Modeling intervention: The Political element in Barbara Bergmann's micro-to-macro simulation projects

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Abstract: Over a period of twelve years, Barbara Bergmann developed several models of the labor market using microsimulation, eventually integrated in a "Transactions Model" of the entire US economy, built with Robert Bennett and published in 1986. The paper reconstructs the history of this modelling enterprise in the context of the debates on the micro-foundations of macroeconomics and the role of macroeconomic expertise from the 1970s stagflation to the late 1980s. It shows how a political element – her focus on distributional effects of policies – was central to her criticism of macroeconomic modelling and how both her epistemic and political positions were increasingly marginalized in the 1980s.

Keywords: microsimulation, Bergmann (Barbara R.), transactions model

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Introduction[3]

> Given the amount of pain and suffering inflicted by recessions, macro-economics is the most important field of economic study, and deserves more rigorous methods. Micro-simulation provides rigor, realism, and an ability to incorporate complexities revealed by more empirical investigations into the working of business.
>
> (Bergmann 2005a, 10)

In standard economics textbooks, minimum wage policies are modeled as an external shock that disturbs the otherwise well-functioning market adjustment process. In the famous diagram familiar to most bachelor students in economics, the supply and demand curves cross at the equilibrium point, at the wage level corresponding to zero unemployment by equalizing demand and supply of labor. Minimum wage policy breaks this harmony: a horizontal line is drawn to impose a "price of labor" too high for the employers' demand of labor to absorb the augmented supply of laborers willing to work for this new wage rate.

State intervention, e.g. minimum wage legislation, is conceptualized as a distortion to a quasi-natural economic system. This conception of intervention may fit well with the scientific public *persona* of the economist as the ultimate advocate for *Laissez-Faire*. While this non-interventionist stance is rooted in the history of political economy, and especially in the legacy of Adam Smith's "system of liberty", political economy was radically transformed in the 20th Century. The two world wars provoked the "interventionist turn" and the postwar diffusion of Keynesianism puts the management of the economy at the center government's action.

Starting in the 1970s, this trend was reversed, with the ascent of the so-called "neoliberal" wave that dismissed state intervention as inefficient. Or so goes the standard narrative. Just as textbook examples, this narrative tells a simple story on the discipline of economics and on the politics of knowledge. This paper draws a more complicated picture of the transition out of the era of Keynesian interventionism by providing a case study of changes and tensions in

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economists' modeling of intervention. Labor, and the modelling of labor policies in particular, were central to these debates -- chief among it the issue of unemployment.

How has the modeling of state intervention evolved in economics from the 1970s? The paper focuses on Barbara Bergmann's "micro-to-macro" simulation model. Broad definitions of simulation usually refer to models that "mimic" or "reproduce" a (social) system using a computer program whose automatic runs produce sets of "simulated" data. *Micro*-simulation refers to the disaggregated level of the model and data produced. Bergmann's specific approach was to construct a macroeconomic model built on the foundations of microsimulation modeling: at the outset, the model considers economic agents making decisions (how much to work, how much to consume or invest) based on various behavioral rules in reaction to a specific policy intervention; by aggregating iteratively the results of individual actions, the model simulates the effects of this intervention on macroeconomic variables, such as inflation, unemployment and GDP.

Microsimulation involves modeling the behavior of various types of agents – households, individuals, firms, public institutions. Each agent is represented as an independent entity with its own characteristics, preferences, and decision rules. Microsimulation models aim to capture the heterogeneity among types of agents and how their decisions and interactions shape the overall outcomes of the system. The modeling usually starts by a representative sample of the population (e.g., groups of households with various levels of income) and the working of the model "consists in observing the state of the sample under different scenarios" (Fontana 2006b, 102). Crucially these types of models are not a set of simultaneous equations as usually used in macroeconomics, but rather an iterative recursive process based on the use of algorithms (Morgan 2012, 318). Microsimulation produces information on individuals that can be aggregated to some levels (groups, sectors, nations) in a bottom-up fashion. Historically, this technique has been used to study the cost and distributional impact of public policies.

In the United States, microsimulation started to be used in the late 1960s in the context of Johnson's "war on poverty". By the 1970s, it had become a central tool for evaluating the consequences of various welfare and social policies (Kraemer et al. 1987). Statistician Constance F. Citro and economist Eric A. Hanushek opens the report of the "Panel on evaluation of micro-simulation models" with a description of a casual scene in Washington

D.C.: “Exhausted analysts” from the U.S. Congressional Business Office preparing the final estimates backing the *Family Support Act*, a piece of legislation signed by President Reagan in 1984. Since 1974, indeed, the *Budget Act* has required all administrations to produce estimations of the cost and distributional effects of any policy they envision.[4]

In this type of modeling practice, the policy itself is a focal point: its effects are an open question rather than, by hypothesis, a distortion. This paper explores how economists thought about policy intervention in the 1970s and early 1980s through investigating Bergmann’s building and use of micro-to-macro simulation models. Over a period of twelve years, Bergmann developed several models of the labor market using microsimulation, eventually integrated in a “Transactions Model” of the entire US economy, built with Robert Bennett, and published in 1986. Bergmann studied with Guy Orcutt, the celebrated pioneer of the microsimulation methodology and leader of several team projects – including the Urban Institute’s microsimulation model known as DYNASIM (Cheng 2020). Her ambition was to build an alternative to macroeconometric modeling: Transferring the way intervention was modeled in microsimulation of social policies to macroeconomic policies.

