

Understanding Robert Lucas (1967–1981): his influence and influences[☆]

Alexandre F.S. Andrada

Universidade de Brasília (UnB), Brazil

Received 27 January 2016; received in revised form 30 June 2016; accepted 6 September 2016

Available online 22 September 2016

Abstract

This paper analyzes Robert Lucas's contribution to economic theory between 1967 (year of his first solo publication) and 1981 (the year before the emergence of Real Business Cycle approach), and it has two parts. The first one, using citation data from three different sources, we try to answer two questions: (i) What are Lucas's most influential papers currently? (ii) How has this influence changed through time? We show, for instance, that according to two of those three sources, Lucas's most influential paper today is not from his business cycle research agenda, which gave him his Nobel Prize in 1995. Moreover, it is clear the loss of influence of Lucas's macroeconomic theory since the early 1980s. In the second part, by cataloging all the works that Lucas had used as bibliographical references in his papers and separating them in two categories (positive and negative), we try to understand who exerted influence on him. We show that the author that Lucas most cited in a positive context were John Muth, Milton Friedman and Edmund Phelps. The authors more often cited in a negative context were John M. Keynes and A. W. Phillips. We discuss the reasons behind this data.

© 2016 The Author. Production and hosting by Elsevier B.V. on behalf of National Association of Postgraduate Centers in Economics, ANPEC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

JEL classification: B; B2; B22; B3; B31

Keywords: Robert Lucas; New classical macroeconomics; Citation analysis; Bibliometrics

Resumo

O texto analisa as contribuições à teoria econômica desenvolvidas por Robert entre os anos de 1967 (quando de sua primeira publicação solo) e 1981 (ano imediatamente anterior à emergência da abordagem de ciclos reais). O artigo tem duas partes. Na primeira, fazendo-se uso de dados de citação de três fontes distintas, tenta-se responder as seguintes questões: (i) qual artigo de Lucas – do período analisado – é hoje o mais influente? (ii) como se comportou essa influência ao longo do tempo? Mostra-se, por exemplo, que segundo duas das três fontes utilizadas, o artigo de Lucas atualmente mais influente não pertence à sua agenda de pesquisa sobre ciclos econômicos, a qual lhe garantiu o prêmio Nobel em 1995. Além disso, é clara a perda de influência da teoria de ciclos de Lucas, notadamente a partir do início dos anos 1980. Na segunda parte, após a catalogação de todos os textos usados por Lucas como referência bibliográfica nos artigos de nossa amostra, os separamos em duas grandes categorias: citações positivas

[☆] A previous version of this paper entitled “Understanding Robert Lucas (1967–1981)” – was presented at the **4th ESHET Latin American Conference** held in Belo Horizonte (Brazil) in 2014 and at the **History of Economics Society Annual Conference** held in East-Lansing (USA) in 2015. We are thankful to the participants from both Conferences – their comments, compliments and criticism were crucial.

E-mail address: afsa@unb.br

Peer review under responsibility of National Association of Postgraduate Centers in Economics, ANPEC.

e negativas. Os autores que Lucas mais comumente cita de maneira positiva são John Muth, Milton Friedman e Edmund Phelps. Já os autores mais comumente citados em um contexto negativo são John M. Keynes e A. W. Phillips. Analisam-se as questões por detrás dessa observação.

© 2016 The Author. Production and hosting by Elsevier B.V. on behalf of National Association of Postgraduate Centers in Economics, ANPEC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Palavras-chave: Robert Lucas; Macroeconomia Novo Clássica; Análise de citações; Bibliometria

1. Introduction

In this paper, we make use of citation data obtained from four different sources in order to understand the current state and the changes in Robert Lucas's influence over the scientific community. The twenty-seven papers that Lucas published between 1967 (year of his first solo publication) and 1981 (the year before the emergence of Real Business Cycle approach) are analyzed. The list of papers we use here was obtained from Lucas's own public *curriculum vitae*.¹

The objective is to answer two main questions. First, which are Lucas's currently most influential papers from that period and why they are still so influential? Second, we want to understand how Lucas's influence changed through time. In order to do so, a ranking of Lucas's five most cited papers in different instants of time – 1985, 1995, 1995, 2005 and 2014 – is constructed.

It is not trivial to define or measure something like *intellectual influence*. Any attempt to do it will be subject of heavy and meaningful criticism. This is not ignored here. However, for the sake of simplification, in this paper, it is postulated that if the paper (A) has more citations than paper (B), then (A) is *more influential* than (B). It is important to keep the limitations of this affirmation in the back of the mind. Citation data is certainly not a perfect proxy of influence. However, despite its flaws, we believe it can capture some aspects of intellectual influence. Even if a paper is cited in a negative context, this suggests that it is perceived by the community as relevant; otherwise, it would simply be ignored. Despite the polemical and controversial nature of many of Lucas's papers, the majority of the citations is certainly not of a negative type. Another justification for our approach: this paper does not use citation data in order to compare the influence of different authors from different epochs, approaches, fields, or languages. It is restricted to just one author's works, published in a very short period of time.

This is a hypothesis – that citation captures some aspects of the concept *influence* – which one must feel comfortable with in order to read this paper, otherwise, it will be a meaningless effort.

Another limitation is related to the quality of the data. The sources we use are also subject to criticism due to their limitations, inconsistencies, etc. They use different population samples, have different bias and incompleteness, so they are all imperfect.

In the second part of the paper, a list of all papers that Lucas used in his publications from our sample as bibliographical references is constructed. Its role is to show us with whom Lucas was dialoguing in that time. Those papers are separated in two groups: positive and negative references. It is easier to define the last one. A negative reference is when someone cites a work in order only to criticize it, presenting it as an example of a bad theory, a seriously flawed approach to a question, something that the scholarly community should discharge as useless or outdated. A positive reference, on the other hand, is used as a starting point for further developments, to justify some approach or method, etc. It does not mean that a positive reference is not subject to any criticism, but those criticisms are qualitatively different than the ones present in a negative reference.

2. I – Lucas's influence

Several works of great quality have investigated Lucas's contributions from different perspectives and approaches. Hall (1996), Fischer (1996), Svensson (1996) and Chari (1998), for instance, seek to explain in details the reasons why Lucas deserved his Nobel Prize by analyzing some of his most relevant articles and the influence it had on economics. They all highlight the use (and the consequences) of the rational expectations hypothesis, the equilibrium approach to business cycles and Lucas's econometric critique as the essence of his contributions to economic theory.

¹ Available at: https://economics.uchicago.edu/pdf/reLucas_cv_2012.pdf.

Blinder (1987) and Vercelli (1991) analyze some aspects of the history of macroeconomics from the point of view of the methodological divergences between Lucas and Keynes. Silva (2013) and De Vroey (2010) develop their argumentation based on Lucas's personal archive available at Duke University in order to explain the emergence of some aspects of his theory. Buiter (1980), Laidler (2002), Hoover (1984, 1988), McCallum (1989) and Seidman (2005) choose a less personal approach, discussing Lucas's works in the context of the pros and cons of new classical economics.

We choose a different strategy to understand Lucas: we try to construct our argumentation based on numbers. The data we collected provides us an interesting picture of Lucas's influence over the scholar community. Even though Bibliometrics and Scientometrics are well-established tools used also by economists, we are not familiar with any other paper that had done something similar to what we do here, so we believe that this is an original contribution to this topic of the History of Economic Thought.² It is not easy to define what this thing called *influence* is, nor is it trivial to measure it, and citation data is certainly not a perfect proxy for it. However, citation data definitively captures some dimensions of the concept of influence [see Narin (1976), Zuckerman (1987), and Nicolaisen (2007)].

We analyze 27 papers that Lucas published between 1967 and 1981, as reported in his own public curriculum vitae. Replies, the erratum of *Some international evidence* and review articles are absent from that list. The same is true of his 1977 paper, *A Report to the OECD by a group of independent experts*, although it was included in his book, *Studies in Business-Cycle Theory*, from 1983. We decided not to include those papers for two reasons. First, since Lucas omits them from his curriculum, he is implicitly stating that those are non-relevant works to his intellectual trajectory. Second, those papers usually have few and even none references and/or citations.

Our citation data was obtained from three distinct sources: Google Scholar, Web of Science (WoS), and IDEAS RePEc (Research Papers in Economics). Jstor's data is also used in more specific contexts. Those sources are very distinct, and they all had their flaws and qualities. [see Meho and Yang (2006) and Bar-Ilan (2008) for an introductory debate about this issue].

Table 1 shows the ranking of citations as reported in December 2015 by those 3 sources. They are all in consonance about which are Lucas's five most influential papers nowadays. In chronological order: *Expectations and Neutrality of Money* (1972), *Some International Evidence on Output-Inflation Tradeoffs* (1973), *Econometric Policy Evaluation: A Critique* (1976), *Asset Prices in an Exchange Economy* (1978) and *On the Size Distribution of Business Firms* (1978).

According to Google Scholar, *Econometric policy* and *Asset prices* are respectively his most influential works from this period. WoS and IDEA, however, surprisingly present *Asset prices* in the first position. According to IDEAS, it has 20% more citations than *Econometric policy*. WoS reports an even bigger difference, 55% percent. This is somewhat puzzling because *Asset prices* is not a paper on business cycles, Lucas's best-known research agenda from the seventies.

