From disequilibrium to equilibrium macroeconomics: Barro and Grossman's trade-off between rigor and realism[1]

> "Current state of macro theory: existing models in which behavior is fully rational have important counter-factual implications –see Lucas and Sargent-Wallace. Existing models that are more realistic have gaps in their microfoundations – e.g. Barro and Grossman's work provides no theory of price and wage adjustment. The present paper [aims to provide] a macro model that will represent a better trade-off between rigor and realism."[2]

Introduction

The 1970s marked a period of profound change in macroeconomics. After long years of domination, Keynesian macroeconomics was challenged by the New Classical Economics of Robert Lucas (1972, 1975). This involved a battle between two approaches to modeling economies. On one side, macroeconomists considered that market prices varied too slowly to ensure a continuous equilibrium on markets. This led them to model how individuals and markets behaved, under rationing constraints. New classical economists, on the other side, assumed that price variations occurred instantaneously and ensured equilibrium on markets. This led them to model how economies behaved when individuals realized their optimization plans. My article contributes to explain why the equilibrium approach came to dominate the field. My case study is Robert Barro and Herschel Grossman.

Barro and Grossman are interesting figures because they changed sides. Until the mid-1970s, they contributed to the development of disequilibrium macroeconomics. In 1971, Barro and Grossman elaborated the basic disequilibrium model. In 1976, they wrote the first book on disequilibrium macroeconomics, *Money, Employment, and Inflation*. However, at the end of the 1970s, Barro and Grossman came to advocate for equilibrium models. In two articles published in 1979, they claimed that Lucas had identified the "good" approach to macroeconomics. The goal of my article is to explain this radical move.

[1] Université Côte d'Azur, Groupe de Recherche en Droit, Économie et Gestion, e-mail : plassardromain@gmail.com

[2] Excerpt from "Employment fluctuations and risk," an unpublished manuscript written by Herschel I. Grossman in the 1970s. See Grossman's papers, Box 1 OF-IUF-G5, John Hay Library Special Collections.

Historians tried to explain why Barro and Grossman changed their modeling strategy. To do so, they focused on the problems posed by disequilibrium macroeconomics. According to Roger Backhouse and Mauro Boianovsky (2013), Barro and Grossman failed to complete their disequilibrium program of microfoundations. This would explain why they stopped investigating disequilibrium macroeconomics. The same argument was formulated by Michel de Vroey, in his *History of Macroeconomics. From Keynes to Lucas and Beyond* (2016). The problem with these historical analyses is twofold. They don't explain why Barro and Grossman were seduced by equilibrium macroeconomics. Then and more importantly, none of the three historians reconstructed the path that led Barro and Grossman to change their modeling strategy.

By contrast, I trace how and why Barro and Grossman came to privilege equilibrium over disequilibrium macroeconomics. To do so, I make an extensive use of the archival documents left by Grossman, at Brown University. Then, I portray the intellectual context in which Barro and Grossman were involved. Last but not least, I focus on the way Barro and Grossman built and used models. Several questions are addressed: What was their method when modeling economies? Did Barro and Grossman have the same goals when using disequilibrium and equilibrium models? What were their criteria to choose between the disequilibrium and the equilibrium approaches to macroeconomics?

From the beginning of the 1970s, Barro and Grossman's goal was to build a business cycle model. Their method was to start from the Walrasian framework, to introduce a friction, and to discuss the qualitative properties of the resulting model. Early on, they considered two frictions: price stickiness and incomplete information about market prices. This led Barro and Grossman to elaborate disequilibrium and equilibrium models. By exploring their qualitative properties, their ambition was to determine what was the best framework for analyzing the business cycle. They had two criteria: "rigor" and "realism." According to Barro and Grossman, a model was "rigorous" when all its features could be deduced from individuals' decisions. For instance, price stickiness had to be explained as the consequence of optimal behavior. Then, Barro and Grossman considered that a model was "realistic" if its qualitative properties matched the stylized facts of the business cycle. In particular, the model had to establish a causal relationship between monetary and real variables. The question was whether disequilibrium or equilibrium macroeconomics offered the better trade-off between rigor and realism. In a first step, Barro and Grossman did not establish a ranking between disequilibrium and equilibrium macroeconomics. But, in a second step, Barro (1977a) found that disequilibrium

macroeconomics could not be based on sound microfoundations. At the same time, Barro (1976, 1977a, 1977b) found that incomplete information was the critical factor in the determination of economic fluctuations. This led him to discard disequilibrium macroeconomics and to advocate for equilibrium models *à la* Lucas. Barro discussed this conclusion with Grossman. After some resistance, Grossman ended up agreeing with Barro.

1. Two alternative approaches to modeling the business cycle

In the early 1970s, Barro and Grossman considered two approaches to modeling economies. The first one consisted of introducing market price stickiness into Walrasian general-equilibrium theory. This led Barro and Grossman to develop disequilibrium models, following in Don Patinkin's (1956) and Robert W. Clower's (1965) footsteps.[3] The second approach, presented as an alternative departure from the Walrasian framework, assumed that individuals had incomplete information about the spatial distribution of market prices. This led Barro and Grossman to develop equilibrium models, following in Dale Mortensen's (1970, 1974) footsteps. That simultaneous development of equilibrium and disequilibrium models raises the issue of what was Barro and Grossman's research goal. The answer can be found in *Money, Employment, and Inflation*. In chapter 7, Barro and Grossman (1976) compared equilibrium and disequilibrium models. They discussed their capacity to explain the determination of production and employment, on the basis of individuals' decisions. They also discussed the models' capacity to match the stylized facts of the business cycle. This reveals the existence of a ranking process based on rigor and realism criteria, and whose purpose was to identify the best approach to the business cycle.

1.1 Two alternative approaches to the microfoundations of macroeconomics

Barro and Grossman initiated their disequilibrium program of microfoundations between 1968 and 1971, at Brown University.[4] In 1968, Grossman wrote "Market Disequilibrium in a Macro-Economic Context". In this research project (submitted to the National Science Foundation), he argued that the "existing macro-economic literature" (i.e.,

[3] For further details, see my working paper "Following in Patinkin's and Clower's Footsteps: Barro, Grossman, and the Development of Disequilibrium Macroeconomics" (Plassard, 2018).

[4] In the preface of Money, Employment, and Inflation (1976), Barro and Grossman explained that their "monograph [was] the outgrowth of ideas developed while [they] were colleagues at Brown University from 1968 to 1971. During that period, [they] became aware that [they] shared similar reservations about the weak foundations of conventional macro-economic analysis. [They] both felt the need for a substantial restructuring of these foundations, especially to deal adequately with the problem of exchange under non-market-clearing conditions" (1976: xi).

Walrasian macroeconomics *à la* Hicks) was inappropriate for "explaining and predicting the behavior of the actual economy.[5] For the actual economy may rarely, if ever be in equilibrium" (1968: p. 5). According to Grossman, the bulk of actual exchange took place while individuals would like to buy and/or to sell more, given market prices. Hence the need to "analyze explicitly the behavior of macro-economic systems which [were] not necessarily or even typically characterized by market equilibrium" (1968: p. 5). Such an approach to macroeconomics already attracted Barro's interest while he was in graduate school at Harvard (Backhouse and Boianovsky, 2013: p. 67). Thus, when arriving at Brown University in 1968, he engaged with Grossman.[6] This resulted in a collaboration which culminated in the publications of "A General Disequilibrium Model of Income and Employment" (1971) and of *Money, Employment, and Inflation* (1976).

The 1971 article was still hot off the press when Barro and Grossman started exploring the incomplete information approach to macroeconomics. In a letter sent on 20 October 1971, Grossman informed Clower that he was "working on a paper which [contrasted] what [he considered] to be two alternative approaches to employment theory – the 'incomplete information' approach of Alchian, Phelps, et. al., and the 'non-market-clearing' approach of [Clower], Barro and [himself]."[7] At that time, Barro and Grossman were writing *Money, Employment, and Inflation* (1976). This book, commissioned by Clower on behalf of Basic Books, intended to provide a comprehensive study of the disequilibrium program of microfoundations exposited in the 1971 article.[8] However, Barro and Grossman felt the need to broaden its scope. In a letter sent on 28 March 1972, Grossman informed Clower that several extensions were considered.[9] In particular, Barro and Grossman wanted to include "some

[5] "The existing macro-economic literature deals primarily with analysis of the characteristics and stability properties of market equilibrium: that is, the condition of equality between aggregate supply and demand. The classic example is the Hicksian comparative static analysis of the values of dependent variables consistent with market equilibrium" (1968: p. 5).