Bergmann’s micro-to-macro approach provides a valuable perspective to examine the “microfoundations” of macroeconomics debate in the specific context of the 1970s. The terms “microeconomics” and “macroeconomics” were coined in the 1930s by Ragnar Frisch and Jan Tinbergen (Hoover 2012, 22–25). However, it was during the 1970s that the distinction gained prominence, coinciding with rising interrogations around the “microfoundations” of macroeconomics—i.e. the exploration of whether macroeconomic phenomena could be explained by aggregating microeconomic behaviors. Theoretical and empirical discussions flourished to bridge the gap between micro and macro levels (Duarte and Lima 2012).

The debate surrounding the microfoundations of macroeconomics raged throughout the 1970s: it resulted in the emergence of a new research program known as “new classical economics”, championed by Robert Lucas and Thomas Sargent. This new approach had a

[4] The *Congressional Budget and Impoundment Control Act* of 1974 is generally framed as the Congress getting back control over Federal spending after the Nixon years. It created both the House and Senate Budget Committees and the Congressional Budget Office (CBO), largely staffed by economists, and first led by Alice Rivlin (Berman 2022, 68–70).

profound influence on the trajectory of macroeconomic research. Beyond the methodological and epistemological questions raised by the microfoundations debate, it also had implications for expertise and policy intervention. Lucas and Sargent's emphasis on a certain type of microfoundations contributed to undermining the scientific legitimacy of large-scale macroeconometric models. Paradoxically, these models gained popularity in the late 1960s and were widely utilized in institutions for forecasting and policy analysis (Kraemer et al. 1987; Backhouse and Cherrier 2019; Duarte and Sergi 2023), but they faced criticisms from many academic economists and supposedly displayed limited ability to accurately forecast and capture the period's instability.

In response, new classical economists and Lucas in particular proposed an alternative expertise, rooted in macroeconomic models that featured representative agents optimizing objective functions in a microeconomic-type framework (Hoover 2012; De Vroey 2016). Like Bergmann, Lucas had a strong and central interest in the labor market.[5] With Leonard Rapping, they proposed microfoundations for the negative correlation between inflation and unemployment, based on workers' intertemporal substitution between work and leisure on the labor market (Lucas and Rapping 1969). This approach thus supposed that workers voluntarily decide to remain unemployed. But the overall goal of such a research project was also policy-oriented: deriving optimal policy rules specifying, for instance, a desired rate of money supply growth or limits on public deficits (Goutsmedt et al. 2019).

Bergmann occupied a unique in-between position, rejecting the representative agent approach, while emphasizing the need for specific connections between the micro and macro level of analyses. Her stance was influenced by her attention to modeling the intricacies of policy interventions and their distributional consequences. Thus, her original approach provides an insightful vantage point for understanding the tensions and transformations of the 1970s in economic analysis, expertise, and policy intervention.

Crucially, these methodological differences have epistemic and political implications, because they touch on the (im)possibility to track distributional effects on groups and individuals. For

[5] To be more accurate, Lucas worked first on the substitution between capital and labor during his Ph.D. (obtained in 1964) and took interest in labor market microfoundations only after that. One of his co-supervisor was H. Gregg Lewis, the head figure of the new type of labor economics that emerge at Chicago. But his work on the labor market with Rapping can be seen as the starting point of the new classical research program (Snowdon and Vane 2005, 220; da Silva 2017).

Bergmann, the social sciences should provide an objective method to evaluate distributional effects simply because society is formed of various groups of individuals, not represented by an average representative agent. This epistemic value is doubled by a political one: distributional effects are one of the main criteria to assess the direction of policies and their effects in terms of social justice. This political element somehow entrusted in modeling itself is important. The (negative) reception of Bergmann's work shows both the shift towards specific standards of modeling in macroeconomics (epistemic shift) as well as the shift in interventionist knowledge (political shift): from the 1970s onwards, the burden of proof would tend to rest on those advocating for intervention.

The first section describes Bergman's microsimulation of the labor market in the context of the late "war on poverty", mainly associated with a project on "the economics of discrimination" (Bergmann 1971; 1974b; Bergmann and Krause 1972). We analyze how this work aimed to develop a disaggregated view of unemployment and brings tools for new interventionist policies in a context of rising unemployment. The second section shows how Bergmann modeled policies using the "Transactions Model" of the U.S. economy, first applied to the *Humphrey-Hawkins Full Employment Act* (Bergmann and Bennett 1977; Bennett and Bergmann 1984; 1986; Bergmann, Eliasson, and Orcutt 1980). A "political element"—the modeling of intervention itself—is integrated in modeling policy experiments, in contrast with modeling intervention as external shock. In a last section, Bergmann's microsimulation is contextualized within the debates on the micro-foundations of macroeconomics on the one hand and on the proper way to build macroeconomic models; and within the debates on the use of microsimulation in policy on the other hand. Finally, Bergmann's micro-to-macro model was neither used by policymakers, nor recognized in academic circles. We describe in conclusion the main explanations of this "failure to influence" which are at once institutional, methodological, and political.

1. Microsimulation at the end of the "war on poverty"

Welfare issues came to the forefront of the Cold War in the late 1960s.[6] In January 1964, Lyndon Johnson initiated the "war on poverty", advocating for increased state involvement,

[6] Historians documented this shift from methods applied to warfare towards welfare issues: in urban planning (Light, 2005), general welfare administrations (Jardini, 1996, chapter 6), some agencies of the 'war on poverty'

notably in education and healthcare. This set of policies created incentives and allocated funds that prompted social scientists to develop models, produce evidence, and policy evaluation schemes, as well as to collect new data. The Office of Economic Opportunity (OEO), the "weak agency" (Pedriana and Stryker 2004) established in 1964 to plan the "war", had a pivotal role in promoting such research. While the first years of the agency were devoted to programs implementation, Nixon transformed the institutions into a research agency, appointing Donald Rumsfeld as director in April 1969. Rumsfeld made the OEO an agency for research and experimentation, crucially moving away from its function of administrator of social programs (Gwyn 1976, 179). Many research centers and institutions received funding from the OEO to produce research, notably on microsimulations (Kraemer et al. 1987, chap. 2). The University of Maryland was such a place.

