

THE “PLACE OF THE PHILLIPS CURVE” IN MACROECONOMETRIC MODELS: THE CASE OF THE FEDERAL RESERVE BOARD’S MODEL (1966–1980s)

BY
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In the article I examine how model builders from the academia and from the Federal Reserve Board confronted the Phillips curve in the construction and subsequent modifications of the Federal Reserve, MIT, and University of Pennsylvania macroeconomic model. It is argued that academic debates on Milton Friedman’s and Edmund Phelps’s accelerationist hypothesis, and the evolution of the macroeconomics discipline, did not affect the model-building agenda at the Division of Research and Statistics at the Board over the 1970s and 1980s.

I. INTRODUCTION

Academic literature on postwar macroeconomics refers to Milton Friedman’s and Edmund Phelps’s expectational Phillips curve as a turning point. The central role played by expectations in explaining wage change and the acceleration of inflation, along with its implications for aggregate demand policies, are told as a challenge to which Keynesian economists surrendered in the 1970s (Gordon 2011, p. 20; Hall 1976; King 2008, pp. 331–332; Okun 1980, p. 818; Mankiw and Reis 2018, p. 82; Santomero and Seater 1978, p. 515; and Snowdon and Vane 2005, p. 140, among others).

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James Forder (2014) investigated the history of the Phillips curve, arguing that this standard narrative is a myth—a myth he demolished by carefully documenting the very different types of empirical, theoretical, and policy-oriented works associated with the label “Phillips curve.” Forder shows that Friedman’s 1967 Presidential Address was not path-breaking and that the post-1968 literature was not devoted to responding to his challenge. In particular, empirical studies after Friedman (1968a) did not merely concentrate on establishing whether the long-run Phillips curve was vertical and did not have the expectational argument as its principal objective.

Forder examines an extensive academic and non-academic literature but devotes little attention to macroeconometric models, how they embedded the wage and price sector within a larger system of equations, and whether the macroeconometric literature was affected by Friedman’s and Phelps’s accelerationist hypothesis. According to Forder, macroeconometric models were short-run forecasting models, thus little involved in the long-run Phillips curve debate. Moreover, because they were conceived as “works in progress” that continuously developed, it would be hard to grasp how the Phillips curve relationships were approached (Forder 2014, p. 99).¹

To investigate whether and how macroeconometric model builders confronted the academic debate on the Phillips curve, on wage change, expectations, and the policy trade-off is the object of this article. I concentrate on the first Federal Reserve Board’s model, the so-called Federal Reserve-MIT-University of Pennsylvania (henceforth FMP-MPS) model, resulting from a collaboration between economists from the Division of Research and Statistics at the Board, under Frank de Leeuw’s supervision, and academic economists (especially PhD students), under the directorship of Franco Modigliani and Albert Ando.² The collaboration formally lasted from 1966 to 1970 with the delivery of the model to the Federal Reserve Board of Governors. Since then, model builders from the Board and from the academia went on to update and modify the model separately.³

The close interactions of the two teams were likely to open the model construction to academic studies and debates, trying to combine theoretical achievements with econometric practice, policy simulations, and forecasts. Indeed, its first version closely followed the macroeconomics mainstreams, i.e., Keynesian economics and structural

¹ On the history of the Phillips curve, also see Qin (2011). Although she refers to the Cowles Commission structural modeling, connecting its consolidation and, then, reformation or abandonment to the history of modeling the inflation and unemployment trade-off, Qin did not mention the Federal Reserve-MIT-University of Pennsylvania macroeconometric model.

² Frank de Leeuw (chief of the Special Studies Section) was responsible with Modigliani for the design of the financial sector and for the entire structure of the macroeconometric model. However, at the end of 1968 he left the Board and moved to the Urban Institute of Washington. James Pierce became the main person responsible for the model over the 1970s. The model changed various names: from the Federal Reserve Board-MIT model to the Federal Reserve-MIT-University of Pennsylvania model (FMP). In 1970, with the end of the Board’s financial support, the model was renamed MIT-University of Pennsylvania-Social Science Research Council (MPS) model (see Rancan 2019, p. 453n10).

³ On the academic side, the model was entrusted to the Wharton Economic Forecasting Associates Inc. (WEFA), which became responsible for its updating and circulation. The WEFA, a not-for-profit organization, was founded by Lawrence Klein in 1969 and located at the economics department of the University of Pennsylvania. Regarding the collaboration between the Federal Reserve Board and Ando and Modigliani, see Ando’s memoranda for the Board of Governors and the Social Science Research Council (undated, Box RW 14, Franco Modigliani Papers; henceforth MP). Also see Modigliani (2001, p. 101; Rancan 2019, p. 451).

econometric modeling.⁴ Nevertheless, from the late 1970s there was no longer such a close parallelism between the evolution of the discipline and the macroeconomics practiced in public institutions.⁵ By looking at the model updating and respecification, it becomes apparent that major changes in the academic research lines did not affect the model-building agenda at the Division of Research and Statistics. Flint Brayton et al. (1997), from the Federal Reserve Board, explain the model modifications over the 1970s and 1980s as the result of economic events (oil shocks), institutional reforms (the freeing of exchange rates in 1973), and, to a lesser extent, academic developments. However, they also acknowledge that the model specification responded to “shifts in the consensus view,” arguing, “As a new consensus developed in the late 1980s and early 1990s, the Federal Reserve models were redesigned to incorporate, at least partially, the evolving new paradigm” (Brayton et al. 1997, pp. 3, 5). In other words, model builders at the Board were aware of the evolution of the discipline, but their research agenda had different timing and paths.⁶ The FMP-MPS model was maintained in operation until the mid-1990s, and the wage and price sector, considered the “culprit” of the rational expectations revolution, was little modified and regarded as one of the more stable parts of the model (Brayton et al. 1997, p. 3; see Ando and Brayton 1995). Under this perspective, the paper is a case study of the changing traction of academic disputes in non-academic economic spheres by looking at the way an ambiguous, yet much-debated, object called the Phillips curve was used by the FMP-MPS modelers, some being more academically oriented and others more policy oriented. Initially they were all involved in academic disputes, but from the 1970s onwards discussions on what to model at the Federal Reserve Board appear to follow a different, more distant, and independent dynamics on their own.⁷

II. WAGE AND UNEMPLOYMENT RELATIONSHIPS: THE STRUGGLE WITH THE PHILLIPS CURVE

The FMP-MPS model was designed to qualitatively and quantitatively analyze the channels through which monetary and fiscal actions influenced aggregate demand. Different research groups formed by academic economists and from the Federal Reserve Board staff worked on separate blocks of the macroeconomic model. While the latter especially concentrated on policy simulations and forecasting, academic economists

⁴ Still today the model is considered the “apotheosis of the neoclassical synthesis” and representative of the state of the art of macroeconomics in the late 1960s and early 1970s (Blanchard 2008, pp. 635–636; also see Goodfriend and King 1997; Fischer 1987, 1988; Mankiw 1990).

⁵ The Federal Reserve Board was not an exception among public institutions. As an example, at the conference on rational expectations and econometric practice organized by Lucas and Sargent (Lucas and Sargent 1981), only two non-academic institutions participated: the Federal Reserve Bank of Minneapolis (where Sargent began his research), and the NBER (see Goutsmedt et al. 2018, p. 23).

⁶ Since the mid-1970s, the Board also began to work on a new large-size IS-LM structural model, a multi-country model of 200 equations, following Lawrence Klein’s *Project Link*. The multi-countries model (MCM) was applied during the 1980s to simulate alternative scenarios in an open economy (Brayton et al. 1997, p. 5).

