

1. Introducing Jacques Drèze

Graduate programs in economics rest on three building blocks: microeconomics, macroeconomics and econometrics. In each of these three areas, the name of Drèze surfaces as a common name. Indeed, there is a "*Drèze criterion*" for decisions by business firms under uncertainty; there is a "*Drèze equilibrium*" for market clearing with unemployment; and there is a "*Drèze prior*" for statistical analysis of structural econometric models. This observation points unmistakably to the breadth and depth of his research: a breadth spanning across the three pillars of contemporary economics. A depth testified in *each domain* by paternity of an original concept of lasting value. Drèze did his PhD at Columbia University, with a thesis on "*Individual decision making under partially controllable uncertainty*" under the supervision of William Vickrey. After a first academic job at Carnegie in Pittsburgh, he joined the University of Louvain in 1958. Around 1960, economists at continental European universities pursued their research in isolation. Until 1966, his published work mostly derived from his thesis but 1966 marked an important turning point. Together with colleagues from business and engineering, he launched the "*Centre for Operations Research and Econometrics*" (CORE). It was a success, so much so that Gérard Debreu could write in 1989: "*By the end of the 1960s, CORE had become the major research centre in mathematical economics outside the US*".² We review both his scholarly contributions and his role on the international scene of economics sequentially.

2. Conceptual foundations of decision making under uncertainty

Rigorous analysis of economic decisions under uncertainty, initiated by Ramsey and de Finetti in the 30's, took form after World War II, with von Neumann and Morgenstern's *Theory of Games and Economic Behaviour* for situations of strategic interaction, then Savage in *Foundations of Statistics* for games against nature and statistical decisions. The logical integration of these two theories has been accomplished in 2009 by Aumann and Drèze (146) who show that subjective expected utility maximisation characterises rational behaviour in both contexts.³ Between games of strategy and games against nature, there remains a middle ground where uncertainties are partially controllable by the decision-maker – situations labelled "games of strength and skill" by von Neumann and Morgenstern, or "moral hazard" in subsequent work. These situations have retained the Drèze's attention ever since his unpublished dissertation (8, 76, 123). Rational behaviour is again characterised by subjective expected utility maximisation, where the utility is state-dependent, and the maximisation encompasses the choice of an optimal subjective probability from an underlying feasible set. Drèze has thus been instrumental in unifying the conceptual foundations of the whole field of decision-making under uncertainty. With reference to state-dependent preferences and moral hazard, a natural application of long-standing interest to economists concerns the provision of safety, for instance through road investments aimed at saving lives. The analysis of such problems, initially approached in a rather mechanical way, has been reoriented when Drèze introduced in 1962 (12) the "willingness-to-pay" approach, now widely adopted.

3. Bayesian econometrics: the Drèze prior

One important by-product of the theory of rational decisions under uncertainty has been the emergence of the *Bayesian school of statistics*. It views statistical decision as no different from other decision problems, and statistical inference as concerned with the revision of subjective probabilities on the basis of observations. Bayesian analysis of structural econometric models raises specific difficulties, linked to the so-called "identification problem. The development of suitable Bayesian methods for this problem followed circulation in 1962 of a Discussion Paper fully developed in several subsequent papers (34,39,41,61).

¹ Title of the interview published in *Macroeconomics Dynamics* (2005) and reprinted in "*Inside the economist's mind*", edited by Samuelson and Barnett (Blackwell Publishing, 2006).

² Quoted from the address in honour of Drèze at a conference organized at the occasion of his retirement.

³ Numbers in parenthesis refer to the publications listed in Drèze's CV.

4. From decision theory to econometrics and economic theory

How do decision theory, econometrics and economic theory relate to each other? Early on, Ken Arrow borrowed from decision theory and statistics the idea of representing economic uncertainties through "states of the world" a simple device that has permitted the extension to uncertainty of the theory of general equilibrium (GET) under certainty known as the "Arrow-Debreu model".⁴ In his presidential address to the *Econometric Society* in 1971 (27), Drèze writes: "*We should now regard as a realistic challenge the formal analysis of decision problems in economics, resting on a specification of ends and means firmly rooted in economic theory, incorporating a probabilistic treatment of econometric information, and making use of the possibilities offered by mathematical programming techniques to compute optimal policies*". That sentence defines concisely the research program at CORE, where economists, econometricians, game theorists and operations researchers interact. His own contributions to this program encompass decision theory and Bayesian econometric methods, as noted above. They include occasional forays in game theory (37,53,75), mathematical programming (14,35) and dynamical systems (45,47). They consist mostly of theoretical and applied papers, spanning micro and macro issues.