Barbara Bergmann arrived in Maryland in the mid-1960s. Bergmann graduated in a time where discrimination against Jews and women was rampant and had a lot of difficulties finding a job. After graduating from Cornell University in Mathematics, Bergmann began working at the New York office of the Bureau of Labor Statistics in the late 1940s: she entered at the "lowest professional rung" and became Head of her unit within two years (Olson 2007, 477).[7] There, she was advised by a "research economist" to apply for Graduate School she never thought of doing. Bergmann was admitted to Harvard a year later.

Bergmann became a teaching assistant for statistician and sociologist Fred Mosteller and economists Wassily Leontief and Franco Modigliani. Although she recalls being introduced to Keynesianism by Alvin Hansen (Olson 2007, 478), her strongest avowed legacies were to Guy Orcutt's empirical work (Bergmann 2005a, 10). After receiving her PhD in 1959, she became a senior research associate for the Harvard Economic Research Project, then left for a position at the Council of Economic Advisor as a senior staff economist (1961-1962). After traveling to

(Patterson, 2000; Forget, 2010), or towards domestic problems such as race relations (Chassonnery-Zaïgouche & Larrouy, 2017).

[7] "I had graduated in the midst of the first post-World War II recession, and jobs were scarce. […] In those days, there was discrimination against Jews, and the want ads were segregated by sex under "Help Wanted, Male" and "Help Wanted, Female". All of the latter were for maids, department store salesladies, and clerical workers. I looked for a job for months in the male category, never getting a nibble. […] (People ask me whether I myself have ever been discriminated against. My answer is, "Of course, from beginning to end."). (Bergmann 2005a, 9)

Peru and Bolivia as part of a Brookings Institution team studying highway investments the following years, she settled as an Associate Professor at the University of Maryland in 1965. It is in Maryland that she resumed her own work using simulation. Her personal passion and skills for computers and programming and her Harvard training in input-output modeling and microsimulation would be applied to the subject that will occupy her in the 1970s: how to fix the labor market?

In the 1960s, simulation was, in fact, an umbrella term for many practices. Historians usually locate early uses of simulations in a variety of practices associated with game theory, analog computer building and early artificial intelligence developments (Morgan 2004) whose origins are found in engineering and physics practices from the mid-20th Century (Fontana 2006a). The democratization of mainframes, and later, the rise of personal computers from the 1980s radically changed the scale and usage of simulation. The use of microsimulation in public administrations, started in the late 1960s, rose to prominence in the 1970s, and became routine in the 1980s (Kraemer et al. 1987, chap. 2).

Bergmann's (1973; 1975) first project using microsimulation was funded by a grant from the Office of Economic Opportunity, and was technically supported by the Computer Science Centre of the University of Maryland, which offered an "extraordinarily free access to a mainframe computer" (Bergmann 2005a, 10). At the same time, she started two courses that link her two interests: one of the first courses on poverty and discrimination, as well as one of the first courses in an American university on computer simulation (Olson 2007, 478). Two papers resulted from this early project on the microsimulation of the labor market: one paper, published in *Econometrica*, focused on poverty incidence of rising unemployment (Bergmann 1973); the other "Econometrics and the labor market analysis" was presented at the annual American Economic Association meeting and modeled the "job search" in the labor market (Bergmann 1975).

In the first paper, Bergmann simulated the movements in and out of unemployment to study the impact of unemployment and income on poverty. She targeted previous works done in the context of the "war on poverty" (Aaron 1967; Gallaway 1965; Mooney and Metcalf 1965). While there seems to be little doubt that unemployment increases poverty incidence and growth of income reduces it, "regression [analysis] has contributed little more than a

verification of this expectation" but "fails to deal with certain complexities of the process" (1973, 956).

The model simulated a labor market with 1000 workers representing the "working poor" (956). The time unit is a week. Each week, a certain number of randomly selected unemployed individuals would find employment, while an equal number would become unemployed (thus maintaining a constant unemployment rate). These weekly transitions in and out of employment (i.e. the "turnover") resulted in varying weekly incomes for each individual. Successive rounds of simulation over a year allows to calculate the annual income of each individual and identify individuals below the designated "poverty threshold".[8] It was then possible to test "different values assigned to the weekly wage, the number unemployed, and the number of job slots turning over" (957). The main outcome demonstrated that poverty incidence was responsive to changes in turnover rates for given wage and unemployment rate. Moreover, the relationship between poverty and turnover was "by no means a simple linear or logarithmic [relation]. It is not even monotonic" (1973, 958)—concretely, a low or high rate of turnover reduced poverty.

Bergmann's main claim with these early simulations was methodological: "through the very process of mimicking in the computer the micro-processes of the phenomenon one is studying", the method has the capacity "to automatically depicts the nonlinearities and interactions of variables implicit in the economist's view of how the process under study works" (*ibid.*). Crucial here was the trade-off between adding variables to the model for increased realism, and the handling of the model. Bergmann also insisted on the plasticity of her model. Important elements such as the stratification of the labor market by race, sex and occupation, or the possibility to model more than one worker in a family (ruled out in the model here), could be incorporated. Indeed, it meant producing additional scenarios "of how the element in question affects the process one is studying and translating that scenario into a modification of the computer program of the simulation" (962).