⁷ On a history of postwar macroeconomics that comprises the macroeconomics practiced outside academia, to enrich our knowledge of the evolution of the discipline, see Boumans and Duarte (2019).

were also interested in the model theoretical underpinning and consistency.⁸ In his interviews with Robert Hetzel, James Pierce recalls that the model forecasts were needed to complete the Greenbook, which represented the basis for policy discussions at the Federal Open Market Committee (FOMC) meetings. However, he also acknowledged that at the Board they were all aware of the model's shortcomings in forecasting and that a great deal of judgment and model adjustments were always required (Pierce 1995, pp. 4–6).⁹

As for the academic team, Ando and Modigliani insisted on the connections between their macroeconomic analysis and the model structural relationships, arguing that the FMP-MPS model was not conceived as only a short-run forecasting model. It was also concerned with an understanding of the long-run equilibrium properties with the steady state that should act as a reference point for the system's dynamics.¹⁰ Discussing an early version at the 1968 meeting of the Econometric Society, Modigliani explained the reasons for the building of another macroeconometric model, stressing its distinctive purposes: "The focus of our research ... differs in several respects from any of the existing models. In the first place our main concern was not with forecasting but rather with analyzing the mechanisms through which policy tools, and particularly the tools of monetary policy, affected economic activity, and the nature and magnitude of the lags involved in the process" (1968, Box RW 15, p. 1). Therefore, Modigliani added, the "specification of the model should be dictated as closely as possible by the existing body of economic theory, blended with relevant institutional considerations, rather than by the goal of obtaining the closest possible fit" (1968, Box RW 15, p. 2, MP).¹¹ Ando also suggested that the model could have been an important teaching device for graduate courses to reduce the gap between economic theory and practice (undated, Box RW

⁸ On the trade-offs between the model theoretical consistency and forecasting performance, see Backhouse and Cherrier (2019, sec. 3).

⁹ In this paper I do not investigate the role played by the macroeconometric model, and the Phillips curve in particular, in policy decisions. Robert Holland (member of the Federal Reserve Board from 1973 to 1976) recalled that the monetary policy of the 1970s did not rely heavily on the macroeconometric model or the Phillips curve relationships (1994, pp. 44–45). For an extensive documentation of the doctrinal and conceptual framework guiding the Federal Reserve policy decisions in the 1970s, see, among others, DiCecio and Nelson (2013), Nelson (2005), Orphanides (2003), and Romer and Romer (2004), who showed that the Phillips curve ideas did not drive US policy. By looking at the FOMC transcript from 1979 to 2003, Meade and Thornton (2012, p. 198) showed that the "Phillips curve framework" played a much less prominent role in the Federal Reserve's policy making than it did in macroeconomic models used to evaluate Federal Reserve policy. Acosta and Cherrier (2021) also argue that Chairman William McChesney Martin, as well as his successor Arthur Burns, had no confidence in attempts to quantify the Federal Reserve policy through econometric models.

¹⁰ See Ando's report to the Board of Governors (October 1969, Box CO1, MP); also see Ando (1981), Visco (2005), and Rancan (2020).

¹¹ Modigliani was not explicit about what "body of economic theory" he referred to. In the 1966 research project on the FMP-MPS model he submitted to the Social Science Research Council, Modigliani explained that their aim was to develop models that link the financial and monetary sector with real variables, "making use insofar as possible to models already in existence." Modigliani mentioned the Brookings model, Stephen Goldfeld's econometric model of the monetary and financial sector, Brunner and Meltzer's, and Meigs's models on the relationships between the monetary and financial sector and the real sector. Ando, in his notes, referred instead to Modigliani's 1963 version of the Keynesian theory and a modified Solow's growth model as departure points.

15, p. 1, MP).¹² He explained that the model performance should not be based on its forecasts but on its ability to catch the system behavior “over a fairly long period” (undated, Box RW 15, p. 11, MP).

The model was structured along Keynesian lines with aggregate demand and money supply that influenced real output by way of short- and long-run interest rates determined by two term structure equations. Underlying the short-run dynamics there was a modified version of Robert Solow’s growth model (see Modigliani 1975b; Szenberg and Ramrattan 2008, ch. 6; Rancan 2020). As for the construction of the wage and price sector, different groups of modelers from the Board and the MIT worked on it in different phases of the project, following similar lines of reasoning. It was finally based on a “standard” Phillips curve relating the rate of wage change to past inflation and unemployment. Wage changes were transmitted on prices through a markup over costs in the oligopolistic commodities markets.

The wage and price block of equations was introduced endogenously only in the last version of the model after several attempts. Difficulties in assessing the Phillips curve’s theoretical basis and its consistency with the model as a whole, along with empirical fit and data problems, were behind these attempts. Most of the attention concentrated on a proper specification of the relationship between wage change and unemployment, which should be able to account for the structural modifications of the labor market, particularly its segmentation and an appropriate measure of the unemployment variable.

Alfred P. Tella and Nelson J. Tinsley, both from the research staff of the Board of Governors, worked on a first specification of the wage and price sector, a version of which they discussed at the 1967 annual meeting of the American Statistical Association. Their focal points were the measure of unemployment adjusted for hidden unemployment, and of potential output, with a distinction between full capacity output and full employment output (Tella and Tinsley 1968, pp. 669–670).¹³ However, their specification was probably unsatisfactory since in the first published report on the FMP-MPS model, tests and simulations were carried out with the wage and price sector still exogenous (see de Leeuw and Gramlich 1968). In a 1968 memorandum it was claimed that its proper specification was the main gap in the last version of the macroeconomic model. After a description of the sector’s main features, and particularly of the recursive property from prices to wages, it was concluded that despite all the econometric attention, the wage equation was still the weakest: “We are still not clear as to whose behavior is being represented and what the basis is for some of the variables in the equation” (Anonymous, April 18, 1968, p. 6, MP).

Modigliani, as well, presenting a preliminary version of the FMP-MPS model, only mentioned the wage equation. He focused to a large extent on the model’s theoretical structure and long-run steady state properties. He analyzed the price equation for a given wage and introduced only verbally and very briefly the wage equation, stating, without further details, that the basic model of wage determination has “elements in common with the so-called Phillips curve, in that the rate of change of money wages is related, in part, to unemployment. However, it differs from it in a number of significant respects” (1968, Box RW 15, p. 45, MP). The model had an equation measuring the “speed of

¹² On the FMP-MPS model structure, also see Gramlich and Jaffee (1972), and Cooper (1974).

¹³ Regarding Tella and Tinsley’s 1967 model discussed at the annual meeting, I found only a summary on the 1968 Federal Reserve Bulletin.

adjustment” of prices to wages that, Modigliani explained, might depend on the extent of pressure in the labor market: “when unemployment is very low, employers are led to bid up wages in the effort to secure scarce labor, then prices may adjust faster to the change of wages” (1968, Box RW 15, p. 45, MP). He concluded that partly for data problems, the wage and price sector had not yet reached a “satisfactory state,” and, therefore, to close the model and for policy simulations, the wage rate was taken as exogenous (1968, Box RW 15, pp. 44–45, MP).

Soon after Tella and Tinsley, George de Menil, a PhD student at MIT, and Jared Enzler (from the Board) began to work on this block of equations. It was their model, to which I return below, that was embedded in Ando and Modigliani’s version of the FMP-MPS model discussed at the American Economic Association meeting of December 1968. They were, however, still cautious about it, arguing that it was in progress although it tracked the data “surprisingly well” (Ando and Modigliani 1969, p. 311). Indeed, a few months earlier, in a September 1968 report, Ando claimed that they had not yet been able to put together a wage equation that was acceptable:

[W]e are taking the level of wages as exogenous for the time being. But it is absolutely essential that the determination of the wage level be made endogenous to the system, in order that the system be considered an adequate description of the U.S. economy. Furthermore, it is difficult to justify the procedure in which the time pattern of wages is assumed to be the same under different sets of monetary and fiscal policies. Franco has worked on the estimation of the wage equation rather hard this summer, and he expected to continue to do so until we have resolved this vexing problem, with the assistance of George de Menil of Boston College. (1968, Box CO1, p. 5, MP)

At the Board of Governors meeting of May 1969, de Menil discussed a paper on the determinants of the price level in which the wage and price equations were not simulated together (de Menil 1969, Box RW 14, MP). Only in the October 1969 report could Ando finally write that “Franco and de Menil have worked on the specification and estimation of a wage equation ... [which explains] the data reasonably well.... Their efforts appear to be beginning to pay off, and hopefully by early 1970, we will have a fairly satisfactory wage equation that can be incorporated into the model” (Ando 1969, Box CO1, p. 2, MP).

Ando and Modigliani (1969) explained that the wage equation was built in the tradition of Phillips (1958), George Perry (1966), and Norman Simler and Alfred Tella (1968), whose focus was the structure of the labor market. They especially concentrated on the composition of the labor force and its modifications. Simler and Tella showed that to be a good proxy of the excess demand, the reported unemployment must be adjusted by considering hidden unemployment—that is, workers discouraged from participating in the labor force—whose size varied directly with the level of employment (1968, pp. 3–4; see also Santomero and Seater 1978, p. 507). Simler, Tella, and Perry were concerned with an understanding of whether the economy was becoming more inflation-prone, looking at the labor market behavior.