5. Essays on economic decisions under uncertainty

The work of Drèze on the economics of uncertainty through the mid-80's is collected in his volume of *Essays on Economic Decisions under Uncertainty* (B2), published in 1987. In his review of that book, John Hey Editor of *The Economic Journal*, writes: "*Drèze is one of a handful of economists whose names are synonymous with the economics of uncertainty; with the possible exception of Kenneth Arrow he has probably done more than any other economist since the war in advancing economic knowledge in this area*". The twenty chapters are organised in seven parts, covering successively decision theory, market allocation, consumption, production, the firm under incomplete markets, labour and public decisions. Under market allocation comes an important paper (21) on the interpretation and properties of the general equilibrium model pioneered in Arrow (1953). The more significant piece in the next part is a classic paper with Modigliani on savings and portfolio choices under uncertainty (28).

6. Incomplete markets: the Drèze criterion

Part V of the *Essays* (33,60,67) starts from the obvious remark that markets for contingent deliveries are largely incomplete. Even after the introduction of "derivatives" and "options", many uncertainties remain that cannot be traded on insurance or asset markets. Business firms need to evaluate risks that are not priced in the market and therefore "profit maximisation" is not a well-defined criterion. Inspired by an earlier contribution of Peter Diamond,⁵ Drèze addresses that problem in (33), and solves it by introducing the "*Drèze Criterion*", giving an operational content to the notion of shareholders' interests. The ensuing literature on risk-taking by firms is largely based on that paper and (33) documents another finding of momentous importance. *Even when firms act in the best interests of shareholders, and commodity as well as asset markets are competitive, the market does not deliver an efficient allocation of resources!* If firms choose production plans and households choose portfolios, the feasible set is not convex. Correlated adjustments in production and portfolios offer scope for improvements. There goes the cornerstone of welfare economics, namely the twin theorems stating that competitive allocations are efficient and every Pareto efficient allocation can be sustained as a competitive equilibrium. Correct under complete markets, these results break down when markets are incomplete. This finding has two implications of great practical and timely relevance: (i) the claim that competitive markets bring about efficiency needs qualification, particularly relevant for macroeconomics, and (ii) efficiency may sometimes be enhanced by completing markets, in particular markets for sharing risks (as illustrated in 117,126,129,131).

⁴ "Le rôle des valeurs boursières pour la répartition la meilleure des risques", in *Econométrie*, CNRS, Paris, 1953 (translated in *Review of Economic Studies*, 31:91-96, 1964).

⁵ "The role of a stock market in a general equilibrium model with technological uncertainty", *American Economic Review*, 42: 759-76, 1967.

7. Human capital and risk bearing

Part VI opens with a public lecture on *Human Capital and Risk Bearing* (48). The innovative idea here is the transposition of the reasoning underlying the theory of "implicit labour contracts" to the understanding of wage rigidities and unemployment benefits. When markets are incomplete, so that workers cannot insure the risks associated with their future terms of employment, competitive clearing of labour markets is not second-best efficient: wage rigidities cum unemployment benefits offer scope for improvement. The lecture develops this theme informally, pending formal developments reviewed below (section 11) but the idea and conclusions are present in 1979. It actually applies to any situation where uninsurable uncertainty about future prices entails welfare loss for economic agents. Even though price rigidities entail a loss of productive efficiency, this can be more than offset by a gain of risk-sharing efficiency. What may be specific to the labour market is the realistic possibility of imposing minimum wages and organising unemployment compensation.

8. Price rigidities and quantity constraints: the Drèze Equilibrium

Sections 6 and 7 above contain the key to the transition from uncertainty to macroeconomics in Drèze's research itinerary. Given his continued interest in real world problems, he was also influenced by the emergence and persistence of unemployment in Europe. In the early 70's, motivated by the potential role of price rigidities for enhancing risk-sharing efficiency, he defined equilibria with price rigidities and quantity constraints in a general equilibrium context. His 1975 paper (36) introduces the so-called "*Drèze equilibrium*" at which supply (demand) is constrained only when prices are downward (upward) rigid. That paper was followed by several others (51,55,63,75), exploring properties of the new concept. Of particular significance to future developments is the existence of equilibria with no rationing of the demand side – "*supply-constrained equilibria*" – that correspond to empirically relevant macroeconomic situations (55). In the meantime, Bénassy and Younès⁶ had approached the same problem from a macroeconomic angle when prices are fixed. There was a lively interest in fixed price economies, and specifically in a three-good macroeconomic model, first formulated by Barro and Grossman and later extensively studied by Malinvaud.⁷ That model invited empirical estimation. Following a joint paper by Drèze and Sneessens (71), a major project (the *European Unemployment Program*) directed by Drèze and Layard led to estimation of a common disequilibrium model in ten countries (B4,93,94) that inspired policy recommendations in Europe for several years (more on this below).