Bergmann's approach to microsimulation differed from other existing approaches, as she sought a "middle ground" between what she considered to be inadequate "regression-

[8] She uses the poverty threshold for 1967 ($3410 for a 4-person family) for non-farm laborers (regarding the calculation of this poverty threshold, see O'Connor 2001, 183–85).

runners" and complex "large-model micro-simulators" that "take years to build" and "tend to be unavailable to economists not involved in their building" (955). In particular, she made explicit reference to the work of Orcutt's team at the Urban Institute and the team of Harvard urban economists at the NBER.[9] By contrast, Bergmann's simulation projects were not a team effort, resulting in smaller-scale models.[10] Indeed, her first project was "a combination of a very simple do-it-yourself simulation model", used "to prepare the data before regression" and "explor[e] the nonlinearities and variable interaction of the phenomena under study" (1973, 955). The "stripped-down simulation" itself is a 20-lines program written in FORTRAN.

However, Bergmann soon became involved in the development of a larger model known as the "Transactions Model", even though it remained manageable by a few individuals. While her early microsimulation projects, funded by the "war on poverty" institutions, addressed debates in microeconomics, her aim was to develop a micro-to-macro approach capable of addressing macroeconomic phenomena such as fluctuations in unemployment and inflation. The objective was to tackle these issues within a realistic economic system, employing mainly a bottom-up approach. Additionally, the emphasis on increased model realism aimed to make it practical for simulating and analyzing policy interventions.

2. "Decision-Making and Its consequences": Policy Experiments using Microsimulation

Published under the auspices of the NBER, Bergmann developed a first micro-to-macro model simulating a "representative economy" of the US economy in 1974 (Bergmann 1974a). Over a period of more than twelve years, she developed several parts of this initial model which would eventually be integrated in the "Transactions Model" (Bergmann and Bennett 1977; Bennett and Bergmann 1984; 1986; Bergman 1980). The latter was built in collaboration with economist Robert Bennett, a colleague at the University of Maryland and, during the last stage of the project, with programmer William T. Sutton. The project was supported by a National Science Foundation grant.[11]

[9] One can speculate on why she did not work again with Orcutt on the Urban Institute model, operated from the next-door Brookings Institution, as they collaborated when she was a graduate student and will collaborate in the 1980s.

[10] For example, the NBER Urban Simulation model was a large-scale model describing a city (based on studies of Detroit, Illinois) in terms of employment, population, housing, housing prices, and transit and road networks and produce simulated data on the location and investment decisions (Ingram et al. 1972).

[11] Bergmann was Principal Investigator for the NSF Grant APR77-14693 entitled "Simulation of Varying Configurations of Policies Relating and Prices". She received $324,200.00 for the period 1977-1981. Interestingly,

The Transactions Model represents the U.S. economy "by a much smaller-scaled simulated economy, in which the actors are 800 worker-consumer-asset holders, 12 firms, each of which produces the product of a particular industrial sector, the federal government, a consolidated state/local government, and the monetary authority" (Bergmann and Bennett 1977, 267). The functioning of the simulation is similar to any microsimulation: it keeps "tracks" of the situation, history, "actions", and interactions of the agents "in considerable detail"; the macroeconomic magnitudes are generated endogenously by the model, e.g. "the simulated GNP accounts and flow of funds accounts are based on the summed transactions between individual actors, in which money is exchanged against goods, services or claims" (*ibid.*). By contrast with Bergmann's previous microsimulations, the supply side of the economy is fully represented: "firms make production and pricing decisions endogenously, and try to hire enough workers to realize their production plans at wages they set endogenously" (*ibid.*).

In the early version of the model, Bergmann (1974a, 488) listed the potential uses of the model. The "most obvious use" would be as a "forecasting tool", even if she prudently mentioned that one needed to see "whether, when the monetary side is further flesh out, the model will do as well as the Wharton School model, the FRB-MIT model, the DRI model, or any of their competitors".[12] The inherent tension between Bergmann's theoretical objective to rival large-scale macroeconometric models and the usual objectives and applications of microsimulations for welfare policy analysis becomes apparent even in her initial model of the entire US economy. She mentioned its "valuable use" as a "tool of policy analysis" (*ibid.*), giving two examples: various taxation changes as well as policy of price controls—a timely issue regarding the rising inflation of the period. Finally, microsimulation can also "be modestly useful in mediating some of the doctrinal disagreements so prominent in current discussions of macro-economic issues" (488-489).

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the grant was managed by the Engineering directorate (the "Civil, Mechanical and Manufacturing Innovation" division) of the NSF, not by the "social, behavioral and economic sciences" directorate which usually funds economics projects.

[12] The Wharton model, under the leadership of the Nobel Prize-to-be Lawrence Klein, was the direct successor of the famous Klein-Goldberger model (Klein and Goldberger 1955). The FRB-MIT model was the macroeconometric model developed by the US Federal Reserve (Backhouse and Cherrier 2019). The model of the DRI, a private firm founded notably by Otto Eckstein, was a macroeconometric model used by the Congress Budget Office and the Office of Management and Budget in the 1970s (Kraemer et al. 1987, chap. 3; Duarte and Sergi 2023). For a history of large-scale macroeconometric models, see Bodkin, Klein, and Marwah (1991).