Econometric policy evaluation: a critique – also known as the *Lucas critique* – was first presented at the Carnegie-Rochester Conference Series on Public Policy in April 20, 1973,³ but it was only published in September 1976. It appeared as a supplement to the *Journal of Monetary Policy*, where the papers from that Conference were presented. According to King (2003: 249), Brunner, as organizer of the event, “asked Lucas to write a survey of the empirical evidence on the Phillips curve”. What he obtained, though a masterpiece, was a different product. Robert J. Gordon and David V. Pritchett were then commentators of Lucas's article.

The *Lucas critique* is a simple idea. Its main argument was that the structural econometric models then in vogue (Klein-Goldberger or Cowles Commission type⁴) were useless to predict the behavior of the economy after some policy intervention. Since agents are rational and can change their behavior, estimated parameters based on previous

² Biddle (1996) investigated the influence of Wesley Mitchell through a citation analysis; and this work is certainly a source of inspiration for us. Bjork et al. (2014) analyze the citation pattern of Nobel Prizes laureates in Economics. However, they do not have as explicit an analysis of Lucas as they have for Samuelson, Tinbergen, Hicks, Arrow, Friedman, Sen, Mundell and Hayek.

³ “The Carnegie-Rochester Conference on Public Policy was initiated in the early 1970's through the efforts of the Bradley Policy Research Center at the William E. Simon School of Business Administration at the University of Rochester and the Center for the Study of Public Policy at Carnegie Mellon University. Under the leadership of the late Karl Brunner (University of Rochester) and Allan Meltzer (Carnegie Mellon University) the Conference developed into a semi-annual event occurring in April in Rochester and November in Pittsburgh” (<http://www.carnegie-rochester.rochester.edu/>).

⁴ “The Cowles program was intended to combine economic theory, statistical methods, and observed data to construct and estimate a system of simultaneous equations that could describe the workings of the economy. The aim was to learn from such a system of equations how economic policy could improve the performance of the economy”. Christ (1994:31).

Table 1
Lucas's selected bibliography (1967–1981).^a

Year	Title	Citations in 2015		
		GS	WoS	IDEAS
1976	Econometric policy evaluation: A critique	<u>6.726</u>	770	892
1978	Asset Prices in an Exchange Economy	4.988	<u>1.194</u>	<u>1.074</u>
1972	Expectations and the neutrality of money	4.747	1.111	844
1973	Some International Evidence on Output-Inflation Tradeoffs	3.065	1.027	438
1978	On the Size Distribution of Business Firms	2.828	700	403
1977	Understanding business cycles	1.707	166	176
1969	Real Wages, Employment, and Inflation ^a	1.144	333	120
1975	An Equilibrium Model of the Business Cycle	1.094	398	102
1967	Adjustment Costs and the Theory of Supply	1.085	353	173
1981	Investment Under Uncertainty ^a	940	5	183
1979	After Keynesian macroeconomics ^a	889	–	54
1980	Methods and Problems in Business Cycle Theory	719	132	97
1974	Equilibrium search and unemployment ^a	662	224	186
1980	Equilibrium in a Pure Currency Economy	657	154	179
1972	Econometric Testing of the Natural Rate Hypothesis	603	–	–
1967	Optimal investment policy and the flexible accelerator	505	–	–
1980c	Two Illustrations of the Quantity Theory of Money	458	121	112
1978	Unemployment Policy	217	44	17
1970	Capacity, Overtime, and Empirical Production Functions	195	91	37
1969	Price Expectations and the Phillips Curve ^a	174	49	17
1981	Tobin and Monetarism: A Review Article	150	51	21
1980	Rules, discretion, and the role of the economic advisor	132	–	–
1971	Optimal management of a research and development project	96	30	7
1968	Estimation and inference for linear models in which subsets of the... ^a	81	38	–
1972	A note on price systems in infinite dimensional space ^a	71	–	12
1972	Unemployment in the Great Depression: Is there a full explanation? ^a	64	29	10
1967	Tests of a Capital-Theoretic Model of Technological Change	60	17	–
	Σ	34.057	7.037	5.154

Sources: Lucas's Bibliography 1967–1981 as reported by his curriculum vitae. Google, Web of Science and IDEAS citations values as observed in December 2015.

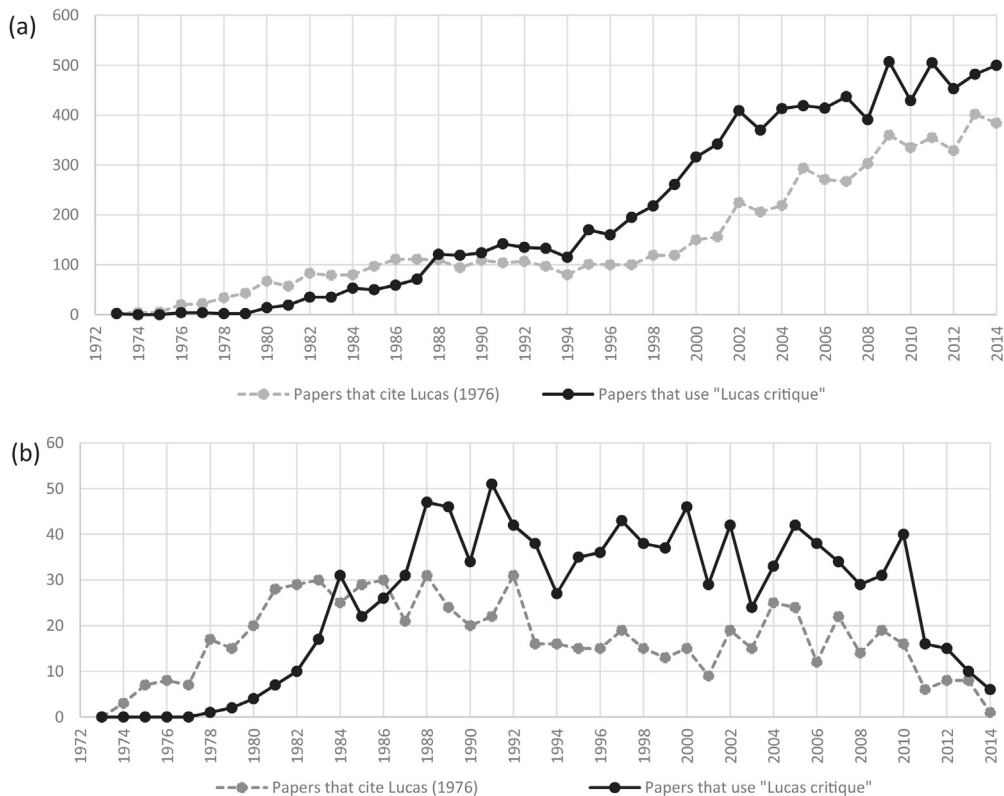
The underline values emphasize the article with more citations according to each one of the sources.

^a Paper with coauthors.

observation may change their value in a significant and unpredictable way, so counterfactual exercises of economic policy were pointless. Even if some sort of adaptive expectations rule is used, those problems still apply.

The expression *Lucas's critique* already appears in Gordon's comments, which were, by the way, very moderate. His argument was that Lucas was right when he says that not *all* simulations will provide useful results, however, he argues, *some* simulations may be useful. This may happen when parameter shifts can be estimated from the sample data or can be deduced from a priori theory. Thus, Lucas is right, "but he goes too far when he charges the 'econometric tradition' is 'fundamentally in error'" (Gordon, 1976, p. 57). Lucas replies that Gordon and him agree on almost everything, but "Gordon's comment manages to leave the impression that relatively modest modification of current models will serve to correct their difficulties. To me, this is like trying to design an airplane by putting wings on a steam engine [...]" (Lucas, 1976b, p. 62). Pritchett's (1976) comments are more favorable to Lucas, and he concludes: "Although the takeoff point and the degree to which Lucas's discussion is extended may be objectionable, his basic thrust is unimpaired".

It is clear that Lucas's insight was not new, he even suggest its existence on the works of Frank Knight, for instance. Hicks (1936: 241) in his review of the Keynes's *General Theory*, for example, affirmed: "It is unrealistic to assume that an important change in data – say the introduction or extension of a public works policy – will leave expectations unchanged, even immediately". In addition, according to Fischer (1983: 271): "The general point made by the critique is correct and was known before it was so eloquently and forcefully propounded by Lucas".



Graphic 1. [a and b]. Occurrence of the term “Lucas critique” and citations to Lucas (1976a,b).

Source: Google Scholar; Jstor. Results for “Business”, Business and Economics” and “Economics” journals.

In a recent interview, Lucas said that it “was written in the early 70s” and that “its main content was a criticism for specific models”, which “implied an operational way of extrapolating into the future to see what the ‘long run’ would look like”. Despite that, he believes that “the term ‘Lucas critique’ has survived, long after that original context has disappeared”, and that “it has a life of its own and means different things to different people. Sometimes it is used like a cross you are supposed to use to hold off vampires: Just waving it an opponent defeats him. Too much of this, no matter what side you are on, becomes just name calling. (Lucas, 2012).

Lucas is suggesting that his critique is a creature that surpassed its own creator. We try to test this hypothesis. Graphic 1 [a and b] presents two pieces of information. The number of papers that cited Lucas (1976a), and the papers that used the term “Lucas’s critique”. Graphic 1a shows this information from the Google Scholar database, while Graphic 1b, the Jstor database. Both graphics show that until the second half of the 1980s, the citations to Lucas (1976a) were more common than the use of the expression “Lucas critique”. From that period onwards, there are more papers that simply use the expression, than directly cite Lucas’s 1976 paper. This suggests that the Lucas’s critique is really bigger than Lucas (1976a), the expression became part of economists’ vocabulary, so it can be used without the necessity of explicitly make reference to its original source. As one can freely talk about the “Phillips curve” without citing Phillips (1958), the same is certainly valid for the “Lucas critique”.⁵

In order to determine if the “Lucas critique” really means different things for different people, it is necessary to check the context that it is used in those papers. This is an interesting piece of research, but it goes beyond the scope of this paper.