[6] In "Money, Interest, and Prices in Market Disequilibrium" (1971), Grossman acknowledged that his article "benefited from extensive discussions with Robert Barro" (1971: p. 943).

[7] Herschel I. Grossman's papers, Box 3 OF-IUF-G5, John Hay Library, Brown University.

[8] Money, Employment, and Inflation was supposed to be part of a series of textbooks. Unable to commission other textbooks, Basic Books cancelled its publication (Backhouse and Boianovsky, 2013: p. 73). In the end, Barro and Grossman's book was published by Cambridge University Press.

[9] "The book will extend the analysis in the following ways: 1) analysis of capital and securities, both private and government; 2) analysis of expectations and adjustment mechanisms […]; 3) analysis of the interplay between unemployment and inflation, i.e., Phillips relationships; 4) analysis of the interplay between inflation, interest rates, and aggregate demand" (Herschel I. Grossman's papers, Box 3 OF-IUF-G5, John Hay Library, Brown University). Most of these extensions were presented in articles. For instance, Barro and Grossman addressed expectations in "Suppressed inflation and the supply multiplier" (1974). Moreover, Grossman discussed Phillips's statistical regularities and stagflation in "The cyclical pattern of unemployment and wage inflation" (1974).

discussion of the approach to employment *à la* Alchian, Mortensen, and Lucas & Rapping."[10] What they did. Barro and Grossman (1976) developed two frameworks for analyzing the determination of output and employment. The first one, associated to the disequilibrium program of microfoundations, was explored from chapters 2 to 6. The second one, associated to the incomplete information program of microfoundations, was discussed in chapter 7.[11]

The two frameworks characterized "alternative" departures from the Walrasian-general equilibrium model:

> Chapter 2 departs from the Walrasian framework to consider output and employment under non-market-clearing conditions. This chapter constitutes the analytical core of the monograph. The crucial assumption is that wages and prices respond sluggishly to shift in demand […] Chapter 7 returns to the basic model of chapter 1 and considers an alternative departure from the Walrasian framework – namely that economic units have incomplete information regarding the spatial distribution of wages and prices (1976: p. 4).

There was a common analytical structure to all chapters of *Money, Employment, and Inflation* (1976). It was a perfect competition model where firms, households, and a government interacted through two markets.[12] The labor market, where labor services were exchanged against money, and the market for goods, where consumable commodities and public services were exchanged against money. In this context, government had to collect tax and/or to supply money balances to offer public services; firms demanded labor and supplied both consumable commodities and public services in view of maximizing profits; and households aimed to maximize their utility by choosing the quantity of goods to demand, the quantity of labor to supply, and the quantity of real balance to transfer from one period to another. In chapter 1, these economic units evolved in a frictionless system of markets. They had perfect information about market prices, and the "privilege of recontracting" ensured that exchange took place only under market-clearing conditions (1976: p. 31). The problem was that "recontracting [did] not

[10] Herschel I. Grossman's papers, Box 3 OF-IUF-G5, John Hay Library, Brown University.

[11] All the results presented in chapter 7 were already formulated by Grossman in "Aggregate Demand, Job Search, and Employment" (1973). However, his model was different. Grossman (1973) assumed that firms set wages and prices. In *Money, Employment, and Inflation*, market prices were parametric (1976: p. 239).

[12] Firms' and households' behaviors were analyzed through representative units: "when analyzing the behavior of firms, working households, and retired households, we consider the 'representative' unit; that is, a unit whose behavior, expect for its atomistic scale, is identical to the behavior of the aggregate of such units. The representative unit is essentially an average unit. Consequently, we are able to move freely between the individual and aggregate, and we use the same notation to represent both" (1976: p. 9).

characterize actual markets. In reality, offers to buy and sell [were] usually binding, and the bulk of actual exchanges [took] place at non-market-clearing prices" (1976: p. 38). Moreover, "price adjustments" could not be viewed as "instantaneous responses to discrepancies between quantities supplied and demanded." For "if all prices behaved in this manner, [output and employment] would [be determined] as if there were a recontracting mechanism" (1976: p. 39). Hence the need to consider that the "process of adjustment to market-clearing prices [took] a significant amount of time" (1976: p. 39). From chapters 2 to 6, Barro and Grossman developed a general-equilibrium model where, by assumption, prices and wages responded sluggishly to discrepancies between supply and demand. By contrast, disequilibrium transactions were excluded in the general-equilibrium model presented in chapter 7 (1976: p. 238). This model departed from the Walrasian framework because individuals no longer had perfect information about the spatial dispersion of market prices (1976: p. 239).

Disequilibrium model

Under non-market-clearing conditions, individuals no longer behaved as if they could buy and sell as much as they wanted given market prices: "the failure of a market to clear [implied] that actual quantities transacted [diverged] from the quantity supplied or from the quantities demanded. From the standpoint of the individual, these divergences [appeared] as constraints, to be taken into account when formulating behavior in other markets" (1976: p. 40). To model the behavior of firms under quantity constraints, Barro and Grossman rested on Patinkin's ([1956] 1965) spill-over effect (1976: p. 43). They considered that in situations of excess supply in the market for goods, firms would reduce their demand for labor services by taking into account the constraints on their sales (1976: p. 42). The same logic applied to situations of excess demand in the labor market. Firms would reduce their output by taking into account the constraint on their purchases of labor services (1976: p. 69). In parallel, Barro and Grossman used Clower's (1965) dual-decision hypothesis to model how households behaved out of equilibrium (1976: p. 50). In situations of excess supply in the labor market, workers would reduce their demand for goods and their demand for money balances by taking into account the constraints on their labor income (1976: p. 50); in situations of excess-demand in the market for goods, they would reduce their supply of labor services and increase their demand for money balances (forced saving) by taking into account the constraints on their purchases of goods (1976: pp. 70-71).

When revising their plans, individuals expressed "effective" supplies and "effective" demands. These functions provided the basis for explaining the determination of output and employment, and the change in market prices. Barro and Grossman assumed that "actual transactions [equaled] the smaller of the quantities supplied and demanded" (1976: p. 40). To be more specific, in situations of general excess supply, "effective demands for labor services and commodities [determined] both employment and output" (1976: p. 55). By contrast, the level of economic activity was determined by "effective supplies of commodities and labor services" in situations of general excess-demand (1976: p. 79). After transactions were completed, market prices varied according to effective excess demands (1976: p. 95). For instance, prices and wages decreased when the effective supply was higher than the effective demand in the labor market and in the market for goods. Otherwise, prices and wages increased.

Equilibrium model with incomplete information

In the absence of perfect information about prices and wages, individuals no longer made choice under certainty. Either because they had to expect the evolution of market prices over time, or because they had to estimate the distribution of market prices over space. In *Money, Employment, and Inflation*, Barro and Grossman focused on the latter form of speculation. Following in Mortensen's (1970, 1974) footsteps, they "[considered] a framework in which both the labor market and the commodity market [involved] a large number of spatially distinct market places" (1976: p. 238). Moreover, they assumed a random distribution of individuals across markets (1976: p. 238). Under these circumstances, individuals could pay and receive different wage rates and commodity prices for the same labor services and commodities. Hence why they sought to estimate the difference in wages and prices from market place to market place.

When facing a rate of exchange different from their estimation of the mean rate of exchange, the change in individuals' estimation was less than equiproportionate (1976: p. 240). Then and more importantly, individuals completed transactions only when the actual rate of exchange was better than the estimation of the mean rate of exchange. For instance, an "household [accepted] an actual wage offer which [was] high relative to its subjective estimate of the mean wage rate" (1976: p. 240). Otherwise, it refused employment and engaged in further job search (1976: p. 241). The same logic applied when speculative behavior entered into the determination of consumption demand, labor demand, and output supply. Output and

employment were determined when all individuals satisfied their optimizing plans, i.e., when the commodity and labor markets cleared.

1.2 Two competing approaches to modeling the business cycle

In *Money, Employment, and Inflation*, Barro and Grossman used disequilibrium and equilibrium models to explain the determination of output and employment. The question is why these two approaches to macroeconomics were considered at the same time. The answer can be found in Chapter 7, and in an article that Grossman wrote in 1973, "Aggregate Demand, Job Search, and Employment."