9. Co-ordination failures: continuum of equilibria

The next steps in the theoretical research came with the work of Roberts on supply-constrained equilibria at competitive prices, and then with Herings' dissertation.⁸ In both cases, there appear results on existence of a continuum of Drèze equilibria. Following this, he proved existence of equilibria with arbitrarily severe rationing of supply (113). Next, in a joint paper with Herings and others (132), the generic existence of a continuum of Pareto-ranked supply-constrained equilibria was established for a standard economy with some fixed prices. An intuitive explanation of that surprising result is that if some prices are fixed and the remaining are flexible, the level of the latter prices relative to the former introduces a degree of freedom that accounts for the multiplicity of equilibria. Less rationing is associated with a higher price level, thus formalising a trade-off between inflation and unemployment, comparable to a Phillips curve. However, the continuum reflects co-ordination failures, not short-run price dynamics à la Phillips. The fact that price-wage rigidities can sustain co-ordination failures adds a new twist in explaining involuntary unemployment. At the same time, multiple equilibria created problems for the definition of expectations and introduced a new dimension of uncertainty.

⁶ Benassy, "Neo-Keynesian disequilibrium theory in a monetary economy", *Review of Economic Studies*, 42: 502-23.

Younès, "On the role of money in the process of exchange and the existence of a non-Walrasian equilibrium", *Review of Economic Studies*, 42: 489-501, 1975.

⁷ Barro, R.J. and H.I. Grossman (1971), "A general disequilibrium model of income and employment", *American Economic Review*, 61: 82-93. Malinvaud, E., *The Theory of Unemployment Reconsidered*, Blackwell, 1977.

⁸ See "An equilibrium model with involuntary unemployment at flexible, competitive prices and wages", *American Economic Review*, 77:856-74, 1987; and *Static and Dynamic Aspects of General Disequilibrium Theory*, Kluwer, 1996.

10. General equilibrium with money, price-wage rigidities and incomplete markets

In dealing with price rigidities, it is important to distinguish nominal from real rigidities. The work reviewed so far concerns real economies. Drèze started work on monetary economies in the mid-90's, jointly with Polemarchakis (116, 122, 127, 136) and his 1992 Paolo Baffi Lecture "*Money and Uncertainty: Inflation, Interest, Indexation*" (B6). Inside money facilitates transactions but is dominated by bonds as a store of value. At competitive-like equilibria, there is nominal indeterminacy of the overall price level and of the variability of inflation rates (around expected levels determined by nominal interest rates). Price stickiness lifts the nominal indeterminacies but introduces the real indeterminacy of multiple equilibria (132). Putting all this together, one obtains a general equilibrium model with money, price-wage rigidities and incomplete markets, which largely encompasses macroeconomics as outlined in his Presidential Address to the *International Economic Association* (124). The model has been further generalised to encompass increasing returns to scale in production (82, 83) and imperfect competition (134).

11. Wage rigidities contribute to risk-sharing efficiency

In the foregoing, repeated reference has been made to "price-wage rigidities", with emphasis on their implications. But how does one explain the presence of rigidities in the first place? This is where section 7 above comes in, to provide the second link from uncertainty to macroeconomics: under incomplete markets, wage rigidities contribute to risk-sharing efficiency. The theme of the 1979 lecture (48) is taken up in several papers (91,95,101), exploring the definition and implementation of second-best wage rigidities. These papers predate the work on co-ordination failures described in section 9, which provides a deeper rationale for wage flexibility and reconciles flexibility of labour costs to firms with risk-sharing efficiency of labour incomes, if needed through wage subsidies (119,125,131).