In another interview, published in 2005, when asked: “How important do you think the ‘Lucas critique’ has been?”, Lucas answered: “I think it has been tremendously important, but it is fading” [LUCAS in Snowdon and Vane (2005:

⁵ Ericsson and Irons (1995) in a more restricted research also observed this phenomenon: “In many articles, “Lucas critique” is a household word and citations to the paper itself may be missing” (Ericsson & Irons, 1995: 10–11).

282)]. [Graphic 1a](#) seems to contradict this impression. However, this may show the increase in GS's population so we cannot really make such a statement. Jstor, which has a more stable population, show us that, while from 1980 and 1992 the number of yearly citations to [Lucas \(1976a,b\)](#) was in the 20–30 range, from 1993 to 2011, it fell to the 10–20. This may be a signal that Lucas's critique was really not as influential as it had been a couple of decades ago, corroborating Lucas's impression.

Finally, it is worth commenting that the Lucas critique does not seem to have so obvious consequences in empirical terms, albeit its strength has been enormous among economists. [Ericsson and Irons \(1995, p. 39\)](#), for example, in a controversial study concluded that “Lucas critique is a possibility theorem, not an existence theorem” and “an extensive search of the literature reveals virtually no evidence demonstrating the empirical applicability” of it.

Asset prices in an exchange economy published in 1978, is now Lucas's most influential paper – from our sample – according to WoS and IDEAS. It is not a paper on monetary policy, inflation or unemployment. Instead, it is an exemplar of a contemporaneous paper published by *Econometrica*, i.e., a work of applied mathematics, dealing with a very pragmatic question. [Hall \(1996\)](#) explains its importance:

“... Lucas built the theoretical foundation for the determination of asset price under uncertainty. [...] Lucas's 1978 paper elegantly formalized the relationship between real activity, preferences for consumptions goods, and asset prices within a general equilibrium model built up from first principles. Lucas gave structural content to the relationship alluded to in the finance literature. . . . Lucas's model provided a powerful method for analyzing equilibrium asset prices. One specifies a dynamic model with fully elaborated preferences, endowments, and technology, then solves it for the optimal intertemporal allocation of consumption. . . . Few papers today address issues in equilibrium asset pricing without referring to Lucas's seminal work. ([Hall, 1996](#): 41-3).

Before the 1970s, scholars dealing with the question of asset pricing usually relied on partial equilibrium models in their analysis. Then authors like Robert C. Merton in 1973, Mark Rubinstein in 1976, Douglas T. Breeden in 1979 and Lucas developed intertemporal stochastic general equilibrium models in order to improve the understanding about the behavior and predictability of asset prices. This research agenda has a clear relation with Eugene Fama's efficient market hypothesis (EMH), developed in the early 1960s. EMH states – roughly – that stock prices, for instance, accurately reflect all the available information about a firm and the economy, and promptly changes when new information emerges. This hypothesis has a relation with the theory that stock prices behave as a random walk process, such that $E_t[P_t] = P_{t-1} + \varepsilon_t$. Another hypothesis close to the random walk one is the Martingale difference hypothesis (MDH) which is defined: if $Y_t = X_t - X_{t-1}$ then one can say that Y_t follows a Martingale if $E[Y_t | Y_{t-1}, Y_{t-2}, \dots] = 0$.

Lucas's model is one of the pioneers in the approach currently known as consumption-based asset pricing model. It was also the starting point to the tremendously famous [Mehra and Prescott \(1985\)](#) paper on the equity premium puzzle.

EMH and MDH have a clear relation with the rational expectation hypothesis (RHE). If agents do not commit systematic forecasting errors and prices reflect all information available, and economic agents behave as if they know the true model of the economy, it is impossible for anyone to beat the market systematically. It is also impossible for the government, for example, to anticipate and smoothly burst a stock price bubble. All those results went under severe criticism after the 2008 subprime crisis. Lucas stated in his 2003 presidential address to the American Economic Association that “[...] macroeconomics in this original sense has succeeded: Its central problem of depression-prevention has been solved, for all practical purposes, and has in fact been solved for many decades ([Lucas, 2003](#), p. 1). History promptly proved him wrong, and Queen Elizabeth's famous question to British economists about the crisis – “Why did nobody notice it?” – is painfully relevant. In an article published in *The Economist*, entitled “In defense of the dismal science”, Robert Lucas uses EMH to defend himself and traditional economic theory from those attacks.

One thing we are not going to have, now or ever, is a set of models that forecast sudden falls in the value of financial assets [...]. This is nothing new. It has been known for more than 40 years and is one of the main implications of Eugene Fama's “efficient-market hypothesis” (EMH), which states that the price of a financial asset reflects all relevant, generally available information. If an economist had a formula that could reliably forecast crises a week in advance, say, then that formula would become part of generally available information and prices would fall a week earlier. (The term “efficient” as used here means that individuals use information in their own private interest. It has nothing to do with socially desirable pricing; people often confuse the two.) ([Lucas, 2009](#)).

In a 2005 interview [Snowdon and Vane (2005: 301)], Lucas said; “My most influential paper on ‘Expectations and the Neutrality of Money’ [1972a] came out of a conference that Phelps organized where Rapping and I were invited to talk about our Phillips curve work”.⁶ Afterwards the interviewers asked him; “Do you consider your 1972 Journal of Economic Theory paper on ‘Expectations and the Neutrality of Money’ to be your most influential paper?” His answer was “It seems to be, or maybe the paper on policy evaluation [1976]”.

Expectations and the neutrality of money, perceived by Lucas as his most influential paper, currently occupies the second position on the WoS ranking, and the third on Google and IDEAS. This work is truly a modern classic in the History of Economic Thought. It is a heavily mathematical work. Lucas first submitted it to the *American Economic Review*, but its anonymous referee argued in his report that one of the reasons to reject it was exactly because of its excessive mathematical content [Gans and Shepherd (1994)]. The *Journal of Political Economy* then published it.

Lucas constructs an artificial economy (an explicit mathematical model) capable of mimicking [Lucas (1980a)] the apparent short-run trade-off between inflation and output/employment, while also respecting long-run classical dichotomy. Making use of Phelps’s islands, Samuelson’s overlapping generation model and Muth’s rational expectations, all in consonance with Lucas and Rapping’s (1969a,b) framework and Lucas and Prescott’s (1971) definition of equilibrium. The paper was an innovative and sophisticated interpretation of Phelps and Friedman’s natural rate hypothesis. It tried to explain the positive correlation between nominal and real variables through the incompleteness of information available to agents in the short run and the need to “extract signal” from observed price movements. It also corroborated the optimality of Friedman’s k-rule of monetary policy.

Lucas (1994 [1983]) argues that this paper influenced his research along three directions. “First, it was clear that Rapping’s and my original view that our supply theory could be combined fairly easily with an IS-LM-type aggregate-demand theory was not working out as planned”. According to Lucas, because of the change from adaptive to rational expectations, it was no longer possible to investigate the behavior of a single market without making explicit reference to its interactions with the rest of the system. “Second, the construction of an explicit model economy undergoing what was in some sense a business cycle made it possible to see whether the econometric methods we were using. . . would give us the correct answers in a model economy about which we know everything. Here the answer was very clearly negative”. Thus, here we have the origin of Lucas’s econometric critique and Lucas’s (1972) econometric test of the natural rate of unemployment. Lucas says that the third direction is related to renewing his interest in pre-Keynesian business cycle theory, where he found not a set of bad theories, “but a sophisticated literature”. This third effect appears clearly in Lucas’s polemical papers, where he insistently defends the hypothesis that Keynes’s General Theory was a theoretical deviation from the classical approach to business cycles issues.