In both cases, disequilibrium macroeconomics was compared to equilibrium macroeconomics. First, Barro and Grossman judged the strength of their microfoundations. They verified whether the models were built from the behavior of individuals, and whether macro-phenomena were deduced from optimization plans. This was the rigor criterion. Second, Barro and Grossman judged the model's capacity to reproduce some aspects of the economy. They had a list of four stylized facts. The model had to replicate a causal relationship between monetary and real variables; the existence of layoffs without any change in the nominal wage; the absence of cyclical variation in the real wage; and the pro-cyclical variations in consumption expenditures.[13] The model therefore had to match the stylized facts of the business cycle. This was the realism criterion.

Rigor and realism criteria served to rank disequilibrium and equilibrium macroeconomics. The goal of Barro and Grossman was to determine what was the best approach to modeling the business cycle. Next section presents their first comparative analysis.

2. No ranking

According to Barro and Grossman (1976), disequilibrium macroeconomics was realistic, but not rigorous. Its basic flaw was that market price stickiness reflected no one's optimizing behavior. At the same time, Barro and Grossman argued that equilibrium models *à la* Mortensen (1970, 1974) achieved rigor at the sacrifice of realism. Speculative behavior and the

[13] Barro and Grossman justified the existence of two stylized facts. An econometric study led by François Sellier and Claude Zarka (1966) showed how important was the phenomenon of layoffs over the business cycle. Drawing on their empirical study, Barro and Grossman indicated that "layoffs [explained] for about two-thirds of total separations in industrialized western countries" (1976: p. 249). Then, Edwin Kuh (1966) and Ronald Bodkin (1969) were the references to justify the absence of cyclical variation in the real wage. The other two stylized facts were not justified.

resulting effects on production and employment levels could be rationalized. However, the relationship between aggregate demand and output was inconsistent with empirical evidence. For instance, cyclical variations in employment involved counter-cyclical variations in the real wage. Under these circumstances, Barro and Grossman chose not to establish a ranking between disequilibrium and equilibrium macroeconomics. Their choice can be explained in the light of the intellectual context. Barro and Grossman thought they could use Martin Baily's (1974) and Costas Azariadis's (1975) implicit contract theory, to rationalize market price stickiness. At the same time, Barro and Grossman considered that Lucas (1975) had identified a promising approach to the business cycle. Due to these potential improvements, it made sense to adopt a wait and see position, and not to rank disequilibrium and equilibrium macroeconomics.

2.1 Disequilibrium vs. equilibrium macroeconomics

According to Barro and Grossman, the strength of disequilibrium macroeconomics was its realism. On that basis, it was possible to portray four features of market economies. It was possible to portray: i) a causal relationship between aggregate demand and output; ii) the existence of layoffs without any change in the nominal wage; iii) the absence of cyclical variation of the real wage over the business cycle; and iv) the pro-cyclical variations in consumption expenditures [need to elaborate on each point].

The problem with disequilibrium macroeconomics was its lack or rigor. The failure of markets to clear was not rationalized in Barro and Grossman's model. Market prices were fixed exogenously, by a market authority in the spirit of the Walrasian auctioneer. It followed that price stickiness was not deduced from optimizing behavior. Barro and Grossman concluded that disequilibrium macroeconomics achieved realism at the sacrifice of rigor.

The opposite was true with equilibrium macroeconomics. According to Barro and Grossman, the strength of equilibrium macroeconomics was its rigor. The equilibrium approach to economics put all macro relationships on sound microfoundations [need to explain why].

The problem was its lack of realism. For instance, Barro and Grossman showed that within equilibrium models, cyclical variations in employment involved counter-cyclical variations in the real wage [need to explain all the counter-factual implications of equilibrium macroeconomics]. Due to the lack of realism of equilibrium macroeconomics, Barro and Grossman had doubts about the importance of incomplete information to explain fluctuations.

2.2 Avenues for a better trade-off between rigor and realism

At the time when Barro and Grossman finished writing *Money, Employment, and Inflation*, implicit contract theory was emerging. The early models were developed by Baily (1974) and Azariadis (1975). Both economists were concerned with the determination of the wage rate. Coverage against unexpected variations in aggregate demand was central to their analysis. By assumptions, workers were risk averse and sought to be covered against income variations. Employers, on their side, were risk neutral. Accordingly, workers and employers had a common interest in setting contracts that specified a state-invariant wage rate, for an insurance premium. According to Barro and Grossman, this microeconomic framework could be used to address the lack of rigor of disequilibrium macroeconomics. This was because it could rationalize the slow adjustments of wages and prices. A potential suggested by Grossman, in a letter sent to Baily on 26 April 1973:

> I would like to suggest an important extension to your analysis. Your firm announces at time zero a strategy with respect to wages and employment which, if optimal, involves a fixed wage. My question concerns the absence of provisions for revision of this strategy. Your discussion would seem to imply that the strategy is set once and for all, but this implication suggests permanent wage rigidity, which is surely too strong a result. However, at the other extreme, if you were to assume that the strategy could be revised costlessly at any time, you would be led to the uninteresting conclusion that the firm would reset the wage each period *after* the state variable becomes known. Thus, what seems necessary to complete your analysis in an interesting way is the introduction of an explicit and finite cost of revising the existing wage and employment strategy and the derivation of optimal criteria for undertaking such revisions. Fortunately, I can suggest an excellent reference to this problem – namely, the paper by Barro in the *RES* January 1972.[14]

[14] Herschel I. Grossman's papers, Box 3 OF-IUF-G5, John Hay Library, Brown University. Grossman sent almost the same letter to Azariadis on 26 April 1973 (see Box 1 OF-IUF-G5, John Hay Library, Brown University). At that time, Grossman and Azariadis "had a contract from the U.S. department of Labor to work on the theory of labor contracts and variations in employment" (Letter from Grossman to Michael Parkin, 10/21/1974, Box 2 OF-IUF-G5, John Hay Library, Brown University).

The relationship between implicit contract theory, Barro's (1972) analysis of price adjustment costs, and the microfoundations of disequilibrium macroeconomics, was established in the introduction of *Money, Employment, and Inflation* (1976):

> The development of a convincing theory of the market-clearing process represents a still unsolved puzzle. The existing literature provides few clues as to useful approaches. Examples of models which do suggest explanations for market-clearing friction include Barro (1972), who emphasizes lumpy costs of changing prices and the stochastic nature of demand […] More recent contributions, which emphasize risk aversion and implicit contracts, include Azariadis [1975] and Baily (1974). The development of such a theory [of the market-clearing process] ranks high on our agenda for current and future research (1976: p. 5).

The challenge was to substitute sluggishness to rigidity of market prices in Azariadis's and Baily's framework. Barro and Grossman's solution was to elaborate a model in which the terms of contracts could be revised. The expected result was to complete the disequilibrium program of microfoundations.

Whilst forming this expectation, Barro and Grossman maintained their interest in the incomplete information program of microfoundations. This may be due to the influence of Lucas.[15] What generated the Phillips curve was the lack of information that prevented individuals from distinguishing monetary from real disturbances. When individuals were surprised by an expansionist monetary policy, they had to determine whether the increase in prices reflected an increase in demand or an increase in the general price level. Since individuals attributed a fraction of observed price movements to real disturbances, output and employment increased. Hence why inflation was inversely related to unemployment. However, this inverse relationship was temporary. Since individuals were supposed to correct any error in anticipation, they realized that price movements were due to monetary disturbances. Accordingly, output and employment came back to their natural rates. From there, Lucas sought to explain economic fluctuations. In 1975, he showed that fluctuations resulted from monetary surprises, and persisted because of serially correlated movements in the stock of money (Hoover, 1988: pp. 40-41). A result that led Barro and Grossman to reconsider the significance

[15] For a detailed presentation of Lucas's contributions to macroeconomics, see Hoover (1988) and De Vroey (2016).

of speculative behavior in the determination of the business cycle. When finalizing writing *Money, Employment, and Inflation*, Barro was at the University of Chicago.[16] There, he engaged with Lucas about his equilibrium model of the business cycle.[17] Knowing Lucas's results, Barro and Grossman could not be definite about the realism of the "incomplete information" program of microfoundations. This had to remain an open question.

To conclude, Barro and Grossman (1976) considered that it was too early to determine what was the best approach to modeling the business cycle. This was because disequilibrium and equilibrium macroeconomics were in the process of being improved. Under these circumstances, it made sense to adopt a wait and see position. What Barro and Grossman did (1976). The resulting *statu quo* contrasts sharply with Barro and Grossman's defense of equilibrium macroeconomics, at the end of the 1970s. Next section explains how and why they came to privilege equilibrium over disequilibrium macroeconomics.

