. American vs. British visualization in economics textbooks

As we have seen, the rise of visual representation in postwar economics textbooks was made possible by the emergence of a visual language of demonstration and persuasion that could be used to solve the pedagogical problems related to the influx of students. Because this context was specific to the United States, it would be interesting to see whether a similar development occurred in British economics textbooks. The latter undoubtedly witnessed an equally significant increase of visual representation: whereas Frederic Benham's *Economics* of 1938, contained only 23 diagrams, Stonier and Hague's *A Textbook of Economic Theory* of 1953, had seven and a half times more diagrams. Yet, a comparison between American and British textbooks shows that the use of visual representation was different in nature. Unlike their American counterparts, British economics textbooks contained many sophisticated analytical diagrams and few

[24] See also Silk's book of 1959, *The Research Revolution*. For a complete account on Leonard Silk, see Mata (2007).

[25] It is noticeable that Silk obtained his PhD in economics at Duke University in 1947, before working for McGraw-Hill's *Business Week*.

statistical ones – sometimes there were none. More generally, in spite of the profusion of visual language, books looked more austere than their American counterparts. The differences can be explained by looking at Richard Lipsey's *An Introduction to Positive Economics* of 1963, which is often regarded as the British counterpart of Samuelson's *Economics*.[26] In fact, Lipsey was himself critical of Samuelson's teaching methods and his own book was partly written in reaction against *Economics* vulgarizing aspects.

Lipsey was born in Canada and began his economic studies at the University of Victoria, in British Columbian in 1947. He was a rather average student having studied unsuccessfully psychology, the history of western philosophy before turning to economics. Some of his fellow students were war veterans who were fifteen years older and had left school for lack of financial support during the Great Depression. He began studying more intensively when he realized he had intuitions about economic theorizing, having in mind "a rather dramatized, mechanical version of a Walrasian general equilibrium system". Lipsey's early adoption of the diagrammatic method in economics may be explained by his reading of Kenneth Boulding's *Economic Analysis* (1941), which was replete with diagrams.[27] Boulding thought that visual language should be used in economic education, not only because of its simplicity and its appeal to the eye, but because the mind perceived the world as an ensemble of forms, shapes and fittings.[28] Lipsey was particularly impressed with Boulding's graphical exposition of Hotelling's model of spatial differentiation. Like many students of his time, he did not consider pursuing further mathematical studies but turned instead to statistics.[29]

[26] See King & Millmow (1999) and Backhouse & Medema (2007).

[27] This is reconstructed from Lipsey's autobiographical essay (1997).

[28] See Boulding (1988). Boulding, who was given American citizenship in 1949, was a British-raised economist who had studied in Oxford before leaving England for the University of Chicago in 1932. Though his economic thinking was rather original, his adoption of visual language as a language of theorizing was rooted in the Marshallian tradition of diagrammatical analysis, which was dominant in Great Britain in the 1930s.

[29] Bowen's report of 1953 shows that in 1950, only 2 per cent of US graduate students were considered as good in mathematics, according to their supervisors.

After a quick stay at Chicago, he went to the London School of Economics in 1953, having received a grant to write a PhD dissertation under the supervision of Helen Makower.[30] Lipsey's chosen field of study for his dissertation was foreign trade theory, which had been previously investigated with the help of diagrammatic analysis. Yet Lipsey had chosen a very particular problem in the field of international trade, that of trade unions, which had been developed by Jacob Viner. He soon realized that, for this study, the use of diagrams would not suffice:

> I had been taught only two techniques for analyzing problems in international trade. The first was numerical examples … The second was geometry which was the dominant tool of analysis and which was well expounded in Meade's *Geometry of International Trade*, and at which Harry Johnson was a master. But customs unions problems as I saw them required three countries and three commodities. … So, like many economists and as a PhD student at the LSE I set out to read R.G.D Allen's *Mathematical Analysis for Economists* began to teach myself how to differentiate x^2.[31]

Yet diagrammatic analysis was still predominant at LSE, with the presence of James Meade and Harry Johnson. Meade's *Geometry of International Trade*, published in 1952 was a technical textbook in the British tradition, in which foreign trade theory was used as a pretext to a series of finger exercises in geometry that the students were expected to overcome in order to address various economic subjects in the future.[32] Johnson was interested by Lipsey's first article about trade union and helped him publish it. It is in that context that Lipsey began to write his textbook. At this time, his

[30] Makower (1910-1998) was part of a group of brilliant students at the LSE – among whom Abba Lerner, Ursula Webb and Paul Sweezy, founders of the *Review of Economic Studies* – and had defended her PhD dissertation there in 1937. After years outside of the LSE – doing statistical studies at Oxford under Jacob Marschak and at UNESCO under Gunnar Myrdal, she had come back in 1949 to teach the theory of international trade.

[31] Lipsey (1997: *vi*).