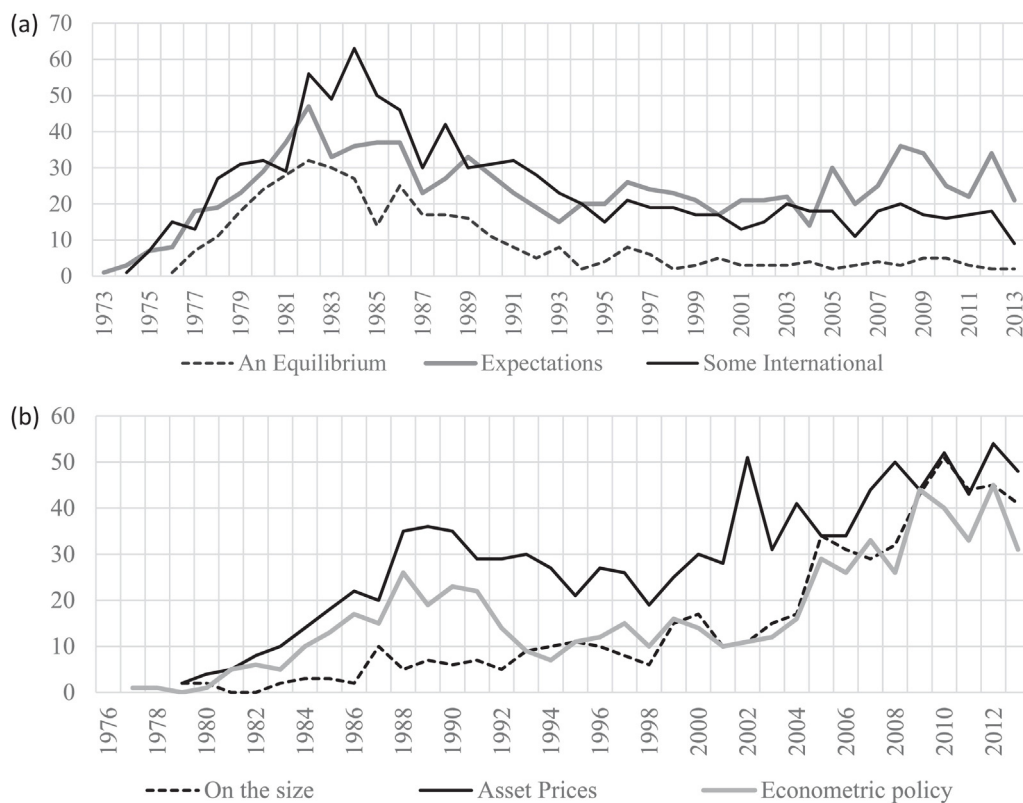
The 1972 model represents the first serious effort made by Lucas to construct a stochastic general equilibrium model, grounded on a sound microeconomic basis (i.e., a perfect competition framework, rational agents in Muth’s sense, and continuous market clearing), capable of mimicking the known behavior of the economy during business cycles. His 1975 paper, *An equilibrium model of business cycle*, represents another step toward this goal, and its structure is closer to that we observe in current workhorse models of Macroeconomics. Kydland and Prescott (1982) cite the latter instead of *Expectations and the neutrality of money*. Lucas’s models, however, were only qualitative,⁷ while Kydland and Prescott (1982) were capable of giving clear quantitative answers. Thus, if Kydland and Prescott are the fathers of DSGE models, Lucas is one of their grandfathers.

It is important to notice the role of theoretical “agenda setter” that Lucas had in the 1970s. He was not capable of offering an alternative to “Keynesian” macroeconomic models but he attracted an enormous amount of attention to that problem with his critique. Lucas was also not capable of constructing a stochastic general equilibrium model of the business cycle able to provide quantitative answers, but his ambition is the basis of current Macroeconomics models. This is why Prescott once said that Lucas is “the master of methodology, as well as defining problems” (Prescott in Snowdon and Vane, 2005: 351).

Graphic 2a shows us that the maximum of annual citations that *Expectations and the neutrality of Money* received was 47, in 1982. It then started a downward trajectory until 2004. This curve’s behavior certainly has a relation with

⁶ The *Journal of Finance* published in 2004 a short text on Lucas biography and intellectual contributions. It says; “Lucas wrote his most influential paper, *Expectations and the Neutrality of Money*, which built on the work he had done with Prescott and also situated his and Rapping’s model of labor supply in a general equilibrium context”.

⁷ “. . . los modelos ilustrativos como el de Robert E. Lucas Jr., “*Expectations and the neutrality of money*”. . . son demasiado abstractos para que sea posible compararlos ni siquiera aproximadamente con las series temporales agregadas observadas”. (Lucas, 1988: 50).



Graphic 2. [a and b]. Citation patterns according to WoS.

Source: WoS.

the emergence of Real Business Cycle theory in 1982, which offered a better framework for those interested in an equilibrium approach to business cycle issues. Lucas's misperception theory of the business cycle, based on monetary shocks soon lost its appeal. At first, despite praising Kydland and Prescott's (1982) model, Lucas insisted on the monetary nature of fluctuations [s. Lucas (1988)], but he soon capitulated. In a recent interview, Lucas talked about this controversy of the main cause of business cycle, and how he and most of the scholar community have changed their mind in the last four decades.

I was [initially] convinced by Friedman and Schwartz that the 1929-33 downturn was induced by monetary factors. . . I concluded that a good starting point for theory would be the working hypothesis that all depressions are mainly monetary in origin. Ed Prescott was skeptical about this strategy from the beginning. . . I now believe that the evidence on post-war recessions (up to but not including the one we are now in) overwhelmingly supports the dominant importance of real shocks. But I remain convinced of the importance of financial shocks in the 1930s and the years after 2008. Of course, this means I have to renounce the view that business cycles are all alike! (Lucas, 2012).

Some international evidence on output-inflation tradeoffs, published in 1973, is a simpler study when compared with Lucas (1972). Lucas (1973: 330) says that the "main object of this study" was "not to 'explain' output and price level movements within a given country" – he had already achieved this in his early works – "but rather to see whether the terms of the output-inflation 'tradeoff' vary across countries in the way predicted by the natural rate theory". That paper has two parts. First a linear model is developed, which respect the following hypothesis: (i) aggregate demand determines nominal output, (ii) price information is incomplete in the short run, and; (iii) agents' inferences are rational, thus they know the true probability distribution of relevant variables. He then obtains what is currently known⁸ as the

⁸ See, for example, Romer (2006): "Lucas Imperfection-Information Model".

‘Lucas supply curve’, which predicts that the short run trade-off depends on the surprise component of price changes and on the observed variance on price level. The second part of the paper is devoted to an econometric exercise in order to check this hypothesis. Lucas uses data from a group of 18 heterogeneous countries between 1951 and 1961. He shows the difference observed on stable countries like the USA and on those unstable such as Argentina. Results could not falsify his theory.

This paper appeared with some mistakes in its econometric framework – “Neil Wallace has pointed out a serious conceptual error in the tests”, said Lucas (1976: 985), so in 1976 an Errata was published by the *American Economic Review*. According to Lucas (1976a,b), those mistakes do not invalidate his main conclusions. Lucas’s imperfect information model had great consequences for the study of the game played between the Monetary Authority and the public. We observe echoes of Lucas (1973a) in other works, for example, Sargent and Wallace (1975), Barro and Gordon (1983) and so on.

Those two papers – *Expectations and the Neutrality of Money* (1972) and *Some International Evidence... (1973)* – are the essence of Lucas’s misperception theory of the business cycle, and according to Lucas himself, this was what the Swedes had in mind when they gave him the Nobel Prize.⁹ This monetary theory of the business cycles soon lost relevance, and Lucas changed his beliefs. In his 1987 textbook “Models of Business Cycles”, Lucas uses a simplified version of the Kydland and Prescott (1982) model as a framework, but not without complaining about its lack of monetary variables, which he considers “an error”.¹⁰

Graphic 2a shows a citation curve trajectory that is very similar for both papers. The maximum amount of citations that *Some International Evidence* received was 63, in 1984. Then a severe downward trend begins. In 2013, for instance, it received only 9 citations.

Hall (1996), when discussing Lucas’s contributions to Economics, considers five papers as “classics”: *Investment under uncertainty* from 1971 (with E. Prescott), *Expectations and neutrality of money* from 1972, *Asset prices in an exchange economy* from 1978, *Optimal fiscal monetary policy in an economy without capital* from 1983 (with N. Stokey) and *On the mechanics of economic development* from 1988. Svensson (1996: 9) in his text also highlights Lucas’s contributions that are not related to business cycles as being “investment theory... financial economics... monetary theory... dynamic public economics... international finance and... economic growth”. Chari (1998) selected bibliography of Lucas contains 15 works from 1969 to 1996. Those authors, who know Lucas’s contributions very well, simply ignore his currently fifth most cited paper: *On the Size Distribution of Business Firms*.

The *Bell Journal of Economics* published it in its 1978 autumn issue. *Papers in honor of Hebert A. Simon* was the name of an entire session of that issue, and it compiled papers presented on the Conference Honoring Herbert A. Simon that happened at Carnegie-Mellon University in October 1977. Edward Prescott wrote the introductory text for those papers.

A phenomenon of considerable interest to Simon has been the size distribution of firms. Classical economic theory either predicts an optimal firm size or assumes constant returns to scale and puts no restrictions on firm size distribution. In fact, the empirical size distributions are almost invariably Pareto or lognormal in their tails. To account for this, Simon proposed a stochastic firm growth model (1955b) and (Ijiri and Simon, 1977) that generates the skew distributions of the type observed. Lucas’ paper is also concerned with the size distribution of firms, and it explains both the highly skewed distribution of firm size and why firm size has increased over time. The basic elements that drive the Lucas model are a distribution of managerial talent and a changing stock of capital. There is a resulting equilibrium size distribution for which individuals with more managerial talent manage larger firms, and for which society’s product is maximized. (Prescott, 1978: 492).

In a very didactical text, Edward Green (2011) explains the *raison d’être* of this research agenda. First, US data clearly shows that the size of firms is distributed log-normally and that those firms, independent of their size, grow

⁹ “... fue por ella que los suecos me otorgaron el premio”. (Lucas, 1996:74). *Estudios Públicos*, 66 (otoño 1997).

¹⁰ When discussing business cycles models Lucas (1988: 49–50) says: “De todos ellos, el más útil para nuestros fines es el modelo desarrollado recientemente por Kydland y Prescott. Su modelo se centra exclusivamente en consideraciones neoclásicas de tipo real (frente a las de tipo monetario), lo que considero un error, pero es el único modelo que conozco que es teóricamente coherente... y que ha sido desarrollado hasta el punto que sus implicaciones pueden ser comparadas con las series temporales observadas, de una forma cuantitativa seria”. About his own model, that includes also monetary shocks, he says: “... los modelos ilustrativos como el de Robert E. Lucas Jr., “Expectations and the Neutrality of Money”... son demasiados abstractos para que sea posible compararlos ni siquiera aproximadamente con las series temporales agregadas observadas”.

Table 2
Lucas's top five papers (Google Scholar and WoS).