Even if model builders were working on the model specification when Phelps (1967) and Friedman (1968a) put forward the accelerationist hypothesis, and the wage equation had since the beginning lagged inflation among the explanatory variables, the role played by change in price expectations was not addressed. The rate of change of prices was apparently read as the influence of changes in the cost of living on the wage

determination process. It is not clear whether it was also understood in terms of expectations of future price change. In any case, it was not the focal point of the model specification.¹⁴ To have a proper modeling of the labor market behavior was seen as being as important as modeling price expectations for an understanding of the wage determination process and, since the mid-1960s, to explain the worsening of the trade-off between inflation and unemployment.

III. THE PHILLIPS CURVE TRADE-OFF

In 1970 the Federal Reserve Board and the Social Science Research Council (SSRC) sponsored a conference on “The Econometrics of Price Determination,” devoted to understanding the inflation process through a survey of the most well-known macroeconomic models of that time: the OBE, the Wharton model, the Brookings model, the FMP-MPS model, and the St. Louis model. It was, therefore, representative of the state of art on the modeling of the wage and price sector of macroeconomic models. Of all of them, only the St. Louis model embedded a long-run vertical Phillips curve, arguing that its shape was not merely an “academic question” because of its relevant policy implications (Andersen and Carlson 1972, p. 167), and Robert Lucas applied rational expectations to test Friedman’s natural rate of unemployment (Lucas 1972). In his overview of the conference results, James Tobin referred only briefly to Lucas’s now famous paper and emphasized instead the “widely accepted” explanation of inflation that emerged from the conference, according to which inflation was the result of interactions between a labor market approaching full employment and oligopolistic price setting. Tobin concluded that even if a “pragmatist” might agree in principle with the natural rate hypothesis, he also believed that “a trade-off does exist for policy-makers as well as statisticians” (1972, p. 13).

Discussing the FMP-MPS wage and price equations, de Menil and Enzler (1972) first pointed out the importance of interactions among real variables, prices, and wages in macroeconomic models, which imply a trade-off between unemployment and inflation that is valid in both the short and long runs. They faced the verticality issue on empirical ground on the basis of the price coefficient estimates. In a footnote, they also criticized Lucas’s dismissal of adaptive expectations and the conclusion that inflation increases output only when it is unexpected.

Their wage equation was quite “standard” with money wages that responded slowly to a disequilibrium in the labor market, and to the lagged rate of change of prices:

$$\frac{PL_t - PL_{t-1}}{PL_{t-1}} = d_0 + d_1 \left[\frac{LF_t - LE_t}{(LF_t + LA_t)} \right]^{-1} + d_2 \frac{PCON_{t-1} - PCON_{t-2}}{PCON_{t-2}}$$

¹⁴ As discussed by Forder (2014), to add the rate of change of price among the explanatory variables was a standard practice before Friedman (1968a), as in the case of Perry (1966), who had already read it in terms of adaptive price expectations (also see Santomero and Seater 1978, pp. 509–510).

PL corresponds to wage rate, LF to labor force, LE to employment, LA to armed force, PCON to price of consumption; see de Menil and Enzler (1972, p. 280).¹⁵

Changes in the money wage rate were transmitted to prices through an oligopolistic setting price model, in which labor costs played a major role; de Menil and Enzler mentioned further refinements of the model in the direction of additional disaggregation of the labor market into unionized and non-unionized, thus focusing on the bargaining aspects of wage determination.¹⁶ To them, in the case of separation between union and non-union labor markets, using two different wage equations, the implications for the long-run Phillips curve depends on the nature of the spillover from one sector to another (for a similar reasoning, also see Modigliani 1968, Box RW 15, MP).¹⁷ Behind their analysis, there seems to be the “lubrication” argument that, according to Forder, provided a rationalization of the persistence (long-run) trade-off, put forward before Friedman’s and Phelps’s challenge (see Forder 2010, pp. 335–336; and 2014, pp. 76–80). As Forder explains, by considering labor markets covering different employment situations, some in excess and some in short labor supply, and the different speeds by which money wages fall and rise, it was demonstrated that the average wages tend to rise and there can be inflation even if there is unemployment, independently from the expectations argument. Inflation “lubricates” the labor market and transforms downward nominal wage rigidity into downward real wage rigidity.

However, de Menil and Enzler did not discuss in depth the rationale behind the Phillips curve trade-off. They simply acknowledged that the effects of price change on the full model multipliers depended upon the level of unemployment, with the Phillips curve becoming steeper for low rates, and stressed that in highly inflationary periods, such as 1966 to 1968, the feedback from prices to real variables leads to a marked increase of traditional multipliers with the economy becoming highly unstable.¹⁸ They were also aware that the trade-off was not “easy to apply” or “infallible,” arguing that the analysis of the Phillips curve’s dynamics showed the difficulties a policy maker faced if he wanted “to avail himself of the choices the curve offers” since “there is a long tail to the lag distribution for the effect of the unemployment rate on the rate of inflation,” and because “other variables besides unemployment ... influence the rate of inflation” (de Menil and Enzler 1972, p. 301). They concluded that they were “pessimistic”: keeping inflation within moderate bounds would have required a relatively large amount of unemployment unless the Phillips curve was shifted to the left.

¹⁵ To account for the impact of the Armed Forces on the labor force, it was estimated separately from the civilian labor force (see de Menil and Enzler 1972, pp. 280–281).

¹⁶ They referred to different wage mechanisms underlining union and non-unionized labor markets, such as the frequency of negotiations, intersector differences in the elasticity of money wage change to variables such as price change and profits (expected to be higher in unionized labor markets), and to demand pressures (which would be higher in non-unionized markets). This research line was especially developed within the Social Science Research Council that in 1969 sponsored Michael Wachter’s research project on the mechanism of wage determination in unionized and non-unionized markets (Box RW 14, MP).

¹⁷ I wish to thank James Forder for suggesting this point to me.

¹⁸ Indeed de Menil and Enzler referred to the destabilizing effects of inflationary expectations on stock prices, real rates of interest, and credit rationing. According to them, an increase in the rate of price change reduced real interest rates and increased stock prices and, therefore, consumption through the life cycle hypothesis. It also raised investment because of the reduction of real interest rates, also affecting residential housing through the relaxation of credit rationing (1972, p. 299).

Even if Friedman's accelerationist hypothesis was on the Board of Governors' table since the mid-1960s, model builders did not ascribe any role to a change in expectations. They concentrated on the structure of the labor market also for a possible explanation of the trade-off and its worsening.

The Accelerationist Argument at the Federal Reserve Board

During the 1965 and 1966 Academic Consultant meetings, Friedman anticipated most of the contents of his Presidential Address, criticizing the Federal Reserve discretionary policy through his emphasis on the inflationary role of price expectations.¹⁹ At the October 1965 meeting Friedman presented a memorandum entitled "The Lessons of U.S. Monetary History and Their Bearing with Current Monetary Policy" (Friedman 1965, Box PS 1, MP), outlining the empirical results of his study with Anna Schwartz (Friedman and Schwartz 1963). His departure point was the high correlation between the rate of change of money and nominal income, arguing that the actual rate of money growth was not indefinitely sustainable without rises in price. The beginning of inflation would have changed expectations with nominal interest rates that would also start to rise, overcoming the so-called liquidity effect of rapid money growth, leading the economy to a recession. As in his Presidential Address, Friedman pointed out that the expansive effects of monetary policy were possible only with an unexpected inflation. Therefore, to maintain the actual rate of economic growth required a higher and higher rate of money increases, which intensified the pressure on prices.

A year later, at the June 1966 meeting, Friedman went back to this reasoning, discussing a paper on "Current Monetary Policy" (commented on by Paul Samuelson) in which he explicitly referred to the Phillips curve. He considered the memorandum an "addendum" to his 1965 analysis, arguing that the acceleration of money growth had finally led to a change of price expectations with the rise of money supply that was now accompanied by a rise of interest rates.²⁰ Warning again about the risk of a recession by continuing the expansive monetary policy, he relied on the Phillips curve trade-off: "In my opinion, there is no perpetual trade-off between inflation and unemployment. The trade-off is between acceleration of inflation and unemployment, which means that the real trade-off is between unemployment now and unemployment later" (June 15, 1966, Box PS 1, p. 8, MP; also see Friedman 1968b).

Friedman's claims were dismissed by a laconic comment by Samuelson, who noticed only that 1966 was a year of demand-pull inflation and that, despite the "Chicago school insistence," the monetary policy over most of 1966 was restrictive rather than expansive.