[32] Meade (1952: 5): "This book is written merely to show how various trade situations may be geometrically represented, so that the student can himself employ the geometrical technique for the solution of the various problems which he subsequently encounters".

experience as teacher had left him dissatisfied with Samuelson's *Economics*, especially its treatment of microeconomic theory:

> At the time, the prevailing US textbook was Samuelson. I had taught my first introductory course … out of its third edition. The macro was great, but the micro was not. When one had finished the macro, the micro came as an afterthought with the kind of attitude 'Well kiddies, the examiners will want you to know some of these curves so here they are, boring though they may be'. I had been raised a microeconomist and firmly felt that all macro relations had to be derived from micro foundations and I set out to make micro as interesting and as relevant as it had been under Marshall.[33]

Though he advocated the reading of Samuelson's textbook in the preface, calling it "the best text-book at an elementary level", Lipsey adopted a slightly different approach. Whereas Samuelson's diagrams were simple figures that did not need to be worked at by the student, Lipsey stressed the importance of individual work over diagrams. In the book preface, he noted (Lipsey 1963: *xiv*): "The student should be prepared … to spend a very long time on difficult sections. He should not be discouraged if, occasionally, he finds himself spending an hour on only two or three pages. A paper and pencil is a necessary piece of equipment in his reading. Difficult arguments should be followed by building up one's own diagram while the argument unfolds, rather than by relying on the printed diagram which is, perforce, complete from the beginning". Thus, many visual representations contained in Lipsey's textbook were plotted drawing the student's attention to the necessity of drawing them on a sheet of paper. This technical orientation of the use of visual language could be explained by Lipsey's own experience as a student, but also by the educational culture that existed at the LSE, and which considered diagrams as exercises. Quantitatively, the book had 173 diagrams, most of them being analytical, not statistical. This was the most surprising for a book which constantly insisted on the necessity of testing economic theory. The use of statistics in the book was often theoretical, when Lipsey attempted to show how the theory of demand could be observed in the reality (figure 6 below).

[33] Lipsey (1997: *x*).

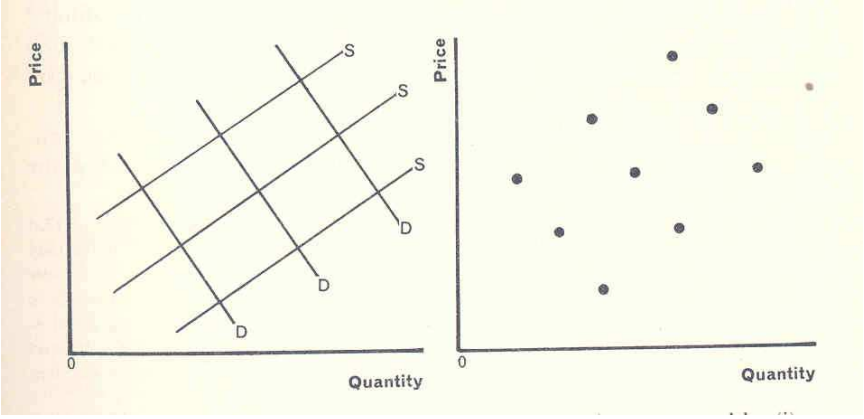

Figure 6. Theory of Demand and its observation (Lipsey 1963: 157)

The macroeconomic section also contrasted with that of Samuelson's textbook. In spite of the use of a circular flow diagram to explain how investment determined income, Samuelson's main working tools to explain macroeconomic theory remained the 45 degree diagram and the Keynesian Cross. On the other hand, Lipsey did not make use of those diagrams, using only a series of circular flow diagrams on which he indicated the values of the various aggregates. Actually, the author was quite critical of Samuelson's Keynesian cross, and more generally of the way Keynes's theory was explained in US textbooks. According to him, one of the drawbacks of a diagrammatic exposition of the Keynesian theory was that it did not tell whether the equality of saving and investment was the consequence of a definitional identity or an equilibrium condition. Lipsey's problem with the idea that the equality of saving and investment could be the consequence of a definitional identity was that a testable prediction could not be deduced from a definition but only from a working hypothesis. Lipsey, who frequently used the machine invented by New Zealand economist A.W. Phillips to represent the circular flow of goods, was unable to get the right numbers and identities out of it. His interpretation was that the equality of saving and investment could only be an equilibrium condition. Because he had to use Phillips's machine to reach this conclusion, Lipsey only used circular flow diagrams that were derived from it to teach macroeconomics and no analytical diagram.