3. Privileging equilibrium over disequilibrium macroeconomics

While conducting research on implicit contract theory, Barro (1977a) showed that disequilibrium macroeconomics could not be based on sound foundations. Moreover, he showed that market price stickiness was not central to macroeconomic fluctuations (1977a). At about the same time, while doing research on equilibrium macroeconomics, Barro showed that incomplete information was the critical factor to understand the fluctuations of economic activity. He reached this conclusion by discussing the qualitative properties of an equilibrium model *à la* Lucas (1972), and by testing whether "monetary surprises" had real effects. It followed a theoretical (1976) and an empirical support (1977b) for equilibrium macroeconomics. On that basis, Barro concluded that the equilibrium approach was better than the disequilibrium approach to the business cycle. He discussed this conclusion with Grossman. After various exchange of letters, Barro convinced Grossman that he was right.

3.1 Implicit contract theory or how disequilibrium macroeconomics was disqualified

In his "Long-term contracting" article, Barro (1977a) claimed that implicit contract theory could not offer microfoundations to disequilibrium macroeconomics. To explain why,

[16] Barro was a visiting professor at the University of Chicago from 1972 to 1973. On 20 March 1973, Grossman informed Michael Parkin that "Barro [had] accepted the [associate professor] position at Chicago" (Herschel I. Grossman's papers, Box 2 OF-IUF-G5, John Hay Library, Brown University).

[17] Lucas thanked "Robert Barro, Fisher Black, Edward Prescott, and Thomas Sargent" for many helpful comments on an earlier draft of "An Equilibrium model of the Business Cycle" (1975: p. 113).

he focused on how individuals set contracts. Barro pointed out that "the specification of quantity determination rules [was] as much a part of the long-term contractual arrangement as [was] the agreement about wages schedules" (1977a: p. 308). Two questions followed. First, could contractual arrangements rationalize market price stickiness? According to Barro, the models developed by Jo Anna Gray (1976) and Stanley Fisher (1977) showed that it was possible. In their models, the nominal wage was fixed before employers and workers knew the level of aggregate demand. But part of price variations passed on to the nominal wage, "through an indexing rule" (1977a: p. 310). Thus, once individuals failed to anticipate the level of aggregate demand, wages variations occurred. This result proved that the problem with implicit contract theory did not lie in its capacity to rationalize market price stickiness. Hence Barro's second question: could the quantity determination rule rationalize the failure of markets to clear? Therein lay the problem. Due to the postulate of individual rationality, "the employment rule [was] selected in order to maximize the total pie possessed by the two parties". According to Barro, this was the case only when the labor market cleared: "whenever there [was] a departure of the marginal product of labor from the marginal value of time there [was], ex post, an unexploited opportunity for mutual gains from trade. Namely, any movement of l towards l^* (accompanied by appropriate side payments) would make both firms and workers better off" (1977: p. 311). Therefore, firms and workers were led to specify an employment rule that ensured equilibrium on the labor market in all circumstances (1977: p. 311). It followed that implicit contract theory could not rationalize the failure of markets to clear.

Despite this $l = l^*$rule, it remained "optimal for firms to perform the insurance function of guaranteeing to the workers, ex ante, a fixed [nominal] wage" (1977a: p. 312). Barro concluded that implicit contract theory was still appropriate for explaining the rigidity of nominal wages and layoffs. He explained that "a negative money shock would increase [the real wage] W/P above [its equilibrium value] $(W/P)^*$. The value of l^s [the labor supply] associated with the 'prevailing' real wage would then exceed the amount of employment, l^*, which was determined at the intersection between the l^d and l^s curves. The gap between $l^s(W/P)$ and l^* [thus reflected] non-wage rationing behavior" (1977a: p. 312).[18] However, according to Barro, the model ceased to establish a causal relationship between aggregate demand and output. An expansionary monetary policy would decrease the real wage below its

[18] Barro (1977a) stressed that layoffs were, in this case, the outcome of optimal choices: "In fact, the situation is Pareto optimal because employment is determined where the marginal product of labor is equated to the marginal value of time. The 'excessive' real wage reflects a stochastic outcome whose possibility was fully considered in specifying the initial terms of the contract" (1977a: p. 312).

equilibrium value. But the level of employment would not increase – the $l = l^*$ rule applied in all circumstances. Therefore, the decrease in the real wage had consequence only on ex-post income distribution. Barro (1977a) concluded that market price stickiness was not central to explain employment fluctuations:

> My own view is that contracting theory has more pertinence for natural rates of employment and output than for the business cycle. In fact, the principal contribution of the contracting approach to short-run macro-analysis may turn out to be its implication that some frequently discussed aspects of labor markets are a façade with respect to employment fluctuations. In this category one can list sticky wages, layoffs versus quits, and the failure of real wages to move countercyclically (1977a: p. 316)

Finding that market price stickiness was not key to understanding the business cycle was puzzling for Barro (1977a: p. 315). In the disequilibrium models developed with Grossman, economic fluctuations were due to frictions in the market-clearing process. That situation led Barro to reflect on what was fundamental to the disequilibrium approach to macroeconomics. He focused on the models developed by Gray (1976) and Fisher (1977). According to Barro, their models could establish a causal relationship between aggregate demand and output because of their employment determination rule. Just like Baily (1974) and Azariadis (1975), Gray (1976) and Fisher (1977) assumed that employment was determined along the labor demand curve (1977a: p. 310). Under these circumstances, an unexpected variation in the money supply decreased the real wage below its equilibrium value and, in turn, enhanced the level of employment. However, such an employment rule was inconsistent with individual rationality. Workers and employers had no reason to agree on an employment determination rule that did not maximize their surplus. Barro concluded that what was "fundamental to [the] 'non-market-clearing' analysis [was] the nonexecution of some *perceived* mutually advantageous trades" (1977a: p. 315). It followed that disequilibrium macroeconomics could not be based on sound microfoundations.

In short, while doing research on implicit contract theory, Barro reached two conclusions: the lack of rigor of disequilibrium macroeconomics could not be addressed, and its capacity to explain the business cycle was questionable. These two conclusions resulted from one claim: only the $l = l^*$ rule was consistent with individual rationality. This is what Barro and Grossman discussed in their correspondence. At first, Grossman was not convinced by

Barro's analysis of quantity determination rules. In a letter sent on 31 December 1975, Grossman indicated that:

> when [there is a negative shock on the money supply], your proposed employment rule, $l = l^*$, together with the contractually fixed nominal wage rate, can imply negative profits for the firms. […] I would argue that the cost to the firm of financing negative profits probably rules out contracts with both fixed w and $l = l^*$."[19]

On 6 January 1976, Barro replied back. He argued that Grossman missed the point. The problem with negative profits "[related] to the question of fixed wage contracts and not to the $l = l^*$ rule. For any contract you set up that [allowed] $l \neq l^*$in some situations, [it was possible to] find a mutually preferable one that involved $l = l^*$. [One could] not get around the basic point that $l = l^*$[maximized] the total available pie."[20] This point was stressed again, in a letter sent on 14 January 1976, because Grossman was "still missing the basic point." This led Barro to clarify his view: "Suppose I construct a contract (contract I) with fixed worker income that allows for $l \neq l^*$ in state α. Suppose, then, that state α occurs. In this sate the firm and worker could both be made better off by moving to $l = l^*$ and arranging an appropriate side payment. (If $l < l^*$, the worker would receive an extra payment along with the move to $l \neq l^*$. If $l > l^*$, the worker would pay the firm along with the move.) Hence, the contract (contract II) that specifies the side payment and $l = l^*$ in state α stochastically dominates contract I. QED?"[21]

Grossman did not acknowledge openly that he was convinced by Barro's demonstration in his reply. But he did, in correspondence with other economists. This is the case in Grossman's correspondence with William Poole. While reacting to Poole's article, "Rational Expectations in a Macro Model," Grossman claimed:

> In my view, pre-determined wages do not explain why monetary, i.e., aggregate demand, disturbances affect employment, because the incorporation of an insurance element in worker compensation does not require that the criteria for determining employment differ from the criteria that would determine employment in a hypothetical auction market […] I was surprised that you made

[19] Herschel I. Grossman's papers, Box 1 OF-IUF-G5, John Hay Library, Brown University.
[20] *Ibid*.
[21] *Ibid*.