Paper	1985	1995	2005	2010	2014
Ranking (Google)					
"Econometric policy evaluation: A Critique" (1976)	1	1	1	1	1
"Expectations and the neutrality of money" (1972)	2	2	2	3	3
"Some International Evidence on Output-Inflation Tradeoffs" (1973)	3	3	4	4	4
"Real Wages, Employment, and Inflation" (1969)	4	5	[7]	[7]	[7]
"An Equilibrium Model of the Business Cycle" (1975)	5	[6]	[9]	[9]	[9]
"Understanding Business Cycles" (1977)	[11]	[8]	5	[6]	[6]
"Asset Prices in an Exchange Economy" (1978)	[12]	4	3	2	2
"On the Size Distribution of Business Firms" (1978)	[24]	[14]	[6]	5	5
Ranking (WoS)					
"Some International Evidence on Output-Inflation Tradeoffs" (1973)	1	1	1	1	3
"Expectations and the neutrality of money" (1972)	2	2	2	2	2
"An Equilibrium Model of the Business Cycle" (1975)	3	4	5	[6]	[6]
"Real Wages, Employment, and Inflation" (1969)	4	5	[7]	[8]	[8]
"Adjustment costs and the theory of supply" (1967)	5	[7]	[6]	[7]	[7]
"Asset Prices in an Exchange Economy" (1978)	[7]	3	3	3	1
"Econometric policy evaluation: A Critique" (1976)	[8]	[6]	4	4	4
"On the Size Distribution of Business Firms" (1978)	[17]	[10]	[8]	5	5

Source: Google Scholar and WoS.

The bold is just a way to emphasize the top five papers in each point of time.

at the same rate. This last result is known as Gibrat's law. These observations seem to be in contradiction with the common hypothesis that the economy operates in a long-run competitive equilibrium scenario. Jacob Viner, in a 1936 work, tried to reconcile this empirical data with the theory. According to him, not all firms share the same production function, so some of them have a larger efficient scale than others. In 1958, Charles Bonini and Hebert Simon presented an alternative theory, developing a probabilistic model of firms' growth. Their model implies that any observed result in terms of size distribution is compatible with the hypothesis of competitive equilibria. Simon and Bonini's model – differently from Viner's – did not suggest the need or desirability of anti-monopoly policies. This is because any exogenously imposed size for the firms would have significant costs in terms of efficiency when compared with the 'natural' result determined by market competition. Lucas (1978b) begins his paper discussing these two models. Then based on an insight of Henry Manne and Olivier Williamson, he develops a general equilibrium model that takes into consideration the managerial skills that are unequally distributed on society as an explanation of those empirical facts about firm size we presented. Lucas (1978a,b,c) also wants to deal with two other observations: (i) "Over time, concurrently with the growth of the aggregate capital stock in per capita terms, the size of firms (on average) has grown", and; (ii) "The compensation of CEOs is roughly proportional to the numbers of workers that they respectively employ" (Green, 2011: 10).

Graphic 2b shows that this paper was not cited frequently during its first twenty years; however, from 1998 on, the citation line changes dramatically its inclination.

2.1. How Lucas's influence changed through time

Table 2 shows the ranking of Lucas's most cited papers at five points of time: 1985, 1995, 2005, 2010 and 2014. We constructed it using data from Google and WoS. According to Google, Lucas's econometric critique has always been his best-known and influential work from our sample period. Tables 1 and 2 allow us to disagree with Fischer (1996, p. 11) when he says that despite Lucas's contribution to several areas of Economics, "he is best known and most influential for his work in macroeconomic theory and policy". Nevertheless, this may be true outside the academic world. In 1995 – year he received the Nobel Prize – *Asset prices* already appears as his fourth most influential work from that period. Curiously, not even Lucas was fully aware of his influence on the scholarly community.

The WoS ranking reports the existence of eight papers among Lucas's five most cited papers from 1985 to 2014. There is divergence about only one of them: Google's ranking includes *Understanding business cycles* while WoS

includes *Adjustment costs and the theory of supply*. The puzzling observation is that, according to WoS, “Econometric critique” only made it to the top five between 1995 and 2005. This is not an intuitive result.

Nonetheless, there seems to exist another force behind the changes in [Table 2](#)’s rankings. This force is the obsolescence of Lucas’s Business Cycle research agenda. For instance, *An equilibrium model of the business cycle* represented the height point of Lucas’s ambition to construct a stochastic macroeconomic general equilibrium model. This was his fifth most influential paper in 1985 and has lost importance ever since. We speculate that one reason is the appearance of [Kydland and Prescott \(1982\)](#), who were under the influence of Lucas’s methodology and intellectual ambition. Their model was simpler and better, and they became the reference for those interested in a macroeconomic market clearing framework. In addition, Lucas’s monetary theory of business cycles was replaced by a real (i.e. non-monetary) theory. The early 1980s marked the decay of the New Classical School and the establishment of Real Business Cycles as the true opponent of the Keynesian tradition. [Graphic 2a](#) suggests that it is a plausible hypothesis.

This is not a particularity of Google Scholar ranking. [Kim et al. \(2006\)](#), using Web of Science as their source of citation data, showed that Lucas’s most cited papers – for our period of interest – were: *Some international evidence* (with 907 citations), *Expectations and Neutrality of Money* (838) and *Asset prices* (772). Those authors also show that the relative decline of Macroeconomics (or business cycles) was not a phenomenon that affected only Lucas; it was a generalized movement starting in the 1990s.

It seems that Macroeconomics is more inclined to episodes of scientific revolutions than other fields in Economics. For instance, in Growth Theory – a field that gained importance on the last three decades – Robert Solow’s 1956 model is still “true”. In Microeconomics (general equilibrium), Arrow and Debreu 1954 model is also “true” (or, at least, relevant). In Finance, Black and Scholes model is still a very useful framework. While in Macro, maybe [Kydland and Prescott \(1982\)](#) – in terms of workhorse model – is the oldest thing a PhD student should read. Therefore, we should expect that Lucas’s papers dealing with more perennial questions (Econometric theory, Finance and Microeconomics) would last longer in terms of influence than his business cycle papers. A non-expert audience may in the future still know Lucas because of his works in Macroeconomics. Among the scientific community; however, he will probably be remembered – in terms of citations – because of his works in those other areas.

3. II – Lucas’s influences

One of the functions of a relevant study in the History of Ideas is to provide to the public a better comprehension about some book, an author or of a school of thought. [Skinner \(1969\)](#) talks about two orthodoxies in this field. There is a group defends the autonomy of the text, such that we need only to carefully and repetitively read a piece of intellectual production. This approach is also known as internal History. Another group insist on the importance of the context, such that one can only really know an intellectual work if he fully understand the economic, sociological, and political scenario that surrounded it. This is called external History. An important element of the so-called context is the comprehension of the dialog that the author is participating in and in which his paper fits. One always writes a text with a known potential audience in the back of one’s mind. We try to understand this rhetorical side of Lucas’s works from a more objective approach. We cataloged all the works he cites in the bibliographical references of his papers from our sample. We do it in order to know exactly with whom he was debating.

References can appear in several different contexts; for the sake of simplicity, we distinguish just two¹¹: positive and negative, as already defined earlier in this paper.

We classified the references used by Lucas in 26 of the 27 papers. Only the references used in *Optimal Management of a Research and Development Project* – which is one of Lucas less often cited papers from the period – are absent from our list. As a result, we have a gross total of 527 texts (including repeated texts, Lucas’s own articles, government reports, etc.). Some works appear repeatedly, which indicates their importance of these to his investigations during that period. [Table 3](#) summarizes some of this information.

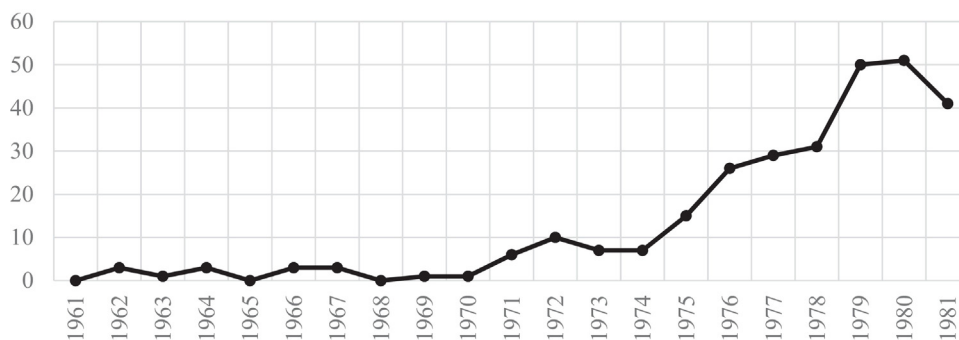
A first thing to notice is that this list contain seven Nobel Prize winners: Milton Friedman who won it in 1976, Franco Modigliani in 1985, Trygve Haavelmo in 1989, Robert Lucas in 1995, Edmund Phelps in 2006, Dale Mortensen in 2010 and Thomas Sargent in 2011. Another remarkable feature of the list: five out of the sixteen workers listed on

¹¹ See [Posner \(1999\)](#) for a deeper analysis of this question.

Table 3
List of Lucas's most common references (1967–1981).