¹⁹ The Academic Consultant meetings were established by Chairman Martin in 1964. Leading academic economists were invited to discuss with the Board economists monetary policy issues (see Acosta and Cherrier 2021, p. 12; Rancan 2019, p. 451). On Friedman's early speeches and drafts of his 1968 Presidential Address, see Forder (2018).

²⁰ According to Friedman, the higher the price expectations, the higher the nominal interest rates that borrowers were willing to pay and lenders to demand. This "price expectations effect," as he labeled it, along with the income effect (increase of income and, therefore, of demand for money) would explain the positive relation between money supply and interest rate (see Friedman 1966, Box PS 1, MP).

However, while suggesting an expansive monetary policy, Samuelson stressed that it must be accompanied by a restrictive fiscal policy to keep inflation under control.²¹

Friedman did not return to the instability of the inflation and unemployment trade-off and the expectational argument during the subsequent Academic Consultant meetings. In his 1971 (June) memorandum, he concentrated instead on the relationships between money growth and interest rates to emphasize that his previous analysis was confirmed by data. His focal point was that interest rates could not be a guide of monetary policy since the Federal Reserve did not control either the real interest rates or the nominal one in the long-run. They were a by-product of monetary policy and of other forces, and could be “neither an ultimate end nor an effective means” (Friedman 1971, Box PS 1, MP).²² As it appears, the verticality issue was not central at the Board meetings, also later all over the 1970s, as it was not for model builders. Among the few exceptions were Robert Gordon’s memorandum “The Inflation and Unemployment Dilemma” he discussed at the December 1972 meeting, where he still concentrated on the modification of labor force composition as a cause for the worsening of the trade-off; and Modigliani’s 1975 memorandum in which he introduced the non-inflationary rate of unemployment concept (NIRU), which he further elaborated in a Brookings paper with Lucas Papadeimos (1975).

IV. DID THE LONG-RUN VERTICAL PHILLIPS CURVE MATTER?

In a paper discussed at the Federal Reserve Financial Analysis Committee on the supposed Keynesian bias of large-scale structural models, Edward Gramlich and James Pierce (1970) analyzed extensively the long-run behavior of the FMP-MPS model, in particular the stability of the unemployment and inflation trade-off they considered to be the most important point of contention between monetarists and Keynesians—a contention, however, they minimized. As did de Menil and Enzler (1972), Gramlich and Pierce approached the long-run shape of the Phillips curve as an empirical issue to be solved by estimating the price coefficient. They also emphasized that whatever the empirical results, they would have not undermined the model theoretical structure or its policy implications. Indeed, the FMP-MPS model combined the Keynesian and the long-run neoclassical theories, with the speed by which initial movements in real income were eliminated depending on how close the economy was to full employment. According to them, the main difference with monetarists was not the vertical Phillips curve but that for monetarists inflation was unstable at any but the natural rate, while Keynesians “would say that the economy can trade-off controllable inflation and unemployment along a stable curve” (Gramlich and Pierce 1970, p. 10). They associated the vertical Phillips curve with hyperinflationary economies, and the non-vertical

²¹ Forder (2014, 2018) showed that Friedman’s accelerationist argument was circulating in various places before his 1967 Presidential Address, and that his main target was not the Phillips curve but the Federal Reserve Board’s discretionary policy, as Friedman’s memoranda at the Board confirmed. Under this perspective, the memoranda are particularly important since Friedman was speaking to his “ideal” audience, trying to convince the Board economists of the inflationary and depressive effects of the accelerating rate of money growth.

²² On Friedman’s speeches at the Board, see Nelson (2009).

Phillips curve with economies that have remained in a stable price range over most of the estimated period or that have not experienced prolonged deviations from the “natural rate of unemployment,” with no further discussion of this point (1970, p. 12).²³ They concluded quite ambiguously that it was not “appropriate” to constrain the long-run value of the price coefficient to unity since their aim was to analyze the adjustment process: “Even if one agrees in principle that in the very long-run [the coefficient] is unity, we still may not want to impose this condition to study the questions being asked of the large scale models.” Nonetheless, they also added that “the theoretical likelihood of at least a ‘natural range’ of unemployment rate should be used in evaluating policy prescriptions. Attempts to reduce unemployment perpetually below its equilibrium value may be self-defeating in the long-run unless attempts are made to structurally reduce the natural unemployment rate” (1970, pp. 12–13).²⁴ A similar argument had been already put forward by Perry (1966), who considered the “degree to which living costs directly affect wages” among the most interesting questions to be analyzed rather than constraining the coefficient to one (pp. 22–23; quoted from Forder 2014, p. 61).

Ando, as well, in his notes for the monograph on the macroeconomic model, explained that the notion of a natural rate of unemployment was rejected since it was “unconvincing,” and “mainly because the purpose of formulating the long-run model” was to “establish a reference point for later short-run dynamic analysis, and the natural rate hypothesis appears unsuitable for this purpose on theoretical and empirical ground” (Ando 1972, Box RW 14, p. 16, MP). According to Ando, the rate of change of prices could be accepted as an argument of the wage equation as long as the coefficient was substantially less than unity. He briefly mentioned the dispute in the profession on the validity of the Phillips curve trade-off, arguing that its adequacy to describe the money wage behavior was not an issue. The Phillips curve, Ando pointed out, was not “interwoven with other parts of the MPS model” and, therefore, it could be replaced with “almost any theory of the determination of money wage rates other than the marginal productivity considerations, and the remaining parts of the MPS model will accommodate the change quite easily” (Ando 1972, Box RW 14, p. 36, MP). According to him, the most important point about the Phillips curve trade-off debate was to establish the only indirect mechanism through which changes in money supply influenced the level of nominal wages and prices: through changes in interest rates, the cost of capital,

²³ Gramlich and Pierce referred to Modigliani as the first one to provide this kind of explanation. As for hyperinflation, in his Presidential Address Friedman referred to the case of Brazil. On this, see Boianovsky (2020), according to which Friedman’s closeness with South American countries and his awareness of Brazil’s inflation acceleration in the 1960s influenced his reasoning on the natural rate hypothesis (see also Gordon 2011, p. 16). In the 1966 memoranda Friedman referred instead to the case of Japan.

²⁴ Years later, Gramlich recalled that at the Board, “the modelling group was quite aware of the natural rate hypothesis.... We knew that an adaptive expectations Phillips curve would explode if the lag coefficient was one—we just couldn’t get its estimated value [to] be one. We had yet to apply Kalman filters or other split-sample techniques and were yet to realize the problems with the sum of the lagged coefficients test. But even apart from lag effects, as papers by Bill Poole (another Division of Research and Statistics staff member from those days), George de Menil (another Franco student) and Jerry Enzler show, our nonlinear Phillips curves became very, very steep at low unemployment rates, implying that inflation would become uncontrollable at low unemployment rates” (2004, p. 3; see also Szenberg and Ramrattan 2008, p. 149).

output, and unemployment; that is, by relying on the excess demand rather than changes in price expectations (1972, Box RW 14, p. 36, MP).²⁵

At the 1972 symposium “Macroeconometric Models Comparison,” Ando still referred to the long-run Phillips curve as an open, purely empirical question (Ando 1974, p. 544). Modigliani, as well, in a paper presented at a 1972 SSRC conference, discussed de Menil and Enzler’s model based on the “conventional Phillips mechanism” because the coefficient was “a good deal less than unity” (Modigliani 1975b, p. 254). And, at the February 1975 Academic Consultant meeting and in his Brookings paper with Papademos, Modigliani explicitly rejected Friedman’s accelerationist hypothesis. Modigliani and Papademos (1975) suggested the alternative concept of NIRU, defined as the rate at which price change is stable, to support real versus monetary targets and discretionary versus fixed rules policy, arguing that expansionary policies did not accelerate inflation. Both in the paper with Papademos as in the meeting with the Board staff, Modigliani explained that the NIRU was consistent with “the vertical and non-vertical Phillips curve schools,” thus avoiding the conceptual question of the shape of the Phillips curve at extreme values. According to Modigliani and Papademos, the issue at stake was not theoretical but practical, relative to the estimate of the value and stability of the non-inflationary rate that would justify a “heavily fiscal stimuli and an accommodating monetary policy” (Modigliani 1975a, Box PS2, MP).²⁶ Modigliani also pointed out that from 1957 to 1970, the acceleration of money stock and the acceleration of inflation went against each other, and that until 1974 the correlation between changes in inflation and change in money supply, current and lagged, was approximately zero. He finally rejected the key role of changing expectations, arguing that the monetarists’ expectations view “makes no sense” unless “one presumes that manufacturers and merchants all over the country follow avidly the monetary statistics coming out of St. Louis ... and immediately change their prices,” concluding that the only influence of money on prices was indirect, through aggregate demand and employment (1975a, Box PS2, MP).