> no reference to Barro's [1977a] useful paper on 'Long-Term contracting, Sticky Prices, and Monetary Policy'[22]

Just like Barro, Grossman considered that in a model with contractual arrangements and rational expectations, workers and employers agreed to set the equilibrium level of employment in all circumstances. Moreover, Grossman came to accept all the implications of Barro's (1977a) analysis. In "Why does Aggregate Demand Fluctuates" (1979a), Grossman claimed that "implicit contractual arrangements for shifting risk from workers to employers has led to models that [rationalized] the observed stickiness of measured real wage rates and [explained] the alleged symptoms of non-wage rationing of employment without invoking the failure of markets to clear" (p. 65). Then, Grossman argued that the "essential aspect of the non-market-clearing paradigm [was to consider] situations in which *perceived* gains from trade [were] foregone because buyers and sellers [were] limited to transacting at a wage-price vector that [did] not equate quantities supplied and demanded" (1979a: p. 65).[23] Last but not least, Grossman considered that market price stickiness was not key to explain economic fluctuations since it "[was] not a causal factor connecting aggregate demand and employment" (p. 67).

Accordingly, following in Barro's footsteps, Grossman came to conclude that disequilibrium macroeconomics could not be based on sound microfoundations, and that its capacity to get the essence of the business cycle was questionable.

3.2 An increase in the empirical underpinnings of equilibrium macroeconomics

At the same period, Barro strengthened the empirical underpinnings of the incomplete-information program of microfoundations. In "Unanticipated Money Growth and Unemployment in the United States" (1977b), he gave a statistical support to Lucas's (1972, 1975) approach to fluctuations. Barro (1977b) showed that unexpected changes in the stock of money affected output and employment. The same result was also obtained via theoretical models. In "Rational Expectations and the Role of Monetary Policy (1976), Barro generated

[22] Letter from Grossman to Poole (21 Dec 1976). Herschel I. Grossman's papers, Box 1 OF-IUF-G5, John Hay Library, Brown University.

[23] Several economists questioned Barro and Grossman's characterization of disequilibrium macroeconomics. For instance, in a correspondence with Grossman, Robert Gordon pointed out that individuals exploited all arbitrage opportunities in the disequilibrium models developed by Takashi Negishi (1976) and Frank Hahn (1977, 1978). To explain why, Gordon stressed that within their imperfect competition framework, individuals operated on their perceived demand curves. Cf. Letter from Gordon to Grossman, 31 July 1978, Box 2 OF-IUF-G5, John Hay Library, Brown University.

economic fluctuations in a rational-expectations model *à la* Lucas (1972). Barro concluded that the causal relationship between aggregate demand and output involved incomplete information about monetary and real disturbances. This result was stressed again in "Long-term contracting, sticky prices, and monetary policy" (1977a). There, Barro considered a rational-expectation model in which workers and firms set contracts. Within this framework, he focused on how firms could exploit the lack of information about monetary vs. real disturbances. When engaging in contracts, employers and workers knew that a productivity shock changed the equilibrium level of employment while a monetary shock did not. However, unlike workers, firms were directly affected by a productivity shock. Accordingly, they could (temporarily) "misrepresent this value to the workers" when the economy was subjected to monetary disturbances (1977a: p. 314). For instance, firms could overstate their perception of a productivity shock when the general price level raised. This would "substantiate a claim that l^* had increased" and, in turn, an increase in economic activity (1977a: p. 314). Barro concluded that incomplete information was central to the causal relationship between aggregate demand and employment.

When Barro conducted his research on equilibrium macroeconomics, he discussed his results with Grossman. Grossman was convinced by their validity. In a letter sent on 19 December 1975, Grossman acknowledged the strength of Barro's statistical study:

> I did finally finish reading your draft of 'Unanticipated Money Growth and Unemployment in the United States.' I was impressed by the ingenuity of your formulation, the care and clarity with which you interpreted the results, [and] the overall good fit.[24]

Thereafter, Grossman was convinced by the theoretical verdict formulated by Barro (1976, 1977a). In "Employment fluctuations and the mitigation of risk" (1979b), Grossman argued that "a further implication of Barro's [1977a] analysis [was] that, risk-mitigating arrangements notwithstanding, assumptions about incomplete information [seemed] to be necessary to explain why actual macroeconomic behavior [differed] qualitatively from the predictions of the Walrasian model […] In addition, a number of recent papers – see, for example, Barro (1976) and Lucas (1975, 1977) – have shown that incomplete information [was] sufficient, even without taking into account of contractual inflexibilities, to generate non-Walrasian fluctuations in employment. The correct conclusion [was] that risk-mitigating arrangements [were] neither

[24] Herschel I. Grossman's papers, Box 1 OF-IUF-G5, John Hay Library, Brown University.

necessary nor sufficient to cause monetary or other macroeconomic disturbances to have so-called real effects" (1979b: p. 346). What was central to economic fluctuations was the limited ability of agents to distinguish monetary from real disturbances.

Following in Barro's footsteps, Grossman thus came to conclude that incomplete information was the critical factor in the determination of fluctuations. Likewise, Grossman had concluded that disequilibrium macroeconomics could not be based on sound microfoundations and that price stickiness was not central to the business cycle. Therefore, at the end of the 1970s, Barro and Grossman considered that the trade-off between rigor and realism was better in equilibrium than in disequilibrium macroeconomics. Hence why they came to privilege business cycle models *à la* Lucas.

4. The trade-off between rigor and realism

Despite their defense of equilibrium macroeconomics, Barro and Grossman considered that the issue of its realism was still opened. This led them to devise new tests of equilibrium macroeconomics. Their econometric results questioned Lucas's capacity to explain actual fluctuations. Barro and Grossman showed that the inability of economic agents to perceive correctly an ongoing monetary policy had no significant effect on production and employment. At about the same time, they reconsidered their position on the role of market price stickiness in macroeconomic fluctuations. They no longer excluded the possibility that market price stickiness could be the source of the business cycle. However, Barro and Grossman never reconsidered their rejection of disequilibrium macroeconomics. Equilibrium macroeconomics remained the good approach to explain fluctuations. The reason was that it was rigorous. Accordingly, Barro and Grossman ended up privileging rigor over realism to support equilibrium macroeconomics. I show that such a trade-off reflected how Barro and Grossman resolved the tensions between theory and facts.

4.1 Privileging rigor over realism

To address the empirical validity of equilibrium macroeconomics, Barro (1977b) tested whether unanticipated money movements affected production and employment. His statistical study showed that they did. Monetary surprises had significant real effects. But could one conclude that Lucas's framework explained actual fluctuations? In 1977, Barro suggested that his econometric test was not specific enough. This was because "the proposition that only unanticipated money movements [had] real effects [was] clearly more general than the specific

setting of [Lucas's (1972) or Sargent & Wallace's (1975)] models" (1977b: p. 101). In particular, it also underlined the disequilibrium models developed by Gray (1976) and Fisher (1977). The difference was that the causal relationship between monetary and real variables involved the failure of markets to clear, not the inability of agents to correctly perceive an ongoing monetary policy. That situation led Barro and Grossman to consider new tests of equilibrium macroeconomics. They were presented in "Money Stock Revisions and Unanticipated Money Growth" (Barro & Hercowitz, 1980), and in "Tests of Equilibrium Macroeconomics Using Contemporaneous Monetary Data" (Boschen & Grossman, 1982). According to Barro and Hercowitz (1980), the formulation of a test adapted to equilibrium macroeconomics required to proxy the unperceived money growth. Their idea was to use the revisions of the money stock data published by the Federal Reserve. Their test thus consisted of determining whether output and employment could be explained by the discrepancy between the initial and the final reports on money growth. On their side, Boschen and Grossman (1982) conditioned their empirical study upon a modification of equilibrium macroeconomics. They considered a model in which individuals processed information on current monetary policy and took into account the revisions of monetary data. On that basis, they tested whether a perceived monetary policy was neutral and whether revisions of monetary data were non-neutral (1982: p.311).

This resulted in three econometric tests. All three questioned the empirical validity of equilibrium macroeconomics. On the one hand, Barro and Hercowitz showed that "the discrepancy between initial and final reports on money growth rates [had] no explanatory power for unemployment and output" (1980: p. 266). This suggested that incomplete information could not be central to business fluctuations (1980: p. 266). On the other hand, Boschen and Grossman showed that a perceived monetary policy could have significant real effects, and that revisions of monetary data might be neutral (1982: p. 311). It followed that the "two tests [provided] strong evidence against the reality of the equilibrium approach to modelling macroeconomic fluctuations" (1982: p. 311).