12. Growth and employment: the scope for a European initiative

This last theme takes us into the realm of policy. The emergence of unemployment in the 70's mobilised the attention of Drèze. He naturally turned to his earlier associate and lifetime friend Franco Modigliani for advice on macroeconomic policies, resulting in a paper (56) that contains methodological innovations (an early formulation of the "union-wage model", and Bayesian integration of classical estimates from several models) and a discussion of work sharing, a topic to which he returned in (73). Already in the 80's and early 90's, Drèze campaigned for two-sided policies of demand stimulation and supply-side restructuring (100). The position paper "*Growth and employment: the scope for a European initiative*" prepared by Belgian and French economists (103,104) advocates an ambitious program of public investments coupled with elimination of social security contributions by employers on minimum wages. That paper has influenced the programs of reduced contributions on low wages introduced recently in several countries. The logic of these two-handed policies stands out more sharply in the light of the work on co-ordination failures (124) that are more naturally remedied through demand stimulation. But deficit spending could lead to continued growth of the public debt, a question that is particularly relevant today. Accordingly, substituting profitable investments and variable social security contributions for deficit spending and straight wage rigidities takes us away from orthodox Keynesianism and ahead of New Keynesian economics.

13. The breadth and depth of Drèze's research: an overview

The breadth extends across microeconomics, macroeconomics and econometrics. It extends all the way from theory to econometrics and policy. It encompasses positive as well as normative economics. The depth provides quality to what otherwise might be superficial dispersion. In almost every area that has retained his attention, Drèze has contributed many original ideas some of them having had a lasting influence. One important manifestation of breadth with depth is the integration into the unified framework of an extended general equilibrium model. While many others are concerned with tracing the microeconomic foundations of macroeconomics, thereby acknowledging a methodological duality as starting point, he has traced the "macroeconomic implications of microeconomics". Another similar manifestation comes from the integration of decision theory, Bayesian econometrics and economic theory into the methodologically unified approach to economic decisions laid out in his Presidential Address to the *Econometric Society* (27). The

foregoing brings out the technical mastery displayed by Drèze, in his continued efforts to extend formal theory and quantitative methods in the directions required by policy problems. Some might worry that the human side of economics has been neglected in the process, a concern easily dispelled: Drèze is a humanist concerned with human well-being as illustrated by the choice of research topics, from the value of life, through labour management, to economic and social security, or Third World debt.

14. Economic research and teaching in Europe: CORE, EDP, EEA

We ought to complete this appraisal of Drèze's research by reporting the widely shared view that his contribution to economics in Europe goes beyond that and owes a lot to his unique role in institutional developments. Three landmarks of that contribution stand out: the *Centre for Operations Research and Econometrics* (CORE), the *European Doctoral Program in Quantitative Economics* (EDP) and the *European Economic Association* (EEA).

We have mentioned above his role in the creation of CORE in 1966, and its rapid growth into a leading research centre of international significance. His outside connections were critical in gathering support and in attracting foreign members or visitors. Even more significantly, his personality ingrained the spirit of collaboration and mutual support for which CORE is aptly renowned. As expressed by Robert Aumann, CORE is "*a unique breeding ground; a place where cross-fertilisation leads to the conception of new ideas, as well as a womb – a warm, supportive environment in which these ideas can grow and mature*".⁹ Equally if not even more significantly, CORE has served as a model, emulated in other European countries, often at the hands of former CORE members or visitors.

It is also at CORE, and again at the initiative of Drèze, that EDP was conceived in 1975. Two ideas came together: an institution should not organise its own doctoral program if it cannot do as well as leading institutions elsewhere; education for research is greatly enhanced if students attend at least two institutions, being thereby led to hear confronting opinions and form their own! These ideas were realised under EDP, where several universities¹⁰ organise a joint doctoral program, with all students attending at least two institutions and having access to supervisors from both. This was clearly a significant educational innovation and contribution to European integration.

Again, it is at CORE that the EEA was conceived in 1985. The idea came from Jean Gabszewicz and Jacques Thisse. The first secretary, who really put the idea to work, was Louis Philips. Drèze was the first President. Together, these four CORE members gave birth to the EEA, which today plays a useful role in issuing a journal of recognised quality, holding annual meetings, organising summer schools for young PhD's and providing a platform for the labour market of economists.

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⁹ See *Contributions to Operations Research and Econometrics*, B. Cornet and H. Tulkens (Eds), MIT Press 1989.

¹⁰ Initially, Bonn, LSE and Louvain. It now includes Paris (EHESS), Pompeu Fabra (Barcelona), the European University Institute (Florence) and Tel-Aviv.