²⁵ He reaffirmed this position in a 1981 article in which Ando defended the FMP-MPS model against both Lucas and Sargent’s attacks and Sims’s criticisms to structural macroeconomic models. Ando acknowledged that classical propositions hold in the steady state and that money supply was not only neutral but could also be “super neutral,” that is, neutral with respect both to the level of money supply and its rate of growth, depending on whether or not the Phillips curve became vertical in the long run. He clarified, once again, that the “MPS model could accommodate either alternative” (Ando 1981, p. 339).

²⁶ Modigliani’s memorandum at the Board and Modigliani and Papademos’s (1975) article on the non-inflationary rate of unemployment were devoted to convincing policy makers that inflation accelerated only when unemployment fell below the NIRU, therefore arguing that expansionary policies still played a role. In spite of their different meanings, Modigliani and Papademos’s NIRU concept was quickly associated with Friedman’s natural rate hypothesis and considered a first step Keynesian economists took towards the acceptance of Friedman’s analysis (see Hall and Sargent 2018, p. 126). Unlike Friedman’s natural rate hypothesis, the NIRU was a political benchmark to be reached through an active role of stabilization policies. By contrast, Friedman’s natural rate hypothesis was understood as a theoretical concept derived from Wicksell’s natural rate of interest resulting from frictional and structural market forces, with deviations from it explained by errors in expectations. According to Modigliani, on a theoretical level the Phillips curve’s verticality was translated into a choice between an explanation of unemployment in terms of expectations errors and attempts to read the phenomenon in an equilibrium context, in contrast with an explanation of lack of jobs in an imperfect world (see Modigliani 1977, 1986).

While, in the beginning of the 1970s, modelers of the Board staff retained a negative-slope Phillips curve because of empirical estimates, and Ando and Modigliani still referred to the vertical Phillips curve as an open issue, then rejecting in 1975 Friedman's natural rate hypothesis (Modigliani and Papademos 1975), at the 1973 Brookings conference Pierce and Enzler acknowledged that in the long run it became vertical, and discussed the role of monetary policy in the context of stagflation (Pierce and Enzler 1974).

The Vertical Phillips Curve in the FMP-MPS Model Context

Commenting on the state of macroeconomics in the mid-1970s, Robert Hall argued that there was not a major defense of traditional Keynesian thinking against the fresh-water (monetarists) attack, particularly with reference to the Phillips curve (Hall 1976, p. 6). Similarly Robert Gordon (1976, pp. 54–55) explained that most of the movement of professional opinion in the non-monetarist camp was forced to accept Friedman's natural rate hypothesis because, by 1971 data, the acceleration of inflation in the late 1960s and 1970s no longer allowed the statistical rejection of the natural rate hypothesis. Gordon was among the first to introduce the natural rate hypothesis in the Keynesian framework. In his 1978 macroeconomics textbook, he acknowledge the long-run vertical Phillips curve and accepted an explanation of stagflation as due to the change in price expectations. However, as mentioned, at the 1972 meeting with the Board of Governors, Gordon still analyzed the worsening of the Phillips curve trade-off on the basis of demographic reasons, such as change in the age–sex–color composition of the labor force, along with inflationary expectations resulting from the rapid price increases of the years from 1966 to 1969. Gordon's speech concentrated on the construction of a proper measure of the dispersion of unemployment rates, which, for him, was the most problematic issue to be solved (Gordon 1972, Box PS 2, MP).²⁷

In 1973 Pierce and Enzler introduced the long-run vertical Phillips curve in the wage and price sector of the FMP-MPS model. However, that did not lead to a recognition of Friedman's and Phelps's argument, and it did not reflect the supposed consensus the accelerationist hypothesis was gaining within academia. Their vertical Phillips curve did not imply a change of the structural relationships underlying the wage and price sector, focusing on a supply shock explanation. A unit price coefficient was simply imposed on de Menil and Enzler's (1972) wage equation because its re-estimates by adding the period from 1969 to 1971 showed that for a given unemployment rate, prices rose almost proportionally to wages. They acknowledged that any attempt to reduce unemployment below its "natural rate" (whose meaning they did not clarify) would ultimately "fuel an explosive increase in the rate of inflation" (Pierce and Enzler 1974, pp. 19–20).

²⁷ For a review of the literature on the meaning and measure of the dispersion of unemployment, see Santomero and Seater (1978, pp. 508–510). About Gordon's analysis of the labor market and the trade-off, see Gordon (1971), according to which to move the Phillips curve on the left, the functioning of the labor market must be improved through a higher skill level of workers or by encouraging labor mobility. On a similar reasoning, based on the distinction between skilled and unskilled workers, see Modigliani and Tarantelli (1973). On Gordon's conversion to Friedman's natural rate of unemployment and the accelerationist hypothesis, see Goutsmedt and Rubin (2018). Among leading Keynesian economists who, instead, continued to reject Friedman's argument, there were especially Solow and Tobin (see Solow 1976; Tobin 1972).

Pierce and Enzler did not refer to the academic debate, and explained the inflation process by the wage and price spiral that began with the exogenous oil shock. They claimed the difficulties faced in modeling the wage change process, since it was consistent with a number of alternative hypotheses about the structure of the sector, all fit the data equally well but with different implications about the impact of external shocks on the model as a whole (Pierce and Enzler 1974, p. 22). The alternative specifications they had in mind were not Friedman's or Phelps's but Perry's (1970) hypothesis on the composition of labor force, and Gordon's (1970) flexible price coefficient, which led to a kink in the Phillips curve. Despite their best fitting, and although by considering Perry's hypothesis the price coefficient was still lower than unity, the search for a compromise between the model's ability to explain individual sectors and the ability to track data of the entire model led to neglect of Gordon's and Perry's specification (Pierce and Enzler 1974, p. 20).²⁸

The meaning of past inflation among the explanatory variables, or the role played by change in expectations for an understanding of the acceleration of prices and the wage and price spiral, was not addressed. Pierce and Enzler mentioned only the difficulty in assessing the role of adaptive expectations in the wage equation, arguing that the reading of the price change coefficient in terms of "wage earners' expectations of future inflation" would lead to a lesser influence of price rise on wage:

One might question whether an increase in prices due to something like the formation of a cartel by the oil-producing countries would be extrapolated in the manner the price term indicates. After all, the industry cannot be cartelized more than once. To the extent wage earners are aware of the source of the initial rise in price, they may not react as strongly as the wage equation implies. (Pierce and Enzler 1974, p. 29)²⁹

Pierce and Enzler carried out policy simulations for the period from 1969 to 1973 on the effects of an external once-and-for-all oil shock on prices and unemployment under the hypothesis of an accommodating or non-accommodating monetary policy. They acknowledged that with non-accommodating policy, the rate of inflation and unemployment returned to its original level but after a very long run, pointing out that the adjustment process required that the system must be stable, and there were no guarantees that the cyclical mechanism was stable, with the "the MPS model [that was] barely so" (1974, pp. 28, 39). Under an accommodative monetary policy, the real output declined much less, but the wage and price spiral would continue to a greater extent. For the inflation rate to return to its value in the long run, it was required that the average unemployment rate be sufficiently high in the transition period. Pierce and Enzler did not discuss further any policy conclusions. As they explained, they could have derived a monetary policy that maximized an objective function based on the unemployment and inflation rate. However, they did not want "to enter in the debate about the parameters of the objective functions," concluding that "whether or not the outcome of [an] accommodating monetary policy is regarded as superior to the outcome with

²⁸ They explained that by using their wage equation, the full model simulations improved, "in the sense that the results accorded better with our a priori expectations concerning the reaction of the economy to shocks" (1974, p. 22).

²⁹ On possible reasons explaining the introduction of price change into the Phillips curve equation, see Santomero and Seater (1978, pp. 509–510).

unchanged policy [depended] on the weights assigned to the unemployment and inflation objectives” (Pierce and Enzler 1974, p. 46).³⁰

The 1974 version of the wage and price block remained almost unchanged throughout until the FMP-MPS model was dismissed in the mid-1990s. As Brayton and Eileen Mauskopf pointed out in their reports on the model updates, wage changes were still explained by the conventional Phillips curve with the distributed lag on price inflation that captures the effects of expected inflation and lagged adjustments to past price changes (1985, pp. 200–201; also see Brayton and Mauskopf 1987).