Occurrences	Author (year)	Title
11	John Muth (1961)	"Rational Expectations and the Theory of Price Movements"
10	Milton Friedman (1968)	"The Role of Monetary Policy"
9	R. Lucas and L. Rapping (1969)	"Real Wage, Employment and Inflation"
8	Robert Lucas (1972)	"Expectations and the Neutrality of Money"
7	Edmund Phelps et al. (1970)	"Microeconomic foundations of employment and inflation theory"
6	Thomas Sargent (1976)	"A Classical Macroeconometric Model for the United States"
	Edmund Phelps (1968)	"Money-Wage Dynamics and Labor-Market Equilibrium"
5	Alban W. Phillips (1958)	"The Relation Between Unemployment and the Rate of Change of..."
	T. Sargent and N. Wallace (1975)	"Rational Expectations, the Optimal Monetary Instrument, and the..."
	Robert Lucas (1976a,b)	"Econometric Policy Evaluation: A Critique"
4	John Keynes (1936)	"The General Theory of Employment, Interest and Money"
	Franco Modigliani (1944)	"Liquidity Preference and the Theory of Interest and Money"
	Trygve Haavelmo (1961)	"A Study in the Theory of Investment"
	Edmund Phelps (1970)	"Introductory chapter in <i>The Microeconomic foundations...</i> "
	Dale Mortensen (1970)	"A theory of wage and employment dynamics"
	Robert Barro (1976)	"Rational Expectations and the Role of Monetary Policy"

Source: Bibliographical references in Lucas's papers.



Graphic 3. Citations to Muth (1961) 1961/1981 – Jstor.

Source: Jstor.

it were published in the *Phelps volume*. They are, Lucas and Rapping (1969a), Edmund Phelps (1968, 1970), Dale Mortensen (1970) and the volume itself.

There are no big surprises in Table 3. Milton Friedman and Edmund Phelps' natural rate of unemployment and John Muth's rational expectation hypothesis are the basis of Lucas's misperception theory of the business cycles.

John Fraser Muth (1930–2005) certainly played a huge role on the development of Lucas's business cycle theory. Lucas cites Muth's (1961) rational expectation paper in 11 different occasions; so it was used in roughly 44% of the papers he wrote between 1967 and 1981. The first reference to it appeared in Lucas and Rapping (1969a).

In 1962 – a year after the publishing of his paper – Muth received a PhD in mathematical economics from Carnegie–Mellon having Franco Modigliani as advisor. Muth taught at that same University from 1956 to 1964. He and Lucas were, thus, colleagues during Lucas's first years at the Graduate School of Industrial Administration at Carnegie–Mellon. Lucas definitively was a great spreader of Muth's theory [see Sent (2002)]. Brannon (2006: 19) says that "Rational Expectations and the Theory of Price Movements," "was little noted at the time of its release, and one of the referees fought against its publication, claiming it was of little consequence". Fischer (1996, p. 13) says something similar: "Despite the remarkable quality of the Muth papers, the rational expectations assumption was little used in macroeconomics in the 1960s". This really seems to be the case. Google Scholar shows us that between 1961 and 1970, Muth (1961) had only 50 citations – including Lucas and Rapping (1969a,b) and Lucas (1967). Between 1970 and 1980, on the other hand, it had 444 citations. Graphic 3 – which uses Jstor data – clearly shows that it is from 1970 on that Muth (1961) got recognition and this is certainly due – in a great extent – to Robert Lucas. It was Lucas

who took Muth's hypothesis out of limbo and applied it to a set of problems very distinct from its original context. This is one of the reasons why Lucas did not have to share the Nobel with Muth. According to the Prize committee:

John Muth (1961) was the first to formulate the rational expectations hypothesis in a precise way. He used it in a study of the classic cobweb phenomenon. Muth's analysis was restricted to a single market in partial equilibrium. The importance of the rational expectations hypothesis became apparent when Lucas extended the hypothesis to macroeconomic models and to the analysis of economic policy. (The Royal Swedish Academy of Sciences, 1995).

Milton Friedman (1912–2006) was one of the most influential intellectuals in recent U.S. history. He won the John Bates Clark Medal in 1951 and the Nobel Prize in Economics in 1976, achieving the academic recognition that few can even imagine. He was also a public figure and a sought-after economic advisor.

Friedman taught Economics at Chicago from 1946 to 1977. At the time when Lucas was a graduate student, Friedman was one of the great stars of the university. Lucas takes the opportunity to praise Friedman on several occasions.

In the fall of 1960, I began Milton Friedman's price theory sequence. I had been looking forward to this famous course all summer, but it was far more exciting than anything I had imagined. [...] Certainly Friedman's brilliance and intensity, and his willingness to follow his economic logic wherever it led all played a role. After every class, I tried to translate what Friedman had done into the mathematics I had learned from Samuelson. [...] Friedman's course ended my long career as a conscientious, near-straight A student. Now if a course did not promise to be a life-changing experience, I lost interest and attended only sporadically. I accumulated many C's, but also a lot of time to pursue what I found interesting. (Lucas, 1995).

According to G. S. Maddala, Lucas's PhD classmate:

At Chicago, Milton Friedman was the star performer at the seminars. Everyone was scared of him. It was fun having him there. My class turned out to be perhaps the best ever at Chicago, but I never knew it and nobody imagined at the time. Among my classmates was Bob Lucas, who won a Nobel Prize (he along with all the others got a "B" grade in Friedman's course!). (Maddala, 1993, p. 756)

Friedman had not only a "philosophical" influence over Lucas – as he had over other Chicago students, but also a very practical one. There is a reason why New-Classical school was also known as "Monetarists mark II" [Tobin's (1981)]. Friedman's (1968) "The role of monetary policy" – present in more than 1/3 of Lucas's papers from our sample – was his presidential address delivered at the 18th Annual Meeting of the American Economic Association that occurred in December 1967 in Washington D.C. Friedman's presentation happened on December 27, at the Sheraton Hotel. Arthur F. Burns, his former professor, was the chairman. This presidential address is a classic of the recent history of economic thought. According to Google it has more than 6000 citations. This paper presents the fundamentals of Monetarist creed: monetary policy cannot peg the real interest rate nor unemployment below its natural rate (except in the short-run and only if the monetary shock is unanticipated). According to the Monetarist view, monetary policy should first not be itself a source of economic disturbance. It should provide a stable and predictable scenario for private agents' decision-making. In order to do so, it should not be conducted in a discretionary way, but clearly and with stable rules.

When asked about the importance of Friedman (1968), Lucas said:

It had a huge influence on me. Leonard Rapping and I were doing econometric work on Phillips curves in those days and that paper hit us right when we were trying to formulate our ideas. Our models were inconsistent with Friedman's reasoning and yet we couldn't see anything wrong with his reasoning. It was a real scientific tension of trying to take two incompatible points of view and see what adjustments you can make to end up in a coherent position. Edmund Phelps was pursuing similar ideas. Phelps spelled out the theory a little more clearly than Friedman did and he had an enormous influence on me as well. (LUCAS in Snowdon and Vane, 2005, p. 278).

The 2006 Nobel Prize winner Edmund Strother Phelps, Jr. (1933) also had an enormous influence on Lucas. As Jevons, Walras and Menger independently and (almost) simultaneously "invented" the marginal utility theory, Friedman and Phelps in the early 1960s simultaneously developed an adaptive-expectation-based analysis of the Phillips curve. Phelps' (1968) "Money-Wage Dynamics and Labor-Market Equilibrium" – which Lucas cites on five occasions – is part of this research agenda. According to Backhouse and Boianovsky (2014):

“Money-wage dynamics and labor-market [. . .] first version [. . .] was distributed as a University of Pennsylvania Discussion Paper in February, 1967, before being published in the *Journal of Political Economy* (1968a). In this paper, Phelps explored the relationship between wage changes [. . .], labor turnover, unemployment and vacancies. [. . .] The main thrust of this paper was to counter the notion, widespread in the literature, that the cost inflation at high levels of aggregate demand was linked to the existence of trade union monopolies in the labor market. (Backhouse and Boianovsky, 2014: 89).

Phelps’ paper *The New Microeconomics in Inflation and Employment Theory* was presented in 1969 at the 81st Annual Meeting of the American Economic Association. It became part of the book *Microeconomic foundations of employment and inflation theory* published in 1970 and which is best-known as the *Phelps volume*. This volume contains papers that were submitted to a Conference that happened at UPenn in January 1969, organized by Phelps himself. This conference “brought together more than a dozen people working on these problems relating to information and labor markets”; it also “created a community of economists on the problem” (Backhouse and Boianovsky, 2014, p. 90). The volume, in other words, synthesized the research on Phillips curve and labor market frontiers, with Phelps, already a respected economist, as leader. This was a great source of publicity to Lucas, who was just beginning his career. “This was the kind of fame that Leonard and I had dreamed of, and the book and the conference Ned organized around it gave us the first experience either of us had had of being at the forefront of an important research area” (Lucas, 2001: 19). By the 1970’s, however, as Phelps says, the battle he was fighting with Keynesians, such as Tobin and Solow, in late 1960’s, changed: “To some extent, the battle then became to be one between the Keynesians versus Lucas, and I was actually bypassed” (Phelps in Horn, 2009: 255).