After the mid-1970s, microsimulation became increasingly defined in relation to policy analysis due to the fact such techniques were largely used by federal and state agencies (Haveman and Hollenbeck 1980; Kraemer et al. 1987, chap. 2). Some authors have proposed a definition of microsimulation specifically based on motivation by policy interest (e.g., Martini and Trivellato 1997). Bergmann and Bennett's works exemplified this trend, the political element being introduced in their model *via* policy experiments. Crucial here was whether the same evaluation tools used for welfare and social policies—microsimulation models—were transferable to macroeconomic (monetary and fiscal) policy. The case of unemployment stands at the crossroads of this question.

The first publication of the (yet unfinished) Transactions Model was applied to the Humphrey-Hawkins bill (Bergmann and Bennett 1977), which had become a focal point of political debates regarding the fight against unemployment.[13] At the time of Bergmann and Bennett's writing, the bill was still being discussed in Congress. The bill aimed to establish a specific numerical target for unemployment, with the government pledging not to exceed that level (Goutsmedt 2022). Additionally, the bill proposed the creation of public jobs for individuals with limited prospects in the private sector. That was this aspect of the proposed legislation that Bergmann and Bennett sought to examine and test.

They used the micro-simulated macroeconomic model of the US economy to "rerun the history of the 1973-1975 period" and model two possible implementations of the bill: a "low option" where individuals could enter the Public Service Employment program after ten weeks of unemployment, with a wage set at 75% of corresponding private sector wages; and a "high option" where entry could occur after six weeks with same wage, but a higher maximum wage (268). Assumptions were made regarding the likelihood of different groups of individuals joining the program and accepting a public job. Then, both options were tested using a simulated automatic mechanism of job creation in the event of worsening employment conditions (266). The results of the simulation were straightforward:

> Neither of the [Public Service Employment] programs simulated was capable of preventing a rise in unemployment rates although the high option program

[13] See Andelic (2019) and Goutsmedt (2022) for detailed history of the political and economic debates around this piece of legislation, from the first drafts to its enactment by Carter in October 1978.

> succeeded in arresting the rise in unemployment rates by the end of 1974. Both programs significantly moderated the force of the recession on the labor market at a moderate net cost to the Federal government. (268)

The net cost of government action fell because of "extra tax revenues" in the second half of the period (270). Unlike unemployment insurance, which had similar fiscal implications, the Public Service Employment programs also provided the additional benefit of providing tangible services through the employment of individuals in the public sector. The authors emphasized that Public Service Employment is an instrument to be used along with other "conventional" policy instruments (i.e. macroeconomic policies), rather than as a substitute for them. Yet, the simulation did not yield inflationary outcomes. Whether this would have happened this way depends on the decision-making rules chosen—rules, the authors insist, that might be changed to test the model (*ibid.*).

In this paper, microsimulation was framed as "an instrument", "a vehicle" to simulate the effects of policy (266). It provided a way to do experiments with real and potential policies and advocate customization according to various theoretical insights.[14] The policy intervention was the starting point. The focus was not solely on assessing the overall effectiveness of a particular policy, but rather on examining how it impacts specific groups of individuals and whether the targeted population was effectively reached through the program. Hence the insistence on the disaggregated level: for Bergmann, policymakers should be interested in understanding the distributional effects of policies rather than focusing only on aggregate outcomes.

One crucial methodological aspect of Bergmann and Bennett's approach was their reliance on a notion of "scenario". Bergmann and Bennett added different scenarios using the Transactions Model, which were later presented in two important conferences on microsimulation in Stokholm in 1977 and in Washington D.C. in 1978 (Bergmann, Eliasson, and Orcutt 1980; Haveman and Hollenbeck 1980).[15] Both proceedings were an exposition of

[14] For a similar vision of experiments, see Rivlin (1974).

[15] The 1977 conference held in Stockholm was arranged jointly by The Industrial Institute for Economic and Social Research (IUI) and IBM Sweden. The second conference was held in Washington D.C. and sponsored by the Institute for Research on Poverty at the University of Wisconsin (created with an OEO grant), the NSF and Mathematica Policy Research. Mathematica Policy Research was a company created in 1968 to conduct the New

"state-of-the-art" microsimulation models (7 models in 1977, 13 in 1978), most of them built for specific institutions in the U.S., Sweden, West Germany, but also specific regions and cities. Applications' range was wide: food stamp policies, public transfers, negative income tax, welfare reforms of the labor market (e.g. the "Program for Better Jobs and Income"), energy policies, health care reforms, fiscal policy, corporate and personal tax integration proposal, regional impact of tax-transfer policies, housing programs, military exports policies, etc. The debates focused on comparative advantages of all the models presented, and large discussion on the relationship to (and the quality of) data. The main orientation of both conferences was the use of microsimulation for "rational decision making", specifically because the methodology provided analysis of distributional effects across specific micro-units, "not just an aggregate or a mean", and allow for the modeling of actors' response to policy (Haveman and Hollenbeck 1980, xxii). Expertise was built within the models, using scenarios to model policy interventions.

3. Lost-in-Between: Macro Wars, Toy Models, and Large-Scale Microsimulations

Bergmann and Bennett published the full version of the Transactions Model in a monograph in 1986 (Bennett and Bergmann 1986), twelve years after Bergmann's (1974a) first publication about the model. The Transactions Model ambitions was to compete with macro-economic models, not just to test welfare sectoral policies: it was supposed to target aggregate income, inflation and unemployment. Bergmann's macroeconomics envy reflected a critical positioning regarding macroeconomics state and evolution in the 1970s, especially in the microfoundations debate. But her positioning was informative about the transformations and interrogations around macroeconomic expertise in the period, especially regarding the modeling of policy intervention and its social consequences.

Jersey Negative Income Tax Experiment and specialized notably in the development of microsimulation models (Kraemer et al. 1987, chap. 2).