In a couple of papers coauthored with Ando (1995) and with Ando and Arthur Kennichell (from the Research and Statistics Division), Brayton still defended the Phillips curve performance, providing also a theoretical explanation (Ando, Brayton, and Kennichell 1991). To Ando, Brayton, and Kennichell, stagflation implied nothing definitive about its reliability since it was not merely the result of a correlation between the rate of inflation and the rate of unemployment. Both variables were endogenous to the whole macroeconomic model. On this ground, they claimed that the traditional Phillips curve was dismissed mainly for ideological reasons:

In discussions of macroeconomic theory and policy since the mid-1970s, it is often taken for granted that conventional macroeconomic models have failed in some fundamental way to account for the actual development of the US economy and that the prime culprit in this failure is the Phillips curve (Lucas and Sargent 1978, 1981). For those of us who have followed the performance of the modified Phillips curve and associated equations through the 1970s and most of the 1980s, the widespread perception of the complete failure of these equations to “explain” movements of prices and wages during this period has been a complete puzzle, since these equations have been more stable and more reliable over time than most other empirical macroeconomic relationships during the period in question, at least in the US. (Ando, Brayton, and Kennichell 1991, p. 201; also see Ando and Brayton 1995, p. 277; Ando 1981, p. 360)³¹

Ando, Brayton, and Kennichell’s (1991) essay was devoted to providing evidence on how the wage and price block of the FMP-MPS model accounts for the dynamic pattern of unemployment and inflation from the 1960s to the 1980s, and to understanding whether changes in money supply were inflationary regardless of other conditions. Their point of departure was a reading of the Phillips curve in terms of a structural relation; that is, the inflation and unemployment relationship was conditional on a number of external factors, such as supply conditions (1991, pp. 202, 206; see also Ando and Brayton 1995). They carried out static and dynamic simulations of de Menil and Enzler’s (1972) original model and Brayton and Mauskopf’s (1985) most recently modified version, which embedded the vertical Phillips curve, to establish the stability of the wage and price relationship and its ability to predict over a long run (the period under consideration was 1961 to 1989). According to their estimates, de Menil and Enzler’s (1972) price and wage relationship was stable as long as the relevant external conditions were stable (i.e., over the 1960s), while in the 1970s and 1980s, the Phillips curve underestimated the

³⁰ Also see Pierce’s comment to Modigliani and Papademos, where he pointed out the role of value judgments in assessing the “appropriate” policy (Pierce 1975, p. 163).

³¹ See also Klein (2006, p. 2). Ando, Brayton, and Kennichell’s paper was discussed at the symposium Klein organized in 1985 on the comparison of econometric models (which followed the 1972 symposium).

rate of inflation because of the low value of the price coefficient. Nonetheless, they remarked that the model caught the “basic time pattern of the historical inflation.” although not the level of inflation, “reasonably well.” By contrast, the simplest relation between inflation and unemployment, independent from other factors, became meaningless (Ando, Brayton, and Kennichell 1991, p. 210). They emphasized that as soon as the price coefficient was recognized to be close to unity, the performance was improved by fitting the data closely, as Brayton and Musakopf’s modified version showed.

They also read the Phillips curve performance as a test against Lucas’s critique (1976) since the sample period they considered included two important breaks: the oil crisis and dollar devaluation of 1973 to 1975, and the 1979–80 shift in the monetary policy regime. According to them, because their dynamic simulations showed no evidence of modifications of agents’ behavior (i.e., in the way they formed their expectations) in response to those events, they concluded that even if one could agree in principle with the Lucas critique, what mattered was how serious the agents’ shifts were under a practical perspective (also see Ando 1981, pp. 208–210).³²

Their empirical tests were published just when the FMP-MPS was dismissed and replaced by the FRB/US macroeconometric model in 1995. According to its builders, its structure was not very far from that of the FMP-MPS model, especially regarding the long-run neoclassical conditions for equilibrium, with short-run sticky price disequilibrium and monetary policy having significant effects. Nonetheless, the introduction of rational expectations as the most important transmission channel of monetary policy represented a definite break in the approach to the inflation and unemployment relationship, now explained in terms of unexpected inflation.³³ However, more than fifteen years has passed since the earlier academic dispute on the Phillips curve unstable trade-off. The FRB/US model is described as close to the new Keynesian models, representing a new consensus within the discipline. What happened to the macroeconomics discipline during the years of the 1970s and 1980s was, instead, not captured by model builders at the Research and Statistical Division of the Federal Reserve Board.

V. CONCLUSIONS

Through policy simulations and forecasts, the FMP-MPS model analyzed the system’s response to exogenous shocks and the channels and the length of time over which monetary and fiscal actions influenced aggregate demand. This paper reconstructs the difficulties model builders faced in the specification and estimation of the wage and price sector and its endogenization with the FMP-MPS macroeconometric model in the late 1960s. Although contemporary to the debate on the long-run Phillips curve, most of the attention was devoted to proper specification of the unemployment rate and the understanding of the labor market behavior. The underlying model of wage rate determination

³² Blanchard (1984) and Blinder (1988) also tested the stability of the Phillips curve against the Lucas critique. On Keynesians’ reactions to the Lucas critique, also see Goutsmedt et al. (2019).

³³ See, for example, Fischer’s (1987) rereading of Modigliani’s 1963 model, putting it in the new Keynesian framework with rational expectations, and Modigliani’s critical reaction. For a comparison between new Keynesian and Keynesian economics, see De Vroey and Duarte (2013).

was mainly based on bargaining, with past inflation that entered among the explanatory variables of wage changes as a measure of the cost of living.

The model builders from the Federal Reserve Board and academia did not address Friedman's and Phelps's accelerationist argument, even if Friedman's critique of the long-run Phillips curve and his advocacy of a monetary rule were known since the mid-1960s, and the Federal Reserve Board economists, along with the academic economists working on the model, were well aware of rising inflation.

The dispute over the stable or unstable trade-off in the long run appears marginal; it was faced as an empirical issue that did not undermine the model theoretical structure. Indeed, the introduction of a vertical Phillips curve in the mid-1970s was not the result of academic debates. As soon as empirical estimates showed that wages adjusted proportionally to price change, a unit price coefficient was simply imposed on the previous wage equation. Since then the wage and price sector remained almost unchanged until the dismissal of the FMP-MPS model in 1995, and was regarded as one of its more stable blocks (Brayton et al. 1997, p. 3; see also Ando and Brayton 1995).

Under this perspective, model builders who worked on the Phillips curve in the context of the FMP-MPS model showed the "disconnect" between the research line pursued within academia and the macroeconomics applied by institutions since the 1970s onwards. While it is true that Keynesian analysis appeared at that time inadequate to answer the problems associated with stagflation, it also appears that the evolution of macroeconomics from Friedman and Phelps to the new classical economics is only part of the narrative, with the discipline that moved in different directions and with different timing.

REFERENCES

- Acosta, Juan, and Beatrice Cherrier. 2021. "The Transformation of Economic Analysis at the Federal Reserve during the 1960s." *Journal of the History of Economic Thought* 43 (3): 323–349.
- Andersen, Leonall C., and Keith M. Carlson. 1972. "An Econometric Analysis of the Relation of Monetary Variables to the Behavior of Prices and Unemployment." In O. Eckstein, ed., *The Econometrics of Price Determination*. Washington: Board of Governors of the Federal Reserve System, pp. 166–183.
- Ando, K. Albert. Undated. *Notebook 1968–1969*. Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Writings and Speeches Series, Box RW 15.
- . 1968–1969. *Reports and Memoranda on the FRB-MIT-Penn Model to the Federal Reserve Board of Governors*. Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Correspondence Series, Box CO1 and Writings and Speeches series, Box RW 15.
- . 1972. *FRB-MPS Model*. Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Writings and Speeches Series, Box RW 14.
- . 1974. "Some Aspects of Stabilization Policies: The Monetarist Controversy." *International Economic Review* 15 (3): 541–571.
- . 1981. "On a Theoretical and Empirical Basis of Macroeconometric Models." In J. Kmenta and J. Ramsey, eds., *Large-Scale Macro-Econometric Models*. New York, Oxford: North-Holland Publishing, pp. 329–367.
- Ando, K. Albert, and Flint Brayton. 1995. "Prices, Wages, and Employment in the US Economy: A Traditional Model and Tests of Some Alternatives." In Rod Cross, ed., *Natural Rate of Unemployment: Reflections on 25 Years of the Hypothesis*. Cambridge: Cambridge University Press, pp. 256–298.