At the same time, Barro and Grossman reconsidered their position on the significance of market price stickiness in the business cycle. In the preface to the Japanese edition of *Money, Employment, and Inflation*, Grossman reflected on "the present state of the theory of

macroeconomic fluctuations."[25] In that process, he argued that "to fit the facts, we seem to have to use models that [involved] the failure of markets to clear and/or ad-hoc expectations." Barro, on his side, did not discuss the empirical validity of disequilibrium macroeconomics in the preface. But he did in *Money, Expectations, and Business Cycles* (1981). Just like Grossman, Barro no longer argued that price stickiness was not central to macroeconomic fluctuations. While reflecting on the results obtained in "Money Stock Revisions and Unanticipated Money Growth" (1980), Barro addressed the empirical validity of the unperceived vs. unanticipated theories of the trade cycle.[26] He argued that "if the initial reports on the money stock [were] viewed as observable with a negligible time lag, [the econometric result obtained with Hercowitz] would support the view that unanticipated, rather than unperceived, money were the important stimulus for output" (1981: p. 73). This was tantamount to considering that market price stickiness was the source of actual fluctuations.

In spite of this, Barro and Grossman kept defending the equilibrium approach to the business cycle. Barro explained why in the preface to the Japanese edition of *Money, Employment, and Inflation*:

> It would not be fair presently to describe the equilibrium approach as providing a complete theoretical and empirical picture of business fluctuations. Explanations for the short-run non-neutrality of money are especially troublesome within this setting. However, these difficulties reflect the model's requirement that the major propositions can be deduced from an internally-consistent framework in which individual rationality prevails […] It seems pointless to return to disequilibrium microanalysis, in which the major business cycle results stem from incomplete aspects of the model.[27]

[25] Barro and Grossman wrote two separate prefaces. In a letter sent to Hirotaka Kato (the translator of *Money, Employment and Inflation*), Grossman explained that "Barro [preferred] this arrangement of two separate prefaces, [which did not reflect any] major disagreement" (8 October 1980, Box 3-OF-IUF-G5, John Hay Library, Brown University). I found the English version of these prefaces in Grossman's papers. Thanks to Yutaka Furuya, I could check the potential differences with the Japanese's. There is nothing to report.

[26] As a reminder, Barro and Hercowitz pointed out that "purely nominal shocks [could] influence real behavior not because these shocks [were] contemporaneously unperceived, but rather because these shocks were unpredictable at earlier dates. The imposition of unanticipated, but not necessarily contemporaneously unperceived, money movements on an economy with long-term nominal contracts is viewed as a source of business fluctuations in models constructed by Gray (1976) and Fisher (1977)" (1980: p. 258).

[27] Excerpt from Barro's preface to the Japanese edition of *Money, Employment, and Inflation* (Herschel I. Grossman's papers, Box 1-OF-IUF-G5, John Hay Library, Brown University).

Once again, the rigor and realism criteria were used to rank disequilibrium and equilibrium macroeconomics. What seemed new, however, was the relative importance of the two criteria. Until now, rigor and realism criteria seemed to be weighted equally. Here, Barro privileged rigor over realism. Equilibrium macroeconomics was not realistic but, unlike disequilibrium macroeconomics, it was based on sound microfoundations. This was enough to justify further development of the equilibrium approach to the business cycle, and to discard disequilibrium macroeconomics. Grossman was on the same page. In a letter sent to the translator of *Money, Employment, and Inflation*, Grossman argued:

> Barro and I agree, except in whatever subtleties might be reflected in our choice of words. Specifically, [Barro] writes that models that involve failure of markets to clear and/or ad-hoc expectations are 'pointless', whereas I write that 'reliance on such devices is not satisfactory'.[28]

Accordingly, Barro and Grossman ended up making a trade-off between rigor and realism to support equilibrium macroeconomics.

4.2 The defense of equilibrium macroeconomics

Such a trade-off is puzzling. Since the beginning of the 1970s, Barro and Grossman insisted on the model's capacity to explain the business cycle. So why did the realism of disequilibrium macroeconomics no longer weight in their ranking process? Then, on two occasions, Barro and Grossman came to conclude that incomplete information was not central to the determination of fluctuations. So why did they continue to support the equilibrium approach to the business cycle? All this raises again the issue of why Barro and Grossman privileged equilibrium over disequilibrium macroeconomics. To understand their choice, it is necessary to go beyond a comparative analysis of the two frameworks. The way Barro and Grossman resolved the tensions between theory and facts seems to have been the decisive factor.[29]

[28] Letter from Grossman to Kato, 5 January 1981 (Box 3-OF-IUF-G5, John Hay Library, Brown University).

[29] What also weighted in their decision was that unlike disequilibrium macroeconomics, equilibrium macroeconomics was appropriate for assessing policy activism. Barro explained why, in 1979. According to Barro, the issue of the "efficiency of private arrangements relative to governmental actions" (1979: p. 56) was assumed away in disequilibrium models. By assumption, State was more efficient than markets: "the private sector inefficiency [was] represented by sticky wages or prices [and contrasted with] the flexibility of such government policy instruments as the money supply, taxes, or expenditures" (1979: p. 54). By contrast, equilibrium macroeconomics modeled government as private agents and replaced "the arbitrariness of supply unequal demand […] by a serious explanation, such as imperfect information about exchange opportunities" (1979: p.

It all began with the lack of realism of Walrasian theory. According to Barro and Grossman, Walrasian theory was inappropriate for analyzing the business cycle. This was because in a frictionless system of markets, a change in the money supply did not have any effects on production and employment (1968: p. 5; 1972: p. 1354; 1976: p. 23). Barro and Grossman concluded that frictions in the economy were central to fluctuations. This resulted in a strategy to reconcile theory with facts. It consisted of inhibiting the operation of markets. Barro and Grossman never questioned the key building blocks of Walrasian theory. For instance, economic activity continued to be coordinated by an authority *à la* Walras in their disequilibrium model. "Market agents" were supposed to ensure the compatibility between individuals' plans and to realize transactions (1976: p. 10; p. 40). More generally, individual optimization and perfect competition always prevailed in their macroeconomic models. All this suggests that when facing a tension between theory and facts, Barro and Grossman accepted any modifications of Walrasian theory as long as they respected its core principles. Therein lay the problem with disequilibrium macroeconomics. Barro and Grossman considered that the failure of markets to clear involved a break with the principle of individual optimization.[30] Accordingly, disequilibrium macroeconomics could no longer be an option. It had to be discarded, no matter its capacity to match the stylized facts of the business cycle.

By contrast, the equilibrium approach to the business cycle remained to be explored. Its inconsistency with data was not viewed as a fatal flaw. This was because one could have some doubts about a statistical observation, but not about a theoretical demonstration. Barro and Hercowitz made this point in the conclusion of "Money Stock Revision and Unanticipated Money Growth" (1980). True the misperception of money growth rates had no significant effect on output and employment levels. However, one could not conclude that Lucas had failed to explain fluctuations (1980 p. 266). This was because "the strongest theoretical arguments for real monetary effects [depended] on confusions between relative and absolute changes, which

56). It followed that the efficiency of the private system could be compared to the efficiency of governmental actions without any bias. Hence why unlike disequilibrium macroeconomics, equilibrium macroeconomics could be used to guide economic policy. Grossman was on the same page (1979a: p. 68).

[30] Depending on the model's assumptions, the failure to exploit arbitrage opportunities could be consistent with individual's rationality. Peter Howitt explained why, in a letter sent to Grossman: "If you add the assumption that workers and firms know exactly who should trade with who to make everyone better off, and that they could carry these trades at no cost, then it is a genuine puzzle to explain why they don't carry them out. But surely the spirit of disequilibrium models is that this information is not universally known, that the process by which potential trading partners contact one another and communicate offers takes time, and that this process is somehow captured by assuming that people can communicate only through the auctioneer, who operate at a finite speed. Under this interpretation people do not learn instantaneously about possible mutually advantageous trades, and the puzzle you talk of don't arise" (Letter from Howitt to Grossman, 29 Dec 1982).

[required] the underlying money stocks to be temporarily unperceived" (1980: p. 266). At the same period, Grossman also defended equilibrium macroeconomics claiming that theory had the upper hand on facts. This line of defense was adopted in a correspondence with Robert Solow. Grossman questioned an observation made by Solow to defend the disequilibrium approach to the business cycle:

> You 'observe' that markets fail to clear, whereas I 'observe' that the sun revolves around the earth. Both 'observations' are suspicious for the same reasons. First, they are inconsistent with general theories – the theory of neoclassical general equilibrium in one case, and the theory of gravity in the other case – that account for a wider range of phenomena. Second, these general theories provide alternative interpretations of the phenomena underlying our 'observations.' Specifically, neoclassical theory suggests contractual explanations for layoffs. These explanations do not involve any failures to realize perceived gains from trade – that is to say, any failure of markets to clear.[31]

The second argument was analogous to Barro and Hercowitz's. According to Grossman, the existence of non-clearing labor market could be questioned because neoclassical theory offered an alternative explanation of unemployment. In an equilibrium model with contractual arrangements, the level of employment was not a constraint imposed on workers and employers. It was the result of an optimal choice. Since this explanation resulted from a theoretical demonstration, Grossman considered that it was more reliable than Solow's view on fluctuations. It followed a reason to support equilibrium macroeconomics.