3.1. Bergmann and the microfoundations of macroeconomics

In the early 1970s, "new classical" macroeconomists Lucas and Sargent famously stressed the need for macroeconomics to rely more on microeconomic theory (Duarte and Lima 2012; De Vroey 2016): it was necessary to reintegrate "aggregative problems such as inflation and the business cycle within the general framework of 'microeconomic' theory" (Lucas 1987, 107).[16] The underlying consideration was that "only when macroeconomic aggregates are explicable as consequences of well-formulated optimization problems for individuals […] will macroeconomic reasoning be secure" (Hoover 1988, 87).

This criticism of macroeconomic theory extended to macroeconometric models used for forecasting and policy analysis: these models would be unreliable for policy analysis because they failed to consider the reaction of agents to changes in policy.[17] If the new classical arguments gained traction in macroeconomics in the 1970s and beyond, the issue of the microfoundations of macroeconomics had already become prominent from the late 1960s, and other approaches to microfoundations had been proposed (Hoover 2012).[18]

New classical economists such as Lucas and Sargent proposed a research program that relied on both (i) optimization problems as in the standard microeconomic theory and (ii) agents with rational expectations, that is agents who know the "model" of the economy and draw from this model expectations that are right on average. Such fundamental principles paradoxically implied that simulated disaggregate (multi-agent) models were simply impossible in terms of computational capacity. New classical economists therefore resorted to the artifact of the representative-agent: their models were populated by one (representative) household and one firm which are optimizing their utility and profits under constraints. The new classical research program sparked intense debates in this period and

[16] These economists' approach was quickly labelled "new classical" in the 1970s in reference to John Hicks (1937) "Mr. Keynes and the 'classics'", because it relied on a market-clearing assumption (Hoover 1988, chap. 1).

[17] That is the argument of the "Lucas critique" (Lucas 1976; see also Goutsmedt et al. 2019). Outside of the criticism of macroeconometric models, new classical economists also developed different contributions concluding on the ineffectiveness of monetary or fiscal policies with respect to the real economy (De Vroey 2016, chap. 9).

[18] The issue of the consistency between macroeconomic relationships and microeconomic behavior was as old as the conceptual separation between microeconomics and macroeconomics (Duarte and Lima 2012, 4–5). The term "microfoundations" was coined in the 1950s and predates by far the contributions of Lucas and Sargent.

was met with considerable resistance (Backhouse and Boianovsky 2012; Goutsmedt et al. 2019), but it was notably successful in establishing attention to microfoundations in macroeconomics in the years that followed.

Bergmann also endorsed the quest for anchoring macroeconomics "in descriptions of micro-economic behavior," "a principle well understood and universally agreed to, although often only loosely honored in practice" (Bergmann 1974a, 475). But her micro-to-macro approach was in stark contrast to the new classical micro-foundational program. Even if she generally avoided referring to the contributions of new classical economists in the 1970s and 1980s, she explicitly criticized the program in a retrospective article (Bergmann 2005b, 59–61). She favored an approach that does not "pass from micro to macro informally" (64).

Bergmann's main contention was first with the unrealistic micro-foundations of the labor market that she found in Lucas and Rapping (1969), which implied that workers could forgo work today in hope of better real wages later. This vision of the labor market, in which individuals make decisions based on the disutility of labor, was in sharp contrast to both Keynesian and institutionalist views of the labor market. This application of price theory to labor was embedded in a larger movement that redefined labor economics in the 1960s and 1970s, along the lines drawn by Chicago economists around H. Gregg Lewis work (Rees 1976).

Bergmann also later criticized the "expectation-garbage" of the "rational expectation school" (Bergmann, 1987, 195). Bergmann's microsimulation models did not use rational expectations—nor did Bergmann discuss the hypothesis. In the Transactions Model, forward-looking expectations enter the decision of actors only when "considerable damage is possible if the future is very different from the present" (Bennett and Bergmann 1986, 10). Bennett and Bergmann discarded the importance of expectations for short-time decisions like production decisions and jobs.

Another research program on microfoundations competed with new classical economics: the "aggregation program" (Hoover 2012). Contrary to the former, the dialogue between microeconomics and macroeconomics promoted by the aggregation program was not only of "logical implication", because the "commitment to microeconomics [wa]s not merely theoretical (...) but empirical" (44). This research program was well rooted at the Wharton

School of the University of Pennsylvania under the auspices of Lawrence Klein. Klein's ideal process was to start with existing data and some macroeconomic equations and then "constantly work to disaggregate it and to elaborate it in the direction of a complete" model (41).

To put it simply, Klein's approach was top-down, while Bergman's favored a bottom-up process. What came first for Bergmann was the multiplicity of agents: the Transactions Model simulated the succession of decisions by different households and firms, depending on some rules of thumb (Bergmann et al. 1980, 23-24). These decisions lead to interactions and thus to transactions between the different agents. The aggregation of all these transactions then determines the macroeconomic variables.[19]

Bergmann's positioning in the microfoundations debate relied first on epistemological motivations: she saw micro-simulated macroeconomic models as the shorter path towards more realism. When remembering the 1980s, Bergmann recalled "equations with macro variables [were] constructed on the basis of loose verbal analogies to supposedly valid microeconomic equations" (Bergmann, 2005c, 10). That "[h]ighly mathematical accounts of the derivation of individuals' behavior are not infrequently followed by vague verbal descriptions of what goes on when individuals come together and interact" was her main contention (Bergman 1990, 100).