- Ando, K. Albert, Flint Brayton, and Arthur Kennichell. 1991. "Reappraisal of the Phillips Curve and Direct Effects of Money Supply on Inflation." *Comparative Performance of U.S. Econometric Models*. Oxford: Oxford University Press, pp. 201–226.
- Ando, K. Albert, and Franco Modigliani. 1969. "Econometric Analysis of Stabilization Policies." *American Economic Review* 59 (2): 296–314.
- Anonymous. 1968. "A Preliminary Price-Wage Labor Sector for the FRB Model." Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Writings and Speeches Series, Box 13.
- Backhouse, E. Roger, and Beatrice Cherrier. 2019. "The Ordinary Business of Macroeconomic Modeling: Working on the Fed-MIT-Penn Model 1964–1974." *History of Political Economy* 51 (3): 425–448.
- Blanchard, J. Oliver. 1984. "The Lucas Critique and the Volcker Deflation." *American Economic Review* 74 (2): 211–215.
- . 2008. "Neoclassical Synthesis." In Steven N. Durlauf and Lawrence E. Blume, eds., *The New Palgrave: Dictionary of Economics*. Second edition. Volume 5. London: Macmillan Press Ltd, pp. 634–637.
- Blinder, Alan S. 1988. "The Fall and Rise of Keynesian Economics." *Economic Record* 64 (4): 278–294.
- Boianovsky, Mauro. 2020. "The Brazilian Connection in Milton Friedman's 1967 Presidential Address and 1976 Nobel Lecture." *History of Political Economy* 52 (2): 367–396.
- Boumans, Marcel, and Pedro G. Duarte. 2019. "The History of Macroeconomic Modeling: An Introduction." *History of Political Economy* 51 (3): 391–400.
- Brayton, Flint, Andrew Levin, Ralph Tryon, and John C. Williams. 1997. "The Evolution of Macro Models at the Federal Reserve Board." <https://www.federalreserve.gov/pubs/feds/1997/199729/199729pap.pdf>, pp. 1–42. Accessed January 4, 2022.
- Brayton, Flint, and Eileen Mauskopf. 1985. "The Federal Reserve Board MPS Quarterly Econometric Model of the US Economy." *Economic Modelling* 2 (3): 170–292.
- . 1987. "Structures and Uses of the MPS Quarterly Econometric Model of the United States." *Federal Reserve Bulletin* 93: 93–109.
- Cooper, J. Phillip. 1974. *Development of the Monetary Sector, Prediction and Policy Analysis in the FRB-MIT Penn Model*. Lanham: Lexington Books.
- de Leeuw, Frank, and Edward M. Gramlich. 1968. "The Federal Reserve–MIT Econometric Model." *Federal Reserve Bulletin* (January): 11–40.
- de Menil, George. 1969. "Determinants of Aggregate Wage Level." Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Writings and Speeches Series, Box RW 14.
- de Menil, George, and Jared J. Enzler. 1972. "Prices and Wages in the FR-MIT-Penn Econometric Model." In *The Econometrics of Price Determination Conference, Oct. 30–31 1970 Washington D.C.* Publications Services, Divisions of Administrative Services, Board of Governors of the Federal Reserve System, pp. 277–308.
- De Vroey, Michel, and Pedro G. Duarte. 2013. "In Search of Lost Time: The Neoclassical Synthesis." *B.E. Journal of Macroeconomics* 13 (1): 965–995.
- Di Cecio, Riccardo, and Edward Nelson. 2013. "The Great Inflation in the United States and the United Kingdom: Reconciling Policy Decisions and Data Outcomes." In M. Bordo and A. Orphanides, eds., *The Rebirth of Modern Central Banking*. NBER. Chicago: University of Chicago Press, pp. 393–438.
- Eckstein, Otto, ed. 1972. *The Econometrics of Prices Determination*. Washington: Board of Governors of the Federal Reserve System.
- Fischer, Stanley. 1987. "1944, 1963 and 1985." In Rudi Dornbusch, Stanley Fischer, and John Bossons, eds., *Macroeconomics and Finance: Essays in Honor of Franco Modigliani*. Cambridge, MA: MIT Press, pp. 227–256.
- . 1988. "Recent Developments in Macroeconomics." *Economic Journal* 98 (391): 294–399.
- Forder, James. 2010. "Friedman's Nobel Lecture and the Phillips Curve Myth." *Journal of the History of Economic Thought* 32 (3): 329–348.

- . 2014. *Macroeconomics and the Phillips Curve Myth*. Oxford: Oxford University Press.
- . 2018. "What Was the Message of Friedman's *Presidential Address* to the American Economic Association?" *Cambridge Journal of Economics* 42 (2): 523–541.
- Friedman, Milton. 1965. "The Lessons of US Monetary History and Their Bearing with Current Monetary Policy." Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Professional Service Series, Box PS1.
- . 1966. "Current Monetary Policy." Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Professional Service Series, Box PS1.
- . 1968a. "The Role of Monetary Policy." *American Economic Review* 58 (1): 1–17.
- . 1968b. *Dollars and Deficits: Inflation, Monetary Policy and the Balance of Payments*. Englewood Cliffs, NJ: Prentice Hall.
- . 1971. "Monetary Aggregates and Monetary Policy." Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Professional Service Series, Box PS1.
- Friedman, Milton, and Anna J. Schwartz. 1963. *A Monetary History of the United States, 1867–1960*. Princeton, NJ: Princeton University Press.
- Goodfriend, Marvin and Robert G. King. 1997. "The New Neoclassical Synthesis and the Role of Monetary Policy." *NBER Macroeconomics Annual* 12: 231–296.
- Gordon, Robert J. 1970. "Discussion Paper for the November 20 Federal Reserve Consultant Meeting. Large Scale Econometric Models, Policy Multipliers, and the Problem of Forecasting." Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Professional Service Series, Box PS2.
- . 1971. "Steady Anticipated Inflation: Mirage or Oasis?" *Brookings Papers on Economic Activity* 2: 499–510.
- . 1972. "The Inflation and Unemployment Dilemma." Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Professional Service Series, Box PS 2.
- . 1976. "Comments on Modigliani and Ando." In Jerome L. Stein, ed., *Monetarism. Studies in Monetary Economics*. Volume I. Amsterdam, New York, Oxford: North-Holland Publishing, pp. 52–66.
- . 2011. "The History of the Phillips Curve: Consensus and Bifurcation." *Economica* 78 (309): 10–50.
- Goutsmedt, Aurélien, Erich Pinzón-Fuchs, Matthieu Renault, and Francesco Sergi. 2018. "Criticizing the Lucas Critique: Macroeconometricians' Response to Robert Lucas." https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2837766, pp. 1–46; accessed February 2018.
- . 2019. "Reacting to the Lucas Critique: The Keynesians' Replies." *History of Political Economy* 51 (3): 535–556.
- Goutsmedt, Aurélien, and Goulven Rubin. 2018. "Robert J. Gordon and the Introduction of the Natural Rate Hypothesis in the Keynesian Framework," edited by Sylvie Rivot and Robert W. Dimand. Special issue, *History of Economic Ideas* 26 (3): 157–187.
- Gramlich, M. Edward. 2004. "Remarks by Governor Edward M. Gramlich at the Federal Reserve Board Models and Monetary Policy Conference, Washington, D.C., March 26, 2004." <https://www.federalreserve.gov/boarddocs/speeches/2004/20040326/default.htm>. Accessed March 25, 2022.
- Gramlich, Edward M., and Dwight M. Jaffee. 1972. *Savings, Deposits, Mortgage, and Housing: Studies for the Federal Reserve-MIT-Penn Economic Model*. Lanham: Lexington Books.
- Gramlich, Edward M., and James L. Pierce. 1970. "Do Large-Scale Macro-Econometric Models Have a Keynesian Bias?" Federal Reserve System Financial Analysis Committee. Edward Gramlich Papers, Bentley Historical Library, Michigan University, Box 1, pp. 1–24.
- Hall, E. Robert. 1976. "Notes on the Current State of Empirical Macroeconomics." https://web.stanford.edu/~rehall/NotesCurrentStateEmpirical1976.pdf?source=post_page, pp. 1–7. Accessed February 4, 2022.