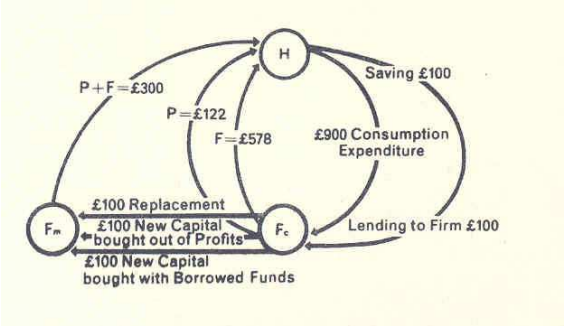

Figure 7. Lipsey's use of circular flow diagrams to teach macroeconomic theory (Lipsey 1963: 157)

Despite his intensive use of visual representation in his textbook, Lipsey considered visual language as inadequate to treat the most complex issues of economic theory. He did provide a rather weak justification for the use of diagrams in the preface, noting that "[The] logical process [of discovering various implications of certain assumptions] may be carried in words, geometry or mathematics. These procedures are usually interchangeable and the only consideration in choosing between verbal, geometrical and mathematical forms of reasoning are economy and ease in making these deductions" (Lipsey 1963: 22). Further in the text, he added :

> "Geometry has the advantage of appealing to the eye. Most people find it easier to comprehend a functional relation when a 'picture' of it is drawn, than when it is stated in a mathematical equation … Great ingenuity has been shown by some economic theorists in inventing dodges so that the relationship between more than two things could be shown on a two-dimensional graph. Beyond a certain stage, however, such graphs become extremely cumbersome and difficult to follow … For this reason most introductory textbooks rely almost exclusively on verbal and geometrical analysis, while an increasing number of advanced works rely almost exclusively on mathematical analysis, using only a few two-dimensional geometrical illustrations to give readers a 'feel' for the more general analysis" (Lipsey 1963: 29).

It is clear from what precedes that Lipsey saw the use of visual representation in economics textbook as an exercise to develop the student's ability to think rigorously, not as an element of demonstration or communication of a pre-existing economic theory. This is how the author himself had come to economic theorizing This conception of economic education was quite opposite to the one that predominant in the

United States. Lipsey became conscious of this opposition as he attempted to publish his successful textbook in the US market.

> It soon became clear, however that *IPE* was too austere and too sophisticated for the typical first-year US undergraduate … Slowly, over the editions, three-quarters of all the things that made *IPE* distinctive were eliminated from *Economics*… This slowly gave way under enormous US market pressure to teach theory as something closer to revealed truth, particularly in micro. It was a very painful process and, although a good but more orthodox book emerged, I felt at every stage that I was taking part in the dismemberment of my own baby.[34]

Economics, coauthored with the help of Peter Steiner contained much more diagrams than its British counterpart – there were more than 300 visual aids disseminated in the book – but it was closer in spirit to Samuelson's method and the peculiarly American features we studied in section 2. One possible explanation for this difference was that in the 1960s decade, 40 % of American teenagers were pursuing higher studies, whereas in UK, they were only 7 %. Thus, the demand side remains crucial to explain the evolution of economic education, and then that of the economics textbook.

5. Concluding remarks

In this paper, we have shown that the increasing use of visual representation in US economics textbook involved a change of the place of visual language in American visual culture. The diffusion of visual representation as a language of mass communication was rendered necessary by the influx of students in the early postwar period. In textbooks like Samuelson's *Economics*, the use of diagrams was prompted by the necessity to communicate the economic results which have been derived from the use of mathematics, when the latter was fast becoming the prevailing language of theorizing. In other terms, visual representation has been conceived mainly as a language of vulgarization in US economics textbooks. Its rise does not reflect much the technical aspects of the discipline than the increasing gap existing between the

[34] Lipsey (1997: *xi*).

theorization and the diffusion of economic knowledge. The same thing could not be asserted about British economics textbooks. In the latter, visualization has been used as a way to encourage the student's rigorous thinking.

Though the democratization of American universities is one of the reasons that may explain the differences existing between American and British visualization in economics textbooks, another possible reason is the preexistence of a visual culture that was specific to British economic theory. Because British economic theory as it had been developed in the early 19th century relied much on the use of the diagrammatic method, it was natural to use visual representation as a tool that shaped the student's intuitions and on which the research was expected to rely. Such visual culture did not exist in US economics, which relied more on verbal statements – and latter on the use of the algebraic method –, so that visualization could be brought from outside of the discipline. Therefore, economic education in the US was more permeable from the larger culture prevailing in the society than it was in the United Kingdom.

Another question that is raised by our paper is how one individual's behavior toward visual representation relates to the larger movement of the increasing use of those in the economics profession. In the case of Samuelson for example, the fact that he used visual representation as a tool of communication may be linked to the fact he did not use much diagrams in his scientific articles, and was an ardent defender of the algebraic method.[35] On the other hand, Lipsey's use of diagrammatic analysis in his textbook seems derived from the way he used it in his own scientific works. Conversely, it is possible that the way textbooks writers like Samuelson and Lipsey have used visual representation in their textbooks influenced how subsequent research has been done, contributing to change the economists' visual culture. Yet trying to appraise how much these economists have been influenced by a preexisting visual culture and how much they influenced it in return may not lead to important results. Our purpose was mainly to show how visual culture, among a community of researchers or

[35] See Giraud (2007).

within the wider society, and personal experiences interact in the diffusion of economic ideas.

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