In addition to her criticism of the unrealistic modeling of individuals' behaviors, Bergmann also voiced concerns regarding the representation of firms in macroeconomics. The critique stemmed partly from the limited availability of disaggregated data on firms (in comparison to households data). Moreover, economists had "very little knowledge of how [firms] make their decisions and conduct their business" (Bennett and Bergmann 1984, 94). This was the consequence of economists "theorizing (...) in the offices and seminar rooms" and running

[19] The bottom-up approach of Bennett and Bergmann starts from microeconomic behaviors and tests different parameters to see which set of parameters allows to aggregate microeconomic behaviors in a way that produce macroeconomic aggregates fitting the 'real world' macroeconomic data. Nonetheless, it is worth noting that Bennett and Bergman sometimes resigned themselves to using standard estimation techniques "for dealing with parameter estimation in conventional macroeconomic models–fitting macro equations and translating the result onto the microeconomic level" (Bennett and Bergmann 1986, 4; see also Bergmann 1974a, 486).

regressions “on data collected for other purposes” rather than deriving firms’ behavior “from first-hand contact with business people” (*ibid.*).[20]

Bergmann, and the co-editors of the 1977 symposium on microsimulation, also targeted the absence of explicit representation of the market process in macroeconometric models, a “serious drawback” (Bergmann et al. 1980, 13). Finally, Bergmann believed that microsimulation models offered another additional advantage over standard macroeconometric models: they facilitated a more “realistic representation” of the various policy instruments that “frequently work on the micro level” (Bennett and Bergmann 1984, 92-94). This aspect aligned with Bergmann’s ambition with the Transactions Model: to propose a new approach to building macroeconomic models that could serve as an alternative to existing models, and so to transform the way macroeconomists approached policy analysis.

3.2. An alternative to macroeconometric models for new policy analysis

Bergmann’s ambition was to compete with large-scale macroeconometric models by building a microsimulation model able to produce macroeconomic results. As soon as 1974, Bergmann claimed the ‘Transaction model’ should soon do “as well as the Wharton School model [headed by Klein], the FRB-MIT model, the DRI model” (Bergmann 1974a, 488).

These large-scale forecasting models had gained traction in various institutions since the late 1960s and early 1970s. The FRB-MIT model had become widely utilized within the Federal Reserve for forecasting the future behavior of macroeconomic variables and assessing the impact of different policies (Acosta and Cherrier 2021; Backhouse and Cherrier 2019). These macroeconometric models gradually spread to public administrations during the 1970s (Kraemer et al. 1987, chap. 3; Berman 2022, chap. 3). They also entered the market of business forecasts, with models like the DRI one experiencing a surge in sales for their forecasting services (Duarte and Sergi 2023).

[20] Later on, she made a similar point by referring to Hall and Hitch’s (1939) survey of firms’ practices regarding price-setting (Bergmann 2005b, 63). The results of the initial study called into question the theoretical ideas that firms set their prices at their marginal cost, in a similar fashion as Lester’s famous study (1946). This triggered a controversy with some neoclassical economists (Hausman and Mongin 1997). An important piece of this debate was Friedman’s influential essay (1953), stating that what matters was not the realism of the hypothesis, but the empirical validity of the model’s conclusions. Consequently, economists may legitimately do “as if” firms were maximizing profits. Bergmann’s stance testified to the persistence of this controversy in economics.

As large-scale macroeconometric modeling gained wider usage, they also faced mounting criticism. The oil shock of 1973 following the Kippur war and the resulting increase in inflation exposed their difficulty to correctly forecast the rise of prices (Lucas and Sargent 1978). New classical economists were particularly vocal in their critique, highlighting the arbitrary adjustments made to the models' forecasts to align them with actual data (Lucas 1976, 23).

Bergmann followed a similar line of criticisms some years later: she considered that current macroeconometric models were performing "little better" than the Klein-Golberger model of 1955 (Klein and Goldberger 1955; Bennett and Bergmann 1984, 92; see also 1986, 1). Yet, the research program around large-scale macroeconometric models remained dynamic in the 1970s, even if their popularity collapsed in academia (Goutsmedt 2017). In his presidential lecture for the American Economic Association in 1977, Klein advocated for the development of a "Keynes-Leontief" modeling approach, which would place greater emphasis on capturing the supply-side dynamics of the economy (Klein 1978). Klein defended the expansion of large-scale models through the incorporation of "satellite" models, such as a model of commodities markets, to better understand notably the behavior of oil prices. This proposed extension aimed to enhance the overall capability of the models to provide a more comprehensive analysis of the economy, considering various interrelated factors that influence macroeconomic outcomes.

Bergmann's reservations about the aforementioned perspective may stem from her focus on different issues. She kept underlining the limitations of large-scale macroeconometric models in carefully assessing the distributional effects of various policies, an area in which microsimulation excelled (Bennett and Bergmann 1986, 2). [21] She argued that the regressions used to estimate macroeconometric models equations tended to overlook "non-linearities and boundary conditions" (Bennett and Bergmann 1984, 92), which are precisely where potential distributional effects and the understanding of how different social groups would be impacted by a policy intervention reside.

[21] Bergmann made this point again in her later criticisms of macroeconomics, underlying the inability of macroeconomic equations to "capture distributional effects" (Bergmann 2005b, 61). Bergmann targeted explicitly the lack of analysis on the effects of tax cuts, which are generally concentrated on the wealthy. Her point echoes the criticisms raised in the 1960s against Kennedy's tax cuts and the macroeconomic Keynesian approach of Kennedy's Council of Economic Advisers that left out the distributional effects (Goutsmedt 2022).