- Hall, E. Robert, and Thomas J. Sargent. 2018. "Short- and Long-Run Effects of Milton Friedman's Presidential Address." *Journal of Economic Perspectives* 32 (1): 121–134.
- Holland, Robert. 1994. "Interview of Robert Holland Conducted by Robert L. Hetzel." Federal Reserve Bank of St. Louis July 13, Robert Hetzel Oral History Collection. https://fraser.stlouisfed.org/archival-collection/robert-hetzel-oral-history-collection-4927/robert-c-holland-interview-501750/content/pdf/holland_r_19940713, pp. 1–54. Accessed March 25, 2022.
- King, Robert G. 2008. "The Phillips Curve and U.S. Macroeconomic Policy: Snapshots, 1958–1996." *Economic Quarterly* 94 (4): 311–359.
- Klein, R. Lawrence. 2006. *Long-Run Growth and Short-Run Stabilization : Essays in Memory of Albert Ando*. Cheltenham: Edward Elgar Publishing.
- Lipsey, G. Richard. 1978. "The Place of the Phillips Curve in Macroeconomic Models." In A. R. Bergstrom, ed., *Stability and Inflation*. Chichester: John Wiley & Son, pp. 49–76.
- Lucas, Robert E. 1972. "Econometric Testing of the Natural Rate Hypothesis." In O. Eckstein, ed., *The Econometrics of Price Determination*. Washington: Board of Governors of the Federal Reserve System, pp. 50–59.
- Lucas, Robert E. and Thomas J. Sargent, eds. 1978. *After the Phillips Curve: Persistence of High Inflation and High Unemployment*. Boston: Federal Reserve Bank of Boston.
- . 1981. *Rational Expectations and Econometric Practice*. Minneapolis: University of Minnesota Press.
- Mankiw, Gregory. 1990. "A Quick Refresher Course in Macroeconomics." *Journal of Economic Literature* 28 (Dec.): 1645–1660.
- Mankiw, Gregory, and Ricardo Reis. 2018. "Friedman's Presidential Address in the Evolution of Macroeconomic Thought." *Journal of Economic Perspectives* 32 (1): 81–96.
- Meade, Ellen E., and David L. Thornton. 2012. "The Phillips Curve and US Monetary Policy: What the FOMC Transcripts Tell Us." *Oxford Economic Papers* 64 (2): 197–216.
- Modigliani, Franco. 1963. "The Monetary Mechanism and Its Interaction with Real Phenomena." *Review of Economics and Statistics* 45, 1 (Part 2, Suppl.): 79–107.
- . 1966. "Outline of Proposal Research Project on the Links between Monetary Policy and Aggregate Demand." Paper presented to the members of the Subcommittee on the Monetary Mechanism of the Social Science Research Council Committee on Economic Stabilization. Bank of Italy Historical Archive, pp. 1–7.
- . 1968. "Econometric Models of Stabilization Policies." Paper presented to the Third Far Eastern Meeting of the Econometric society, June 27, 1968. Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Box RW 15, pp. 1–45.
- . 1975a. "Monetary Policy for 1975." Franco Modigliani Papers, David M. Rubenstein Rare Book and Manuscript Library, Duke University, Professional Service Series, Box PS2.
- . 1975b. "The Channels of Monetary Policy in the Federal Reserve-MIT-University of Pennsylvania Econometric Model of the United States." In G. A. Renton, ed., *Modelling the Economy*, Social Science Research Council's Conference on Economic Modelling, July 1972. London: Heinemann Educational Book, pp. 240–267.
- . 1977. "The Monetarists Controversy or, Should We Forsake Stabilization Policies?" *American Economic Review* 67 (2): 1–19.
- . 1986. *Raffaele Mattioli Lectures: The Debate over Stabilization Policies*. Cambridge: Cambridge University Press.
- . 2001. *Adventures of an Economist*. New York, London: Texere.
- Modigliani, Franco, and Lucas Papademos. 1975. "Targets for Monetary Policy in the Coming Year." *Brooking Papers on Economic Activity* 1: 141–165.
- Modigliani, Franco, and Ezio Tarantelli. 1973. "A Generalization of the Phillips Curve for a Developing Country." *Review of Economic Studies* 40 (2): 203–223.
- Nelson, Edward. 2005. "The Great Inflation of the Seventies: What Really Happened?" *Advance in Macroeconomics* 5 (1): 1–50.

- Okun, Arthur M. 1980. "Rational Expectations with Misperceptions as a Theory of the Business Cycle." *Journal of Money, Credit and Banking* 12, 4 (Part 2): 817–821.
- Orphanides, Athanasios. 2003. "The Quest for Prosperity without Inflation." *Journal of Monetary Economics* 50 (3): 633–663.
- Perry, George. 1966. *Unemployment, Money Wage Rates, and Inflation*. Cambridge, MA: M.I.T. Press.
- . 1970. "Changing Labor Markets and Inflation." *Brookings Papers on Economic Activity* 3: 411–441.
- Phillips, A. William. 1958. "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861–1857." *Economica* 25 (100): 283–289.
- Pierce, James. 1975. "Discussion." In F. Modigliani and L. Papademos, "Targets for Monetary Policy in the Coming Year." *Brooking Papers on Economic Activity* 1: 163.
- . 1995. "Interview of James Pierce Conducted by Robert L. Hetzel." Federal Reserve Bank of St. Louis, April 27. Robert Hetzel Oral History Collection. https://fraser.stlouisfed.org/archival/4927/item/501773/content/pdf/pierce_j_19950427, pp. 1–40. Accessed February 4, 2022.
- Pierce, James, and Jared J. Enzler. 1974. "The Effects of External Inflationary Shocks." *Brookings Papers on Economic Activity* 1: 13–61.
- Phelps, Edmund S. 1967. "Phillips Curves, Expectations of Inflation and Optimal Unemployment over Time." *Economica* 34 (135): 254–281.
- Qin, Duo. 2011. "The Phillips Curve from the Perspective of the History of Econometrics." *History of Political Economy* 43 (suppl.): 283–308.
- Rancan, Antonella. 2019. "Empirical Macroeconomics in a Policy Context: The Fed-MIT-Penn versus the St. Louis Model (1965–1975)." *History of Political Economy* 51 (3): 449–470.
- . 2020. "From Dynamics to Stabilization: Albert Ando and Franco Modigliani's Contributions to Economic Growth and Fluctuations (1959–1970)." *European Journal of the History of Economic Thought* 27 (4): 1–29.
- Romer, Christina D., and David H. Romer. 2004. "Choosing the Federal Reserve Chair: Lessons from History." *Journal of Economic Perspectives* 18 (1): 129–162.
- Santomero, M. Anthony, and John J. Seater. 1978. "The Inflation and Unemployment Trade-Off: A Critique of the Literature." *Journal of Economic Literature* 16 (2): 499–544.
- Simler, J. Norman, and Alfred Tella. 1968. "Labor Reserves and the Phillips Curve." *Review of Economics and Statistics* 50 (1): 32–49.
- Snowdon, Brian, and Howard R. Vane. 2005. *Modern Macroeconomics: Its Origin, Development and Current State*. Cheltenham: Edward Elgar.
- Solow, M. Robert. 1976. "Down the Phillips Curve with Gun and Camera." In David A. Belsley, Robert M. Solow, Edward J. Kane, and Paul A. Samuelson, eds., *Inflation, Trade, and Taxes: Essays in Honor of Alice Bourneuf*. Columbus: Ohio State University Press, pp. 3–22.
- Szenberg, Michael, and Lall Ramrattan. 2008. *Franco Modigliani: A Mind that Never Rests*. Basingstoke, New York: Palgrave Macmillan.
- Tella, Alfred, and Peter A. Tinsley. 1968. *The Labor Market and Potential Output of the FRB-MIT Model: A Preliminary Report. Study Summary. Federal Reserve Bulletin* 54 (8): 669–670.
- Tobin, James. 1972. "The Wage-Price Mechanism: Overview of the Conference." In O. Eckstein, ed., *The Econometrics of Price Determination*. Washington: Board of Governors of the Federal Reserve System, pp. 7–15.
- Visco, Ignazio. 2005. "From Theory to Practice in Macroeconometric Models: Post-Keynesian Eclecticism." In "Franco Modigliani between Economic Theory and Social Commitment." *BNL Quarterly Review* LVIII (233–234): 67–90.