Another reason was suggested at the beginning of Grossman's quotation. Unlike disequilibrium macroeconomics, equilibrium macroeconomics was fully consistent with the "theory of neoclassical general equilibrium." According to Grossman, this theory proved to be able to explain a large "range of phenomena." It thus made sense to believe in its capacity to explain the business cycle. Barro was on the same page (1981: p.73).

Therefore, Barro and Grossman considered that a proper equilibrium model of the business cycle existed. It just had to be discovered. However, neither Barro nor Grossman kept working on the business cycle. At the end of the 1980s, Barro started working on economic

[31] Letter from Grossman to Solow, 13 February 1981 (Grossman's papers, Box 1-OF-IUF-G5, John Hay Library, Brown University).

growth. Grossman, on his side, started working on the economics of conflict. That suggests that they never succeeded in formulating a realistic equilibrium model of the business cycle.

5. Conclusion: anti-empiricism and the domination of equilibrium macroeconomics

Several reasons may explain why Barro and Grossman privileged equilibrium over disequilibrium macroeconomics. The goal of my article was to determine whether, and to what extent their decision was due to some sort of superiority of equilibrium *vis-à-vis* disequilibrium macroeconomics.

This comparative approach turned out to be appropriate for explaining Barro and Grossman's decision. Throughout the 1970s, Barro and Grossman compared disequilibrium and equilibrium models. They compared their rigor (i.e., the capacity to deduce aggregate phenomena from individual's decisions), and their realism (i.e., the capacity to match the stylized facts of the business cycle). The resulting comparative analyses thus offered a basis to explain why Barro and Grossman came to advocate for equilibrium models *à la* Lucas. Then, and more importantly, Barro and Grossman were looking for the best approach to the business cycle. The competition was between disequilibrium and equilibrium macroeconomics. On one side, fluctuations resulted from market price stickiness and involved the failure to realize standard optimization plans. On the other side, fluctuations resulted from a lack of information about market prices and involved pareto-efficient behavior. Barro and Grossman's challenge was to determine which modeling strategy offered the better trade-off between rigor and realism. Accordingly, it made sense to address the relative performance of equilibrium and disequilibrium macroeconomics.

In a first step, Barro and Grossman did not establish a ranking between the two frameworks. This is striking in *Money, Employment, and Inflation* (1976). Barro and Grossman (1976) argued that disequilibrium macroeconomics achieved realism at the sacrifice of rigor. It could portray a causal relationship between aggregate demand and output; the existence of layoffs without any change in the nominal wage; the absence of cyclical variation of the real wage over the business cycle; and the pro-cyclical variations in consumption expenditures. But Barro and Grossman (1976) did not succeed in rationalizing price stickiness and the associated failure of markets to clear. It followed that a key building block of disequilibrium macroeconomics was not based on sound microfoundations. By contrast, Barro and Grossman

(1976) argued that equilibrium macroeconomics achieved rigor at the sacrifice of realism. In equilibrium models *à la* Mortensen (1974), all macro relationships could be deduced from individuals' decisions. But the relationship between aggregate demand and employment was inconsistent with empirical evidence. For instance, cyclical variations in employment involved counter-cyclical variations in the real wage. Barro and Grossman (1976) concluded that just like disequilibrium macroeconomics, equilibrium macroeconomics *à la* Mortensen (1974) was flawed. This situation led me to explain why Barro and Grossman did not establish any ranking. I argued that it was because disequilibrium and equilibrium macroeconomics were in the process of being improved. According to Barro and Grossman (1976), implicit contract theory could fill the lack of microfoundations of disequilibrium macroeconomics. At the same time, they acknowledged that Lucas (1972, 1975) had found a promising approach to the business cycle. Under these circumstances, it made sense to adopt a wait and see position. What Barro and Grossman (1976) did. But it did not last long.

In a second step, Barro and Grossman came to support equilibrium macroeconomics. While doing research on disequilibrium macroeconomics, Barro (1977a) showed that contractual arrangements could rationalize market price stickiness but not the failure of markets to clear. This was because no contract could justify the determination of quantities under non-market-clearing conditions. Otherwise, contracts would have been inconsistent with individual rationality. Individuals' surplus was maximized only under market-clearing conditions. It followed that in a model including contracts and rational expectations, the failure of markets to clear amounted to a failure of individuals to execute some perceived mutually advantageous trades. Barro concluded that disequilibrium macroeconomics could not be based on sound microfoundations. Then, Barro (1977a) showed that as soon as quantities were determined under market-clearing conditions, price stickiness no longer ensured a causal relationship between monetary and real variables. He concluded that market price stickiness was not central to the business cycle. At the same time, while doing research on equilibrium macroeconomics, Barro found that incomplete information was the critical factor to explain macroeconomic fluctuations. Barro (1976) reached this conclusion by discussing the qualitative properties of an equilibrium model *à la* Lucas (1972), and by testing whether "monetary surprises" had real effects (1977b). Systematically, Barro discussed his conclusions with Grossman. After some resistance, Grossman always ended up agreeing with Barro.

That intellectual journey shows that at the end of the 1970s, Barro and Grossman privileged equilibrium macroeconomics because it offered a better framework than

disequilibrium macroeconomics. However, one cannot conclude that the superiority of equilibrium macroeconomics was the only factor underlying their decision. In the early 1980s, this explanation did not work anymore. Barro and Hercowitz (1980) showed that unperceived money growth did not explain output and employment fluctuations. On their sides, Boschen and Grossman showed that a perceived monetary policy could have significant real effects, and revisions of monetary data might be neutral (1982: p. 311). Accordingly, Barro and Grossman came to conclude that equilibrium macroeconomics was not realistic. At the same time, they reconsidered their position on the role played by market price stickiness in macroeconomic fluctuations. More or less explicitly, they argued that the slow adjustments of prices and wages were central to explain the business cycle. As a result, Barro and Grossman were somehow back to the situation faced in *Money, Employment, and Inflation*. They considered that disequilibrium macroeconomics achieved realism at the sacrifice of rigor, and that equilibrium macroeconomics achieved rigor at the sacrifice of realism. However, this time, they defended the equilibrium approach to the business cycle.

To understand why, it was necessary to go beyond a comparative analysis of disequilibrium and equilibrium macroeconomics. The key was to discuss how Barro and Grossman resolved the tensions between Walrasian theory and facts. To explain the business cycle, Barro and Grossman required to modify Walrasian theory. But the modifications had to respect its core principles. However, disequilibrium macroeconomics broke with the principle of individual optimization. They concluded that disequilibrium macroeconomics had to be discarded, no matter its capacity to reproduce the stylized facts of the business cycle. At the same time, Barro and Grossman considered that a theoretical demonstration was more reliable than observations. However, equilibrium macroeconomics allowed to explain fluctuations on the basis of individual's decisions. Barro and Grossman concluded that equilibrium macroeconomics remained to be explored, despite its inconsistencies with data. Their defense of equilibrium macroeconomics was therefore due to the dominance of theory in the choice of models.

This anti-empiricist view was questioned by some contemporary economists. In Grossman's papers, I found that Frank Hahn, Edmond Malinvaud, and Robert Solow expressed their disagreement. Malinvaud and Solow stressed the need to test and possibly reject the core principles of Walrasian theory. Special attention was given to rational expectations. In a correspondence with Solow, Grossman argued that "it was more appropriate to refer to rational expectations as a postulate rather than a hypothesis." He concluded that the existence of rational

expectations was "not testable, just like the postulate of utility maximization."[32] Solow disagreed. According to Solow, the "intrinsic plausibility [of the rational expectation hypothesis] mattered when interpreting observations."[33] Its use therefore had to be conditioned on econometric testing. Malinvaud was on the same page.[34] Then, Hahn and Solow insisted on the significance of involuntary unemployment to understand short-run fluctuations. According to Solow, "the failure of markets to clear was the heart of the matter. Those who [claimed] to see labor markets clearing (i.e., workers on their supply curve) [needed] to explain why workers [felt] themselves to be experiencing excess supply" during the downturn.[35] On his side, Hahn asked Grossman: "In what sense exactly has British (or U.S.) economic history over the past 100 years been Pareto-Efficient? *The Times* here published a picture of 3000 Americans queueing in the snow for 300 jobs. Isn't the Johnsonian approach of calling a spade a spade sometimes useful? E.g. is it unnatural to suppose that the 3000 preferred the job to idleness?"[36] Hahn's questions sounded like Solow's claim. To explain correctly the business cycle, models had to leave room for involuntary unemployment. If it was not the case, the model had to be discarded.