The approach taken by Bergmann and Bennett (1977) in assessing the potential effects of the Humphrey-Hawkins bill provides a notable example of Bergmann's perspective: while perspicacious, it was not in tune with growing concerns over inflation.[22] During the bill's negotiations, economists expressed concerns that implementing a binding numerical target for unemployment could lead to inflationary pressures (Goutsmedt 2022). These concerns were rooted in the concept of the Phillips curve, which posited a negative relationship between unemployment and inflation rates. Lower levels of unemployment would result in increased wage demands by workers, in turn leading to higher prices. Economists thus relied on regression analyses of inflation and unemployment to evaluate the inflationary risks associated with the bill.

However, this approach failed to consider the true purpose of the legislation, which aimed to address the exclusion of specific segments of the population, such as African Americans and other minorities from the labor market through the creation of employment opportunities (Andelic 2019). The advantage of the Transaction Model for Bergmann and Bennett in assessing the impact of the Humphrey-Hawkins bill was its ability to shift the focus to a dimension that was not easily captured by large-scale macroeconometric models: it allowed the examination of the process by which public jobs were created to hire the unemployed as unemployment worsened.

Bergmann's modeling approach and her views about policy intervention must be understood in the context of the debates that permeated the "liberal bloc" since the mid-1960s onwards. Even in the 1960s, Keynesian expertise faced criticism from left-wing politicians and intellectuals. Kennedy's tax cut advocated by the "New economics" of Harvard and MIT macroeconomists (Romani 2018) came under attack for neglecting the distributional consequences of the policy, which was perceived as favoring the wealthy (Goutsmedt 2022). The Department of Labor and its staff advocated for "more interventionist micro-level approaches" but received "little serious consideration" due to the "intellectual dominance of the macro-oriented Council of Economic Advisers" (Weir 1987, 393). This dynamic persisted into the 1970s when Carter's CEA undermined the Humphrey-Hawkins bill, which initially

[22] More generally, the impact of inflation was not central in the Transactions Model, by contrast with policy discussions at the time (Goutsmedt et al. 2019). For instance, inflation was barely mentioned by Bergmann and Bennett (1986) and is discussed by Bergmann only in relation to women's labor supply (Vickery, Bergmann, and Swartz 1978).

aimed to promote low unemployment as a means to foster the integration of minorities (Andelic 2019). The opposition to the bill was indeed grounded in a macroeconomic relationship between inflation and unemployment (Goutsmedt 2022).

The debates surrounding these policy issues illustrate the ongoing tensions and disagreements within the liberal bloc over the appropriate approach to economic policy. In this context, Bergmann's perspective and emphasis on micro-level interventions and distributional consequences contrasted with the dominant macroeconomic focus of the time. More than just a methodological innovation or a new academic research area, Bergmann's Transactions Model testifies of a desire to produce interventionist knowledge that would transform the current state of economic policy and macroeconomic expertise, running against the rising tide of macroeconomics new mainstream.

4. Conclusion

A quick look at bibliometric data shows that the Transactions Model has gained little recognition in economics (Table 1). Already in the 1980s was the model received with skepticism. During the Stockholm conference on microsimulation models, Donald Nichols (1980) insisted on the scientific benefit of the approach, "since this model is a first", demonstrating "it was possible to construct such a thing" is a success. "Like the first automobile, the fact that it runs is of interest rather than the question of whether it's better than a horse for the purpose of transportation": From this point of view, it's a success, but Nichols "d[oesn't] think [the model] beats the horse" (41).

Three elements explain the fate of the Transactions Model: institutional grounding, technical change, and timing. Contrary to Klein, Bergmann could not count on fellow economists and institutional support (see Pinzon-Fuchs 2017 for a description of Klein's institution building) nor on a private company (on the example of the DRI see Duarte and Sergi 2023). The same argument applies to a comparison with Orcutt's career and impact. After a first failed attempt in the 1960s (Cheng 2020), Orcutt later succeeded in raising money and institutional support. Bergmann did not have a large team and she did not receive support from her institution. Bergmann spent a large amount of her time fighting a discrimination case against her own employer in a promotion dispute as well as testifying in other discrimination cases (Small 2022; Chassonnery-Zaïgouche 2020). As a woman and a Jew, she always insisted she was not

welcomed in the profession in the early day of her career and never felt "plug-in" the elite of the discipline, a sentiment reflected in her somewhat ambivalent position: recognized and celebrated for some of her works in feminist economics (see Strober 1998 and the whole issue in *Feminist economics*), ignored when talking about anything else, and in particular macroeconomics, she was rather isolated her entire career.

These institutional elements combined with technological changes. Bergmann was an early adopter of computers technology and a programmer herself. In 1983, the Wharton model was introduced to micro-computer (Renfro 2004, 67). The Transactions Model was made for mainframe and was not transferred to personal computers. Just as the hopes of Orcutt to build a microsimulation of the entire economy were diverted and he shift towards smaller scale projects (Day 1990, 3), financial and organizational support, as well as genuine interest from other researchers, never reached the level of making the Transactions Model a serious contender in the macroeconomics wars.

Another element is timing. Bergmann has a whole (not so simple) career behind her and was stunned to the core by contemporary developments in macroeconomics. But a whole new generation was already there. Bergmann's last paper using microsimulation was published in the *Journal of Economic Perspectives.* A broad presentation of her micro-to-macro perspective, the paper presents a simple program that could be run on any personal computer. Written with the more popular BASIC language, she envisions the model can be used for "theoretical exploration, empirical research, or classroom demonstrations" (Bergmann, 1990, 99). The ambitions were dramatically scaled down.

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Table 1: Citations of some contributions of Bergmann (1969-1995; Web of Science data)

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