From Table 3 we observe only two negative references: Keynes (1936) and Phillips (1958). Lucas uses Keynes (1936) as a reference in four non-technical (polemical) papers: *Understanding Business Cycles* (1977), *Unemployment Policy* (1978), *After Keynesian Macroeconomics* (1979) and *Methods and Problems in Business Cycle Theory* (1980b). The second chapter of the General Theory – the postulates of the classical economics – is the main target of Lucas’s critiques in the first two papers. In that chapter, Keynes presents the neoclassical theory about the determination of employment level. The supply curve of labor is determined by optimizing decision of households, such that the utility of wage is equal to the disutility of labor, and the demand curve is determined by the equality between the real wage paid and the marginal product of labor. In this scenario – says Keynes – only two types of unemployment exist. First, there is the voluntary unemployment, such that the current wage is inferior to the minimum subjective wage that a worker wants to earn (this concept also embraces the unemployment caused by restrictive rules set by unions and legislators). There is also the frictional unemployment, due to the inherent difficult to match job vacancies and unemployed workers. Keynes then suggests the existence of a third type of unemployment, the involuntary unemployment. This category played a central role in the Keynesian tradition, both old Keynesians as also Non-Market-Clearing Keynesianism. To Lucas (1978a,b,c), this distinction between types of unemployment was wrong and useless.

In *Understanding Business Cycles*, Lucas states:

“Keynes chose to begin the General Theory with the declaration (for Chapter II is no more than this) that an equilibrium theory was unattainable: that unemployment was not explainable as a consequence of individual choices and that the failure of wages to move as predicted by the classical theory was to be treated as due to forces beyond the power of economic theory to illuminate”. (Lucas, 1977a, pp. 11–12).

The same type of criticism appears in *Unemployment Policy*. In this paper – which is mainly a criticism of the useless (according to Lucas) concepts of full (as also involuntary) unemployment and the use of economic policy in the quest to attain it. Lucas affirms:

“The idea that policy can and should be directed at the attainment of a particular specifiable level of the measured rate of unemployment (as opposed to mitigating fluctuations in unemployment) owes its wide acceptance to John Maynard Keynes’s General Theory. It is there derived from the prior hypothesis that measured unemployment can be decomposed into two distinct components: “voluntary” (or frictional) and “involuntary”, with full employment then identified as the level prevailing when involuntary unemployment zero. [. . .]” (Lucas, 1978a,b,c, p. 353).

In *After Keynesian Macroeconomics* and in *Methods and Problems in Business Cycle Theory* Lucas presents a broader type of criticism. His analysis deals with the position of Keynes’s book in the history of business cycle analysis. In *After Keynesian Macroeconomics* he says:

Economists prior to the 1930s did not recognize a need for a special branch of economics, with its own special postulates, designed to explain the business cycle. Keynes founded that subdiscipline, called macroeconomics, because he thought that it was impossible to explain the characteristics of business cycles within the discipline imposed by classical economic theory, a discipline imposed by its insistence on adherence to the two postulates (a) that markets be assumed to clear, and (b) that agents be assumed to act in their own self-interest. [...] After freeing himself of the straight-jacket (or discipline) imposed by the classical postulates, Keynes described a model in which rules of thumb, such as the consumption function and liquidity preference schedule, took the place of decision functions that a classical economist would insist be derived from the theory of choice” (Lucas, 1979, p. 58).

Lucas did not inherit the intellectual respect that Friedman cultivated for Keynes. While Friedman (1968: 1) praises “Keynes’s rigorous and sophisticated analysis”, Lucas believes that “Keynes’s actual influence as a technical economist is pretty close to zero” [LUCAS in Usabiaga Ibanez (1999)].

The traditional narrative about the Phillips curve, understood as a deterministic menu, and the theoretical anticipation of its break by Friedman and Phelps on the late 1960s, is present in Lucas’s speech. Since history is written by the victors, this narrative became the truth. However, this is a questionable historical interpretation. Lucas’s commonly¹² attributes to Phillips (1958) and Samuelson and Solow (1960) the idea of a stable and exploitable trade-off between inflation and unemployment, but none of these authors suggests it explicitly or even implicitly. Phillips’ paper – developed in just one weekend – has fairly modest ambitions. The question he raised was: since prices move according to the excess of demand, will one observe this same behavior in the labor market? If the unemployment rate is a proxy for excess of demand, and wages are the price in that market, one should expect to observe a negative relation those two variables (in terms of rate of change). What was somewhat surprising in Phillips’ work is that this relation was observed for in a long period. When authors like Samuelson and Solow also found an analogous relation and its validity in countries other than the UK, this apparent regularity became a strong empirical result. It is not ordinary in social sciences to observe this kind of regularity through time and space.

The Phillips curve as a menu is the central point of Lucas’s criticism toward “Keynesianism”. This was the weakest link on the chain. It is not unusual, in intellectual controversies, that someone simply creates a caricature of his adversary. This seems to be the case of Lucas on the Phillips curve. In Lakatosian terms, we believe that Lucas used this rhetorical strategy in order to present the Keynesian approach as a degenerate research program, falsified by the economic events, while his alternative approach as a progressive research program, which not just predicted and explained the stagflation, as also provided new tools, new insights and new observations to economists.

4. Conclusion

We have presented a citation analysis of Lucas’s papers published between 1967 and 1981, using three different sources of data. According to two of them, Lucas most influential paper from that period is one in asset pricing, which is somewhat surprisingly since he won the Nobel Prize because of his business cycle research. Even to Lucas this may be unexpected. In several interviews he states that he believes that *Expectation and the Neutrality of Money* was his most influential paper, and we show that this is inaccurate if one accepts citations as a proxy of influence. We also showed that Lucas’s business cycle papers have lost importance since early 1980s, this is probably due to the emergence of the Real Business Cycle approach in 1982, which captured the attention of those who are interested in a market-clearing approach to economic fluctuations and made Lucas’s monetary theory of the cycles irrelevant. *Expectations and the Neutrality of Money* (1972), *Some international evidence of the on output-inflation tradeoffs* (1973), and *An Equilibrium Model of Business Cycle* (1975) present a hump-shaped citation curve, with its height point between 1982 and 1984. Nonetheless, Lucas methodology remains as a cornerstone in Macroeconomics.

Lucas’s papers on asset pricing and firms’ sizes, on the other hand, show a positive inclined citation curve. Lucas’s asset pricing paper is now his most cited work from that period according to Web of Science and Ideas Repec. Those two papers deal with areas of Economics that seems to be less prone to scientific revolutions in comparison with

¹² “The earliest wage-price sector embodying the “trade-off” is (as far as I know) in the 1955 version of the Klein–Goldberger model. It has persisted, with minimal conceptual changes, into all current generation forecasting models. The subsequent shift of the “trade-off” relationship to center stage in policy discussions appears due primarily to Phillips and Samuelson and Solow” (Lucas, 1976a,b: 257).

Macroeconomics. Lucas's econometric critique paper also shows a similar pattern in its citation curve. This paper became a central piece in the history of Macroeconomic thought in the 20th century and the term "Lucas critique" became bigger than the paper itself. It is used in different contexts with different meanings. This is also contradicts Lucas impression that his econometric critique is losing importance.

We also cataloged all the papers that Lucas used as bibliographical references in his works from our sample. The authors that Lucas most often cited were John Muth, Milton Friedman and Edmund Phelps. This is not surprising. Lucas misperception theory of the business cycles is a direct product of Friedman and Phelps critiques toward the Phillips Curve, and John Muth's rational expectation hypothesis was a crucial element in the New Classical Revolution and one of the reasons why Lucas was laureate of the Nobel Prize. Those authors are used, thus, as positive references. Keynes and Phillips, on the other hand, are the authors that Lucas most often cited in a negative reference. Lucas managed to present his research program to the public as a progressive one, while the Keynesian – represented by Keynes and Phillips – was clearly refuted by the economic reality of stagflation.