Because the choice of models had to be guided by experience, Hahn and Solow preferred disequilibrium over equilibrium macroeconomics. The same applied with Malinvaud. On the contrary, because of their anti-empiricism, Barro and Grossman ended up advocating for equilibrium models *à la* Lucas. This suggests that equilibrium macroeconomics came to dominate because the anti-empiricist stance was shared by most macroeconomists.

References

Azariadis, C. (1975). Implicit Contracts and Underemployment Equilibria, *Journal of Political Economy*, 83, pp. 1183-1202.

[32] Letter from Grossman to Solow, 3 February 1978 (Grossman's papers, Box 1-OF-IUF-G5, John Hay Library, Brown University).
[33] Letter from Solow to Grossman, 4 March 1978 (Grossman's papers, Box 1-OF-IUF-G5, John Hay Library, Brown University).
[34] For further details on how Malinvaud viewed the rational expectation hypothesis, see Matthieu Renault (2016: pp. 298-300).
[35] Letter from Solow to Grossman, 20 February 1981 (Grossman's papers, Box 1-OF-IUF-G5, John Hay Library, Brown University).
[36] Letter from Hahn to Grossman, 18 February 1983 (Grossman's papers, Box 3-OF-IUF-G5, John Hay Library, Brown University).

Backhouse, R.E., and Mauro, Boianovsky. (2013). *Transforming Modern Macroeconomics: Exploring Disequilibrium Microfoundations 1956-2003*. Cambridge: Cambridge University Press.

Baily, M.N., (1974). Wage and Employment under Uncertain Demand. *Review of Economic Studies*, 41, pp. 37-50.

Barro, R.J., (1972). A Theory of Monopolistic Price Adjustment, *Review of Economic Studies*, 39, pp. 17-26.

Barro, R.J., (1974). Are Government Bonds Net Wealth? *Journal of Political Economy*, 82 (6), pp. 1085-1117.

Barro, R.J., and Grossman, H.I. (1971). A general disequilibrium model of income and employment, *American Economic Review*, 61, pp. 82-93.

Barro, R.J., and Grossman, H.I. (1974). Suppressed Inflation and the Supply Multiplier, *Review of Economic Studies*, 41, pp. 87-104.

Barro, R.J., and Grossman, H.I. (1976). *Money, Employment, and Inflation*. Cambridge University Press: London.

Barro, R.J., and Grossman, H.I. (1982). *Money, Employment, and Inflation*. Japanese Translation, McGraw-Hill Kogakusha Ltd.

Barro, R.J. (1976). Rational Expectations and the Role of Monetary Policy. *Journal of Monetary Economics*, 2, pp. 1-32.

Barro, R.J. (1977a). Long-Term Contracting, Sticky Prices, and Monetary Policy, *Journal of Monetary Economics*, 3, pp. 305-316.

Barro, R.J. (1977b). Unanticipated Money Growth and Unemployment in the United States, *The American Economic Review*, 67 (2), pp. 101-115.

Barro, R.J and Hercowitz, Z. (1980). Money Stock Revisions and Unanticipated Money Growth, *Journal of Monetary Economics*, 6, pp. 257-267.

Barro, R.J. (1981). Money, Expectations, and Business Cycles, New York: Academic Press.

Bodkin, R.G., (1969). Real Wages and Cyclical Variations in Employment, *Canadian Journal of Economics*, 2, pp. 353-374.

Boschen, J. and Grossman, H.I. (1980). Tests of Equilibrium Macroeconomics Using Contemporaneous Monetary Data, Journal of Monetary Economics, 8, pp. 309-333.

Clower, R.W. (1965). The Keynesian Counter-Revolution: A Theoretical Appraisal, in *The Theory of Interest Rates*, ed. F.H. Hahn and F.P.R Brechling [1965], pp. 103-125, Reprinted in Walker [1984], pp. 34-58.

De Vroey, M. (2016). *A History of Macroeconomics from Keynes to Lucas and Beyond*, Cambridge University Press.

Gray, J.A. (1976). Wage Indexation: A Macroeconomic Approach, *Journal of Monetary Economics*, 2, pp. 221-235.

Grossman, H.I., (1968). Market Disequilibrium in a Macro-Economic Context. Manuscript. Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University.

Grossman, H.I., (1971). Money, Interest, and Prices in Market Disequilibrium. *Journal of Political Economy*, 79 (5), pp. 403-413.

Grossman, H.I., (1973). Aggregate Demand, Job Search, and Employment. *Journal of Political Economy*, 81, pp. 1353-1369.

Grossman, H.I., (1974). The Cyclical Patter of Unemployment and Wage Inflation. *Economica*, 41 (164), pp. 943-961.

Grossman, H.I., (1975). The Nature of Optimal Labor Contracts. Read at Third Reisenburg Symposium, On the Stability of Contemporary Economic Systems.

Grossman, H.I., (1979a). Why Does Aggregate Demand Fluctuate? *The American Economic Review*, 69 (2), pp. 64-69.

Grossman, H.I., (1979b). Employment Fluctuation and the Mitigation of Risk. *Economic Inquiry*, 17, pp. 344-359.

Grossman, H.I. (1983). The Natural-Rate Hypothesis, the Rational-Expectations Hypothesis, and the Remarkable Survival of Non-Market-Clearing Assumptions, Carnegie-Rochester Conference Series on Public Policy, 19, pp. 225-246.

Fisher, S. (1977). Wage Indexation and Macro-Economic Stability, Journal of Monetary Economics, pp. 107-147.

Hahn, F. (1977). Exercises in Conjectural Equilibria. *Scandinavian Journal of Economics*, 79, pp. 210-226.

Hahn, F. (1978). On non-Walrasian Equilibria. *Review of Economic Studies*, 45, pp. 1-17.

Hoover, K. (1988). *The New Classical Macroeconomics: A Skeptical Inquiry*. Oxford: Blackwell.

Howitt, P. (1979). Evaluating the Non-Market Clearing Approach. *The American Economic Review*, 69 (2), pp. 60-63.

Kydland, F., and E., Prescott. (1977). Rules rather than Discretion: The Inconsistency of Optimal Plans, *Journal of Political Economy*, 85, pp. 473-491.

Kuh, E. (1966). Unemployment, Production Functions, and Effective Demand, *Journal of Political Economy*, 74, pp. 238-249.

Leijonhufvud, A. (1968). *On Keynesian economics and the Economics of Keynes*. Oxford University Press: New York.

Lucas, R.E., Jr. (1972). Expectations and the Neutrality of Money, *Journal of Economic Theory*, 4, pp. 103-124.

Lucas, R.E., Jr. (1975). An Equilibrium Model of the Business Cycle, *Journal of Political Economy*, 83, pp. 1113-1144.

Lucas, R.E., Jr. (1977). Understanding Business Cycles, in *Stabilization of the Domestic and International Economy*, K. Brunner and A. Meltzer, eds., New York: North Holland.

Mortensen, D.T., (1970). A Theory of Wage and Employment Dynamics, in E.S. Phelps, *et al., Microeconomic Foundations of Employment and Inflation Theory*. Norton: New York.

Mortensen, D.T., (1974). Job Matching Under Imperfect Information, read at conference on 'Evaluating the Labor Market of Social Programs, Princeton.

Negishi, T. (1976). Unemployment, inflation, and the micro-foundations of macroeconomics. In M.J. Artis and A.R. Nobay (eds.) *Essays in Economic Analysis*. Cambridge: Cambridge University Press, pp. 33-49.

Patinkin, D. ([1956] 1965). *Money, Interest and Prices*. 2nd ed. New-York: Harper & Row.

Plassard, R. (2018). Following in Patinkin's and Clower's Footsteps: Barro, Grossman, and the Development of Disequilibrium Macroeconomics, Working-Paper.

Poole, W. (1976). Rational Expectations in the Macro Model, Brookings Papers on Economic Activity, 2, pp. 463-514.

Sargent, T. and N., Wallace. (1975). Rational Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule. *Journal of Political Economy*, 83, pp. 241-254.

Sellier, F. and C. Zarka (1966). *International Differences in Factors Affecting Labor Mobility*, International Labor Organization: Geneva.