References

- Backhouse, R.E., Boianovsky, 2014. *Transforming Modern Macroeconomics. Exploring Disequilibrium Microfoundations, 1956–2003*. Cambridge University Press.
- Bar-Ilan, J., 2008. Which H-index? A comparison of WoS, Scopus and Google Scholar. *Scientometrics* 74 (2), 257–271.
- Barro, R.J., Gordon, D.B., 1983. Rules, discretion and reputation in a model of monetary policy. *J. Monet. Econ.* 12 (1), 101–121.
- Biddle, J., 1996. A citation analysis of the sources and extent of Wesley Mitchell's reputation. *Hist. Polit. Econ.* 28 (2), 137–169.
- Bjork, S., Offer, A., Söderberg, G., 2014. Time series citation data: the Nobel Prize in economics. *Scientometrics* 98 (1), 185–196.
- Blinder, A.S., 1987. Keynes, Lucas, and scientific progress. *Am. Econ. Rev.*, 130–136.
- Brannon, I., 2006. Remembering the man behind rational expectations. *Regulation* 29, 18.
- Buiter, W.H., 1980. The macroeconomics of Dr. Pangloss: a critical survey of the new classical macroeconomics. *Econ. J.*, 34–50.
- Chari, V.V., 1998. Nobel laureate Robert E. Lucas, Jr.: architect of modern macroeconomics. *J. Econ. Perspect.* 12 (1), 171–186.
- Christ, C.F., 1994. The Cowles Commission's contributions to econometrics at Chicago, 1939–1955. *J. Econ. Lit.*, 30–59.
- De Vroey, M., 2010. *Lucas on the Lucasian Transformation of Macroeconomics: An Assessment*. University of Louvain (mimeo).
- Ericsson, N.R., Irons, J.S., 1995, March. The Lucas Critique in Practice: Theory Without Measurement. International Finance Discussion Paper, No 506. Board of Governors of the Federal Reserve System.
- Estudios Públicos, 1997. *Conversación con Robert E. Lucas, Jr. Vol 66, otoño 1997.*, pp. 73–118.
- Fischer, S., 1983. Comment on Macrofusion: the dilemmas of economic policy. In: Tobin, J. (Ed.), *Macroeconomics, prices, and quantities: essays in memory of Arthur M. Okun*. Brookings Institution, Washington, D.C., pp. 267–276.
- Fischer, S., 1996. Robert Lucas's Nobel memorial prize. *Scand. J. Econ.*, 11–31.
- Friedman, M., 1968. The role of monetary policy. *Am. Econ. Rev.* 58, 1–17.
- Gans, J.S., Shepherd, G.B., 1994. How are the mighty fallen: rejected classic articles by leading economists. *J. Econ. Perspect.*, 165–179.
- Gordon, R.J., 1976. Can econometric policy evaluations be salvaged? A comment. In: *Carnegie-Rochester Conference Series on Public Policy*, vol 1., North-Holland, pp. 47–61.
- Green, E., 2011. *Economics 457W Notes 4. Size Distribution and Hierarchical Structure of Firms*. Draft: 2011.03.13, <http://personal.psu.edu/eug2/457W/notes-4.pdf>.
- Hall, R.E., 1996. Robert Lucas, Recipient of the 1995 Nobel Memorial Prize in economics. *Scand. J. Econ.*, 33–48.
- Hicks, J.R., 1936. Keynes' theory of employment. *Econom. J.* 46 (182), 238–253.
- Hoover, K.D., 1984. *New Classical Macroeconomics*. Blackwell, Oxford.
- Hoover, K.D., 1988. *The New Classical Macroeconomics: A Sceptical Inquiry*. Basil Blackwell, Oxford.
- Horn, K.I., 2009. *Roads to wisdom, conversations with ten Nobel laureates in economics*. Edward Elgar Publishing.
- Keynes, J.M., 1936. *The general theory of employment, interest and money*. Macmillan, London.
- Kim, E.H., Morse, A., Zingales, L., 2006. What has Mattered to Economics Since 1970 (No. w12526). National Bureau of Economic Research.
- King, R.G., 2003. [Disagreement about inflation expectations]: comment. *NBER Macroecon. Annu.*, 248–257.
- Kydland, F.E., Prescott, E.C., 1982. Time to build and aggregate fluctuations. *Econom. J.*, 1345–1370.
- Laidler, D., 2002. 14 The new-classical contribution to macroeconomics. *Macroecon. Read.*, 334.
- Lucas Jr., R.E., 1967. Adjustment costs and the theory of supply. *J. Polit. Econ.* 75, 321.
- Lucas Jr., R.E., 1972. Expectations and the neutrality of money. *J. Econ. Theory* 4 (April (2)), 103–124.
- Lucas Jr., R.E., 1973a. Some international evidence on output-inflation tradeoffs. *Am. Econ. Rev.* 63 (June (3)), 326–334.
- Lucas Jr., R.E., 1973b. Wage inflation and the structure of regional unemployment: comment. *J. Money Credit Bank.* 5 (Part II F (1)), 382–384.
- Lucas Jr., R.E., 1976a. Econometric policy evaluation: a critique. *Carnegie-Rochester Conf. Ser. Public Policy* 1 (January (1)), 19–46.
- Lucas Jr., R.E., 1976b. Reply. *Carnegie-Rochester Conf. Ser. Public Policy* 1 (January (1)), 61–62.
- Lucas Jr., R.E., 1977a. Understanding business cycles. *Carnegie-Rochester Conf. Ser. Public Policy* 5 (January (1)), 7–29.
- Lucas Jr., R.E., 1977b. Some international evidence on output-inflation tradeoffs: reply. *Am. Econ. Rev.* 67 (September (4)), 731.
- Lucas Jr., R.E., 1977c. Reply to muench and polemarchakis and weiss. *J. Econ. Theory* 15 (August (2)), 351–352.
- Lucas Jr., R.E., 1978a. Unemployment policy. *Am. Econ. Rev.* 68 (May (2)), 353–357.

- Lucas Jr., R.E., 1978b. On the size distribution of business firms. *Bell J. Econ.* 9 (Autumn (2)), 508–523.
- Lucas Jr., R.E., 1978c. Asset prices in an exchange economy. *Econometrica* 46 (November (6)), 1429–1445.
- Lucas Jr., R.E., 1979. A report to the OECD by a group of independent experts OECD, June 1977: a review. *Carnegie-Rochester Conf. Ser. Public Policy* 11 (January (1)), 161–168.
- Lucas Jr., R.E., 1980a. Equilibrium in a pure currency economy. *Econ. Inq.* 18 (April (2)), 203–220.
- Lucas Jr., R.E., 1980b. Methods and problems in business cycle theory. *J. Money Credit Bank.* 12 (November (4)), 696–715.
- Lucas Jr., R.E., 1980c. Two illustrations of the quantity theory of money. *Am. Econ. Rev.* 70 (December (5)), 1005–1014.
- Lucas Jr., R.E., 1988. *Modelos de ciclos económicos*. Alianza Editorial, Madrid, España.
- Lucas, R.E., 1996. Nobel lecture: monetary neutrality. *J. Polit. Econ.* 104 (4), 661–682.
- Lucas Jr., R.E., 2001. Professional memoir. Nobel Economists Lecture Series, San Antonio, Texas.
- Lucas Jr., R.E., 2003. Macroeconomic priorities. *Am. Econ. Rev.* 93 (1), 1–14.
- Lucas Jr., R.E., 2009. In defense of the dismal science. *Economist* August <http://www.economist.com/node/14165405>.
- Lucas Jr., R.E., 2012. Economic dynamics interviews Robert Lucas on modern macroeconomics. *Econ. Dyn. Newsl.* 14 (November).
- Lucas Jr., R.E., Prescott, E.C., 1971. Investment under uncertainty. *Econometrica* 39 (September (5)), 659–681.
- Lucas Jr., R.E., Rapping, L.A., 1969a. Price expectations and the Phillips curve. *Am. Econ. Rev.* vol. 59 (June (3)), 342–350.
- Lucas Jr., R.E., Rapping, L.A., 1969b. Real wages, employment, and inflation. *J. Polit. Econ.* vol. 77 (September/October (5)), 721–754.
- McCallum, B.T., 1989. New classical macroeconomics: a sympathetic account. *Scand. J. Econ.*, 223–252.
- Meho, L.I., Yang, K., 2006. A new era in citation and bibliometric analyses: web of science. Scopus, and Google Scholar, arXiv preprint cs/0612132.
- Mehra, R., Prescott, E.C., 1985. The equity premium: a puzzle. *J. Monet. Econ.* 15 (2), 145–161.
- Mortensen, D.T., 1970. A theory of wage and employment dynamics. In: Phelps, E.S., et al. (Eds.), *Microeconomic Foundations of Employment and Inflation Theory*. Norton, New York.
- Muth, J.F., 1961. Rational expectations and the theory of price movements. *Econometrica*, 315–335.
- Narin, F., 1976. *Evaluative Bibliometrics: The Use of Publication and Citation Analysis in the Evaluation of Scientific Activity*. Computer Horizons, Washington, DC, pp. 206–219.
- Nicolaisen, J., 2007. Citation analysis. *Annu. Rev. Inf. Sci. Technol.* 41 (1), 609–641.
- Phelps, E.S., et al., 1970. *Microeconomic Foundations of Employment and Inflation Theory*, Norton. New York, pp. 167–211.
- Phelps, E.S., 1968. Money-wage dynamics and labor-market equilibrium. *J. Polit. Econ.* 76, 678–711.
- Phillips, A.W., 1958. The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861–1957. *Economica* 25 (100), 283–299.
- Posner, R.A., 1999. *The Theory and Practice of Citations Analysis, With Special Reference to Law and Economics*.
- Pritchett, D.V., 1976. Econometric policy evaluation: a critique (comments). *J. Monetary Econ.* 1, 63–64, Carnegie-Rochester Conference Series on Public Policy.
- Romer, D., 2006. *Advanced Macroeconomic*, 3rd edition. McGraw-Hill, New York.
- Samuelson, P.A., Solow, R.M., 1960. Analytical aspects of anti-inflation policy. *Am. Econ. Rev.* 50 (2), 177–194.
- Sargent, T.J., Wallace, N., 1975. “Rational” expectations, the optimal monetary instrument, and the optimal money supply rule. *J. Polit. Econ.*, 241–254.
- Seidman, L.S., 2005. The new classical counter-revolution: a false path for macroeconomics. *East. Econ. J.*, 131–140.
- Sent, E.M., 2002. How (not) to influence people: the contrary tale of John F. Muth. *Hist. Polit. Econ.* 34 (2), 291–319.
- Silva, D.F.R., 2013. Lucas’s Early Research in the 1960’s. In: *XLI Encontro Nacional de Economia*. ANPEC, Foz do Iguaçu.
- Skinner, Q., 1969. Meaning and understanding in the history of ideas. *Hist. Theory*, 3–53.
- Snowdon, B., Vane, H.R., 2005. *Modern Macroeconomics: Its Origins, Development and Current State*. Edward Elgar Publishing.
- Svensson, L.E., 1996. The scientific contributions of Robert E. Lucas Jr. *Scand. J. Econ.*, 1–10.
- Tobin, J., 1981. The monetarist counter-revolution today – an appraisal. *Econ. J.*, 29–42.
- Usabiaga Ibanez, C., 1999. *The Current State of Macroeconomics. Leading Thinkers in Conversation*. Macmillan, London.
- Vercelli, A., 1991. *Methodological foundations of macroeconomics: Keynes and Lucas*. Cambridge University Press.
- Zuckerman, H., 1987. Citation analysis and the complex problem of intellectual influence. *Scientometrics* 12 (5–6), 329–338.